1st IGAC-iCACGP ECR Online Conference

Conference Guide 2023

1st IGAC-iCACGP ECR online conference November 17, 2023

Table of Contents

Welcome Letter

Dear Early Career Researchers,

Welcome to the inaugural IGAC Early Career Researchers (ECR) Online Conference 2023. And a special warm welcome to those new to the IGAC community! We're thrilled to witness the enthusiasm and dedication you, students and early career researchers, bring to the global atmospheric chemistry community.

This conference is a result of collective efforts within the IGAC Scientific Steering Committee (SSC) to adapt to the evolving landscape of atmospheric chemistry research. Traditionally, iCACGP and IGAC host a biennial in-person conference, invaluable for researchers worldwide to convene, network, exchange insights, and collaborate on environmental challenges.

Recognizing changing needs, the IGAC-iCACGP ECR SSC introduces this pilot ECR Conference. A reflection of our commitment to nurturing the next generation of atmospheric chemists.

Key considerations driving this decision include:

1. **Accessibility:** A remote-only conference allows participation from researchers worldwide without travel expenses, visa limitations, promoting diversity and inclusion.
2. **Knowledge Sharing:** It provides a platform for ECRs to present their work, receive feedback, and engage with other researchers, fostering new ideas and perspectives.
3. **Community Building:** Building a supportive environment among ECRs is a priority. This conference offers networking and lasting connections for career growth.
4. **Adaptation to Changing Circumstances:** Recent global events highlight the need for flexible conference formats, ensuring research and collaboration continue unhindered.

This ECR Conference is an excellent addition to our community, offering a platform for emerging research, connecting, and learning. It's your opportunity to showcase innovative research, gain insights from esteemed colleagues, and contribute to atmospheric chemistry.

We encourage active participation from all ECRs to make this conference a success. We're excited about its potential for the future of atmospheric chemistry and the positive impact you'll have on environmental challenges.

We look forward to virtually meeting you at the conference and celebrating your work.

Warm regards,

Emily Matthews & Maximilien Desservettaz
On behalf of the IGAC-iCACGP ECR Conference Organizing Committee

Sponsors

We appreciate our conference sponsors for their essential support. Their contributions have made this event possible. Let's connect and learn from them to make this conference a fruitful experience for all.

Future Earth is a network of scientists, researchers, and innovators designed to provide the knowledge needed to support transformations towards sustainability. Future Earth focuses on systems-based approaches and seeks to deepen our understanding of complex Earth systems and human dynamics across different disciplines.

https://futureearth.org/about/our-work/

Copernicus has been a partner of scientists since 1988. By publishing highly reputable peer-reviewed open access journals, Copernicus promotes scientific work worldwide. Since 2001, Copernicus has been dedicated to open access as a principle and it has focussed on promoting scientific work and we are very grateful for its support of our conference.

https://www.copernicus.eu/en

The European Space Agency (ESA) is a 22-member intergovernmental body devoted to space exploration, which was founded in 1975. With its headquarters in Paris and a staff of around 2,200 people globally as of 2018. ESA is responsible for setting a unified space and related industrial policy, recommending space objectives to the member states, and integrating national programs like satellite development into the European program as much as possible.

https://www.esa.int/

The National Centre for Atmospheric Science is a world leading research centre, funded by the Natural Environment Research Council (UK). NCAS research falls into three key areas. These are air pollution, climate and high-impact weather and long-term global changes in our atmosphere.

https://ncas.ac.uk/

The International Association of Meteorology and Atmospheric Sciences (IAMAS) was founded in 1919 and focuses on providing the scientific community with platforms to present, discuss and promote the newest achievements in meteorology, atmospheric science and related fields.

https://www.iamas.org/

A big thank you …

… to the ECRs who volunteered at our conference and facilitated our group activities. Your help and contributions play a vital role in the conference's success. Thank you for your support, and we look forward to more collaborations in the future.

… to the established scientists for their review of posters, elevating the quality and scientific significance of our event and research.

… to the IGAC and iCACGP SSCs for their advocacy and support, to make this conference happen. Without your initiative there would be no IGAC-iCACGP ECR SSC and no ECR online conference. Also, your focus and support for ECR within the atmospheric chemistry community is second to none.

… to Langley for helping with all the logistics, admin and continued support over the past few months.

… to our ECR highlight speakers, whose presentations enrich the conference with a variety of atmospheric chemistry relevant science talks. Thank you for sharing your research and inspiring the IGAC-iCACGP ECR community.

… to our skills workshop speakers for their inputs on scientific skills and concepts in general. The topics and expertise you share with us is crucial for fruitful science of the individual and as a community.

… once again to our sponsors that made this conference and our poster prizes possible. Thank you for supporting IGAC-iCACG early career researchers.

… last but not least to all the participating ECRs from all different time zones and countries and disciplines within the atmospheric chemistry community. We, the IGAC-iCACGP ECR SSC hope that this is the first of many ECR conferences to come.

Introduction to IGAC and iCACGP

IGAC Project

The IGAC (International Global Atmospheric Chemistry) Project seeks to facilitate atmospheric chemistry research towards a sustainable world. This is achieved through IGAC's four focal activities: advancing knowledge, fostering community, building capacity, and engaging society.

IGAC sponsors a number of activities and working groups to support this effort. Make sure to visit their dedicated space in the conference main hall to learn more about those.

Please see IGACProject.org for more information.

iCACGP

What is iCACGP?

The international Commission on Atmospheric Chemistry and Global Pollution (iCACGP also abbreviated CACGP) is one of the Commissions in IAMAS (International Association of Meteorology and Atmospheric Sciences), which in turn is one of the associations within IUGG (International Union of Geodesy and Geophysics) under the non-governmental ICSU (International Council for Science) family.

What does iCACGP do?

iCACGP supports atmospheric chemistry research that contributes to solving the basic societal issues of water supply, food production, and human/ecosystem health. This is done through an enhanced understanding of the fundamental mechanisms that control atmospheric composition and development of improved predictive capabilities.

Please see http://www.icacgp.org/ for more information.

Introduction to the IGAC-iCACGP ECR SSC

The first IGAC-iCACGP Early Career Researcher Scientific Steering Committee was formed in January 2023, following a recruitment effort during the joint iCACGP-IGAC 2022 meeting in Manchester, UK. 22 members from across the globe serve on the committee. We meet bimonthly for general Committee business and more frequently when planning events, such as this ECR conference.

The ECR SSC has identified three major activities through which to improve the experience of early career researchers within the IGAC community:

- **Communication:** Improve outreach to early career researchers, particularly in developing nations and underserved scientific communities.
- **Engagement:** Incite early career researcher to join IGAC activities and working groups, and partake in IGAC activities. Outreach and combine efforts to fellow scientific organizations (e.g. SOLAS, iLEAPS, LAECESS, etc.).
- **Career development:** Provide resources and workshops to enhance early career researchers career perspectives, and provide networking opportunities.

We are developing new ways for early career atmospheric chemistry researchers to interact, grow their networks, and connect with the wider global IGAC Network. This conference is the first large-scale effort of that goal.

Maximilien Desservettaz (Co-chair)
Cyprus Institute, Cyprus

Emily Matthews (Co-chair)
University of Manchester, UK

Tanzina Akther
University of Houston, USA

Simone Thirstrup Andersen
Max Planck Institute for Chemistry, Germany

Hannah Bryant
University of Edinburgh, UK

Tess Carter
George Washington University, USA

Sebastian Diez
University of York, UK

Tamryn Hamilton
North West University, South Africa

Nasim Hamzeh
Ferdowsi University of Mashhad, Iran

Sonla Hèzouwè
University of Lomé, Togo

Leonard Kirago
Stockholm University, Sweden and Kenya

Rachana Kulkarni
Indian Institute of Tropical Meteorology (IITM), India

Worradorn Phairuang
Faculty of Geosciences and Civil Engineering, Kanazawa University, Japan., Thailand

Martin Otto Paul Ramacher
Hereon Institute of Coastal Environmental Chemistry, Germany

Tom Randa
Africa Center for Technology Studies, Kenya

Stephanie Schneider
McMaster University, Canada

Imran Shahid
Qatar University, Qatar

Muhammad Zeeshaan Shahid
University of the Punjab, Pakistan

Steven Turnock
Met Office Hadley Centre UK, UK

Bert Verreyken
Royal Belgian Institute of Space Aeronomy (Brussels, BE) and the University of Liege – Gembloux Agro-Biotech (Gembloux, BE), Belgium

Karn Vohra
University College London , UK

Li (Patrick) Yuanzhe
School of Science and Technology at Sophia University, Japan

Conference Schedule (UTC time)

Nov 17th, UTC (location in Gather)	**Asia/Oceania**	**Europe/Africa/ Middle East**	**Americas**	**Access links**
Highlight Talks (Plenary room)	**03:00 - 04:30**	**10:00 - 11:30**	**16:00 - 17:30**	**Zoom**
Icebreaker (Side meeting room)	**04:40 - 05:25**	**11:40 - 12:25**	**17:40 - 18:25**	**Zoom**
Collaborative Climate Activity (Side meeting room)	**05:50 - 06:50**	**12:50 - 13:50**	**18:50 - 19:50**	**Zoom**
Skills Workshops (Side meeting room)	**07:00 - 07:50**	**14:00 - 14:50**	**20:00 - 20:50**	**Zoom**
Poster Session (Poster room)	**08:00 - 09:00**	**15:00 - 16:00**	**21:00 - 22:00**	**Gathertown**

ECR only
All

Conference Instructions

Access the conference via GatherTown

The 1st IGAC-iCACGP ECR Online Conference is held in GatherTown, from which you can access all the different conference formats, such as highlight talks, ice-breaker activities, the climate game, skill talks and the poster session. Therefore,

1. Access the GatherTown platform 5 min prior to the conference session in your time zone by clicking https://app.gather.town/app/iHXGLhImSykrW31V/ecr23. For GatherTown instructions see the GatherTown Guidelines (next page).
2. Once you are in GatherTown, join the highlight session by going from the Main hall to the Plenary room, where you press x on your keyboard as described in the GatherTown Guidelines.
3. All other formats in the schedule can be accessed via GatherTown by going to the room shown in the overview schedule above and the detailed schedule below. If this does not work, use the zoom link as given in the schedule overview above.
4. If you have any questions or issues while in GatherTown, look for the people with the status **"IGAC-iCACGP ECR SSC"**.

Poster sessions

All poster sessions take place in the poster room in GatherTown. Each time zone has an area designated for the posters presented in that time zone. Posters presented in multiple time zones have multiple poster numbers and can therefore be found in all the time zones they are presented in. **We recommend accessing GatherTown prior to the conference to find your poster and make sure it is located in the right place.**

Presenters will be informed via email when to be by their poster to be available for a poster judge to visit - **if the presenter is not present when the poster judge is by the poster, then the presenter cannot win a poster prize.**

Poster evaluation for prizes and feedback will be based on the following criteria:

- Quality of poster layout: easy-to-follow layout, appropriate font(s), and color schemes that don't take away from the reading experience
- Visual presentation quality: good clear diagrams/graphs/maps, not too word heavy - aesthetically pleasing
- Quality of project description: aims, methods, results, and conclusions are all clear and easy to follow
- Questions: Ability to discuss the motivation for the work

A panel consisting of IGAC SSC members and IGAC-iCACGP ECR SSC members will go through all posters across the three time zones judged to be worthy of a poster prize in the weeks after the conferences and decide who will be awarded the six poster prizes. **Recipients of the poster prizes will be informed directly via email after the conference and be announced on the IGAC-iCACGP's social media platforms (website, *X*, facebook, WeChat).**

GatherTown Guidelines

Access

URL: https://app.gather.town/app/iHXGLhImSykrW31V/ecr23

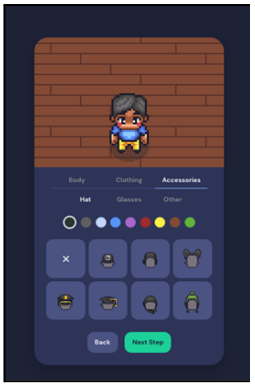
Requirements
Join from your computer on any OS (Windows, Mac OS, Linux).
Mobile devices are not fully supported, we strongly recommend against it

Web browser
We recommend using Chrome or Firefox browsers for Gather. Safari is supported in beta.

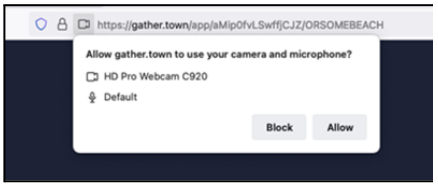
Desktop Version
There is also a desktop version of Gather for both Windows and Mac.
See https://gather.town/download.

Getting started

Character Style & Name
Before you enter the IGAC-iCACGP ECR 2023 conference Gather space, you will choose and customize your character. This character will remain the same when closing the page and reopening. You can further customize it later too.
You will also name your character. Please make sure to enter first and last name. You may also add your institution in brackets

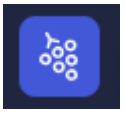


Browser Settings and Permissions
Gather must request permission to use your mic and camera from the web browser. To work properly, Gather should be allowed access to the microphone and camera.



Tutorial
If you've never used Gather before, you may see a tutorial. We recommend you do this tutorial, it is very brief.

Preferences
Change your settings by accessing the menu just left of your name at the bottom left of the screen.This include selecting your mic, camera and speakers.



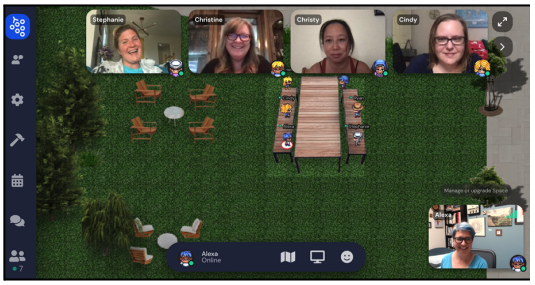
Exploring

Navigation
Use the arrow keys or WASD keys to move in Gather.

Move to Map Point
Using your mouse, double click on a location in the map to automatically move there. When using this feature, Gather will try to avoid taking you through private spaces.

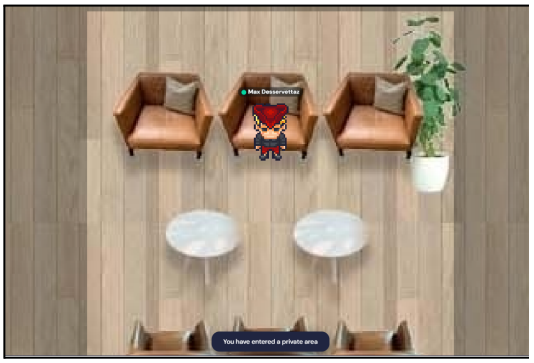
Zoom in/out
Easiest: using the scroll wheel of the mouse
On Mac, hold the command key and press the – or + keys
On PC, hold the CTRL key and press the – or + keys
(Note: Smart Zoom must be disabled for this to work)

Conversations



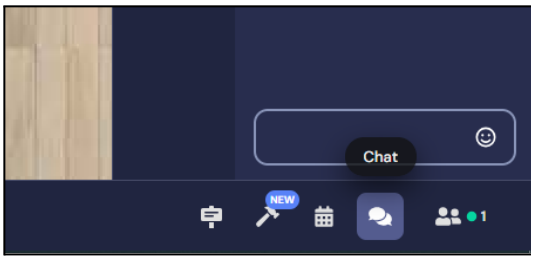
As you navigate around Gather you will see other people. When you are far away the other characters look faded. As you get closer, the characters become more vivid and their video and audio will appear. However, if you once again navigate your avatar away, you will quickly lose your colleague's video and audio.
If there are many other people, you can toggle between their videos.

Private Areas



Private areas are places in the map where participants can only see and hear each other. All poster squares are private areas.
Text will notify you when you enter a private area, and the background of the private area will be lighter than the surrounding area.

Chat



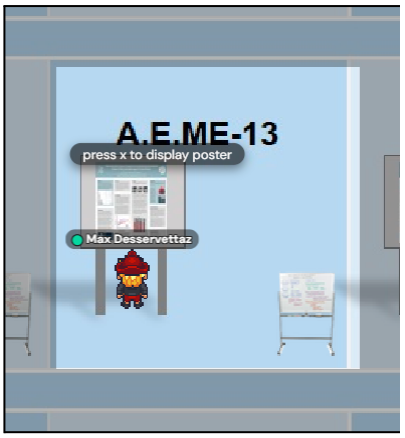
You can chat with people who are nearby, or with everyone in the same room by clicking on the chat button at the bottom right corner. You can also have a private chat by going through the participants button next to it..

Locate and Follow
Find another participant by using "Locate on map" and Gather will draw a line to them. If you select "Follow" Gather will move you automatically to the person you are following.

Ghost Mode
If you get surrounded by other characters and can't move, you can press "G" to turn into a ghost and move through other participants.

Poster sessions

When you enter a poster area, as you get close to the poster, you will be prompted to Press X to open the poster.
Zoom in closer to the poster using the controls at the top or on the right side of the poster.



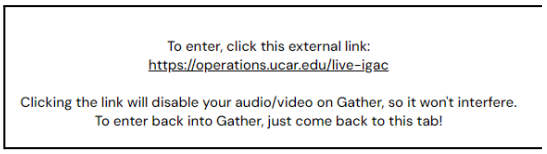
During the poster session, we **<u>recommend</u>** the presenters share their screen in their poster area to guide people more clearly through their content.

We have also included a white board at each poster location, to leave notes and questions.

Other sessions

The Highlight talks, Icebreaker, climate activity, and workshop will take place over Zoom, which can be accessed using the direct link or through Gathertown, where you can join by clicking the x button on your keyboard after entering the Plenary or Side meeting rooms.

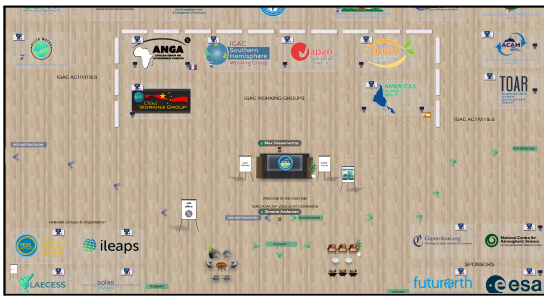
You will then be prompted to click on an external link. Click on the link and join the zoom session. This also disables your mic and camera in Gather town.



After the session is over, close the tab. After you close the external tab, the Gather tab will remain. Click on the Re-enter button to return back to Gather.

Main hall

We highly encourage you to explore our Gathertown space and visit the different IGAC activities and IGAC working groups, as well as our sponsors and sister organisations in the **Main hall**.



Each space has links to websites, and additional information as posters, social media links and videos.

Please contact igacecr@igacproject.org if you have any issues joining Gather.

Detailed Conference Schedule (UTC time)

03:00 - 09:00 UTC
— Asia / Oceania session —

03:00	**Welcome and Highlight talks** (GatherTown Plenary room) 03:00 - Welcome 03:10 - Mr. Shahid Uz Zaman 03:35 - Dr. Beata Bukosa 04:00 - Dr. Jiaru Li
04:30	***10 min break***
04:40	**Ice Breaker Activity** (GatherTown Side meeting room)
05:25	***25 min break***
05:50	**Climate Activity** (GatherTown Side meeting room)
06:50	***10 min break***
07:00	**Skills workshop with Prof. Clare Murphy** (GT Side meeting room)
08:00	**Poster Session** (GatherTown Poster room)
09:00	**End of Asia / Oceania session**

10:00 - 16:00 UTC
— Africa / Europe / Middle East session —

10:00	**Welcome and Highlight talks** (GatherTown Plenary room) 10:00 - Welcome 10:10 - Dr. Nansi Fakhri 10:35 - Mr. Samuel J. Cliff 11:00 - Ms. Priscilla Adong
11:30	***10 min break***
11:40	**Ice Breaker Activity** (GatherTown Side meeting room)
12:25	***25 min break***
12:50	**Climate Activity** (GatherTown Side meeting room)
13:50	***10 min break***
14:00	**Skills workshop with Dr. Ari Asmi** (GT Side meeting room)
15:00	**Poster Session** (GatherTown Poster room)
16:00	**End of Africa / Europe / Middle East session**

16:00 - 22:00 UTC
— Americas session —

16:00	**Welcome and Highlight talks** (GatherTown Plenary room) 16:00 - Welcome 16:10 - Dr. Tailine Corrêa dos Santos 16:35 - Dr. Pamela Dominutti 17:00 - Dr. Mary Angelique G. Demetillo
17:30	***10 min break***
17:40	**Ice Breaker Activity** (GatherTown Side meeting room)
18:25	***25 min break***
18:50	**Climate Activity** (GatherTown Side meeting room)
19:50	***10 min break***
20:00	**Skills workshop with Dr. James Crawford** (GT Side meeting room)
21:00	**Poster Session** (GatherTown Poster room)
22:00	**End of Americas session**

Highlight Speakers

Asia / Oceania

Shahid Uz Zaman

Shahid Uz Zaman is a lecturer at the Department of Chemistry at Bangladesh University of Engineering and Technology (BUET) in Dhaka, Bangladesh. He earned his Bachelor of Science in Chemistry in 2018 and his Master of Science in Inorganic and Analytical Chemistry in 2019 from the University of Dhaka, Bangladesh. Shahid Uz Zaman's research centers on atmospheric chemistry, particularly indoor air pollution. He also investigates topics related to remote sensing, Aerosol Optical Depth (AOD) monitoring, black carbon (BC), brown carbon (BrC), climate change, and their associated health impacts.

Currently, Shahid is involved in the development of a Low-cost sensor network aimed at reducing $PM_{2.5}$ air pollution levels in heavily contaminated regions in Southeast Asia in collaboration with Duke University, USA. This approach combines low-cost satellite-enhanced $PM_{2.5}$ sensors with meteorological modeling and source identification techniques. Shahid is also involved in the chemical composition and source apportionment of $PM_{2.5}$ in ambient air in collaboration with Akita Prefectural University, Japan.

Abstract: Insights of Indoor Air Pollution in Dhaka, Bangladesh

The capital city of Dhaka, Bangladesh has a population of ~21 million and is growing at an astounding rate of 4.2% annually. Accompanying the recent growth is increasingly poor air quality, although the region lacks adequate monitoring necessary to assess health impacts and the potential success of future mitigation strategies. As one of the world's most densely populated urban centers, Dhaka faces unique challenges in maintaining indoor air quality. Indoor air pollution sources in this vibrant city are diverse and multifaceted, including cooking practices, vehicular emissions, building materials, and other indoor activities. Prolonged exposure to indoor air pollutants in Dhaka carries severe health implications, contributing to a rise in respiratory illnesses and cardiovascular diseases among its residents. This presentation will delve into the specific health risks faced by Dhaka's inhabitants due to indoor air pollution, emphasizing the urgency of addressing this issue. Our study underscores the critical presence and impact of indoor air pollution in key settings such as hospitals, schools, and houses. Drawing upon our research findings, I will present a comprehensive overview of the nature and extent of indoor air pollution in Dhaka.

Dr. Beata Bukosa

Dr. Beata Bukosa is an Atmospheric Modeller at NIWA (National Institute of Water and Atmospheric Research) based in Wellington, New Zealand. Her research focuses on understanding the global and regional cycle of the two main greenhouse gases, carbon dioxide (CO_2) and methane (CH_4). She is interested in exploring the spatial and temporal variability of these gases and improving their flux estimates by combining atmospheric models and measurements. Her current work is part of the CarbonWatch-NZ and MethaneSAT research programmes, focusing on the development of inverse (i.e., top-down) methodologies to quantify emissions and uptake of CO_2 and CH_4 using both ground-based and satellite measurements.

Abstract: Advancements in greenhouse gas measurements and modelling in Aotearoa New Zealand

Aotearoa New Zealand's measurement, modelling and research programmes are expanding. Here, we will present an overview and newest results of the CarbonWatch-NZ and MethaneSAT projects that contributed to this expansion, as well as the implication of these research programmes on a global scale.

CarbonWatch-NZ utilizes inverse modelling (i.e., top-down methods) to estimate New Zealand's carbon uptake and emissions on a national, regional and urban scale. Current greenhouse gas reduction strategies rely on budget estimates that are evaluated with inventory methods (i.e., bottom-up methods). The most recent Intergovernmental Panel on Climate Change (IPCC) guidelines refinement recommends using independent methods, such as atmospheric inverse models as a complementary tool when estimating greenhouse gas budgets. Our inversion results suggest a stronger carbon dioxide (CO_2) uptake for the last decade relative to bottom-up estimates, potentially pointing to a more efficient carbon uptake capability of indigenous forests. In contrast to CO_2 our national scale methane (CH_4) inversion suggests a good agreement with bottom-up estimates. Here, we will discuss the importance of these results and present our measurement and modelling system.

MethaneSAT is a yet to be launched novel satellite designed to detect targeted CH_4 emissions. It was developed as a CH_4 reduction strategy by detecting CH_4 emissions from oil and gas leaks (i.e., point sources), globally. The New Zealand team's aim is to develop an agricultural CH_4 emission (i.e., diffuse sources) estimation capability using data from the satellite. MethaneSAT is an American-New Zealand partnership (Environmental Defense Fund (EDF), MethaneSAT LLC and the New Zealand government) including a collaborative work between NIWA and the Harvard University. 85% of New Zealand's CH_4 emissions are from agricultural processes which enables unique testing opportunities. Here, we will discuss the importance of this satellite mission and present modelled CH_4 scans for agricultural targets across New Zealand.

Dr. Jiaru Li

Jiaru is a Post-Doc at Kyoto University and guest researcher at National Institute for Environmental Studies in Japan. She is working on investigating OH reactivity in field observations, understanding the mechanism of ozone production, and detecting multiphase reactions regarding HO_2 uptake onto synthesized aerosols in laboratory studies. Her research interests also cover the detection of RO_2 radicals and kinetic studies of radical-radical reactions.

Abstract: HO_2 uptake onto aqueous inorganic aerosols: Detection of radical reactivity and uncertainty to ozone production

HO_2 radicals act as the main reservoir of OH radicals, and ozone and secondary organic aerosols are the by-products of the interconversion of radicals. However, the source and sink of HO_2 are not well understood which may bring uncertainties to radical budget and oxidant generation. This study presents the detection of uptake of HO_2 onto aerosols using the chemical conversion method combined with laser-pump and laser-induced fluorescence technique. Several synthesized aqueous inorganic aerosols and seawater spray from two sites were detected. Transition metal ions including Cu(II) and Fe(II) confirmed an enhancement role on the uptake process. Large variations in the uptake coefficient necessitate a clear understanding of the heterogeneous process to get a precise simulation of uptake coefficient spatiotemporally. The heterogeneous kinetics in the bulk phase was analyzed based on the transistor model. Furthermore, the relationship of HO_2 uptake and ozone production was quantitatively assessed, which can be used to understand local/global photochemistry.

Africa / Europe / Middle East

Dr. Nansi Fakhri

Dr. Nansi is a lecturer at Saint Joseph University (USJ) in Lebanon and is working as a Research affiliate at Emissions, Measurements, and Modeling of the Atmosphere (EMMA) Research Group at USJ. She is also a research affiliate at the Climate & Atmosphere Research Center (CARE-C) of The Cyprus Institute.

She obtained her bachelor and master's degree in Canada and completed her joint PhD in Atmospheric Chemistry from the University of Montréal (UdeM - Canada) and Saint Joseph University (USJ - Lebanon). She has been awarded 12 Scholarships throughout her research.

Her main research expertise is the emissions of aerosols, their chemical characterization for their source apportionment and the evaluation of the health risk associated with the exposure to these pollutants. She is also passionate about scientific innovation.

Abstract: PM2.5 Sources in the East Mediterranean-Middle East City Beirut: Chemical Characterization and Contribution to Ambient Concentrations

Although air quality has improved in many developed countries, the Mediterranean Basin still suffers from serious air pollution. Lebanon is located along the eastern coast of the Mediterranean Sea and represents one Middle Eastern country where PM levels have been found to regularly surpass the World Health Organization (WHO) standards (LNSAQM, 2017); the average concentrations of PM2.5 were six to ten times higher than the maximum mean yearly guidelines set by WHO (5 μg/m^3) (Abdallah et al., 2018, Borgie et al., 2016, WHO, 2021). Source apportionment using positive matrix factorization (PMF) including both organic and inorganic species has been established for the first time in a Middle Eastern country to identify PM2.5 sources and their contributions in the Greater Beirut Area, a typical East Mediterranean Middle Eastern city. Two approaches were adopted in the study: one with inorganic species and the other with the addition of organics (PMF-org). The average PM2.5 concentration found exceeded the WHO guidelines of 5 μg/m^3 by a factor of six. Results of this study clearly indicate the major role of road transport which is an important source of emissions in the region. The inclusion of organic molecular markers in PMF allowed the identification of 4 sources. Moreover, this study pointed to the importance of including new metrics in addition to the PM mass concentration to the air quality standards in the Middle East reflecting the potency and toxicity where the compliance with the WHO recommendations is impossible due to high natural background. Even though diesel generators presented a very small contribution in term of mass (~0.30 μg/m^3) compared to other sources such as crustal dust (~6 μg/m^3), the health risks associated with this source cannot be fully determined by the PM2.5 mass concentration alone since the potency is not the same.

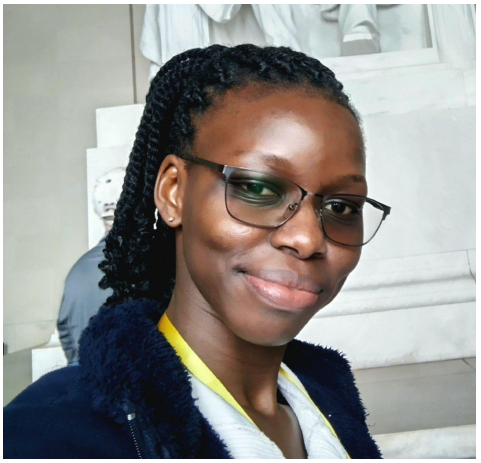
Samuel J. Cliff

Samuel Cliff is a final year PhD student in the Wolfson Atmospheric Chemistry Labs (WACL) at the University of York, UK, where he also completed his chemistry undergraduate degree. He spent his Masters' year at the Facility for Airborne Atmospheric Measurements (FAAM) operating and maintaining the core chemistry suite of instruments onboard the FAAM research aircraft, taking rapid measurements of CO_2, CH_4, SO_2, O_3 and CO. That project involved characterisation of different spectroscopic techniques for their suitability for airborne measurement of CO and improving understanding of ozone production in African biomass burning plumes.

His current research focuses on the use of emissions datasets for decision-making in the transition to net zero greenhouse gas emissions and towards attaining safe levels of air quality.

Abstract: Unreported VOC emissions from road transport including from electric vehicles
There are widespread policy assumptions that the phase-out of gasoline and diesel internal combustion engines will over time lead to much reduced emissions of Volatile Organic Compounds (VOCs) from road transport and related fuels. However, the use of real-world emissions measurements from a new mobile air quality monitoring station demonstrated a large underestimation of alcohol-based species in road transport emissions inventories. Scaling of industry sales statistics enabled the discrepancy to be attributed to the use of ancillary solvent products such as screenwash and deicer which are not included in internationally applied vehicle emission methodologies. A fleet average non-fuel non-exhaust VOC emission factor of 58 ± 39 mg veh^{-1} km^{-1} was calculated for the missing source, which is greater than the total of all VOCs emitted from vehicle exhausts and their associated evaporative fuel losses. These emissions are independent of the vehicle energy/propulsion system and therefore applicable to all road vehicle types including those with battery-electric powertrains. In contrast to predictions, vehicle VOC emissions may actually increase given a predicted growth in total vehicle kilometers driven in a future electrified fleet and will undergo a complete VOC respeciation due to the source change.

Priscilla Adong



Priscilla Adong is a PhD student at University College Dublin and a Research Associate Fellow at AirQo project's AFRETEC. Her research areas include machine learning, remote sensing, wireless sensor networks, and air quality monitoring. She holds a master's in Data communications and Software Engineering and a bachelor's in Computer Science from Makerere University. She is also an Alumna of the US Department of State's International Visitors Leadership Program. With several years of industry experience, Priscilla has honed her skills in programming, research, and leadership. Previously, she worked as a data scientist at AirQo-Makerere University, where she focused on building, validating, and maintaining predictive air quality models. She actively takes on a mentorship role, providing guidance and support to students from diverse backgrounds. Her dedication to fostering the next generation of talent is evident through her facilitation of student engagements and STEM challenges.

Abstract: AI-Enabled Air Quality Monitoring and Management
One of the major consequences of rapid urbanisation in Africa is the deteriorating air quality, especially in urban areas. Of the 7 million premature deaths attributed annually to the effects of ambient and indoor air pollution globally, 1.1 million occur in Africa. Although air quality datasets in Africa are steadily growing, most African cities still lack data and evidence to tackle air pollution due to the high cost of traditional monitoring. There is a promising

opportunity to leverage Internet of Things (IoT) and Artificial Intelligence (AI)-based environmental sensing and modeling systems to support air quality monitoring and management. These technologies offer cost-effective and efficient solutions by delivering real-time data and valuable insights for informed decision-making in air pollution monitoring and mitigation. In this presentation, we will delve into the applications of AI in air quality monitoring and management, such as sensor placement optimisation, calibration, air quality predictions, and device fault detection. More specifically, we will showcase some of the use cases implemented by AirQo, while highlighting the immense potential of AI in shaping the future of air quality monitoring and management in low-resource settings and ultimately enhancing the well-being of African populations.

Americas

Dr. Tailine Corrêa dos Santos

Dr. Tailine Corrêa dos Santos is a Post-doctoral research associate at the Environmental Management Superintendence at the University of São Paulo, Brazil. Worked in the USP Sustainability Program in Air Quality, to diagnose sources and update emissions inventories, in partnership with the state government's environmental agency. PhD in Atmospheric Sciences from USP's Institute of Astronomy, Geophysics and Atmospheric Sciences, with an emphasis on studies of volatile organic compounds in urban forests. Master in Environment and Water Resources with multidisciplinary experience in atmospheric pollution. Graduated in Atmospheric Sciences from the Federal University of Itajubá. Experience in meteorological and air quality instrumentation. Researcher in atmospheric and air monitoring, health, and air quality public policies.

Abstract: Local public policy and scientific research together to air quality

Accelerated population growth, urbanization, and industrialization have led to an increase in atmospheric emissions and air pollution, not only at a local level but also with regional and global impacts. In regions like São Paulo, where economic significance, high population density, and industrial activities converge, faces serious air pollution problems, making it an important case study for evaluating actions to reduce pollutants. Scientific research plays a crucial role in understanding local levels of air quality, and their associations with economic, environmental, and health factors. In São Paulo, public air quality control policies rely heavily on local emissions inventories, incorporating measurement and estimation metrics, as well as strategic guidelines that leverage scientific references. This data-driven approach enables decision-makers to appoint new control technologies and craft policies to reduce pollutants. Over the last four decades, there has been a significant reduction in pollutant concentrations. And recently, with a government-university partnership in the state of São Paulo, significant progress has been made in this direction. This collaboration has been pivotal in generating tangible progress by applying scientific knowledge directly to emission sources. Here highlights the importance and challenges of the two sectors working together and formulating actions, with an emphasis on results. Challenges persist and are needed to

bridge the gap between scientific research and policy implementation. Breaking down the barrier and applying scientific knowledge to the formulation of public policies and the implementation of actions directly at the sources of emissions improving air quality and control climate change. This includes addressing political, economic, and social hurdles, ensuring a seamless translation of scientific findings into effective policies. The commitment to continued collaboration, data-driven decision-making, and proactive engagement with stakeholders will be pivotal in sustaining the progress and fostering a cleaner and healthier environment for the people of São Paulo and beyond.

Dr. Pamela Dominutti

Pamela Dominutti is currently a Postdoctoral research fellow at the Institute of Environmental Geosciences (University Grenoble-Alpes, FR). Her scientific interests focus on the characterization of air pollution, emission sources and their impacts on the atmosphere and population, particularly in the Global South. During her PhD and postdocs, she has developed experience in measurements and campaigns in the field and on-board research aircraft. She obtained her PhD in Atmospheric Sciences at the University of Sao Paulo (BR) and carried out postdoctoral research at the University of York (UK), the University Clermont Auvergne and the University Grenoble Alpes (France), where she has been involved in several air quality projects.

She is currently on the steering committee of LAECESS (Latin America Early Career Earth System Scientist Network) and one of the co-chairs of the VOC working group of the Global Emissions Initiative (GEIA).

Abstract: The LAECESS Network: addressing the challenges of the next generation of scientists in Latin America

Early career (ECR) Earth system researchers in Latin America and the Caribbean region (LAC) have faced several challenges, such as limited funding opportunities, substandard scientific facilities, lack of job security and unrepresented groups equality issues. In addition, worsening regional environmental and climatic crises demand that this new generation of scientists contribute to solving these crises by raising public awareness and encouraging research.

Recognizing the need to converge and take collective action to be a part of the solution, the Latin America Early Career Earth System Scientist Network (LAECESS) was created in 2016. Since the beginning of our network, we have been working to reduce the gap between the early careers in LAC, trying to promote research and providing information related to job opportunities, webinars, workshops and a space for discussion and collaboration.

During this talk, we will present the main actions and goals of our network, with the purpose of reaching out and opening it to other ECRs in the region and around the globe. We will

also present how being part of the network can impact and support our personal research work as ECR working with and for Latin America Science.

Dr. Mary Angelique G. Demetillo

Mary Angelique Demetillo focuses on the use of remote-sensing observations to describe and address air pollution inequality in cities as a postdoctoral researcher in the Science Directorate Chemistry and Dynamics Branch at NASA Langley Research Center. She recently earned her Ph.D. in environmental sciences with a focus on atmospheric chemistry from the University of Virginia as a NASA FINESST recipient.

She recently served as a delegate in the Space Generation Congress NASA Earth Science Working Group focused on international discourse towards “expanding global efforts to implement Earth Science to Action Strategies.”

Currently, she is investigating the surface and near-surface representativity of widely-anticipated near-surface ozone (O_3) product from NASA’s recently-launched Tropospheric Emissions: Monitoring of POllution (TEMPO) space-based sensor and contributing to airborne science research campaigns focused on atmospheric composition and trace gas spatiotemporal variability in major cities.

Abstract: On the use of Remote-sensing Observations for Urban Air Pollution Inequality Analyses

While air quality has improved over the last few decades, pollutant concentrations are highly variable within cities, and disproportionately impact people of color and low-income. Until recently, we have been limited in our ability to address air pollution burden differences between communities, in part, due to a lack of observations with sufficient spatiotemporal resolution. Technological improvements in remote-sensing observations of airborne and satellite sensors have sufficient resolution to now capture steep pollutant spatial gradients within urban regions.

In this presentation, I will share a detailed analysis of the ability of next-generation satellite observations to capture neighborhood-level differences in NO_2 and observationally constrain a major driver of air pollution inequality in U.S. cities. Overall, I find satellite-based NO_2 remote-sensing captures unequal burden between communities as a function of race-ethnicity and income in US cities and find a significant decrease in the largest contributor to inequalities would lead to a reduction in intra-urban inequalities. Additionally, I share current work expanding these results to community-level differences in secondary pollutant burden.

Ice-breaker Introduction

ECRs are invited to join us for an engaging ice-breaker activity, designed to foster connections among your peers and enhance your knowledge of IGAC and iCACGP. You will be split into breakout rooms and be given the opportunity to discuss your research whilst showcasing your creative side. Each breakout room will then go head to head in a bid to be crowned 'champions of IGAC and iCACGP'!

The Ice-breaker activity can be accessed either via GatherTown or the zoom link given in the schedule overview.

Note - for ice-breaker and climate activity:
There will be a Chinese/French/Spanish breakout room in the respective time-zones, for the ECRs who communicated their preference.
将为表达自己偏好的 ECR 提供一个中文分组讨论室。
Il y aura une salle en Francais pour les ECRs qui auront expresse le besoin.
Habrá una sala de descanso de habla hispana para los ECR que comunicaron su preferencia.

Climate Activity Introduction

As global temperatures continue to rise, understanding which policies and targets will be useful to curb this increase becomes a complex challenge. We can tackle the issue through changes in our energy production, how we use our land and produce food and the technologies we invest in. However, agreeing on a solution, which is able to simultaneously benefit all stakeholders and reach climate goals, has proved to be difficult on the global stage.
The interactive climate activity will make use of the En-ROADS Climate Solutions Simulator to attempt this challenge (https://www.climateinteractive.org/en-roads/). You will be split into breakout rooms and given a group to represent during the discussion. The aim will then be to negotiate on different policies to try and reach 1.5°C global average temperature warming by 2100, while still protecting the interests of your group.

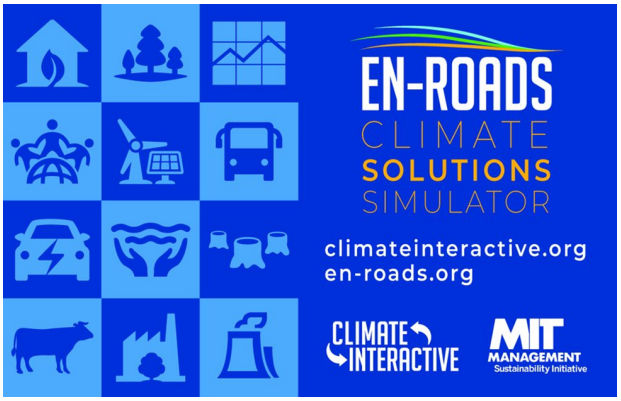


Image from the @ClimateInteract twitter (*X*) account. The visuals show examples of policies which can be targeted to reach the goal.

The climate activity can be accessed either via GatherTown or the zoom link given in the schedule overview.

Skills Workshop Speakers

Prof. Clare Murphy, Australia

Clare Murphy is currently a Professor in Physical Chemistry at the University of Wollongong, Australia in the School of Chemistry and co-chair of the IGAC SSC. She began her scientific career in 1990 as a “Scientific Officer” for the Radioactivity Group at the National Physical Laboratory (NPL) in the UK. In 1994, Clare moved to the Environmental Standards Group in the analytical Science Team at NPL to help in the European research efforts to determine the extent of stratospheric ozone depletion in the northern polar regions. Her research involved solar remote sensing of atmospheric trace gases using Fourier transform spectroscopy as part of the Network for Detection of Atmospheric Composition Change. In 2002, Clare moved to Australia to work as a research scientist at the University of Wollongong in the Centre for Atmospheric Chemistry and began her doctorate work in 2004 at the same University. Upon completion of her Ph.D. in 2009, Clare became a lecturer in Physical Chemistry at the University of Wollongong. She continues her research in solar remote sensing of atmospheric trace gases, has been involved in a number of satellite validation exercises, and has broadened her research interests to include ground level atmospheric composition with a focus on fires and air quality.

Workshop Topic Asia/Oceania: Designing & implementing field campaigns on a low budget.

Dr. Ari Asmi, Finland

Ari has a background in climate science, working in the interface between atmospheric observations and climate models. After his doctorate, he started to work on more interoperable observational data development, and he also became an active member of the rapidly developing Research Data Alliance (RDA). He has been involved in the core team developing the ENVRI community of European environmental research infrastructures, being part of direction of the major cluster projects ENVRI PLUS and ENVRI FAIR, as well as participating in different roles in several other European Commission funded projects particularly in connection to EOSC. In addition to his pan-European and domain specific skills, Ari has significant knowledge of national level Open Science environments and the research data management challenges faced by Research Performing Organisations (RPOs). Since 2022, he has led the Research Data Alliance Association (Europe), and starting 2023, coordinates the RDA TIGER project.

Workshop Topic Africa/Europe/Middle East: Ethics in Science.

Dr. James Crawford, USA

Jim Crawford received his B.S. in Mathematics from the United States Military Academy in 1986 and his Ph.D. in Atmospheric Chemistry from the Georgia Institute of Technology in 1997. Since that time, he has been a research scientist at NASA's Langley Research Center. From the start of his graduate studies in 1991 and throughout his career, his research has been associated with airborne field studies conducted across the globe by NASA's Tropospheric Chemistry Program and collaborating partners. His interests include the photochemistry of tropospheric ozone and free radicals, the global budget of reactive nitrogen, the influence of clouds on trace gas transport and chemistry, and the use of satellites to study long-range pollution transport and air quality. Most recently, he has served as the principal investigator for an air quality focused field study (DISCOVER-AQ) aimed to improve the diagnosis of surface air quality conditions from satellite observations. Jim was part of the IGAC SCC from 2015-2022, where he served as co-chair.

Workshop Topic Americas: International Collaboration.

The workshop sessions can be accessed either via GatherTown or the zoom link given in the schedule overview.

ECR Volunteers

Name	Institution	Name	Institution
Fernando Santos	Uni. of Singapore, Singapore	Alex Tardito Chaudhri	Uni. of Edinburgh, UK
Xiaorui Wu	Uni. of Singapore, Singapore	Damaris Tan	Uni. of Edinburgh, UK
Hasan Nawaz	Uni. of Wollongong, Australia	Emma Sands	Uni. of Edinburgh, UK
Adhitya Sutresna	Uni. of Melbourne, Australia	Carla Roesch	Uni. of Edinburgh, UK
Susan John	Uni. of of Wollongong, Australia	Katherine Taylor	Uni. of Edinburgh, UK
Arpit Awasthi	ISSER Mohali	James Mollard	Uni. of Edinburgh
Sachin Kumar Mishra	ISSER Mohali	Marrick Braam	Uni. of Edinburgh
Shahid Uz Zaman	Uni. of Engineering and Technology Bangladesh	Lea Fink	Helmholtz-Zentrum Hereon
Samiha Nahian	Uni. of Dhaka, Bangladesh	Stefan Wolff	Max Planck Institute for Chemistry, Germany
Li Xu	Uni. of Science and Technology, China	Julián Gelman Constantin	National Atomic Energy Commission, Argentina
Zhaomin Yang	Shandong University, China	Josefina Urquiza	National Technological University, Argentina
Wen Yi	Tsinghua University, China	Behrooz Roozitalab	UCAR, USA
Pamela Dominutti	University of Grenoble Alpes, France	Sara Grisales Vargas	University of Antioquia, Colombia
Ronny Badeke	Helmholtz-Zentrum Hereon, Germany	Pamela Dominutti	University of Grenoble Alpes, France
Johannes Bieser	Helmholtz-Zentrum Hereon, Germany	Kelvin Bates	University of Colorado Boulder, USA
Hiram Abif Meza Landero	Helmholtz-Zentrum Hereon, Germany	Emily Costa	Uni. of Michigan, USA
Olivia Jackson	Uni. of Manchester, UK	Ariel Scagliotti	National Technological University, Argentina

List of Posters

Asia / Oceania

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-1	**Hasan Nawaz** The University of Wollongong	**Satellite remote sensing of methane and its sources in Australia.** Satellite study, Remote sensing, Greenhouse gases
As.Oc-2	**Wenxin Zhao** Nanjing University	**Long-term Variability of Black Carbon Emissions Constrained by Gap-filled Absorption Aerosol Optical Depth in China and Associated Premature Mortality.** Modelling study, Air quality, Health
As.Oc-3	**Rikita Bhandari** Tribhuvan University	**Modeling of Traffic Related Air Pollution within Urban Street Canyons of the Kathmandu Valley, Nepa**l. Modelling study, Air quality, Field study
As.Oc-4	**Abdul Hakim bin Ramli** The National University of Malaysia	**Variability and potential sources of chlorinated very-short gases in the east coast of Peninsular Malaysia.** Trace Gases
As.Oc-5	**Bea Bukosa** NIWA	**How well can MethaneSAT detect and quantify pastoral agricultural emissions?** Satellite study, Remote sensing, Greenhouse gases, Modelling study
As.Oc-6	**Jiaru Li** University of Kyoto	**Relative humidity and pH dependence of HO2 uptake onto aqueous inorganic aerosols.** Laboratory study, Multiphase chemistry, Aerosols
As.Oc-7	**Muhammad Naeem** Department of Environmental Sciences University of Gujrat	**Determination of CH4 and CO2 Flux from Open Dumps in Pakistan.** Greenhouse gases
As.Oc-8	**Shahid Uz Zaman** Bangladesh University of Engineering and Technology	**Aerosol Climatology Characterization and Spatio-Temporal Variation of Aerosol Optical Depths over Bangladesh.** Satellite study, Remote sensing, Aerosols, Air quality
As.Oc-9	**Isha Thakur** G.B. Pant National Institute of Himalayan Environment	**Source apportionment and seasonal variability of ambient air pollutants and Nature based solution to control air pollution : A Study of a semi urban location of Himachal Pradesh.** Air quality, Modelling study, Laboratory study, Greenhouse gases
As.Oc-10	**Nasim Hamzeh** Atmospheric Science and Meteorology Research Center	**Investigation of PM2.5 and PM10 pollutions in Khuzestan plain in Southwest Iran.** Air quality
As.Oc-11	**Ranjit Solanki** Sardar Vallabhbhai National Institute of Technology	**Hourly PM2.5 and PM10 Matter Concentrations Prediction in Pune, India, Using AERONET Aerosol Optical Depth (AOD) and Meteorological Data.** Air quality, Aerosols
As.Oc-12	**Sindhu S** National Atmospheric Research Laboratory	**Volatile Organic Compounds impact on Ozone and Secondary Organic Aerosols formation in the rural atmosphere: Assessing estimation and seasonal variability.** Trace gases

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-13	**Wentai Zhang** The Hong Kong University of Science and Technology	**Marine Isoprene Emissions: Insights from Himawari-8.** Modelling study, Satellite study, Remote sensing, Ocean-Atmosphere interactions, Trace gases
As.Oc-14	**Devaprasad m** Physical Research Laboratory	**Dual carbon isotope-based brown carbon aerosol characteristics at a high-altitude site in the north-eastern Himalayas.** Field study, Air quality, Climate, Health, Aerosols
As.Oc-15	**Kiran Rambhau Suryawanshi** SVNIT	**Usability of the Low-cost Sensor Monitors for Improved Air Quality Monitoring.** Field study, Air quality
As.Oc-16	**Prashant Tripathi** Sri Sathya Sai Institute of Higher Learning	**Detection of the nylon 66 microplastics in the inhalable fraction of aerosols in microenvironments using UHPLC-MS/MS.** Air quality, Aerosols
As.Oc-17	**Durga Prasad Patnana** Sri Sathya Sai Institute of Higher Learning	**Measurements of phthalic acid esters, polycyclic aromatic hydrocarbons, derivatives of polycyclic aromatic hydrocarbons, trace metals and polyethylene terephthalate microplastics bound to PM2.5 at a suburban city in North West Indo-Gangetic Plain.** Field study, Aerosols, Air quality
As.Oc-18	**Ge Deng** National Institute for Environmental Studies	**Impact of boreal fires on black carbon aerosols in the western Arctic Ocean: inferences from shipborne observations and model analyses.** Field study, Modelling study, Aerosols, Trace gases
As.Oc-19	**Paul Adigun** University Of Tsukuba	**Anthropogenic fingerprint on Extreme Precipitation over East Asia.** Greenhouse gases, Aerosols, Modelling study, Air quality, Climate
As.Oc-20	**Sze In Madeleine Ng** The Chinese University of Hong Kong	**Heterogeneous OH Oxidation of Benzyl Sulfate: A First Insight into Atmospheric Fate of Aromatic Organosulfates.** Laboratory study, Multiphase chemistry, Aerosols, Air quality
As.Oc-21	**Hao Xu** National Institute for Environmental Studies	**Ground-based validation of TROPOMI NO2 total and tropospheric column using Pandora spectrometer in Tsukuba, Japan.** Satellite study, Remote sensing, Trace gases, Aerosols
As.Oc-22	**Poonam Mangaraj** Research Institute for Humanity & Nature	**Assessing the impact of stubble emissions from Northwest India on Delhi's air quality** Air quality, Health, Field study, Modelling study
As.Oc-23	**Sherin Hassan Bran** ChiangMai University	**Seasonal Distribution of PM2.5 Mass Concentration and its Significant Sources in Thailand** Modelling study, Aerosols, Clouds, Ecosystems
As.Oc-24	**Kingkan Chaisaward** Mahidol university	**Theoretical study on the OH-initiated atmospheric reaction of acetamiprid insecticide** Modelling study
As.Oc-25	**Huyen Truong** Saitama Univeristy	**Chemical characteristics of PM2.5 and PM0.1 during the highly polluted periods in Hanoi, Vietnam** Field study, Air quality, Aerosols
As.Oc-26	**Wenli liu** Peking University	**Temperature accounts for the gap in lifetime of cooking organic aerosol at laboratory and field during wintertime** Field study, Laboratory study, Aerosols, Multiphase chemistry
As.Oc-27	**Mujahid Farid** University of Gujrat	**Atmospheric Chemistry of Aerosols and Their Role in Global Climate Change** Aerosols

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-28	**Dhananjay Kumar** Vikram Sarabhai Space Centre	**What controls the molecular fingerprint of water-soluble organic compounds in size-segregated aerosols during the ACE-Asia campaign?** Field study, Air quality, Aerosols
As.Oc-29	**Nur Azalina Suzianti Feisal** Management and Science University	**The Consequences of Bauxite Mining on Respiratory Health and Lung Functions in School Children Exposed to Indoor Pollutants** Air quality, Field study, Health
As.Oc-30	**Xiaorui Wu** National University of Singapore	**Effects of Refined Sea Salt Markers on Source Apportionment of Coastal Urban PM2.5** Field study, Aerosols, Air quality
As.Oc-31	**NOR DIANA ABDUL HALIM** Universiti Kebangsaan Malaysia	**Evaluation of Urban Air Quality in Malaysia's Largest Conurbation Area: Towards Long-Term Sustainable Air Quality Management** Air quality, Land-Atmosphere interactions
As.Oc-32	**Ruqian Miao** Peking University	**Particulate pollution from mobile sources in China** Air quality, Aerosols
As.Oc-33	**Ravi Kant** Indian Institute of Remote Sensing	**Comparative Analysis of Vertical Water Vapor Distribution Between GNSS Tomography and GFS Reanalysis Data** Remote sensing, Satellite study, Greenhouse gases, Climate, Modelling study
As.Oc-34	**Hafsa Shahzad** University of the Punjab	**Long-term analysis of Air Pollutants over Greenland and comparison of air quality with Asian regions using Remote Sensing** Remote sensing, Air quality, Trace gases, Aerosols
As.Oc-35	**Amna Ijaz** Aix-Marseille University	**Online CHARON PTR-ToF-MS measurements elucidate residential heating as the major contributor of wintertime organic aerosol in Fairbanks, Alaska** Air quality, Aerosols
As.Oc-36	**Arpit Awasthi** Indian Institute of Science Education and Research Mohali	**Extreme summertime ozone pollution over the north-west Indo-Gangetic Plain driven by amplified peroxy-radical chemistry due to precursor emissions.** Air quality, Land-Atmosphere interactions, Trace gases, Field study, Health
As.Oc-37	**Sachin Kumar Mishra** Indian Institute of Science Education and Research Mohali	**Inter-comparison of benzene, toluene, and C8 - aromatics using PTR-TOFMS, PTR-QMS, and TD-GC-FID measurements in a South Asian urban environment** Field study, Instrument development
As.Oc-38	**Sai Phalguna Kanikaram** Sri Sathya Sai Institute of Higher Learning	**Ambient PM2.5 and some of its organic constituents induce TDP43 aggregation and could potentially modulate Amyotrophic Lateral Sclerosis progression.** Health, Air quality, Aerosols
As.Oc-39	**lailatus siami** Chung Yuan Christian University	**Carbon Dioxides from Vessel Cargo Emission – A Complex Network Approach** Greenhouse gases, Field study
As.Oc-40	**Raj Singh** Indian Institute of Science Education and Research Mohali	**Source apportionment of volatile organic compounds during paddy-residue burning season in north-west India reveals large pool of photochemically formed air toxics** Field study, Modelling study, Air quality, Health, Trace gases, Multiphase chemistry

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-41	**Karishma Yadav** DayalBagh Educational Institute	**Study of aerosol behavior based on morphological quality assessment before and after Diwali of a semi-arid region in Agra, Uttar Pradesh, India** Air quality, Aerosols
As.Oc-42	**Kaspia Rahman Tanima** European University of Bangladesh	**Health Impact Assessment of Construction Workers Associated With Air and Noise Pollution** Air quality, Health
As.Oc-43	**Pratibha Vishwakarma** Indian Institute of Technology Kanpur	**Analysis of the chemical attributes and origin of particulate-bound polycyclic aromatic hydrocarbons (PAHs) in the north-east part of India** Air quality, Health, Climate, Laboratory study, Aerosols
As.Oc-44	**Remya Balan** Vikram sarabhai space center	**Water-soluble organic aerosols over South Asia : Impact of primary and secondary sources** Aerosols
As.Oc-45	**Shobhna Shankar** Indira Gandhi Delhi Technical University for Women	**Recent Trends in Emissions and Health Risk Assessment of Heavy Metals from Anthropogenic Sources** Health, Air quality
As.Oc-46	**Maywalin Jumsai Na Ayutthaya** Mahidol University	**Health impacts and cost assessment of fine particulate matter formation: A conceptual introduction** Health, Air quality
As.Oc-47	**Stephen MacFarlane** University of Wollongong	**Impacts of Aromatic Chemistry on the Global Atmosphere** Modelling study
As.Oc-48	**Nguyễn Đoàn Thiện Chí** Vietnam National University	**Calibration of DustTrak and low-cost sensors and their application for assessment of inhalation exposures to traffic-related PM2.5 and PM1 in Ho Chi Minh city** Air quality, Health, Aerosols
As.Oc-49	**Sai Sanwid Pradhan** Sri Sathya Sai Institute of Higher Learning	**Fine particulate matter and its constituents induce mutant Huntingtin aggregation and potentially modulate the course of Huntington's disease.** Air quality, Health, Aerosols
As.Oc-50	**Adhitya Sutresna** University of Melbourne	**PMF representation of biomass burning organic aerosols from sea salt-interfered measurements using capture vapouriser-ToF-ACSM** Field study, Aerosols, Instrument development
As.Oc-51	*Withdrawn*	
As.Oc-52	**vikas rawat** University of Delhi	**Probing the impact of COVID lockdown on aerosol dynamics: Insights into vertical distribution, subtype, and secondary particle formation in Central Himalaya** Aerosols, Modelling study, Satellite study, Air quality, Greenhouse gases, Remote sensing
As.Oc-53	**pooja pawar** Indian Institute of Tropical Meteorology	**Chemistry of atmospheric ammonia over South Asia - a source of nitrogen pollution** Modelling study, Air quality, Field study, Aerosols
As.Oc-54	**Bakhat Rawat** University of Wollongong	**Long-term monitoring of atmospheric Hg0 at Kennaook /Cape Grim, Australia** Field study

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-55	**Kumari Aditi** Banaras Hindu University	**Assessing meteorological influences on amplifying regional aerosol loading over Indo-Gangetic Plain** Satellite study, Remote sensing, Air quality, Climate, Aerosols, Land-Atmosphere interactions
As.Oc-56	**Akanksha Pandey** Banaras Hindu University	**To constitute variations in prevailing aerosols within the cities and its outskirts using multi-satellite high-resolution retrievals over South Asia** Satellite study, Remote sensing, Air quality, Aerosols, Climate, Land-Atmosphere interactions
As.Oc-57	**DR NOOR HAZIQAH KAMALUDIN** Universiti Teknologi MARA	**Air quality assessment and the respiratory health effects among stall workers at the night markets in Selangor** Air quality, Health
As.Oc-58	**Ayesha Mariam** University of the Punjab	**Quantification of PM2.5 concentration variations in Pakistan using remote sensing approaches** Satellite study, Remote sensing, Air quality, Climate, Health, Aerosols
As.Oc-59	**Ashirbad Mishra** Utkal University	**Particulate Matter Emission from Traffic-Induced Resuspended Road Dust in India** Air quality, Aerosols, Modelling study
As.Oc-60	**Yuantao Wang** Tianjin University	**The Impact of Strong Dust Storm on Molecular Compositions of Atmospheric Organic Aerosols in Tianjin, North China** Field study, Air quality, Aerosols
As.Oc-61	**Samiha Nahian** University of Dhaka	**Occurrence and Risk Assessment of PM2.5- bound heavy metals in residential homes of Dhaka, Bangladesh** Air quality, Health, Aerosols
As.Oc-62	**Pallavi Sahoo** Utkal University	**Quantification and hotspot identification of ammonia emission from livestock and fertilizer sector over India** Air quality, Trace gases, Climate, Aerosols
As.Oc-63	**Siti Aminah Anshah** Universiti Kebangsaan Malaysia	**Detecting and Monitoring Air Pollution in Malaysia Using AOD from Himawari Satellite: An Analysis of the October 2023 Haze Event** Satellite study, Remote sensing, Air quality, Aerosols
As.Oc-64	**Sofia Banu** University of the South Pacific	**Understanding Air Quality and PM2.5 - A Review of Particulate Bound Mercury** Air quality, Climate, Health, Ecosystems, Land-Atmosphere interactions, Ocean-Atmosphere interactions, Multiphase chemistry, Aerosols
As.Oc-65	**Jingwei Zhang** Yunnan University	**Amplified role of potential HONO sources in Ozone formation in North China Plain during autumn haze aggravating processes** Modelling study, Air quality, Trace gases, Aerosols
As.Oc-66	**Wiwiek Setyawati** BRIN	**Meteorological Impact on The Composition of Inorganic Aerosol in Urban and Suburban Regions** Field study, Laboratory study, Aerosols
As.Oc-67	**Piotr Jakubowski** NAFAS	**Democratizing Air Quality Data in Indonesia For Better Health** Air quality, Health
As.Oc-68	**Nor Syamimi Sufiera Limi Hawari** Universiti Kebangsaan Malaysia	**Measurement of ambient volatile organic compounds in Malaysia: variations, source apportionment, and health risk assessment** Air quality
As.Oc-69	**Fernando Santos** National University of Singapore	**Using a Ground-based Spectrometer and Satellite Data to Understand Biases in Southeast Asia Air Quality** Satellite study, Trace gases, Air quality, Remote sensing

Poster ID	Name & Affiliation	Poster title & Topics
As.Oc-70	**Sarika Gupta** Indira Gandhi Delhi Technical University for Women	**Spatio-temporal composition and Health risk assessment of Polycyclic Aromatic Hydrocarbons (PAHs) at two different sites of Delhi -NCR, India** Air quality, Aerosols
As.Oc-71	**Pauziyah Mohammad Salim** Universiti Kebangsaan Malaysia	**Comparison Of Level 2 And Level 3 No2 Tropomi Data Over Peninsular Malaysia** Satellite study, Remote sensing, Air quality
As.Oc-72	**Hartini Binti Mahidin** National University of Malaysia	**A Decade Trend of Surface Ozone and Nitrogen Oxides in East Malaysia** Greenhouse gases
As.Oc-73	**Marziat Rahman** Stamford University Bangladesh	**Spatial Distribution of Air Quality in Sensitive Locations, Bangladesh** Air quality
As.Oc-74	**Jefri Yusof** Management and Science University	**The dual impacts of heavy metals found in natural rubber latex** Air quality, Laboratory study
As.Oc-75	**Vikrant Tomar** Aryabhatta Research Institute of Observational Sciences	**Long term changes (2007 – 2022) in surface ozone at a high-altitude site in the central Himalayas** Trace gases, Air quality
As.Oc-76	**Rehana Khan** Peshawar	**Aerosol Optical Properties And Its Implications To Atmospheric Heating Rate By Remote Sensing And Statistical Techniques** Aerosols, Remote sensing
As.Oc-77	**Rupal A.** Ministry of Earth Sciences	**Assessing Uncertainties in Stubble-Based Fire Detection and Estimation** Field study, Satellite study, Remote sensing, Air quality, Aerosols
As.Oc-78	**Vaishnav Bartariya** Dayalbagh Educational Institute	**Exploring the Dynamic Relationship Between Clouds and Aerosols in the Indo-Gangetic Basin** Field study, Air quality, Aerosols, Clouds, Land-Atmosphere interactions, Climate
As.Oc-79	**Priyanka Srivastava** National Institute for Environmental Studies	**Constraining Urban Emissions Sources of Trace Gases in Asian-Oceania Using Year-round Cargo-Ship Observations** Field study, Modelling study, Satellite study, Air quality, Greenhouse gases, Trace gases, Aerosols
As.Oc-80	**Fasiha Safdar** National University of Science and Technology	**Changes in TOA Net Flux over South Asia and Pakistan with Changing Cloud Radiative Effect (CRE) and Aerosols** Satellite study, Remote sensing, Climate, Air quality, Clouds, Aerosols

Africa / Europe / Middle East

Poster ID	Name & Affiliation	Poster title & Topics
A.E.ME-1	*Withdrawn*	
A.E.ME-2	**Maximilien Desservettaz** The Cyprus Institute	**Emission of volatile organic compounds from residential biomass burning and their rapid chemical transformations.** Field study, Air quality, Trace gases
A.E.ME-3	**Issoufou OUARMA** Université Nazi BONI	**Particulate and gaseous pollution in a West African city : case study of Ouagadougou.** Field study, Air quality
A.E.ME-4	**Rikita bhandari** Tribhuvan University	**Modeling of Traffic Related Air Pollution within Urban Street Canyons of the Kathmandu Valley, Nepal.** Modelling study, Air quality, Field study
A.E.ME-5	*Withdrawn*	
A.E.ME-6	**Ioubna Bouhachlaf** Mohammed V University in Rabat	**Air quality monitoring systems based on Internet of Things (IOT).** Air quality, Field study
A.E.ME-7	**Blanca Rios** Instituto de Ciencias de la Atmósfera y Cambio Climático	**Reduction in Crop Yield in Mexico Due to Ozone Associated with Emissions from Biomass Burning.** Modelling study, Air quality, Trace gases
A.E.ME-8	**Clément Dumont** Gembloux Agro-Bio Tech	**Study of biogenic volatile organic compound emissions and depositions over a mixed temperate forest by PTR-TOF-MS and eddy covariance.** Ecosystems, Trace gases, Land-Atmosphere interactions, Field study
A.E.ME-9	**Flossie Brown** University of Exeter	**Fire-driven ozone damage to the Amazon decreases plant productivity.** Modelling study, Air quality, Land-Atmosphere interactions, Trace gases
A.E.ME-10	**Bert Verreyken** Royal Belgian Institute of Space Aeronomy	**Source characterization of reactive carbon in a mixed forest ecosystem (Vielsalm, BE).** Field study, Trace gases
A.E.ME-11	**Jacob Taamte** Research Centre for Nuclear Science and Technology	**Low-cost air quality monitoring devices design for low- and middle-income countries** Instrument development, Remote sensing, Air quality, Aerosols, Clouds, Health
A.E.ME-12	**Ailish Graham** University of Leeds	**Monitoring Exposure to Air Pollution (Haze) from Fires in Indonesia using low-cost PM2.5 sensors** Air quality, Field study, Modelling study, Health
A.E.ME-13	**Eva Pfannerstill** University of California, Berkeley	**Temperature-dependent emissions dominate ozone and aerosol formation in Los Angeles.** Field study, Air quality, Land-Atmosphere interactions, Trace gases
A.E.ME-14	**Glenn-Michael Oomen** BIRA-IASB	**Weekly-derived biogenic VOC fluxes over Europe constrained by TROPOMI HCHO data in 2018-2022.** Modelling study, Satellite study, Remote sensing, Air quality, Trace gases
A.E.ME-15	**Alexander Taridau Chaudhri** University of Edinburgh	**An Idealised Model for Fast Prototyping of Hydrogen Deposition Schemes.** Modelling study, Land-Atmosphere interactions, Trace gases

Poster ID	Name & Affiliation	Poster title & Topics
A.E.ME-16	**Steven Turnock** Met Office Hadley Centre	**The Climate, Air Quality and Health co-benefits and trade-offs from different future mitigation scenarios involving Near-Term Climate Forcers in UKESM1.** Modelling study, Air quality, Climate, Health
A.E.ME-17	**Hisham Rawas** University of Lille	**Oxidation of Phosmet Insecticide Initiated by HO• Radical in Air and Water Environments: Mechanistic, Kinetic, and Ecotoxicity Studies.** Ecosystems, Land-Atmosphere interactions, Aerosols, Modelling study
A.E.ME-18	**Martin Otto Paul Ramacher** Helmholtz-Zentrum Hereon	**Why current exposure estimates are biased low - the impact of population activity and outdoor-to-indoor infiltration on regional scale exposure to air polluation.** Modelling study, Air quality, Health
A.E.ME-19	**Lorrie Jacob** Cambridge University	**Improving our understanding of sulfur chemistry above the ocean: the development and evaluation of a dimethyl sulfide oxidation mechanism.** Laboratory study, Modelling study, Climate
A.E.ME-20	**Dembele Massitan beny** Atlantic Technical University	**Saharan dust transport towards tropical Atlantic Ocean and South America: a 3-dimensional analysis based on Livas aerosol climatology.** Aerosols, Air quality, Modelling study, Remote sensing
A.E.ME-21	**KALLIOPI PETRINOLI** National Observatory of Athens	**Linking sources of organic aerosol at a major Mediterranean city to health: long-term observations and oxidative potential** Air quality, Health, Aerosols
A.E.ME-22	**Christin Fernholz** Max-Planck-Institute for Chemistry	**Kinetics of the reaction of OH with methyl nitrate (232–343 K)** Laboratory study
A.E.ME-23	**Vichawan Sakulsupich** University of Cambridge	**The role of sulfur oxidation on aerosol and cloud properties and radiative effects in UKESM1 CMIP6 historical experiments** Modelling study, Climate, Multiphase chemistry, Aerosols, Clouds
A.E.ME-24	**Adrian Jost** Max Planck Institute for Chemistry	**Enhancing global SO2 emission inventories using Sentinel-5P TROPOMI satellite data** Satellite study, Remote sensing, Trace gases, Aerosols
A.E.ME-25	**Anahita Sattari** National Research Centre	**Assessing Transport Sector Impact on Urban Air Quality in Warsaw, Poland** Air quality, Modelling study
A.E.ME-26	**Felix Paul** University of Uyo	**Air quality index and health dynamics in changing climate of the niger delta region of nigeria** Air quality, Climate, Health
A.E.ME-27	**Talha Saeed** National University of Sciences & Technology	**1st NASA Pandora Spectrometer of South Asia: Exploring the Profile of Atmospheric Trace Gases in Pakistan** Satellite study, Remote sensing, Climate, Trace gases, Air quality
A.E.ME-28	**Pauline Pouyès** Univeristy of Bordeaux	**Field chemical characterization and laboratory heterogeneous reactivity of markers of biogenic secondary organic aerosol (BSOA) formation and fate** Field study, Laboratory study, Air quality, Climate, Land-Atmosphere interactions, Multiphase chemistry, Aerosols, Health
A.E.ME-29	**Luna Cartayrade** University of Lille	**Examining the Atmospheric Breakdown of Relevant Methylated Selenium Species Upon Exposure to HO· Using Computational Methods** Aerosols, Modelling study, Trace gases, Ecosystems, Health

Poster ID	Name & Affiliation	Poster title & Topics
A.E.ME-30	**Sonia Taamalli** University of Lille	**Unraveling the monohydration processes of oxygenated mercury compounds** Modelling study, Climate, Health, Ecosystems, Land-Atmosphere interactions
A.E.ME-31	**Wenli Liu** Peking University	**Temperature accounts for the gap in lifetime of cooking organic aerosol at laboratory and field during wintertime** Field study, Laboratory study, Aerosols, Multiphase chemistry
A.E.ME-32	**Panayiotis Kalkavouras** National Observatory of Athens	**Does New Particle Formation enhance Cloud Condensation Nuclei and droplet number in a major city of the Eastern Mediterranean?** Climate, Aerosols, Clouds
A.E.ME-33	**Karolin Voss** Heidelberg University	**Total stratospheric bromine [Bry] inferred from balloon-borne solar occultation BrO measurements using the new balloon-borne UV/vis spectrometer** Field study, Instrument development, Remote sensing, Trace gases
A.E.ME-34	**Freja F. Oesterstroem** University of Copenhagen	**Changes in the Response of Stratospheric Ozone to Future Explosive Volcanic Eruptions** Modelling study, Climate
A.E.ME-35	**Connor Barker** University college london	**Megaconstellation mission emission inventory development for determining the impact on stratospheric ozone and climate** Modelling study, Climate, Aerosols, Greenhouse gases, Trace gases
A.E.ME-36	**Peeyush Khare** Yale University	**Ambient Observations and Laboratory Characterization of Asphalt-Related Secondary Organic Aerosol** Field study, Laboratory study, Air quality, Aerosols
A.E.ME-37	**Abdelfettah BENCHRIF** National Center for Nuclear Energy	**Comprehensive Analysis of PM10 and PM2.5 Composition in four Moroccan Cities: Emission Sources and Geographical Variations** Air quality, Aerosols, Field study
A.E.ME-38	**Gunther Türk** Max Planck Institute for Chemistry	**First ground-deployment of a new small-footprint cavity-ring-down spectrometer for NO3 and N2O5 in a temperate forest during the ACROSS campaign** Field study, Instrument development, Air quality
A.E.ME-39	**Saloni Vijay** ETH Zurich	**Absorption Ångström exponent as a marker of local Black Carbon sources: A case of Blantyre, Malawi** Air quality, Field study, Aerosols
A.E.ME-40	**Ravi Kant** Indian Institute of Remote Sensing	**Comparative Analysis of Vertical Water Vapor Distribution Between GNSS Tomography and GFS Reanalysis Data** Remote sensing, Satellite study, Greenhouse gases, Climate, Modelling study
A.E.ME-41	**Olivia Jackson** University of Manchester	**Understanding Atmospheric Transport and Volatility of Pesticides Using Mass Spectrometry** Air quality, Laboratory study, Aerosols
A.E.ME-42	**Damaris Tan** UK Centre for Ecology & Hydrology	**Assessing the impact of European open biomass burning on UK air quality** Modelling study, Air quality, Aerosols
A.E.ME-43	**Emma Sands** University of Edinburgh	**Satellite observations highlight influence of both vegetation and fire on atmospheric composition over the southern Amazon** Satellite study, Remote sensing, Land-Atmosphere interactions, Trace gases

Poster ID	Name & Affiliation	Poster title & Topics
A.E.ME-44	**Amna Ijaz** Aix-Marseille University	**Online CHARON PTR-ToF-MS measurements elucidate residential heating as the major contributor of wintertime organic aerosol in Fairbanks, Alaska** Air quality, Aerosols
A.E.ME-45	**Christoph Riess** Wageningen University	**Monitoring NOx emission compliance from space combining TROPOMI data and models** Modelling study, Satellite study, Trace gases, Air quality, Remote sensing
A.E.ME-46	**Bex Horner** University College London	**Vertical profiles of global tropospheric nitrogen dioxide (NO2) and ozone (O3) obtained via cloud-slicing of TROPOMI partial columns** Modelling study, Satellite study, Remote sensing, Greenhouse gases, Clouds
A.E.ME-47	**Eszter Kovacs** University of Leeds	**Latitudinal gradient in cloud droplet number concentration of Southern Ocean liquid clouds explained by aerosol sources** Modelling study, Satellite study, Remote sensing, Ocean-Atmosphere interactions, Aerosols, Clouds
A.E.ME-48	**Christian Saravia** University of Brandenburg Cottbus-Senftenber	**Spatiotemporal ammonia (HN3) emission and source detection in Brandenburg Germany** Air quality, Trace gases
A.E.ME-49	**Ashish Kumar** University of York	**Unmasking the Sizzling Secrets of Cooking Emissions!** Laboratory study, Air quality, Trace gases
A.E.ME-50	**Eleanor Gershenson-Smith** University College London	**Profiling air pollution over the Central London atmosphere in summer and winter 2023** Remote sensing, Air quality, Modelling study
A.E.ME-51	**Pamela Dominutti** Université Grenoble Alpes	**Particulate MSA in continental sites** Field study, Air quality, Aerosols
A.E.ME-52	**Nana Wei** University College London	**Reactive nitrogen in the global upper troposphere from recent and historical commercial and research aircraft campaigns, TROPOMI and GEOS-Chem** Modelling study, Trace gases, Multiphase chemistry
A.E.ME-53	**Zixuan Cheng** University of Manchester	**Eddy covariance measurements of black carbon emissions in central London** Air quality, Health, Aerosols, Land-Atmosphere interactions
A.E.ME-54	**Prince Junior Asilevi** Kwame Nkrumah University of Science and Technology	**Air Pollution Control using homemade non-thermal plasma technology** Laboratory study, Air quality
A.E.ME-55	**Charlotte Stapleton** University of York	**Oceanic Ozone Deposition: Shipborne Eddy Covariance Measurements and a Revised Parameterisation Representing the Process** Ocean-Atmosphere interactions, Field study, Modelling study
A.E.ME-56	**Samiha Nahian** University of Dhaka	**Occurrence and Risk Assessment of PM2.5- bound heavy metals in residential homes of Dhaka, Bangladesh** Air quality, Health, Aerosols
A.E.ME-57	**Ayassou Koffi** Université de Lomé	**Simulation de l'impact des émissions d'hydrofluorocarbures (hfc) au togo sur la température moyenne mondiale** Greenhouse gases, Modelling study, Climate

Poster ID	Name & Affiliation	Poster title & Topics
A.E.ME-58	**Giovanni Pugliese** Max Planck Institute for Chemistry	**Soil volatile organic compound fluxes from Amazon rainforest soil** Field study, Ecosystems, Land-Atmosphere interactions, Trace gases
A.E.ME-59	**Hiram Abif Meza Landero** Helmholtz-Zentrum Hereon	**Investigating the global atmospheric transport of PFAS using the next-generation chemistry transport model ICON-ART and a newly developed emission model** **Modelling study, Air quality, Trace gases**
A.E.ME-60	**Carolina Nelson** Max Planck Institute for Chemistry	**Chemical ionization mass spectrometry (CIMS) aircraft measurements of PAN and PAA in the tropical atmosphere** Field study, Instrument development, Trace gases
A.E.ME-61	**Gongda Lu** University College London	**Near-Automated Estimate of Nitrogen Oxides City Emissions Applied to South and Southeast Asia** Satellite study, Air quality, Trace gases
A.E.ME-62	**Diana Pereira** Université Paris Cité and Univ Paris Est Creteil	**Secondary organic aerosol composition in the urban and sub-urban area of Paris: an application of molecular tracers** Field study, Aerosols, Laboratory study
A.E.ME-63	**Karn Vohra** University College London	**Health burden of air pollution linked to each major oil and gas lifecycle stage in the US** Modelling study, Air quality, Health, Aerosols, Trace gases
A.E.ME-64	**Prerita Agarwal** University of Edinburgh	**Quantifying the dominant sources influencing the 2016 particulate matter pollution episode over northern India** Modelling study, Air quality, Aerosols
A.E.ME-65	**Kwabena Fosu-Amankwah** C. K. Tedam University of Technology and Applied Sciences	**Exposure Of Passengers In Minivans (“Trotro”) To Particulate Matter (Pm) During Peak Traffic Hours In Kumasi** Air quality
A.E.ME-66	*Withdrawn*	
A.E.ME-67	**Sakshi Ahlawat** National Physical Laboratory	**Emissions of particulate associated – Water Soluble Organic Carbon from residential biofuels burned in rural region of Western India** Aerosols, Air quality
A.E.ME-68	**Aditya Nalam** Freie Universitaet Berlin	**Effects of International Ship-NOx Emissions on Surface Ozone Concentration: Global Model Calculations using perturbation and tagging approaches** Modelling study
A.E.ME-69	**Erwan Volent** IMT Nord Europe CERI EE	**Impact of Volatile Organic Compounds emitted by the ships on air quality in the Channel** Field study, Trace gases

Americas

Poster ID	Name & Affiliation	Poster title & Topics
Americas-1	**Maximilien Desservettaz** The Cyprus Institute	**Emission of volatile organic compounds from residential biomass burning and their rapid chemical transformations.** Field study, Air quality, Trace gases
Americas-2	*Withdrawn*	
Americas-3	**Ariel Scagliotti** Universidad Tecnológica Nacional	**Uncertainties assessment of regional aerosol classification schemes.** Aerosols, Air quality, Modelling study, Remote sensing
Americas-4	**Rikita bhandari** Tribhuvan University	**Modeling of Traffic Related Air Pollution within Urban Street Canyons of the Kathmandu Valley, Nepal.** Modelling study, Air quality, Field study
Americas-5	**Alma Reyna Galván** UNACAR	**BTEX levels and health risk analysis in two urban sites in San Francisco of Campeche.** Field study, Laboratory study, Air quality, Health, Land-Atmosphere interactions
Americas-6	**Hongru Shen** Fudan University	**Unexpected significance of a minor reaction pathway in daytime formation of biogenic highly oxygenated organic compounds.** Laboratory study, Aerosols
Americas-7	**Taylor West** University of Maryland	**Analyzing Trends in Air Quality During a Drought: A Case Study to Improve Public Health Response to Drought Threats.** Air quality, Health, Climate, Satellite study, Land-Atmosphere interactions, Aerosols
Americas-8	**Habineza Theobard** Carnegie Mellon Universtiy	**Chemical Characterization of Air Pollution in Kigali, Rwanda: Insights from Continuous Aerosol Speciation and Black Carbon Monitoring.** Field study, Modelling study, Air quality, Health, Multiphase chemistry, Trace gases, Aerosols
Americas-9	**Bert Verreyken** Royal Belgian Institute of Space Aeronomy	**Source characterization of reactive carbon in a mixed forest ecosystem (Vielsalm, BE).** Field study, Trace gases
Americas-10	**Jacob Taamte** Research Centre for Nuclear Science and Technology	**Low-cost air quality monitoring devices design for low- and middle-income countries** Instrument development, Remote sensing, Air quality, Aerosols, Clouds, Health
Americas-11	**Maria Florencia Tames** Grupo de Estudios de la Atmósfera y el Ambiente	**Understanding air pollution exposure dynamics: a novel model for exposure assessment.** Modelling study, Air quality, Health
Americas-12	**Sérgio J. Gonçalves Junior** Rio de Janeiro State University	**Revealing changes in sea salt aerosol geochemistry in the WAIS induced by stratospheric ozone depletion.** Field study, Laboratory study, Satellite study, Climate, Ocean-Atmosphere interactions, Land-Atmosphere interactions, Aerosols
Americas-13	**Olivia Sablan** Colorado State University	**Investigating prescribed and agricultural fires in Kansas and Florida, USA from 2022-2023.** Field study, Satellite study, Air quality, Aerosols

Poster ID	Name & Affiliation	Poster title & Topics
Americas-14	**Shuang Wu** University of Alberta	**Utilizing a chemical two-dimensional (2D) partitioning model to visualize the phase distributions of emerging indoor organic pollutants.** Laboratory study, Modelling study, Air quality, Health, Multiphase chemistry, Aerosols
Americas-15	**Colleen Marciel Rosales** OpenAQ	**Statistical metrics for intercomparison of two instrumental methods.** Instrument development
Americas-16	**May Chim** University of Cambridge	**Climate Projections Very Likely Underestimate Future Volcanic Forcing and its Climatic Impacts.** Modelling study, Climate, Aerosols
Americas-17	**Yingxiao Zhang** University of Michigan	**Effects of pollen on hydrometeors and precipitation in a convective system** Modelling study, Aerosols, Clouds, Ecosystems
Americas-18	**Josefina Urquiza** Consejo Nacional de Investigaciones Científicas y Técnicas	**Uncertainty analysis of satellite aerosol products used as PM2.5 predictors in Latin American cities** Satellite study, Remote sensing, Aerosols, Air quality
Americas-19	**Darshi Tharika** SUNY College of Environmental Science & Forestry	**Computational Chemistry Re-interprets Laboratory and Field Studies of Oxidation of Hg(0) Initiated by Nitrate Radical** Trace gases, Land-Atmosphere interactions, Modelling study
Americas-20	**Kathryn Moore** Colorado State University	**Characterizing Ice Nucleating Particles over the Southern Ocean using Simultaneous Aircraft and Ship Observations** Field study, Satellite study, Climate, Ocean-Atmosphere interactions, Aerosols, Clouds
Americas-21	**Natalie Kille** University of Wyoming	**Wildfire emissions during the BB-FLUX campaign: an example of measurements from the University of Wyoming King Air Facility** Field study, Remote sensing, Trace gases, Clouds, Aerosols
Americas-22	**Noribeth Mariscal** Wayne State University	**Ozone Atmospheric Chemistry in Southeast Michigan during the Michigan-Ontario Ozone Source Experiment (MOOSE)** Modelling study, Air quality
Americas-23	**MELISA CARLA DIAZ RESQUIN** CNEA	**Random forest algorithm for the prediction of Buenos Aires air quality** Modelling study, Air quality
Americas-24	**Alison Bain** Oregon State University	**Physical properties of aerosol containing short chain organosulfates** Laboratory study, Aerosols
Americas-25	**Yunsong Liu** The Pennsylvania State University	**Reconciling a national methane emission inventory with in-situ measurements** Greenhouse gases, Field study
Americas-26	**Kelvin Bates** NOAA	**The global budget of atmospheric ethanol: new constraints from remote and urban measurements** Field study, Modelling study, Land-Atmosphere interactions, Ocean-Atmosphere interactions, Trace gases, Air quality
Americas-27	**Christian Saravia** University of Brandenburg Cottbus-Senftenber	**Spatiotemporal ammonia (HN3) emission and source detection in Brandenburg Germany** Air quality, Trace gases

Poster ID	Name & Affiliation	Poster title & Topics
Americas-28	**pamela dominutti** Université Grenoble Alpes	**Particulate MSA in continental sites** Field study, Air quality, Aerosols
Americas-29	**Facundo Baraldo** Comisión de Energía Atómica	**Assembly of analytical techniques and statistical methods in the study ofparticulate matter 2.5 in Buenos Aires.** Field study, Laboratory study, Remote sensing, Air quality, Health, Aerosols
Americas-30	**Logan Forshee** University of Michigan	**Identifying and quantifying secondary aerosol in polluted Fairbanks, Alaska on an individual-particle basis** Field study, Air quality, Aerosols
Americas-31	**Yue Chen** The University of Leeds	**Local and Remote Radiative and Temperature Impacts from Recent Rapid Changes in PM2.5 Air Pollution over China** Modelling study, Air quality, Climate, Aerosols
Americas-32	**Esther Atinuke Olonimoyo** University of Maryland	**HPLC-PDA Method Development, Optimization, and Validation for The Quantification of Organic Acids** Aerosols, Field study, Laboratory study, Instrument development
Americas-33	**Emily Costa** University of Michigan	**Chemical Composition, Morphology, and Sources of Individual Atmospheric Particles in the Urban Alaskan Winter** Field study, Air quality, Aerosols
Americas-34	**Miguel Ricardo Alipuddin Hilario** The University of Arizona	**Quantifying aerosol scavenging efficiencies in tropical convective clouds over the West Pacific** Field study, Aerosols, Clouds
Americas-35	**BIGHNARAJ SARANGI** University of Puerto Rico	**Major African dusts intrusions in Puerto Rico based on the long term in-situ ground measurements of aerosol optical properties.** Field study, Remote sensing, Satellite study, Air quality, Climate, Aerosols
Americas-36	**Kristen Okorn** NASA	**Linking Ground-Based Sensor Data to Airborne and Satellite Observations during the AEROMMA Campaign** Field study, Air quality, Trace gases
Americas-37	**Saeideh Mohammadi** University of Iowa	**Secondary organic aerosol yields of decamethylcyclopentasiloxane (D5) and Octamethylcyclotetrasiloxane (D4) in an Oxidation Flow Reactor** Laboratory study, Air quality, Aerosols
Americas-38	**Beatriz Herrera** University of Toronto	**Variability and trends of ammonia from ground-based FTIR measurements and global chemical transport models** Modelling study, Remote sensing, Air quality, Trace gases
Americas-39	**Glen Chua** Princeton University	**Methane mitigation to counteract the climate and composition effects of hydrogen leakage and reduction in other short-lived climate forcers from a future hydrogen economy** Modelling study, Greenhouse gases, Trace gases, Aerosols, Climate, Air quality
Americas-40	**Genevieve Lorenzo** University of Arizona	**Sub-saturated Aerosol Hygroscopicity during the CAMP2Ex Airborne Campaign** Field study, Aerosols, Air quality
Americas-41	**Giovanni Pugliese** Max Planck Institute for Chemistry	**Soil volatile organic compound fluxes from Amazon rainforest soil** Field study, Ecosystems, Land-Atmosphere interactions, Trace gases
Americas-42	**Andrew Holen** University of Michigan	**Sources and contributions of trace metals within wintertime fine particulate matter in a sub-Arctic city** Field study, Air quality, Aerosols

Poster ID	Name & Affiliation	Poster title & Topics
Americas-43	**Judy Wu** University of Michigan	**Mixing state of secondary aerosol in the wintertime Arctic: a bulk and single-particle study on chemical aging** Field study, Aerosols, Climate, Air quality
Americas-44	**Sergio Ibarra-Espinosa** University of Colorado	**COVID-19 impacts on the US methane emissions** Modelling study, Greenhouse gases
Americas-45	**Adam Ahern** CIRES	**A comparison of direct measurements of stratospheric aerosol size distributions with aerosol retrievals from limb sounding measurements (OMPS/LP V2)** Field study, Remote sensing, Aerosols, Satellite study
Americas-46	*Withdrawn*	
Americas-47	*Withdrawn*	
Americas-48	**Fasiha Safdar** National University of Science and Technology	**Changes in TOA Net Flux over South Asia and Pakistan with Changing Cloud Radiative Effect (CRE) and Aerosols** Satellite study, Remote sensing, Climate, Air quality, Clouds, Aerosols

Full abstracts by time zones

Asia / Oceania

As.Oc-1

Satellite remote sensing of methane and its sources in Australia

Hasan Nawaz, Clare Murphy, Nicholas Deutscher

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Abstract

Methane (CH4) contributes to 20% of global warming caused by greenhouse gases. Therefore, the mitigation of CH4 emission is important to tackle short-term global warming. This study presents spatial variations of total column average dry air mole fraction of CH4 from TROPOspheric Monitoring Instrument (TROPOMI) over Australia during February 2019 - April 2023. Different sources of CH4 have been identified including biomass and fossil fuel burning, wetlands, coal mines, feedlots, and agricultural areas. High CH4 enhancements in the Northern Australia is due to biomass burning and wetlands emissions, whereas in the Eastern Queensland is because of coal mining activities. The wetlands hotspot in the Northern Queensland could be real or an artifact due to high surface albedo in the TROPOMI CH4 retrieval. Seasonally, the concentration of CH4 is found to be high over Australia during spring (September-November) followed by winter (June-August), summer (December-February), and autumn (March-May) seasons.

Poster research topic(s): Satellite study, Remote sensing, Greenhouse gases

As.Oc-2

Long-term Variability of Black Carbon Emissions Constrained by Gap-filled Absorption Aerosol Optical Depth in China and Associated Premature Mortality

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Abstract

Black carbon (BC) plays an important role on air quality, public health, and climate, while its long-term variations in emissions and health effect were insufficiently understood for China. Here, we present the spatiotemporal evolution of BC emissions and associated premature mortality for China over 2000-2020, based on an integrated framework combining satellite observations, a machine learning technique, a “top-down” inversion approach and an exposure-response model. We find the “bottom-up” approach might underestimate the BC emissions, particularly in less developed western and remote areas. The national pollution controls are estimated to reduce the annual BC emissions by 26% during 2010-2020, reversing the growth of 8% during 2000-2010. The emissions in main coal-production provinces had declined by 2010, but rebounded afterwards. In contrast, provinces with higher economy and urbanization levels had experienced emission growths (0.05-0.10 $Mg/km^2/yr$) by 2010 and declined greatly (0.07-0.23 $Mg/km^2/yr$) during 2010-2020. The national annual BC-associated premature mortalities range between 733,910 (95% confidence interval: 676,790-800,250) and 937,980 cases (864,510-1,023,400) for different years. The changing BC emissions contributed 78,590 cases (72,520-85,600) growth within 2000-2005 and 133,360 (123,150-145,180) reduction within 2010-2015. Strategies differentiated by region are needed for further reducing BC emissions and its health and climate impacts.

Poster research topic(s): Modelling study, Air quality, Health

As.Oc-3, A.E.ME-4, Americas-4

Modeling of Traffic Related Air Pollution within Urban Street Canyons of the Kathmandu Valley, Nepal

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Abstract

In the Kathmandu Valley, people who live close to main streets are constantly exposed to higher amounts of particulate matter and other air pollutants. The primary objective of the study is to model air pollution dispersion due to traffic within the urban street canyons of the Kathmandu Valley using the Operational Street Pollution Model (OSPM). The data was collected and analyzed for three seasons, i.e., pre-monsoon, monsoon, and post-monsoon, within street canyon and non-canyon pairs. Because of skewness in our data, Wilcoxon signed-rank test with a 5% level of significance was performed, and the statistical result rejected the null hypothesis and claimed that the ambient PM concentration in street canyons was much higher than in non-canyons. Higher pollutant concentrations in the street canyons in comparison to non-canyons was found which might be due to tall structures that restrict wind flow and constrain the dispersion of air masses within the street canyons. A good agreement between measured and modeled concentrations for PM2.5 concentration (0.60) was found, although the model overestimates PM2.5 concentrations. The generalized additive model and Spearman's correlation gave insight that more than meteorological parameters, vehicle emissions affect the concentrations of pollutants in the streets of the Kathmandu Valley. Among other fleets, two-wheelers (91.3%) led to higher emissions in the street canyons in comparison to passenger cars, HDVs, and LDVs. A drop in pollutants concentration was found in monsoon season with increased wind speed and precipitation that led to wet deposition of particulates, and higher concentrations during rush hours have been linked with continuous flow of vehicles, congestion, and reduced speed of vehicles in the street canyons. Our study suggests that the revision of the model with respect to the Asian scenario (incorporating TPT from two-wheelers) would provide a better accuracy.

Poster research topic(s)

Modelling study, Air quality, Field study

As.Oc-4

Variability and potential sources of chlorinated very-short gases in the east coast of Peninsular Malaysia

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Abstract

The ongoing increase in emissions of anthropogenic, short-lived chlorine compounds is a significant contributor to ozone depletion. This study attempts to evaluate the variability of chlorinated very-short gases (VSLS) within the Southeast Asian region and to discern any deviations from their baseline levels. This study delves to identify the potential source locations and types that may be contributing to the fluctuations in chlorinated VSLS levels. Long-term measurements of chlorinated VSLS mixing ratios were conducted at the Institute of Ocean and Earth Sciences (IOES) in Bachok, Kelantan, Peninsular Malaysia.These measurements were conducted during the Northeast Monsoon (NM) season spanning from 2014 to 2020.This study focuses on chlorinated VSLSs, including chloroform ($CHCl_3$), 1,2-dichloroethane (CH_2ClCH_2Cl), and dichloromethane (CH_2Cl_2).The UK Met Office's Numerical Atmospheric Modelling Environment (NAME) model was employed to ascertain potential source locations and types of these gases.The results show that the concentrations of all these gases consistently surpass the annual mean mole fractions (ppt) established by the AGAGE network, specifically measuring 8.9 ppt for $CHCl_3$, 7.53 ppt for CH_2ClCH_2Cl, and 32.7 ppt for CH_2Cl_2. For instance, the median concentration of CH_2Cl_2 was rigorously documented at 86.08 ppt, 69.18 ppt, 66.85 ppt, 107.81 ppt, and 89.02 ppt during each Northeast Monsoon season from 2014 to 2020. NAME model's footprints show that the fluctuations in chlorinated VSLS levels may likely have been influenced by the pathways traversed by air masses before reaching Bachok. The variability in the measured mixing ratios of chlorinated VSLS is also significantly influenced by cold surge events prevalent during the Northeast Monsoon Seasons. In summary, these findings collectively underscore the pivotal role of Southeast Asia as a prospective source region for the emission of halogenated gases.

Poster research topic(s)

Trace gases

As.Oc-5

How well can MethaneSAT detect and quantify pastoral agricultural emissions?

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Abstract

MethaneSAT is a joint American and New Zealand satellite mission, which involves a partnership between Environmental Defense Fund (EDF), MethaneSAT LLC and the New Zealand government. The satellite is scheduled for launch in early 2024 and it is designed to target specific 200 km x 200 km regions and map methane (CH_4) within those regions at 100 m x 400 m resolution with unprecedented precision (2 ppb precision).

The core mission of the satellite is to support emissions reductions by detecting and quantifying CH_4 emissions from oil and gas leaks (i.e., point sources), globally. The Aotearoa New Zealand team's aim is to develop and test the capability to use the satellite to detect agricultural CH_4 emissions. New Zealand is an ideal place to detect this capability due its large CH_4 emissions, 85% of which are from agricultural sources. Here, we will present details of the research programme to develop and test this capability. We will present preliminary results of modelled atmospheric CH_4 values for the main agricultural targets across Aotearoa New Zealand and emission estimates from the selected agricultural targets.

Poster research topic(s)

Satellite study, Remote sensing, Greenhouse gases, Modelling study

As.Oc-6

Relative humidity and pH dependence of HO_2 uptake onto aqueous inorganic aerosols

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Abstract

Heterogenous HO_2 loss processes have been recognized as a potential sink of radicals, and they can further impact the generation of ozone and secondary organic aerosols considering HO_2 act as the main reservoir of OH. Although previous studies have reported the uptake coefficient of HO_2 onto aerosols, however, kinetics of the multiphase reactions is not well understood. HO_2 uptake process is labile regarding the intricacy of aerosol chemical and physical properties. This work aims to investigate the influence of relative humidity (RH) and aerosol pH on HO_2 uptake over a wide range. RH can change the phase, size, and water content of aerosols, which should be treated carefully in the simulation of radical budget in ambient environment. Also, determination of aerosol pH is challenging because currently there is no available technique to measure the pH of aerosols directly. The result of this study can provide a better understanding on the multiphase HO_2 involved reactions and can be embedded into models for a precise mapping of radical budget in a large scale.

Poster research topic(s)

Laboratory study, Multiphase chemistry, Aerosols

As.Oc-7

Determination of CH_4 and CO_2 Flux from Open Dumps in Pakistan

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Abstract

Open dumping sites and landfills globally are significant contributors to greenhouse gases (GHGs) emissions, specifically methane (CH_4) and carbon dioxide (CO_2), intensifying global warming and climate change. Unfortunately, these sites lack energy recovery mechanisms. We utilized the static chamber method at Lohsar (Rawalpindi), I-12 (Islamabad), and Harro (Attock) dumpsites to measure CO_2 and CH_4 emissions throughout the year, from July 21 to June 2022, enabling a comprehensive examination of emission variations. The mean CO_2 flux for Rawalpindi, I-12, and Attock sites were ranged from 23.83 to 165.32 mg m^{-2} min^{-1}, 6.31 to 86.78 mg m^{-2} min^{-1}, and 10.55 to 84.72 mg $m^{-2}min^{-1}$, respectively. CH_4 flux values for these sites ranged from 7.43 to 47.43 mg m^{-2} min^{-1}, 1.38 to 24.46 mg m^{-2} min^{-1}, and 3.73 to 34.74 mg m^{-2} min^{-1}. All sites featured three waste zones based on waste age: zone 1 (>10 years), zone 2 (<10 years), and zone 3 (fresh waste <5 years). Our results identified zone 3 as a significant greenhouse gas emission hotspot, with zone 1 exhibiting the lowest emissions. Seasonal fluctuations in CH_4 and CO_2 flux rates were observed, peaking during the rainy season and decreasing in winter, attributed to heightened biological activity and increased disintegration processes during wet seasons. Regression analysis revealed a positive relationship between temperature and humidity with CH_4 and CO_2 flux. Rainfall also exerted a notable influence on CH_4 and CO_2 flux, with varying positive and negative relationships, indicating the presence of other influencing factors. Additionally, paired sample T-Tests demonstrated significant emission rate disparities among different zones and across all three dumpsites. These findings underscore the need to consider site-specific attributes and conditions, providing valuable insights for waste management authorities and policymakers to develop effective, sustainable strategies for mitigating GHG emissions and addressing global warming.

Poster research topic(s)

Greenhouse gases

As.Oc-8

Aerosol Climatology Characterization and Spatio-Temporal Variation of Aerosol Optical Depths over Bangladesh

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Abstract

Atmospheric aerosols affect human health, alter cloud optical properties, influence the climate and radiative balance and contribute to the cooling/warming of the atmosphere. Aerosol Optical Depth (AOD) is a crucial parameter for assessing aerosol content and determining the level of air pollution. In this study, we represent almost seven years' aerosol optical behavioral patterns of six major cities in Bangladesh with emphasis on trends, seasonal variations, sources characterization, comparison between ground (AERONET) and satellite (MODIS Terra and Aqua) measurements, and relation with particulate matter (PM). In addition, aerosol climatology based on AERONET over Bangladesh was conducted for eight years (2012–2019), focusing on two characterization schemes. Four aerosol parameters, such as extinction Angstrom exponent (EAE), absorption AE (AAE), single scattering albedo (SSA), and real refractive index (RRI), were exclusively discussed to determine the types of aerosol. The light absorption properties of aerosol were inspected tagging the association between size parameters similar to fine mode fraction (FMF), AE, and absorption parameters (SSA and AAE). High AOD values (>0.70) were obtained in most of the western parts of the country in all seasons. Decreasing patterns were observed from northwest to southeast. Both PM2.5 and PM10 were well correlated with all AODs but weakly correlated with AE. AODs, AE, and PM were negatively associated with meteorological variables such as rainfall, relative humidity, wind speed, and temperature. Two types of aerosols were potentially identified, e.g., biomass-burning and urban/industrial types over Bangladesh with insignificant contribution from the dust aerosol. Black carbon (BC) was the prominent absorbing aerosol (45.9%–89.1%) in all seasons with negligible contributions from mixed BC and/or dust and dust alone. The results of aerosol parameters will substantially impact the aerosol radiative forcing, climate modeling, and air quality management in Southeast Asia’s heavily polluted region.

Poster research topic(s)

Satellite study, Remote sensing, Aerosols, Air quality

As.Oc-9

Source apportionment and seasonal variability of ambient air pollutants and Nature based solution to control air pollution : A Study of a semi urban location of Himachal Pradesh.

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Abstract

Air quality has degraded severely in different parts of the world in past few years. Air quality has also degraded in Indian Himalayan region in the past years. The present study deals with the study of pollutant SO2, NO2, Nox and greenhouse gas CO2 in the year 2022 at Mohal- Kullu Himachal Pradesh. Gaseous air pollutants were monitored using gas analyzers manufactured by Thermo fisher Scientific. The results revealed that pollutant NOX and SO2 showed bimodal pattern peaks during the morning (8–10 am) and evening (6–9 pm) hours when traffic levels were high. SO2,NO2,NOx and CO2 showed highest average concentration of 2.12±0.03ppb, 1.66±0.06 ppb, 8.15±0.58 ppb and 475.46±3.31 ppm in the month of October, September ,June and April 2022 respectively . SO2 showed highest concentration in winter season while the lowest in summer while CO2, and NOX showed highest concentration in summer season. Further Source apportionment of pollutants using positive matrix factorization revealed Source apportionment revealed that dust transport (65.2%) and biomass burning (33.0%) were the major contributor for SO2, Vehicles are the major contributors of NO2 (86.8%) and NOx (82.1%) in the region. By understanding the seasonal variability and sources of air pollutants several nature based solution can be used can be used as a sustainable way to mitigate air pollution. Some of the sensitive species such as lichens, algae, and trees have been used as bio-indicators of air quality while plant species with high APTI value can be used to mitigate air pollution. The present study will be helpful for researchers understand the seasonal pattern and sources of pollutants in this region and to suggest mitigating measures to control air pollution in the region.

Poster research topic(s)

Air quality, Modelling study, Laboratory study, Greenhouse gases

As.Oc-10

Investigation of PM2.5 and PM10 pollutions in Khuzestan plain in Southwest Iran

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Abstract

PM2.5 and PM10 atmospheric particulate matters are harmful pollutants that affect human health. Iran is particularity affected by air pollution due to traffic and industry. This study analyzes the pollutant level in Khuzestan plain in SW Iran using ground station measurement from 2016 to 2021. Also, AOD550 MODIS/Terra showed a high amount of aerosol optical depth is this area. The mean PM10 and PM2.5 level was 115.5 and 40.58 respectively during the study period, which are much higher than WHO recommendation reports. Tehran province is a very small province in comparison with Khuzestan however 17.5 percent of the Iranian population lives in Tehran province. Although, there is a huge number of populations and consequently huge number of vehicles and factories, the level of PM2.5 in Khuzestan province is 1.25 times of PM2.5 level in Tehran. It seems that increasing PM2.5 level is largely affected by natural sources in comparison with anthropogenic air pollution sources in SW Iran.

Poster research topic(s)

Air quality

As.Oc-11

Hourly PM2.5 and PM10 Matter Concentrations Prediction in Pune, India, Using AERONET Aerosol Optical Depth (AOD) and Meteorological Data.

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Abstract

Pune, is one of the populous and second largest city of Maharashtra, it is surrounded by the western margin of the Deccan plateau, with an altitude 560 m above sea level. It situated at about 18° 32" N and 73° 51" E longitude. This study uses AERONRT AOD level 2.0 data and observed hourly averaged PM (Both PM 10 and PM 2.5), meteorological data is taken from taken from Central Pollution Control Board (CPCB) site at Pune to estimate particulate matter (PM). Statistical results reveals that the major pollutant in Pune City is PM 10 during the pre-monsoon season; the average concentrations of PM 2.5 and PM 10 are 85 µg/m 3 and 110 µg/m 3 , respectively. The relation between AOD and PM 2.5 /PM 10 using Model I Linear Regression Model II Multiple Linear Regression with meteorological data. The main aim of the study is that the PM 2.5 and PM 10 estimation using regression methods. Relationship has been found out between PM 2.5 and AERONET AOD with and without meteorological parameters Temperature (T), Relative Humidity (RH) and wind speed (WS). Then, multilinear regression method is used between PM and meteorological variables. AndAERONET AOD and T were having positively coefficients whereas, RH and WS were having negative coefficients when compared with PM2.5, while AERONET AOD having positively coefficients whereas T, RH and WS were having negative coefficients when compared with PM10.

Poster research topic(s)

Air quality, Aerosols

As.Oc-12

Volatile Organic Compounds impact on Ozone and Secondary Organic Aerosols formation in the rural atmosphere: Assessing estimation and seasonal variability

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Abstract

Volatile Organic Compounds (VOCs) serve as precursors for tropospheric ozone (O_3) and Secondary Organic Aerosol (SOA) formation. The formation of O_3 and SOA serve as direct indicators of the oxidative capacity specific to a given chemical environment, varying between urban and rural atmospheres. The current study investigates the oxidizing capacity of the relatively less explored tropical rural atmosphere. This is accomplished by measuring concentrations of various VOCs and combining these with OH loss rates to estimate the potentials for O_3 and SOA formation (OFP and SOAP, respectively). Continuous diel VOC measurement data encompassing four distinct seasons and comprising over 4000 samples, have been utilized to estimate OFP and SOAP and their variations across different seasons. Additionally, efforts have been made to comprehend the contribution of different sources to O3 and SOA formation. The results indicate that, 1, 3, 6-trimethyl benzene and the VOC group of aromatics exhibit the highest OFP at the observational site. Among seasons, the post-monsoon period exhibits the highest OFP. The increased presence of biogenic VOCs, such as ethylene, propylene, and 1-butene during monsoon, likely due to heightened vegetation cover, could account for the elevated OFP. Similarly, n-dodecane and the VOC group of long-chain alkanes show the highest SOAP. The summer season has the highest SOAP, owing to the enhanced concentrations and photochemistry initiated by OH radicals. Within the PMF-modelled sources, biomass-burning VOCs make a substantial contribution to both OFP and SOAP, distinguishing the rural atmosphere from its urban counterpart, where traffic emissions predominantly influence OFP and SOAP.

Poster research topic(s)

Trace gases

As.Oc-13

Marine Isoprene Emissions: Insights from Himawari-8

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Abstract

Isoprene, the most abundant non-methane biogenic volatile organic compound in Earth's atmosphere, carries significant implications for remote ocean-atmosphere photochemistry. However, estimates of marine isoprene emissions vary dramatically across methods, and the absence of continuous in-situ measurements hampers our ability to discern spatiotemporal variations. Leveraging Himawari-8 observations and model simulations, we present marine isoprene emission estimates for the western Pacific Ocean and the eastern Indian Ocean. While coastal areas typically serve as emission hotspots, our study reveals an unexpected emission reservoir in the central equatorial Pacific Ocean, with emissions surpassing those in the North and South Pacific Oceans by 18%. Notably, emissions in this equatorial region increased by 5.5 ± 0.1% annually between August 2015 and December 2020, a trend not observed in other oceanic regions. Our investigation of marine isoprene oxidation impacts based on satellite observations suggests a critical role for NO2 in aerosol formation from isoprene in the remote ocean atmosphere. In summary, our research advances our understanding of marine isoprene emissions, shedding light on their spatiotemporal dynamics and their role in atmospheric photochemistry in remote oceanic regions.

Poster research topic(s)

Modelling study, Satellite study, Remote sensing, Ocean-Atmosphere interactions, Trace gases

As.Oc-14

Dual carbon isotope-based brown carbon aerosol characteristics at a high-altitude site in the north-eastern Himalayas

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Abstract

This study presents findings from the analysis of $PM_{2.5}$ samples collected between January and April 2017 at Shillong (25.7 °N, 91.9 °E; 1064 m above mean sea level), a high-altitude site located in the north-eastern Himalayan region. The research aims to investigate the influence of locally generated versus long-range transported aerosols on the characteristics of brown carbon aerosols in the study area. Multiple chemical species and dual carbon isotopic measurements (^{13}C and ^{14}C) were employed for this purpose. The biogenic fraction (f_{bio}), calculated from radiocarbon measurements, exhibited a range of 67% to 92% (mean 78% ± 7%) and displayed a strong correlation with biomass burning (BB) tracers such as f_{60}, K^+, and the OC/EC ratio. Additionally, the $\delta^{13}C$ values (-26.6 ± 0.4) in Shillong were found to have lower variability compared to other BB tracers, indicating limitations in its utility for source apportionment in the study region. The estimated $\delta^{13}C$ value of the BB endmember was found to be -29.1 ± 0.6, resembling values reported for paddy residue burning emissions. Furthermore, a significant positive correlation was observed between $f_{bio}$and mass absorption efficiency at 365 nm for both water- and methanol-soluble Brown Carbon (BrC), suggesting that biomass burning in Shillong emits highly absorptive BrC. The relative radiative forcing (RRF) of water- and methanol-soluble BrC with respect to elemental carbon (EC) was determined to be 10.8% ± 5.2% and 23.2% ± 16.4%, respectively, underscoring the substantial radiative impact of BrC in the study area. These findings highlight the global significance of the observed high RRF of BrC, as it may contribute to Himalayan glacier melting, warranting further consideration in climate studies and policy initiatives.

Poster research topic(s)

Field study, Air quality, Climate, Health, Aerosols

As.Oc-15

Usability of the Low-cost Sensor Monitors for Improved Air Quality Monitoring

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Abstract

Air pollution is a pressing global concern driven by urbanization, population growth, increased traffic, industrialization, and energy consumption. Developing nations face the dual challenge of high pollution levels and limited air quality monitoring infrastructure due to the high installation and maintenance costs associated with traditional monitoring stations. As cities strive to become more liveable, the integration of smart technologies, such as Low-Cost Sensor (LCS) monitors, emerges as a promising solution to bridge the gap between sparse government measurements and the growing demand for spatio-temporal air quality data. This study evaluates the performance of three LCS monitors, PurpleAir, Atmos, and AQMesh in comparison to the reference monitor from 1st February to 31st May 2023 in Surat City, India. The reference monitor is situated at the Continuous Ambient Air Quality Monitoring Station (CAAQMS) at the Science Center, Surat (21°10'9.15" N, 72°47'45.84" E). The findings reveal a significant correlation between the PM2.5 concentrations measured by all LCS devices and the reference monitor, with the AQMesh monitor demonstrating notable accuracy for PM10 concentrations compared to PurpleAir and Atmos. The variations in Relative Humidity and Ambient Temperature measurements among the three sensor devices in comparison to the reference monitor need further investigation to enhance the reliability of environmental data collected by the LCS monitor. For enhancing the accuracy and reliability of sensor devices there is a need to redefine the inherent algorithms by considering regionwide atmospheric chemistry of particulate matter. Though the reliability of LCS monitors is currently under investigation, these devices present a wide range of versatile applications. These include real-time localized monitoring, temporary site assessments, and identifying pollution hotspots.

Poster research topic(s)

Field study, Air quality

As.Oc-16

Detection of the nylon 66 microplastics in the inhalable fraction of aerosols in microenvironments using UHPLC-MS/MS

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Abstract

Microplastics (MPs) pollution has become a matter of environmental concern in recent times. Airborne MPs have recently become one of the major pollutants in the atmosphere which act as a carrier for several toxic pollutants and are known to have mutagenic and teratogenic adverse effects on human health. Further, recent *in-vitro* studies have shown that microplastics can lead to diseases like asthma, bronchitis and oxidative stress. In recent reports it has been found that microplastics in indoor environment are much higher in concentration compared to the outdoor environment. Nylon 66 is one of the most abundant MPs found in the microenvironments. In this study, we present an optimized method for the mass quantification of nylon 66 MPs present in the fine particulate matter (PM 2.5) using an ultra-high-performance liquid chromatography coupled to triple quadrupole mass spectrometer (UHPLC-MS/MS). Teflon filters are used for mass quantification of airborne nylon 66 MPs with a good recovery. Using this method, a pilot study was carried out to measure the mass concentrations of nylon 66 based MPs in the inhalable fraction of aerosols in a shopping complex located in the town of Puttaparthi, Andhra Pradesh, India. Observed mass concentrations of nylon 66 MPs in this study are in the range of 0.30 ng m^{-3} to 4.37 ng m^{-3}. Thus, our study clearly demonstrates the presence of inhalable fraction of nylon 66 based MPs in the microenvironment and their mass concentrations are reported using UHPLC-MS/MS. This is the first ever study to report a method for the determination of mass concentrations of nylon 66 based MPs present in the indoor fine particulate matter (PM 2.5) using the UHPLC-MS/MS method. Further, this method can be extended to determine of mass concentrations of other types of polyamide-based MPs in the environment.

Poster research topic(s)

Air quality, Aerosols

As.Oc-17

Measurements of phthalic acid esters, polycyclic aromatic hydrocarbons, derivatives of polycyclic aromatic hydrocarbons, trace metals and polyethylene terephthalate microplastics bound to $PM_{2.5}$ at a suburban city in North West Indo-Gangetic Plain

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Abstract

The Indo-Gangetic Plain (IGP) region is one of the hotspots of elevated levels of ambient particulate matter (PM) among the few regions of the globe. PM bound by hazardous chemical constituents increases health risks in humans. In this study, we report the measurements of phthalic acid esters (PAEs), polycyclic aromatic hydrocarbons (PAHs) and their derivatives, metals and polyethylene terephthalate (PET) microplastics (MPs) bound to $PM_{2.5}$ and their associated health risks at Mohali, a suburban city in North West Indo-Gangetic Plain. Bis – (2 ethylhexyl) phthalate (17.94 ng m^{-3}), benzo[b]fluoranthene (36.13 ng m^{-3}) and 9 nitroanthracene (20.05 ng m^{-3}) are the most abundant PAE, PAH, and derivative of PAH, respectively at the measurement site. Benzo[a]pyrene (4.66 ng m^{-3}), a Group 1 carcinogen had exceeded the threshold limits (1 ng m^{-3}) set by NAAQS, India. Diagnostic ratios show that fossil fuel combustions are the major sources of $PM_{2.5}$ bound PAHs.

Fe (918.05 ng m^{-3}) is the most abundant metal bound to $PM_{2.5}$ observed at Mohali. Among the metals measured, Ni and Cd have exceeded the limits set by WHO, USEPA and NAAQS, India. Enrichment factors (EF) revealed that Fe, Ba, Li and Mn are crustal enriched metals (EF < 10); Pb and Cr are moderately contributed by anthropogenic sources (EF is between 10 to 100) and Zn, Cd, Ni and Sn are highly influenced by anthropogenic sources (EF > 100) at the measurement site. Further, we have carried out a pilot study to identify and quantify PET MPs in ambient $PM_{2.5}$ collected at Mohali. The maximum concentrations of PET MPs observed at Mohali are 157.98 ng m^{-3}.

The estimated incremental lifetime cancer risk due to inhalation exposure to $PM_{2.5}$ bound $B[a]P_{equ}$, Cd, Ni and Cr at the measurement site have exceeded the threshold limit set by USEPA.

Poster research topic(s)

Field study, Aerosols, Air quality

As.Oc-18

Impact of boreal fires on black carbon aerosols in the western Arctic Ocean: inferences from shipborne observations and model analyses

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Abstract

Boreal fires are thought to be an important source of black carbon aerosols (BC) in the Arctic Ocean atmosphere during summer, but observational evidence is limited due to infrastructure and logistical difficulties. We did systematic shipborne observations on BC mass concentrations (m_{BC}) in the Western Arctic Ocean up to 80° N during the summer and early autumn of 2016–2020. In addition, we analyzed the emission sources and transport paths responsible for high-BC episodes based on global chemistry-transport model simulations. The mean m_{BC} in the Arctic Ocean in 2019 was over 70 ng m^{-3}, much higher than in other years (approximately 10 ng m^{-3}). This may be due to the fact that wildfires occurred more frequently in the Arctic region in 2019 than in other years. Model analyses suggested that biomass burning contributed the most to the observed BC in the western Arctic Ocean and the marginal seas. Furthermore, we identified 10 elevated-BC episodes from the five years observation. Model analyses also indicated that most episodes were attributed to the air masses transported from boreal fires to the Arctic Ocean, which could occur near-surface and/or through the lower to middle atmosphere. This study provides crucial datasets on BC mass concentrations and highlights the significant impacts of boreal fires on the observed Arctic BC during the summer and early autumn seasons.

Poster research topic(s)

Field study, Modelling study, Aerosols, Trace gases

As.Oc-19

Anthropogenic fingerprint on Extreme Precipitation over East Asia

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Abstract

The impact of human-caused climate change on extreme precipitation across East Asia was evaluated using historical simulations from the Coupled Model Intercomparison Project Phase 6 (CMIP6). A human-caused signal was detected and separated from natural forcing with minimal uncertainty. Three signal detection analyses isolated the greenhouse gas signal, which was robustly detectable. According to greenhouse gas-only simulations, extreme precipitation events are projected to increase for 20, 50, and 100-year return levels. The further analysis estimated the role of human-caused forcing in increasing precipitation during summer, with vertical moisture advection primarily responsible for the amplification of anomalous precipitation during summer. Both dynamic and thermodynamic factors contributed to enhanced vertical moisture. However, dynamics played a more significant role, amplified by greenhouse forcing. Human-caused warming has accelerated tropospheric warming and increased atmospheric moisture content. This increased low-level moisture convergence and vertical motion, favoring amplified precipitation.

Poster research topic(s)

Greenhouse gases, Aerosols, Modelling study, Air quality, Climate

As.Oc-20

Heterogeneous OH Oxidation of Benzyl Sulfate: A First Insight into Atmospheric Fate of Aromatic Organosulfates

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Abstract

Aromatic organosulfates (OSs), characterized by a sulfate ester group ($–OSO_3^-$) being covalently bonded to an aromatic backbone, are widespread constituents in urban secondary organic aerosols (SOA). They are resulted from the reaction of aromatic hydrocarbons with sulfur dioxide or inorganic sulfates. While extensive atmospheric and environmental health studies have drawn attention to aromatic hydrocarbons as well as their oxygenated and nitrogen derivatives, related research on aromatic OSs, being the sulfur derivatives, is in scarce.

Here, we provide a first insight into the chemical transformation of aromatic OSs via hydroxyl radicals (OH)-initiated heterogeneous oxidation. High-purity sodium benzyl sulfate ($C_7H_7O_4SNa$) was synthesized in-house and selected for a case study due to its atmospheric prevalence. To simulate an OH exposure equivalent to about 2 weeks in the atmosphere, we deployed an oxidation flow reactor at 70 % RH and room temperature, interfaced to a scanning mobility particle sizer (SMPS). Particle-phase products were collected for offline analysis by direct injection into ultrahigh-resolution Orbitrap mass spectrometer.

Our results reveal that at particle surface-weighted mean diameter of 142 ± 5 nm, benzyl sulfate decays at a reaction rate constant (k) of (2.90 ± 0.03) $x10^{-13}$ cm^3 $molecule^{-1}$ s^{-1}, corresponding to an effective OH uptake coefficient (γ_{eff}) of 0.124 ± 0.025. Kinetic data estimates a long lifetime of 26.6 days under typical $[OH]_g$ (~1.5 $x10^6$ molecule cm^{-3}), indicating its persistence against OH oxidation. From the mass spectra evolution, we observed a prominent rise in signal intensity of HSO_4^- without significant detection of functionalized products. We propose reaction mechanism which suggests that fragmentation into inorganic sulfates, without emerging formation of new OSs, is a dominant fate of benzyl sulfate upon heterogeneous OH oxidation. We speculate that fragmentation may generate phenyl structures which partition into the gas phase. Further investigation of structurally-different aromatic OSs is paramount.

Poster research topic(s)

Laboratory study, Multiphase chemistry, Aerosols, Air quality

As.Oc-21

Ground-based validation of TROPOMI NO_2 total and tropospheric column using Pandora spectrometer in Tsukuba, Japan

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Abstract

The vertical column density (VCD) of total and tropospheric NO_2 (Total and Tropo NO_2 VCD) can be obtained using satellite. However, satellite-derived NO_2 VCD is affected by uncertainties such as the cloud fraction, and aerosol optical depth. A certain error occurs in terms of data inversion accuracy, necessitating additional ground observation verification. In this study, the ground-based Pandora spectrometer collected the Total and Tropo NO_2 VCD from August 2021 to August 2023, to verify the Total and Tropo NO_2 VCD product (daily and monthly average data), that comes from the TROPOspheric Monitoring Instrument (TROPOMI).

The results show that the spatial distributions of NO_2 in Pandora and TROPOMI exhibit a similar tendency and seasonality, showing the characteristics of being high in winter and low in summer. For Total NO_2 VCD, a weak relationship (r^2 = 0.32) between Pandora and TROPOMI was observed, with TROPOMI data showing an underestimation (slope of 0.74). Conversely, Tropo NO_2 VCD exhibits a stronger relationship (r^2 = 0.7), with an underestimation reflected by a slope of 0.82. This observed underestimation in TROPOMI can be attributed to the relatively large size of the TROPOMI ground pixel (3.5 × 5.5 km) and the a priori used in the retrieval compared to the relatively small field-of-view of the Pandora instrument. Moreover, aerosol types such as dust and sphere contribute to the differences between Pandora and TROPOMI in Total and Tropo NO_2 VCD. Our study demonstrates that the underestimations of Total and Tropo NO_2 VCD products in TROPOMI were possibly due to the shielding effect of aerosol.

Poster research topic(s)

Satellite study, Remote sensing, Trace gases, Aerosols

As.Oc-22

Assessing the impact of stubble emissions from Northwest India on Delhi's air quality

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Abstract

Severe air pollution caused by crop residue burning (CRB) is one of the most frequent environmental problems worldwide and makes news headlines every harvest season. In Northwest India, burning paddy stubble following harvest is a traditional practice in the post-monsoon season (September-November). Considering the current circumstances, the Research Institute for Humanity & Nature (RIHN) initiated a project 'AAKASH' entitled "An Interdisciplinary Study toward Clean Air, Public Health, and Sustainable Agriculture: The Case of Crop Residue Burning in North India", in collaboration with various institutions in India. An intensive field campaign was conducted to measure air pollutants in the states of Punjab, Haryana, and Delhi-National Capital Region (NCR) in Sep-Nov 2022 using a network of 29 Compact & Useful $PM_{2.5}$ Instrument with Gas sensors (CUPI-Gs). CUPI-Gs detect carbon monoxide (CO), ozone (O_3), and nitrogen oxides (NO_X), which are crucial elements in estimating secondary $PM_{2.5}$ production in the CRB's downwind zones. A similar effort is also been conducted for the current year 2023, with the goal of understanding the links and persistency between the ground conditions (fire counts, winds, etc.) and $PM_{2.5}$ abundances. Additionally, our aim is to study the health implications of short-term exposure to $PM_{2.5}$ in the regions where daily mean $PM_{2.5}$ exceeded 500 µgm-3 frequently and lasted over a week. Geospatial and numerical modeling tools are being used for (a) creating observation-based $PM_{2.5}$maps for human exposure to air pollution in rural Punjab and Haryana; (b) estimation and prediction of $PM_{2.5}$ transport from source regions to the Delhi NCR using WRF-Chem and FLEXPART; and (c) development of air pollutant emission inventories for simulating the observed $PM_{2.5}$ variabilities. Some of these information is disseminated through our website in near real-time: https://aakash-rihn.org/en/campaign2023/.

Poster research topic(s)

Air quality, Health, Field study, Modelling study

As.Oc-23

Seasonal Distribution of $PM_{2.5}$ Mass Concentration and its Significant Sources in Thailand

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Abstract

This study aims to investigate the seasonal distribution of $PM_{2.5}$ mass concentration and quantify the contributions from potential emission sources across various regions of Thailand during the El Nino year of 2019. The study utilized a regional chemical transport model, WRF-Chemv4.2 to simulate aerosol mass concentration and assess the plausible effects of emission sources. Model results were validated using observed $PM_{2.5}$ mass from 64 stations of the Pollution Control Department, Thailand (PCD). Seasons were classified as summer (March-May), rainy (June-October), and winter (November-February), while regions were defined as north, northeast, central, east, and south. A regional average of daily $PM_{2.5}$ mass from the observation stations was considered for the analysis. The north and northeastern parts of Thailand exhibited higher daily $PM_{2.5}$ mass during summer about 25 - 165 μgm^{-3} and 20 - 120 μgm^{-3}, respectively. Meanwhile, the central and eastern regions experienced relatively higher mass during winter (15 to 90 μgm^{-3}). The southern regions showed better air quality (< 25 μgm^{-3}) during all the seasons. The Index of Agreement between the simulated and observed $PM_{2.5}$ for all regions was found 0.73, 0.81, and 0.82 during summer, rainy, and winter seasons, which indicate the model outputs were comparable to the observations with an overestimation <10%. Further, the study reveals that biomass burning contributes about 72% and 17% from anthropogenic emissions to the total $PM_{2.5}$ mass concentration during summer, while natural emissions dominate (~60%) in the rainy season.

Poster research topic(s)

Modelling study, Aerosols

As.Oc-24

Theoretical study on the OH-initiated atmospheric reaction of acetamiprid insecticide

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Abstract

Acetamiprid become one of pesticide substance which more considered as widely use in field of planting industry to prevent insects. Acetamiprid was reported as a highly water-soluble compound and slowly degrades by photodegradation. According to the United States Environmental Protection Agency reports in 2002, the major degradation pathway is an aerobic soil metabolism, and the products may be very persistent in aquatic systems under certain conditions. However, there is not many acetamiprid degradation mechanism in environment. Therefore, it is interesting to study the degradation process in atmosphere of acetamiprid via the oxidation process initiated by hydroxyl radical.

The aim of this present work is to investigate the reactivity of Acetamiprid with hydroxyl radical in aqueous phase. Herein, the abstraction of hydrogen and the addition of hydroxyl radical reactions were studied via computational chemistry using the M06-2X/6-31+G(d,p) level of theory. The energetics of reaction were performed utilizing density functional theory M06-2X with 6-311++G(3df,3dp) basis set. H-abstractions from the methyl groups are the most favourable pathways. The rate constants of all abstraction and addition pathways will be calculated. The results of ecotoxicity and atmospheric life-time will be determined and discussed.

Poster research topic(s)

Modelling study

As.Oc-25

Chemical characteristics of PM2.5 and PM0.1 during the highly polluted periods in Hanoi, Vietnam

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Abstract

This study aims to investigate the chemical characteristics of PM2.5 and PM0.1 during the pollution episodes in Hanoi, Vietnam, which is crucial for identifying the formation pathway and shifts in particle sizes. Daily samples were collected on the rooftop of a four-story school building in the winter of 2020 (from 14 October to 15 December), using Nanosampler (Model 3182, KANOMAX) for PM0.1 and cyclone (URG-2000-30EH) PM2.5. The results showed the occurrence of six pollution episodes of PM2.5 (with daily mass concentrations exceeding 50 µg/m3), lasting from two to ten days. The average PM2.5 mass concentration was 59.5 µg/m3; however, the peak PM2.5 concentration could exceed 100 µg/m3 during the pollution episodes. The peaks of carbonaceous and ionic species in PM2.5 were also detected during the pollution episodes, approximately 2-8 times higher than those observed during non-episode periods. The remarkable increase in sulfate, nitrate, ammonium (SNA), and water-soluble organic carbon (WSOC) concentrations suggests the significant contribution of secondary aerosols. A slightly elevated concentration of PM0.1 was observed during the episodes, fluctuating from 3 – 12 µg/m3. The increase in SNA and WSOC concentration in PM0.1 was insignificant compared to that in PM2.5, suggesting the more pronounced influence of secondary particles on PM2.5 concentration. No relationship between relative humidity (RH) and carbonaceous and ionic species was observed in PM2.5, while that was seen in PM0.1. The negative relationship between RH and SNA species in PM0.1, along with the stable presence of PM0.1 in the study area proved in our previous studies, indicates the possibility of the growth of particles under stagnant air conditions and high RH.

Poster research topic(s)

Field study, Air quality, Aerosols

As.Oc-26, A.E.ME-31

Temperature accounts for the gap in lifetime of cooking organic aerosol at laboratory and field during wintertime

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Abstract

Cooking organic aerosol (COA) is one of the major constituents of particulate matter in urban areas. COA is oxidized by atmospheric oxidants such as ozone, changing its physical, chemical and toxicological properties. However, atmospheric chemical lifetimes of COA and its tracers such as oleic acid are typically longer than that have been estimated by laboratory studies. We tackled the issue by considering temperature. Namely, we hypothesized that increased viscosity of COA at ambient temperature accounts for its prolonged atmospheric chemical lifetime in wintertime. Laboratory experiments and wintertime atmospheric observation in Beijing were conducted for proving the idea. Laboratory generated COA particles were exposed to ozone for the temperature range of -20 °C ~ 35 °C. The pseudo-second order chemical reaction rate constants (k2) decreased for lower temperatures, likely due to formation of highly viscous states. The experimental finding was supported by observational data in Beijing when ozone was likely the dominant oxidant. In combination with the observed atmospheric temperature, we suggest the atmospheric chemical lifetime of COA is longer in wintertime than that in summertime for temperate and boreal regions.

Poster research topic(s)

Field study, Laboratory study, Aerosols, Multiphase chemistry

As.Oc-27

Atmospheric Chemistry of Aerosols and Their Role in Global Climate Change

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Abstract

This chapter provides a brief discussion about the aerosol particles with their atmospheric composition, their different emission sources either natural (biogenic, volcanos, sea salt, desert dust) or anthropogenic (biomass burning, fossil fuel burning). Further, it included the different pathways through which aerosol components entered the atmosphere in the aerosol phase. The aerosols interact with clouds, radiations, and other atmospheric components in different ways which as a result will affect the climatic patterns, i.e., precipitation, temperature, etc. The atmospheric chemistry of aerosols is of great importance, mainly sulfate aerosols regarding their ability to affect the climate both in a positive and negative way. The physicochemical properties of aerosols and their lifetime in the atmosphere and the different ways in which they will affect climate are important. They affect the climate indirectly through their impact on clouds and have direct effects on climate through scattering and solar radiation's absorption into space. Keeping in view the effects of aerosols on climate and their cooling effect on the atmosphere, different ways are discussed which will help in mitigating climate change.

Poster research topic(s)

Aerosols

As.Oc-28

What controls the molecular fingerprints of water-soluble organic compounds in size-segregated aerosols during the ACE-Asia campaign?

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Abstract

The present study focuses on water-soluble organic components of size-segregated aerosol particles collected during the ACE-Asia campaign in northern Japan in the spring of 2001. The distinct air masses encountered during the sampling period are reflected in the composition and size distribution of water-soluble organic compounds. The distribution of organic acids in all aerosol particle sizes with a dominance of oxalic acid followed by malonic and succinic acid suggested that water-soluble organic aerosols over northern Japan were photochemically processed during long-range atmospheric transport. The considerable fraction of oxalic acid was found in the supermicron size bins in the aerosol samples affected by the transport of dust particles from the East Asian continent. This result suggests its production via heterogeneous oxidation reactions on the surface of dust particles during long-range transport to northern Japan. Significant positive correlations of oxalic acid and related polar compounds with nitrate and calcium were found in the suprmicron mode of the samples affected by dust particles, indicating further evidence of the heterogeneous production of water-soluble organic compounds in calcium-rich supermicron mode aerosols. The calculated aerosol liquid water (ALW) content and comparison with organic species demonstrated that both precursor compounds and ALW content likely play a role in forming oxalic acid in the submicron mode aerosol in most samples. The impact of anthropogenic sources was more prominent in the supermicron mode than the submicron mode particles when aerosols were more induced from the continent and vice versa in the samples with more oceanic impact. Our results suggest that the air masses from the East Asian continent and surrounding ocean considerably control the chemical composition of atmospheric aerosols over northern Japan.

Poster research topic(s)

Field study, Air quality, Aerosols

As.Oc-29

The Consequences of Bauxite Mining on Respiratory Health and Lung Functions in School Children Exposed to Indoor Pollutants

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Abstract

The uncontrolled mining activities in Malaysia have created a dusty environment that impacts children's health, especially the respiratory system. The aim of this study is to investigate the effects of indoor pollutants from bauxite mining activities on respiratory health and lung functions in school children. A comparative cross-sectional study was conducted on 270 students randomly selected from Government Primary Schools. Questionnaires were used to collect information on their background and their respiratory health symptoms. A lung function test was performed using a spirometer according to the American Thoracic Society standards. Environmental sampling for particulate matter (PM10) and heavy metals from indoor air and dust were collected using a Gillian Personal High-Volume Air Sampler and 400W vacuum cleaner and were analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Results showed the concentration of particulate matter (PM10) and heavy metals (As, Cd, Ni, and Pb) in indoor air and dust were significantly higher in the studied area ($p<0.001$). The highest reported symptoms in the studied area were cough with flu (48.0%) followed by nasal congestion (45.9%), runny nose (42.6%), and headache (41.2%), and significant differences between the two groups. Students in the studied area have significantly lower ($p<0.01$) lung function ratios in comparison. Higher pollutant concentrations of PM10 and heavy metals concentrations in indoor air, window dust, and corridor dust were significantly associated with all reported health symptoms and reduction of lung functions ($p<0.05$). Lower values of lung function were found to be significantly associated with runny nose, nasal congestion, dry throat, chest tightness, chest tightness at night, and chest tightness after outdoor activities. The findings indicate that air pollution emissions related to bauxite mining mainly occurring in Malaysian communities might increase the risk of respiratory disease in children.

Poster research topic(s)

Air quality, Field study, Health

As.Oc-30

Effects of Refined Sea Salt Markers on Source Apportionment of Coastal Urban $PM_{2.5}$

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Abstract

Sea-salt (ss) aerosols in $PM_{2.5}$ are often quantified through source apportionment by applying sodium (Na^+) and chloride (Cl^-) as the markers, but both markers can be substantially emitted from anthropogenic sources. In this study, we differentiate ss from non-ss (nss) portions of Na^+ and Cl^- to better apportion $PM_{2.5}$ in a coastal tropical urban environment. Size resolved ionic profiles accounting for Cl^- depletion of transported airborne sea salt were applied to 162-day measurements during 2012 and 2018–2019. Results show that the nss (likely anthropogenic) portions, on average, account for >50% of total Na^+ and Cl^- in submicron aerosols (PM_1). This corresponds to 2.5 μg/m^3, or ~10 times overestimation of sea salt in submicron if one attributes all Na^+ and Cl^- to sea salts. Employing the newly resolved ss- and nss-portions of Na^+ and Cl^- to source apportionment of urban $PM_{2.5}$ via positive matrix factorization (PMF) uncovers the presence of transported anthropogenic emissions during the southwest monsoon, contributing to 13% of $PM_{2.5}$. Interestingly, considering sea salt ageing based on the extent of depletion of Cl^- (i.e., PMF_{aged}) further resolves the contribution of traffic & road dust to $nssNa^+$ (12% to total $nssNa^+$). According to PMF_{aged}, more than 35% of $nssCl^-$are associated with secondary aerosols, suggesting secondary nature of Cl^- in $PM_{2.5}$.

Poster research topic(s)

Field study, Aerosols, Air quality

As.Oc-31

Evaluation of Urban Air Quality in Malaysia's Largest Conurbation Area: Towards Long-Term Sustainable Air Quality Management

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Abstract

The capital of Malaysia has undergone urbanization since the 1980s, which led to the formation of the largest conurbation area, Kuala Lumpur Extended Mega Urban Regions (KLEMUR). This study aims to understand the air quality trends in KLEMUR, particularly concerning land use changes. Statistical and geostatistical analysis is used to analyze air pollutants (PM_{10}, O_3, NO, NO_2, NO_x, CO, and SO_2) and land use data (built-up areas, vegetation, and water bodies). The results showed increased trends in air pollutants, except for SO_2, which decreased due to improvements in fuel consumption. However, the annual mean concentration of PM_{10} exceeded both the Malaysian Ambient Air Quality Standard (MAAQS) and WHO guidelines. Despite COVID-19 lockdowns, PM_{10} concentrations remained above recommended limits. The meteorological conditions during the seasonal monsoon mainly affected PM_{10} and O_3. Principal Component Analysis (PCA) indicated that motor vehicle and industrial emissions significantly contributed to the total variance (53.61-63.42%), and factor loadings greater than 0.70 include NO, NO_2, NO_x, CO, and SO_2. Motor vehicle emissions, demonstrated by a NO/NO_2 ratio exceeding 2.0, heavily influenced KLEMUR's air quality. Land use changes in KLEMUR showed an increase in built-up areas (4.0%), a decrease in vegetation (3.3%), and a reduction in water bodies (2.3%). This expansion led to an increased dispersion of air pollutants from the central region toward the southern and northern areas. Land use changes significantly impacted NO, NO_2, NO_x, CO, and SO_2, with positive correlations with built-up areas and negative correlations with vegetation and water bodies. Geographically Weighted Regression (GWR) revealed that changes in built-up areas and vegetation spatially influenced 80–90% of KLEMUR's air pollution, while water bodies only influenced 20–70% of it. These findings were used to propose an air quality framework that emphasizes land use changes, and promotes sustainable urban environments, clean air, and economic growth.

Poster research topic(s)

Air quality, Land-Atmosphere interactions

As.Oc-32

Particulate pollution from mobile sources in China

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Abstract

Mobile sources are an important contributor to atmospheric particulate matter, which has adverse impacts on human health. Quantifying the particulate contributed by mobile sources, especially those that have an aerodynamic diameter of 2.5 μm or less (PM2.5), is essential for the control of particulate pollution. The contribution from mobile sources includes primary aerosols emitted directly and secondary aerosols formed from gas-phase precursors. Among these components, secondary organic aerosols (SOA) from mobile sources is highly unclear, because the precursors, their emissions, and SOA formation mechanisms remain underrepresented. In this study, the SOA formation potential of on-road air in Beijing was investigated using a fleet-chasing oxidation flow reactor (OFR) under high-NOx conditions onboard a mobile laboratory. SOA precursors were measured simultaneously by a suite of state-of-the-art instrumentation to estimate their contributions, which suggests the dominant role of intermediate-volatility or semivolatile organic compounds (I/SVOC) in SOA formation potential from fleet vehicles with a contribution of 67%. With constraints from OFR, the nationwide SOA formation potential from mobile sources is estimated to be 0.96 Tg for the year 2018 with 79% contributed by gasoline vehicles due to their large amounts. Implementing the OFR-constrained SOA formation potential into a widely-used chemical transport model, GEOS-Chem, shows that SOA from mobile sources is concentrated in populated regions like eastern China with the population-weighted concentrations of 0.71 and 0.64 μg m-3 in winter and summer, respectively. There is a large gap between the estimation results by the OFR-constrained and traditional yield-based methods, suggesting highly uncertain emissions of I/SVOC that need more constraints. SOA contributes 17-27% and 4-6% of PM2.5 formed from gasoline and diesel exhausts, respectively, from urban to rural areas, highlighting the importance of SOA in estimating the health impact of mobile sources.

Poster research topic(s)

Air quality, Aerosols

As.Oc-33, A.E.ME-40

Analyzing Vertical Water Vapor Distribution: A Comparative Study of GNSS Tomography and GFS Reanalysis Data

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Abstract

PWV, or Precipitable Water Vapor, serves as a vital metric for quantifying the total amount of water vapor present in the Earth's atmosphere. It measures the hypothetical amount of liquid water that would result if all the water vapor in a vertical column condensed. Typically expressed in units of kilograms per square meter (kg/m2) or millimeters (mm) of liquid water depth, PWV plays a crucial role in understanding atmospheric dynamics. It's important to note that water vapor is not uniformly distributed throughout the atmosphere; the majority is found in regions below 700 hPa, or approximately 3 kilometers above the Earth's surface.Unlike relative humidity, which is temperature-dependent, PWV is an absolute measure of the air's water content. It is typically determined using remote sensing techniques, such as satellite-based radiometers or ground-based GPS receivers, which employ microwave radiation to estimate the water vapor quantity in the atmosphere helping us study processes like precipitation, cloud formation, and water vapor transport. Analyzing deviations between GNSS tomography and GFS results aids in assessing the precision of the tomography model. These deviations, ranging from -7 g/m3 to +8 g/m3 with an average mean deviation of -1.745 g/m3, offer valuable insights into the accuracy of the model. These variations are mostly negative, and the distribution of these deviations' attributes can be studied using water vapor density iso-surfaces. The analysis of discrepancies between GNSS tomography and GFS results is essential for model improvement. However, it's imperative to acknowledge the inherent limitations and uncertainties associated with modeling and measurement techniques. Further research is needed to better understand the observed variations, the effects of vertical constraints, and the temporal resolution of gradient computations in tomographic models. To enhance the accuracy of atmospheric water vapor density measurements, ongoing improvements in the tomographic model and measurement techniques are warranted.

Poster research topic(s)

Remote sensing, Satellite study, Greenhouse gases, Climate, Modelling study

As.Oc-34

Long-term analysis of Air Pollutants over Greenland and comparison of air quality with Asian regions using Remote Sensing

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Abstract

The meteorological, chemical, and atmospheric mechanisms of the Arctic environment are still challenging to understand. Greenland is a region with very less population having an Arctic tundra climate with temperatures as low as -18°C, which makes it an interesting region for air quality study. Due to the severe weather, residents of Greenland spend 70% of their time indoors. This study analyzes air pollutants such as ozone (O3), particulate matter (PM), carbon monoxide (CO), and sulphur dioxide (SO2) to monitor the air quality of Greenland, further comparing it with regions with high population and pollution such as various countries of Asia. The pollutants were retrieved from Modern-Era Retrospective Analysis for Research and Applications, version-2 (MERRA-2) model, and Sentinel-5P Tropospheric Monitoring Instrument (TROPOMI) which is a nadir viewing passive grating imaging spectrometer. The study uses products on a monthly time scale from 2005 to 2022. Moreover, time series analysis showed the highest variation of pollutants during the spring and summer seasons comprising months of March, April, and May (MAM) and June, July, and August (JJA). Furthermore, pollutant sources over Greenland were analyzed by plotting trajectories using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) which helped determine the contribution of natural, anthropogenic, and transboundary pollution sources over the region. This research can be further used to analyze trends of pollutants and their relationships with prevailing meteorological parameters.

Poster research topic(s)

Remote sensing, Air quality, Trace gases, Aerosols

As.Oc-36

Extreme summertime ozone pollution over the north-west Indo-Gangetic Plain driven by amplified peroxy-radical chemistry due to precursor emissions.

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Abstract

Every year in May, the north-western Indo-Gangetic Plain experiences its worst ozone pollution with ambient ozone frequently exceeding 100 ppb, due to a combination of warm and dry weather and agricultural biomass burning emissions. Till date, however, a mechanistic study of the oxidant and radical chemistry during these periods has been lacking. Here using a novel in-situ dataset of measured ozone precursors, including isoprene, acetaldehyde, and nitrogen oxides, we calculate the Leighton ratios and evaluate daytime peroxy radical budgets for three contrasting periods experienced in May 2023. While two periods had lower NOx (~10 ppb) but contrasting ozone levels of ~50 ppb (I) and 90 ppb (III), respectively, period II was impacted strongly by wheat residue-fire plumes and associated with high ambient average daytime ozone (~90 ppb) and higher NOx (~20 ppb). Leighton ratios were much higher than 1, with average values of 3, 4.5, and 7.5, for periods I, II, and III, respectively, suggesting a significant role of peroxy-radicals in the ozone formation chemistry. Peroxy radical mixing ratios, namely the sum of hydroperoxy and alkyl peroxy radicals (RO2*=HO2+RO2) more than doubled to ~1.4 ppb during period II, relative to periods I (RO2*=0.5) and II (RO2*=0.6), respectively, suggesting strong amplification and perturbation of radical chemistry contributing to the high ambient ozone in period II. The ozone production regime was found to be VOC-limited for all three periods, with warmer conditions generally associated with higher ambient ozone. Isoprene and acetaldehyde were the highest contributors to the VOC OH reactivity across all periods. With climate change likely to increase regional temperatures, our results and insights suggest that ozone pollution may exacerbate even as efforts to mitigate the currently more serious particulate matter pollution bear fruit of radical chemistry due to precursor emissions.

Poster research topic(s)

Air quality, Land-Atmosphere interactions, Trace gases, Field study, Health

As.Oc-37

Inter-comparison of benzene, toluene, and C8 - aromatics using PTR-TOFMS, PTR-QMS, and TD-GC-FID measurements in a South Asian urban environment

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Abstract

Benzene, toluene and C-8 aromatic compounds such as xylenes and ethyl benzenes are major volatile organic compounds emitted from a variety of biomass burning and urban emission sources. Due to their high reactivity and known toxicity, it is important to measure them at both high temporal resolution and with good accuracy. While mass spectrometry techniques afford speed, gas chromatographic methods afford greater specificity. Here, we report comparisons of measurements of these compounds using a proton transfer reaction quadrupole mass spectrometer (PTR-QMS), a thermal desorption gas chromatography-flame ionization detector (TD-GC-FID) and a high-resolution proton transfer reaction time of flight mass spectrometer (PTR-TOF MS 10K) from the megacity of Delhi. The comparison was done over three seasons: post-monsoon, winter, and summer. The mass resolution ($m/\Delta m$) of PTR-TOF MS is 10K, which allows for better mass resolution as compared to PTR-QMS, which is 1 amu. TD-GC-FID is a gas chromatographic technique that separates the compounds on the basis of their retention time through a column. We found very good agreement among the three instruments for all the periods. Benzene and toluene were the major contributors (~95 % and ~92%) among all the compounds detected at m/z 79 and m/z 93, respectively measured using the mass spectrometers. The compounds contributing to C8 – aromatics included mostly ethylbenzene and the isomers of xylene. The contribution of the isomers of xylene is ~49%, while that of ethylbenzene was ~42% thus, these two account for ~91% of the total mass concentration detected as sum of C8 – aromatics. The results suggest that mass spectrometric measurements of these compounds even in complex emission environments can be treated with high confidence.

Poster research topic(s)

Field study, Instrument development

As.Oc-38

Ambient $PM_{2.5}$ and some of its organic constituents induce TDP43 aggregation and could potentially modulate Amyotrophic Lateral Sclerosis progression.

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Abstract

Amyotrophic Lateral Sclerosis (ALS) is a progressive, incurable, degenerative motor neuron disease that eventually leads to the death of the patient. The disease can be sporadic accounting for 90% of ALS cases or genetic accounting for 10%, with SNPs (Single Nucleotide Polymorphism) in SOD1 (Superoxide dismutase), FUS (Fused in Sarcoma), TDP43 (TAR DNA Binding Protein 43) and C9orf72 (C9 open reading frame 72) contributing to the bulk of the genetic contributors. Studies have demonstrated that exposure to ambient $PM_{2.5}$ is associated with neurodegenerative diseases like Alzheimer's, and Parkinson's disease as well as ALS. $PM_{2.5}$ is known to influence protein aggregation by inducing oxidative stress or mitochondrial dysfunction. Previous studies have demonstrated a correlation between $PM_{2.5}$ and TDP43 aggregates in the Mexican population. In view of these findings, we have studied the aggregation of wild-type TDP43 in the yeast model of ALS using the screened organic and inorganic constituents of ambient $PM_{2.5}$ samples collected in Delhi. Individually tested organic and inorganic constituents of $PM_{2.5}$ like Benzo [a] anthracene (B[a]A), Benzo [a] Pyrene (B[a]P), Benzo [b] fluoranthene (B[b]F), Dibenz [ah] anthracene (D[ah]A), Indeno [1,2,3-cd] pyrene (Ind) as well as $Cd^{2+,}$ Fe^{2+}, Cr^{6+}, and Ni^{2+} have shown a significant increase in TDP43 aggregation. Further, we have also observed that the ambient sample with elevated levels of PAHs had induced aggregation of TDP43 significantly. Thus this pilot study demonstrates $PM_{2.5}$-induced, elevated levels of TDP43 aggregates in the yeast model which can indicate the exacerbation of ALS disease in highly polluted environments. To our knowledge, this might be the first study showing $PM_{2.5}$ and some of its organic and inorganic constituents which could directly modulate aggregation of $PM_{2.5}$ with potential implications for the disease.

Poster research topic(s)

Health, Air quality, Aerosols

As.Oc-39

Carbon Dioxides from Vessel Cargo Emission – A Complex Network Approach

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Abstract

Large cargo capacity with low fuel use is one of the important features of efficient sea transport. As the trend of globalization, a huge amount of sea transport between countries increases more than ever, leading to a worsening CO_2emission situation. CO_2 emissions may surge 50-250% by 2050, posing environmental challenges. Complex Network Analysis (CNA) simplifies intricate systems into networks, which enhances the understanding in revealing the topology patterns and interconnections of the seaport networks. Few studies focus on shipping route emissions with CNA, despite widespread bottom-up atmospheric research. This study was conducted to visualize CO_2 emission in 2022 by using CNA, and then analyzed each port using vertex strength. Total vessel dataset consisted of 20,354 international sea transport trips. A total of 883 domestic and international sailings encompassing Taiwan ports were collected for constructing a CO_2 emission complex network, including 76 ports and 241 routes weighted with CO_2 emission volume. Kaohsiung port stands out as a key hub in the network, characterized by its significant high degree. This prominence is demonstrated through its connectivity to 33 routes. The CAT/STA route, spanning Ningbo, Shanghai, Shekou, Kaohsiung, Melbourne, Sydney-Botany Bay, Brisbane, Kaohsiung, and Ningbo, exhibits the highest emissions at 203,596 tons/year. In contrast, the HP3 route, covering Busan, Kaohsiung, Nansha, Haiphong, Yantian, Hong Kong, Cagayan De Oro, Cebu, Hong Kong, Nansha, Kaohsiung, and Busan, shows the lowest emissions, totaling 9,001 tons/year. Spearman's rank correlation coefficient (ρ) and its p-value were 0.847 and $0.05x10^{-20}$, respectively, indicated a strong positive relationship between vertex strength and activity in each port with CO_2 emissions. Incorporating our research findings into policy might resulted robust global strategies targeting CO_2 emission reduction.

Poster research topic(s)

Greenhouse gases

As.Oc-40

Source apportionment of volatile organic compounds during paddy-residue burning season in north-west India reveals large pool of photochemically formed air toxics

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Abstract

Paddy-residue burning is associated with poor air quality in north-west India during October–November every year. However, till date a quantitative study of its contribution to ambient volatile organic compounds (VOCs) using highly time-resolved measurements within the region has been lacking. Several VOCs like benzene are carcinogenic and also fuel formation of secondary pollutants such as secondary organic aerosol (SOA) and ozone. Here, we undertake quantitative source-apportionment using a PMF source-receptor model on a high-quality in-situ measured dataset of 54 VOCs in Punjab, India, and validate the model results using source profiles. The contribution of the seven most dominant sources to the total VOC mass concentrations were: daytime photochemistry and biogenic VOCs (BVOCs) (26%), followed by solid-fuel usage and waste-disposal (18%), traffic (two-wheeler 14% and four-wheeler 10%), photochemically aged biomass burning (17%), industries and solvent usage (9%), and fresh paddy residue burning (6%). Ozone production potential was dominated by solid fuel usage and waste disposal (25%), followed by traffic (two-wheeler 11% and four-wheeler 12%), BVOCs and photooxidation products (21%), photochemically aged biomass burning (16%), industries & solvent usage (9%) and fresh paddy residue burning (6%). SOA production was dominated by traffic (two-wheeler 26% and four-wheeler 28%) followed by solid fuel usage and waste disposal (22%), photochemically aged biomass burning emissions (15%) with minor contribution from industries & solvents (6%), fresh paddy residue burning (2%) and photochemistry and biogenic VOCs (1%). Comparisons with global emission inventoriesREASv3.2.1 and EDGARv4.3.2, showed both overestimate the industry and solvent source. Further, EDGARv4.3.2 underestimated the traffic source whereas paddy residue burning emissions are absent in REASv3.2.1. Although the overall mass contribution of paddy-residue burning emissions isn't high, our results show that health-relevant compounds emitted directly and formed photochemically from biomass burning sources active at this time are majorly responsible for the unhealthy air.

Poster research topic(s)

Field study, Modelling study, Air quality, Health, Trace gases, Multiphase chemistry

As.Oc-41

Study of aerosol behavior based on morphological quality assessment before and after Diwali of a semi-arid region in Agra, Uttar Pradesh, India

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Abstract

Diwali is a Hindu holiday celebrated every autumn in India, known locally as the Festival of Lights. Setting off fireworks on this day will cause air and noise pollution, which has a negative impact on human health. In this study, Particulate matter monitoring is conducted over 24 hours at Dayalbagh Educational Institute college campus, Agra, India during Diwali, 2021. PM1 and PM10 concentrations were studied for seven days in November 2021. The average concentration of PM10 and PM1 during Diwali month was recorded as 202.596±51.616, and 345.71±61.374 µg/m3 respectively was significantly higher during Diwali and exceeded the National Ambient Air Quality Standards (NAAQS). Furthermore, the relative humidity, wind speed, and Temperature during this month were found to be 62.866±11.38 %, 0.385±0.385m/sec, and 24.263±2.83˚C. Meteorological parameters were found to play a significant role in influencing pollutant concentration. The PM10 morphology and mapping of elements were done using SEM–EDX. The enrichment factor (EF) showed Zn and Pb originating from anthropogenic activities. The air quality data was validated using a test of variance, correlation, and principal component analysis (PCA). Correlation analysis shows that PM1, PM10, and RH (Relative Humidity) are negatively correlated with WS (Wind speed). PM1, and PM10, are positively correlated with RH. It is observed that there is a strong negative correlation between PM10 and WS, and PM10 and Temp. It is time to introduce regulations on burning fireworks to reduce pollution to achieve a sustainable atmosphere.

Poster research topic(s)

Air quality, Aerosols

As.Oc-42

Health Impact Assessment of Construction Workers Associated With Air and Noise Pollution

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Abstract

Air and noise pollution are key environmental concerns that have an immense effect on the health of construction workers. The primary aim of this study is to ascertain the effects of air and noise pollution on construction workers, while also quantifying the amounts of air and noise pollution present at specific construction sites. This study involved conducting a 360 Questionnaire survey and selecting 22 construction areas from Dhaka City, Gazipur District, and Narayanganj District for the purpose of collecting raw air and noise data. The data collection for air and noise pollution was conducted using automated portable instruments, specifically the Aeroqual S500 Air Quality Monitor and the Lutron SL4023 Sound Level Meter. According to the survey, the primary contributors to air pollution were determined to be vehicle emissions, accounting for 50.8% of the total, followed by dust generated from construction sites, which accounted for 38.9%. The study found, 8% of construction workers, consistently have respiratory issues as a result of air pollution. Furthermore, 20% of respondents aged above 60 years are affected by respiratory problems. In addition, respondents within the age range of 51-60 years experience occasionally headaches. It has been observed that 20% of individuals aged 60 and above experience hearing impairment as a result of exposure to noise pollution. Similarly, among individuals aged 40 to 50 years, the prevalence of hearing impairment is reported to be 12%, while for those aged 31 to 40 years, it is 6%. The construction site located in Kamarapara of Dhaka city exhibited the highest levels of pollution. The concentration of PM_{10} and $PM_{2.5}$ was measured to be 397 $\mu g/m^3$ and 131 $\mu g/m^3$, respectively. Among the investigated sites, Prottasha Bridge site in Tongi District exhibited significantly high levels of noise, where the equivalent sound pressure level was measured to be 92 dB.

Poster research topic(s)

Air quality, Health

As.Oc-43

Analysis of the chemical attributes and origin of particulate-bound polycyclic aromatic hydrocarbons (PAHs) in the north-east part of India

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Abstract

Polycyclic aromatic hydrocarbons (PAHs), known to have detrimental effects on both human and animal health, are the subject of this study when attached to particulate matter. It examined sixteen distinct PAHs that were found in PM2.5 particles in the northeast region of India during the winter season as determined by the US Environmental Protection Agency (USEPA). The study investigated the temporal variation of these PAHs and the influence of meteorological parameters such as temperature, wind speed, relative humidity, and planetary boundary layer height on their concentration. The study discovered that, relative to other meteorological conditions, the height of the planetary boundary layer and ambient air temperature had the most significant impact on PAHs concentrations during the sampling period. Throughout this time, the average concentration of all PAHs was 157.2 ± 127.7 ng/m³, with a greater prevalence of high molecular weight PAHs than low molecular weight ones. Benzo(b,j)fluoranthene accounted for 27.26% of the total amount of the 16 PAHs that were investigated, while di-benzo(a,h)anthracene followed at 10.37%. The main sources of PAH emissions for the studied site, according to a source identification study utilizing isomeric PAHs ratios, include crop residue burning, vehicular emissions, coal, and wood combustion. When PAH emissions from the current location are compared to those from other northern Indian towns, it is found that vehicle emissions are a common source of PAH emissions in all compared cities. At the studied site, burning crop residue, coal, and wood combustion appear to be the leading causes of PM2.5-bound PAHs.

Poster research topic(s)

Air quality, Health, Climate, Laboratory study, Aerosols

As.Oc-44

Water-soluble organic aerosols over South Asia : Impact of primary and secondary sources

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Abstract

Water-soluble fraction of organic aerosols has been identified as a key component in atmospheric aerosols due to its ability to act as cloud condensation nuclei (CCN). This work discusses about the spatio-temporal variability in WSOC mass concentration, sources (primary and secondary contributions), the role of long-range air-mass transport in modulating their abundance, at distinct sectors over south Asia namely; Himalayan, Indo-Gangetic Plains, North-west Indian, South-Peninsular and adjacent marine regions. The data of carbonaceous aerosols (EC, OC, and WSOC) reported in the literature in addition to our own data were used to understand the nature and sources of WSOC over South Asia. The analysis was carried out using three different ratios; OC/EC for source identification, WSOC/OC for long-range atmospheric transport (ageing) and WSOC/SOC to understand the primary and secondary contribution of WSOC. The present investigation revealed that, the primary OC that have undergone significant chemical processing as a result of long-range transport have a significant influence on WSOC formation over south Asia, especially under IGP outflow regions such as southern peninsular and adjacent marine regions. Overall, oxidation and ageing of primary organic aerosols emitted from biomass burning was found to serve as an important source of WSOC over south Asia.

Poster research topic(s)

Aerosols

As.Oc-45

Recent Trends in Emissions and Health Risk Assessment of Metals from Various Anthropogenic Sources

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Abstract

Metals can migrate and undergo chemical transformations in the atmosphere. This review summarizes studies revealing metal content in particulate matter collected for varying sampling durations and at different sites. The sites considered included traffic, coastal urban, industrial, coalfields, residential, construction and demolition, and background. The elemental levels were found to vary according to geography and the prevailing season. The study focused on elemental loading mainly upon PM2.5. Broadly, the industrial sites showed higher concentrations of Ca, Cu, and Zn. Fe and Ba were found to dominate coalfields, coastal urban, and urban traffic sites. Zn, Ni, and Cr marked their presence at sites with developmental activities. Titanium was found in samples from construction and demolition sites and residential sites, only. The trace elements obtained at certain sites were namely, Cd, As, V, Mn, and Pb. The voids such as wind direction, wind speed, and local emission sources were not addressed in these studies. These could have elaborated more about the atmospheric traversion of the elements analyzed. Hence, the present study is intended to present precisely the health risk assessments for the studied sites.

Poster research topic(s)

Health, Air quality

As.Oc-46

Health impacts and cost assessment of fine particulate matter formation: A conceptual introduction

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Abstract

In recent decades, air pollution, specifically fine particulate matter (PM2.5), was identified as a global health concern. Indeed, PM2.5 exposure had detrimental effects on the health of the population as a whole. The diverse sources of PM2.5 included transportation, the open burning of agricultural residue, and industrial processes. Several measures were implemented to combat PM2.5, including the promotion of renewable energy and public transportation, the enforcement of emission standards, and the reduction of biomass burning. However, the issue persisted, and additional efforts were required. The study aimed to assess and compare the health impacts and costs of PM2.5 from various sectors in Thailand and provide policy recommendations to reduce the impacts. The first part involved the development of an emission inventory for PM2.5 from different sectors in Thailand. The second part assessed the health impacts and costs of PM2.5 emissions in Thailand using the Life Cycle Impact Assessment (LCIA). Total emissions were related to health impacts via characterization factors, which were adapted for Thai-spatially differentiated values. Human health impacts, expressed in the unit of disability-adjusted life years, were ultimately linked to monetary value to determine health costs related to each scenario. The purpose of the study was to provide a comprehensive understanding of the contribution of each sector and identify effective reduction policies and practices. The study's results could have helped policymakers and other interested parties come up with and carry out effective plans to lower the harmful effects and costs of PM2.5 on health, which would have improved the environment and public health in Thailand.

Poster research topic(s)
Health, Air quality

As.Oc-47

Impacts of Aromatic Chemistry on the Global Atmosphere

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Abstract

Aromatics are an important subset of volatile organic compounds (VOCs), emitted mostly by anthropogenic sources such as vehicle exhaust, industry, and solvent usage. These sources make them particularly important in urban environments, accounting for up to 60% of total VOCs in urban and semi-urban areas. Aromatic species can undergo atmospheric oxidation resulting in significant contributions to both ozone and secondary organic aerosol (SOA) production, making it important for air quality to understand aromatic chemistry. The impacts of aromatic chemistry can be examined using Chemical Transport Models (CTMs) that simulate atmospheric processes. However, CTMs are only useful if they can be trusted to provide an accurate description of the real atmosphere.

Here, we evaluate the aromatic chemical mechanism in GEOS-Chem, a global CTM, which has not been previously evaluated against observations. To evaluate the aromatic mechanism, we compare GEOS-Chem model simulations to measurements from the Korea-United States Air Quality (KORUS-AQ) aircraft campaign, during which a variety of aromatic species and their oxidation products were measured around the Korean Peninsula from May to June 2016. Based on these comparisons and a variety of sensitivity simulations, changes are made to the chemical mechanism and emissions to improve model performance. In this poster presentation, we will discuss the changes to the model and how they improve model performance, with comparisons between the baseline model, updated model, and observations. We will also provide analysis of the atmospheric budget of two aromatic species, phenol and cresol, using the updated model.

Poster research topic(s)

Modelling study

As.Oc-48

Calibration of DustTrak and low-cost sensors and their application for assessment of inhalation exposures to traffic-related PM2.5 and PM1 in Ho Chi Minh city

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Abstract

The in-traffic microenvironment can enhance personal exposure to fine particulate matter (PM). With this study, we aimed to calibrate a DustTrak instrument (DustTrak 8533 DRX Aerosol Monitor, TSI Incorporated, Shoreview, MN, USA) and low-cost sensors (AS-LUNG-P sensors) and then assess inhalation exposure to PM2.5 and PM1 for different commuters in central areas of Ho Chi Minh City (HCM). The DustTrak instrument and low-cost sensors were calibrated using a gravimetric method under side-by-side conditions. Relationships between the DustTrak signals and PM concentrations measured by the gravimetric method were identified using simple linear regression models for PM2.5 ($R2 = 0.998$, p-value < 0.05) and PM1 ($R2 = 0.989$, p-value < 0.05). Meanwhile, PM concentrations determined by the AS-LUNG-P sensors and the gravimetric method were correlated using two-segmented linear regressions. To obtain the corresponding two-segment regression equations, the response of the AS-LUNG-P sensors was compared with the corrected DustTrak data. The coefficient of variation (CV) evaluated for all sensors was smaller than 10%, indicating that the data were applicable for particle assessment. For inhalation exposure assessment, the results showed that commuters using open transport modes, such as bikes, motorbikes, and walking, were exposed to more PM than those using closed transport modes (e.g., cars). Specifically, the bicyclists had the highest inhaled doses of PM among the open transport groups. PM exposure levels in the morning were higher than in the afternoon. Additionally, exposure levels to PM concentrations rapidly increased when passing through intersections of major roads and moderately decreased when using surgical facemasks.

Poster research topic(s)

Air quality, Health, Aerosols

As.Oc-49

Fine particulate matter and its constituents induce mutant Huntingtin aggregation and potentially modulate the course of Huntington's disease

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Abstract

Huntington's Disease (HD) is a progressive neurodegenerative disease that is caused due to the expansion of CAG repeat (triplet code for glutamine) in the gene Huntingtin resulting in a protein with expanded Poly-glutamine tract leading to protein aggregation. The symptoms include motor, behavioural and cognitive dysfunction. Though CAG repeat length correlates inversely with age of onset and directly with severity, considerable variations are observed. The observed variations in complications point to disease modifiers. Studies have demonstrated that exposure to ambient $PM_{2.5}$ is associated with neurodegenerative diseases and might modulate disease potentially through reactive oxygen species (ROS) production and mitochondrial dysfunction. In this study, we show that $PM_{2.5}$ and its constituents modulate mutant Huntingtin aggregation (mHTT) in the yeast model of HD. The individual organic compounds and metal ions constituents of $PM_{2.5}$ like benzo [a] anthracene (B[a]A), and Indeno [1,2,3-cd] pyrene (Ind) as well as salts of Cd^{2+}, Fe^{2+}, Cr^{6+}, Ni^{2+} and Pb^{2+} had shown significant increase in mHTT aggregates. Ambient $PM_{2.5}$ samples of Delhi with elevated levels of organic constituents have shown significantly enhanced mHTT aggregation. Thus these results demonstrate that exposure to the elevated levels of ambient $PM_{2.5}$ and its metal ions as well as organic constituents could modulate mutant aggregation with implications for disease progression.

Poster research topic(s)
Air quality, Health, Aerosols

As.Oc-50

PMF representation of biomass burning organic aerosols from sea salt-interfered measurements using capture vapouriser-ToF-ACSM

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Abstract

Sea salt has been shown to interfere in measurements of biomass burning organic aerosols (BBOA) using the Capture Vapouriser Time-of-Flight Aerosol Chemical Speciation Monitor (CV-ToF-ACSM) when the instrument is deployed in environments where particles from the two sources coexist, such as in coastal Australia. Interference is caused by the molecular fragment weighing 60 amu (m/z 60) being a key marker ion of particles from both sea salt and biomass burning, which cannot be distinguished using the instrument's unit mass resolution. This phenomenon has not been reported on in studies using a CV-ACSM or CV-Aerosol Mass Spectrometer focusing on BBOA as nearly all of them have been conducted in locations more than 100 km inland. Further analysis also shows that when CV-ToF-ACSM data from coastal locations are used as inputs for factor analysis model Positive Matrix Factorisation (PMF), the detection of sea salt also leads to an underprediction of BBOA in PMF factors. This study aims to identify a method to resolve BBOA in coastal Australia more representatively using PMF by removing data points in which sea salt measurements dominate BBOA, which can be classed as its own species in ACSM fragmentation calculations. Data for this study were collected from three locations in coastal Australia: baseline site Kennaook-Cape Grim, Tasmania; Cataract, NSW, directly adjacent to the Black Summer bushfires during the COALA-2020 campaign; and Aspendale, Victoria, a bayside Melbourne suburb. Sea salt points were removed by applying a threshold concentration of m/z 44 from the CV-ToF-ACSM as that marker ion represents oxidised organic aerosols that are not formed from sea salt. This study compares PMF solutions with and without removal of sea salt points and finds that solutions made after sea salt removal improves the approximation of m/z 60 to total organic mass ratios.

Poster research topic(s)

Field study, Aerosols, Instrument development

As.Oc-52

Probing the impact of COVID lockdown on aerosol dynamics: Insights into vertical distribution, subtype, and secondary particle formation in Central Himalaya

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Abstract

This study investigates the impact of the COVID-19 lockdown on aerosol characteristics in the north India during three distinct phases in 2020 in comparison to 2017-2019. Strict lockdown measures led to a substantial reduction in daily $PM_{2.5}$ concentrations (μg m^{-3}) including primary aerosols, with Delhi/NCR (DN) (range, PI: 30-270 to PII: 30-70) experiencing about a 62% decrease and Nainital (NT) (PI: 3-20 to PII: 4-12) showing a minor reduction of approximately 8% for a couple of weeks. Surprisingly, the relative decrease of different primary aerosols (NO_x and SO_x) did not significantly decrease PM concentrations in the regions. During the lockdown, absorbing aerosols like BC, OC, and DAOD decreased significantly while SO_4 levels increased, indicating a dominance of scattering mode secondary aerosols. Vertical analysis of aerosols revealed substantial reductions in aerosol content (EC) across all altitudes in both areas (~60%), with a sharper decline in the foothills of Central Himalaya (CH). Particulate depolarization (PDR: 44%) and Color Ratios (PCR: 31%) declined with altitude, indicating fine particle prevalence at higher altitudes in the NT region. In contrast, DN showed increased asphericity of larger particles near the surface due to heterogeneous mixing and hygroscopic growth. Also, aerosol subtype occurrences changed significantly, such that higher Polluted dust (PD) and Dust (DU) frequencies were observed at lower and upper altitudes, decreasing in the mid-range (2-4 km) due to boundary layer processes. Moreover, unlock phase showed substantial ozone (O_3) level enhancements in the IGP belt, including CH foothill areas, with increased oxidizing capacity attributed to secondary particle contributions and Stratosphere and Troposphere Exchange events, particularly notable in SO_4 in the CH region and HNO_3 in DN. These findings highlight the significance of secondary aerosols in reduced primary emissions and emphasize the need for the comprehensive study of chemistry models to resolve aerosol components effectively.

Poster research topic(s)

Aerosols, Modelling study, Satellite study, Air quality, Greenhouse gases, Remote sensing

As.Oc-53

Chemistry of atmospheric ammonia over South Asia - a source of nitrogen pollution

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Abstract

Atmospheric ammonia (NH_3) is one of the largest sources of reactive nitrogen primarily emitted by agricultural activities and has dramatically altered nitrogen flows on our planet. In the atmosphere, NH_3 is a highly reactive and soluble alkaline gas. It exacerbates eutrophication and acidification in ecosystems and plays a key role in atmospheric chemistry. We first compared the global chemical transport model with monthly averaged satellite distributions and limited ground-based NH_3 observations across Southeast Asia. Furthermore, we conducted high-temporal-resolution simulations of NH3 along with ammonium (NH_4^+) and total ammonia (NH_x) (sum of NH_3 and NH_4^+) over the Indo-Gangetic Plain (IGP) region utilizing the Weather Research and Forecasting model coupled with chemistry (WRF-Chem) and observations made at The Winter Fog Experiment (WiFEX). Under the winter conditions in Delhi, hydrogen chloride (HCl) actively promotes PM2.5 formation, such as ammonium chloride (NH_4Cl). We hence added chloride (HCl/Cl^-) to the WRF-Chem and found that the NH_4^+ concentration increased by 13.1 μg m^{-3}, the NH_x concentration increased by 9.8 μg m^{-3}, and the NH_3 concentration decreased by 3.2 μg m^{-3}, which aligns better with the measurements. Our research revealed that achieving precise simulations of NH_3 concentration demands advanced chemistry combined with an accurate emission inventory. Consequently, we integrated these methodological advancements and presented the spatial distribution of NH_3 and its chemistry over South Asia using an updated emission inventory Emissions Database for Global Atmospheric Research (EDGAR V6) and country-specific emission inventories developed as part of the South Asian Nitrogen Hub (SANH) and compared it with the EDGAR-Hemispheric Transport of Air Pollution (HTAP) emission inventory. The simulated NH_3 showed less concentration than EDGAR-HTAP emissions, suggesting reduced NH_4^+ formation. Nevertheless, the pronounced dry and wet deposition of nitrogen species raises concerns regarding the eutrophication of water bodies and nitrogen pollution across the IGP region and South Asia.

Poster research topic(s)

Modelling study, Air quality, Field study, Aerosols

As.Oc-54

Long-term monitoring of atmospheric Hg^0 at Kennaook /Cape Grim, Australia

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Abstract

The atmosphere is a key component of the biogeochemical cycle mercury from source to receptor. The long-term monitoring of atmospheric elemental mercury (Hg^0) is critical for the effective evaluation of the Minamata Convention. To date, atmospheric Hg has been sparsely measured in the Southern Hemisphere (SH), with shorter records available relative to the Northern Hemisphere (NH). Therefore, long-term continuous monitoring of atmospheric Hg initiated in 2013 at the pristine environment of Kennaook/Cape Grim (Tasmania) is particularly valuable. Here, we present an analysis of atmospheric elemental mercury (Hg^0) measurements conducted at Kennaook/Cape Grim. Hg^0 has been measured continuously with 5-min resolution using a Tekran-2537B instrument since 2011 and since June 2017, an additional instrument 2537X. For this study, we used the data from Tekran-X instrument measured from 2017-2021. The mean Hg^0 concentration from the Tekran-X was 1.05±0.05 ng m^{-3} from 2017-2021. The mean measured at Kennaook/Cape Grim is lower than the NH background value (1.5-1.7 ng m^{-3}) but in the range of previous estimates of the SH background (1.0-1.3 ng m^{-3}). There is no clear seasonality in Hg^0 concentrations observed at Kennaook/Cape Grim; however, values are somewhat higher in winter (Jun-Aug) compared to other seasons, reflecting that the southern ocean contributes the Hg at Cape Grim. There is evidence of high Hg^0 associated with air masses coming from the southwest direction influenced by the Southern Ocean.

Poster research topic(s)

Field study

As.Oc-55

Assessing meteorological influences on amplifying regional aerosol loading over Indo-Gangetic Plain

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Abstract

Spatio-temporal variations in aerosol loading over central to lower Gangetic plain, South Asia was explored with emphasis on how regional meteorology influences building up high aerosol loading over the region. Visible Infrared Imaging Radiometer Suite (VIIRS) on-board Suomi National Polar-orbiting Partnership (S-NPP) DB AOD at 550 nm and ERA5 reanalysis meteorological data were explored during October to December months from year 2020 to 2022. We note, elevated AOD over the lower to central IGP region during these months was mainly attributed to poor vertical mixing and limited dispersion of pollutants. Existing meteorological conditions was characterized by low temperatures, weak wind speed, greater subsidence, and a shallow planetary boundary layer height (avg. 1 Km). Measured omega and planetary boundary layer height revealed a strong inverse relationship with regional VIIRS DB AOD. These meteorological conditions favored greater pollutant accumulation near the surface within the boundary layer. Besides, a strong anti-cyclone characterized with positive omega value (0.05 to 0.09 (pa/sec)) influenced subsidence of aerosols. Such aerosols usually coming through long-range transport from upper Gangetic plain, getting subside over central to lower Gangetic plain, result in an increase in regional AOD. We also note a complex association between meteorological variables and AOD over the region which was not solely driven by the local emissions of air pollutants. The findings offer a valuable resource for addressing air quality challenges over central to lower Gangetic plain and developing effective solutions to mitigate the adverse impacts of air pollution.

Poster research topic(s)

Satellite study, Remote sensing, Air quality, Climate, Aerosols, Land-Atmosphere interactions

As.Oc-56

To constitute variations in prevailing aerosols within the cities and its outskirts using multi-satellite high-resolution retrievals over South Asia

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Abstract

Spatio-temporal nature in aerosol optical and microphysical properties over four major cities across the Indo-Gangetic Plain, South Asia namely Karachi, Delhi, Varanasi and Dhaka, was explored fusing multi-satellite aerosols products. Emphases were made to assess any distinctions in aerosol loading and aerosol sub-types over the cities and its surrounding (1°x1°). Both spatial and vertical distribution of aerosols was explored using Multiangle Implementation of Atmospheric Correction (MAIAC) algorithm applied on Aqua MODIS retrievals over land at 1 km resolution and Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP, CALIPSO) version 4 level 2 AOD database at 30-60 m resolution, retrieved between 2018-2022. Within the city, the highest annual mean AOD was noted in Varanasi (0.70) followed by Delhi (0.68). In Varanasi, the peak aerosol loading (AOD:0.85) was noted in winter, whereas highest post-monsoon specific AOD was retrieved in Delhi (0.92). The MODIS DB angstrom exponent (AE at 10 km resolution) indicated the presence of diverse particle sizes across the cities, while Aura OMI retrieved UVAI signaled the dominance of UV-absorbing aerosols within Delhi and Varanasi, and UV-neutral aerosols in Dhaka and Karachi. The prevailing aerosols were systematically classified into six distinct subtypes viz. urban, smoke, mineral dust, marine, biogenic and miscellaneous aerosols following a classification scheme that effectively constrained both particle size and aerosols' capacity of UV absorption. Urban aerosols predominated in Karachi and Varanasi, while Delhi and Dhaka experienced prevalence of smoke aerosols. Notably, AOD retrieved within the city boundary exceeded AOD retrieved at the outskirts of the city but within 1x1 degrees region whereas no specific variations in aerosol vertical profiles and aerosol sub-types were recognized. We note that variations in aerosols loading in and around the city potentially influence the regional air quality and modify urban heat island effect over the cities across the Indo-Gangetic plain of South Asia.

Poster research topic(s)

Satellite study, Remote sensing, Air quality, Aerosols, Climate, Land-Atmosphere interactions

As.Oc-57

Air quality assessment and the respiratory health effects among stall workers at the night markets in Selangor

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Abstract

Assessing air quality in night markets in Selangor is an important concern, as poor air quality can indeed pose health risks to both workers and visitors. The study aims to determine the association between air quality assessment and the respiratory health effects among stall workers at night markets in Selangor. This research used a handheld DustTrak DRX Aerosol Monitor 8534 for real-time measuring air quality parameters of PM2.5, and 3M QuesTempo 36 Area Heat Stress Monitors (WBGT) to monitor ambient temperature, relative humidity, windspeed and solar radiation. The respiratory health effects were measured by using validated questionnaire adopted from American Thoracic Society on 60-night market workers. The PM2.5 concentration was found exceed National Ambient Air Quality Standards (NAAQS) with mean 0.059 ± 0.195 mg/m3. The relative humidity also was recorded higher with 75.917 ± 7.082 %. Meanwhile, WBGT shows no significant exceed than standard limit with mean 27.477 ± 1.045°C. The night market workers who work for less than 10 years shows significant association of getting cough ($\chi 2$= 12.00, p= 0.050). Even though, the mean of WBGT was not exceed the standard limit, there is a significant prevalence of getting cough with phlegm due to the WBGT exposure with (PR=4.071, p= 0.020). The high relative humidity and PM2.5 was observed from cooking activities in the night markets and the vehicle emission. Evaluating the air quality in night markets in Selangor is of significant importance, as inadequate air quality undeniably presents health threats to the night market workers.

Poster research topic(s)

Air quality, Health

As.Oc-58

Quantification of $PM_{2.5}$ concentration variations in Pakistan using remote sensing approaches

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Abstract

Ambient fine particulate matter ($PM_{2.5}$) having aerodynamic diameters less than 2.5 μm is a primary component of air pollution. Due to its adverse impacts on human health, air quality, and the ecosystem, it attains considerable public concern all over the world. During the recent few decades, various cities in Pakistan have been among the world's top most polluted cities and experienced severe health issues due to poor air quality. Therefore, the current study intended to probe the spatiotemporal variations and trends of $PM_{2.5}$ concentration in Pakistan. Moreover, we also analyzed the health risks caused by the long-term population exposure to $PM_{2.5}$. To do so, the study employed long-term remotely sensed satellite datasets of $PM_{2.5}$ and population density during 1998 to 2021. The results indicate that during the study period, the overall average $PM_{2.5}$ concentration is 45.9±19.7 μg/m^3 which is far above the WHO air quality guidelines. Seasonal variations indicate the highest average concentration of 50.2±23.7 μg/m^3 in the summer season. We observed the hotspot of $PM_{2.5}$ in Lahore, Karachi, Sukkur, Hyderabad, Peshawar, Mirpur Khas, Larkana, Bahawalpur, Quetta, and Kalat. These areas also experienced the highest health risks due to long-term exposure to $PM_{2.5}$. The outputs of the health risk assessment analysis indicate the highest health risk in summer.

Poster research topic(s)

Satellite study, Remote sensing, Air quality, Climate, Health, Aerosols

As.Oc-59

Particulate Matter Emission from Traffic-Induced Resuspended Road Dust in India

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Abstract

India faces a rapid increase in particulate matter (PM) emissions, which is considered a leading risk factor for human health. One of the significant sources of this PM is resuspended road dust which has been explored comprehensively in polluting the air of both urban and rural areas. Current research is the first of its kind, which estimates emissions from resuspended road dust due to Indian transport at a spatial and temporal level during 2020. This emission inventory is developed at a very high resolution of 10 km × 10 km and quantifies the PM over the Indian road network. Emissions from the paved and unpaved roads have been calculated using the activity data such as the number of registered vehicles, Vehicle Kilometers travelled, silt content of the roads, number of precipitation days and other meteorological data. From the study, it has been found that the total PM_{10} and $PM_{2.5}$ emission was ~4.37 Tg/yr and ~0.47 Tg/yr respectively. The highest PM_{10} emission is from the unpaved roads of urban regions, followed by the unpaved road of rural areas. The paved areas show considerably lesser emissions than the unpaved zones. The two-wheelers are found to be the primary contributor of PM_{10} in both areas. The second-largest emission is from four-wheelers, followed by HCV in the urban area, whereas LCV and miscellaneous sources take that place in rural areas. Our study highlights the road dust emission for road networks over India, which can provide a valuable reference to policymakers for air pollution management at regional levels.

Poster research topic(s)

Air quality, Aerosols, Modelling study

As.Oc-60

The Impact of Strong Dust Storm on Molecular Compositions of Atmospheric Organic Aerosols in Tianjin, North China

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Abstract

Dust storms are prevalent and severe meteorological phenomena that transport substantial quantities of dust, constituting a pivotal source of atmospheric aerosols. These dust aerosols carry minerals and pollutants, significantly impacting human health, atmospheric chemistry, regional and global climates, and biogeochemical cycles. Therefore, investigating dust aerosols is essential for addressing air pollution and global change concerns. While past research has focused on inorganic components, the organic elements of dust aerosols have received relatively little attention. To address this gap, we collected atmospheric fine particulate matter ($PM_{2.5}$) in Tianjin, North China, and used Gas Chromatography/Mass Spectrometry (GC/MS) to measure organic molecular markers, including saccharides, biogenic, and anthropogenic SOA markers. This allowed us to uncover the concentrations and sources of organic aerosol molecular composition in a downwind megacity affected by multiple spring dust storms, as well as to identify the characteristics and potential influencing factors of organic molecular composition. Additionally, we tentatively analyzed the effects of dust particles on the formation of secondary organic aerosols (SOA) during dust haze events.

Our study revealed that dust storms influence the concentrations and sources of primary and secondary organic aerosols in downwind regions by transporting substantial amounts of dust aerosols. Dust particles can promote SOA formation by providing sites for atmospheric chemical reactions. Furthermore, during dust storms, significant fluctuations in meteorological conditions facilitate plant emissions and accelerate air pollution dispersion.

In summary, our research enhances our understanding of how dust storms affect the molecular composition of organic aerosols in polluted megacities downstream, within the broader context of global change.

Poster research topic(s)

Field study, Air quality, Aerosols

As.Oc-61, A.E.ME-56

Occurrence and Risk Assessment of $PM_{2.5}$- bound heavy metals in residential homes of Dhaka, Bangladesh

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Abstract

This study aims to develop a better understanding of indoor exposure of $PM_{2.5}$ in residential environment of Dhaka, Bangladesh. Indoor $PM_{2.5}$ samples were collected for 24 hours to quantify six heavy metals (Pb, Cr, Zn, Fe, Cu, and Mn). The 24- hour average indoor $PM_{2.5}$ concentration was 100± 19.4 μgm^{-3}, with a range of 123 to 77.1 μgm^{-3}. Zn and Fe contributed 85% to the total detected heavy metals. Enrichment factor analysis showed that, Pb, Cr, Zn, and Cu had anthropogenic origin, whereas Fe and Mn originated from crustal sources. Positive Matrix Factorization (PMF) model resolved four sources of $PM_{2.5}$, namely- vehicular emission (4.8%), crustal sources (17.6%), Zn source (44.6%), and mixed source (32.9%). Health risk assessment revealed that, children were at 2.18 times greater non-carcinogenic risk than adults. Mn had the highest hazard quotient contribution (85%). The carcinogenic risk was 5.18×10^{-4}, which was higher than the acceptable limit (1×10^{-6}) and indicated that, 1 in 1930 individuals had a possibility of developing cancer in his lifetime. The total cancer risk was almost entirely (99%) contributed by Cr. The average hazard ratio (HR) for indoor $PM_{2.5}$ was 6.68 (>1), which implied extremely deteriorated indoor air quality in residential homes of Dhaka, Bangladesh.

Poster research topic(s)

Air quality, Health, Aerosols

As.Oc-62

Quantification and hotspot identification of ammonia emission from livestock and fertilizer sector over India

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Abstract

Ammonia (NH3) is a highly alkaline constituent in the atmosphere, which acts as a key precursor towards the neutralization of gaseous nitric acid and sulfuric acid. During their neutralization, secondary inorganic aerosols are formed that in turn increase the ambient particulate matter concentration. A major amount of ammonia is emitted from livestock excreta and fertilizer applications. These sectors jointly contribute to 57% and 80% of total ammonia at the global scale and in Asia respectively. Since India is one of the major livestock-bearing countries, the need for a high-resolution comprehensive gridded Emission Inventory (EI) of ammonia becomes a foremost requirement which has been fulfilled by this study for the base year 2022. As per the 20th Livestock Census of India, the total livestock population stands at 536.76 million, which was found to be emitting ammonia of nearly 2109.73 Gg/yr. The highest amount of ammonia is emitted by the cattle i.e. ~48.9%, followed by the buffaloes and poultry which emit ~21.5% and ~12.9% of total ammonia respectively. The inventory also includes ammonia emission from the most commonly used synthetic nitrogen fertilizers in India such as urea, diammonium phosphate (DAP), ammonium sulfate and NPK fertilizers. The maximum amount of ammonia i.e. ~95.7% is emitted from Urea as it is the most widely used fertilizer across the country. The total ammonia emission from fertilizer application amounts to ~4992.2 Gg/yr. Our results indicate that such high emissions of ammonia could impose a serious threat to the ecosystem and human health unless strategic mitigation efforts are not taken for its reduction.

Poster research topic(s)
Air quality, Trace gases, Climate, Aerosols

As.Oc-63

Detecting and Monitoring Air Pollution in Malaysia Using AOD from Himawari Satellite: An Analysis of the October 2023 Haze Event

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Abstract

Air pollution is a major environmental concern in Malaysia, requiring the monitoring of its sources and levels to mitigate its adverse effects on public health and the environment. The objective of this study is to analyse aerosol optical depth (AOD) data obtained from the Himawari satellite for the purpose of detecting the haze event that occurred in Malaysia during the first week of October 2023. The Himawari satellite is classified as a geostationary satellite that offers the capability of providing high temporal data. The investigation of Aerosol Optical Depth (AOD) data obtained from the Himawari satellite in early October 2023 has revealed that several locations in Malaysia had AOD levels beyond 1. This observation indicates a detectable increase in air pollution inside the country. Hotspots in Kalimantan and Sumatra can also be identified using Himawari data towards the end of September 2023. The use of Himawari Aerosol Optical Depth (AOD) data presents an important tool in the detection and monitoring of air pollution in Malaysia. In future research activities, the comparison of Aerosol Optical Depth (AOD) data obtained from the Himawari satellite with ground-based data will be studied once the more recent data becomes accessible. The results of this study have the potential to make valuable contributions towards improving the development of economic strategies and research collaborations with the goal of reducing haze occurrences in Malaysia and Southeast Asia.

Poster research topic(s)

Satellite study, Remote sensing, Air quality, Aerosols

As.Oc-64

Understanding Air Quality and PM2.5 -A Review of Particulate Bound Mercury

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Abstract

Particulate matter (PM) including $PM_{2.5}$ and PM_{10} is a mixture of solid particles and liquid droplets present in air (e.g. aerosols composed of small droplets of liquid, dry solid fragments, dust, dirt, soot or smoke). PM can encompass a wide range of materials like inorganic ions, elemental carbon, metallic as well as organic compounds and have varied size, shape and chemical composition . These particles can be released from sources such as wildfires, dust, vehicle exhaust, burning wood and agricultural biomass, construction sites, pavements and industrial activities.

$PM_{2.5}$ are fine particulate matter having a diameter of 2.5 microns or less, inhalable and easily passes into the blood streams. Exposure to $PM_{2.5}$ is associated with a variety of health issues such as respiratory problems, cardiovascular problems, and even premature death. The EPA annual standard of $PM_{2.5}$ is 12 $\mu g/m^3$ whilst WHO recommended a stringent limit to be 5 $\mu g/m^3$.

Heavy metals attached to $PM_{2.5}$ have shown to be capable of triggering a variety of respiratory and cardiovascular illnesses. Of interest is mercury (Hg), which exists naturally and anthropogenically. Being persistent, Hg cycles amongst the air, ocean, land and biosphere. Within the atmosphere, it has a large residence time; thus, travels large distances. In the atmosphere, particulate bound (PB) Hg exists; and is part of $PM_{2.5,}$ with a relatively short residence time of hours to several weeks; thus, playing a vital role in atmospheric deposition. PBHg is a global environmental concern due to its sensitivity to physiochemical processes, thus resulting in large deposition velocities and scavenging coefficients, and later enters terrestrial and marine ecosystems. The deposition flux of PBHg depends heavily on emission types.

Hence, this poster provides a review on the air quality and $PM_{2.5}$; in particular it considers PBHg and looks into the health risk effects on humans as well as the environment.

Poster research topic(s)

Air quality, Climate, Health, Ecosystems, Land-Atmosphere interactions, Ocean-Atmosphere interactions, Multiphase chemistry, Aerosols

As.Oc-65

Amplified role of potential HONO sources in Ozone formation in North China Plain during autumn haze aggravating processes

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Abstract

Co-occurrences of high concentrations of PM2.5 and ozone (O3) have been frequently observed in haze-aggravating processes in the North China Plain (NCP) over the past few years. Higher O3 concentrations on hazy days were hypothesized to be related to nitrous acid (HONO), but the key sources of HONO enhancing O3 during haze-aggravating processes remain unclear. We added six potential HONO sources, i.e., four groundbased (traffic, soil, and indoor emissions, and the NO2 heterogeneous reaction on ground surface (Hetground)) sources, and two aerosol-related (the NO2 heterogeneous reaction on aerosol surfaces (Hetaerosol) and nitrate photolysis (Photnitrate)) sources into the WRF-Chem model and designed 23 simulation scenarios to explore the unclear key sources. The results indicate that ground-based HONO sources producing HONO enhancements showed a rapid decrease with height, while the NO+OH reaction and aerosol-related HONO sources decreased slowly with height. Photnitrate contributions to HONO concentrations were enhanced with aggravated pollution levels. The results suggest the potential but significant impact of Photnitrate on O3 formation, and that more comprehensive studies on Photnitrate in the atmosphere are still needed.

Poster research topic(s)

Modelling study, Air quality, Trace gases, Aerosols

As.Oc-66

Meteorological Impact on The Composition of Inorganic Aerosol in Urban and Suburban Regions

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Abstract

We investigate the correlation between daytime and nighttime meteorology and atmospheric inorganic aerosol concentration in urban and suburban to find the meteorological factors controlling the formation of inorganic aerosol. Five days campaign were held in Bandung (Urban) from 27 Jun – 2 Jul 2022, and in Serpong (Suburban) from 25 – 30 Jul 2022. The sampling duration was 12 Hours (Day and Night). The sampling method was a Filter pack with a flow rate set to 5 L/Min. Meteorological data was measured using AWS. Chemical analysis: Ion Chromatography. Statistical analysis: Spearman's rho correlation. During the campaign, we found that daytime mean inorganic aerosol concentrations at the urban site were higher than at nighttime, but at suburban was vice versa. The three highest daytime concentrations in urban are Ca^{2+}, SO_4^{2-}, NO_3^-, while nighttime are SO_4^{2-}, Ca^{2+}, and NH_4^+ aerosols. The daytime and nighttime in suburban are SO_4^{2-}, NO_3^- and NH_4^+ aerosols. Windrose shows that during the campaign, urban daytime and nighttime wind dominant come from eastern Bandung, while suburban daytime and nighttime are from the Northeastern Serpong or DKI Jakarta. In the urban region, in the daytime, temperature and relative humidity control SO_4^{2-}, Cl^-, and Ca^{2+}concentrations. But at nighttime, only temperature seems to strongly influence SO_4^{2-}, NH_4^+, and Mg^{2+} concentrations. Positive correlation Windspeed with Cl^- indicates distant transport in the daytime. In suburban, Day, and nighttime, temperature is the only meteorological factor controlling NO_3^-, Cl^- and Ca^{2+} concentrations.

Poster research topic(s)

Field study, Laboratory study, Aerosols

As.Oc-67

Democratizing Air Quality Data in Indonesia For Better Health

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nafas Indonesia, Jakarta, Indonesia

Abstract

Indonesia's air pollution problem has been no secret for decades, which has left many citizens appalled and outraged. In 2020, Nafas Indonesia, the country's first home-grown air quality platform began operations and over the past 3 years has deployed Indonesia's largest outdoor air quality network. With over 200 low cost sensors in 15 cities, Nafas provides access to air quality data free through an application which provides real-time health updates to hundreds of thousands of users. Recently published joint research together with Halodoc, Indonesia's largest telemedicine company, showed that each 10 ug/m3 increase in PM2.5 in Jakarta caused a 33% increase in teleconsultations for respiratory illnesses. Nafas has since started combining indoor and outdoor air quality data to understand the relationship of our environments both inside and outside of buildings. We've discovered that construction trends in tropical countries contribute to penetration of outdoor pollutants up to 100% in many offices, schools, gyms and homes. Using air quality data, Nafas has been able to provide health insights but also ensure that our buildings are healthier and safer. In this session, Nafas will share its key learnings of successfully building a private air quality ecosystem in Indonesia including - setting up low cost networks, partnering with health startups and improving health in buildings.

Poster research topic(s)

Air quality, Health

As.Oc-68

Measurement of ambient volatile organic compounds in Malaysia: variations, source apportionment, and health risk assessment

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Abstract

Volatile organic compounds (VOCs) have been recognised as the major contributors to atmospheric photochemical reactions, originating from both anthropogenic and biogenic sources. This study aims to determine the variation and distribution of VOC levels in Malaysia, identify the potential emission sources of VOC levels, and evaluate the health risks associated with VOC exposure. In this study, a total of 29 ambient VOCs were detected at 10 continuous air quality monitoring (CAQM) stations (including urban, sub-urban, industrial, and background areas) operated by the Malaysian Department of Environment (DOE) from January 2018 to December 2019. The positive matrix factorisation (PMF) model was performed for the identification of the potential VOC source profiles in the ambient air. The health risk assessment (HRA) approach was employed to calculate the hazard quotient (HQ) for non-carcinogenic and lifetime cancer risk (LTCR) for carcinogenic risk of BTEX via the chronic inhalation route for both adults and children. Therefore, the expected results of this study are that the concentration of VOCs recorded the highest concentration in urban areas, with exhaust vehicles and industrial activities being the primary sources of VOCs. Several VOC components are predicted to influence the formation of ground-level ozone (O_3) and secondary organic aerosols (SOA). The presence of benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations, which are significant components of VOCs, are anticipated to have a considerable impact on adults and children, both in terms of chronic non-carcinogenic and potential carcinogenicity.

Poster research topic(s)

Air quality

As.Oc-69

Using a Ground-based Spectrometer and Satellite Data to Understand Biases in Southeast Asia Air Quality

Fernando Santos, Santo Salinas, Tan Li

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Abstract

Global emissions from industrial and transport activity, in addition to land change for intensive agriculture, have continuously increased since the pre-industrial era, driven mainly by economic and population growth. Such activity has generated immediate and long-term impacts on the local and regional atmospheric environments, especially on air quality in Southeast Asia (SEA). For instance, in Singapore, air pollution levels are strongly affected by atmospheric circulation, and Its variability is controlled by meteorological conditions and large-scale circulation patterns, including monsoon dynamics and the occurrence of biomass burning over the SEA. Therefore, accurate daily observations of NO2 and O3 made from satellites (OMPS, OMI, and TROPOMI) are critical to our ability to quantify and understand the local and regional air quality environment, particularly from the Geostationary Environment Monitoring Spectrometer (GEMS); the first instrument in the geostationary constellation (GEMS, TEMPO, and Sentinel-4) to produce hourly dataset measurements. Nevertheless, the SEA is especially challenging for satellite observations since the sensitivity of retrievals at near-surface levels can be reduced in environments with a high degree of cloud cover, heavy particle pollution, changes in the O3 profile within the boundary layer, viewing geometry angle, biomass burning and stratospheric intrusion events. To better understand and reduce the biases between ground-based (Pandora spectrometer) and gridded (satellite and atmospheric models) trace gas datasets, we performed an exploratory data analysis using preliminary NO2 and O3 products from the Pandora spectrophotometer and GEMS instrument. The analysis will focus on: (a) Identifying NO2 and O3 diurnal spatiotemporal biases using remote sensing data and (b) characterizing meteorological patterns at SEA. The outcomes of this study will significantly reduce uncertainties of NO2 and O3 algorithm retrievals from GEMS.

Poster research topic(s)

Satellite study, Trace gases, Air quality, Remote sensing

As.Oc-70

Spatio-temporal composition and Health risk assessment of Polycyclic Aromatic Hydrocarbons (PAHs) at two different sites of Delhi -NCR, India

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Abstract

In India, PAHs associated with PM_{10} reflect their origin from mixed sources such as vehicular emissions, coal combustion, industrial setups, biomass/waste burning, construction activities etc. Comparative studies of spatio-temporal composition and health risk assessment of PAHs have been done. PM_{10} aerosols have been collected at Indira Gandhi Delhi Technical University for Women (IGDTUW), Delhi and Faridabad (FBD) on Quartz fiber filters (QFFs) twice a week during the year 2015. At IGDTUW, Delhi, the annual average concentration of PAHs was 288.0±19.4 ng m^{-3} with higher values in winter than summer. Faridabad showed 493.48±27.8 ng m^{-3} of PAHs with no peculiar seasonal trend. The high levels at Faridabad with no seasonal trend indicate emissions were coming from any special event i.e. metro rail construction, consistent during almost the entire year and the aerosols were found to be dominant in high molecular weight PAHs. This may be due to the strong influence of local sources (industrial emissions and high diesel vehicles at construction sites and stone crushers). The B(a)P concentrations were found to be higher in winter (43.75±31.8 ng m^{-3}) than in summer (27.49±23.3 ng m^{-3}), monsoon and post monsoon due to increment of domestic heating and favorable temperature and solar intensities for dispersion of B(a)P particles. The contribution of PAHs showed lowest contribution of 2-3 rings (4.2 to 15.41 %) PAHs compare to 5 and 6-ring congener, ranging from 71.23 to 89.2 %. The diagnostic ratios indicate the mixed sources like traffic, residential heating, wood combustion and other sources at both the sites. Equivalent factors (TEFs) of all PAHs in terms of B(a)P toxicity were used for evaluation based on USEPA, 1993. The lung cancer risk (CR) was found to be higher than the range prescribed by EPA at both the sites.

Poster research topic(s)

Air quality, Aerosols

As.Oc-71

COMPARISON OF LEVEL2 AND LEVEL 3 NO2 TROPOMI DATA OVER PENINSULAR MALAYSIA

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Abstract

Despite the fact that Level 2 data of TROPOMI air pollution satellite data provides comprehensive insight into the pollutant concentrations, its analysis necessitates substantial computational resources and programming expertise. This presents difficulties for researchers who lack access to sophisticated server computers and knowledge of complex programming languages. Level 3 TROPOMI data, which can be extracted using the user-friendly Google Earth Engine (GEE) platform, is an alternative. Using cloud-based data processing, GEE eliminates the need for expensive hardware and reduces the learning curve, making it accessible even to novice users. Objective of the study is to quantify the level 2 and level 3 mean of nitrogen dioxide (NO2) from TROPOMI before and after COVID Lockdown over Peninsular Malaysia and to compare the level 2 and Level 3 NO2 concentration daily data analysis . Level 2 NO2 data was found to be more reliable and suitable for daily analysis, providing consistent and accurate NO2 concentration measurements. Level 3 data, on the other hand, were not suitable for daily analysis as many missing data were detected due to its high threshold of its cloud masking algorithm (QA 0.75). However, Level 3 NO2 data is useful for longer-term analyses, such as monthly or annual assessments, as it enables the examination of NO2 pollution trends and patterns over time.

Poster research topic(s)

Satellite study, Remote sensing, Air quality

As.Oc-72

A Decade Trend of Surface Ozone and Nitrogen Oxides in East Malaysia.

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Abstract

This study examined the long-term trend of surface ozone (O3) concentrations and nitrogen oxides (NOX) levels at eight continuous air quality monitory sites (CAQMS) in East Malaysian from 2010 to 2020. This study also investigates the characteristics of pollutants behaviour (O3 and NOX) at monitoring sites (categorised into urban, suburban, and background areas) and evaluates the association between O3 and NO2/NO ratio. During the study period, the deseasonalised monthly average (Mmean) O3 showed significant increases at SQ1 (0.18 ppb yr-1) and SQ4 (0.24 ppb yr-1) in Sarawak and SS5 (0.29 ppb yr-1) in Sabah. The trend values for deseasonalised 8-h Mmean and Dmax-Dmean O3 concentrations also increased significantly at SQ1, SQ2, and SS5, with a rate of 0.29, 0.26, 0.55, and 0.31, 0.32, 0.62 ppb yr-1, respectively. Between 2010 and 2020, land-use changes near stations SQ1 and SS5, in booming city centres may have caused the trend shift. These changes included highway construction, urban development, and industrial estate expansion. These further sites significantly reduce deseasonalised Mmean 03 levels including, SQ2 (-0.2 ppb yr-1, p = 0.001) and SQ3 (0.19 ppb yr-1, p = 0.001) in Sarawak and SL8 (0.17 ppb yr-1, p = 0.1) in Labuan. All stations indicate a significant downtrend/reduction in deseasonalised Mmean NO, NO2, and NOX over 2010-2020 (p = 0.001), except for SS7 and SL8 (p-values ranging from 0.1 and 0.01) and SS7's non-significant trend. The trends do not necessarily oppose Mmean O3 trends. The result is anticipated since O3 photochemistry is not the primary driver of O3 concentrations. A significant positive correlation was found between O3 and NO2/NO ratio with accelerating sequence from SS6, SQ4, SS5, and SS7. This research is crucial for designing surface O3 management policies at national and state levels, especially in tropical regions.

Poster research topic(s)

Greenhouse gases

As.Oc-73

Spatial Distribution of Air Quality in Sensitive Locations, Bangladesh

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Abstract

The analysis of air quality in sensitive areas in Bangladesh demonstrates notable disparities, wherein densely populated urban areas like Dhaka exhibit heightened levels of air pollution as a result of industrial, development operations and traffic congestion, while rural regions frequently exhibit superior air quality. It is imperative to prioritize the monitoring and enhancement of air quality in these vulnerable areas in order to protect the health and overall welfare of the populace and reduce the detrimental impacts of pollution. The aim of this study is to observe and assess the levels of Particulate Matter (PM_1, $PM_{2.5}$, and PM_{10}) concentrations in specific land use declared as sensitive or silent areas. This study was carried out at a total of 515 distinct sites, employing a portable Air Quality Monitor. The study reveals that the mean values of PM_1, $PM_{2.5}$, and PM_{10} in a sample of 515 locations were recorded as 63.93, 103.80, and 128.23 μg/m^3, respectively. The study revealed that the mean $PM_{2.5}$ concentration (111.96 μg/m^3) across various land use types was significantly elevated, exceeding the Bangladesh National Ambient Air Quality Standards (NAAQS) by almost 1.72 times. It was determined that the alterations in the concentration of all the chosen parameters across different land uses were not statistically significant. The average concentrations of PM_1, $PM_{2.5}$, and PM_{10} in various areas are as follows: the hospital area exhibits concentrations of 69.23, 111.96, and 137.08 μg/m^3 respectively, the religious institute area shows concentrations of 68.71, 110.22, and 132.15 μg/m^3 respectively, the educational institute area displays concentrations of 61.65, 100.60, and 126.99 μg/m^3 respectively, and the administrative office area demonstrates concentrations of 56.13, 92.43, and 116.70 μg/m^3 respectively.

Poster research topic(s)

Air quality

As.Oc-74

The dual impacts of heavy metals found in natural rubber latex

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Abstract

The presence of heavy metals in plant parts due to environmental uptake can have adverse effects on the plant's health and integrity. In this study, we analyzed various heavy metals in natural rubber (NR) latex collected from Mantin, Negeri Sembilan, Malaysia (suburban area), and Batu Embun, Pahang, Malaysia (rural area) over a 12-month period. We used acid digestion as a sample pre-treatment and employed inductively coupled plasma-optical emission spectrometry (ICP-OES) to detect and quantify heavy metals, including Cr, Cu, Fe, Mn, Pb, and Zn. Subsequently, we conducted plasticity tests and created polystyrene/natural rubber (PS/NR) blends to study the impact of heavy metals on NR's integrity. The plasticity retention index (PRI) showed an inverse relationship with the concentration of heavy metals in NR. Interestingly, high levels of heavy metals in latex acted as a beneficial compatibilizer in PS/NR blends, resulting in enhanced tensile strength and impact energy. The blends with the highest deposited heavy metals (4391.2 ppm) demonstrated the greatest tensile strength (27.4 MPa) and impact energy (17.55 kJ/m2). Conversely, the blends with the least accumulated heavy metals (18.8 ppm) exhibited the lowest tensile strength (2.61 MPa) and impact energy (2.70 kJ/m2). Moreover, high levels of heavy metals in the blends contributed to a more uniform phase distribution of PS/NR. Our findings indirectly illustrate the role of NR in reducing heavy metal levels in the environment, thereby making it an effective compatibilizer in PS/NR blending.

Poster research topic(s)

Air quality, Laboratory study

As.Oc-75

Long term changes (2007 – 2022) in surface ozone at a high-altitude site in the central Himalayas

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Abstract

Rapid economic growth in South Asia has resulted in widespread urbanization and industrialization. However, systematic long-term observations of trace gases, particularly ozone, are severally lacking in the region, especially in the Himalayan region. In view of this, surface ozone observations initiated at a high-altitude site (Nainital, 29.40 N, 79.50 E, 1948 m amsl) in the central Himalayas in October 2006. This study presents the long-term trends (2007-2022) in surface ozone and explores the factors influencing its diurnal and seasonal variabilities and assess the long-term changes. Insignificant daytime photochemical buildup in ozone, except during biomass burning periods in spring, suggests that this site is a regionally representatively site for the northern South Asia. Ozone levels at this site are found to be predominantly affected by transported air masses, mountain-valley breezes, and stratospheric intrusions. The back air-trajectories assisted analysis of air-masses residence time and ozone shows highest background ozone levels during spring while lowest during summer-monsoon. The long-term trend is found not to be very prominent, but it showed a very slight negative (about 0.5 ppbv/yr) trend for 2007-2015 period, while a positive trend (about 1.2 ppbv/yr) for 2016-2022 period. Trend of different percentiles reflected its irregular distribution around the mean/median trend and influence of biomass burning could not be ascertain in long-term changes. Long term trend in the MERRA2.0, ERA5, CAMS reanalysis ozone data and AIRS ozone are also made and these results will be presented during the conference.

Poster research topic(s)

Trace gases, Air quality

As.Oc-76

AEROSOL OPTICAL PROPERTIES AND ITS IMPLICATIONS TO ATMOSPHERIC HEATING RATE BY REMOTE SENSING AND STATISTICAL TECHNIQUES.

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Abstract

To highlight an in depth understanding, the present study aims to investigate and evaluate the aerosol optical properties by examining long-term datasets focusing over the urban sites of central Asia by using remote sensing and statistical techniques.

Using ground-based measurements (AERONET), and Model derived (MERRA-2), data set a significant variation in the optical properties were observed at the study region. Aerosols' long term trend variation and their impact on radiative forcing was also introduced in this work. The aerosol optical properties namely, aerosol optical thickness (AOT440), Angstrom Exponent (ANG440-870), single scattering albedo (SSA), asymmetry parameter (ASP), volume size distribution (VSD), and complex aerosol refractive index (RI) were investigated using the daily averaged values of each parameter.

Furthermore, the research employed Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) model to estimate the annual mean direct aerosol radiative forcing for the selected study domain. Large heterogeneity (as observed in aerosol properties (AOT, ASY, and SSA)) is investigated to be useful for separating the scattering (coarse) and absorbing (fine urban industrial) aerosol types as due to the particle size distribution, whereas the largest deseasonalized trend was noticed affiliated with the changes in circulation dynamics, atmospheric convergence and decrease in aerosol transport from the continental regions. Further, a detailed knowledge on the dominant absorption aerosol types was investigated to unravel the mechanisms of aerosol radiative forcing and improve the accuracy of satellite remote sensing.

Poster research topic(s)

Aerosols, Remote sensing

As.Oc-77

Assessing Uncertainties in Stubble-Based Fire Detection and Estimation

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Abstract

India is the world's second-largest agriculture-based economy with year-round crop cultivation, producing a substantial volume of agricultural waste, encompassing crop residues. The continuous degradation of air quality in the Indian region has often been attributed to the intensification of the conventional practices of biomass (crop stubble) burning, especially in the north-western region of India. Detection of stubble fire-based emissions has always been a challenge since satellite observations have significant uncertainties. Therefore, accurate quantification of biomass burning is vital for air quality forecasts and management strategies. In this study, we used Sentinel-2 Multispectral Instrument (MSI) datasets, which offer high-resolution imagery and spectral data. These datasets allowed us to precisely identify the agricultural fields affected by stubble burning during the autumnal pre-burning period (September-October 2022) and the burning period (October-November 2022) in the regions of Punjab and Haryana. These satellite observations are accompanied with ground-based measurements to validate their estimates. The estimated paddy crop area of 45746.37 km^2 derived from Sentinel-2 data closely matches the ground-based observations of 46731 km^2. However, due to the limited frequency of VIIRS overpasses over the study region, it fails capture the peak burning events of individual agricultural fires, which are typically small and short-lived. Furthermore, the coarser spatial resolution of 375m with VIIRS results in underestimation of approximately 73% of the burnt area, covering only about 6300 km^2, as opposed to the ~23000 km^2burned area detected by Sentinel-2. Uncertainties also result from missed fire detections during satellite transit, cloud cover, and the non-detection of partial burns in small areas. In this study, our aim is to quantitatively assess biomass burning and provide valuable insights for reducing the uncertainties in biomass burning emission datasets.

Poster research topic(s)

Field study, Satellite study, Remote sensing, Air quality, Aerosols

As.Oc-78

Exploring the Dynamic Relationship Between Clouds and Aerosols in the Indo-Gangetic Basin

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Abstract

The Indo-Gangetic Basin is a region of paramount importance in understanding the complexities of atmospheric interactions, climate dynamics, and air quality. Aerosols and clouds are key components of the atmospheric system, with the potential to significantly influence regional climate and hydrological patterns. This study delves into the intricate relationship between clouds and aerosols in this dynamic region. Over a span of 2022-23, data from the MODerate Resolution Imaging Spectro-radiometer (MODIS) were meticulously analyzed to unravel the climatology, trends, and correlations between aerosol and cloud parameters. The findings reveal a compelling narrative of spatial and temporal heterogeneity, with particular prominence along the coastal areas of the Indo-Gangetic Basin. Climatological analysis exposes patterns of aerosol loading, with elevated Aerosol Optical Depth (AOD) exceeding 0.5 in the outflow region near the Indian subcontinent, while the northern equatorial open ocean experiences lower AOD levels below 0.2. Cloud properties exhibit a distinct dichotomy, characterized by optically thicker deep convective clouds in the southern Bay of Bengal and thinner, shallow clouds in the northwestern Arabian Sea. Intriguingly, trend analysis underscores shifts in the region's aerosol and cloud dynamics. AOD and cloud effective radius exhibit increasing trends, whereas cloud optical depth, cloud top temperature, and cloud top pressure display a decreasing pattern. Sub-regional assessments highlight varying trends, with coastal regions demonstrating a significant increase in aerosol loading. The spatial correlations between aerosol and cloud properties reveal noteworthy insights. Cloud effective radius and cloud fraction exhibit positive correlations with Aerosol Optical Depth, suggesting complex interplays between aerosols and cloud microphysics. In contrast, cloud optical depth, liquid water path, cloud top temperature, and cloud top pressure display negative correlations with aerosol levels.

Poster research topic(s)

Field study, Air quality, Aerosols, Clouds, Land-Atmosphere interactions, Climate

As.Oc-79

Constraining Urban Emissions Sources of Trace Gases in Asian-Oceania Using Year-round Cargo-Ship Observations

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Abstract

Simultaneous shipborne observations of trace species and aerosols are important to monitor anthropogenic emissions and assess their reduction potential. However, despite being a key to countermeasure global warming and air pollution, such observations are limited in the Asian region, one of the emissions hotspots. In this context, we report the results from continuous year-round (Jan 2022-Mar 2023) cargo-ship (Nichiyu-maru) observations of trace gases (CO, CO_2, CH_4, NO, NO_2, NOy, O_3 and SO_2) and aerosols (size segregated PM, BC, EC, OC) measured simultaneously along the Japanese East coast, a hub to the major industrial areas. This enables us to characterize the in-situ distribution of these trace species under a single calibration standard scale. The results show significant spatial and temporal variations of these species across the Japanese East Coast with a spring maximum. Using high-resolution emissions inventory, observed characteristic ratios and the Lagrangian transport model, we constrain their sources focusing on the major urban bays - Tokyo, Nagoya, Kobe and Hiroshima. Additionally, the background levels of CO, CO_2 and CH_4 are delineated from their excess values and it is shown that the CO_2 excess levels were high but remained lower than 35 ppm for all four regions. Further, we estimate monthly CO emissions using top-down approach and show that they better capture monthly CO variations compared to REAS and CEDS emissions inventories. Current work serves as a baseline to further utilise these systemic observations for validating GOSAT data and developing top-down emissions for Japan.

Poster research topic(s)

Field study, Modelling study, Satellite study, Air quality, Greenhouse gases, Trace gases, Aerosols

As.Oc-80, Americas-48

Changes in TOA Net Flux over South Asia and Pakistan with Changing Cloud Radiative Effect (CRE) and Aerosols

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Abstract

Clouds exhibit a key role in the earth's climate system by influencing atmospheric radiative heating, surface energy balance, general circulation and resulting precipitation. The main control on incoming top-of-atmosphere (TOA) solar radiation aside from the sun-Earth geometry is the planetary albedo, which can change as clouds or aerosols change. At the same time, clouds help control outgoing longwave radiation (OLR) and absorbed solar radiation (ASR).

The Clouds and the Earth's Radiant Energy System (CERES) satellite data for Cloud properties and Net Flux with a spatial resolution of 1˚x 1˚ has been used for analysing the changes in the atmospheric energy balance over Pakistan and South Asia. The parameters have been studied at the seasonal scales to better understand the relationship of clouds and radiation patterns with climatic trends.

Results depict a decreasing trend in TOA Net Flux over South Asia (-0.15 w/m2/year) and Pakistan (-0.12 w/m2/year) implying either a decrease in absorbed shortwave radiation or an increase in outgoing longwave radiation in cooling at the TOA (20 km). Cooling is observed in the winter season whereas warming is seen in other seasons in Pakistan. Furthermore, only winter season has a decreasing trend in Net Flux while all other seasons depict an increase in Net Flux, implying an increase in absorbed radiation and decline in outgoing radiation.

Shortwave CRE is observed to have decreased (-0.14 w/m2/year) whereas as longwave CRE has increased (+0.13 w/m2/year) over the area during 2001-2018, both being most pronounced in the pre-monsoon seasons. These findings point towards an increase in warming properties of clouds and decrease in the cooling effect. The radiation and cloud properties would be further correlated with the increasing aerosols in the region, specifically during pre-monsoon and post-monsoon events of haze and smog.

Poster research topic(s)
Satellite study, Remote sensing, Climate, Air quality, Clouds, Aerosols

Africa / Europe / Middle East

A.E.ME-2, Americas-1

Emission of volatile organic compounds from residential biomass burning and their rapid chemical transformations.

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Abstract

Biomass combustion releases a complex array of Volatile Organic Compounds (VOCs) that pose significant challenges to air quality and human health. Although biomass burning has been extensively studied at ecosystem levels, understanding the atmospheric transformation and impact on air quality of emissions in urban environments remains challenging due to complex sources and burning materials. In this study, we investigate the VOC emission rates and atmospheric chemical processing of predominantly wood burning emissions in a small urban centre in Greece. Ioannina is situated in a valley within the Dinaric Alps and experiences intense atmospheric pollution accumulation during winter due to its topography and high wood burning activity. During pollution event days, the ambient mixing ratios of key VOC species were found to be similar to those reported for major urban centres worldwide. Positive matrix factorisation (PMF) analysis revealed that biomass burning was the dominant emission source (>50%), representing two thirds of OH reactivity, which indicates a highly reactive atmospheric mixture. Calculated OH reactivity ranges from 5 s-1 to an unprecedented 278 s-1, and averages at 93 ± 66 s-1 at 9 PM, indicating the presence of exceptionally reactive VOCs. The highly pronounced photochemical formation of organic acids coincided with the formation of ozone, highlighting the significance of secondary formation of pollutants in poorly ventilated urban areas. Our findings underscore the pressing need to transition from wood burning to environmentally friendly sources of energy in poorly ventilated urban areas, in order to improve air quality and safeguard public health.

Poster research topic(s)

Field study, Air quality, Trace gases

A.E.ME-3

Particulate and gaseous pollution in a West African city : case study of Ouagadougou

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Abstract

Nowadays, ambient air pollution is a serious public health issue. Thus, Western African cities are not excluded from this phenomenon. These cities are characterized by rapid and uncontrolled growth with limited means to support this growth, thus contributing significantly to sanitary risks. Indeed, this demographic growth generates a strong need for transportation, which leads to an increase in road traffic emissions and air pollution due to the great rate of poorly maintained engines, unpaved roads, important number of imported second-hand vehicles that do not respect emission standards and poor fuel quality. This study assesses particulate and carbon monoxide air pollution levels in the streets of a West African city (Ouagadougou, Burkina Faso). A total of 16 classified measurement sites were selected in the city of Ouagadougou with a uniform spatial distribution. Of these sites, four were traffic proximity sites. For all traffic sites, the average measured concentration of carbon monoxide for an hour was 579 ± 153 µg/m^3 and the average concentration for eight hours was 439 ± 87 µg/m^3. For the other sites, the average value was 434 ± 191 µg/m^3 and 394 ± 113 µg/m^{3}respectively for an hour concentrations and for eight hours' average concentrations. For PM's except two sites the average $PM_{2.5}$ concentrations measured ranged from 18 to 32 µg/m^3 and PM_{10} ranged from 147 to 268 µg/m^3.

Poster research topic(s)

Field study, Air quality

A.E.ME-6

Air quality monitoring systems based on Internet of Things (IOT)

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Abstract

Nowadays, air pollution is the most important environmental problem in the world and a major health and environmental danger, affecting our daily activities and quality of life. The development of industrial activities is one of the main reasons for the urgency of air monitoring. That allows for careful analysis, supervision, and control of the operations of a system or process in real-time. In order to mitigate the challenges of air pollution, a large number of technologies related to the Internet of Things (IoT) have been developed to assess and monitor the various parameters of air quality, To examine the latter, it has been proposed to use a temperature and humidity sensor, a carbon monoxide (CO), carbon dioxide (CO2), nitrogen dioxide (NO2) sensor, and an air pressure sensor. To obtain information on the meteorological parameters of a specific area. These sensors are associated with the programming board. A Wi-Fi module is also associated with this card and allows it to send information to the data cloud to process the information collected by the different sensors. The air quality and measurements taken by the designed system were accurate and the measurements were taken in parts per million (PPM). Our study is based on monitoring the weather from an automatic wireless weather station for the evaluation of air quality performance based on using an intelligent system with the use of sensors.

Poster research topic(s)

Air quality, Field study

A.E.ME-7

Reduction in Crop Yield in Mexico Due to Ozone Associated with Emissions from Biomass Burning

PhD Blanca Estela Rios[1], PhD Francisco Estrada-Porrúa[2,3]

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Abstract

In Mexico, tropospheric ozone has converted into an air pollution problem that has triggered decreases in the harvest and quality of crops and a negative impact on vegetation. In this research, we evaluate the effects of the tropospheric ozone on the production of maize and wheat and the resulting economic losses from May to August of 2019 to the national level from a scenario of the ozone produced by total emissions and those formed by the emissions of biomass burning scenario, using the WRF-Chem model. The ozone fields obtained from the WRF-Chem are transformed to accumulated ozone above a threshold of 40 ppb (AOT40) for the crop-growing season, and crop yield losses are estimated using maize and wheat-specific ozone concentration–response functions. The results of this study show that relative yield losses ranged from 0.1 to 2.4% for maize, which is equivalent to 545 thousand metric tons, and 0.5 and 40% for wheat corresponding to 1100 metric tons, with the losses focused in central and northern Mexico. The national maize production losses are valued at 120 million USD for maize and 230 thousand USD for wheat. The ozone produced by biomass burning damages only 1% of the national total of maize; however, it reaches up to 8% in Chiapas. The damage caused by ozone to wheat production was not significant. This study highlights the need to increase monitoring networks in Mexico to make strategic ozone observations, especially in rural areas, to adopt effective ozone precursor mitigation measures.

Poster research topic(s)

Modelling study, Air quality, Trace gases

A.E.ME-8

Study of biogenic volatile organic compound emissions and depositions over a mixed temperate forest by PTR-TOF-MS and eddy covariance

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Abstract

Volatile organic compounds (VOCs) play a key role in atmospheric chemistry, with approximately 90% of global emissions attributed to biogenic sources (BVOCs). Forests, being primary BVOC emitters, merit special attention. Traditionally, technical limitations restricted flux measurements to a limited set of dominant BVOC species, hindering the simultaneous detection of a wide range of BVOCs with adequate sensitivity.

To address this gap, BVOC fluxes were measured in spring-summer 2022 over a mixed temperate forest in the Belgian Ardennes using a PTR-TOF-MS instrument (PTR-TOF-4000, Ionicon Analytik GmbH). O_3 fluxes were concurrently acquired using fast and slow ozone analysers in order to complete the BVOC flux dataset. BVOC+O_3 concentration profiles were frequently recorded at seven levels along the flux tower, ranging from ground level up to 51 meters.

(Un)calibrated BVOC mixing ratios were derived from results of the Ionicon Data Analyzer software (IDA, Ionicon Analytik GmbH), and fluxes were computed by eddy covariance. The IDA software detected approximately 570 m/z peaks. Based on the flux limits of detection, a novel methodology was developed for detecting compounds with significant exchange. In total, 33 ions exhibited significant emissions or depositions, sometimes even for brief periods.

On average, all species were emitted during the measurement period, except for formaldehyde and the ion characterized by m/z = 49.027. The BVOC budget was dominated by monoterpenes, isoprene and methanol, accounting for 51%, 28% and 7% of the net flux respectively. Notably, BVOC emissions displayed a clear dependence on air temperature, along with instances of methanol and ethanol deposition linked to adsorption/desorption in water films.

Future analysis will delve deeper into BVOC flux dynamics and their correlation with O_3 fluxes, meteorological and phenological variables. Flux and profile data will also be used to infer sources and sinks location within the ecosystem through inverse modelling.

Poster research topic(s)

Ecosystems, Trace gases, Land-Atmosphere interactions, Field study

A.E.ME-9

Fire-driven ozone damage to the Amazon decreases plant productivity

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Abstract

Fires emit the ozone precursor NOx, which is often the limiting precursor controlling ozone production in remote locations such as tropical forests. In fact, interannual variability in tropical fire activity is highly correlated with variability in surface ozone concentration, demonstrating that fire drives annual and seasonal ozone trends over the Amazon.

One of the negative effects of surface ozone is reduced plant productivity. We use JULES, a land surface model, to evaluate the effect of ozone from fires on net primary productivity (NPP) in the Amazon, and find that the annual NPP loss from ozone-plant damage is 35-45 % the magnitude of the direct carbon emissions from fires. i.e. neglecting ozone damage from fires may underestimate the impact of fires on carbon fluxes. Furthermore, examining the interannual variability in ozone-plant damage and fire activity since 1995 reveals that, on average, ozone-plant damage was largest during extreme events (e.g. El Nino-driven droughts). However, this varies spatially, with areas strongly affected by drought showing a decrease in ozone-plant damage due to reduced stomatal conductance. As climate change may increase the frequency of drought events in the tropics, this study informs of current and future risks of ozone-plant damage in the tropics.

Poster research topic(s)

Modelling study, Air quality, Land-Atmosphere interactions, Trace gases

A.E.ME-10, Americas-9

Source characterization of reactive carbon in a mixed forest ecosystem (Vielsalm, BE)

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Abstract

Volatile organic compounds (VOCs) are key in atmospheric chemistry and exert an impact on air quality and the disruption of the climate. The terrestrial biosphere is the largest global source of organic carbon in the atmosphere. During periods of seasonal change or when the ecosystem is under stress (biotic or abiotic), VOC exchanges between ecosystems and the atmosphere are less well understood. Due to the paucity of long-term datasets in a variety of natural environments, full characterizations VOCs, and specifically oxygenated VOCs (OVOCs), under non-nominal conditions are limited.

In order to address this, a long-term measurement campaign was set up in the Belgian Ardennes (Vielsalm, BE; 50.3050°N, 5.9981°E). The site selected for this study is a mixed forest ecosystem, host to a 51 m high flux tower which is part of the ecosystem component within the Integrated Carbon Observations System (ICOS). Reactive trace gas analyzers have been integrated at the station from April 2022 to measure (O)VOC and ozone concentrations above and along the forest. Ambient air was sampled sequentially from different inlets located at the top and along the flux tower through 60 m long heated and thermally insulated perfluoroalkoxy Teflon tubes. (O)VOC concentration measurements were carried out with a time-of-flight based proton-transfer-reaction mass-spectrometry instrument (PTR-TOF 4000; Ionicon Analytik GmbH, Austria).

In the current study, we aim to present an overview of data obtained at the measurement site since the start of the campaign. Additionally, a characterization of sources contributing to the local VOC abundance using a positive matrix factorization approach will be presented. This analysis preludes future work in characterizing the impact of different eco-system components and atmospheric chemistry processes on above-canopy fluxes.

Poster research topic(s)

Field study, Trace gases

A.E.ME-12

Monitoring Exposure to Air Pollution (Haze) from Fires in Indonesia using low-cost $PM_{2.5}$ sensors

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Abstract

Indonesia's Central Kalimantan province on the island of Borneo is home to extensive peatlands and tropical forests. The regions forests store vast amounts of carbon, locked away in their trees and particularly peat, with the Kalimantan peat carbon store estimated to be in the range of 6.6 to 12.6 Gt. Moreover, peatlands deliver numerous important ecosystem services to local people, including maintaining air and water quality, providing timber and non-timber forest resources, and supporting fish populations for local consumption. Despite these benefits, Central Kalimantan's peatlands and tropical forests remain vulnerable to various anthropogenic disturbances. In particular, in dry (El Niño) years, such as 2015, peat fires may burn for prolonged periods with significant impacts, including on carbon emissions, biodiversity, public health and the Indonesian economy. In their intact natural waterlogged and forested state, tropical peatlands rarely burn and therefore fires are concentrated in the extensive areas that have dried to some degree due to deforestation and/or drainage for agriculture and timber extraction. Here, fires can burn down into the underlying peat, where they can smoulder for prolonged periods and are the primary cause of air pollution events affecting SE Asia.

Despite the large impact of fires on air quality, there are few ground-based measurements in Central Kalimantan. To address this, earlier this summer we deployed a network of low-cost $PM_{2.5}$ sensors around the region, which are reporting near real-time $PM_{2.5}$ concentrations from peatland fires that are currently burning, for the first time (since this is an El Niño year). Sensors were deployed in several villages, a remote location and the capital city Palangkaraya where they are monitoring indoor and outdoor $PM_{2.5}$ concentrations for different socioeconomic groups. Here, I will show some initial results from the monitoring and present plans for the future.

Poster research topic(s)

Air quality, Field study, Modelling study, Health

A.E.ME-13

Temperature-dependent emissions dominate ozone and aerosol formation in Los Angeles

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Abstract

Despite declines in transportation emissions, air pollution in urban North America and Europe remains at unhealthy levels. This has challenged conventional understanding of the sources of their volatile organic compound (VOC) precursors. Using airborne flux measurements to map emissions of an unprecedented range of VOCs, we demonstrate that biogenic terpenoid emissions account for ~60% of ozone and secondary organic aerosol formation potential in summertime Los Angeles, and that this contribution strongly increases with temperature. We also show that some important anthropogenic VOC emissions increase with temperature, an effect which is not represented in current inventories. Efforts to mitigate urban air pollution need to take into account that climate warming will strongly change emission amounts and composition.

Poster research topic(s)

Field study, Air quality, Land-Atmosphere interactions, Trace gases

A.E.ME-14

Weekly-derived biogenic VOC fluxes over Europe constrained by TROPOMI HCHO data in 2018-2022

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Abstract

Biogenic emissions of volatile organic compounds (BVOCs) have a profound impact on air quality due to their important role as precursors of ozone and secondary organic aerosols. Many non-methane VOCs (NMVOCs) are emitted by vegetation and fire events, from which a large fraction oxidizes to formaldehyde (HCHO). Here, we employ the high spatiotemporal resolution HCHO product from the Sentinel-5p TROPOMI mission in order to improve biogenic emission estimates over Europe using inverse modelling.

The inversion strategy relies on the MAGRITTEv1.1 chemical transport model, which includes a detailed chemical representation of isoprene oxidation. The inversion scheme minimizes the overall difference between observed and modeled HCHO columns by varying the VOC fluxes from different emission categories, namely anthropogenic, biogenic, and biomass burning emissions. The a priori NMVOC emissions are provided by MEGAN-MOHYCAN for biogenic compounds, QFED for fire emissions, and CAMS-GLOB-ANT for anthropogenic emissions. The TROPOMI HCHO columns are corrected for systematic biases on the basis of comparisons with FTIR measurements at European sites.

The high TROPOMI data quality allows the use of weekly-averaged data as top-down constraints for the first time, instead of monthly averages used in previous studies. This constitutes a great improvement in the top-down emission estimation, given the strong meteorology-induced variability of isoprene emissions. The satellite data suggest a large increase in biogenic emissions in Europe; the optimized isoprene emissions are approximately doubled with respect to their a priori values. This result stems from the high (bias-corrected) HCHO columns that are observed by TROPOMI. This work is performed in the context of the European Commission H2020 SEEDS (Sentinel EO-based Emission and Deposition Service) project.

Poster research topic(s)

Modelling study, Satellite study, Remote sensing, Air quality, Trace gases

A.E.ME-15

An Idealised Model for Fast Prototyping of Hydrogen Deposition Schemes

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Abstract

I decompose the variability of atmospheric hydrogen mole fractions into timescales across a set of surface stations (NOAA GML CCGG, 2009-2021). From these measurements, I show that the amplitude and phase of the seasonal cycle of these fractions can be well described as a function of latitude. The amplitude of the seasonal cycle increases with northward latitude, and the day in the year of peak hydrogen mixing ratio shows a partition between hemispheres. This is understood as molecular hydrogen leaving the atmosphere mainly by deposition into land surfaces, with another smaller sink due to the reaction with the hydroxyl radical. While an accurate surface deposition scheme for hydrogen remains elusive in the literature, there have been several prototype schemes proposed in recent years (Paulot et al., 2021).

I have developed an idealised two-layer latitude-height model of the troposphere that I use as a dynamical toolbox to understand the response of the seasonal hydrogen cycle to the surface deposition scheme. By running a series of numerical experiments that couple meridional transport and a series of idealised hydrogen deposition schemes, I show how atmospheric hydrogen may respond to surface conditions. The preliminary results that I provide show how key features of the seasonal variability of atmospheric hydrogen emerge from highly idealised deposition schemes. I present this model as a tool to aid the development of prototype deposition schemes using low computational cost numerical integrations to scan parameter space.

Poster research topic(s)

Modelling study, Land-Atmosphere interactions, Trace gases

A.E.ME-16

The Climate, Air Quality and Health co-benefits and trade-offs from different future mitigation scenarios involving Near-Term Climate Forcers in UKESM1

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Abstract

Near-term climate forcers (NTCF) include components such as tropospheric O_3 and aerosols or fine particulate matter (with a diameter less than 2.5 microns – $PM_{2.5}$). They can both exert effects on the climate, via interactions with the radiation balance, and in elevated concentrations at the lowest most levels of the atmosphere can lead to poor air quality and detrimental impacts on human health. Future mitigation scenarios that include changes to NTCFs can therefore impact on both air quality and climate. Here we use results from UKESM1 (an Earth system model with interactive chemistry and aerosols) in different future sensitivity scenarios that consider air pollutant emission mitigation, future climate change and land-use change, conducted as part of the Aerosol and Chemistry Model Intercomparison Project (AerChemMIP). We assess the impact on air pollutants (in terms of change in ambient surface concentrations) and human health (in terms of long-term adult mortality from exposure to ambient air pollutants) by comparing the results from these sensitivity scenarios to the future reference scenario ssp370, a scenario that involves low mitigation of climate and air pollutants. Strong mitigation of aerosols and O_3 precursors, including large reductions in global CH_4 concentrations, produce the largest benefits to air quality (10-25% reduction in O_3 and $PM_{2.5}$ concentrations) and human health (>25% reduction in the rate of long-term premature mortality). Benefits to health are largest across Asia for these scenarios (a 44% reduction in the mortality rate). However, if anthropogenic emissions increase in line with the reference pathway (ssp370) then the future air pollutant health burden worsens over south Asia and Africa. If future climate change is not reduced then there are increases in the future air pollution health burden over Europe for $PM_{2.5}$ and East Asia for O_3, which can be large enough to offset any benefits from emission mitigation.

Poster research topic(s)

Modelling study, Air quality, Climate, Health

A.E.ME-17

Oxidation of Phosmet Insecticide Initiated by HO• Radical in Air and Water Environments: Mechanistic, Kinetic, and Ecotoxicity Studies

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Abstract

Phosmet is an organophosphorus insecticide widely used in agriculture to control a range of insects; recently, it was banned by the European Union in 2022 due to its harmful effects. However, its environmental degradation and fate have not yet been evident. Thus, the phosmet oxidation by HO• radical was theoretically studied in this work using the DFT approach at the M06-2X/6-311++G(3df,3pd)//M06-2X/6-31+G(d,p) level of theory. Three different mechanisms were considered, including formal hydrogen transfer (FHT), radical adduct formation (RAF), and single electron transfer (SET). The mechanisms, kinetics, and lifetime were studied in the gas and aqueous phases, in addition to its ecotoxicity evaluation. The results show that FHT reactions were dominant in the gas phase, while the RAF was more favourable in the aqueous phase at 298 K, while the SET was negligible. The branching ratio indicated that H-abstractions at the methyl and the methylene groups were the most predominant, while the most favourable HO•-addition was observed at the phosphorous atom of the dithiophosphate group. The overall rate constant values varied from 1.2 × 109 (at 283 K) to 1.40 × 109 M-1 s-1 (at 323 K) in the aqueous phase, and from 6.29 × 1010 (at 253 K) to 1.32 × 1010 M-1 s-1 (at 323 K) in the gas phase. The atmospheric lifetime of phosmet is about 6 hours at 287 K, while it can persist from a few seconds to several years depending on the temperature and [HO•] concentration in the aqueous environment. The QSAR-based ecotoxicity evaluation indicates that phosmet and its degradation products are all dangerous to aquatic organisms, although the products are less toxic than the phosmet. However, they are generally developmental toxicants and mutagenicity-negative compounds.

Poster research topic(s)

Ecosystems, Land-Atmosphere interactions, Aerosols, Modelling study

A.E.ME-18

Why current exposure estimates are biased low - the impact of population activity and outdoor-to-indoor infiltration on regional scale exposure to air pollution.

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Abstract

The estimation of human exposure to air pollution underlies well-known methodological challenges. Two of the major challenges are (1) the application of population activity and (2) the consideration of outdoor pollutant concentrations infiltrating indoor environments. These two aspects are frequently ignored in current exposure assessments at regional scales and introduce BIAS, which leads to non-representative exposure estimates.

Consequently, in this study we developed a method for regional exposure estimates by taking into account population activity, as well as infiltration of air pollutants to indoor environments. Therefore, we applied the time-microenvironment-activity concept in combination with different datasets for spatial and temporal distribution of the European population. The applied datasets are mainly JRC ENACT datasets for day and night time populations for the whole of Europe, Copernicus Monitoring Service land use information, the GHSL data package 2022 and Eurostat population statistics. The result is a framework that allows for the whole of Europe to create grids of population activity in different microenvironments with a spatial resolution of 1x1 km2 and a temporal resolution of 1 hour. Additionally, each microenvironment is assigned to seasonal dependent literature based outdoor to indoor infilatration factors. The resulting dynamic population grids can be applied to mapped air pollutant concentrations derived with any air quality model, for any European domain or period.

Finally, we applied (1) the developed dynamic exposure model and (2) a static residential addresses dataset to air pollutant concentrations to regions in Europe and compared the resulting exposure estimates. The results show differences in population exposure to PM2.5, NO2 and O3. In general, the results indicate that the exposure derived with established approaches is lower compared to the developed approach, which means that the adverse health effects might currently be underestimated for the European population.

Poster research topic(s)

Modelling study, Air quality, Health

A.E.ME-19

Improving our understanding of sulfur chemistry above the ocean: the development and evaluation of a dimethyl sulfide oxidation mechanism

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Abstract

Dimethyl sulfide (DMS), originating from phytoplankton, is the largest natural source of sulfur in the atmosphere. Some oxidation products of DMS have been found to contribute to cloud condensation nuclei; understanding the oxidation mechanism of DMS can help constrain its contribution to the Earth's radiative balance.

The discovery of a new pathway of the DMS oxidation mechanism, forming hydroperoxymethyl thioformate, has led to chamber studies that further explore the OH-initiated oxidation of DMS, and the development of near-explicit DMS mechanisms. These mechanisms had yet to be evaluated through intercomparison studies.

In this recently submitted work (Jacob et al., 2023), we conducted a thorough literature review to develop a gas-phase DMS oxidation mechanism based on the MCM v3.3.1, with 62 reactions added and 21 reactions adjusted. We evaluated this mechanism against other recently developed mechanisms by using them to simulate chamber studies. Our mechanism outperformed the other mechanisms, having the lowest average fractional gross error for 8 of the 14 measured DMS products. A box model of a marine boundary layer was run to assess how the mechanisms compare in more realistic conditions. We found that the deviations between the mechanisms were still prominent, indicating that the differences in the mechanisms are of atmospheric importance.

Our work demonstrates the importance of the recent developments in the oxidation of DMS. It provides a new near-explicit mechanism, which has been evaluated against different mechanisms through chamber studies. This mechanism can be used as a basis to compare the performance of reduced mechanisms used in global atmospheric models.

Jacob, L., Giorio, C., and Archibald, A. T.: Extension, Development and Evaluation of the representation of the OH-initiated DMS oxidation mechanism in the MCM v3.3.1 framework, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2023-2223, 2023.

Poster research topic(s)

Laboratory study, Modelling study, Climate

A.E.ME-20

Saharan dust transport towards tropical Atlantic Ocean and South America: a 3-dimensional analysis based on Livas aerosol climatology

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Abstract

Understanding the spatial distribution of aerosol particles is essential to evaluating their influence on the climate system. The main objective of this research was to study the Saharan dust plume structure over Mindelo City, in Cabo Verde, and during its transport towards remote areas of the tropical Atlantic Ocean and Americas using the recently developed LIdar climatology of Vertical Aerosol Structure for space-based lidar simulation studies (LIVAS), a 3-D multi-wavelength global aerosol optical database based on CALIPSO satellite products. A preliminary comparison of daily and monthly scales of the backscatter and extinction coefficient profiles between LIVAS and PollyXT, a ground-based lidar system operated at Mindelo City, indicated a good agreement. The application of LIVAS columnar and vertical optical properties products to characterize the seasonal variability of Saharan dust transport over Mindelo shows that most of the dust transported occurs from June to September and has a maximum of 2 to 5 km. During the dry season, from December to January, aerosol loading in the free troposphere is dramatically reduced, and most of the dust is transported within the (MBL,) in a layer up to ~2.5 km. Dust mean contribution to the backscatter profile during summer varied from ~90% in the free troposphere to less than 25% in the MBL and during the dry season, the contribution in the free troposphere is reduced to less than 50%. The magnitudes of dust transport, as identified by the extinction coefficient profile are highest in boreal summer and spring and lowest in autumn. The northward shifts of the dust plume are further during the summer, reaching the latitude of 25oN. And it leads to the transport of dust toward Central America and the Caribbean. Winter is the season that the lowest amount of dust arrives in the remote western tropical Atlantic and South America.

Poster research topic(s)

Aerosols

A.E.ME-21

Linking sources of organic aerosol at a major Mediterranean city to health: long-term observations and oxidative potential

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Abstract

In accordance with the World Health Organization, air pollution is responsible for the premature death of 7 million people per year. Particulate Matter (PM) constitutes one of the critical indicators for estimating the health impacts of air pollution; while Organic Aerosol (OA) comprises a significant fraction of fine particles in the atmosphere. Monitoring of OA levels in near real time and successfully identifying their sources, is a key component for the development of further emission reduction strategies. Furthermore, recent studies have indicated that the measurement of aerosol oxidative potential (OP) is an even more crucial metric and an important representative proxy of health impacts - compared to the PM mass concentration - as it estimates the ability of PM to generate Reactive Oxygen Species (ROS) in human cells.

In the current study, one year measurements were used from long term observations of non-refractory submicron aerosol chemical composition, which are performed using an Aerosol Chemical Speciation Monitor (ACSM), along with source apportionment of recorded OA. The study is taking place in the Eastern Mediterranean urban environment of Athens at the Thissio Monitoring Site located in the center of the city. OA source apportionment was conducted via Positive Matrix Factorization, using the SoFi Pro toolkit, implementing the multilinear engine (ME-2) solver (Canonaco et al., 2013). The OP of fine fractions of ambient aerosol was concurrently studied and quantified through application of the dithiothreitol (DTT) assay, using a semi-automated system. Black carbon (BC) data were recorded in parallel, by a 7-wavelength aethalometer AE-33 for the same period, leading to the additional calculation of spectral absorption coefficients for BCIf, BCsf separately, and their equivalent black carbon concentrations. OP appears to be well correlated to biomass burning sources, mainly during the coldest period of the year, while in summer, secondary atmospheric processes dominate.

Poster research topic(s)

Air quality, Health, Aerosols

A.E.ME-22

Kinetics of the reaction of OH with methyl nitrate (232–343 K)

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Abstract

Rate coefficients (k_4) for the reaction of hydroxyl radicals (OH) with methyl nitrate (CH_3ONO_2) were measured over the temperature range 232-343 K using pulsed laser photolysis to generate OH and pulsed laser-induced fluorescence to detect it in real-time and under pseudo-first-order conditions. In order to optimize the accuracy of the rate-coefficients obtained, the concentration of CH_3ONO_2 (the reactant in excess) was measured on-line by absorption spectroscopy at 213.86 nm for which the absorption cross-section was also measured ($\sigma_{213.86}$ = 1.69 ± 0.07 • 10^{-18} cm^2 $molecule^{-1}$). The temperature-dependent rate coefficient is described by $k_4(T)$ = 7.8 • 10^{-13}exp[(-1036 ± 41)/T] cm^3 $molecule^{-1}$ $s^{-1}$with a room temperature rate coefficient of k_4(298 K) = (2.37 ± 0.15) • 10^{-14} cm^3 $molecule^{-1}$ s^{-1} where the uncertainty includes an assessment of potential systematic bias. This new dataset helps to consolidate the databases for this rate coefficient and to significantly reduce its uncertainty and thus uncertainty in the atmospheric lifetime of CH_3ONO_2.

As part of this study, an approximate rate constant for the reaction of H-atoms with CH_3ONO_2 (k_9) was also derived at room temperature: k_9(298K) = (1.72 ± 0.46) • 10^{-13} cm^3 $molecule^{-1}$ s^{-1}.

Poster research topic(s)

Laboratory study

A.E.ME-23

The role of sulfur oxidation on aerosol and cloud properties and radiative effects in UKESM1 CMIP6 historical experiments

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Abstract

Understanding the link between anthropogenic emissions and radiative forcing remains a challenge in climate research. Linkages arise between emissions, atmospheric chemistry and climate through the formation of secondary aerosols such as sulfate, nitrate and organic aerosols. Sulfur dioxide (SO_2) is an important aerosol precursor with the largest sources coming from anthropogenic activity. The lifetime of SO_2 is short, and a principal sink is the conversion to sulfate via oxidation. Unlike well-mixed greenhouse gases, anthropogenic aerosols are heterogeneously distributed because of localised emissions and the short atmospheric residence time. Thus, SO_2 conversion to aerosol is important to aerosol distribution reflecting both its emission location and the locally available oxidants; both of which are changing rapidly and disparately with time.

This work uses the UKESM1 to investigate the modelled response of sulfate aerosol properties and cloud properties to emissions increases and oxidant changes over the period 1850-2014. From an analysis of the CMIP6 and AerChemMIP experiments, we show that there have been significant changes in the atmospheric oxidation processes of SO_2 over this period with consequences for the calculated radiative forcing.

In UKESM1 historical experiments, the gas-phase reaction with hydroxyl radicals dominates the oxidation pathways. This channel is the most sensitive to oxidant changes and contributes to new aerosol particle formation. We present an analysis of the impacts of these sulfur oxidation changes on aerosol and cloud properties and radiative forcing. Ultimately, this work contributes to the improvement of our process-level understanding of Earth system models that interactively simulate aerosol from precursors and aims to improve the accuracy of aerosol radiative forcing predictions.

Poster research topic(s)

Modelling study, Climate, Multiphase chemistry, Aerosols, Clouds

A.E.ME-24

Enhancing global SO_2 emission inventories using Sentinel-5P TROPOMI satellite data

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Abstract

We provide a global database of SO_2 emissions from point sources generated from TROPOMI observations of SO_2(COBRA product) for the time range 2018-2022. Our algorithm derives the advection of SO_2 by combining TROPOMI SO_2 column densities and ERA5 wind fields, i.e., taking the product of the vertical column density gradient and the horizontally projected wind speed. In addition, several corrections, e.g., for satellite sensitivity and topography, are applied. For each point source error estimates are given, considering the uncertainties of the various retrieval steps.

A fully automated iterative detection algorithm of point sources from around the world forms the basis of our catalog. The catalog includes a list of 130 locations identified as substantial SO_2 sources. Most of these locations are close to power plants included in the Global Power Plant Database (GPPD), volcanoes in the Global Volcanism Program (GVP) Volcano Database, or match entries in previously compiled SO_2 inventories.

The emissions in our catalog are in good agreement (Pearson correlation coefficient (r) of 0.82) with those recorded in existing SO_2 datasets (Fioletov et al., 2023) but are higher by about 36%.

The catalog was created as part of the World Emission (2022) project, funded by ESA, which focuses on quantifying emissions of different species that can be detected by satellite instruments (including SO_2). The complete SO_2 catalog will be publicly available via the World Emission Portal at https://app.world-emission.com.

Poster research topic(s)

Satellite study, Remote sensing, Trace gases

A.E.ME-25

Assessing Transport Sector Impact on Urban Air Quality in Warsaw, Poland

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Abstract

Urban air quality poses a significant challenge due to the dense population and elevated pollutant levels. To devise successful strategies for better air quality, it's crucial to discern the impact of various emission sources within the city in contrast to external influences.

In urban areas of Poland, the primary source of particulate matter emissions is the residential sector, with transportation being a significant contributor to pollution, especially concerning NO2.

The primary aim of the project was to assess the impact of the transport sector on air quality in Warsaw, with a specific focus on NO2 and PM10 concentrations. The project utilized the integrated ATMO-Street model chain, incorporating the GEM-AQ model as the background concentration model coupled with the bi-Gaussian plume dispersion model IFDM and the street-canyon module OSPM.

Initially, model validation was conducted using data from nine measurement stations within the study area. The ATMO-Street model significantly improved results for NO2 concentration at the traffic station, improving the GEM and IFDM models' performance by 62% and 46%, respectively, with the traffic sector contributing to 84% of NO2 concentration.

Conversely, the ATMO-Street model enhanced the model performance for PM10 concentration by 15% compared to the GEM model, which had previously underestimated the traffic station's impact, estimating a 25% traffic contribution to PM10 concentration. To address this, resuspension emissions were introduced in addition to the initial emissions from the transport sector, which were initially missing. Comparing model results with and without resuspension emissions revealed an increase in traffic's contribution to PM10 concentration to 33%, accompanied by enhanced model results at the traffic station.

Poster research topic(s)

Air quality, Modelling study

A.E.ME-26

Air quality index and health dynamics in changing climate of the niger delta region of nigeria

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Abstract

The study was set to assess the effect of air quality index on health dynamics in the Niger Delta Region of Nigeria. The study employs the multi-stage sampling design. Data was analyzed using geospatial and geostatistical techniques with the mean values of the air pollutant concentrations estimated for the measurements. The gasman auto sampler was used to monitor the concentration of Nitrogen dioxide (NO2), Sulphur dioxide (SO2) Carbon monoxide (CO), hydrogen Sulphide (H2S) and Methane (CH4). These gases are known to induce respiratory disease in exposed humans. It was found that the concentration of Sulphur dioxide (SO2) ranged between 0.041 and 0.050 ppm; Methane (CH4) concentration ranged between 0.137 and 0.213 ppm; Nitrogen dioxide (NO2 concentration ranged between 0.19 and 0.52 ppm; Hydrogen Sulphide (H2S) concentration ranged between 0.126 and 0.156 ppm; and Carbon monoxide (CO) concentration ranged between 77.67 and 85.33 ppm. The diseases found to be prevalent in the study area as a result of air pollution are Pulmonary Tuberculosis (5.2%), Cerebrospinal Meningitis (10%), Headache (30%), Whooping cough (10%), Measles (5%), Dizziness (23%), Catarrh (35%), Pneumonia (10%), Shortness of breath (17%), Sore throat (20%), Eye irritation (30%), Cough (25%), Sneezing (33%), and Skin irritation (30%). The average ambient air quality observed in the LGAs (SO2 = 0.046 ppm, CH4 = 0.175, NO2 = 0.36 pp, H2S = 0.146 ppm, CO = 82.5) was worse compared to the World Health Organization Air Quality Permissible Limit (SO2 = 0.01 - 0.1ppm, NO2 = 0.04 - 0.06ppm, CO = 10.0 - 20.0ppm, H2S = 0.06ppm, CH4 = 0.06ppm). This study recommends that drastic measures be put in place so as to reduce the high level of pollution; reforestation should be encouraged to absorb suspended air pollutants; environmental education should be intensified and air monitoring stations installed at strategic locations for continuous monitoring and evaluations.

Poster research topic(s)

Air quality, Climate, Health

A.E.ME-27

1st NASA Pandora Spectrometer of South Asia: Exploring the Profile of Atmospheric Trace Gases in Pakistan

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Abstract

The 1st NASA Pandora Spectrometer of South Asia was recently deployed in Pakistan to investigate the profile of atmospheric trace gases in the country. The spectrometer is a ground-based remote sensing instrument that measures the atmospheric column's optical properties, providing a vertical profile of the trace gases present in the atmosphere. The deployment of the Pandora spectrometer in Pakistan is significant because it is the first such instrument installed in South Asia. The region is known to have high levels of air pollution, which has significant implications for public health and the environment. The spectrometer will allow scientists to study the atmospheric composition and understand the sources and fate of trace gases in the region. The Pandora spectrometer uses a differential optical absorption spectroscopy (DOAS) technique to measure the atmospheric column's optical properties. It can measure a wide range of trace gases, including nitrogen dioxide (NO2), sulfur dioxide (SO2), formaldehyde (HCHO), and ozone (O3). These gases are important because they have both natural and anthropogenic sources, and their presence in the atmosphere can have significant impacts on human health, crop yields, and climate change. It will also provide insights into how these gases are transported and dispersed in the atmosphere, helping to predict their impact on air quality and climate change. In conclusion, the deployment of the 1st NASA Pandora Spectrometer of South Asia in Pakistan is a significant development for atmospheric science in the region. The instrument's ability to measure a wide range of trace gases and provide a vertical profile of the atmosphere's composition will help scientists better understand the sources and fate of these gases in the atmosphere. The data collected by the instrument will be invaluable in developing policies to mitigate the impacts of air pollution on public health and the environment.

Poster research topic(s)

Satellite study, Remote sensing, Climate, Trace gases, Air quality

A.E.ME-28

Field chemical characterization and laboratory heterogeneous reactivity of markers of biogenic secondary organic aerosol (BSOA) formation and fate

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Abstract

Secondary aerosols have been the subject of all attention for several years due to their impacts on both climate change and air quality. In this context, the LANDes EXperiment project (LANDEX) focused on the study of biosphere-atmosphere interactions in the Landes forest ecosystem, established as an open-air laboratory. Indeed, this forest is planted almost exclusively with maritime pines, resulting in specific high monoterpene (mostly α- and β-pinene) and poor isoprene emissions. The aim of the LANDEX project was to study the formation and fate of BSOAs. In-situ photo-oxidation gas-phase processes involving BVOCs were recently reported by Mermet et al. (2021). Such multi-oxidation steps are well-known to lead to the formation of secondary aerosols, that may be subject to different aging processes during their transport.

In this work, the chemical composition of atmospheric particles was investigated using liquid chromatography coupled with time-of-flight mass spectrometry to achieve a molecular speciation of major BSOA markers. Their concentrations were determined in the PM2.5 and PM1 fractions and discussed with the on-line measurements of VOCs, both directly emitted by vegetation and generated through first or second generation oxidation steps.

The complexity of the chemical composition of SOAs, the difficulty to characterize and evaluate their sources and subsequent aging processes, combined with the importance of SOA in terms of impacts, make the need to use reliable atmospheric markers. During air mass transport, markers may undergo (photo-)chemical degradation in either multiphasic but also heterogeneous oxidation which has been poorly documented for BSOA markers. Therefore, gas-surface reactions of 5 particulate-products arising from the oxidation of α- and β-pinene, respectively terebic acid, terpenylic acid, pinonic acid, pinic acid, and 3-methyl-1,2,3-butanetricarboxylic acid (MBTCA) with the main atmospheric oxidants were investigated using a discharge fast flow tube. The first results will be presented in the framework of the Landes forest.

Poster research topic(s)

Field study, Laboratory study, Air quality, Climate, Land-Atmosphere interactions, Multiphase chemistry, Aerosols, Health

A.E.ME-29

Examining the Atmospheric Breakdown of Relevant Methylated Selenium Species Upon Exposure to $HO^{\cdot}$ Using Computational Methods.

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Abstract

Selenium (Se) is found in our diet and originates in the soil where plants grow. Recent findings suggest that rain can also contribute to the selenium deposition in the soil, introducing a new aspect to atmospheric selenium chemistry. This implies that the cycling of selenium in the atmosphere could influence the distribution of selenium in soil, impacting future trends under changing climates.

Computational chemistry tools are being used to explore the fate of selenium-containing species in the atmosphere. The advancement of theoretical kinetics has greatly enhanced our understanding of various atmospheric reactions, allowing precise estimation of associated rate constants. This progress is due to advancements in computational tools and the accuracy of theoretical methods.

Chemical-transport modeling requires thermochemical properties ($\Delta_f H°_{298K}$, $S°_{298K}$, $C_p = f(T)$) and kinetic parameters as input data. Unfortunately, such data are limited for selenium-containing species relevant to the atmosphere. Quantum chemistry methods provide accurate quantitative data within a chemical accuracy range (± 1 kcal mol^{-1}).

Our ongoing research focuses on selenium-containing species involved in the OH-initiated atmospheric degradation of dimethyl selenide (CH_3SeCH_3) and dimethyl diselenide ($CH_3SeSeCH_3$). We conducted a thorough benchmark study using various ab initio, DFT, and composite methods, along with different types of basis sets. The resorting method is M06-2X/aug-cc-pVTZ, known for its kinetic accuracy. We computed molecular properties (such as geometrical parameters and vibrational frequencies) and thermochemical properties, comparing them with existing literature data. The chosen theoretical approaches were then used to elucidate the reaction mechanism of $CH_3SeSeCH_3$, giving new data on an important atmospheric species. We will discuss its implications for atmospheric chemistry.

Poster research topic(s)

Aerosols, Modelling study, Trace gases, Ecosystems, Health

A.E.ME-30

Unraveling the monohydration processes of oxygenated mercury compounds

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Abstract

The structures, vibrational frequencies, and model IR spectra of themonohydrates of oxygenated mercury compounds (BrHgO, BrHgOH, BrHgOOH,BrHgNO2, BrHgONO, and HgOH) have been theoretically studied using theωB97X-D/aug-cc-pVTZ level of theory. The ground state potential energy surface exhibits several stable structures of these monohydrates. The thermodynamic properties of the hydration reactions have been calculated at different levels of theory including DFT and coupled-cluster calculations DK-CCSD(T) with the ANO-RCC-Large basis sets. Standard enthalpies and Gibbs free energies of hydration were computed. The temperature dependence ofΔrG°(T) was evaluated for the most stable complexes over the temperature range 200−400K. Thermodynamic data revealed that the highest fraction hydrated at 298 K and 100%relative humidity will be BrHgNO2−H2Oat~5%.

Poster research topic(s)

Modelling study, Climate, Health, Ecosystems, Land-Atmosphere interactions

A.E.ME-32

Does New Particle Formation enhance Cloud Condensation Nuclei and droplet number in a major city of the Eastern Mediterranean?

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Abstract

Atmospheric new particle formation (NPF) is a significant source of cloud condensation nuclei (CCN) and cloud droplet number concentration (CDNC). While several studies have shown positive contributions of NPF to CCN and CDNC at remote background sites, its effect in polluted environments is still not fully understood, owing to the high background aerosols and increased local emissions. Using 7 years of particle number size distribution measurements from an urban background site in Athens, Greece, we thoroughly assess and quantify the influence of NPF on CCN and CDNC. We show that NPF increases the CCN concentrations (0.10% to 1.00% supersaturation) between 35% and 85%. Enhanced CCN from NPF are mostly observed after 12:00 (UTC+2) and during the transitional seasons (i.e. spring and autumn), where NPF occurs with a frequency above 20%. The CDNC is reduced by 12% and 16% at updraft velocities of 0.3 and 0.6 m s^{-1} compared to that calculated at constant supersaturations (0.10%-1.00 %). The calculated maximum supersaturation (s_{max}) in ambient clouds presents values below 0.15%, which are systematically lower than the predetermined supersaturations used in CCN analysis. Our study highlights the considerable effect of water vapor competition on the variation of CCN and CDNC throughout a typical NPF day. Significant numbers of NPF-formed particles try to reach the CCN sizes, increasing thus the water vapor competition, while the s_{max} that develops in clouds is reduced. The constraining levels of s_{max} hinder the cloud droplet formation when a NPF event takes place. In addition, under increased aerosol particle number concentrations, due to local anthropogenic emissions, the effect of water vapor competition becomes more evident. Therefore, it is necessary to re-examine the meteorological terms and the various sources dominated in polluted regions to evaluate the real fingerprint of NPF on CCN and CDNC, which considerably modulates the climate conditions.

Poster research topic(s)

Climate, Aerosols, Clouds

A.E.ME-33

Total stratospheric bromine [Bry] inferred from balloon-borne solar occultation BrO measurements using the new balloon-borne UV/vis spectrometer

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Abstract

Halogenated compounds, in particular those containing chlorine, bromine and iodine contribute to the global ozone depletion as well as climate forcing. As a result of the Montreal Protocol (1987), the chlorine and bromine loadings of the stratosphere are closely monitored, while the role of iodinated compounds to the stratospheric ozone photochemistry is still uncertain.

To address the questions concerning bromine and iodine compounds, a novel compact solar occultation instrument has been specifically designed to measure UV/Vis absorbing gases by means of Differential Optical Absorption Spectroscopy (DOAS) from aboard stratospheric balloon gondolas. The instrument (power consumption < 100 W) comprises an active camera-based solar tracker (LxWxH ~ 0.40 m x 0.40 m x 0.50 m, weight ~ 12 kg) and a spectrometer unit (LxWxH ~ 0.45 m x 0.40 m x 0.40 m, weight ~ 25 kg). The spectrometer unit houses two grating spectrometers which operate in vacuum and under temperature stabilization by an ice-water bath.

We discuss the performance of the instrument during the first two deployments on stratospheric balloons launched from Kiruna in August, 2021 and from Timmins in August, 2022 within the HEMERA program. Once the balloon gondola was azimuthally stabilized the solar tracker was able to follow the sun with a precision lower than 0.05° (1/10 of sun's diameter) up to solar zenith angles (SZAs) of 95°. The spectral retrieval (of spectra acquired at SZA between 86° and 90°) allows us to infer a BrO mixing ratio of (14.4 +/- 1.7) ppt above 32 km altitude. The total bromine [Bry] in the middle stratosphere is inferred to (17.5 +/- 2.3) ppt by accounting for the [BrO]/[Bry] partitioning derived from a photochemical model. The stratospheric entry date of the probed airmasses is dated to early 2017 +/- 1 yr using profiles of N2O volume mixing ratio measured by the simultaneously deployed mid-IR GLORIA instrument.

Poster research topic(s)

Field study, Instrument development, Remote sensing, Trace gases

A.E.ME-34

Changes in the Response of Stratospheric Ozone to Future Explosive Volcanic Eruptions

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Abstract

Large, explosive volcanic eruptions have the potential to alter spatiotemporal profiles of Earth's ozone column through changes in trace gas composition and aerosol loading of the stratosphere. In the current atmosphere, volcanic eruptions cause ozone loss, as observed following the 1991 Mt. Pinatubo eruption. This is largely due to heterogeneous chemistry on volcanic aerosols increasing the halogen-initiated ozone-depleting catalytic cycles. However, halogen levels in the atmosphere are decreasing due to the success of the Montreal Protocol and subsequent amendments. When background halogen levels eventually reach pre-industrial levels, the impact on ozone of a volcanic eruption is expected to lead to increases in stratospheric ozone rather than decreases. The time when this switch happens is uncertain and depends on greenhouse gas and aerosol loading of the atmosphere.

A large-ensemble 3-D chemistry-climate-aerosol model evaluation of the response of stratospheric ozone to volcanic perturbation of sulfate aerosol in a range of different chemistry-climate states and time frames will be presented, using the SOCOL-AERv2 model (SOCOL = modeling tools for studies of SOlar Climate Ozone Links, AER = 2D aerosol model). The model has previously been shown to represent the SO2 and volcanic aerosol following the 1991 Mt. Pinatubo volcanic eruption well. Volcanic eruption scenarios with a Pinatubo-like volcanic eruption (location and vertical profile) initiated between 2025-2095 have been carried out in order to determine the time when the impact on ozone will change from decreases to increases in stratospheric ozone following a volcanic eruption. The model results are compared for different chemistry-climate scenarios as represented by the Shared Socioeconomic Pathways (SSP) scenarios. Differences in the results for hemispherical and global impacts will be discussed, comparing the impact of each eruption scenario on the aerosol loading of the atmosphere and stratospheric ozone layer.

Poster research topic(s)

Modelling study, Climate

A.E.ME-35

Megaconstellation mission emission inventory development for determining the impact on stratospheric ozone and climate

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Abstract

Satellite megaconstellations have driven a recent surge in launches of rockets and re-entry vaporization of spent satellites. Both processes release large quantities of air pollution throughout all atmospheric layers. Of 8763 satellites currently in orbit, 68% belong to the Starlink and OneWeb megaconstellations and over 530,000 megaconstellation satellites are proposed. The potential environmental impact of these megaconstellation missions remains unregulated and uncharacterized. Here we develop an inventory of the dominant pollutants from megaconstellation and non-megaconstellation rocket launches and re-entries in 2020 to determine the impact of megaconstellation emissions on climate and stratospheric ozone. These pollutants include black carbon (BC), nitrogen oxides (NOx≡NO+NO2), water (H2O), carbon monoxide (CO), alumina (Al2O3) and chlorine species (Cly≡HCl+Cl2+Cl) from rocket launches and nitrogen oxides (NOx≡NO) and alumina (Al2O3) from re-entries. Vertical launch emission profiles are constructed by first determining the vertical distribution of propellant consumption for each rocket type and launch stage, then calculating and applying vertically resolved propellant specific emission indices that account for additional oxidation in the hot rocket plume and changes in atmospheric composition with altitude. Re-entries are geolocated using reported and likely geographic coordinates. The 2020 emissions of Cly (0.78 Gg) and BC (0.22 Gg) remain small compared to other tropospheric anthropogenic sources, however 39-93% of these emissions are injected directly to the upper stratosphere and mesosphere, where long lifetimes could lead to significant ozone depletion. The total propellant mass consumed in 2020 has risen to 37.21 Gg, an increase of 14% relative to 2019. Calculated 2020 re-entry Al2O3 deposited to the mesosphere (0.47 Gg) is more than twice the reported natural contribution from meteorites. Our megaconstellation emission inventory provides the capability to simulate the environmental impacts of megaconstellations on ozone and climate to inform satellite megaconstellation regulation.

Poster research topic(s)

Modelling study, Climate, Aerosols, Greenhouse gases, Trace gases

A.E.ME-36

Ambient Observations and Laboratory Characterization of Asphalt-Related Secondary Organic Aerosol

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Abstract

Asphalt-related emissions comprise of reactive intermediate and semi-volatile organic compounds (I/SVOCs) that can form organic aerosol (OA) in the atmosphere. Yet, the chemical composition of asphalt-based OA and its ambient impacts remain largely understudied. We made ambient measurements using time-of-flight aerosol mass spectrometry (ToF-AMS) that showed significantly increased OA concentrations during a month-long road paving event. Source apportionment via positive matrix factorization revealed enhanced hydrocarbon-like and oxygenated organic aerosol (HOA and OOA) contributions with temporal and diurnal trends distinct from traffic-related sources. In subsequent laboratory experiments, gas-phase emissions from real-world road asphalt samples at application (e.g., 140°C) and in-use (e.g., 60°C) temperatures were oxidized in a chamber and a potential aerosol mass reactor to simulate both short- (<6 hours) and longer-term (1-2 days) aging, respectively. ToF-AMS and proton-transfer-reaction (PTR)-MS were used to analyze the particle- and gas-phase oxidation products, which showed OA production via both self-nucleation and secondary photooxidation pathways. The chemical composition was dependent on material temperature and oxidation conditions, such that daytime oxidation of emissions at paving temperature formed unaged (HOA-like) and less-oxygenated organic aerosol (LO-OOA), while more oxygenated (MO-OOA) was observed at in-use conditions. Subsequent comparisons with other prominent urban sources showed the composition of unaged asphalt-related OA to be similar to other petrochemical sources (e.g. gasoline and diesel vehicle exhaust, lubricating oil) and HOA-like source-apportioned factors in several prior field measurements in different cities, yet different from biomass burning- and cooking-related OA. The aged asphalt-related OA compared with ambient LO-OOA and MO-OOA from prior field measurements depending on extent of oxidation in laboratory tests. Overall, these comparisons to our field and laboratory observations showed that contributions of asphalt-related sources to ambient OA could be incorporated into typical source factors due to their resemblance to OA from other well-known sources.

Poster research topic(s)

Field study, Laboratory study, Air quality, Aerosols

A.E.ME-37

Comprehensive Analysis of PM10 and PM2.5 Composition in four Moroccan Cities: Emission Sources and Geographical Variations

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Abstract

Over one year, different investigations were conducted to examine the emission sources and geographical variations in two principal aerosol fractions (PM10 and PM2.5) and their chemical composition in four Moroccan cities with distinct geographical locations. These cities included two in the Mediterranean Basin (Tetouan and Nador) and two situated along the Atlantic Ocean (Kenitra and Salé). In Salé and Kenitra, aerosol samples were collected using Dichotomous samplers, which separated them into two size fractions: particles below 2.5 µm (fine) and those ranging from 2.5 to 10 µm (coarse). In Tetouan and Nador, measurements of PM10 and PM2.5 were carried out using a PM cut-off cyclone manufactured by URG®. The chemical composition of the collected filters was determined using four analytical techniques: Total X-ray fluorescence, Atomic Absorption Spectroscopy, Microwave Plasma Atomic Emission Spectrometry, and Instrumental Neutron Activation Analysis. The influence of the atmospheric transport scenarios on the levels of PM was elaborated using air mass back-trajectories identifying different main transport patterns specific to each city. Cities along the Mediterranean coast exhibited a higher PM2.5/PM10 ratio (>0.5), indicating a significant contribution from fine anthropogenic particles. Conversely, cities along the Atlantic coast showed a ratio below the 0.5 threshold, implying the prevalence of coarse particles, possibly originating from local pollution emissions specific to these cities. Various methodologies were employed to discern potential emission sources in the study areas, including inter-elemental ratios, receptor modeling (PMF), and trajectory statistics. PMF source apportionment analysis revealed different sources contributing to PM2.5 mass concentrations in Salé City (such as vehicle exhaust and non-exhaust emissions) and Tetouan City (contributions from regional secondary aerosols, local activities, and fresh/aged sea salt). The use of inter-elemental ratios of specific emission source markers designed road traffic as the primary anthropogenic source in Nador City.

Poster research topic(s)

Air quality, Aerosols, Field study

A.E.ME-38

First ground-deployment of a new small-footprint cavity-ring-down spectrometer for NO_3 and N_2O_5 in a temperate forest during the ACROSS campaign

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Abstract

At nighttime, when concentrations of the OH-radical are low, the nitrate radical, NO_3, over takes the role of major initiator of the oxidation of many organic trace gases, especially those containing one or more double bonds. In contrast to daytime, where the lifetime of NO_3 is very short due to its photolysis and reaction with NO, NO_3 can reach mixing ratios of several tens of ppt at night. NO_3 can also react with NO_2 to form N_2O_5. As N_2O_5 is thermally stable, the three trace-gases usually exist in equilibrium:

$NO_3 + NO_2 + M \rightleftharpoons N_2O_5 + M$

Measurements of NO_3 and N_2O_5 are central to our understanding of the fate of NOx at night. Loss of NO_3 to gas-phase reactions (forming e.g. organic nitrates) has a different impact on NOx than formation of N_2O_5 which may hydrolyse on aerosol to form particulate nitrate.

During the ACROSS campaign in Rambouillet Forest (France), a recently built two-channel cavity-ring-down spectrometer was deployed for the first time to record mixing ratios of NO_3 and N_2O_5 at night over a period of several weeks. NO_3 was detected directly at 662nm in one channel while N_2O_5 was first converted to NO_3 in a thermal dissociation inlet before being detected in the same way.

In this work, we describe the new instrument in detail and compare obtained data with those measured by an established cavity-ring-down instrument. We show that, at a sampling height of about 6m, NO_3 and N_2O_5 mixing ratios were low and frequently below the detection limit of both instruments and discuss likely reasons. Furthermore, we point out advances of the instrument since its first deployment.

Poster research topic(s)

Field study, Instrument development, Air quality

A.E.ME-39

Absorption Ångström exponent as a marker of local Black Carbon sources: A case of Blantyre, Malawi

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Abstract

Background: Air pollution, especially in the form of Black Carbon (BC) is a concern because of the potential health effects and global warming potential. In Blantyre, Malawi, air pollution is associated with factors like the use of old vehicles, cooking with solid biofuels, and waste burning. For evidence-informed policymaking, it is important to identify the sources behind spatial hotspots of BC in the city.

Methods: Rather than filter measurements and chemical techniques which require costly laboratory analysis, we tested the use of MA200 micro-aethalometer and the resulting absorption Ångström exponent (AAE) values as a way of identifying specific BC pollution sources. AAE is a parameter that reflects the wavelength dependence of light absorption by particles. We conducted field experiments to determine the AAE of vehicular emissions, the burning of several waste components, and cooking emissions from firewood. We then estimated the sources of BC within the city using mobile and personal monitoring in four settlements.

Results: Theoretically, AAE ranges from 1 to 2. The AAE of fossil fuel-related combustion sources (vehicular emissions, plastics) was closer to 1 while the AAE of burning organics was closer to 2. The mobile monitoring results further supported this finding, with AAE values close to 1 observed on heavy-traffic roads, near the city's biggest dumpsite, and in industrial areas while AAE values were close to 2 where cooking or biomass burning occurred.

Discussion and conclusion: As the first study to focus on ambient BC pollution in Malawi, these findings suggest that AAE can help indicate if the source of BC is fossil fuel-based or organic. However, context knowledge is required to identify the specific fossil fuel/organics combustion source. The study used a simple approach that can be helpful in other similar contexts and could be used as a low-cost alternative to more expensive techniques.

Poster research topic(s)

Air quality, Field study, Aerosols

A.E.ME-41

Understanding Atmospheric Transport and Volatility of Pesticides Using Mass Spectrometry

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Abstract

Pesticides have been used on fields since the 1950s to promote crop yield by reducing crop losses due to diseases and/or pests. Current reported physiochemical properties of pesticides e.g.: vapour pressure, often come with large uncertainties and discrepancies between sources (M.Leistra., 2011). Vapour pressure of low volatility compounds (like most atmospherically relevant species) are difficult to measure, historically being measured at high temperature leading to extrapolation for ambient results. An added layer of complexity is present in pesticides as sources often lead to confidential industrial reports making it hard to know exact how the data has been determined.

To carry out calibration measurements of current use pesticides (CUPs) several techniques can be used. These may include the FIGAERO-TOF-CIMS (Filter Inlet for Gases and AEROsols – Time of Flight – Chemical ionisation Mass Spectrometer), as described by F.D. Lopez-Hilfiker et al., (2016) and A.Ylinsirnö et al., (2021).

The CIMS technique has previously been used to measure low volatility atmospherically relevant compounds however this is the first time these techniques have been used to measure pesticides. The calibration techniques showed orders of magnitude difference in volatility between literature values and those measured by FIGAERO-CIMS.

Further experiments in an Oxidation Flow Reactor (DEKATI) have also been carried out with selected pesticides to monitor their degradation products when exposed to an atmospherically relevant concentration of OH. Initial experiments showed the successful formation of Secondary Organic Aerosol (SOA) in this environment. The FIGAERO-CIMS instrument was used as an online technique connected to the chamber to measure products and fragments in both the gas and particle phase to predict their pathways.

Overall, both the volatility and flow reactor work will allow us to predict the lifetime and fate of pesticides as well as gas and particle partitioning behaviour more confidently in the atmosphere.

Poster research topic(s)

Air quality, Laboratory study, Aerosols

A.E.ME-42

Assessing the impact of European open biomass burning on UK air quality

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Abstract

Wildfires are a fundamental part of the Earth's ecosystem. However, climate change and other factors such as population and land-use changes are altering fire patterns across the globe, resulting in some regions becoming more vulnerable to wildfires. This includes the UK and other regions of Europe.

The aim is to investigate how open biomass burning throughout Europe contributes to UK air quality. Open biomass burning is defined here as wildfires, prescribed burning and agricultural burning. The European configuration of the EMEP MSC-W atmospheric chemistry transport model is used, with a nested UK domain of 3 km x 3 km horizontal resolution (Vieno et al. 2016). Open biomass burning emissions from the Fire INventory from National Center for Atmospheric Research (FINN) v1.5 are included.

The focus here is on the year 2019, with fine particulate matter ($PM_{2.5}$) as a pollutant. We quantify the magnitude of modelled surface concentrations attributed to open biomass burning and identify the spatial origin of the fire contribution to this. The chemical composition of the $PM_{2.5}$ is also considered in detail. Comparisons are made to measurements at sites across the UK.

Simulations show that the contribution of open biomass burning to $PM_{2.5}$ becomes important on a daily timescale during episodic open biomass burning events. While absolute contributions (as temporal and geographic averages) are small compared to current anthropogenic emissions, relative contributions will become more important if increasingly stringent air quality guidelines for human health (WHO, 2021) are to be met in the future.

References:
Vieno, M., Heal, M. R., Williams, M. L., Carnell, E. J., Nemitz, E., Stedman, J. R. & Reis, S. (2016), 'The sensitivities of emissions reductions for the mitigation of UK PM2.5', *Atmospheric Chemistry and Physics* **16**(1), 265–276.
WHO (2021), *WHO global air quality guidelines*, World Health Organization. ISBN 9789240034228.

Poster research topic(s)

Modelling study, Air quality, Aerosols

A.E.ME-43

Satellite observations highlight influence of both vegetation and fire on atmospheric composition over the southern Amazon.

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Abstract

Over a hundred million hectares were deforested between 2010 and 2020. These land cover changes affect regional climate and air quality, in part by modifying the types and amounts of gases and aerosols emitted from the vegetation. Of particular interest are changes to emissions of biogenic volatile organic compounds such as isoprene due to substantial uncertainties in their quantities and subsequent impacts. The southern Amazon is one of the areas that are most affected by 21st century land cover changes. In the period 2001-2019 the area lost over 7 % of its forest cover. Increasing availability of satellite-based records of atmospheric composition allows for studying variations in trace gases and aerosols with land cover to better understand the impacts of deforestation and the often-related fires. By studying satellite observations of 5 trace gases and aerosol optical depth, this work characterises the relationships between vegetation, burned area and atmospheric composition in the region. Formaldehyde, carbon monoxide and aerosol optical depth show signs of links to both vegetation and fires, but the relationships are complex. Significant relationships are found between broadleaf forest cover and isoprene, and burned area and nitrogen dioxide. Isoprene rises by 11 x 10^{14} molecules cm^{-2} for every 10 percentage point increase in forest cover. Nitrogen dioxide increases with burned area, but the relationship is not linear and is better captured by a power law. The results highlight substantial changes in atmospheric composition can be expected with deforestation in the future.

Poster research topic(s)

Satellite study, Remote sensing, Land-Atmosphere interactions, Trace gases

A.E.ME-44, As.Oc-35

Online CHARON PTR-ToF-MS measurements elucidate residential heating as the major contributor of wintertime organic aerosol in Fairbanks, Alaska

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Abstract

Fairbanks, Alaska, is a sub-arctic city, where air quality standards are frequently violated during winter due to enhanced emissions and strong temperature inversions that weaken atmospheric dispersion. Organic aerosol (OA) is a major constituent of atmospheric particulate matter involved in air quality issues and climate. It remains underrepresented in ground-based observations, hampering the accurate assessment and modelling of its impacts. We present the first real-time, in-situ measurements of OA with high temporal resolution (2 minutes) using a Chemical Analysis of Aerosol Online (CHARON) inlet coupled with a proton transfer reaction time-of-flight aerosol mass spectrometer (PTR-ToF-MS). This inlet allows direct sampling and volatilisation of OA into a PTR-ToF-MS. The CHARON PTR-ToF-MS was deployed at an urban centre of Fairbanks in Jan–Feb 2022, along with an Aerodyne high-resolution ToF aerosol mass spectrometer (HR-ToF-AMS). Data from both instruments were subjected to positive matrix factorisation (PMF) to identify and quantify sources or processes contributing to the ambient OA load. The temporal variations in the OA fraction measured by both instruments agreed well. CHARON PTR-ToF-MS also provided insights into the molecular-level composition of OA, owing to relatively weaker fragmentation. In total, eight factors – each representing a distinct source – were resolved by PMF of CHARON PTR-ToF-MS, including four residential heating (RH) sources that co-varied closely in time but featured distinct differences in their mass spectral signatures. Originating from fuel-oil and wood-burning, the RH sources comprised >70% of the OA concentrations measured with the CHARON PTR-ToF-MS, establishing it as the single most important contributor to OA mass in Fairbanks during wintertime. The promising source apportionment and information featured by the CHARON PTR-ToF-MS is not only valuable to inform policy targeting poor air quality in Fairbanks and regions with similar meteorology, but also highlights it as an important tool for atmospheric analyses.

Poster research topic(s)

Air quality, Aerosols

A.E.ME-45

Monitoring NOx emission compliance from space combining TROPOMI data and models

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Abstract

International shipping contributes around 20% of global anthropogenic NOx emissions, causing air pollution along shipping routes. Along with global trade volumes maritime transport is expected to grow further in the upcoming decades. To avoid further degrading air quality along coasts, the International Maritime Organization (IMO) has tightened regulations to reduce nitrogen oxides (NOx) emissions from individual ships. While monitoring of ship emissions on open sea is inherently difficult, satellite retrievals are able to detect NO2 plumes from individual ships and to automatically identify them. However, quantifying NOx emission from individual ships for the purpose of compliance monitoring has yet to be developed in an accurate manner.

In this study, we use the Gaussian plume model PARANOX that accounts for entrainment and detailed chemistry in 10 concentric rings. With PARANOX we create a large library of ~40000 ship NO2 plumes for a large range of NOx emission fluxes and chemical and meteorological parameters. The simulations show how the meteorological and chemical conditions influence the shape and detectability of ship plumes. We find that besides the emission flux, background ozone and wind speed are the most important factors determining the detected NO2 amount of the plume.

Using the plume library we interpret TROPOMI NO2 plumes over the Mediterranean sea originating from individual ships, diagnosed by their coincidence with AIS information, over the Mediterranean Sea. We find emission fluxes of 100-150 g/s, in compliance with current Tier II limits but exceeding Tier III in a future Emission Control Area.

We improve on the course-scale a priori NO2 profiles from the TM5-MP model used in the TROPOMI retrieval, by replacing these with plume-specific a priori NO2 profiles simulated with the PARANOX model. This leads to 25% higher NO2 columns in the regions with plume enhancement, and, in turn, to 30% increased emission levels.

Poster research topic(s)

Modelling study, Satellite study, Trace gases, Air quality, Remote sensing

A.E.ME-46

Vertical profiles of global tropospheric nitrogen dioxide (NO_2) and ozone (O_3) obtained via cloud-slicing of TROPOMI partial columns

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Abstract

Nitrogen oxides (NO_x ≡ NO + NO_2) are long-lived in the troposphere. This impacts the oxidising capacity of the NO_x-limited troposphere and consequently the formation of ozone (O_3). However, routine observations of both NO_x and $O_3$are lacking. To address this, we derive vertical profiles of NO_2 and O_3 using the cloud-slicing method which we apply to partial columns from the TROPOMI satellite instrument. We obtain seasonal multi-year means of NO_2 (June 2018 - May 2022) and O_3 (December 2019 - November 2022) volume mixing ratios at a resolution of 1° x 1° on a global scale in the upper troposphere (320-180 hPa, 450-320 hPa), the mid-troposphere (600-450 hPa, 800-600 hPa) and the boundary layer (1100-800 hPa). We evaluate our products using NASA DC-8 aircraft measurements from the INTEX-A, ARCTAS, SEAC^{4}RS and ATom campaigns. We also evaluate the O_3 product against ozonesonde measurements from SHADOZ and WOUDC. We find that in the mid-troposphere cloud-sliced NO_2 values deviate by less than 40 pptv and O_3 values by less than 30 ppbv from aircraft observations. This is due to the high sampling frequency and ideal conditions for cloud-slicing where concentrations are constant with altitude. Differences reach 70 pptv for NO_2 and 40 ppbv for O_3 in the upper troposphere, where there are fewer cloud-sliced data points to compare to coincident aircraft observations. Across all ozone-sonde sites we find that cloud-sliced O_3 values differ by less than 20 ppbv across the whole troposphere. By comparing tropospheric vertical profiles from cloud-slicing satellite observations to simulations from the GEOS-Chem model we find that GEOS-Chem is underestimating NO_2 concentrations over the global oceans by 30-40 pptv and overestimating NO_2 concentrations over North America and Central Asia by 80-100 pptv in the mid-troposphere.

Poster research topic(s)

Modelling study, Satellite study, Remote sensing, Greenhouse gases, Clouds

A.E.ME-47

Latitudinal gradient in cloud droplet number concentration of Southern Ocean liquid clouds explained by aerosol sources

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Abstract

Aerosol-cloud interactions pose a large uncertainty in climate forcing predictions. Southern Ocean liquid clouds have a higher than expected cloud droplet number concentration (N_d) that global coupled models do not predict.

Satellite retrievals of Southern Ocean liquid clouds over the summer of 2018 were split into over 3000 0.5° × 0.5° cloud grid points. From each grid point, back-trajectories were simulated over 5 days in order to establish the sources of aerosol ending up in these clouds and influencing N_d, removing cloud grid points whose trajectories may be affected by anthropogenic emissions from continents other than Antarctica.

The results show that the increase in N_d towards higher latitudes is caused by sea ice emissions, and the increase does not show up in cloud grid points with only marine sources. In the sea ice affected dataset, there is still an anticorrelation between N_d and cloud latitude, most likely caused by high latitude cloud grid point trajectories generally spending time at higher latitudes, picking up aerosol from Antarctica and the sea ice surrounding it.

Other factors influencing N_d include surface wind speed and the time air masses spent in the free troposphere as opposed to the marine boundary layer, both having opposite effects on clouds with marine sources only and sea ice influenced cloud grid points.

The surface seawater concentration of chlorophyll-a, which is widely used as a tracer of phytoplankton activity and a predictor of dimethyl sulphide (DMS) emission, only showed a correlation with N_d in the cloud grid points that were influenced by sea ice, pointing to the importance of sea ice algae and phytoplankton in the marginal ice zone.

Poster research topic(s)

Modelling study, Satellite study, Remote sensing, Ocean-Atmosphere interactions, Aerosols, Clouds

A.E.ME-48, Americas-27

Spatiotemporal ammonia (HN3) emission and source detection in Brandenburg Germany

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Abstract

Ammonia (NH3) is a highly reactive gas with impacts on environmental aspects such as air quality, visibility, climate change, acid deposition, and eutrophication. Major global sources of NH3 emissions are from agriculture, urban activities, and wildfires. NH3 serves as a vital precursor to aerosol particle formation, eventually transforming into ammonium (NH4+) within the atmosphere.

This study is centered in Brandenburg, Germany, examining land cover classifications and NH3 emissions using satellite-based Earth observation methods. These techniques encompass monitoring both spatial and temporal variations in ground surface sources and the total column of NH3 emissions. Additionally, NH3 emissions are detected in the atmosphere using the Meteorological Operation Satellite (MetOp-B/C) with the Infrared Atmospheric Sounding Interferometer (IASI). A detailed Land Cover Classification map at 10 m resolution is employed for the Brandenburg region. Furthermore, the study utilizes MODIS Aqua/Terra data to collect information on active fires.

The results of this research illustrate the comprehensive analysis of land cover classifications and NH3 emission patterns in Brandenburg. The annual mean NH3 emissions from 2013 to 2022 reveal consistent values, with noticeable increases observed during specific years in northern Brandenburg. The annual distribution of fire spots, as recorded by MODIS Aqua/Terra, highlights potential correlations between fire incidents and ammonia emissions. Notably, boxplot time series data present an intriguing pattern where nighttime NH3 concentrations consistently surpass daytime levels.

In the future, this study aims to employ a multiplatform approach integrating satellite and ground-based observations. The goal is to explore the relationships between secondary aerosol particles and aerosol optical depth (AOD) values in the atmosphere, with a specific focus on the presence of NH3. This investigation will consider additional contributing factors, and dispersion methods, and employ machine learning techniques to gain a deeper understanding of these complex relationships.

Poster research topic(s)

Air quality, Trace gases

A.E.ME-49

Unmasking the Sizzling Secrets of Cooking Emissions!

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Abstract

Cooking food is an integral and often an enjoyable part of our daily life. However, recent studies have also identified it as a major source of pollutants that deteriorate the indoor air quality (IAQ). The cooking processes release a significant amount of volatile organic compounds (VOCs) which can undergo rapid chemical transformations to form secondary pollutants like ozone and particulates. Since humans are known to spend nearly 90% of time in indoor environments, the continuous exposure to such pollutants can be concerning. To have a robust understanding of the chemistry and dynamics that affect the IAQ, it is essential to quantify these emissions. Additionally, there are several factors that can influence the emissions, such as, cooking techniques, ingredients used, duration, and ventilation conditions. In this work we investigated the VOC emission fingerprints measured during the scripted cooking experiments in the DOMESTIC indoor air science facility at the University of York. Realtime VOC measurements were performed using a selected ion flow tube mass spectrometer (SIFT-MS) and using these the VOC emission rates were quantified via mass-balance calculations. Distinct emission profiles were observed for the three standardised recipes: stir-fry, chili and curry, and the different ready to cook microwaveable foods. Identification of individual VOCs revealed some key insights on the emission signatures and their potential implications on the indoor air quality via total OH reactivity and secondary aerosol formation. Understanding the sources, characteristics, and impacts of these emissions is crucial for developing effective mitigation strategies, promoting healthier cooking practices, and ensuring a safe and sustainable indoor environment for all.

Poster research topic(s)

Laboratory study, Air quality, Trace gases

A.E.ME-50

Profiling air pollution over the Central London atmosphere in summer and winter 2023.

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Abstract

London experiences severe air pollution episodes that impact public health. Here, we present retrieved vertical profiles of tropospheric nitrogen dioxide (NO_2) and formaldehyde (HCHO) over Central London from a Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) instrument for January and June 2023. For most days, NO_2 and HCHO follow a predictable pattern: peak NO_2 concentrations during rush hours, peak concentrations of both trace gases within the planetary boundary layer, and limited diurnal variability of HCHO due to a balance between sources (oxidation of volatile organic compounds) and sinks (photolysis). Exceptions to this typical behaviour are two pollution episodes lasting 5 days in January (20–25) and 9 days in June (9–17). The London Mayor issued air pollution warnings for both. The episode in January is associated with cold, foggy conditions that trapped pollution in the city. The summer enhancement in June is due to a very stable high pressure system promoting accumulation of pollution in London. The anomalously warm conditions in June also increased biogenic isoprene emissions that oxidize to form the HCHO detected by the MAX-DOAS. GEOS-Chem reproduces non-pollution episode days in January and June but fails to simulate the large enhancements in tropospheric column NO_2 and HCHO during these pollution events. As GEOS-Chem represents best understanding of atmospheric chemistry, the causes for this deficiency are currently under investigation using not only the MAX-DOAS observations, but also surface in situ air quality network and tall tower (190 m) observations.

Poster research topic(s)

Remote sensing, Air quality, Modelling study

A.E.ME-51, Americas-28

Particulate MSA in continental sites

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Abstract

The oceans play an important role in the atmospheric chemistry of many trace gases and profoundly influence the global sulfur cycle. While emissions of sea spray are the most important source of primary marine aerosol, secondary marine aerosols are mainly formed by the oxidation of volatile organic compounds (VOCs), particularly dimethyl sulfide (DMS). Methanesulfonic Acid (MSA) is present in the atmosphere in both gas and particulate phases.

MSA has been studied for decades in polar regions both in the atmosphere and in ice core records because of its close connection to the production of natural sulfate from the same oxidation process of the DMS. More recently, studies were undertaken in non-polar marine areas and coastal environments. However, very few studies were conducted in continental or high-altitude regions, without direct influence from marine emissions. At the same time, it was shown that source apportionment models are able to identify an MSA factor using sets of off-line PM_{10} and $PM_{2.5}$ measurements from non-coastal sites.

In this work, we evaluate the distribution of MSA from measurements obtained from non-polar regions and its temporal and spatial variability. We also revisited previous source apportionment studies in order to assess the MSA factor and its contribution to the total organic carbon and PM mass. Finally, the discussion on the emission sources and atmospheric processes associated with the MSA formation is tackled.

Poster research topic(s)

Field study, Air quality, Aerosols

A.E.ME-52

Reactive nitrogen in the global upper troposphere from recent and historical commercial and research aircraft campaigns, TROPOMI and GEOS-Chem

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Abstract

Reactive nitrogen (NO_y) in the upper troposphere (UT; 8-12km) impacts climate, air quality, and atmospheric oxidants. Despite this, large uncertainties in NO_y in the UT persist, evidenced by discrepancies between models and observations. We use observations from research (NASA DC8) aircraft and the GEOS-Chem model to identify and quantify these errors after assessing whether DC8 observations offer representative sampling of the atmosphere by comparison to routine observations of total NO_y from commercial (MOZAIC, IAGOS) aircraft campaigns and new data products of $NO_2$from cloud-slicing satellite observations (TROPOMI). Most total UT NO_y, according to DC8, is from a few individual components, namely nitrogen oxides (NO_x; 8-18% of total NO_y) peroxyacetyl nitrate (PAN; 33-49%), nitric acid (HNO_3; 8-10%), peroxynitric acid (HNO_4; 5-11%), and organic nitrates (2-6%), Methyl peroxy nitrate (MPN, 20%). Interannual variability of UT NO_2 from cloud-slicing TROPOMI is negligible. We find that GEOS-Chem compared to DC8 underestimates total NO_y (60-112 pptv) due to low bias in NO_2 (6-36 ppt) and ΣPNs (50-103 pptv), with some of the NO_2bias explained by the model locking up ~10 ppt NO_2 as PPN. This PPN overestimation is due to missing PPN loss processes. The low NO_2 also results from underestimating O_3, as NO_2 mainly forms from NO reacting with O_3 in the UT. Large part of low bias of ΣPNs are from underestimating MPN.

Poster research topic(s)

Modelling study, Trace gases, Multiphase chemistry

A.E.ME-53

Eddy covariance measurements of black carbon emissions in central London

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Abstract

Black carbon (BC) is a significant environmental health and climate forcing concern. Direct measurement of black carbon fluxes using eddy covariance can quantify emissions and identify sources. Previous studies have quantified urban black carbon emissions in highly polluted countries such as China and India, but to date no research has been done in the UK and Europe. This study uses an eddy covariance system using a Single Particle Soot Photometer (SP2) deployed on the BT Tower in London to directly measure BC fluxes in central London. This is as part of the UK Integrated Research Observation System for Clean Air (OSCA). We have produced some primary results including time series of black carbon concentrations and fluxes in central London in winter and summer and diurnal profiles. Comparisons with NOx and organic matter fluxes are also underway to identify the main sources of black carbon in central London and suggest that due to recent emissions controls, cooking may now be the most significant local source rather than transport or space heating.

Poster research topic(s)

Air quality, Health, Aerosols, Land-Atmosphere interactions

A.E.ME-54

Air Pollution Control using homemade non-thermal plasma technology

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Abstract

Volatile organic compound (VOC) emissions from flue gas are critical to the chemistry of urban atmosphere, due to the precursory role in ozone and photochemical smog formation, and thus controlling them is a key task for air pollution prevention and control. Non-thermal plasma (NTP) is a promising technology for VOC abatement via advanced oxidation process, yet until now, the technology requires localisation and adaptation for small-scale operation, especially in low-income countries where vehicular emissions have increased. This paper reports a novel homemade laboratory-scale dielectric barrier discharge (DBD) system generating atmospheric NTP for the degradation of gas-phase VOCs. Strong ionization NTP was generated between the DBD electrodes by a pulse power zero-voltage switching flyback transformer (ZVS-FBT), which caused ionization of air molecules leading to active species formation to convert the organic pollutant to harmless carbon dioxide and water vapor. The system was tested for formaldehyde (HCHO) removal from synthesised flue gas under different concentrations adapted for indoor and outdoor conditions. We highlighted the electrical, chemical, and physical processes producing the plasma in order to ascertain optimum degradation conditions. It is shown that removal efficiency reaches 99% with no secondary pollution, ambient oxygen and water vapor being key players. The study provided a theoretical and experimental basis for the viability of DBD NTP for air pollution control.

Poster research topic(s)

Laboratory study, Air quality

A.E.ME-55

Oceanic Ozone Deposition: Shipborne Eddy Covariance Measurements and a Revised Parameterisation Representing the Process

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Abstract

Tropospheric ozone is a secondary air pollutant that contributes to the oxidative capacity of the atmosphere, impacts human health, and poses a threat to crop security. Dry deposition of ozone to the ocean surface accounts for approximately one third of total global dry deposition, with a high degree of uncertainty. This uncertainty is due to a lack of direct observational measurements, leading to poorly constrained parameterisations representing the process in global models.

In this work, recent shipborne open ocean measurements of ozone fluxes are presented. 20-days of eddy covariance measurements were recorded around the Bermuda Atlantic Time-series Study station (31o40'N, 64o10'W), onboard the R/V Atlantic Explorer. Ozone mixing ratios were recorded at high frequency (9 Hz) using a chemiluminescence detector. Ozone deposition velocities were calculated in the range of 0.0026 – 0.0132 cm/s (IQR), sitting at the lower end of previously reported values.

Ozone is removed by the oceans via chemical reacations at the sea surface, predominantly with iodide. However, exact details of the physical mechanism remain unclear. Observations to date have reported different dependencies on friction velocity (u_*), while current parameterisations representing the process do not predict a dependence on u_* except at very low wind speeds. This work proposes a revised two-layer scheme to represent oceanic ozone deposition that develops upon the state of the art scheme of Luhar et al. (2018) (L18). In L18, the turbulent suppressed surface layer is represented by the reaction-diffusion sublayer depth for ozone, δm, typically 3 μm for the ozone-iodide reaction in water. Here, an alternative definition of the depth of this layer is suggested, δx, against which δm is compared. This modification leads to a variable u_* dependence such that as δm increases, turbulence has a greater influence on ozone loss. This scheme will be constrained by eddy covariance measurements.

Poster research topic(s)

Ocean-Atmosphere interactions, Field study, Modelling study

A.E.ME-57

SIMULATION DE L'IMPACT DES ÉMISSIONS D'HYDROFLUOROCARBURES (HFC) AU TOGO SUR LA TEMPÉRATURE MOYENNE MONDIALE

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Abstract

Contexte : Plusieurs scénarios du GIEC prédisent une augmentation de la température de 1,5°C d'ici 2030 imputable aux gaz à effet de serre (GES) dont les hydrofluorocarbures (HFC) contrôlés par la Kigali Amendement. Objectifs : Ainsi, cette étude vise à simuler l'augmentation de la température d'ici 2030 accordée uniquement aux émissions de HFC au Togo, étant donné que le pays est partie à l'amendement de Kigali et à l'accord de Paris accord.

Méthodes : La méthodologie appliquée dans cette étude est basée sur la projection à 2030 des émissions de HFC en 2018 afin de simuler leur impact sur la température moyenne mondiale à l'aide de l'outil LEAP-IBC.

Résultats : Les émissions de HFC au Togo atteindront 2598,13 GgCO2-e et contribuer à l'augmentation de la température moyenne mondiale de 9,10−5°C représentant 18/100000 des 0,5°C sur la période 2018 à 2030 prédit par les scénarios du GIEC. Cette augmentation accordée aux HFC Le seul secteur togolais montre une fois de plus l'impact des GES sur l'économie mondiale. température moyenne. Ces résultats devraient donc alerter les politiques décideurs à redoubler d'efforts dans la mise en œuvre des mesures d'atténuation.

Poster research topic(s)

Greenhouse gases, Modelling study, Climate

A.E.ME-58, Americas-41

Soil volatile organic compound fluxes from Amazon rainforest soil

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Abstract

Volatile organic compounds (VOCs) play an important role in atmospheric processes that control air quality and climate. Soils are able to consume and emit VOCs, and their contribution to the atmospheric VOC budget may be comparable to that of the vegetation.

In the present study, VOC fluxes from the soil of the Amazon rainforest were measured over 10 days by means of a proton-transfer-reaction time-of-flight mass spectrometer (PTR-ToF-MS) connected to a closed dynamic soil flux measuring system consisting of a gas analyzer for CO2 flux measurements, a multiplexer, and 4 soil chambers. Three chambers were placed on three different types of soil, while one chamber was placed on a perfluoroalkoxy alkane (PFA) foil for blank measurements.

The soil of the Amazon rainforest acted as a net sink of isoprene with uptake rates that showed a diel cycle that followed the isoprene atmospheric concentration. In contrast, the rainforest soil was a source of monoterpenes and sulfur-containing compounds, namely methanethiol and dimethyl sulfide. Monoterpene emissions were temperature-dependent and mainly were generated from litter degradation. Soil emissions of methanethiol and dimethyl sulfide positively correlated with each other, indicating the two sulfur compounds were generated by the same soil processes. Soil VOC flux rates were markedly different between the three extremes of soil, highlighting the impact of soil physicochemical properties on soil gas fluxes.

The results show that the Amazon rainforest soil is essential to the overall ecosystem VOC dynamics. Future experiments will be focused on long-term soil VOC flux measurements to investigate their annual and seasonal variations. Soil VOC fluxes will be parametrized to ambient variables, such as soil temperature and soil moisture, and then included in atmospheric models to simulate current atmospheric chemistry and to improve climate model predictions of ecosystem response to climate changes.

Poster research topic(s)

Field study, Ecosystems, Land-Atmosphere interactions, Trace gases

A.E.ME-59

Investigating the global atmospheric transport of PFAS using the next-generation chemistry transport model ICON-ART and a newly developed emission model

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Abstract

Per- and Polyfluorinated Substances (PFAS) from local sources are a former environmental challenge due to their ability to travel extensive distances, posing persistent threats. The surge in industrial production of chemical synthetic compounds for everyday use products has amplified environmental burdens and human exposure to these often toxic, carcinogenic, or endocrine-disrupting pollutants. Identifying key sources, pathways, and sinks of PFAS is crucial for estimating their adverse effects on human health.

In this study, we employ the ICON-ART (ICOsahedral Non-hydrostatic model with Aerosol and Reactive Tracers) atmospheric circulation model to investigate the long-range transport of selected PFAS. ICON-ART, a global unstructured grid model is suitable to incorporate emissions and realistic precursor degradation chemistry being the basis for our initial exploration towards expanding our approach to encompass a wider spectrum of PFAS compounds.

Our simulations draw from a newly developed global PFAS emission inventory (POPE, Persistent Organic Pollutants Emission Inventory), considering various compartments and relevant proxies. The precise source distribution is essential for accurate pollution transport representation as much as the atmospheric modeling aspect is crucial due to the lifespan of PFAS, enabling them to traverse different circulation scales, covering vast distances and potentially reaching the Arctic.

Besides implementing PFAS emissions, transport, and degradation within ICON-ART, we tested different configurations, involving grid size, simulation periods, and spin-off times, to identify an optimal setup capable of depicting transport pathways and fate across different scales and timeframes. Based on our sensitivity tests, an enhanced atmospheric chemistry transport modeling for other PFAS is planned. Eventually, we aim at integrated atmospheric-marine simulations to assess the influence on PFAS transport and human exposure across multiple compartments. This comprehensive research aims to unravel the complex dynamics of PFAS pollution and global-scale consequences.

Poster research topic(s)

Modelling study, Air quality, Trace gases

A.E.ME-60

Chemical ionization mass spectrometry (CIMS) aircraft measurements of PAN and PAA in the tropical atmosphere

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Abstract

The two trace gases peroxyacetyl nitrate (PAN, $CH_3C(O)OONO_2$) and peracetic acid (PAA, $CH_3C(O)OOH$) are important species for the oxidative capacity of the atmosphere. The secondary pollutant PAN is the most abundant NOX-reservoir species in the clean troposphere while PAA can serve as an indicator for the photochemical activity. Despite their significance for the chemistry of the atmosphere, human health and climate, measurements of PAN and PAA are sparse. We present preliminary in-situ data of both species measured with a chemical ionization mass spectrometer (CIMS) in the clean troposphere above the Amazonian rainforest in the framework of the CAFE Brazil measurement campaign. Clear vertical profiles were observed when analyzing the 20 measurement flights performed during the campaign between December 2022 until the end of January 2023.

Poster research topic(s)

Field study, Instrument development, Trace gases

A.E.ME-61

Near-Automated Estimate of Nitrogen Oxides City Emissions Applied to South and Southeast Asia

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Abstract

In this study, we address the lack of updated nitrogen oxides (NOx) emissions inventories in rapidly developing South and Southeast Asian cities. A well-established approach of deriving city NOx emissions from satellite observations of NO2 tropospheric column densities uses wind rotation to align the city plume along a consistent direction and applies a best-fit Gaussian to estimate top-down NOx emissions. An issue that impacts success of this approach is subjective selection of the area to sample around the city centre. Here we refine this approach, by defining 54 sampling areas to achieve a near-automated approach that we test with TROPOspheric Monitoring Instrument (TROPOMI) NO2 observations over 19 cities with isolated NO2 hotspots in South and Southeast Asia. Our approach is computationally efficient, adaptable to any city size, eliminates the need to manually select suitable sampling areas for each city, and increases the number of cities with successful annual emissions estimates. It also enables derivation of monthly emissions. Our results show annual NOx emissions from cities in South and Southeast Asia range from below 50 mol s-1 for Kabul, to over 100 mol s-1 for Singapore. Large discrepancies between annual top-down and bottom-up emissions are found, particularly at Dhaka (6.5 times) and Kabul (10-fold). The estimated NOx emissions are higher in cold months, a pattern missing in bottom-up inventories, though data loss can impact the quality of monthly emissions. These discrepancies highlight gaps in understanding city NOx emissions. Our near-automated method offers more scalable emissions tracking, aiding better policy decisions.

Poster research topic(s)

Satellite study, Air quality, Trace gases

A.E.ME-62

Secondary organic aerosol composition in the urban and sub-urban area of Paris: an application of molecular tracers

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Abstract

Secondary organic aerosol (SOA) can be formed via the oxidation of volatile organic compounds (VOC) and contribute up to 90% of the OA, however, their formation pathways and chemical composition are not well understood. This work aims to determine the contribution of different VOCs precursors to the atmospheric SOA by combining field measurements during the ACROSS (Atmospheric ChemistRy Of the Suburban foreSt) campaign and chamber experiments in CESAM (Multiphase-Atmospheric Experimental-Simulation-Chamber). Chamber experiments allow the retrieval of the ratio between SOA generated from toluene photo-oxidation and its specific oxidation products (tracers). Field measurements allow description of the chemical composition and the quantification of tracer concentrations in the urban and suburban area (Rambouillet forest) of Paris. The filters collected were analyzed by a thermal-optical method, Orbitrap and UPLC-QTOF-MS (Ultra-Performance-Liquid-Chromatography Time-of-Flight Mass-Spectrometry).

Thermal-optical analysis shows similar organic carbon concentrations for Paris and Rambouillet in spite of their different environments, with mean values of 3.2 and 2.8 μgC/m^3, respectively. Orbitrap analysis shows compounds containing CHO and CHON and highlights the presence of organosulfur compounds at m/z 294 ($C_{10}H_{17}NSO_7$) and 167 ($C_5H_{12}SO_7$), probably associated with α-pinene and isoprene oxidation products. Aromaticity analysis shows the important contribution of polyaromatic compounds for Paris (between 22 to 30 %) and Rambouillet (from 16 to 36 %). Among the anthropogenic species identified with the UPLC-QTOF-MS, 2-methyl-4-nitrophenol and 2-nitrophenol were detected in Paris (0.25 and 1.33 ng/m^3) and Rambouillet (0.07 and 0.34 ng/m^3). The presence of nitro-phenol compounds and the contribution of aromatic compounds show the influence of the urban emissions in the forest area. Finally, combining the tracer concentrations observed in the field and the chamber experiments, the SOA tracer method is applied to estimate the SOA from different VOC precursors. It is observed that nitro-aromatics (tracer 2-methyl-4-nitrophenol) can represent up to 36 % of the SOA in Paris.

Poster research topic(s)

Field study, Aerosols, Laboratory study

A.E.ME-63

Health burden of air pollution linked to each major oil and gas lifecycle stage in the US

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Abstract

US is the world's largest producer of oil and gas. Recent (mid-2010s) increases in production contribute to ambient air pollution with adverse effects on health. Here we quantify the impact of individual stages in the lifecycle on air quality and health. Stages include upstream, midstream, downstream, and end-use activities. We use the GEOS-Chem model to simulate concentrations of health-hazardous air pollutants. Specifically, fine particles ($PM_{2.5}$), nitrogen dioxide (NO_2) and ozone after updating the model with air pollutant precursor emissions for each lifecycle stage from the US EPA National Emissions Inventory for 2017. The model is simulated at high resolution (25-31 km) nested over US. We find that US-wide oil and gas activities contribute to a population exposure of 2.56 ug m^{-3} (26%) of $PM_{2.5}$, 5.36 ppbv (68%) of NO_2, and 5.45 ppbv (11%) of ozone. These are mostly from end-use activities but there are large emissions of volatile organic compounds from oil and gas production. We use a contemporary health risk assessment model to estimate premature mortality from long-term exposure to $PM_{2.5}$ from all activities totaling 49,500 adult premature deaths dominated by end-use (94%). We also estimate 220,400 pediatric asthma incidences from annual NO_2 exposure and 1,820 cancer incidences from lifetime exposure to VOCs (benzene, formaldehyde and acetaldehyde). Our results underscore the need to mitigate air pollutant emissions from the whole oil and gas lifecycle.

Poster research topic(s)

Modelling study, Air quality, Health, Aerosols, Trace gases

A.E.ME-64

Quantifying the dominant sources influencing the 2016 particulate matter pollution episode over northern India

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Abstract

Intense episodic atmospheric pollution, also classified as haze pollution, overwhelms the entire Indo-Gangetic Plain (IGP) in northern India during the post-monsoon season. The exceedingly high aerosol concentrations during this crop residue burning season exert profound impacts on health and visibility for millions of its residents, especially for already polluted cities in this region. To quantify and understand the leading causes and spatiotemporal extent of one such extreme episode in 2016, we conducted idealised emission sensitivity experiments using the WRF-Chem regional chemical transport model. We find that biomass burning emissions have a localised effect mostly across source regions in upper IGP and Delhi (middle IGP), where it has a dominant share (50 - 80 %) towards the elevated daily $PM_{2.5}$ levels. Consequently, switching off biomass-burning emissions decreases averaged $PM_{2.5}$ concentrations by 400 μg^{-3} in upper IGP, followed by 280 μg^{-3} across middle IGP during this episode. Similar biomass-burning dominated enhancements are found for BC particles (up to 90 %) over these regions, while the lower IGP in the east showed increased anthropogenic share in BC loading on most days during the episode. Other biomass-burning dominated fine $PM_{2.5}$ components
in the model include secondary organic aerosols, primary organic aerosols, dust, and nitrate across upper IGP and middle IGP. On the other hand, switching off anthropogenic emissions reduces $PM_{2.5}$ and BC almost everywhere in the domain but additionally elicits regionally dependent features of non-linear chemistry in the model. Furthermore, the timescale and evolution of the entire episode across middle IGP was aided by prolonged atmospheric stratification and air stagnation,
wherein biomass burning $PM_{2.5}$ and BC particles were vertically distributed as high as up to 1 km in the atmosphere. Our work emphasises the need for policy interventions based on observation and model results to reduce agricultural crop burning through improved crop management and targeted approaches.

Poster research topic(s)
Modelling study, Air quality, Aerosols

A.E.ME-65

EXPOSURE OF PASSENGERS IN MINIVANS (“TROTRO”) TO PARTICULATE MATTER (PM) DURING PEAK TRAFFIC HOURS IN KUMASI

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Abstract

Air pollution, particularly PM, is a major concern in urban areas due to its harmful effects on human health. Exposure of urban dwellers to these harmful yet ubiquitous emissions become worse especially under traffic conditions. Passengers, and drivers alike could be at higher risk when exposed to concentrations higher than acceptable human exposure limits. Unfortunately, indoor exposure limits or guidelines are available in Ghana due to lack of data to these exposures in the country. The present study thus aims at assessing and evaluating passengers in Minivan’s (“Trotro”) exposure to PM during peak traffic hours in Kumasi. IQAir Visual Air Pro was used to collect $PM_{2.5}$, and PM_{10} data in “Trotro” during morning and evening time “rush-hours” for some selected days, and roads in Kumasi for a period of two weeks. From the study it was observed that, “Trotro” passengers, and drivers in Kumasi were exposed to higher PM_{10} concentrations than $PM_{2.5}$, for both morning and evening rush-hours. Higher average PM values were however recorded during the evening rush-hours (PM_{10}: 135.7-733.5μg/m^3, $PM_{2.5}$: 116.1-364.8μg/m^3) than the morning rush-hours (PM_{10} : 116.9-543.7μg/m^3, $PM_{2.5}$: 93.2-262.6μg/m^3). PM concentration patterns observed during the course of the study show that, in-“Trotro” PM exposures were highly dependents on surrounding PM source emissions than probably the interior of the vehicles. On the average occupants were exposed to 2.6 - 16.3 times the interim WHO PM_{10} exposure limit of 45μg/m^3, and 6.2 - 24.3 times the interim WHO $PM_{2.5}$ exposure limit of 15 μg/m3. The exceedingly high PM concentrations observed in “Trotro” during rush-hours indicate that occupants in “Trotro” in Kumasi face high potentials of developing health complications such as heart diseases, cancers, and respiratory issues like coughing, shortness of breath and asthma.

Poster research topic(s)

Air quality

A.E.ME-67

Emissions of particulate associated – Water Soluble Organic Carbon from residential biofuels burned in rural region of Western India

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Abstract

Biofuel burning emissions prevalent in the developing countries like India have consistently been a key subject of concern around the world due to their harmful impacts on air quality, human health, and global climate change. Water-Soluble Organic Carbon (WSOC) being an indicator of secondary organic aerosol and 20-80 % of Organic carbon in the atmosphere are important to study since they act as cloud condensation nuclie (CNN), affects the radiative forcing and climate. A total of 321 biofuel samples were collected and burned in laboratory from 161 sites of rural areas from the states of Rajasthan, Gujarat and Maharashtra at district level in western region of India. In this study, the emission of particulate associated Water-Soluble Organic Carbon (WSOC), Water-soluble Total Carbon (WSTC) and Water-Soluble Inorganic Carbon (WSIC) were determined by burning different type of biomass Fuel wood (FW), Dung cake (DC) and Crop residue (CR) used in residential cooking and heating activities in rural region of Western India. The average emissions factor of WSOC, WSTC and WSIC were estimated as FW (0.38±0.07 g/kg,0.45±0.08 g/kg, 0.07±0.02 g/kg); DC (0.94±0.65 g/kg, 1.02±0.39 g/kg, 0.08±0.03g/kg,); CR (0.49±0.03 g/kg, 0.57±0.38 g/kg, 0.08±0.01 g/kg) respectively in western region of India. Among all biofuels studied, DC showed high average emission factor than CR and FW. All the carbon species need to be measured to the avoid the inflation in emission factor from biomass percentage. This study has been made to evaluate the emission factor and achieve a reliable budget estimate of WSOC from different type of biomass fuels used in rural residential area of Western India.

Key words: Biomass burning, WSOC, WSTC, WSIC, Emission factor, Western India

Poster research topic(s)

Aerosols, Air quality

A.E.ME-68

Effects of International Ship-NOx Emissions on Surface Ozone Concentration: Global Model Calculations using perturbation and tagging approaches

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Abstract

Tropospheric ozone is an important air pollutant and greenhouse gas. One of the major sources of tropospheric ozone is the photochemical production from precursors: oxides of nitrogen (NO and NO2, collectively NOx) and volatile organic compounds (VOC), including methane. Emissions from international shipping, constituting more than 10% of global NOx emissions, are increasingly being recognized as an important source of air pollution that subsequently impacts human health. Emissions of NOx from ships can influence the surface ozone concentrations in various ways depending on location and time of year.

We use the tagging technique within Global chemistry-climate model simulations to quantify the contribution of precursor emissions at various marine regions on surface ozone concentration over continental regions. This technique involves modifying the existing chemical mechanism to write out ozone molecules along with the source from which the precursor molecule has been emitted.

Ozone formation from NOx is highly non-linear i.e. change in NOx emissions is not always proportional to ozone production. To understand the impact of ship-NOx emission changes on ozone concentration, we use the perturbation approach. Here, the results of two simulations are compared: one reference simulation with all emissions and a sensitivity simulation with perturbed emissions.

Summarizing so far: tagging calculates the contribution, and perturbation calculates the impact of changes in emission. In this study, we use a combination of these two approaches: perturbation and tagging. We write out the tagged ozone tracers in our set of perturbation simulations. This enables us to address the question: What impacts do ship-NOx emission changes have on various marine regions' (emission control areas and open ocean areas) ship NOx emission contribution to surface ozone concentration changes over land regions? In our poster, we present various results from these simulations.

Poster research topic(s)

Modelling study

A.E.ME-69

Impact of Volatile Organic Compounds emitted by the ships on air quality in the Channel.

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Abstract

Among the regulated sources of pollutants, shipping has a significant contribution to NOx and SO2 global emissions (Corbett et al. 2007). The Annex VI of MARPOL is a regulation updated in 2020 lowering the sulfur content in marine fuel, and specific Sulphur Emission Control Areas have been established where the emissions of sulphur are further restricted, such as the Channel between France and the U.K. However, VOCs emissions also are of importance for atmospheric chemistry because of their role in ozone and SOA formation in proximity of populated coastal zones. This raises the following questions: what are the VOCs emitted by ships under these new emission norms, what are their emission rates and their impact on air quality? Few studies considered the speciation of VOC, yet speciated data is crucial to provide reliable gas-phase atmospheric chemistry modelling and to correctly assess their impact. This study presents the analysis of a dataset obtained during a one-month intensive field campaign in the harbour of Dunkirk in the North of France, which is the third biggest French port. The site was located near ferry and cargo terminals and provides high time resolution measurements of VOCs, using a PTR-ToF-MS, and many other parameters (meteorology, particles, gases). Data analysis allowed the identification of 76 ship plumes based on the combination of favourable meteorological conditions, by harbour office entries and tracers like SO2. Statistical methods show that emission factors for SO2 are consistent with the exhaust measurements (Timonen et al. 2022) and that the emission rates of VOCs are smaller. We plan to use Positive Matrix Factorisation (PMF) to better discriminate the variety of VOC sources of the site, to precise the emission factors. The outputs of this study will enhance the atmospheric modelling of regional air quality monitoring agencies and can help improve emission inventories.

Poster research topic(s)

Field study, Trace gases

Americas

Americas-3

Uncertainties assessment of regional aerosol classification schemes

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Abstract

Aerosols play a critical role in the Earth's climate system, significantly impacting atmospheric processes and human health. Accurate quantification and classification of aerosols through their optical properties are essential for effective climate modeling and environmental assessments. However, this task poses significant challenges in several regions worldwide due to limited data availability. In South America, particularly, the predominantly low Aerosol Optical Depth values hinder the use of optical inversion products for classification. Consequently, researchers resort to direct solar radiation products but at the risk of high error in the results. To address these challenges, this study focuses on assessing the misclassification rate associated with commonly used 2-D threshold-based aerosol classification schemes applied to AERONET sites in South America. The primary objective is to gain new insights into the performance of these schemes and provide comprehensive information about their ability to classify each possible aerosol class. The results reveal that all methods encounter difficulties when distinguishing aerosol types in sectors with low Aerosol Optical Depth. Moreover, each classification scheme tends to either overestimate or underestimate certain aerosol type, and its performance varies depending on the environment of the measurement site. This research introduces a methodology for propagating uncertainties in classification schemes, offering a replicable approach that can guide future research endeavors. By adopting this method, efforts can be directed towards enhancing the accuracy of aerosol typing and reducing ambiguities in aerosol classification.

Poster research topic(s)

Aerosols, Air quality, Modelling study, Remote sensing

Americas-5

BTEX levels and health risk analysis in two urban sites in San Francisco of Campeche.

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Abstract

The objective of this study was to investigate the variation of BTEX levels in ambient air and the health risk in two urban sites in San Francisco de Campeche, during the fall season, 2022. 48 samples were collected for in both sites (site 1: National Institute of Anthropology and History (INAH), site 2: Technological Institute of Campeche, Lerma campus) in three different sampling periods, B1, B2 and B3, through the use of a vacuum pump and tubes glass adsorbents packed with activated carbon. BTEX concentrations were determined using a gas chromatograph with a FID detector. The average concentrations for site 1 and site 2 were: benzene (0.31 and 0.40 μg/m^3), xylenes (0.31 and 0.29 μg/m3), ethylbenzene (0.29 and 0.24 μg/m^3) and toluene (0.23 and 0.20 μg/m^3), for site 1 and site 2, respectively. In addition, the value for the Ozone Formation Potential (OFP) was determined, being xylenes the compounds with higher mean value (1.72 μg/m^3), corroborating that these compounds are the most reactive species during hours of high solar intensity. The influence of BTEX on population health was evaluated using the cancer risk coefficients (LTCR) due benzene inhalation, obtaining values higher than the acceptable limits established by the EPA and the WHO ($1x10^{-6}$ and $1x10^{-5}$, respectively). The LTCR values at site 1 for adults and children were $2.71x10^{-6}$ and $5.12x10^{-6}$, respectively, while at site 2 they were $3.30x10^{-6}$ and $6.25x10^{-6}$ for adults and children, respectively. The non-cancer risk coefficients (HQ) for the studied BTEX were also analyzed, which did not exceed the limit permissible established by the EPA (1.0), so the risk of developing cardiovascular and respiratory diseases is low due to inhalation of these pollutants.

Poster research topic(s)

Field study, Laboratory study, Air quality, Health, Land-Atmosphere interactions

Americas-6

Unexpected significance of a minor reaction pathway in daytime formation of biogenic highly oxygenated organic compounds

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Abstract

Secondary organic aerosol (SOA), formed by oxidation of volatile organic compounds, significantly influence air quality and climate. Highly oxygenated organic molecules (HOM), particularly those formed from biogenic monoterpenes, play a key role in their formation and growth. As the most important daytime oxidant, hydroxyl radical (OH) initiated HOM from monoterpenes is believed to be mainly formed via the OH addition channel. However, for α-pinene, the most abundant atmospheric monoterpene, we found that the minor hydrogen abstraction channel is underappreciated in the HOM formation. We will present our observations and theoretical calculations, showing the role of hydrogen-abstraction and alkoxy radicals for fast autoxidation leading to HOM. We also provide a mechanism and yield, suggesting the non-negligible contribution of the hydrogen abstraction channel to ambient SOA, particularly in OH rich areas.

Poster research topic(s)

Laboratory study, Aerosols

Americas-7

Analyzing Trends in Air Quality During a Drought: A Case Study to Improve Public Health Response to Drought Threats

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Abstract

Air quality has been shown to be significantly correlated with drought severity in the United States, and secondary impacts of droughts such as wildfires and dust storms are known to increase concentrations of airborne particulate matter with adverse effects on human health. This project represents the initial phase of measuring trends in air quality indicators, including Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth (AOD), Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS) aerosol optical thickness (AOT), and Environmental Protection Agency's Air Quality System (AQS) PM2.5 during recent drought conditions in the Pacific Northwest. Using data from the U.S. Drought Monitor (USDM) and Standardized Precipitation Evapotranspiration Index (SPEI), we evaluated these trends across the evolution of drought conditions and constructed maps depicting areas in Oregon and Washington that were vulnerable to changes in air quality during the drought event. By partnering with the University of Nebraska Medical Center's Water, Climate, and Health Program, NOAA National Integrated Drought Information System, Oregon Health Authority, and Washington State Department of Health, these trend analyses can inform public health departments' efforts to prepare for and mitigate the effects of drought on human health.

Poster research topic(s)

Air quality, Health, Climate, Satellite study, Land-Atmosphere interactions, Aerosols

Americas-8

Chemical Characterization of Air Pollution in Kigali, Rwanda: Insights from Continuous Aerosol Speciation and Black Carbon Monitoring.

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Abstract

Limited infrastructure and resources in African countries have resulted in a scarcity of in situ air pollution measurements, hindering our understanding of the concentrations and sources of air pollution. This burden persists despite the extensive influence of non-clean cooking fuels, outdated imported vehicles, rapid urbanization, and biomass burning on air pollution, health, and the environment. In 2019, ambient air pollution was estimated to cause 4.2 million premature deaths globally, with 89% occurring in low and middle-income countries (LMICs). Therefore, air pollution is a significant public health burden, especially in Africa and in LMICs. To help address this gap, we deployed an Aerosol Chemical Speciation Monitor (ACSM) and Magee Scientific Black Carbon Analyzers in Kigali, the capital of Rwanda. Rwanda is an East African country with undergoing rapid urbanization and industrialization whose pollution can be influence by both local and regional emissions. The ACSM measures particulate organic aerosol (OA), sulfate , ammonium , nitrate, and chloride whereas Magee scientific black carbon measure light absorbing particles at 7 different wavelengths. The measured study-average PM1 concentration in Kigali during the campaign was 19.7 μg m−3. OA contributed 71% of particulate matter mass, inorganic species contributed 10% and Black carbon counted for 19% of the measured PM mass concentration. Marker ions in the average ACSM mass spectrum provide insight into important sources of OA at this site, including traffic emissions, biomass/fossil fuel burning, and photochemistry. Positive matrix factorization (PMF) identified 3 source profiles dominated by Hydrocarbon-like Organic Aerosol (HOA, 38%), Biomass Burning-like Organic Aerosol (BBOA,33%) and Oxygenated Organic Aerosol (OOA, 29%), Heavily oxidized OOA was observed with peaks in the afternoon, regardless of the shallower boundary layer and higher particle dilution. The result of this work can be used to complement the misinterpreted air pollution level thought inventories in most of the African countries.

Poster research topic(s)

Field study, Modelling study, Air quality, Health, Multiphase chemistry, Trace gases, Aerosols

Americas-10, A.E.ME-11

Low-cost air quality monitoring devices design for low- and middle-income countries

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Abstract

More and more Africans are living in megacities, where atmospheric pollution reaches high levels. Exposure to air pollution can lead to a wide range of diseases (respiratory diseases, headaches, stroke, cancers, etc.). In a context of long-term exposure, air pollutants can affect every part of the body. Fine particles have been recognized as a leading cause of several diseases including cancer and diabetes. However, air quality data are still scarce in African cities due to the lack of monitors, the high upfront cost of standard monitors being an obstacle. Nevertheless, low-cost IoT components owing to their features are bringing hope. As part of this work, investigations are carried out to develop and popularize inexpensive IoT monitors adapted to the context of low-income countries. Local parameters including dust concentration levels, weather data, wireless communications systems, and electrical grids have been analysed. IoT components including LCD screens, RTC, GPRS/SIM900A, GPS and Wi-Fi modules, microcontrollers (Arduino, Raspberry Pi, ESP32, etc.) and various sensors (dust, gas, temperature, relative humidity, etc.) available on market have been assessed and used. The basic designs obtained include Arduino Uno 328P/GPRS/PPD42NS and ESP32/Wi-Fi/PMSD011. These basic, portable (~200 g) and low-cost (~100 €) configurations have been tested in the laboratory to map their performance. The Particulate matter (PM2.5 and PM10) and temperature/humidity sensors worked well, they are calibrated in the presence of a reference device and the next steps will be air quality monitoring campaigns in urban centers.

Poster research topic(s)

Instrument development, Remote sensing, Air quality, Aerosols, Clouds, Health

Americas-11

Understanding air pollution exposure dynamics: a novel model for exposure assessment

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Abstract

Recent studies have found that both the spatiotemporal variability in air pollutant concentrations and people's mobility play vital roles in estimating personal exposure to air pollutants. In this study, we introduce a model that assesses PM2.5 exposure by considering the daily movements and activities of the population. To accomplish this, we used the TomTom API to generate movement patterns and employed the WRF/CALPUFF model to calculate hourly PM2.5 concentrations maps. While we applied this approach in the Metropolitan Mendoza Area (MMA), Argentina, it can be applied to any location and various pollutants, with some technical considerations. Our findings indicate a significant increase of over 200% in total exposure for individuals living in areas with better air quality who move to areas with poorer air quality. Conversely, total exposure decreased by an average of approximately 17 % for those living in areas with poorer air quality and moving to areas with better air quality. It's noteworthy that, although the highest exposures occur during the commuting period, their contribution to the total daily exposure is roughly 10 %. Additionally, we identified variations in exposure levels based on the type of vehicle used and the selected commuting route. This study underscores the importance of considering human mobility and the spatiotemporal variability of air pollution in estimating total exposure, as neglecting these factors could lead to inaccurate assessments of health risks. Our innovative approach offers a more realistic evaluation of personal exposure levels and potential health effects compared to models that do not account for urban mobility. It provides a better approximation of the true geographic and temporal context in which individuals are exposed to air pollution.

Poster research topic(s)

Modelling study, Air quality, Health

Americas-12

Revealing changes in sea salt aerosol geochemistry in the WAIS induced by stratospheric ozone depletion

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Abstract

Some of the most noticeable effects of global warming can be found in the polar regions. One of the most important effects is increased exposure to UV-B radiation, which has big effects on the polar environment. The depletion of stratospheric ozone, monitored since the 1980s, has led to an increased influx of UV radiation at the Earth's surface. This has created ideal conditions for photochemical reactions to occur on snow surfaces. Gases released during snowpack processes in extreme environments such as Antarctica interact with sea salt particles, leading to changes in the chemical and physical characteristics of aerosols. This study contributes to the evidence regarding the impact of enhanced UV radiation on sea salt aerosols in the West Antarctica. Sea salt aerosols, particularly those originating in the Southern Ocean, play a significant role in maintaining the Earth's radiative equilibrium. Here, we employed a synchrotron-based multi-element microscopic speciation of individual microparticles in order to reveal the molecular features of sea salt aerosols at the Brazilian module Criosfera 1. Scanning Transmission X-ray Microscopy with Near-Edge X-ray Absorption Fine Structure Spectroscopy (NEXAFS/STMX) combined with Computer-Controlled Scanning Electron Microscopy (CCSEM/EDX) were used to identify the molecular changes in sea salt particles due to photolytic processes. A striking discovery was that chlorine had been displaced from sea salt particles when compared to sodium. Approximately 30% of the particles examined in the atmosphere displayed a chemical composition consistent with NaCl-NO3, signifying the presence of chlorine-enriched aerosols resulting from photolytic processes. The integration of these findings with ice core records suggests that the contemporary effects of UV-B radiation on tropospheric chlorine geochemistry are unparalleled in the Holocene epoch. In conclusion, this research offers valuable new insights into the chemical composition of aerosols in polar environments and holds the potential to reduce uncertainties in climate modeling.

Poster research topic(s)

Field study, Laboratory study, Satellite study, Climate, Ocean-Atmosphere interactions, Land-Atmosphere interactions, Aerosols

Americas-13

Investigating prescribed and agricultural fires in Kansas and Florida, USA from 2022-2023

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Abstract

Prescribed and agricultural fires are practiced globally to mitigate wildfire risk, control invasive species, ease harvesting processes, and overall manage vegetation. Smoke produced from these fires adversely impacts air quality and visibility. Monitors for fine particulate matter ($PM_{2.5}$) are often located only in more densely populated regions, which has afforded a limited understanding of the extent of smoke impacts in rural communities. Here, we focus on two case studies in the United States where prescribed and agricultural fires are regularly practiced: Kansas and Florida. In Kansas, the tallgrass prairie is burned in the springtime, whereas, in Florida, sugarcane is burned in the wintertime. To quantify the $PM_{2.5}$ impacts of these local fires, we deployed 38 PurpleAir low-cost $PM_{2.5}$ sensors to Kansas and 31 to Florida. We used observations from these two ground-based networks alongside a suite of satellite products (e.g., NOAA Hazard Mapping System, GOES Aerosol Optical Depth) to determine the $PM_{2.5}$ attributable to smoke. In Kansas, we found mean $PM_{2.5}$ increased by 5.2 μg m^{-3} on local smoke impacted days versus smoke-free days. In Florida, mean $PM_{2.5}$concentrations increase by 3.2 μg m^{-3} on local smoke impacted days. We will discuss spatial and temporal variability of $PM_{2.5}$ in Kansas and Florida and provide insights on how smoke impacts air quality concentrations in different communities. Although these methods were developed for and applied to two regions in the U.S., they could be adapted to understand smoke impacts in other areas of the world due to the low-cost and low-power of PurpleAir sensors along with satellite measurements.

Poster research topic(s)

Field study, Satellite study, Air quality, Aerosols

Americas-14

Utilizing a chemical two-dimensional (2D) partitioning model to visualize the phase distributions of emerging indoor organic pollutants

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Abstract

Given that modern humans spend the majority of their time indoors, the indoor environment plays an essential role in human chemical exposure. Emerging indoor organic pollutants have direct impacts on air quality and human health. For example, microbial volatile organic compounds (MVOCs) are responsible for malodors and certain health issues. Similarly, the flavorings in e-cigarettes and their adducts formed with e-liquids can lead to thirdhand exposures. The phase distributions for these chemicals determine the pathways of human exposure, including inhalation, ingestion, and dermal permeation. The recent discovery of a large volume of indoor reservoirs signifies the importance of indoor partitioning, which is governed by partitioning coefficients. However, current data are insufficient to predict the environmental behaviors of indoor volatile organic compounds (VOCs).

My research focuses on utilizing a chemical two-dimensional (2D) partitioning model to visualize the phase distributions of indoor organic pollutants. Briefly, target species were assumed to achieve equilibrium in a triphasic indoor system (air, polar and weakly-polar reservoirs) according to their water-air partitioning coefficient (Kwa) and octanol-air partitioning coefficient (Koa). We aim to provide more experimental constraints to partitioning coefficients that are subject to the influence of other factors, such as hydration and liquid-phase reactions. In particular, the partitioning coefficients were determined with the inert gas-stripping (IGS) method and variable phase ratio headspace (VPR-HS) technique. The hydration process and liquid-phase reactions were monitored by proton nuclear magnetic resonance (1H NMR) spectroscopy. The obtained values were input into the model to display the indoor phase distribution of target indoor VOCs.

The findings show that many of the harmful VOCs are likely distributed between indoor air and organic-rich reservoirs indoors, and the fraction of which is highly dependent on temperature and the reservoir size. This research provides a more comprehensive view of indoor chemical partitioning and routes of human exposure.

Poster research topic(s)

Laboratory study, Modelling study, Air quality, Health, Multiphase chemistry, Aerosols

Americas-15

Statistical metrics for intercomparison of atmospheric instrumental methods

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Abstract

Ordinary least squares (OLS) regression and parameters like r-squared are usually used in comparing two similar methods, e.g. for instrumentation for atmospheric chemical composition--however, this is oftentimes inadequate or incorrect. Here, the agreement between two instrumental methods for quantifying elemental concentration in PM2.5 was quantified using the concordance correlation coefficient (CCC) and Kendall's tau, two metrics that more adequately describe the agreement between the two instrumental methods. Also explored herein are model II statistical regression techniques, that, unlike OLS regression, account for experimental error in both variates without the asymmetry of choosing a given reference instrument.

Poster research topic(s)

Instrument development

Americas-16

Climate Projections Very Likely Underestimate Future Volcanic Forcing and its Climatic Impacts

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Abstract

Standard climate projections represent future volcanic eruptions by a constant forcing inferred from 1850 to 2014 volcanic forcing. Using the latest ice-core and satellite records to design stochastic eruption scenarios, we show that there is a 95% probability that explosive eruptions could emit more sulfur dioxide (SO_2) into the stratosphere over 2015–2100 than current standard climate projections (i.e., ScenarioMIP). Our simulations using the UK Earth System Model with interactive stratospheric aerosols show that for a median future eruption scenario, the 2015–2100 average global-mean stratospheric aerosol optical depth (SAOD) is double that used in ScenarioMIP, with small-magnitude eruptions (<3 Tg of SO_2) contributing 50% to SAOD perturbations. We show that volcanic effects on large-scale climate indicators, including global surface temperature, sea level and sea ice extent, are underestimated in ScenarioMIP because current climate projections do not fully account for the recurrence frequencies of volcanic eruptions of different magnitudes. We also highlight the climate-relevance of small-magnitude eruptions, which are responsible for 30%–50% of the volcanic effects on selected climate indicators.

Poster research topic(s)

Modelling study, Climate, Aerosols

Americas-17

Effects of pollen on hydrometeors and precipitation in a convective system

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Abstract

Anemophilous (wind-driven) pollen is one type of primary biological aerosol particle (PBAP), which can rupture under high humidity conditions and form smaller sub-pollen particles (SPPs). Both pollen and SPPs can reach the upper troposphere under convective conditions, acting as cloud condensation nuclei (CCN) and ice nucleating particles (INPs), thus influencing cloud formation and precipitation. However, the impacts of these biological aerosols on cold cloud formation and local climate remain unclear as there are large uncertainties on their emission flux and ice nucleating abilities. Here, we incorporate pollen emission and rupture processes in the Weather Research and Forecasting Model with Chemistry (WRF-Chem) simulations and update the Morrison microphysics scheme within WRF-Chem using aerosol-aware INP parameterizations to account for pollen in addition to other anthropogenic and biogenic aerosol. INP parameterizations for pollen and SPP are derived from laboratory experiments. When including pollen rupture rates as observed in a series of chamber studies, SPP concentrations increase, leading to an increase of cloud ice and water by up to 50% and potentially extending the duration of the convective system. Among all simulated hydrometeors, graupel and raindrops exhibit the largest enhancements from the inclusion of SPPs, with intensifying precipitation at the backside of the convective system and a greater spatial extent. Sensitivity simulations indicate that SPPs have a greater effect on cloud microphysical processes than whole pollen grains, and further observational evidence is needed to constrain these processes.

Poster research topic(s)

Modelling study, Aerosols, Clouds, Ecosystems

Americas-18

Uncertainty analysis of satellite aerosol products used as PM2.5 predictors in Latin American cities

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Abstract

In Latin America the lack of $PM_{2.5}$ monitoring stations limits the understanding of air quality in cities and the impact on human health from atmospheric pollutants. To estimate PM concentrations, the Aerosol Optical Depth (AOD) parameter measured by satellite platforms is commonly used, due its extensive spatial coverage. Among the available products, the most suitable for urban applications is MAIAC, due to its high spatial resolution (1km). This product is used as a predictive variable to develop $PM_{2.5}$ concentrations detailed maps. However, the literature rarely includes the uncertainties associated, which could lead to incorrect data usage and inappropriate conclusions. This study evaluates MAIAC algorithm's uncertainty in six densely populated Latin American cities: Sao Paulo, Santiago, Buenos Aires, Medellín, La Paz, and Mexico. A performance evaluation was conducted using typical global metrics (R^2, RMSE, bias) and more detailed ones, the Relative Expanded Uncertainty (REU). This metrics provides information of the relative error structure across the entire dynamic range of AOD. The AOD values found were relatively low (< 0.2) and had a moderate coefficient of determination (< 0.6) compared to the AERONET network used as reference instruments. In the AOD range of 0.05 to 0.15, the REU found in all cases is greater than 50% for all sites. Furthermore, MODIS DT 3km was evaluated. For this product, the uncertainty is always lower (~20-30%) than MAIAC for the same range. While an RMSE and R^2 for MODIS (~0.1 and ~0.49) were less favorable than for MAIAC (~0.08 and ~0.55), the regression line shows that MAIAC values are more biased than MODIS. We conclude that at low aerosol load levels, MAIAC exhibits greater uncertainty than the MODIS DT, as well as a higher bias. This highlights the importance of taking uncertainties into account when using satellite-derived AOD products to estimate PM.

Poster research topic(s)

Satellite study, Remote sensing, Aerosols

Americas-19

Computational Chemistry Re-interprets Laboratory and Field Studies of Oxidation of Hg(0) Initiated by Nitrate Radical

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Abstract

Mercury, a potent neurotoxin, is released into the atmosphere as Hg(0), where it can be oxidized to Hg(II) compounds. Due to very different deposition patterns of Hg(II) versus Hg(0), we need to understand the redox chemistry of atmospheric Hg to unravel the complexities of mercury biogeochemical cycling. Peleg et al., (2015) suggested a role for NO_3, on the basis of the strong correlation between [NO_3] and [Hg(II)] at night. Hence, we used computational chemistry to explore reaction R1 oxidizing Hg(0) to Hg(I) :

$Hg + \bullet NO_3 = NO_3Hg\bullet$ (R1)

followed by two types of reactions oxidizing $NO_3Hg\bullet$ to Hg(II):

$NO_3Hg\bullet + O_3 \rightarrow NO_3HgO\bullet + O_2$ (R2)

$NO_3Hg\bullet + Y \rightarrow NO_3HgY$ (R3)

where Y = BrO, NO_2, NO_3, HO_2, and O_2. The thermodynamics of R2 and R3 calculated at CCSD(T)//DFT resembles the analogous reactions of BrHg• and HOHg•. However, the weak bond of $NO_3Hg\bullet$ (6.5 kcal/mol) causes it to decompose more rapidly than BrHg• (15.5 kcal/mol) or HOHg• (11.0 kcal/mol), so only O_3 has a chance of oxidizing $NO_3Hg\bullet$ to Hg(II).

Peleg et al. concluded that NO_3 was associated with nighttime formation of gaseous Hg(II). Our kinetic simulations indicate that NO_3-initiated production of Hg(II) is at most ~1 pg/m^3 per night, far lower than the 12 pg/m^3 average increase in [Hg(II)] from evening to nighttime observed by Peleg et al. Hence, we conclude that R1 did not contribute to the elevated levels of Hg(II) they observed.

Sommar et al., (1997) reported an upper limit to k1 of 4×10^{-15} cm^3 $molecule^{-1}$ s^{-1} from experiment. Our kinetic analysis indicates that gas-phase loss of Hg(0) would have been undetectably small in their experiment, even if k1 was near the collision limit. So, their reported upper limit is not valid.

Poster research topic(s)

Trace gases, Land-Atmosphere interactions, Modelling study

Americas-20

Characterizing Ice Nucleating Particles over the Southern Ocean using Simultaneous Aircraft and Ship Observations

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Abstract

Supercooled liquid clouds are ubiquitous over the Southern Ocean (SO), even to temperatures below -20 °C, and comprise a large fraction of the marine boundary layer clouds in the region. Earth system models and reanalysis products have struggled to reproduce the observed cloud phase distribution and occurrence of cloud ice over the SO. Recent simulations found the microphysical representation of ice nucleation and growth has a large impact on these properties, however, measurements of SO ice nucleating particles (INPs) to validate simulations are sparse. Observations of INPs are presented from simultaneous aircraft and ship campaigns conducted over the SO in austral summer 2018: the Clouds, Aerosols, Precipitation Radiation and atmospherIc Composition Over the southeRN ocean II (CAPRICORN-2) study on the CSIRO R/V Investigator, and the Southern Ocean Cloud Radiation Aerosol Transport Experimental Study (SOCRATES) on the NSF/NCAR G-V aircraft. The SOCRATES campaign is noteworthy for collecting the first in situ observations in and above cloud in the region. Measurements of INPs active in the immersion freezing mode were made during both projects in real time with Colorado State University (CSU) Continuous Flow Diffusion Chambers (CFDCs) at temperatures below -25 °C, and via offline analysis of aerosol filter, rainwater and seawater samples using the CSU Ice Spectrometers from -10 to -30 °C. While INP concentrations below and above cloud are similar, the ice nucleation efficiency is higher above cloud, supporting model inferences that the dominant INP composition varies with height. In addition, chemical treatments performed on the filter suspensions were used to infer the fraction of biological, organic, and mineral INPs, which varies with latitude and height, and indicate a variety of sources, including local marine aerosol and dust. Aerosol iron measurements collected during CAPRICORN-2, as well as back trajectories, provide additional insights into INP composition and possible sources.

Poster research topic(s)

Field study, Satellite study, Climate, Ocean-Atmosphere interactions, Aerosols, Clouds

Americas-21

Wildfire emissions during the BB-FLUX campaign: an example of measurements from the University of Wyoming King Air Facility

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Abstract

Since 1977 the University of Wyoming's Beechcraft King Air 200T (UWKA) carried out hundreds of atmospheric research projects – supporting instrument development, educational initiatives, and addressing science questions – before retiring in 2022. The UW Next Generation King Air, a modern Beechcraft King Air 350i, is currently undergoing specific modification to accommodate research instrumentation and will make its debut to the science community in 2024. The King Air Facility, encompassing an aircraft and a set of research-grade instruments including radar, lidar, cloud physics, air chemistry, and aerosol probes, was designed to be highly adaptable, including accommodating custom instruments from individual Principal Investigators, to address atmospheric science related questions.

One example of the utility of this facility is the Biomass Burning Flux Measurements of Trace Gases and Aerosols (BB-FLUX) campaign, which sought to quantify the emission fluxes from wildfires and better understand the disparate measurements from satellite and ground-based platforms. Wildfire smoke plumes are heterogeneous – a complex mixture of trace gases and particles that can vary over short spatiotemporal scales. Within plumes, secondary chemistry forms ozone and particulate matter that affects human health. BB-FLUX leveraged in situ and total column trace gas measurements in combination with wind measurements aboard the UWKA to yield wildfire emission fluxes spanning nearly 4 orders of magnitude. Fires of different fuel types were specifically targeted in the northwestern US in the summer of 2018. The BB-FLUX synergistic payload of both remote sensing and in situ instruments allowed determination of total carbon fluxes, which indicate satellite observations in the study area underestimate emissions, especially from smaller fires that can be missed entirely.

This presentation will describe the unique King Air Facility and BB-FLUX as a relevant example to illustrate recent scientific advancements particularly addressing the difference between satellite and aircraft measurement perspectives regarding wildfire emissions.

Poster research topic(s)

Field study, Remote sensing, Trace gases, Clouds, Aerosols

Americas-22

Ozone Atmospheric Chemistry in Southeast Michigan during the Michigan-Ontario Ozone Source Experiment (MOOSE)

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Abstract

Surface ozone (O_3) levels in Southeast Michigan (SEMI) exceed U.S. National Ambient Air Quality Standards (NAAQS), posing risks to human health and agroecosystems. SEMI, a relatively small region in the state of Michigan, contains a majority of anthropogenic emission sources and more than half of the state's population, and is also prone to long-range and transboundary pollutant transport. Understanding the physical and chemical drivers of elevated O_3 through detailed and innovative modeling studies is crucial for addressing this issue. In this study, we explore the distribution of O_3 and its precursors (e.g., NOx & VOCs) over SEMI for the summer of 2021 using the 3-D chemistry-climate model, MUSICAv0 (Multi-Scale Infrastructure for Chemistry and Aerosols, Version 0). Model simulations are evaluated with Michigan-Ontario Ozone Source Experiment (MOOSE) field campaign measurements. A horizontal resolution of ~7 km x 7km in MUSICAv0 was developed over Michigan to better understand the local-scale impacts of chemical and dynamic complexity existing in SEMI. MUSICAv0 with the refined model grid shows excellent skill in capturing diurnal variations of temperature and O_3, but shows larger variations for nitrogen dioxide (NO_2). The MUSICAv0 results for NOx and its oxidation products (e.g., HNO_3) were improved by applying a diurnal cycle to anthropogenic nitric oxide (NO) emissions, as global models generally do not include diurnal variation of emissions. Optimization of regionally-refined, coupled models such as MUSICAv0, through resolution and emission modeling studies, have significant implications for air quality projects at the local-scale and the design of effective surface O_3 mitigation strategies.

Poster research topic(s)

Modelling study, Air quality

Americas-23

Random forest algorithm for the prediction of Buenos Aires air quality

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Abstract

To assess the current air quality situation in the Buenos Aires Metropolitan Area (MABA), Argentina for criteria pollutants (CO, NO_x, SO_2, O_3, PM_{10}) a Random Forest (RF) model has been trained using 2019 surface data from two monitoring sites. This machine learning technique is gaining interest as a method for predicting the average concentrations of atmospheric pollutants at a specific location. Explanatory variables of different types were considered: meteorological, temporal, emission cycles and air pollution concentrations. The results obtained showed that the RF model captured the observed hourly variations and diurnal cycles for all pollutants. In addition, the analysis of partial dependence plots revealed the non-linear relationships between emissions, chemistry and meteorology. For modeling CO concentrations, the variables boundary layer height, and wind speed were the most important. For O_3, the key variables were the concentrations of the other pollutants included in the model. The model's ability to cope with other periods was assessed by comparing its response with that of the numerical atmospheric model results (WRF-Chem) obtained and observations for the period from 28 August to 16 September 2015. The interquartile interval was better represented by the WRF-Chem model while the RF model showed a better performance to reproduce the mean values. Machine learning models require much less computational power but lack the ability to predict meteorological conditions along with pollution levels. Even though WRF-Chem had the biggest advantage of forecasting all the data of the domain study, Random Forest algorithm provided a better accuracy for capturing diurnal cycles.

Poster research topic(s)

Modelling study, Air quality

Americas-24

Physical properties of aerosol containing short chain organosulfates

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Abstract

Organosulfates are known to exist in the aerosol phase, forming through reactions of sulfuric acid and volatile organic compounds as well as fatty acids. Although comprising up to 30% of the organic mass of aerosol in some cases, the impact of organosulfates on the physical properties of aerosol, necessary to assess its climate impact, are greatly under investigated. In this work, we measure the physical properties of aqueous sodium methyl and ethyl sulfates necessary to begin to understand their impact on aerosol radiative forcing. We measure water activity, density, refractive index at 589 nm and surface tension for aqueous solutions of these organosulfates. Density and refractive index are parameterized and can be used for the Lorentz-Lorenz mixing rule to predict the optical properties of aerosol containing short chain organosulfates along with other species. For all measured physical properties, we compare our results to literature data for sulfate salts (sodium sulfate and sodium bisulfate) as well as short chain organic molecules (carboxylic acids and alcohols). Through these comparisons we show that organosulfates have intermediate properties to salts and similarly sized organics, and approximating the properties of the organosulfate portion as organic or inorganic will lead to great errors in the predicted aerosol physical properties.

Poster research topic(s)

Laboratory study, Aerosols

Americas-25

Reconciling a national methane emission inventory with in-situ measurements

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Abstract

The Eastern Mediterranean and the Middle East (EMME) region is an emerging regional hotspot of greenhouse gas (GHG) emissions, and recently overpassed EU GHG emissions. However, due to the absence of systematic atmospheric GHG measurements in EMME, it remains challenging to characterize, validate and quantify the spatial distributions and the strength of emissions in this region. Towards this direction, we performed year-long (Oct. 2020-Sep. 2021) mobile methane (CH4) measurements in Cyprus. Cyprus is an island country located in the eastern Mediterranean Sea with methane emission sources emanating primarily from waste and agricultural activities (UNFCCC, 2021).

The measurements were conducted with a Picarro (G2401) set-up in a moving vehicle (car), with a sonic anemometer installed on the roof. The study's goal was to enhance our understanding of the distribution of methane on the island and ultimately validate the national bottom-up inventory of CH4 emissions. During the measuring period, we were able to quantify the strength of local CH4 emission hotspots at Koshi (active landfill), Kotsiatis (closed landfill) and Aradippou area (cattle farms). These areas account for about 28% of the total CH4 emission in Cyprus. The emission rates of these hotspots were estimated using the Gaussian plume model embedded in the Polyphemus air quality modeling system. The calculated methane emissions from landfills of Koshi and Kotsiatis (25.9 ± 6.4 Gg yr−1) and enteric fermentation of cattle (10.4 ± 4.4 Gg yr−1) were about 129 % and 40 % larger, respectively than the bottom-up sectorial annual estimates used in the national UNFCCC inventory. The parametrization of the Gaussian plume model dominates the uncertainty in our method, with a typical 21 % uncertainty.

Poster research topic(s)

Greenhouse gases, Field study

Americas-26

The global budget of atmospheric ethanol: new constraints from remote and urban measurements

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Abstract

Ethanol is ubiquitous in the troposphere, emitted both by plants and from anthropogenic activity (including industry, solvent use, fuel, and agriculture). As a precursor of acetaldehyde and in turn peroxyacetyl nitrate (PAN), ethanol contributes to the long-range transport of NOx and increased tropospheric ozone production, and its high mixing ratios in cities can be a major sink of OH. Here, we reassess the global budget of tropospheric ethanol by comparing measurements from the Atmospheric Tomography (ATom) and AEROMMA campaigns to simulations using the global atmospheric chemistry model GEOS-Chem. We find that known sources already in the model underestimate observed ethanol mixing ratios by over 90%. To reduce the simulated ethanol bias, we add a range of new ethanol emission sources informed by recent experimental and observational studies, including oceanic emissions, secondary production from the CH3CH2OO + OH reaction, agricultural emissions, vehicular fuel use, and emissions from volatile chemical products (VCPs). We find that the updates substantially improve the comparison of simulated ethanol mixing ratios to ATom measurements, reducing the normalized mean bias across all points from -91% to -23%. VCPs become the dominant atmospheric ethanol source. The remaining negative model bias correlates strongly with VCP and fuel sources, suggesting that anthropogenic emissions are still underestimated. This is particularly true over the South Atlantic, where model bias remains high (-70%) and where ATom sampled strong influence from Brazil, which has a large domestic bioethanol industry and high ethanol fuel use. We find that the increased ethanol sources reduce global tropospheric OH by 2.6% and increase tropospheric ozone by 1.7%, with the strongest effects (up to -18% OH, +6 ppb ozone) in South and East Asia. The new ethanol sources also lead to increased acetaldehyde and, in turn, PAN (+24%), which leads to strengthened redistribution of NOx from continental to remote tropospheric regions.

Poster research topic(s)

Field study, Modelling study, Land-Atmosphere interactions, Ocean-Atmosphere interactions, Trace gases, Air quality

Americas-29

Assembly of analytical techniques and statistical methods in the study of particulate matter 2.5 in Buenos Aires.

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Abstract

In Latin America and the Caribbean, the most urbanized region on the planet, urban air quality is a key issue in almost all its cities, where emissions from transport and industry, biomass burning due to deforestation and agricultural practices, volcanoes and dust, from the Sahara or the arid diagonal that make up the deserts of the South, converge. In this context, PM2.5 is of greatest concern, and with the aim to provide a comprehensive response, a regional project was developed between 2019 and 2024, evaluating levels, chemical composition and local and regional sources simultaneously in 13 cities in the region. In this work we present part of the results obtained for Buenos Aires City.

PM2.5 chemical composition was determined through a set of complementary analytical techniques such as ion chromatography, inductively coupled plasma mass spectrometry and OC-EC analyzer as a thermo-optical method, presenting a complete set of PM2.5 carbonaceous fraction data for the first time in this city.

Levels and temporal variations of metals, ions and EC/OC concentrations has been analyzed, coupling satellite remote sensing products, information from the AERONET network spectrometer (CEILAP-BA) and retro trajectories, obtained by applying the HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) model. Finally, local and regional source contribution has been assessed, using the statistical advantages of principal components, cluster analysis, factor analysis, and multivariate curve resolution among other data analysis methods such as the PMF receptor model. These results constitutes an important baseline information for the city's air quality management and for studying the impact of AMBA emissions on global climate change.

Poster research topic(s)

Field study, Laboratory study, Remote sensing, Air quality, Health, Aerosols

Americas-30

Identifying and quantifying secondary aerosol in polluted Fairbanks, Alaska on an individual-particle basis

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Abstract

Atmospheric aerosols are complex chemical mixtures that significantly contribute to air pollution, and have human health and air quality impacts. Aerosol sources (i.e., natural or human-derived) and secondary chemical reactions in the atmosphere affect particle properties and subsequent health effects. Secondary aerosol species (e.g., sulfate, nitrate, and ammonium) can accumulate on particles through multiphase and heterogeneous reactions and gas-to-particle partitioning, and the presence of these species is indicative of atmospheric processing (aging) of the particles. Traditionally, bulk measurement techniques have been used to study aerosol particles, but they assume a homogeneous particle population and provide limited information about particle sources. Single particle techniques measure the distribution of chemical species for individual particles to identify particle sources and relative particle aging. In Fairbanks, Alaska (USA), a city that frequently experiences poor wintertime air quality, regional topography traps local gaseous and primary particulate emissions. The gaseous species can oxidize, forming lower volatility compounds that partition to the particle-phase and form secondary aerosol. To investigate secondary species within the aerosol population, a single-particle mass spectrometer was used to measure the size and chemical composition of individual aerosol particles during the Alaskan Layered Pollution And Chemical Analysis (ALPACA) field campaign in Fairbanks, Alaska from Jan. – Feb. 2022. The resulting chemical composition data was then combined with bulk measurements to quantify the contribution of secondary species that form during particle aging to particles from different sources. This work helps improve understanding of the differences in aging of aerosols from different sources and how they contribute to wintertime air pollution in Fairbanks, Alaska.

Poster research topic(s)

Field study, Air quality, Aerosols

Americas-31

Local and Remote Radiative and Temperature Impacts from Recent Rapid Changes in PM2.5 Air Pollution over China

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Abstract

The large reduction in anthropogenic aerosol emissions across China in recent years has improved China's air quality but also resulted in changes to the regional aerosol radiative forcing. Here, we aim to understand changes in the sources of anthropogenic fine particulate matter (PM2.5) – emissions of black carbon (BC), sulphur dioxide (SO2) and organic carbon (OC) over China from 2008 to 2016 under a series of policies enacted by the Chinese government, and to determine the resulting changes in radiative forcing both locally and remotely. We use ECLIPSE emission inventory to represent China's emissions of the three pollutants during this period as ECLIPSE inventory is a global inventory and can better estimate China aerosol emission changes. UKESM1 is used to simulate the individual radiative forcing from changes in emissions of all anthropogenic aerosols sources, China BC only, China SO2 only and China OC only between 2008 and 2016. Our results show the largest reductions in BC and OC emissions over China were from the residential and industrial sectors, whilst the largest reduction in SO2 emission was from energy and industrial sectors. Compared with other inventories, ECLIPSE overestimates the reduction of emissions but shows the same trend. The local aerosol radiative forcing from only reducing Chinese emissions of BC, SO2 and OC jointly accounts for more than 90% of the total aerosol radiative forcing changes (0.83Wm-2), while this result is more pronounced across the North Pacific Ocean. This study provides new insight into the impact of regional air pollution emission control policies on climate, based on both changes in individual aerosol components and in total PM2.5. Our results show that air pollution policies can have strong local but remote climate impacts, which should be considered when designing such policies.

Poster research topic(s)

Modelling study, Air quality, Climate, Aerosols

Americas-32

HPLC-PDA Method Development, Optimization, and Validation for The Quantification of Organic Acids

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Abstract

Substantial uncertainties are associated with aerosol chemical composition and secondary organic aerosol formation mechanisms. Current models only consider acetic and formic acids, thereby underestimating organic acid atmospheric concentrations by 50%. In this work, we developed and validated two fast analytical methods for a High-Pressure Liquid Chromatograph coupled with a Photodiode Array detector (HPLC-PDA) for quantifying twelve monocarboxylic and dicarboxylic acids. Analyte separation was performed on an XBridge C18 (4.6 x 150 mm, 3.5 µm) column using a mobile phase solution composed of 10% acetonitrile and 10 mM potassium dihydrogen phosphate buffer solution (KH_2PO_4) acidified with phosphoric acid (H_3PO_4). We optimized existing methods by investigating elution modes, mobile phase pH, and column temperature to improve peak resolution and shorten analysis time. Our proposed method is characterized by a gradient elution mode with flow rates ranging from 1 to 2 mL min -1 and a short analysis time (~7 mins). The calibration curves showed excellent correlation (R^2 > 0.999) and peak resolution (> 1.5). The limits of determination for all six acids (LOD) ranged from 0.87 to 1.51 ppm, while the limit of quantification (LOQ) ranged from 2.63 to. 4.59 ppm. Lastly, the HPLC methods were applied to fog and rainwater samples collected from a building rooftop in an urban environment.

Poster research topic(s)

Aerosols, Field study, Laboratory study, Instrument development

Americas-33

Chemical Composition, Morphology, and Sources of Individual Atmospheric Particles in the Urban Alaskan Winter

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Abstract

Despite the well-known negative health impacts of airborne particulate matter (PM), the chemical composition and sources of aerosol particles in wintertime high-latitude cities are not well characterized. Atmospheric inversion layers in these regions can exacerbate pollution by allowing PM to accumulate to levels that exceed air quality standards. These temperature inversions can also result in the formation of ice fog, a hazardous form of air pollution that occurs at low temperatures in the form of small ice crystals, which remain airborne for extended periods of time. Aerosol particles known as ice nucleating particles can contribute to ice fog formation; however, many questions remain due to the limited observations of particle populations. To improve understanding of wintertime urban air quality, atmospheric particles were collected from January–February 2022 during the Alaskan Layered Pollution and Chemical Analysis (ALPACA) field campaign in Fairbanks, Alaska, USA. Scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX) was used to study the morphology, elemental composition, and mixing state of individual particles in Fairbanks for the first time. These single-particle properties were used to identify the major particle types and sources present in wintertime Fairbanks. The distribution of sulfur across particle types was also examined, revealing both primary sulfur emissions sources and secondary formation through multiphase reactions. These results provide insights into the main sources of wintertime aerosol impacting air quality in Fairbanks and are of high relevance for pollution mitigation efforts.

Poster research topic(s)

Field study, Air quality, Aerosols

Americas-34

Quantifying aerosol scavenging efficiencies in tropical convective clouds over the West Pacific

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Abstract

In-cloud scavenging of aerosols remains a large source of model uncertainty, affecting capabilities to capture the aerosol lifetime and impacts on air quality and climate. While past work quantified aerosol mass scavenging efficiencies (SEs) in midlatitude deep convective clouds (cloud top heights > 8 km above mean sea level) with substantial mixed phase hydrometeors, SEs are less well-known for shallower convection. Using aircraft data over the tropical West Pacific during NASA's Cloud, Aerosol, and Monsoon Processes – Philippines Experiment (CAMP2Ex), we calculated SEs for three cases of tropical marine cumuli (3 – 7 km cloud top heights). SEs of aerosol mass concentrations were determined with a simple entrainment model using measurements of the cloud outflow and nearby clear air. Speciated SEs were calculated for different outflow altitudes (3/4.5/5.5 km) for sulfate (94.1/95.0/86.7%), black carbon (79.6/79.7/72.6%), organics (60.8/49.6/53.1%), ammonium (87.2/53.9/61.3%), and nitrate (61.5% at 3 km). Potential factors influencing SE include the Wegener-Bergeron-Findeisen process at the freezing level (~5 km), the preferential activation and removal of large particles near cloud base, and lightning-produced nitrate. SEs of volume concentration increased with particle diameter: 3 – 100 nm (30 – 50%), 100 – 1000 nm (>92%), and 1 – ~5 μm (>98%), suggesting cloud droplet activation of larger particles followed by autoconversion. Mass-based SEs do not differ substantially between tropical cumuli and midlatitude deep convective clouds, attributable to the negligible particle mass activated at higher supersaturations. The efficient scavenging of BC (>70%) can be explained by an enhanced hygroscopic fraction of BC based on model results from the MUlti-Scale Infrastructure for Chemistry and Aerosols (MUSICA) version 0, suggesting interactions of BC particles with more soluble species during long-range transport from East Asia. The estimates of BC SEs provide direct evidence of substantial BC removal in convection as inferred by previous work and should motivate improvements in chemical transport models.

Poster research topic(s)

Field study, Aerosols, Clouds

Americas-35

Major African dusts intrusions in Puerto Rico based on the long term in-situ ground measurements of aerosol optical properties.

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Abstract

African dust particles play an important role in the climate system, as they can affect the Earth's radiative balance and the hydrological cycle. Mostly during the summertime, million tons of African dust efficiently transported westwards, cross over the Atlantic and impact the atmosphere in the Caribbean and contiguous United States. This led to high aerosol loadings being observed in the Caribbean. This study investigates the climatology of aerosol optical properties (scattering coefficients, absorption coefficients, aerosol optical depth) recorded based on the in-situ ground measurements at Cape San Juan, Puerto Rico (CPR), USA, for about 18 years (2006-2022). Here the research focuses on the frequency and intensity of dust events received for the period and will be discussed. Furthermore, the study will highlight the dust events observed in 2020 and 2021 in terms of record amount of dust, dust plume associated with bioaerosol signature, and some events with possible influence of volcanic aerosols. Given the wide impact of African dust over this region, the research findings would contribute greatly to model development and to better constrain the characterization of dust over the receptor region.

Poster research topic(s)

Field study, Remote sensing, Satellite study, Air quality, Climate, Aerosols

Americas-36

Linking Ground-Based Sensor Data to Airborne and Satellite Observations during the AEROMMA Campaign

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Abstract

In the Los Angeles basin, a wide variety of urban pollutant sources and marine emissions interact via complex mechanisms in the atmosphere, which are difficult to measure and model. In the summer of 2023, we deployed a network of ground-based low-cost air quality sensors in the greater Los Angeles area to coincide with NOAA and NASA's Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) campaign. Sensors were placed near the flight campaign's takeoff location as well as near several planned spiral locations. All but one sensor were also co-located with ground-based remote sensing instruments, including Pandora and Total Carbon Column Observing Network (TCCON) spectrometers. Here, we aim to quantify the discrepancies among these datasets, namely by modeling the surface concentration as a function of airborne and remote sensing measurements. [AH1] Thoroughly calibrated sensor measurements were considered the ground truth surface concentration, and machine learning techniques were used to estimate the surface level and lower tropospheric concentrations. Models including artificial neural networks, random forest regressions, and gradient-boosted decision trees were explored[AH2] , with inputs including airborne and remote sensing column measurements, WRF-Chem outputs, satellite data (including TROPOMI and preliminary TEMPO), and environmental parameters (e.g. temperature, humidity, wind speed, wind direction, solar zenith angle). Sensitivity analyses were performed to determine which model inputs drive surface concentrations. Comparisons were drawn between our ground-truth measurements and ground-based estimates provided by the Pandora network. This work bolsters our ability to close the gap between column, airborne, and ground-based air quality, improving assessments of how representative these data are for health and environmental justice applications.

Poster research topic(s)

Field study, Air quality, Trace gases

Americas-37

Secondary organic aerosol yields of decamethylcyclopentasiloxane (D5) and Octamethylcyclotetrasiloxane (D4) in an Oxidation Flow Reactor

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Abstract

Volatile methyl siloxanes (VMS), commonly found in personal care products (PCP), are recognized as relatively long-lived (~4-10 days at typical oxidant levels) organic gases. They have a potential for long-range transport and are useful as markers of human-influenced air masses. VMS undergo oxidative processes leading to the formation of oxidized volatile methyl siloxanes (oVMS), ultimately contributing to the production of secondary organic aerosols (SOA). In this work, we present results on aerosol yield of seeded and unseeded oxidation of common VMS compounds decamethylcyclopentasiloxane (D5) and octamethylcyclotetrasiloxane (D4). Oxidation occurred in a 13-liter Potential Aerosol Mass Oxidation Flow Reactor (PAM OFR) in OFR185 mode. Gas phase precursor concentrations ranged from approximately 76 to 900 µg.m-3, while OH exposures ranged from 0.6x1013 to 0.9x1013 molecules.s.cm-3. We further present our 0D kinetic modeling framework which assisted in the characterization and interpretation of OFR data. Aerosol yields vary with < 0.1% in lower precursor concentration and OH exposure and increasing to ~ 22% in higher precursor concentration and OH exposure.

Poster research topic(s)

Laboratory study, Air quality, Aerosols

Americas-38

Variability and trends of ammonia from ground-based FTIR measurements and global chemical transport models

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Abstract

Ammonia (NH3) is the most abundant alkaline compound of our atmosphere, and is involved in several reactions, including the neutralization of acids and the formation of particulate matter, with direct consequences to the environment and human health. NH3 is primarily emitted from agricultural sources, however, it is also present in urban and remote environments. NH3 emissions and deposition depend strongly on environmental conditions; temperature and moisture play a crucial role in determining NH3 concentrations on diurnal to annual scales. Previous studies have used satellite measurements to assess the global variability of NH3; however, the interannual variability does not reveal clear trends and it is not possible to determine the diurnal variability as a consequence of the limited satellite observations per day. The objective of this study is to determine and compare the temporal variability and trends of NH3 mainly by using datasets of total columns retrieved from spectroscopic solar absorption measurements performed at twenty ground-based Fourier transform infrared (FTIR) sites globally distributed from 80°N to 45°S, most of them part of the Network for Detection of Atmospheric Composition Change (NDACC). In addition, the FTIR data are compared with NH3 from the GEOS-Chem chemical transport model and from the preliminary Tropospheric Chemistry Reanalysis (TCR-2) NH3 product, to provide additional insight into the variability and trends of NH3. The results show that NH3 trends are increasing in most of the sites, mainly due to the decreasing trends of NOx and SO2 concentrations and a lack of regulations on NH3 emissions.

Poster research topic(s)

Modelling study, Remote sensing, Air quality, Trace gases

Americas-39

Methane mitigation to counteract the climate and composition effects of hydrogen leakage and reduction in other short-lived climate forcers from a future hydrogen economy

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Abstract

Hydrogen (H2) has been proposed as an important fuel to help transition the world towards a zero-carbon economy. However, H2, when leaked into the atmosphere, is an indirect greenhouse gas with a global warming potential GWP100 ~ 12, primarily because H2 prolongs methane (CH4) lifetime, is a source of stratospheric water vapor (H2O), and also increases tropospheric ozone (O3) burden. The atmospheric effects of H2 leakage mirror that of CH4 emissions, and their chemistry is also coupled primarily through sharing the hydroxyl radical (OH) sink. We used an atmospheric chemistry-climate model (CCM), GFDL AM4.1, driven by H2 and CH4 emissions, to probe their interactions. We find that, because changing CH4 and H2 emissions induce similar composition effects, increasing CH4 emissions can enhance H2 effects and vice versa, mitigating CH4 emissions can offset H2 effects. We also find that the composition and effective radiative forcing (ERF) response to increased H2 emissions is dependent on background CH4 emission levels. In particular, the H2 ERF decreases with decreasing CH4 emissions (and vice versa), being up to 70% lower when all anthropogenic CH4 emissions are removed compared to under present-day CH4 emissions.

In addition, the H2 economy also displaces fossil fuels in various sectors. This leads to reductions in other short-lived climate forcers (SLCFs) which include tropospheric O3 precursors like nitrogen oxides (NOx = NO + NO2), carbon monoxide (CO) and non-methane volatile organic compounds (NMVOCs), secondary aerosol precursors like sulfur dioxide (SO2) and ammonia (NH3) and primary aerosols like black carbon (BC) and organic carbon (OC). We investigated a particular H2 economy future and found that, while these reductions improved air quality (by reducing O3 and PM2.5), they cause a net warming ERF. We show that CH4 mitigation is even more important to counteract the combined effects of H2 leakage and reduction in other SLCFs.

Poster research topic(s)

Modelling study, Greenhouse gases, Trace gases, Aerosols, Climate, Air quality

Americas-40

Sub-saturated Aerosol Hygroscopicity during the CAMP2Ex Airborne Campaign

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Abstract

Aerosol hygroscopicity affects the Earth's radiation budget, secondary aerosol formation, cloud formation, health, and remote sensing. The varied local and transported emissions and available moisture in Southeast Asia is ideal for aerosol hygroscopicity studies: one of the goals of the Cloud, Aerosol, and Monsoon Processes Philippines Experiment (CAMP2Ex) airborne measurement campaign from August to October 2019. Aerosol hygroscopicity via light scattering hygroscopic growth factor, f(RH), was calculated from the amplification of (<5 μm dry diameter) aerosol scattering from 20% to 80% relative humidity around the Philippines during CAMP2Ex. Median f(RH) was relatively low (1.26 like polluted environments), due to elemental and organic carbon. Geographically, median f(RH) was lowest, and associated with accumulation mode particles, near Borneo during its biomass burning season. Highest f(RH) was linked with coarser particles around northern Philippines, where f(RH) increased at higher altitudes, probably from convective transport. Convective transport may have decreased and increased hygroscopicity aloft, respectively, for certain case studies, with increased submicron organic and sulfate mass fractions. Cloud processing may have influenced the case with increased sulfate mass fraction aloft, based on volume size distributions. Organics, on the other hand, are known to decrease f(RH). This anticorrelation was most significant at lower altitudes (< 3 km). The highest organic mass fraction and lowest f(RH) was observed for back trajectories from the Maritime Continent along with carbon monoxide concentrations (>0.25 ppm) typical of smoke particles. Back trajectories from the West Pacific were sulfate dominated with the highest f(RH), typical of polluted marine environments, while those from East Asia were typical of urban environments (highest ammonium mass fraction). The CAMP2Ex geographic distribution and associated air mass characteristic for aerosol hygroscopicity documented here provide valuable information for the next step of evaluating results from models used for aerosol-cloud interaction studies.

Poster research topic(s)

Field study, Aerosols, Air quality

Americas-42

Sources and contributions of trace metals within wintertime fine particulate matter in a sub-Arctic city

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Abstract

Prolonged exposure to fine particulate matter (PM2.5, below 2.5 μm in diameter) significantly exacerbates rates of cardiovascular, respiratory, and neurological disease. In particular, inhalation of heavy metals in ambient PM2.5 is associated with elevated oxidative stress in lung and brain tissue. While air quality standards limit PM2.5 concentrations, few guidelines exist for ambient trace metals. During the wintertime, Fairbanks, Alaska (USA) experiences severe PM2.5 pollution caused by regional topography and low temperatures that retain local emissions near the surface. While previous chemical measurements focused on identifying major PM chemical components in Fairbanks, few studies have investigated the sources and contributions of trace metals in the wintertime PM. During the wintertime Alaskan Layered Pollution and Chemical Analysis (ALPACA) campaign in Fairbanks, Alaska, an aerosol time-of-flight mass spectrometer (ATOFMS), which measures the size and chemical composition of individual particles in real-time, and particle sizing instrumentation were deployed to measure single-particle chemical composition and aerosol concentrations. The resulting singleparticle dual-polarity mass spectra from the ATOFMS allows for the identification of particle sources and the distribution of trace metals in the aerosol population. Here, we describe the major sources (i.e., residential heating, vehicle emissions, and mineral dust) and contributions of particulate metal species (i.e., iron, vanadium, and lead) on a single-particle basis. Additionally, the distribution of sulfate within metal-containing particles was investigated. This work improves the understanding of the ambient particulate metals and their impacts on urban wintertime air quality in Fairbanks, AK.

Poster research topic(s)

Field study, Air quality, Aerosols

Americas-43

Mixing state of secondary aerosol in the wintertime Arctic: a bulk and single-particle study on chemical aging

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Abstract

The Arctic is undergoing dramatic transformations due to rapidly increasing surface temperatures, resulting in more open water from reduced sea ice. Therefore, the Arctic atmospheric aerosol population is expected to be changing through new emissions of both natural and anthropogenic sources. The mixing state (distribution) of the chemical species within a particle impacts the particle's climate-relevant properties, including reactivity and hygroscopicity, and potential health impacts, including toxicity. During transport, aerosols undergo aging through chemical reactions and partitioning of semi-volatile compounds, altering their composition and further impacting climate- and health-related aerosol properties. Traditionally, bulk analytical techniques are used for aerosol measurements; however, these methods assume a homogeneous particle population, which is not representative of a real-world population containing individual chemically unique particles. To address this limitation, this work uses a combination of single-particle and bulk techniques to describe aerosol mixing state (distribution of chemical species across the aerosol population) in the context of atmospheric aging. These complementary methods provide a more accurate evaluation of the chemical mixing state of ambient aerosols in the understudied wintertime Arctic. In Nov. – Dec. 2018, a field campaign near Utqiaġvik, Alaska (USA) measured atmospheric aerosol composition using a suite of instrumentation. Single-particle chemical characterization was provided by an online aerosol time-of-flight mass spectrometer and offline computer-controlled scanning electron microscopy with energy dispersive X-ray spectroscopy. Bulk atmospheric particle mass concentrations were measured using an online, continuous light absorption photometer and offline ion chromatography. The particle population was dominated by combustion-derived aerosol, and by examining the main aerosol components associated with this aerosol type (e.g., nitrate, ammonium, organics, black carbon) with respect to sulfate, a common aging marker, the mixing states of individual particles and PM1 (particulate matter < 1μm in diameter) population can be quantified.

Poster research topic(s)

Field study, Aerosols, Climate, Air quality

Americas-44

COVID-19 impacts on the US methane emissions

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Abstract

Methane is a potent greenhouse gas with ~9 years of lifetime, a global warming potential of 30 over 100 years, and radiative forcing of 0.650 Wm-2 since 1750. In the 26th Conference of Parties (COP26), the US signed the Global Methane Pledge, which aims that by 2030, the emissions must be reduced by 30% relative to the 2020 levels. Hence, monitoring and quantifying CH4 emissions has become critical towards national greenhouse gas mitigation. In addition, COVID-19 disrupted normal human activities worldwide. Evidence shows that COVID-19 restrictions resulted in a reduction in air pollutants concentrations, however, more research is needed to understand the direct and indirect impacts of COVID-19 on greenhouse gas emissions. Here we present a detailed quantification of methane emissions over the contiguous US. We assimilated NOAA CH4 ObsPack GLOBALVIEW+ observations between December 2017 and January 2021. We used the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model to simulate atmospheric transport with meteorology from the 12-km NAM nested with Global Forecast System with 0.25 degrees resolution (GFS0.25). We then conducted inverse modeling analyses with different background estimates and prior emissions. Our posterior estimates indicate a reduction of 2020 anthropogenic CH4 emissions compared to the 2019 level in certain areas consistent across all ensemble estimates. This presentation will discuss these 2020 CH4 emission anomalies and their underlying causes.

Poster research topic(s)

Modelling study, Greenhouse gases

Americas-45

A comparison of direct measurements of stratospheric aerosol size distributions with aerosol retrievals from limb sounding measurements (OMPS/LP V2)

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Abstract

Stratospheric aerosols affect both the global radiative budget and the ozone layer via heterogeneous reactions. Cooling caused by the volcanic injections can last for years, and pyrocumulonimbus-inducing wildfires are growing in frequency and intensity due to climate change. It is crucial that we understand the underlying mechanisms the result in the formation, growth, and loss of particles to understand the stratospheric aerosol burden and how it will react to future perturbations. To that end, we must develop climate models and validate them with measurements.

However, measuring aerosols in the stratosphere is challenging using traditional techniques. Continuous balloon-based measurements have been on-going since 1971, but they only provide a snapshot of the aerosol size distribution, and the majority of them are launched from mid-latitudes. Remote sensing methods, like the retrievals made based on measurements from the Ozone Mapping and Profiler Suite Limb Profiler (OMPS/LP), operate continuously and can circle the globe 14.5 times per day.

The aerosol retrievals from this instrument have been developing rapidly in the past years, drawing on information from other remote sensor retrievals, global climate models, and balloon-based measurements to inform the aerosol model used to convert measured irradiance into aerosol size and number. In this work, we will compare the OMPS/LP V2 aerosol product with optical properties measured directly (extinction) and based on direct measurements of aerosol size distributions in the stratosphere. These measurements were made as a part of the NOAA Stratospheric Aerosol processes, Budget and Radiative Effects (SABRE) mission. We measured the aerosol size distribution for particles from 0.03 to 1.5 um in diameter using the Aerosol Microphysical Properties (AMP) suite. AMP was deployed on the NASA WB-57F which performed 21 sorties as far north as 81°N, sampling altitudes between 10 – 18 km, a historically under sampled part of the stratosphere.

Poster research topic(s)

Field study, Remote sensing, Aerosols, Satellite study