ileaps | Integrated Land Ecosystem - Atmosphere Processes Study

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Newsletter

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Editor's Note

Fostering Collaborative Solutions for Environmental Challenges

As we near the conclusion of 2024, the environmental challenges facing our planet demand our immediate and collective attention. The alarming rise in plastic pollution, the health impacts of microplastics, and the intricate dynamics of atmospheric deposition on ocean biogeochemistry serve as stark reminders of the urgency of sustainable action. This year, iLEAPS has played a pivotal role in driving conversations and initiatives that address these critical issues, emphasizing collaboration and innovation.

One of the standout highlights of the year was our Side Event at the iCACGP-IGAC Open Science Conference, which shed light on the environmental and health impacts of global plastic waste trade and microplastic pollution. Developing nations often bear the brunt of inadequate recycling infrastructure, and our discussions emphasized the need for stricter international regulations and enhanced recycling technologies. This event brought together scientists and policymakers, reinforcing the importance of transboundary cooperation in combating these shared challenges.

Our efforts didn't stop at policy discussions. Workshops like FUNCHEM and the SOLAS Conference provided platforms for early-career researchers to engage with seasoned experts, fostering interdisciplinary approaches to tackle uncertainties in fire emissions and atmospheric chemistry. The establishment of standardized microplastic monitoring networks across Southeast Asia has further strengthened the foundation for regional and global data integration, enabling more accurate assessments of pollution's impact on health and ecosystems.

At the heart of these initiatives lies the understanding that no single entity can solve these challenges alone. The interconnected nature of our environmental problems requires a holistic approach—one that brings together scientists, policymakers, industry leaders, and local communities. Whether it's designing advanced filtration systems to mitigate air and water pollution or addressing the socio-economic impacts of urban green spaces, progress depends on the synergy of diverse perspectives and expertise.

As we forge ahead, iLEAPS remains committed to fostering global collaboration. Whether through capacity-building projects, early-career researcher support, or advocacy for sustainable policies, our mission is to catalyse progress. The path forward requires a blend of scientific rigor, innovative policy-making, and grassroots advocacy.

The stakes are high, but so is our collective potential. By fostering collaboration across scientific, political, and societal boundaries, we can address today's challenges while creating a sustainable and equitable future for generations to come.

Acknowledgement

We would like to extend our heartfelt appreciation to Bhagyashri Katre, IITM, Pune, India for her exceptional dedication, expertise, and commitment in crafting this comprehensive Newsletter.

Additionally, we would like to express our gratitude to all those who have provided guidance, feedback, and assistance throughout the development of this report. Your collective efforts have been invaluable in shaping the outcome. We are also truly thankful for the contributions from all authors.

Sincerely,

The iLEAPS IPO

Prof. Dr. Sharifah Norkhadijah Syed Ismail graduated from the University Putra Malaysia (UPM) with a Bachelor Science of Environmental and Occupational Health degree in 2003, and Master of Environmental Management (2006) and Doctor of Philosophy in Environmental Sciences (2011) from the University of East Anglia, United Kingdom. She is currently senior lecturer in Department of Environmental and Occupational UPM and a research associate in the Malaysian Research Institute on Ageing (MyAgeing) and Institute of Social Science Studies (IPSAS), UPM. Her research area is on environmental and occupational health. She specifically focusing on waste management and plastic pollution and its impact to human health. She is also a geospatialist.

Environmental and Public Health Impacts of Imported Plastic and Paper Waste Recycling Industries: A case study of Malaysia

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The high demand for plastic and paper waste has led to the growth of this industry in Malaysia with the total investment of RM199.5 million (USD 43.9 million) (Malaysian Investment Development Authority, 2020). Recycling waste has been an environmental concern were a significant pollution of the surrounding environment results in negative health outcomes in the local community. A study conducted recently around paper and plastic waste processing factories assessed perceived health symptoms among the population, monitored ambient air quality, measure chemicals in water and sediments and microplastic indicating significant environmental and health impacts.

One third of 520 respondents in the health survey were reported having coughing (31.5%), sore throat (28.5%) and hoarseness of voice (24.2.%). As for the unilateral and bilateral eye symptoms, 41.2% of respondents reported experienced itchy eye, 39.2% had watery eye and 35.4%had red eye. Respondents also reported a dry or cracked skin symptoms (33.5%), itchiness (16.7%), skin redness (9.4%) and skin discolouration (6.0%). The most common neurological health symptoms experienced by respondents were fatigue (34.6%), low energy (27.3%), dizziness (26.7%) and muscle ache (25.2%).

Respondents also having mood changes (23.8%), and sleeping issue (20.2%). Those with health symptoms lived in the residential area for less than 5 years and within 5 km from the factory. This finding suggests a clear correlation between duration of stay and proximity to recycling factories with the occurrence of health symptoms.

The average PM2.5 concentration across sampling locations within the waste paper recycling factory recorded the highest PM2.5 levels (61.73 µg/m³ to 62.04 µg/m³). This suggests a strong influence of the factory on air quality at these sites. The data reveals that average PM2.5 concentrations are nearly 30% higher within a 6 km radius of the Industrial Zone compared to areas located outside this perimeter. The concentrations of heavy metals at all sites were significantly higher compared to the control site. Copper (Cu) exhibited the highest concentration at waste paper recycling factory while the lead (Pb) was recorded high at the plastic waste recycling factory. These findings highlight significant levels of pollution or exposure to these metals at each location.

The water at the plastic waste recycling factory showed high level of turbidity (996 NTU), conductivity (1194.33 µS/cm to 41676.33 µS/cm) and total suspended solid (TSS) (768.65 mg/L to 1106 mg/L), exceed the Malaysian National Water Quality Standards (NWQS). The DO levels were low than the required standard an indication of poor water quality (1.35 mg/l to 2.78 mg/l). However, BTEX, phthalates and Bisphenol A (BPA) were below the detection limit.

Samples of road dusts and water contained microplastics at different shapes mainly fiber, fragment, microbeads, and filament. There are mainly made of several polymers includes; Polystyrene (PS); Polyethylene (PE); Polypropylene (PP); Polyvinyl chloride (PVC); Polyethylene Terephthalate (PET); Low density polyethylene (LDPE); Chlorinated Polyvinyl Chloride (CPVC); Polyamide (PA); Epoxy resin (EP); Polymethyl Methacrylate (PMMA); Polycarbonate (PC); Polyethersulfone (PES); Polyurethane plastic (PUPA); Alkyd resin (ALK); and Rayon (RY). The microplastic possibly originated from architectural coating and weathered plastic products (fragement) (Verschoor et al., 2016), textiles such as clothes, curtain, and bedding (fiber) (Dris et al., 2017), household products, fishing net, rope, and lines (filaments) (Dris et al., 2017). The microbeads were mainly from coasting additives (Spencer et al., 2003).

In conclusion, the health symptoms indicate a significant risk especially through inhalation particularly for those living near to the plastic / paper waste processing plants. The assessment has found an significant pollutants trend from the operation of plastic and waste paper recycling factories to the air pollution particularly PM 2.5, and heavy metals. Water quality analysis also indicate significant effects. Microplastics were observed across these sites in the air and water medium.

To address the significant pollutants and health risks identified from the operations of plastic and wastepaper recycling factories, the factory should be equipped with advanced filtration systems such as HEPA filters or electrostatic precipitators to capture particulate matter (PM 2.5) and heavy metals before they released the air into the atmosphere. Wet scrubbers or activated carbon filters can be used to trap harmful gases like dioxins, furans, and volatile organic compounds (VOCs) released during the melting process could reduce the emission to the air. Regular monitoring and enforce strict emission limits to ensure compliance with national and international air quality standards.

Enhance wastewater treatment plants at the recycling facilities to treat heavy metals, chemicals, and microplastics before releasing effluents into water bodies could reduce the effect to the water quality. Introduce filtration systems that can capture microplastics at both air and water outlets of recycling plants.

For water, granular filtration and sand filters are effective; whereas for air, fine-particle air filters can prevent microplastics from dispersing. Regular health screenings for nearby residents, particularly those living within 5 km of the recycling plants is needed to help identify early signs of pollution-related illnesses. Besides, community outreach programs able to educate residents about the potential health risks from air and water pollution and encourage protective practices, such as using air purifiers or drinking filtered water.

Dr. Norfazrin Mohd Hanif is a senior lecturer at Universiti Kebangsaan Malaysia (UKM), holding Bachelor's and Master's degrees in Chemistry from UKM and a Ph.D. in Environmental Sciences from the University of East Anglia, United Kingdom. Specializing in atmospheric chemistry, she explores tropospheric ozone-depleting substances' abundances, emissions, and transport on regional and global scales and investigating the impacts of natural and anthropogenic trace gas emissions on air quality and global climate. Her current research focuses on atmospheric microplastics. She is also passionate about various aspects of atmospheric science and its integration with environmental, health, policy, and socio-economic aspects

Atmospheric Microplastics

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Microplastics are ubiquitous and persistent in the environment due to the high global production and consumption of plastics, coupled with inefficient waste management systems and the slow degradation of plastic materials. Microplastics are no longer restricted to marine and terrestrial environments, they are increasingly contaminating the atmosphere, raising concerns about potential respiratory health risks. While research on marine and terrestrial microplastics is well-established, atmospheric microplastic research is still in its infancy. Most studies are located in North America, Europe, the middle East and East Asia, with very little sampling elsewhere around the world, indicating a critical knowledge gap regarding atmospheric microplastics.

In my presentation, I highlighted the ongoing effort and contribution of our research team in exploring and understanding atmospheric microplastics in Malaysia and Southeast Asia. Our research team at the Universiti Kebangsaan Malaysia is committed to advancing our understanding of atmospheric microplastics. We aim to provide evidence-based insights for informed decision-making to control microplastic pollution and mitigate its impacts on human health and the environment.

Our ongoing research focuses on atmospheric microplastic's occurrence, behavior and fate in various environments.

We collected samples of rainwater, aerosol, and also surface sea water from various environments in Malaysia with different site characteristics such as urban, coastal, pristine island, industrial port areas and tourism areas. The overarching aim is to identify how much microplastic is present in the air, how microplastic varies between different environments and monsoon seasons as well as what are the characteristic and potential sources of microplastic in the atmosphere. The following are what we learned so far from our research:

- The seasonal variations of ambient microplastics were found. Higher levels of microplastic concentrations were recorded during the Northeast monsoon season, due to the long-range transport.
- The variation in colors and shapes observed in the collected microplastics reflects the various origins or degradation stages of atmospheric microplastics.
- The co-occurrence of microplastics with PM2.5 raises significant concerns about potential human health risks.
- Less data on atmospheric microplastic in the country indicating more observations are needed in assessing the exposure pathways and investigating the long-term impacts of atmospheric microplastic.
- Atmospheric microplastic should be treated as a pollutant for long-term monitoring. More evidence is needed to increase awareness and trigger stakeholders to establish relevant policies and regulations to combat plastic pollution..

Additionally, we observed that there were variations in collection, pretreatment, and identification methods across studies which hinder direct comparisons of microplastic data at the national and regional level. The lack of harmonized or standardization protocols has led us to initiate an international project entitled "Establishing a pilot network for microplastic monitoring and analysis in the coastal environment of Southeast Asia". This ongoing project is funded by the Asia-Pacific Network for Global Change Research under the Collaborative Regional Research Programme (CRRP) and has brought together researchers from Malaysia, Thailand, Vietnam, and Japan. This project seeks to explore the variety, traits, origins, and transport of microplastics in various coastal environments across Southeast Asia. A uniform approach for microplastic analysis in air and surface seawater samples are currently being developed in order to enable harmonization and intercomparison of data on microplastic concentrations and characteristics across nations. Engagement with the local community through outreach activities will also be conducted to educate on the health and environmental impact of microplastic pollution. The findings from this research are expected to provide important insights into cross-country comparisons of microplastic types, levels, and sources, ultimately helping to address the issue of plastic pollution on a regional scale. The pilot network created as a result of this project is anticipated to increase the scientists' capacities and show results at the community and policy levels.

Overall, the research efforts highlighted in my presentation contribute to filling the knowledge gap on atmospheric microplastics and emphasize the critical need for further investigation and international collaboration in tackling microplastic pollution.

Dr. M. Nageswar Rao **is** a Project Scientist at the Indian Institute of Tropical Meteorology (IITM), Pune, Ministry of Earth Sciences, Govt of India. He is highly motivated and progress-focused scientist with a long-standing background in the field of environmental chemistry. He attended several fields and lab oriented research, project design and documentation, with over 12 years of research experience, he completed his Ph.D in CSIR-NIO (Govt. of India) associated with Andhra University, he has worked on various aspects of pollution (water, soil, air) and their impact on health and climate change, Environmental Impact Assessment, and their management, Climate change studies. Apart from it, he has experienced on handle analytical instruments in lab (i.e. UV, FUV, GC-FID/MS, CHNS Elemental analyzer, FTIR, IR-MS, ICP-OES, LC/MS…etc) for source identification and quantification of contaminants (organic and inorganic). He is also interested in nature-based solution to mitigate climate change of greenhouse gases (GHGs). He was also worked with NCSCM, Ministry of Environment Forest and Climate Change, Govt. of India. He has published several research publications (mostly lead author) in national and international peer-reviewed with good impact on environmental health and climate science

Airborne Microplastics and associated health risk assessment

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Plastics are a big part of our lives now. In the last ten years, the amount of plastic produced around the world has gone up by about 50%. In 2021, it got to about 400 million tons (Plastics Europe, 2022). If things continue as they are, the amount of mis-managed plastic waste could increase from ~100 million tons in 2015 to ~265 million tons by 2060 (Lebreton et al., 2019). Microplastics (MPs) pollution in the air originates from plastic items, personal care products and breaking down of plastic waste by Photochemical process. They come in different shapes i.e. fragments, fibres, films in the air, ranging from 1 µm to 5mm in size with different colours. The way their surface looks can change depending on the type of plastic used and the effects of weather changes in the environment. They are often made from different types of polymers. Microplastics are found all over the environment because they last a long time, are light weight, and people often toss them out without thinking. Also, airborne microplastics can carry dangerous chemicals, like toxic metals and harmful substances that stay in the environment. These chemicals could increase the chance of getting cancer.

Therefore, plastic pollution is one of the biggest environmental problems faced today. Studies over the past few decades have found this in various places, including food and drinks. However, in recent years scientists have become worried abouthow breathing in harmful microplastics in the air can affect people's health. Therefore, there are still very few studies about airborne microplastics and the health risks they might cause when people are exposed to them in different ways. Out of the 20 most polluted cities in the world, half of them are in South Asia, and these cities have severe air pollution (WHO). India is one of the most developing countries in South Asia and used 18.5 million tonnes of plastic in 2018-2019, about 11 million tonnes, which is 60%, of single-use plastic mainly used for packaging. The Central Pollution Control Board found that the country produces 25,940 tons of plastic waste each day. While Delhi produces 689.8 tons of plastic waste every day, which is the highest among India's mega cities (CPCB, 2022). The fast growth of industrialization and rise in population density have led to more plastic waste in Delhi city trash in recent years. It emphasizes the importance of measuring the amount of microplastic pieces in the air and associated health risk assessment. Therefore, as far as we know, no earlier research has been done in Delhi to find and measure microplastic particles in the air. Thus, we are trying to fill this gap by looking into where atmospheric microplastics are found and what they are like in Delhi City. We have initiated observations in Delhi to assess the status of airborne MPs pollution, possible sources, and associated health risks. The collection of outdoor samples of microplastics associated with aerosols by active pump samplers (low and high-volume samplers) at a constant flow rate for a period of 24 hours with specific sizes of particles i.e. PM10, PM2.5 and PM1.0 (Figure 1). All these samplers were set up on the terrace of IMD in Delhi, located in the capital city of India. The sampling was conducted twice a week for each sample on Quartz and PTFE (47 mm) filter papers (pore size 0.5-2 □m) and has been operational since January 2024. All collected samples were wrapped with aluminium foil and frozen until further analysis.1/2 portion of the particulate matter sample filter was cut with pre-cleaned scissors. Sample preparation of MPs by leaching, digestion, and separation method. After sample preparation, MPs were observed and identified based on visual characteristics mainly shape, colour, and size using fluorescence microscope (OLYMPUS BX41). The morphological characteristics and elemental content of MPs (randomly selected) were investigated using SEM–EDX. The chemical characterisation of polymer in MPs (randomly selected) was analysed by the FTIR spectroscopy method (Figure 2).

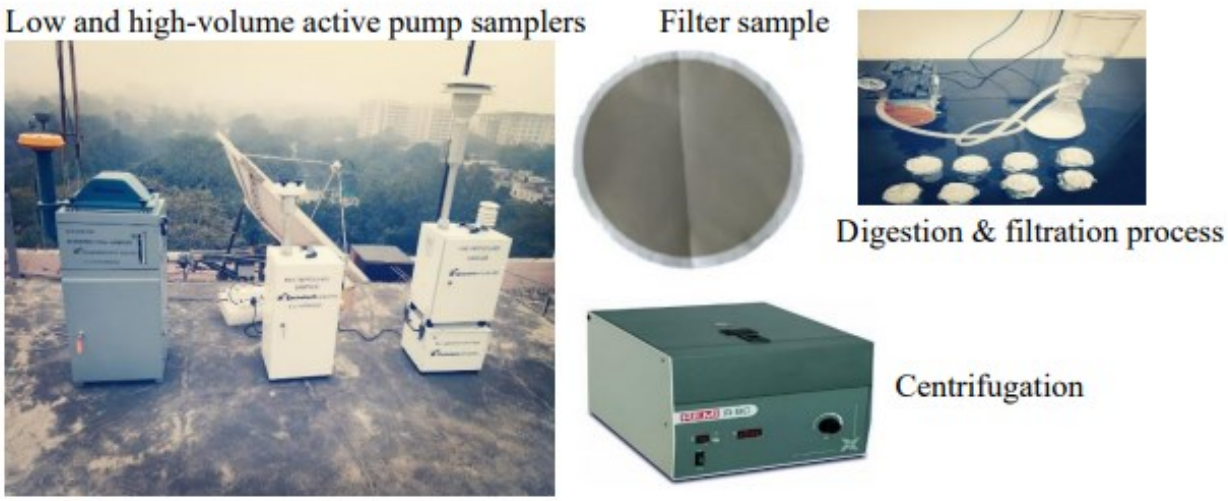

Figure 1: Sample collection and extraction technique of microplastics in aerosols

Fluorescence microscopy SEM-EDX analyser FTIR analyser

Figure 2: Identification and quantification of airborne microplastic by fluorescence microscopy, SEM-EDX and FTIR.

From this pilot investigation, our findings show a significant difference in MPs in particulate fraction. Most fragments and fibers dominated with white/blue colored polymers originated from daily life products and clothing materials. The surface morphology of MPs shows majorly homogenous and degraded pieces. The human intake of MPs via inhalation shows possible risk for people and is expected to breathe in 10 to 20 m3 of air per day (WHO). These finer particles can easily get into the human body via inhalation that can damage human health and cause problems with respiratory diseases that can harm their lungs i.e. asthma, collapsed lung, inflammation of the lung tissue can develop cancer, long-term bronchitis, and pneumonia. We still know very little about how these microplastics build up and affect our bodies in everyday situations. Therefore, based on the current knowledge further long-term measurements are highly required in various locations to investigate the consequences of airborne microplastics on human health.

Acknowledgements

We would like to thank the Director, IITM, Pune and IMD, Delhi, Ministry of Earth Science (MoES, Govt. of India), for providing all necessary facilities and encouraging the work. Thank to Environmental science department of Savitribai Phule Pune University (SPPU) for supporting instrumental facilities. Thank to Borehole Geophysics Research Laboratory (BGRL), Karad for support of SEM-EDX facilities

iLEAPS Side Event on "Global Plastic Waste Imports and Microplastic Pollution" at the iCACGP-IGAC Open Science Conference, Kuala Lumpur, Malaysia, 12 September, 2024.

iLEAPS hosted a Side Event titled "Global Plastic Waste Imports and Microplastic Pollution" during the iCACGP-IGAC Open Science Conference 2024 in Kuala Lumpur. The event, held on September 12, focused on the growing environmental and health challenges posed by plastic waste and microplastics and brought together leading scientists and policymakers to explore the growing global problem of plastic waste, especially in developing countries that are often the recipients of imported waste. The session highlighted the transboundary nature of plastic waste trade and its implications for atmospheric and terrestrial systems. It also discussed the role of microplastics in air pollution and their potential impact on climate through interactions with atmospheric processes. Presenters called for improved policies, international cooperation, and innovative research to mitigate these emerging pollutants and their global effect.

Plastic Waste Trade and its Environmental Impact: The event highlighted the increasing trade of plastic waste, driven by global consumerism and inadequate local recycling infrastructure in many countries. This trade often results in improper disposal methods, exacerbating pollution in land, rivers, and oceans. Attendees examined data on waste import patterns, particularly in Southeast Asia, emphasizing the need for stricter regulations and international cooperation to limit waste exports from developed to developing countries.

Microplastic Pollution and Ecosystem Health: Microplastics, tiny plastic particles resulting from the breakdown of larger plastics, were a central topic. Experts presented studies on the pervasiveness of microplastics in the environment, from soil and freshwater systems to marine ecosystems. These pollutants pose severe threats to biodiversity and enter the food chain, ultimately impacting human health. Novel methodologies for tracking and analyzing microplastic dispersion were showcased, with a focus on improving the accuracy of detection in diverse environments.

Policy and Governance: Panelists discussed policy

solutions, including the enforcement of international agreements such as the Basel Convention. They stressed the need for a unified global strategy to reduce plastic production, improve waste management, and promote a circular economy. Regional initiatives were also examined, with Malaysia's role as a major recipient of plastic waste serving as a case study for the challenges and successes in addressing this issue.

Innovations and Future Directions: The event introduced cutting-edge technologies for recycling and waste management, such as advanced sorting systems and chemical recycling methods. It also highlighted innovative approaches to public engagement and awareness, encouraging grassroots movements to combat plastic pollution.

In conclusion, the iLEAPS Side Event underscored the urgency of tackling the dual crises of plastic waste imports and microplastic pollution. It called for a collaborative global effort that integrates scientific research, policy action, and community involvement to mitigate the environmental and health impacts of plastic pollution.

Acknowledgement

The workshop organizers gratefully acknowledge the support of Dr. Modmd Talib Latif, Chairman of iCACGP-IGAC for facilitating the event.

FUNCHEM: Fire Uncertainty in Chemistry Emissions, and Modelling

A joint BBURNED / iLEAPS hybrid workshop 14-15 September, 2024, Kuala Lumpur, Malaysia

iLEAPS, in collaboration with BBURNED, organized the FUNCHEM Early Career Workshop, focusing on the uncertainties and variability associated with fire emissions, atmospheric chemistry, and modelling. This event, designed to foster interdisciplinary collaboration and innovative problem-solving, was held as part of the iCACGP-IGAC Open Science Conference in Kuala Lumpur, Malaysia, in September 2024 The workshop provided a dynamic platform for early-career researchers in atmospheric chemistry to engage with leading experts. Sessions addressed key topics, including variability in fire emissions, atmospheric chemical transformations, and advanced modeling techniques. FUNCHEM adopted a hybrid format, accommodating both in-person and virtual participants. Attendance was limited to 50 in-person participants, with special provisions to support early-career researchers and attendees from developing countries. The workshop agenda featured keynote talks, interactive discussions, and collaborative activities aimed at fostering engagement and innovation. Key outcomes included the identification of pressing research questions and the initiation of a special journal issue dedicated to multidisciplinary studies in this domain. Participants also had the opportunity to present their ongoing research and network with peers and senior scientists. In addition to organizing the workshop, iLEAPS members played an active role in the event. Notable contributions included talks by iLEAPS SSC Co-Chair Saching Ghude, SSC member Pallavi Saxena, and Saurabh Sonwani, the iLEAPS ECR representative for the Asia and Middle East region. Furthermore, ECR member Rupal Ambulkar presented her work on “Fire Emissions Uncertainty Analysis,” offering valuable insights to the audience.

Key Takeaways

1.Collaborative Spirit: The workshop underscored the importance of cross-disciplinary approaches to address uncertainties related to fire emissions and their atmospheric impacts, promoting collaboration among researchers from diverse fields.

2. Capacity Building: FUNCHEM contributed significantly to skill development and networking opportunities for early-career scientists, enhancing their professional growth.

3. Future Directions: Discussions during the workshop are set to inform a dedicated journal issue, ensuring sustained discourse and innovation in this critical area of research.

The FUNCHEM Early Career Workshop emphasized the necessity of collaborative research in addressing global atmospheric challenges. It also offered a valuable opportunity for early-career scientists to enhance their knowledge, share insights, and build professional connections.

Further details here: Workshop: FUNCHEM (2024) | Atmospheric Chemistry Observations & Modeling

Acknowledgement

The workshop organizers gratefully acknowledge the support of iCACGP and IGAC in facilitating the event, held in conjunction with the iCACGP-IGAC Open Science Conference in Kuala Lumpur from September 10–13, 2024.

Exploring the Nexus: Building Capacity in Understanding the Impacts of Atmospheric Deposition on Ocean Biogeochemistry

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Introduction

iLEAPS in collaboration with SOLAS, GEOTRACES, and IGAC hosted an engaging discussion session at the SOLAS Open Science Conference, held in Goa from 10–14 November 2024. The discussion was led by Semeena V. Shamsudheen from the International Project Office of iLEAPS, Pallavi Saxena, Assistant Professor at the Hindu College, University of Delhi and a member of the Scientific Steering Committee (SSC), and Saurabh Sonwani, Assistant Professor at the Zakir Hussein Delhi College, University of Delhi and the Early Career Representative for iLEAPS, Douglas S. Hamilton, Assistant Professor at North Carolina State University and Early Career Researcher (ECR) representative for SOLAS, Prof. Alessandro Tagliabue, Professor in the Department of Earth, Ocean, and Ecological Sciences at the University of Liverpool, and Prof. Andrew Bowie, Professor in the Oceans and Cryosphere Department at the Institute for Marine and Antarctic Studies, University of Tasmania. Both Tagliabue and Bowie also serve as current and past SSC co-chairs for GEOTRACES, respectively. The session titled "Exploring the Nexus: Building Capacity in Understanding the Impacts of Atmospheric Deposition on Ocean Biogeochemistry" highlighted the intricate relationship between land processes, atmospheric chemistry and aerosol deposition, and ocean biogeochemistry. This nexus is pivotal in shaping the global carbon cycle, as atmospheric deposition plays a key role in open ocean nutrient availability, marine net primary productivity, and ecosystem community dynamics – all of which can modulate the ocean biological carbon pump. The session emphasized the need for a coordinated, interdisciplinary approach to tackle key questions and emerging challenges in this field, emphasizing the importance of collaboration across scientific domains to advance understanding and inform sustainable management strategies.

Key Themes and Objectives

The session proposed establishing a new working group to explore these interactions. This group would draw on the expertise and resources of major scientific networks, including iLEAPS, SOLAS (Surface Ocean-Lower Atmosphere Study), IGAC (International Global Atmospheric Chemistry Project), GEIA (Global Emissions Initiative), GEOTRACES (An International Study of the Marine Biogeochemical Cycles of Trace Elements and Isotopes), and ESA (European Space Agency). This effort aligns closely with Future Earth's

vision and mission to promote transdisciplinary initiatives aimed at addressing climate change and its impacts on ecosystems and the environment. Four primary questions were identified as the foundation for future research and discussion:

Sources Pathways, and Impacts of Atmospheric Deposition

- The session explored the various sources of atmospheric deposition, including both natural (e.g., dust, volcanic ash) and anthropogenic (e.g., industrial or agricultural emissions) contributions and their link with ocean distributions of key nutrients and pollutants. The need to investigate other sourcessuch asship emissions, urban aerosols, and wildfire smoke was also highlighted. Understanding these pathways is critical to predicting their impacts on ocean biogeochemistry.

Interactions Between Oceanic Fluxes and Pollution

- Oceanic emissions, such as dimethyl sulphide (DMS), influence atmospheric chemistry, particularly in the marine boundary layer. The session delved into how these these natural emissions interact with anthropogenic pollutants, affecting cloud formation, albedo, and precipitation patterns. These interactions, in turn, influence nutrient deposition and marine primary productivity.

Pollutant Accumulation in Marine Organisms

- Persistent organic pollutants (POPs), heavy metals, and microplastics are increasingly accumulating in marine ecosystems. The session discussed the processes of bioaccumulation (uptake of pollutants by organisms) and biomagnification (concentration of pollutants as they move up the food chain). These pollutants pose significant risks to marine biodiversity and human health through seafood consumption.

Long-term Implications of Anthropogenic Activities

The session emphasized the need to assess the long-term impacts of human activities, such as fossil fuel combustion and deforestation, on atmospheric deposition and ocean biogeochemical cycles. These activities alter deposition patterns, with implications for nutrient imbalances, ocean acidification, and climate feedback mechanisms.

Following a brief introduction and general discussion, the session transitioned into a 20- minute breakout segment, during which participants were divided into three groups. Each group was facilitated by two convenorsto guide the discussion. In the final 10 minutes of the session, notetakers presented the key suggestions and concerns raised in their respective groups. There was notable support for establishing a cross-GRN Working Group to foster transdisciplinary collaboration in addressing the outlined challenges. However, the support was not unanimous, indicating the need for further deliberation on the group's objectives and scope to ensure its formation is both purposeful and widely endorsed. Concerns were also raised about the technicalities like funding sources, and the need to have a professional graphic designer to convey the message to scientific community as well as general public.

The summary of this breakout sessions revealed a strong alignment across the groups, with shared concerns and ideas provided below:

- Emphasis on global and regional ocean systems, with specific attention to the Indian Ocean due to its unique ecological and biogeochemical challenges.
- Highlighted areas include atmospheric deposition, trace element biogeochemistry, and microplastic impacts.
- Incorporate tools and methodologies from various Global Research Networks (GRNs) and

societies such as SOLAS and IGAC, leveraging their expertise. These groups can act as "Champions" in their respective areas, ensuring specialized contributions to the WG.

- Atmospheric deposition involves complex chemistry, including mineral dust, aerosol composition, and their impacts on trace elements and this can be challenging research and policy area. Addressing deposition and ecosystem responses, along with monitoring CO2 and nitrogen/climate feedback cycles was suggested as one of the key WG research areas.
- Focus on underexplored areas like blue/red plastics, hydrosphere oxygen production, and carbon sequestration in oceans.
- Understanding the long-term implications of anthropogenic activities on marine ecosystems.
- Need for an overarching authority, similar to the International Seabed Authority, to support and coordinate WG activities.
- Engaging with the shipping industry and related sectors to access funding, tools, and collaborative opportunities for ocean exploration.
- Impact of both anthropogenic and natural sources like desert dust, wildfires, crop residue burning, urban pollutants, heavy metals (e.g., copper, chromium, nickel, mercury), and microplastics.
- Investigating ozone depletion mechanisms, extreme marine heatwaves, and physicochemical perspectives of ocean systems was raised an emergin issue.

There was strong recommendation of WG design and operations across the breakout sessions:

- Establish clear sender-receiver communication roles to ensure effective data exchange and dissemination.
- Utilize tools from diverse disciplines to address research questions and develop innovative solutions.
- Ensure that the WG addresses issues ranging from scientific to societal to political.
- Secure resources through industry partnerships and international funding agencies

Expected Outcomes and Collaborative Framework

The proposed working group aims to harness the synergies among Future Earth's Global Research Networks. By integrating their scientific activities, the group seeks to:

- Facilitate Collaboration and Knowledge Sharing: Enhanced cooperation among networks like iLEAPS, SOLAS, IGAC, GEOTRACES and ESA will promote interdisciplinary research, data sharing, and methodological standardization.
- Drive Integrative Approaches to Earth and Environmental Sciences: A holistic understanding of the land-atmosphere-ocean continuum is crucial for developing strategies that capture the complexity of biogeochemical interactions and 4 feedback loops. There was support for forming a Working Group to support transdisciplinary activities, but more consideration of the groups goals and strategy is desirable.
- Inform Sustainable Management Strategies: Leverage collaborations with GRNs, societies, and industries to create a broad, interdisciplinary coalition. Identify and include expertise in policy-oriented and transdisciplinary approaches for effective collaboration, design and operations of the WG.

Conclusion

This session underscored the need for an integrated Earth System approach to understanding the nexus of atmospheric deposition and ocean biogeochemistry. By establishing a new working group, that includes social scientists, lawyers, policy makers apart from

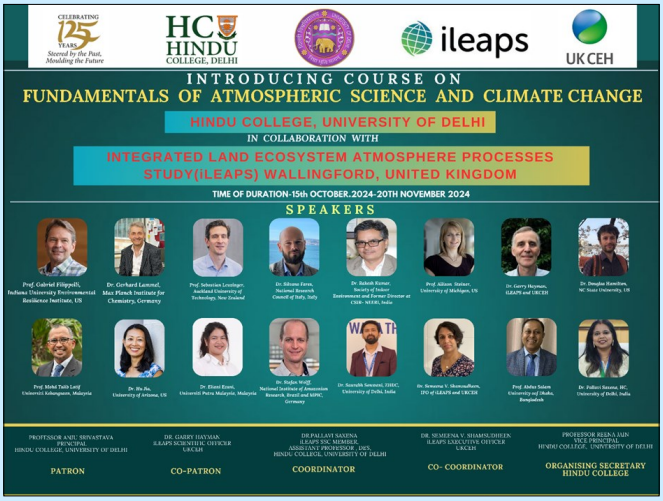
Discussion session participants at the SOLAS Open Science Conference, NIO, Goa, 2024.

researchers can l serve as a transformative platform to address one of the most pressing environmental challenges, ensuring scientific excellence, societal benefit, and environmental sustainability.

Acknowledgement:

iLEAPS, SOLAS, IGAC and GEOTRACES gratefully acknowledge the support of SOLAS IPO and the SOLAS Open Science Organising committee for facilitating the event.

iLEAPS-HC Course on "Fundamentals of Atmospheric Sciences and Climate Change" organized by Hindu College, University of Delhi, India in collaboration with iLEAPS, UK, 15th Oct. to 20th Nov. 2024



iLEAPS and Hindu College, University of Delhi has successfully organized and completed Course on "Fundamentals of Atmospheric Sciences and Climate Change" (Hybrid Mode) at Hindu College, University of Delhi, India started from 15th October till 20th November, 2024. 21 participants of undergraduate, graduate and postgraduate level of different disciplines like Physics, Chemistry, Botany, Environmental Science, Life Science and Geography were selected of Indian national origin from different institutes/universities. This course has been coordinated by Dr. Pallavi Saxena, Assistant Professor, Department of Environmental Science, Hindu College, University of Delhi and iLEAPS SSC Member, Co-coordinated by Dr. Semeena V. Shamsudheen, Scientist, UKCEH and iLEAPS Executive IPO. Prof. Anju Srivastava, Principal, Hindu College, University of Delhi as Patron, Dr. Garry Haymann, Scientist, UKCEH and iLEAPS IPO Science Officer as Co-Patron and Prof. Reena Jain, Vice Principal, Hindu College, University of Delhi as Organizing Secretary. 21 resource persons from iLEAPS community and Speakers of iLEAPS Global Colloquium Series belong to various parts of countries like North America, UK, India, Malaysia, Bangladesh, Germany, New Zealand, Italy and South America had contributed in this course from their interesting and innovative way of teaching, hands-on training on softwares, experimental site videos, demonstrations of models. The list of speakers are: Prof. Gabriel Filippelli, Indiana University Environmental Resilience Institute, US; Prof. Gerhard Lammel, Max Planck Institute of Chemistry, Germany; Prof. Sebastian Leuzinger, Auckland University of Technology, New Zealand and Former iLEAPS SSC Member; Dr. Silvano Fares, National Research Council of Italy, Italy and Former iLEAPS SSC Member; Dr. Rakesh Kumar, Society of Indoor Environment, India; Prof. Allison Steiner, University of Michigan and Former iLEAPS SSC Member, US; Dr. Garry Hayman, UKCEH and iLEAPS IPO Science Officer; Dr. Douglas Hamilton, NC State University, US; Prof. Mohd Talib Latif, Universiti Kebangsaan, Malaysia; Dr. Hu Jia, University of Arizona, US and iLEAPS SSC Member; Dr. Eliani Ezani, Universiti Putra Malaysia and iLEAPS SSC Member, Malaysia; Dr. Stefan Wolff, National Institute of Amazonian Research, Brazil, South America and iLEAPS SSC Member; Dr. Saurabh Sonwani, Zakir Husain Delhi College, University of Delhi, India and Chair of iLEAPS Early Career South Asia and Middle East Region; Dr. Semeena V. Shamsudheen, Scientist, UKCEH and iLEAPS IPO Executive Officer; India and iLEAPS SSC Member. Prof. Abdus Salam, University of Dhaka, Bangladesh and Dr. Pallavi Saxena, Hindu College, University of Delhi, India and iLEAPS SSC Member.

Apart from lectures and hands-on, 2 laboratory full day visits were also arranged in field of air quality instrumentation, measurements, health risk assessment and air quality continuous real-time monitoring stations for students at Envirotech Pvt. Ltd. Delhi, India that was coordinated by Mr. Ashish Gupta, Director, Envirotech Pvt. Ltd on 5th Nov. 2024 and at Air Lab, Central Pollution Control Board, Delhi, India which was coordinated by Dr. S.K. Sharma, Head, Air Quality Division, CPCB, Delhi, India on 7th Nov. 2024. On 25th Oct. interactive session and career counselling was also arranged by Hindu College, University of Delhi. This session was lead by Deputy Director, Asia-Pacific International Programs, USDA-FS and coordinated by Dr. Pallavi Saxena, Hindu College, University of Delhi, The participants were also assessed in every week after rigorous evaluation designed by speakers. 4 assessments were organized in this full course. On the basis of assessment marks, research aptitude, code of conduct for discipline and attendance (more than 90% is compulsory for all students), 4 students were awarded the cash prize and certificate of appreciation. 1st winner is bagged by Mr. Ronak Raj Sharma, B.Sc (H) Physics, Hindu College, University of Delhi, India with Cash Prize of Rs 5000/- ; 2nd Prize was bagged by Mr. Sujal Gupta, B.Sc Life Science, Deshbandhu College, University of Delhi, India with cash prize of Rs 2000/- and 3rd Prize was bagged by 2 students, Mr. Lekshman Raj, B.Sc (H) Environmental Science, Ramanujan College, University of Delhi, India and Ms. Kaveri Nayar, B.A. (H) Geography, Indraprastha College, University of Delhi, India with Cash Prize of Rs 1000/- each.

This course has been inaugurated and started with our opening speaker, Dr. Garry Hayman, Scientist,

UKCEH and iLEAPS IPO Science Officer (online mode) on 15th Oct. 2024 and validectory function on 20th Nov. 2024 was graced by Dr. Rakesh Kumar, President, Society of Indoor Environment, India alonmgwith other members, Dr. Semeena V. Shamsudheen, Scientist, UKCEH and iLEAPS IPO Executive Officer; Dr. Saurabh Sonwani, Zakir Husain Delhi College, University of Delhi, India and Chair of iLEAPS Early Career South Asia and Middle East Region and Dr. Pallavi Saxena, Hindu College, University of Delhi, India and iLEAPS SSC Member in onsite mode. Certificates were distributed to all 21 participants of this course and students also given their great feedbacks, that they liked this course a lot, skilled enough to run the softwares and apply in their research work. All have appreciated the constant and sincere efforts of all organizers and speakers and coordinators of Laboratory visits for making this course successful.

International Training On "Climate Change Mitigation By Using Mytree Model" Organized By Department Of Environmental Science, Hindu College Supported By United States Forest Service (USFS)

An "International Training on "Climate Change Mitigation by Using MyTree Model" organized by Department of Environmental Science, Hindu College, University of Delhi supported by United States Forest Service, 14th March, 2024 has been held successfully. The Patron is Prof. Anju Srivastava, Principal, Hindu College, University of Delhi, Co-Patron is Mr. Justin Green, Coordinator is Prof. Reena Jain, Vice-Principal, Hindu College and Convenor is Dr. Pallavi Saxena, Assistant Professor, Department of Environmental Science, Hindu College, University of Delhi. This training is knowledge and financially supported by USFS. 26 students at undergraduate level of Science courses viz. Physics, Chemistry, Maths, Botany and Zoology were selected and participated in this training from Hindu College. There are two main components of this training:

Expert Talk

The program has started with the expert talk by Mr. Akshat Tyagi, Urban Forestry Consultant, US Forest Service International Programs with the fundamental understanding of urban forest ecosystem, ecosystem services provided by them and the brief introduction of different vegetation models like MyTREE, i-TREE Canopy, i-TREE Data etc. The detailed lecture about MyTREE and how to use this model was instructed by Mr. Pankaj and Ms. Rajeshwari.

They made the students understand this model in a very easy and convienent way and students found it very interesting to apply in their college and interested to prepare an inventory of trees which are maximum benefits to the environment. The session was also opened for interac

tive session with all speakers for 15-20 mins and the informal questions were also been asked in between the lectures by participants to mark their understanding in a better way.

Hand-On Activity

This section of the event made students very happy as they got the opportunity to had the exposure of applying MyTREE model at ground level and by doing field experiments. The students were divided into 13 groups with 2 students each in one group and had measured the DBH of tree and distance from the building and other parameters in the green space outside the Conference Hall. Students had calculated the benefits of about 10-12 different species of trees and able to understand the role of MYTREE in greenbelt development planning and correct plantation purpose.

The program closes with the group photograph and distribution of certificates to all participants and volunteers.

National Training workshop on Atmospheric Aerosol Instrumentation (NT-AAI)

NT-AAI is organized at IITM, Pune during 30th September - 4th October, 2024 by DESK in association with Indian Aerosol Science & Technology Association (IASTA).

Aerosol Science and engineering finds applications in climate, medical sciences, air quality control, material processing and nuclear reactor safety. Currently, India has several research groups working in different such domains for academic, industrial and societal needs. Public engagements in issues pertaining to air quality and health has motivated different institutions to conduct courses, programs and projects having direct relevance. There are several nation-wide programs such as 'National Clean Air Mission' built on the collective efforts of researchers and policy-makers. There are medical applications such as drug delivery, ultra-clean hospital rooms etc., as well as industrial applications ranging from the production of nano particles to the control of contamination in various processes.

Themes and Topics covered are:

- Basics: Aerosol measurements and instrumentation
- Aerosol sampling by different techniques
- Aerosol generators: Nano-scale to micro-scale
- Hygroscopic growth and aerosol-cloud interactions
- Aerosol charge measurements
- Aerosol chemical measurements
- Aerosol physical characterization: Scattering, absorption, aerosol-radiation interaction

Bioaerosol characterisation

Outcome of the workshop:

The workshop addressed aerosol instrumentation and measuring techniques for studying different atmospheric aerosols and their characteristics. Along with basics of aerosols, description and working principle of different aerosol instruments and data processing are also focused. Extensive hands-on training was given to the participants to get exposure to the instruments and their working principles. To enhance the understanding of the datasets obtained from the instruments operated in real-time atmospheric conditions, a comprehensive data analysis session was organized after the demonstration of the respective instruments. The data analysis covered the basic structure of the instrument data sets along with direct and derived parameters obtained from the instruments and its quality control etc. A detailed analysis related to the qualitative and quantitative estimation of biomass burning and fossil fuel contribution to black carbon mass concentration was covered under data analysis session. Also interesting events like new particle formation and related evolution in terms of aerosol number concentration through Scanning Mobility Particle Sizer (SMPS) data was discussed and analysed. Further, methods to estimate aerosol hygroscopicity from chemical composition datasets and its comparison with direct measurement of aerosol hygroscopicity was discussed in the data analysis session. This data analysis training session has enlightened the young workshop attendees with the in-depth exposure in data handing, detailed analysis and applicability of these state of art instrument datasets for aerosol research.

This workshop provided an opportunity to share expertise of seasoned researchers with early stage researchers/students/technocrats.

A visit to High Altitude Cloud Physics Laboratory (IITM), Mahabaleshwar for live demonstration and showing data analysis of sophisticated instrumentation was also arranged as a part of this training workshop.

International Project at Hindu College in collaboration with USDA-FS on "Ecosystem Services from Forest and Urban Ecosystems in Delhi NCR by using Vegetation Models" Phase – II

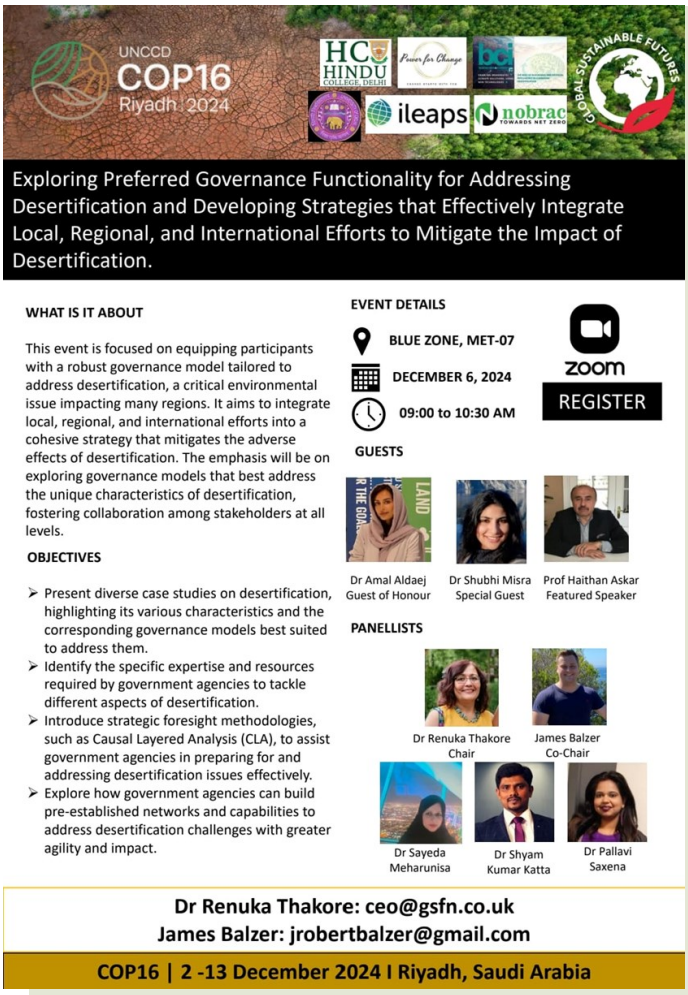
Phase II of International Project on "Ecosystem Services from Forest and Urban Ecosystems in Delhi NCR by using Vegetation Models" at Hindu College in collaboration with USDA-FS was started from 26th Oct. 2024 onwards at various heritage and forest sites in Delhi NCR. The trees and urban green spaces in Delhi NCR are assessed through vegetation models for climate change and air pollution mitigation and other ecosystem services. This project is coordinated by Dr. Pallavi Saxena, Hindu College, University of Delhi, India and iLEAPS SSC Member and USDA-FS, US. 7 students are involved as project assistants from Hindu College, University of Delhi. This project is fully funded by USFS-DA initially for 2 years and may be extended later as per the need of the research problem. This is first of kind of research campaign in India which assess and evaluate the urban green spaces in Delhi NCR as nature-based solutions and can act as effective sustainable tools for climate change and air pollution mitigation.

Invited Speaker at World Sustainability Conference 2024 in online mode organized by The Green Institute, Nigeria in collaboration with University of Birmingham, UK

Dr. Pallavi Saxena, Assistant Professor, Hindu College, University of Delhi, India and iLEAPS SSC Member served as Invited Speaker at World Sustainability Conference 2024 in online mode organized by The Green Institute, Nigeria in collaboration with University of Birmingham, UK on the topic "Urban Green Spaces for Climate Change Mitigation" on 1st November, 2024. This International conference was organized for 2 days 1st to 2nd November, 2024 and started with the Keynote address of Prof. David M. Hannah, University of Birmingham, UK with 9 speakers from

different institutes as Universidad National Autonoma de Mexico, Mexico; University of Birmingham, UK; Centre of Excellence for Climate Change Sustainable Development, Egypt; Oxford Brookes University, UK; University College of London, UK; Britsh Institute of International Comparative and Law, UK; CRPDI, Republik of Congo, Institute for Global Environmental Strategies, Japan and Hindu College, University of Delhi, India. 121 participants were attended this conference and ended up great interactive discussion too.

Speaker and Panelist in Side meeting Session on "Exploring Preferred Governance Functionality for Addressing Desertification and Developing Strategies that Effectively Integrate Local, Regional, and International Efforts to Mitigate the Impact of Desertification" at COP16 Riyadh, Saudi Arabia



This session is hosted by GSFN, UK, iLEAPS, Hindu College, University of Delhi and held on 6th December, 2024 in Hybrid Mode. Dr. Pallavi Saxena, Assistant Professor, Hindu College, University of Delhi, India and iLEAPS SSC Member served as Speaker and Panelist in Side meeting Session on "Exploring Preferred Governance Functionality for Addressing Desertification and Developing Strategies that Effectively Integrate Local, Regional, and International Efforts to Mitigate the Impact of Desertification" at COP16 Riyadh, Saudi Arabia. This session is hosted by GSFN, UK, iLEAPS, Hindu College, University of Delhi and held on 6th December, 2024 in Hybrid Mode. Dr. Saxena delivered her talk on “Role of Land Degradation and Desertification in Impacting Human Health”. This side meeting focuses on case studies on desertification, highlighting its various characteristics and the corresponding governance models best suited to address them; Identify the government agencies to tackle different aspects of desertification; Introduce strategic foresight methodologies, such as Causal Layered Analysis (CLA), to assist government agencies in preparing for and addressing desertification issues effectively and explore how government agencies can build pre-established networks and capabilities to address desertification challenges with greater agility and impact.

UKECH Training Courses

How to write highly cited papers

(12 & 13 February 2025)

https://www.ceh.ac.uk/training/science-paper-impact

Ammonia – Insights for better air quality management (25-27 February 2025)

https://www.ceh.ac.uk/training/ammonia-air-quality-pollutant

Mastering Environmental Data with R: (18-20 March 2025)

https://www.ceh.ac.uk/training/transforming-environmental-data-r

Ecosystem integrity assessment (5 & 6 March 2025)

https://www.ceh.ac.uk/training/hydrometry-river-discharge-monitoring-using-adcps

UKECH Training Courses

Radioecology for Environmental Protection (3 -20 June 2025)

https://www.ceh.ac.uk/training/radioecology

Freshwater phytoplankton identification (7-11 July 2025)

https://www.ceh.ac.uk/training/freshwater-phytoplankton-identification

Train the online trainer - on demand (immediate access for 4 weeks)

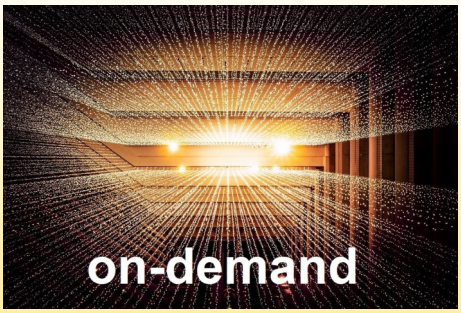
https://www.ceh.ac.uk/training/train-online-trainer-demand

Evidence Synthesis - on demand (immediate access for 4 weeks)

https://www.ceh.ac.uk/training/evidence-synthesis-demand

UKECH Training Courses

Climate data analysis with python - on demand (immediate access for 4 weeks; free for learners from low income ODA countries!)



https://www.ceh.ac.uk/training/climate-data-analysis-python

Ozone and tropical agriculture - on demand (immediate access for 4 weeks; free for learners from low income ODA countries)

https://www.ceh.ac.uk/training/ozone-and-tropical-agriculture

Using drones to map habitats - on demand (immediate access for 4 weeks)

https://www.ceh.ac.uk/training/using-drones-map-habitats-demand

Honours and Recognitions

Rupal Ambulkar

Dr. Gemma Purser

Dr. Sourabh Sonwani

- "IGAC ICACGP recently spotlighted three Early Career Researchers - Ms. Rupal Ambulkar, Dr. Gemma Purser and Dr. Saurabh Sonwani, in their Early Career Spotlight program".

1.https://www.ecr-igac-icacgp.org/2024/06/12/harnessing-digital-innovation-for-global-collaboration-and-research-equity/

2. https://www.ecr-igac-icacgp.org/2024/06/12/ecr-spotlight-dr-gemma-purser/

3. https://www.ecr-igac-icacgp.org/2024/05/14/ecr-spotlight-saurabh-sonwani/

- The iLEAPS Early Career Researcher (ECR) also made valuable contributions as an invited speaker in two distinct sessions at SRI/SSD2024. The first session focused on the "Heterogeneous Role of Urban Blue-Green Spaces on Public Health and Environmental Sustainability," where the speaker discussed the diverse impacts of urban ecosystems on both human health and environmental well-being. In the second session, titled "The Future of Transdisciplinary Sustainability Science," the speaker shared insights on the evolving role of interdisciplinary approaches in addressing global sustainability challenges, highlighting the importance of collaboration across scientific and societal boundaries.

Upcoming Events

- **Eighth WMO International Workshop on Monsoons (IWM-8)**

Date: **17- 21 March 2025**

Venue: **IITM, Pune (Hybrid mode)**

Registration, abstract submission, and more information is available at https://wmo-iwm8.tropmet.res.in/

The International Workshop on Monsoons (IWM) is a major quadrennial workshops series under the World Weather Research Programme (WWRP) of the World Meteorological Organization (WMO). IWM-8, the eighth workshop in this series, is being organized at **Pune, India,** jointly by the Indian Institute of Tropical Meteorology (IITM), Pune, Ministry of Earth Sciences (MoES), Government of India, the WWRP's Working Group on Tropical Meteorology Research (WGTMR) and the WCRP's CLIVAR/GEWEX Monsoons Panel in cooperation with the India Meteorological Department and the International Monsoons Project Office (IMPO). **The workshop will be held at IITM Pune during 17-21 March 2025 in hybrid mode, permitting on-site and virtual participation.**

- **EGU General Assembly**

1. Fog and Dew: Advancing Our Understanding for Better Warning Systems - The Indian Institute of Tropical Meteorology (IITM), Pune, India, in collaboration with iLEAPS and the International Fog and Dew Association (IFDA), is organizing a special session on Fog and Dew at the EGU General Assembly 2025 – "Fog and Dew: Advancing Our Understanding for Better Warning Systems". The session aims to explore the scientific processes governing fog and dew formation, interaction, and environ-mental impact. It will showcase cutting-edge research across disciplines. A special issue in the Atmospheric Chemistry and Physics (ACP) Journal is also being organized for studies sub-mitted to the Fog and Dew Session.

More details at: https://meetingorganizer.copernicus.org/EGU25/session/53503

2. Ecosystem Services and Climate Extremes in Anthropocene: Interactions and Research Gaps - iLEAPS is also organising the following session at EGU2025 that aim to: i) Enhance our knowledge of how climate extremes, in combination with other global change drivers like land-use change and climate warming, impact ecosystem services and biodiversity. ii) Identify methods to mitigate the decline in ecosystem services and functioning caused by climate ex-tremes. iii) Address research gaps in understanding the full feedback loops between biodiversity loss, changes in ecosystem services, and climate extremes. iv) Explore strategies to mitigate the impacts of climate extremes, strengthen ecosystem resilience, and enhance ecosystem services. This session also emphasizes the importance of implementing innovative policy tools and nature-based climate solutions that can improve biodiversity and, in turn, bolster ecosystem services.

More details at: https://meetingorganizer.copernicus.org/EGU25/session/52270.

The 2025 EGU General Assembly will be held both on-site in Vienna, Austria, and virtually from **27 April to 2 May 2025.**

Important Dates:

Abstract Submission is Open on **04 Nov 2024**.

The abstract submission deadline is **15 January 2025**, 13:00 CET.

- **World Meteorological Organization**
- **11th WMO Scientific Conference on Weather Modification**

(Pune, India, 3-7 November 2025)

The Eleventh WMO Scientific Conference on Weather Modification will be held at IITM Pune, India during **3-7 November 2025.**

The Conference is being organized in the following main areas:

a) Weather Modification Research and the study of cloud and precipitation processes
b) Operational weather modification projects, methods, outcome, and their scientific assessments
c) Weather Modification, and the physical and socio-economic environment aspects

Specific sessions will be conducted for

- Observational studies
- Field measurements
- Laboratory Studies
- Modelling studies
- Emerging Technologies for weather modification/ weather forecasting
- Decision support systems and nowcasting towards Weather management
- Advanced statistical methods, including data-driven models, AI/ML
- Physical, environmental, and socio-economic aspects, ethical aspects
- Operational cloud seeding
- Climate Intervention Research, Stakeholders /policymakers perception and demands

Online submission of abstracts will be available through the IITM website.

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Dr. Sahil Bhandari (Head of North America Network)

University of British Columbia, Canada

Dr. Gemma Purser (Head of Europe & Mediterranean Network)

The University of Arizona, Tucson, United States

José Morán (Head of Latin America Network)

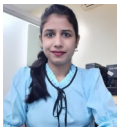
Institute National des sciences appliquees INSA of rouen, France

Tihomir Simin (Head of European Region)

University of Copenhagen, Denmark

Jhonathan R Gamboa (Head of Australia & New Zealand Region)

University of Wollongong, Australia



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