13th Asian Aerosol Conference

3 - 7 November 2024 • Sarawak

Synergizing Aerosol Science, Technology, Policy and Practice towards Sustainable Solutions

E-PROGRAMME BOOK

3rd - 7th NOVEMBER 2024

BCCK KUCHING, SARAWAK, MALAYSIA

ORGANISED BY

Asian Aerosol Research Assembly

THE CLEAN AIR FORUM SOCIETY OF MALAYSIA (MYCAS)

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Sarawak Energy is an energy developer and a vertically integrated power utility based in Sarawak, Malaysian Borneo, with a vision to achieve sustainable growth and prosperity for Sarawak by meeting the region's need for reliable and renewable energy.

Founded in 1921 and built on a foundation of a century of operations, Sarawak Energy is Malaysia's largest renewable energy provider and serves a population of almost 3 million in Sarawak and more beyond its borders.

Sarawak Energy's mission is to light up its communities through a balanced energy mix that is predominantly renewable hydropower, complemented by indigenous gas and coal for energy security and diversity. This is in support of Sarawak's ambition to achieve full electrification by 2025 – ahead of the United Nations Sustainable Development Goal No. 7 target of 2030.

Renewable hydropower development has also enabled Sarawak Energy to expand its generation capacity by exploring alternative renewable energy sources including floating solar and hydrogen, launch Sarawak's first renewable energy certificate and support Sarawak's Post COVID-19

Development Strategy, which aims to make Sarawak a high income society by 2030. Sarawak Energy is a key member and Sustainability Partner of the International Hydropower

Association, a member of the UN Global Compact Network Malaysia, and a member of the Global Reporting Initiative. In 2024, Sarawak Energy became the first global patron of the World Energy Council from Southeast Asia.

Table of Content

Welcome Message 4
by The Right Honourable Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg
(Premier of Sarawak)

Welcome Message 5
by The Honourable Dato' Sri Huang Tiong Sii
(Deputy Minister, Ministry of Natural Resources and Environmental Sustainability of Malaysia (NRES))

Welcome Message 6
by Ts. Dr. Noor Zaitun Yahaya (AHEA UK)
(General Chair)

Welcome Message 7
by Prof. Dr. Juliana Jalaludin
(Co-Chair)

Welcome Message 8
by Prof Chih-Chieh Chen
(AARA President)

Organised by 9

Sincere Appreciation 9

Award List 13

- AARA Fellow Award
- Asian Young Aerosol Scientist Award
- Kanomax Award

Organising Committee 14

Venue Floor Plan 15

Programme At A Glance

- Day 1, 3rd Nov 2024 (SUNDAY) 16
- Day 2, 4th Nov 2024 (MONDAY) 16
- Day 3, 5th Nov 2024 (TUESDAY) 18
- Day 4, 6th Nov 2024 (WEDNESDAY) 20
- Day 5, 7th Nov 2024 (THURSDAY) 22

Plenary Speakers 23

Symposium Speakers 29

Oral Presentation List 48

Poster Presentation List 57

Welcome Message

by The Right Honourable Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg (Premier of Sarawak)

I would like to extend my congratulations to the Clean Air Forum Society of Malaysia (MyCAS), the Asian Aerosol Research Assembly (AARA), and the organising committee of the 13th Asian Aerosol Conference (AAC) 2024. My deepest gratitude also goes to all the sponsors and partners whose support has made this conference possible.

The theme of this year's conference, "Synergizing Aerosol Science, Technology, Policy, and Practice towards Sustainable Solutions," is especially timely, as the region and the world are increasingly focused on managing the health implications of air quality. The long-term exposure to polluted air is linked to increased rates of asthma, chronic respiratory conditions, and other health challenges, making this conference a vital platform for sharing knowledge and strategies to mitigate these risks.

Through the Post-COVID-19 Development Strategy (PCDS) 2030, Sarawak is committed to improving public health outcomes by addressing environmental factors such as air quality. As part of this strategy, our government has prioritised sustainable urban development and air quality monitoring.

In addition, we continue to align our policies with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 3 on Good Health and Well-being and SDG 13 on Climate Action.

I would like to commend the organisers for bringing together scientists, policymakers, and public health experts to explore the intersection of aerosol science and public health policy. The 13th AAC 2024 offers an opportunity to discuss not only the science of aerosols but also the practical solutions that can be applied to protect public health. From advancements in air quality monitoring to public health interventions, the insights shared at this conference will be invaluable to shaping future policies.

The Right Honourable Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg
Premier of Sarawak

Welcome Message

by The Honourable Dato' Sri Huang Tiong Sii (Deputy Minister)

Ministry of Natural Resources and Environmental Sustainability (NRES) would like to extend the heartfelt congratulations to the organiser, the Clean Air Forum Society of Malaysia (MyCAS) for organising and hosting this prestigious event in collaboration with the Asian Aerosol Research Assembly (AARA) with the support from various ministries, local universities, and agencies.

The 13th Asian Aerosol Conference 2024 (AAC 2024) is a critical platform for sharing knowledge, exchanging expertise, and presenting the latest research findings in aerosol science. It marks a significant milestone in our collective efforts to address global climate challenges.

The theme of the AAC 2024, "Synergizing Aerosol Science, Technology, Policy, and Practice towards Sustainable Solutions" provide a platform in emphasising the critical need for a holistic and interdisciplinary approach to addressing aerosol-related challenges across scientific, technological, policy, and practical domains.

To address the challenges related to air quality, the government is finalising the National Clean Air Action Plan 2025-2040 (NCAAP), developed in the earlier Clean Air Action Plan 2010. This plan is designed to enhance Malaysia's ambient air quality and serve as a guiding document that aims to drive unified and comprehensive efforts toward achieving better air quality. The development of NCAAP 2025 – 2040 involves collaboration with various stakeholders, such as government bodies, the private sector, industry players, NGOs, educational institutions, and others.

NRES is adopting a highly aspirational approach to decarbonise by committing to achieve net zero greenhouse gas emissions (GHG) by 2050. In this regard, the ministry is finalising its Long-term Low Emission Development Strategy (LT LEDS) to guide Malaysia in meeting this target.

The Honourable Dato' Sri Huang Tiong Sii

Deputy Minister, Ministry of Natural Resources and Environmental Sustainability of Malaysia (NRES)

Welcome Message

by Ts. Dr. Noor Zaitun Yahaya (AHEA UK) (General Chair)

Welcome to the 13th Asian Aerosol Conference (AAC) 2024! On behalf of the Clean Air Forum Society of Malaysia (MyCAS) and the organising committee, it is my privilege to welcome you to the 13th Asian Aerosol Conference (AAC) 2024. This gathering brings together scientists, researchers, industry leaders, and policymakers to explore key advancements in aerosol science, technology, and the impact of aerosols on the environment and public health.

MyCAS was established in 2014 during the Better Air Quality Conference in Colombo, Sri Lanka, and was formally registered in Malaysia in 2016. Since then, MyCAS has been at the forefront of promoting clean air in this region with a strong commitment to advancing aerosol research, improving air quality, and fostering collaboration through biennial conferences. MyCAS also successfully organised the Better Air Quality Conference 2018. Our mission is to engage stakeholders, promote capacity building, and support efforts for better air quality at both national and international levels.

As a proud member of the Asian Aerosol Research Assembly (AARA), we are honoured to have been entrusted by the AARA Board to host the 13th AAC 2024. This event would not have been possible without the invaluable support of numerous stakeholders, including Business Events Sarawak (BESarawak), the Malaysia Convention and Exhibition Bureau (MyCEB), government agencies, academic institutions, and strategic partners. This conference serves as a platform for exchanging knowledge, showcasing cutting-edge research, and discussing the future of aerosol and technology.

As we come together from diverse disciplines and nations, let us take the opportunity to collaborate, learn, and contribute to the advancement of aerosol research. Together, we are well positioned to shape the future of this important field.

Thank you for joining us and welcoming what promises us to be an engaging and impactful event.

Ts. Dr. Noor Zaitun Yahaya (AHEA UK)
General Chair, 13th Asian Aerosol Conference (AAC) 2024

Welcome Message

by Prof. Dr. Juliana Jalaludin (Co-Chair)

Dear Colleagues and friends

On behalf of the organising committee, It is my great honour and privilege to welcome each of you to the 13th Asian Aerosol Conference 2024.

Serving as co-chair and head of the scientific committee for an event that gathers some of the brightest minds in aerosol science and technology is both humbling and exhilarating. This year's theme, "Synergizing Aerosol Science, Technology, Policy, and Practice towards Sustainable Solutions," underscores our commitment to a holistic, multidisciplinary approach. It emphasises the importance of integrating science, technology, and policy to craft solutions that are not only innovative but also practical and impactful.

Over the next few days, we will witness a remarkable convergence of expertise. We have gathered prominent speakers and leaders renowned across the fields of aerosol research, technology, and policy to share their latest innovations and discoveries. Their work not only enhances our understanding of aerosols but also guides us toward sustainable, science-driven solutions that will shape a healthier and more resilient world.

This conference stands as a testament to the remarkable progress in aerosol science. My heartfelt thanks go to the organising committee for their tireless dedication and exceptional teamwork in bringing the 13th Asian Aerosol Conference 2024 to life, establishing an outstanding platform for scientific advancement and collaborative growth. We are thrilled to present six plenary speakers, five special symposia, 25 oral sessions, and over 340 presentations from 36 countries. Each of you, through your dedication to advancing aerosol science, plays a vital role in shaping a future where technology, policy, and practice converge to address today's challenges and fulfil tomorrow's aspirations.

Thank you, and I wish you all a productive, inspiring, and collaborative conference.

Prof. Dr. Juliana Jalaludin
Co-Chair, 13th Asian Aerosol Conference 2024
Head of Scientific Committee

Welcome Message

by Prof Chih-Chieh Chen (AARA President)

On behalf of the Asian Aerosol Research Assembly (AARA), it is my pleasure to welcome all of you to the 13 th Asian Aerosol Conference (AAC). This gathering exemplifies the commitment and collaborative spirit of our member countries in advancing aerosol science and addressing regional challenges related to air quality, climate, and public health.

The AARA was founded in 1999 with the mission to foster collaboration in aerosol research across Asia. Today, AARA's membership spans diverse countries, each contributing unique expertise to the field. Our biennial AAC has become a platform where these diverse experiences converge, allowing us to exchange knowledge, explore cutting-edge technologies, and develop strategies for the pressing issues of air quality and climate change.

This year's conference, themed "Synergizing Aerosol Science, Technology, Policy, and Practice towards Sustainable Solutions," emphasises our goal to translate research into actions that improve public health and environmental resilience across Asia. The idea of holding a biennial conference emerged as a way to bring together researchers, industry leaders, and policymakers to foster knowledge exchange and collaboration. Since then, the AAC has provided a unique platform to address key topics in aerosol science, including fundamental research, industrial applications, air quality, and climate change.

In addition to presenting current research, AAC 2024 will highlight the Asian Young Aerosol Scientist Award, recognising emerging talent, and the AARA Fellows Award, honouring senior scientists for their significant contributions to AARA. These awards reflect our commitment to fostering the next generation of aerosol researchers and celebrating those whose work has strengthened our field.

We extend our heartfelt recognition to MYCAS for their exceptional role as the organiser of the 13th Asian Aerosol Conference. Their dedication and expertise have significantly contributed to advancing aerosol science and fostering collaboration among researchers and professionals in the field. We appreciate their commitment to excellence and the successful execution of this important event, which has brought together diverse voices and innovative ideas to address global challenges in aerosol research.

As we gather for AAC 2024, I am confident that our discussions will inspire new ideas, forge stronger collaborations, and lead to meaningful advancements in aerosol science for the benefit of our region and the world.

Thank you, and I wish you all a successful and inspiring conference.

Prof Chih-Chieh Chen

AARA President

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Award List

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Yonsei University, South Korea

Prof. Min HU
Peking University, China

Prof. Rajasekhar Balasubramanian
National University of Singapore

Prof. Shih-Chun Candice Lung
Academia Sinica, Taiwan

Asian Young Aerosol Scientist Award

Assoc. Prof. Sheng-Lun LIN
Department of Environmental Engineering, National Cheng Kung University, Taiwan

Prof. Syuichi ITAHASHI
Research Institute for Applied Mechanics (RIAM), Kyushu University, Japan

Kanomax Award

Dr Kensei Ehara
National Institute of Advanced Industrial Science and Technology, Japan

Organising Committee

The organisational arrangements of the 13th AAC 2024 have been managed by the Organising Committee, composed of the Conference Chairs and experts from the organising institutions. We extend our sincere gratitude to all institutions for the contributions of these knowledgeable professionals.

Local Organising Committee

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Ts. Dr. Noor Zaitun Yahaya (AHEA UK) (UMT)

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Nor Suhaili Binti Mohamad Zin (MOHE)
Rahmah binti Biak (NREB) - *Industrial Pocket Talk*
Nornatrah Ahmad (MINTRED) - *Industrial Pocket Talk*
Haji Kamaludin Bin Haji Busrah (MINTRED) - *Sarawak Local Booth*
Sabrina Sihas (MINTRED) - *Sarawak Local Booth*
Halimah Darham (MINTRED) - *Sarawak Local Booth*

Media and Promotion
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Dr. Noor Fatihah Mohamad Fandi (UIAM)

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Dr. Teh Sabariah binti Abdul Manan (UMT)
Azmir bin Md Dom (MOHE)

Secretariat
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Prof. Tawatchai Charinpanitkul (Asian Young Aerosol Scientist Award Chair)
Prof. Puji Lestari (Kanomax Award Committee Chair)
Prof. Dr. Mohd Talib Latif

International Organising Committee

International Advisory Committees (AARA Board Member)

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Prof. Dr. Donggeun Lee
Prof. Dr. Shuncheng Lee
Prof. Dr. Renjian Zhang
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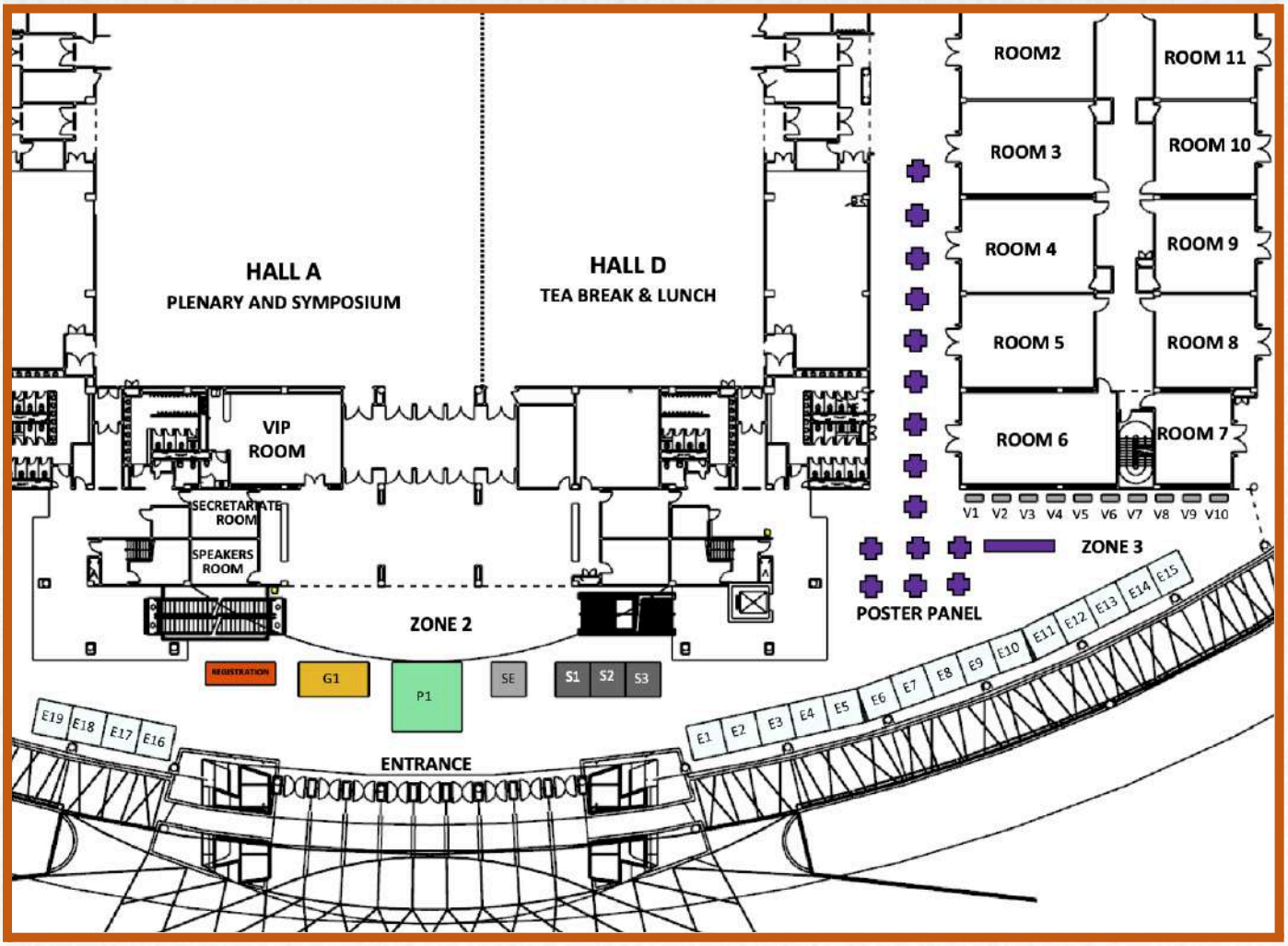
Venue Floor Plan



Programme At A Glance

Day 1, 3rd Nov 2024 (SUNDAY)

Time	Session
13:00 - 17:00	Registration
14:00 - 17:00	AARA Board Meeting
17:00 - 19:00	Welcoming Reception at BCCK

Day 2, 4th Nov 2024 (MONDAY)

Time	Session
08:00 - 08:30	**Registration** The arrival of invited guests and delegates
08:00 - 09:00	Welcome Refreshments
09:00 - 10:00	**Plenary Lecture 1** The World Needs Solutions to Clean Up the Air We Breathe: Can Aerosol Science, Technology and Practice Deliver Them? *Distinguished Prof. Lidia Morawska*
10:00 - 12:00	**Opening Ceremony** Welcoming speech by Chairperson of AAC 2024 *Ts. Dr. Noor Zaitun Yahaya (AHEA UK)* Welcoming speech by AARA President *Prof. Chih-Chieh Chen* Speech by Deputy Minister, Ministry of Natural Resources, Environmental Sustainability of Malaysia *The Honourable Dato' Sri Huang Tiong Sii* Officiating Speech by *The Right Honourable Datuk Patinggi Tan Sri (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg, Premier of Sarawak* AAC2024 Official Launching
12:00 - 12:30	Exhibition Booth Visit
12:30 - 14:00	Lunch

Time	Session					
14:00 - 15:00	**Plenary Lecture 2** *Chairperson: Prof. Ta-Chih (T.C.) Hsiao* Mitigating Aerosol Emissions from Transport Sources in Urban Hotspots *Prof. Dr. Konstantinos Eleftheriadis*					
	ORAL SESSION 1					
	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	Hall A
	Aerosol & Air Pollution in South Eastern Asia Countries (I)	Aerosol Chemistry (I)	Aerosol Exposure & Health Effects (I)	Urban Aerosol & Air Quality (I)	Indoor Air (I)	**Symposium 1** **Emerging Technologies** *Chairperson: Prof Charles Lo*
15:00 - 15:15	AAC24-259	AAC24-34	AAC24-43	AAC24-108	AAC24-26	Ultralow Emission Control Technologies and Advanced Monitoring Devices for PM2.5 and Nanoparticles *Prof. Dr. Chuen-Jinn Tsai*
15:15 - 15:30	AAC24-44	AAC24-54	AAC24-55	AAC24-113	AAC24-220	
15:30 - 15:45	AAC24-46	AAC24-68	AAC24-81	AAC24-154	AAC24-97	Humanizing Technology: Key to Lower Carbon Mobility via Aerosol Emission Management *Dato' Prof. Dr. Ahmad Farhan Mohd Sadullah*
15:45 - 16:00	AAC24-58	AAC24-98	AAC24-89	AAC24-174	AAC24-110	
16:00 - 16:15	AAC24-109	AAC24-129	AAC24-92	AAC24-188	AAC24-114	Application of Environmental Magnetism on Atmospheric Aerosols *Assoc. Prof. Atsushi Matsuki*
16:15 - 16:30	AAC24-168	AAC24-132	AAC24-105	AAC24-202	AAC24-118	
16:30 - 16:45	AAC24-184	AAC24-391	AAC24-164	AAC24-156	AAC24-124	
16:45 - 17:00		AAC24-401	AAC24-405	AAC24-412	AAC24-78	
17:00	Break and end of day 2					

Day 3, 5th Nov 2024 (TUESDAY)

Time	Session					
08:00 - 08:30	Registration					
08:30 - 09:00	AARA Fellows Award Presentation					
09:00 - 10:00	**Plenary Lecture 3** *Chairperson: Prof. Dr. Mohd Talib Latif* Overview of the KPEx and Intensive Observations in Line with the Overflights of ASIA-AQ in the Spring of 2024 *Prof. Neng-Huei (George) Lin*					
10:00 - 10:30	Coffee Break & Poster Session (I)					
	ORAL SESSION 2					
	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	Hall A
	Aerosol & Air Pollution in South Eastern Asia Countries (II)	Aerosol Chemistry (II)	Bioaerosol (II)	Aerosol Exposure & Health Effects (II)	Indoor Air (II)	**Symposium 2** **Impacts of Biomass-Burning Emissions in Southeast Asia** *Chairperson:* *Dr Shantanu Kumar Pani*
10:30 - 10:45	AAC24-196	AAC24-237	AAC24-30	AAC24-115	AAC24-151	Gaseous & Particulate Matter Emission Measured From Tropical Peatland Burning in Central Kalimantan, Indonesia *Prof. Puji Lestari*
10:45 - 11:00	AAC24-21	AAC24-243	AAC24-60	AAC24-148	AAC24-161	
11:00 - 11:15	AAC24-285	AAC24-251	AAC24-61	AAC24-189	AAC24-172	PBL Meteorology and Diurnal Variation of Smoke in Foothill Regions based on UAV, AERONET, and Aerosol Lidar Observations *Prof. Sheng-Hsiang (Carlo) Wang*
11:15 - 11:30	AAC24-309	AAC24-255	AAC24-70	AAC24-215	AAC24-179	
11:30 - 11:45	AAC24-359	AAC24-269	AAC24-85	AAC24-266	AAC24-149	Reduction of Emissions from Biomass Burning in Malaysia: Challenges and Way Forward *Prof. Zailina Hashim*
11:45 - 12:00	AAC24-368	AAC24-277	AAC24-87	AAC24-392	AAC24-248	
12:00 - 12:15	AAC24-372	AAC24-279	AAC24-141	AAC24-398	AAC24-410	Aerosol-Monsoon Interactions: Weather Patterns in a Changing Climate *Dr. Ahmad Fairudz Jamaluddin*
12:15 - 12:30	AAC24-348	AAC24-281	AAC24-145			
12:30– 14:00	Lunch					

Time	Session					
12:30 -14:00	AAQR Editorial Board Luncheon					
14:00 - 15.30	Industrial Pocket Talk ROOM 8 & 9					
14:00- 15:00	Poster Session II & Exhibition					
	ORAL SESSION 3					
	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	Hall A
	Nanoparticles & Nanotechnology (I)	Urban Aerosol & Air Quality (II)	Aerosol Instrumentation (I)	Airborne Microplastics (I)	VOC and secondary precursors	**Symposium 3 Efficient Engineering Controls for COVID-19 and Other Airborne Diseases** *Chairperson:* *Prof. Sheng-Hsiu Huang*
15:00 - 15:15	AAC24-28	AAC24-244	AAC24-65	AAC24-120	AAC24-42	Development of a High-Efficiency Source-Control Device for COVID-19 *Prof. Chih-Chieh Chen*
15:15 - 15:30	AAC24-39	AAC24-256	AAC24-101	AAC24-176	AAC24-53	
15:30 - 15:45	AAC24-67	AAC24-340	AAC24-112	AAC24-180	AAC24-77	Topic 1: Development of a Smart Respirator Topic 2: Experimental Study on Optimal CADR Filter Thickness of Air Purifier *Prof. Chih-Wei Lin*
15:45 - 16:00	AAC24-79	AAC24-353	AAC24-146	AAC24-233	AAC24-204	
16:00 - 16:15	AAC24-104	AAC24-366	AAC24-213	AAC24-239	AAC24-209	Development of a Smart Respirator *Prof. Sheng-Hsiu Huang*
16:15 - 16:30	AAC24-116	AAC24-306	AAC24-229	AAC24-273	AAC24-288	
16:30 - 16:45	AAC24-290	AAC24-275	AAC24-276	AAC24-332	AAC24-298	
16:45 - 17:00	AAC24-354		AAC24-278	AAC24-295		
17:00	Break and end of day 3					

Day 4, 6th Nov 2024 (WEDNESDAY)

Time	Session					
08:00 - 08:30	Registration					
08:30 - 09:00	Asian Young Aerosol Scientist Award Presentation					
09:00 - 10:00	**Plenary Lecture 4** *Chairperson: Prof. Puji Lestari* Assessment of Major Air Pollutants in the Urban Environment of Kuala Lumpur *Prof. Dr. Mohd Talib Latif*					
10:00 - 10:30	Coffee Break & Exhibition					
	ORAL SESSION 4					
	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	Hall A
	Filter and Control Technology	Climate Change, Air Modeling, Meteorology (II) / Bioaerosol	Low Cost Sensor and Sensor Network / Emission Inventory	Indoor Air (III) / Local Biomass Burning	Aerosol-Climate Meteorology (II) / Remote Sensing / Airborne Microplastics	**Symposium 4 Atmospheric Chemistry** *Chairperson:* *Prof. Tawatchai Charinpanitk*
10:30 - 10:45	AAC24-75 -	AAC24-294	AAC24-222	AAC24-250	AAC24-203	Urban Aerosol Physicochemical Properties: Implications for Air Quality and Human Health *Prof. Ta-Chih (T.C.) Hsiao*
10:45 - 11:00	AAC24-99	AAC24-264	AAC24-371	AAC24-253	AAC24-377	
11:00 - 11:15	AAC24-102	AAC24-373	AAC24-403	AAC24-345	AAC24-384	Advancing Atmospheric Chemistry to Improve Air Quality and Human Health *Prof. Balasubramanian*
11:15 - 11:30	AAC24-119	AAC24-380	AAC24-388	AAC24-387	AAC24-47	
11:30 - 11:45	AAC24-152	AAC24-232	AAC24-169	AAC24-106	AAC24-305	Investigating the Levels of Indoor and Outdoor Particulate Matter In Six Southeast Asian Cities *Prof. Anil Namdeo*
11:45 - 12:00	AAC24-287	AAC24-247	AAC24-171	AAC24-317	AAC24-404	
12:00 - 12:15	AAC24-375	AAC24-286	AAC24-282	AAC24-378	AAC24-409	
12:15 - 12:30	AAC24-297	AAC24-293	AAC24-331		AAC24-299	
12:30– 14:00	Lunch					

Time	Session					
14:00 -15:00	**Plenary Lecture 5** *Chairperson: Prof. Selahattin Incecik* Asia Air Quality Status and Trends 2023 *Mr. Bjarne Pedersen*					
	ORAL SESSION 5					
	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	Hall A
	Aerosol Modeling / Aerosol Physics	(III) Aerosol Exposure and Health Affects / Urban Aerosol and Air Quality	(III) Aerosol Chemistry / (II) Nanoparticles and Nanotechnology	(II) Aerosol Instrumentation / (III) Nanoparticles and Nanotechnology	Air Pollution Sources & Mitigation Technologies	**Symposium 5** **Sustainable Climate Action** *Chairperson:* *Prof. Zailina Binti Hashim*
15:00 - 15:15	AAC24-235	AAC24-411	AAC24-284	AAC24-312	AAC24-27	Potential Impacts on Air Pollutants and Future Climate I Southeast Asia *Prof. Selahattin İncecik*
15:15 - 15:30	AAC24-318	AAC24-302	AAC24-289	AAC24-335	AAC24-314	
15:30 - 15:45	AAC24-350	AAC24-313	AAC24-300	AAC24-336	AAC24-315	Emissions, Health Impacts and Cost of Illness Reductions and Energy Transition Scenarios *Prof. Dr. Budi Haryanto*
15:45 - 16:00	AAC24-80	AAC24-320	AAC24-333	AAC24-357	AAC24-316	
16:00 - 16:15	AAC24-83	AAC24-334	AAC24-356	AAC24-365		Indoor Environment and Climate Impacts on Children's Health *Prof. Dr. Jamal Hisham Hashim*
16:15 - 16:30	AAC24-231	AAC24-338	AAC24-271	AAC24-355		
16:30 - 16:45	AAC24-341	AAC24-389	AAC24-283	AAC24-394		Regional Cooperation as Key to Addressing Air Pollution and Climate Change in Asia *Ms. Glynda Bathan-Baterina*
16:45 - 17:00	AAC24-339					
17:00 - 17:30						A Breath of Fresh Air: Malaysia's Experience in Air Quality Management *Dr. Hii Yii Siang*
17:30	Break and end of day 4					
19:00 - 22:00	Grand Dinner at Hilton Hotel					

Day 5, 7th Nov 2024 (THURSDAY)

Time	Session
08:00 - 09:00	Kanomax Award Presentation
09:00 - 10:00	**Plenary Lecture 6** *Chairperson: Assc. Prof. Sr. Dr. Norhayati Mahyuddin* Advancing Climate Action through Sustainable Renewable Energy: An Industrial Perspective *Mr. Marconi Madai*
10:00 - 10:30	Coffee Break & Exhibition
10:50 - 12:30	**Closing Ceremony** Speech by AARA President *Prof. Chih-Chieh Chen* Closing Inauguration *Ts. Dr. Noor Zaitun Yahaya (AHEA UK)* Award Ceremony
12:30 - 14:00	**Conference Ends and Lunch**

Plenary Speakers

Plenary Speaker 1

The World Needs Solutions to Clean Up The Air We Breathe: Can Aerosol Science, Technology and Practice Deliver Them?
Monday, November 4, 2024, 09:00- 10:00

Distinguished Prof. Lidia Morawska
School of Earth and Atmospheric Sciences
Queensland University of Technology (QUT)

Biography

Lidia Morawska is a Distinguished Professor and Australian Laureate Fellow in the School of Earth and Atmospheric Sciences at the Queensland University of Technology (QUT) in Brisbane, Australia. She is the Director of the International Laboratory for Air Quality and Health (ILAQH) at QUT, a World Health Organization (WHO) Collaborating Centre on Air Quality and Health; the Centre Director for the ARC Training Centre for Advanced Building Systems Against Airborne Infection Transmission (THRIVE) hosted at QUT; a Vice-Chancellor Fellow, Global Centre for Clean Air Research (GCARE), University of Surrey, United Kingdom; an Adjunct Professor at the Institute for Environmental and Climate Research (ECI), at the Jinan University, Guangzhou, China; and a Co-Director in Australia for the Australia – China Centre for Air Quality Science and Management (ACC-AQSM). She conducts fundamental and applied research in the interdisciplinary field of air quality and its impact on human health and the environment, with a specific focus on science of airborne particulate matter. She is an author of >1,070 journal papers, book chapters and conference papers. Lidia has been involved at the executive level with a number of relevant national/international professional bodies, is an International Honorary Member of the American Academy of Arts and Sciences, a Fellow of the Australian Academy of Science, Queensland Academy of Arts and Sciences, Royal Society of Biology, and is acting as an advisor to the WHO. She is the recipient of numerous scientific awards including being named in the 2021 TIME100 annual list of the hundred most influential people in the world.

Abstract

Now more than ever we are aware of a multitude of risks we face in indoor and outdoor environments where we live, work and play. Many of these risks are related to the quality of the air we breathe: ambient particulate matter is one of the main risks, as well as airborne infection transmission. Particles in indoor and outdoor air originate from many different sources. Scientific knowledge about the emission, transformation, transport, and impact of particles is advanced, based on decades of research. However, in practice, we cannot protect ourselves from infectious respiratory particles, nor can we derive the exposure–response relationships of ultrafine particles or decide how to scale up the application of low-cost optical particle sensors for routine indoor air monitoring. There are missing elements in the jigsaw puzzle of science, technology, applications, and regulations that prevent us from achieving healthy, clean air for all. How can we complete this puzzle?

Plenary Speaker 2

Mitigating Aerosol Emissions from Transport Sources in Urban Hotspots
Monday, November 4, 2024, 14:00- 15:00

Prof. Dr. Konstantinos Eleftheriadis
Environmental Radioactivity & Aerosol technology for atmospheric & Climate impact Lab,
NCSR Demokritos NCSR “Demokritos”, Athens, Greece

Biography

Over 25 years of research experience related to aerosol physicochemical characterization, application of nuclear techniques to environmental studies and radioactivity including development of novel sampling and measurement techniques. He has established and is responsible for the Demokritos Regional Research Aerosol station, member of the Global Atmosphere Watch network (GAW-DEM), operating since 2007 and Helmos Mountain station since 2016. He has been actively involved in European initiatives for the development of standardized methods, through EUSAAR (European Supersites for Atmospheric Aerosol Research) and ACTRIS (Aerosols, Clouds, and Trace gases Research InfraStructure) activities. He has also served as an Expert in missions for the Regional IAEA/AFRA projects, as well as the National Counterpart for Greece in Regional IAEA programs. He has been the PI and coordinated for Demokritos several EU FP and National programs. Among these, he has coordinated the ENTEC Infrastructure REGPOT FP7 programme for Capacity Building the NCSR Demokritos atmospheric science and technology Infrastructure, led the DG-ENV LIFE+ ACEPT-AIR, FROST DEFEND programmes and was PI for NCSR in the LIFE AIRUSE and LIFE-INDEX programmes. , He has more than 190 publications in peer reviewed journals regarding atmospheric aerosol science, measurement methodology and applications in radiation protection, air pollution and climate impact of atmospheric aerosol. President of the Hellenic Association for Aerosol Research (2015-2023), member of the Pan Eurasian Academy of Sciences

Abstract

Air Quality in urban areas and other hot spots, where transport emissions induce a large impact on human exposure, remains an environmental problem of high complexity attracting strong public interest. The European Commission has proposed revising the Ambient Air Quality Directive to improve Europe’s air quality. New suggested measures include tightening air quality limit values in alignment with WHO levels and improved monitoring of currently unregulated and emerging pollutants. The monitoring of emerging air quality parameters, such as ultrafine particles (UFP) and Black Carbon (BC), is beneficial in terms of gaining a better understanding of air pollution. Supporting and complementing the regular observation networks could underpin the efforts of governments and civil society to comply with the sought SDGs for sustainable cities and communities.Despite the strict Emission Standards, “real world” emissions from transport sources is accepted as a term, indicating a status of only partial success of current fossil fuel emission control, while the high significance of non-exhaust emissions is now recognized. The MI-TRAP project aims to improve the currently available Tools and services for air pollution mitigation from transport sources through a multi-dimensional approach. The project will develop and provide a suite of beyond the state of the art innovative monitoring Instrumentation package, data analysis tools to track emitted pollutants, enable systematic traffic management and evaluate the effectiveness of legislation and control measures. The project will be implemented in ten cities across Europe, aiming to characterize the footprint of transport emission sources and assess their impact on air quality and human health. MI-TRAP will provide the methodologies for collecting and utilizing data for unregulated and emerging transport related air pollutants, including solid particle number (sPN) and bare BC (bBC) (to bridge the gap between lab and real-world conditions), UFPs and number size distributions, non-refractory organics and inorganics, trace and major elements, exhaust gasses, and noise. These data will be complemented with real-time traffic metrics i.e. traffic density and fleet composition. Using novel analytical methodologies and tools, MI-TRAP will a) identify the specific footprint of transport emission sources and traffic-related super-polluters, b) evaluate the impact in ambient air of current emission standards, b) develop tools for short- and long- term assessment of the impact in air quality and human health Integrated platform. MI-TRAP will adopt the novel methodology enabling real-time assessment of the organic and carbonaceous aerosol sources. Specifically, real-time PMF source apportionment will be performed on the ACSM organic aerosol (OA) mass spectra, on the near real-time XRF data, as well as on equivalent black carbon (BC) decomposing it to its fossil fuel combustion (BCff) and biomass burning (BCbb) fractions.

Plenary Speaker 3

Overview of the KPEx and Intensive Observations in line with the Overflights of ASIA-AQ in the Spring of 2024

Tuesday, November 5, 2024, 09:00- 10:00

Distinguished Prof. Neng-Huei (George) Lin
National Central University
Editor-in-Chief Aerosol and Air Quality Research

Biography

Prof. Lin's researches are focused on physical and chemical processes of atmospheric pollutants including acid deposition, cloud chemistry and physics, biomass-burning aerosol, atmospheric mercury, and greenhouse gases, with emphasis on biomass-burning aerosol-cloud-radiative interaction in East and Southeast Asia (i.e. Seven South East Asian Studies, 7-SEAS), and atmospheric background measurements at Mt. Lulin (2,862 m, LABS) in past 20 years. Dr. Lin is also the program coordinator of the Taiwan Acid Rain Network. He has been heavily involved in many international field campaigns, such as ACE-Asia, ABC/EAREX, BASE-ASIA, 7-SEAS and Korea-Japan-HK-Taiwan Asian Continental Outflow Study, Asian Pacific Mercury Monitoring Network (APMMN), etc. He is very active in international collaborations and was frequently invited as a speaker at AMS, AGU, AAC, and professional conferences, symposiums, and workshops. Dr. Lin has published more than 170 SCI papers. Dr. Lin is the Editor-in-Chief of Aerosol and Air Quality Research and has served on the Editorial Board of Atmospheric Environment and Asian Journal of Atmospheric Environment. He has been serving as a member of many technical and advisory committees on international, national, and ministry levels. He served as the Secretary in General, Vice President, and President of the Taiwan Association for Aerosol Research (TAAR) in 2000-2001, 2004-2008, and 2009-2011, respectively, and now is the Fellow and Honorary President of TAAR. Besides, he was elected as the Fellow of the Asian Aerosol Research Assembly (AARA) in 2019, and the Fellow of the Meteorological Society of ROC (Taiwan) in 2021.

Abstract

The Kao-Ping (Kao-Hsiung City and Ping-Tung County) Experiment (KPEx) was conducted in southern Taiwan in the spring of 2024 as the downwind receptor of the 7-SEAS (Seven SouthEast Asian Studies) campaigns in the biomass burning seasons over the northern region of peninsular Southeast Asia. The 7-SEAS' main purpose is to perform interdisciplinary research in the field of transboundary biomass-burning pollution, aerosol-meteorology, and climate interaction in the Southeast Asian region. Participating countries include Indonesia, Malaysia, Philippines, Singapore, Thailand, Taiwan, Vietnam, and the USA. While, KPEx particularly focused on the air pollution in southern Taiwan where is the most polluted and industrialized area with a complex terrain and atmospheric circulations. The comprehensive data collection included a dense network of more than 80 air quality stations, 12 PAMS (continuous measurements of photochemical compounds), 4 lidars of NASA/MPLNET, 7 AERONET sites, more than 10,000 PM 2.5 microsensors, and one high-altitude background station at Mt. Lulin (2,862 m, similar instrumentation to MLO, Hawaii) maintained by the Ministry of Environment of Taiwan (MOENV). This data provided an important anchor for the distribution of surface ozone, fine particulate matter, precursors, and columnar/vertical profiling of aerosol properties. During the KPEx, ground-based NASA/COMMIT (Chemical, Optical & Microphysical Measurements of In-situ Troposphere) mobile laboratory and one Taiwanese COMMIT-like trailer were additionally deployed, as well as several fully-equipped mobiles from MOENV and local agencies. In line with the NASA/ASIA-AQ (Airborne and Satellite Investigation of Asian Air Quality) four overflights of Taiwan on 15 and 28 February, and 15 and 27 March, KPEx specifically conducted four Intensive Observation Periods (IOPs), each for 48 hours,especially including the UAVs operated hourly at 3 sites for vertical canister and absorbing-tube VOCs sampling at multi layers and vertical profiling of aerosol and ozone, and intensive soundings launched every three hours at 4 sites. The aerosol chemistry, HAPs and POPs were also measured at specific surface stations. NASA's DC-8 and GIII aircrafts overflew with the payload of 26 sets of high-precision equipment and airborne lidars/spectrometers. The ultimate goals of this study are (1)To characterize the three-dimensional local circulation, air pollutants, and terrain effect for researching the causes of air pollution in southern Taiwan and validating the model simulations and emission inventory; (2) To advance the understanding of the formation and distribution mechanisms of secondary pollutants, long-range transport of polluted air mass and aging process, improving air pollution modeling, to enhance the assessment capacity on air pollution control; (3) To enhance the capability of precaution of pollution transboundary transport by synergetic ground-based measurements, satellite observation and modeling

Plenary Speaker 4

Assessment of Major Air Pollutants in the Urban Environment of Kuala Lumpur

Wednesday, November 6, 2024, 09:00 - 10:00

Prof. Dr. Mohd Talib Latif
Professor of Atmospheric Chemistry and Air Pollution
Universiti Kebangsaan Malaysia, Malaysia

Biography

Mohd Talib Latif is a professor of Atmospheric Chemistry and Air Pollution at the Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM); and a fellow of the Malaysian Academy of Science (FASc). He completed his BSc in Chemistry and MSc in Environmental Science at Universiti Kebangsaan Malaysia and his PhD at the School of Environmental Science, University of East Anglia, United Kingdom. Currently, he is Chairman of the Department of Earth Sciences and Environment, Faculty of Science and Technology Universiti Kebangsaan Malaysia. His main research work included the composition of atmospheric aerosols, atmospheric gases such as surface ozone and volatile organic compounds (VOCs). His research group has been working closely with government agencies in Malaysia such as the Malaysian Department of Environment (DOE) and the Malaysian Meteorological Department (Met Malaysia) in the area of atmospheric compositions and climate change. At the international level, he is actively involved with the research community within the Asian continent through International Global on Atmospheric Chemistry- Monsoon Asia (IGAC-MANGO) project. Since 2018 he has been appointed to one of the scientific steering committees forthe Surface Ocean Lower Atmosphere Study (SOLAS). He participated in the 3rd IPCC Expert Meeting on short lived climate forces (SLCFs) in 2022. Mohd Talib has received the Top Research Scientist Malaysian (TRSM) Award from the Academy of Science Malaysia for his research and publication in 2018.

Abstract

Air quality in Kuala Lumpur, Malaysia, has been associated with various natural and anthropogenic sources and meteorological conditions. Air pollutants that show seasonal variations and frequently exceed the Malaysia Ambient Air Quality Standard (MAAQS) are particulate matter (PM) and surface ozone (O 3), predominantly related to the monsoon seasons. Other air pollutants such as volatile organic compounds (VOCs), namely benzene, toluene, ethylene, and xylene (BTEX), were found to be recorded at the highest concentration near roadsides. usually associated with daily activities, particularly related to the number of motor vehicles on roads, industrial activities and combustion processes. Combustion from biomass burning during haze episodes increased the concentration of carcinogenic substances such as polycyclic aromatic hydrocarbons (PAHs). Several inorganic PM 2.5 compositions, such as sulfate and potassium, and organic molecules, such as levoglucosan (1,6-anhidro-β-D-glucopyranose), have been identified as indicators for biomass burning. Our latest study on persistent organic pollutants, polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in Kuala Lumpur shows that the Σ17PCDD/PCDF concentration in ambient air was 736 ± 375 fg WHO-TEQ m -3 , whereas PM 2.5 , TSP, and gaseous phase concentrations were 223 ± 161 fg WHO-TEQ m -3 , 337 ± 213 fg WHO-TEQ m -3 and 507 ± 273 fg WHO-TEQ m -3 , respectively. Exposure to the gaseous phase of Σ 17 PCDDs/PCDFs resulted in a greater inhalation lifetime cancer risk (1.58E06-5.28E-06) than exposure to the particulate phases of TSP (9.1E-07-3.0E-06) and PM 2.5 (6.98E-07-2.33E-06).

Plenary Speaker 5

Asia Air Quality Status and Trends 2023
Wednesday, November 6, 2024, 14:00 - 15:00

Mr. Bjarne Pedersen
Executive Director
Clean Air Asia (CAA)

Biography

Bjarne is the Executive Director of Clean Air Asia. Bjarne has a broad international experience, particularly in environmental issues and sustainable development, with a proven track record of achieving meaningful impact through strategic leadership, resource mobilization and team building at all levels. He has taken CAA through continuous growth both regionally as well as in China and India including broadening the work of Clean Air Asia to include the Air, Climate and Public Health nexus. Bjarne holds a MSc in Environmental Studies from Strathclyde University, Scotland.

Abstract

Bjarne Pedersen's presentation will focus on the “2023 Air Quality in Asia Status and Trends” which was prepared by Clean Air Asia as part of the 2023 Better Air Quality Conference (BAQ2023), with support from the Asian Development Bank Asia Clean Blue Skies Program. His presentation will cover the following topics:

(i) status of air quality monitoring in Asia including the number of air quality monitoring stations and degree of accessibility of air quality data in Asia,(ii) air quality trends in Asia including historical pollution trends and air pollution levels relative to WHO air quality guideline values,(iii) main emission sources in Asia based on emission inventories and source apportionment studies, and (iv) air quality policies and measures in Asia including (a) legal frameworks and strategies for air quality management, (b) status of air quality standards in Asia, © policies recognizing air pollution health impacts, (d) communicating air quality, (e) clean air action planning of cities in the region, (f) sectoral policies in transport, residential, agriculture, energy and waste sectors.

Plenary Speaker 6

Advancing Climate Action through Sustainable Renewable Energy: An Industrial Perspective

Thursday, November 7, 2024, 09:00 - 10:00

Mr. Marconi Madai
Senior Vice President of Health, Safety, Security & Environment (HSSE)
Sarawak Energy

Biography

Marconi Madai is the Senior Vice President of Health, Safety, Security & Environment (HSSE) at Sarawak Energy, where he leads a team of over 600 professionals dedicated to driving HSSE excellence in alignment with the Company's vision of achieving sustainable growth and prosperity for Sarawak by meeting the region's need for reliable, renewable energy. Since 2017, Marconi has been instrumental in further strengthening Sarawak Energy's safety culture, driving accountability across all levels. Key initiatives such as the Life-Saving Rules (LSR), Security Golden Rules, Contractor Transformation Programme (CTP), Contractor Environmental Compliance Award (CECA), and the Go Green Campaign, were introduced to enhance the company's health, safety, security, and environmental practices. Together with his team, the introduction of a consequence management framework has helped reduce workplace accidents, while the revised security strategy reinforced crisis management and risk assessment processes. Additionally, Marconi has been a strong advocate for sustainability, leading efforts in Circular Economy initiatives and chairing the Biodiversity Conservation Committee for environmental preservation. Marconi has extensive industry experience, having served in management positions in the chemical industry in Malaysia, where he developed standard operating procedures, oversaw compliance to standards, managed business risks and drove initiatives on human resources and CSR. He graduated with a Bachelor of Science in Chemical Engineering from the University of Utah, Salt Lake City, USA in 1997.

Abstract

Sarawak Energy is an integrated energy development and power utility company and Malaysia's largest renewable energy developer with a vision to achieve sustainable growth and prosperity for Sarawak by meeting the region's need for reliable renewable and affordable energy. As a sign of commitment in advancing climate action, Sarawak Energy was the first Malaysian Company to sign the United Nation Global Compact's 'Business Ambition for 1.5o Celsius' Pledge and the first large corporation in Malaysia to have its near-term science-based targets to be officially approved by the Science Based Target initiative (SBTi). Sarawak Energy's current grid emission intensity stands at 0.199 tCO2eq/MWh and aims to achieve a further reduction to 0.17 tCO2eq/MWh in line with the 'Business 1.5oC' commitment – contributing to the Malaysian Government's target of reducing the nation's carbon emission intensity by 45% by the year 2030. Seventy percent of Sarawak Energy's generation mix is from hydropower. All hydropower facilities operated by Sarawak Energy are guided by the Hydropower Sustainability Standard (HSS), which addresses all aspects of social, environment, technical and economic sustainability. Apart from the existing hydropower facilities, Sarawak Energy is also exploring the development of cascading power sources and floating solar farms to further increase Sarawak's renewable energy footprint. To further strengthen Sarawak Energy's contribution towards climate action, the Company has embedded Nature Based Solutions through Sarawak Energy's Tree Planting, Protection and Habitat Restoration Campaign 2021 to 2030 with the objective of protecting and planting 500,000 trees by year 2030. Sarawak Energy has also developed its Circular Economy Framework to embrace circularity in its business operation.

Symposium Speakers

Symposium 1:
Emerging Technologies

Ultralow Emission Control Technologies and Advanced Monitoring Devices for PM2.5 and Nanoparticles
Monday, November 4, 2024, 15:00 - 15:30

Prof. Dr. Chuen-Jinn Tsai
Lifetime Chair Professor
Institute of Environmental Engineering
National Yang Ming Chiao Tung University (NYCU

Biography

Dr. Chuen-Jinn Tsai is Lifetime Chair Professor of the Institute of Environmental Engineering, National Yang Ming Chiao Tung University (NYCU, formerly NCTU, National Chiao Tung University), Taiwan. He graduated from National Taiwan University and received Ph. D. in 1990 in the Particle Technology Laboratory (PTL), Mechanical Engineering Department, University of Minnesota. In the last ~34 years since he joined NYCU in 1990, he has applied aerosol technology successfully in advancing air pollution sampling, monitoring and control technologies. He won distinguished research awards from Taiwan National Science and Technology Council (NSTC, formerly National Science Council) three times and was promoted as NYCU Lifetime Chair Professor in 2023. In 2022, he received the distinguished MOST fellow award from MOST. Professor Chuen-Jinn is one of the key founding members of TAAR (Taiwan Association for Aerosol Research in Taiwan), and AARA (Asian Aerosol Research Assembly) for which he had served as the Presidents. He has served as the Editor-in-Chief, Co-Editors-in-Chief and Editor for nearly 21 years for AAQR (Aerosol and Air Quality Research, http://www.aaqr.org/) since 2003. He received the 2006 International Aerosol Fellow (IAF) award from the IARA (International Aerosol Research Assembly, www.iara.org), 2015 Asian Aerosol Fellow and 2012 Fellow of Taiwan Association for Aerosol Research (TAAR) to recognize his outstanding research, technical development, education and service contributions to aerosol science and technology. In 2018, Taiwan PM2.5 Control Association (PMCA, pmca.tw) was founded by him and colleagues to promote air environmental monitoring and control industry in Taiwan and help Taiwan and ASEAN Countries improve air quality for better health and welfare. He currently serves as the honorary PMCA president after serving as the president for two terms (2018-2022). (chuen-jinn-tsai.org)

Abstract

To improve air quality, controlling PM2.5, nanoparticles and precursor gases from industrial sources is very critical. For this purpose, an effective honeycomb wet scrubber (HWS) and a novel WEP (wet electrostatic precipitator) have been designed and tested. The HWS has a high specific surface area (e.g. 480 m2/m3) with high removal efficiency for mixed acid gases (>95%) in high-tech industry while the pressure drop is kept to be very low at about 80 Pa. A hybrid air pollution control system combining CT (cooling tower)-HWS-WEP was pilot-tested to remove SO2 and PM2.5 emissions very efficiently (>99%) achieving ultralow emission control, while the white smoke was also eliminated at the same time. For advanced air pollutant monitoring, our group has improved the accuracy of impactor-based size classifiers for PM10, PM2.5 and PM0.1 by using Non-Bouncing Impactor (NBI) techniques for mass and number concentration measurements. Based on the NBI, a new Novel Electrostatic Particle Sizer (NEPS) has further been developed and tested recently to obtain ambient nanoparticle number distributions which are in good agreement with those of the commercial SMPS in a long-term field monitoring study. This talk will present these novel technologies in a hope to improve the monitoring and control methods for a better air environment.

Humanizing Technology: Key to Lower Carbon Mobility via Aerosol Emission Management

Monday, November 4, 2024, 15:30 - 16:00

Dato' Prof. Dr. Ahmad Farhan Mohd Sadullah
Vice Chancellor
Universiti Putra Malaysia (UPM)

Biography

Dato' Prof. Dr. Ahmad Farhan Mohd Sadullah is presently the Vice Chancellor of Universiti Putra Malaysia (UPM) and Professor in Transport Studies. Between March 2017 and April 2021, he was appointed as the Deputy Vice-Chancellor (Academic & International) of USM. Preceding his term as Deputy Vice Chancellor, he was both the Dean of the School of Civil Engineering and the Director of the USM's Engineering campus. He is widely regarded as a leading expert in transport matters in Malaysia. He was the founding member of the Commission Member of the Land Public Transport Commission (SPAD), and was made the Interim Chairman from 2017 until the day SPAD was decommissioned by the government. As a commission member, he has helped to steer the organisation and the public transport strategies of the country. He was appointed as the Director General of the Malaysian Institute of Road Safety Research (MIROS) between 2008 and 2011, and was critical behind many road safety strategies of the country. He is still very active championing road safety in Malaysia. In 2016, Ministry of Transport (MOT) Malaysia appointed him as the Cluster Head for the National Blue Ocean Strategy (NBOS) for MOT on road safety. For his work in road safety, he was accorded the Road Safety Icon Award by the Road Transport Department Malaysia (JPJ) in 2015. He has been advising the Penang State government and was instrumental behind the Penang Road Safety Strategies 2014-2020, the only state in Malaysia with such initiative. He continues to be the champion of road safety, and has been advocating for a new approach for road safety in order to produce the desired results. In Universiti Sains Malaysia (USM), Farhan was acknowledged for his leadership qualities very early in his career.

Abstract

The positive correlation between vehicular mobility and aerosol emissions has long been established. Consequently, many nations aspire to achieve low-carbon mobility as part of their sustainable mobility strategies, while simultaneously managing aerosol emissions more effectively. The advancement of technology is often cited as a key enabler for various strategies aimed at achieving lower carbon mobility. These technologies can enhance the effectiveness and efficiency of numerous approaches, such as reducing vehicular mobility, promoting active transportation, managing modal splits, improving vehicle technology, optimizing infrastructure, and achieving a balance between demand and supply. However, many of these technologies have not reached their full potential, resulting in numerous initiatives falling short of their intended outcomes and failing to meet the desired low-carbon mobility targets. This presentation will argue for the need to humanize technology to ensure that its application yields better results in terms of achieving lower carbon mobility and more effective management of aerosol emissions.

Application of Environmental Magnetism on Atmospheric Aerosols

Monday, November 4, 2024, 16:00 - 16:30

Assoc. Prof. Atsushi Matsuki
Institute of Nature and Environmental Technology,
Kanazawa University, Japan.

Biography

Atsushi Matsuki, is an Associate Professor at the Institute of Nature and Environmental Technology, Kanazawa University, Japan. He holds a Ph.D. and MSc in Atmospheric Physics and Chemistry from Nagoya University, and a BSc in Marine Science from Tokai University. His research has focused on the long-range transport of mineral dust, as demonstrated in his Ph.D. thesis on the persistence of background KOSA in the East Asia-Western Pacific region. Matsuki has held various academic positions, including Specially Appointed Assistant Professor at Kanazawa University and JSPS Research Fellow at Université Clermont-Auvergne (former Université Blaise Pascal) in France and Kanazawa and Nagoya Universities in Japan. His work includes establishing the Noto Ground-Based Research Observatory and participating in international aircraft campaigns to measure cloud residual particles.

His research interests include aerosol-cloud interactions, heterogeneous chemistry of aerosols, and individual particle analysis. He has developed new analytical methods for characterizing aerosols and has provided field evidence of humidity-dependent gaseous uptake by aeolian mineral dust. Matsuki is a member of the Japan Society of Atmospheric Chemistry, Japan Association of Aerosol Science and Technology (JAAST), and the Meteorological Society of Japan. He has served on the JAAST committee and is an editor for several journals, including Aerosol and Air Quality Research and Atmosphere. He has received numerous awards, including the Young Scientists' Prize from Japan's MEXT, Minister of Education, Culture, Sports, Science and Technology (MEXT), Japan and the Young Aerosol Researcher Award from Japan Association of Aerosol Science and Technology (JAAST).

Abstract

Iron oxide (FeOx) particles are emitted from human activities (e.g., fossil fuel combustion, traffic, and steelworks) and natural soil/desert dust sources. Such FeOx aerosols have been increasingly concerning due to their toxicity and associated health risks, as well as their light absorbing nature, which potentially promotes global warming. FeOx, including magnetite (Fe3O4), maghemite (γ-Fe2O3) and hematite (α-Fe2O3), are representative minerals that can be detected as magnetic particles (MPs) by environmental magnetic analyses. It is expected to be highly sensitive to certain metal-containing or crustal aerosols. However, to date, no studies have attempted to rigorously distinguish the relative contribution of Asian dust (AD) and anthropogenic emissions on aerosol magnetic properties in a region under direct influence of Asian continental outflow. In this study, This talk will present and evaluated the applicability of environmental magnetism as a novel approach for the source identification of atmospheric aerosols.

Symposium 2:
Impacts of Biomass-Burning Emissions in Southeast Asia

Gaseous & Particulate Matter Emission Measured From Tropical Peatland Burning in Central Kalimantan, Indonesia

Tuesday, November 5, 2024, 10:30 - 11:00

Prof. Puji Lestari
Professor of Air Quality Management and Atmospheric Chemistry
Bandung Institute of Technology-Indonesia

Biography

Puji Lestari is a Professor in Air Quality Management and atmospheric chemistry at Faculty of Civil and Environmental Engineering (FCEE), Bandung Institute of Technology (ITB). She received her Ph.D degree in Environmental Engineering, major in air pollution from Illinois Institute of Technology, Chicago, USA in 1996. She is currently appointed as a Chair of Research Group on Air and Waste Management of ITB. Her research interest includes air quality monitoring and modeling, aerosol characterization and speciation from different sources including biomass burning, emission inventory and source apportionment. She also conducts research on emission characteristic from various sources such as transport, recidential cooking, biomass burning (agriculture and peatland burning) and industries burning waste and biomass. Since 1999, Dr Lestari has been leading as a Project Investigator for many national and International research projects on air quality and atmospheric chemistry. She also has many peer review publications and many international collaborations with many international Universities and Research institutes such as AIT, KCL, Dalhousie Univ, The Univ of Tokyo, US NASA, NIES-Japan, WRI and ICCT-USA. In 2018 she is invited to serve as a Panel member of Development Methodology for GHG Emission Reduction strategy in Indonesia and become a member of expert panel of IPCC in developing emission inventory methodology for SLCP. She also involved in many professional organization activities such as 7SEAS, IGAC mango, IBBI, PII, and CAI Asia etc, In 2023, she established Indonesia Aerosol Association (IAA) and become the first president of IAA.

Abstract

Peatland and forest fire occurred regularly in Indonesia especially in Sumatra and Kalimantan where the peatland areas are mostly located. The impact of peatland fires become a global concern due to the gaseous and particulate matter generated from this peatland fire. This study aimed to develop field emission factors of gaseous pollutants, PM2.5, OC/EC, and water-soluble ions, and to estimate the total gas and particulate emissions from peatland fires. This study was conducted in Palangka Raya, Central Kalimantan, in September 2019 during the main fire episode. Gas samples were collected using the LGR-ICOS analyzer at a flow rate of 0.5 L/min. In comparison, particulate pollutant samples were collected using two Airmetrics Mini Volume Portable Air Samplers at a flow rate of 5 L/min with Quartz fiber and PTFE filters. For further analysis, quartz fiber filters were used for carbon aerosols, while PTFE filters were used for water-soluble inorganic ions. The gaseous emission factors determined in this study for CO2, CO, and CH4 were 1589.5 ± 41.8 g/kg, 236.5 ± 25.7 g/kg, and 5.4 ± 1.3 g/kg, respectively. Meanwhile, the emission factors for PM2.5, OC, EC, and water-soluble inorganic ions, were 27.8 ± 41.8 g/kg, 18.1 ± 8.9 g/kg, 0.25 ± 0.06 g/kg, 1.7 ± 0.7 g/kg, and 62.5 ± 32.3 mg/kg, respectively. With peat burned density of 0.11 g/cm3, a burned depth of 37 cm, and a total area burned of 317,749 ha, peatland fires in Central Kalimantan in 2019 had emitted CO2, CO, PM2.5, total carbon aerosol, and water-soluble ions, about 34.9 ± 0.9 Tg, 5.3 ± 0.6 Tg, 0.6 ± 0.3 Tg, 0.4 ± 0.2 Tg, and 36.7 ± 15.9 Gg, respectively.

PBL Meteorology and Diurnal Variation of Smoke in Foothill Regions based on UAV, AERONET, and Aerosol Lidar Observations

Tuesday, November 5, 2024, 11:00 - 11:30

Prof. Sheng-Hsiang (Carlo) Wang
Professor in Atmospheric Sciences
National Central University

Biography

Dr. Sheng-Hsiang (Carlo) Wang has long been dedicated to the study of atmospheric radiation and aerosols, with a focus on the optical properties of aerosols and their radiative effects. In recent years, Dr. Wang has actively participated in the 7-SEAS international research program, conducting field observation experiments in Thailand and Vietnam to gain a deeper understanding of the optical properties and vertical distribution of aerosols in the major biomass burning emission areas of northern Indochina. Additionally, he has been involved in the establishment of the Taiwan Lidar Network to study the vertical distribution characteristics of aerosols, the background atmospheric radiation monitoring stations, the development of unmanned aerial vehicle observation technology to address shortcomings in atmospheric vertical observation, and the development of miniature sensors to construct environmental Internet of Things (IoT) technology.

Abstract

The foothills present a unique environment where meteorological conditions significantly influence air quality due to complex terrain and localized weather phenomena (e.g., mountain-valley breezes). In Southeast Asia, millions of people reside in foothill regions, making them particularly vulnerable to air quality issues exacerbated by both natural and anthropogenic factors. This presentation explores the intricate interactions between Planetary Boundary Layer (PBL) meteorology and smoke aerosols in foothill regions, leveraging Unmanned Aerial Vehicle (UAV) technology for enhanced data collection and analysis. By utilizing UAV, AERONET, and aerosol lidar observations and a network of low-cost PM2.5 sensors collected during a field campaign in Fang, Chiang Mai, Thailand, in March 2019, we investigate the characteristics of the PBL and the diurnal variation of aerosol dispersion. Results indicate that easterly winds and high PM2.5 concentrations dominate in the morning, transitioning to turbulent westerly winds in the afternoon, which enhance pollutant mixing. However, on high pollution days, a stable PBL structure leads to significant aerosol accumulation below 400 meters. The studies highlight the influence of complex terrain and meteorological conditions on haze formation, with nocturnal air quality deteriorating due to stable atmospheric conditions and katabatic flow, resulting in increased PM2.5 concentrations at night. Together, these findings provide crucial insights into the interactions between biomass burning, aerosol dynamics, and air quality, contributing to a deeper understanding of regional pollution mechanisms and informing future research and policy initiatives.

Reduction of Emissions from Biomass Burning in Malaysia: Challenges and Way Forward

Tuesday, November 5, 2024, 11:30 - 12:00

Prof. Zailina Binti Hashim
Professor of Environmental Health
Universiti Putra Malaysia

Biography

Prof. Dr. Zailina Hashim was a Professor of Environmental Health (EH) in UPM. Her field of specialization is Environmental Health Risk Sciences and Children's Environmental Health. Her Ph.D degree was from the University of Michigan, USA. She introduced the BSc degree programme in Environmental and Occupational Health at UPM in 1998 and has been in the academia for 37 years. She is also an Expert Member of NEHAP under the Ministry of Health.

Abstract

Air pollutant emissions from the biomass and open burning thrust area or sector may not be a significant contributor to the overall pollutant emission load for Malaysia, except maybe during the occasional haze periods, due to transboundary sources of open burning of forest or agriculture lands from overseas. Air emissions from biomass and open burning activities are well addressed in our National Policy on Environment. The Malaysian government has implemented various laws and regulations to manage and control biomass burning.

The current status of emissions in Malaysia due to biomass, and open burning from various data published in literatures, government documents and report on biomass burning were reviewed. The focus manage and control open burning are as follow: i) To prevent open burning activities through strengthening policy, law and legislation enforcement ii) To strengthen the prevention management of open burning of peatland, and agricultural waste, through the implementation of action plans iii) To curb transboundary haze.

Key regulations on biomass burning in Malaysia is the Environmental Quality Act 1974 (EQA 1974). Under Section 29A, open burning is prohibited except in certain circumstances where permits are granted by Department of Environment (DOE). Violation of this law can result in penalties. Some exceptions to the open burning ban are allowed under the Environmental Quality (Declared Activities) Open Burning Order 2003, including: Controlled burning for religious or cultural reasons, agricultural disease prevention and residue management if authorized by DOE. The National Action Plan on Open Burning 2019 is Malaysia's national action plan aimed at controlling and reducing open burning, particularly during dry seasons, to prevent air pollution and public health issues caused by haze. The National Biomass Action Plan 2023-2030 aims to position Malaysia as a leader in sustainable energy through the enhanced utilization of biomass resources, primarily focusing on oil palm biomass. In addition, the National Action Plan on Peatland 2011, highlights the importance of maintaining peatlands not only to protect biodiversity and ecosystems but also to prevent carbon emissions that contribute to climate change. Malaysia supports the Roadmap on ASEAN Cooperation towards Transboundary Haze Pollution Control with Means of Implementation as well as empowering the National Haze Action Plan. Challenges on biomass burning include the following: Remote and inaccessible areas, limited resources, lack of public awareness, economic pressures, coordination among agencies, lack in detection and reporting facilities, and complex legal processes. Strategy and action plans in the control and management of biomass burning are incorporated in the Proposed Framework for the 2025-2040 National Clean Air Master Plan. From the strategies and action plans included, emissions from biomass burning can be further controlled and reduced.

In view of the prevailing scenario on air quality in Malaysia, the government's aspiration to improve ambient air quality, it is imperative to assess and control the sources of biomass and open burning which contribute to poor air quality, even though their contributions may be small.

Aerosol-Monsoon Interactions: Weather Patterns in a Changing Climate

Tuesday, November 5, 2024, 12:00 - 12:30

Dr. Ahmad Fairudz Jamaluddin
Senior Meteorologist
Malaysian Meteorological Department Malaysia

Biography

Dr. Ahmad Fairudz B. Jamaluddin is a senior meteorologist with over 25 years of professional experience at the Malaysian Meteorological Department (MetMalaysia). He has served as the Director of the Atmospheric Science and Cloud Seeding Division since October 2019. In this role, he is responsible for the operation of atmospheric composition monitoring systems, including the Global Atmospheric Watch (GAW) stations, as well as the early warning systems for air pollution caused by haze, volcanic eruptions, and space weather. Dr. Ahmad Fairudz holds a Ph.D. in climate studies from the National University of Malaysia, with a focus on the Southeast Asia region. He is actively involved in national climate change initiatives and serves as the Co-Chair of the Technical Working Group on Research and Systematic Observations for Malaysia's 4th National Communication (NC4) under the UN Framework Convention on Climate Change (UNFCCC).

Abstract

It is undeniable that climate extreme has increasingly affected Malaysia in recent times. Recordings of increased extreme convective events modulated by tropical depressions and storms, heatwave events and annual temperature trends requires Malaysia to undertake adequate measures to monitor climate change. As such, in this presentation, recent updates on the atmospheric composition monitoring network of MET Malaysia and its utilization towards observations supporting climate change monitoring is given. The range of activities discussed in this presentation will mainly cover monitoring of greenhouse gases, ozone and acid deposition; and air quality modelling works being presently undertaken. Trends of pH and concentrations of cations and anions deposited across different regional classifications are used to picture the acid deposition phenomenon in Malaysia. Recent trends in stratospheric ozone across Malaysia and Indonesia seem to be indicating reduction in convective activity leading to increase in free tropospheric ozone.

Symposium 3:
Efficient Engineering Controls for COVID-19 and Other Airborne Diseases

Development of a High-Efficiency Source-Control Device for COVID-19

Tuesday, November 5, 2024, 15:00 - 15:30

Prof. Chih-Chieh Chen
Institute of Environmental and Occupational Health Sciences,
National Taiwan University, Taipei, Taiwan

Biography

Chih-Chieh Chen received his Ph.D. in Environmental Health from the University of Cincinnati in 1991 and subsequently joined NIOSH in Cincinnati, Ohio. After joining the National Taiwan University in 1993, he continued his doctoral research on respiratory protection. He expanded his research scope to the comprehensive aspects of aerosol technology, including aerosol generation, sampling, measurement, and control. Dr. Chen is involved in many professional associations promoting environmental and occupational hygiene.

Abstract

COVID-19 is primarily spread through aerosols. Humans produce aerosol emissions when they cough, sneeze, or breathe. Source control is the most effective means of reducing emis-sions from the perspective of the control hierarchy. Preventing particles exhaled by infected people from contaminating the environment is critical to breaking the chain of transmission of COVID-19. This study aims to develop a breath-responsive personal exhaled aerosol receiver (BR-PEBAR) to capture exhaled particles without burdening the wearer's breathing.

BR-PEBAR comprised a hood, a connecting tube, a filter unit, and a fan powered by a lithium battery. A pressure-sensor-based microprocessor controlled the autofeedback following the breathing pattern. A mannequin and a breathing machine simulated actual wearing and breath-ing conditions. The capture efficiency of BR-PEBAR was evaluated in an aerosol chamber to validate the aerosol capture efficiency and optimize the design. A condensation particle coun-ter was used to measure the aerosol concentrations upstream and upstream of the BR-PEBAR, to determine the capture efficiency

The results showed that the hood's optimal height, width, and thickness were 3 cm, 10 cm, and 2 cm, respectively. The 3D transparent sheet was designed to adjust the distance between the sheet and the face. The design of retaining air volume effectively minimized the interaction of the exhaled airflow with the environment. The BR-PEBAR achieved 99.9% capture efficiency without creating significant negative pressure inside the BR-PEBAR. The current version of the centrifugal fan could cope with the peak flow of 100 L/min after overcoming the resistance of an N95 grade filter cartridge, and made it suitable for most of the medium load works.

The hood can be worn with ear straps or headbands depending on the total weight of the face piece and part of the connecting tube. The heavier components of the system could be hung from the neck strap or tied to the waist belt for comfort. The connecting line might become an obstacle for certain operations. In that case, a half-face type respirator with a carefully de-signed cross-sectional area slot in the nose bridge might be easier to operate. If necessary, the capture efficiency could be increased by adjusting the baseline negative pressure within the hood, but that would be at the expense of the shorter service life of the filter and the battery.

The BR-PEBAR has high capture efficiency and comfort. It can contain viral aerosols and control airborne diseases by preventing exhaled particles from contaminating the environment. Patients with airborne diseases should wear a BR-PEBAR. If this novel device is well promot-ed and wearers understand how it works and how to wear it correctly, there will be no more quarantines and lockdowns when the next virus hits.

Topic 1: Study on Performance Test Methods of Air Cleaners
Topic 2: Experimental Study on Optimal CADR Filter Thickness of Air Purifier
Tuesday, November 5, 2024, 15:30 - 16:00

Asst. Prof. Chih-Wei Lin
Institute of Environmental and Occupational Health Sciences,
National Taiwan University, Taipei, Taiwan

Biography

Chih-Wei Lin, Ph.D., earned his doctorate in occupational medicine and industrial hygiene from National Taiwan University in 2012. After completing postdoctoral research at National Taiwan University, he became a project assistant professor there. His research focuses on aerosol technology, industrial hygiene, and industrial ventilation.

Abstract

Abstract Topic 1: Study on Performance Test Methods of Air Cleaners

During the pandemic, people spent more hours than usual indoors. However, contaminated air increased the risk of contracting COVID-19. The most common way to purify indoor air is by using air cleaners. This study centers on evaluating and maximizing the Clean Air Delivery Rate (CADR), a metric that quantifies the volume of purified air provided by air cleaners. First, two testing methods—CADR Pull Down (CADR PD) and CADR Single Pass (CADR SP)—were examined. The results show that CADR PD can be affected by particle size distribution, unlike CADR SP , which is not influenced because it is determined by the Most Penetrating Particle Size (MPPS). Second, filter thickness is used as a parameter to maximize the CADR. The study concludes that for each fan and filter combination, an optimal filter thickness exists to maximize CADR, which is crucial for enhancing air purifier efficiency and longevity. The findings recommend slightly reducing filter thickness below the optimal CADR thickness to prolong filter life while maintaining effectiveness. This study provides practical insights for improving the design and performance of air purifiers used in indoor environments.

Abstract Topic 2 Experimental Study on Optimal CADR Filter Thickness of Air Purifier

Many air purifiers use high-efficiency filters to maximize the Clean Air Delivery Rate (CADR); however, theoretically, a filter with higher efficiency may have a higher pressure drop, which can lower the airflow rate and result in a reduced CADR. This study investigates the relationship between filter thickness and the CADR of air purifiers. A homemade air purifier with varying filter thicknesses and fan powers was utilized. Results indicated that while filtration efficiency increases with thicker filters, the optimal CADR is achieved at a specific filter thickness. The study concludes that for each fan and filter combination, there is an optimal filter thickness to maximize CADR, which is crucial for enhancing air purifier efficiency and longevity.The findings recommend slightly reducing filter thickness below the optimal CADR thickness to prolong filter life while maintaining effectiveness. This study provides practical insights for improving the design and performance of air purifiers used in indoor environments.

Development of a Smart Respirator

Tuesday, November 5, 2024, 16:00- 16:30

Prof. Sheng-Hsiu Huang
Institute of Environmental and Occupational Health Sciences,
National Taiwan University, Taipei, Taiwan

Biography

Sheng-Hsiu Huang earned his Ph.D. in occupational hygiene from the Institute of Occupational Medicine and Industrial Hygiene at National Taiwan University (NTU) in 2001. After four years of alternative military service at the Institute of Occupational Safety and Health in Taiwan, he joined the NTU Aerosol Research Laboratory, founded in 1993 by Professor Chih-Chieh Chen, as a project-appointed researcher. He is an assistant professor at NTU's Institute of Environmental and Occupational Health Sciences. Dr. Huang specializes in the generation and measurement of aerosols. His research focuses on engineering control of respiratory infectious diseases, air filtration, lung deposition, aerosol therapy, aerosol emissions and monitoring, respiratory protection, and the development of aerosol instruments.

Abstract

The viral photos titled "Mark of Glory," depicting exhausted medical staff with bruises from wearing protective gear, sparked public appreciation and emphasized the need for improved protective equipment. In response, this study modified a half-facepiece elastomeric respirator into a lightweight, breath-responsive powered air-purifying respirator (BR-PAPR). A miniature centrifugal blower was designed using 3-D printing technology. A breath-responsive (BR) system was developed to adapt airflow to the user's breathing patterns. The BR-PAPR maintains a minimum positive pressure in the facepiece and effectively reduces the discomfort caused by wearing the respirator. This prototype highlights the potential for further improvements in PAPR design through advancements in blower and sensor technology, enhancing comfort and efficacy for healthcare professionals.

Symposium 4:
Atmospheric Chemistry

Urban Aerosol Physicochemical Properties: Implications for Air Quality and Human Health

Wednesday, November 6, 2024, 10:30 - 11:00

Prof. Ta-Chih (T.C.) Hsiao
Professor | Graduate Institute of Environmental Engineering,
National Taiwan University Joint Appointment Associate Research Fellow
Research Center for Environmental Changes, ACADEMIA SINICA

Biography

Ta-Chih Hsiao is a professor at the Graduate Institute of Environmental Engineering at National Taiwan University, where he brings a wealth of expertise in civil and environmental engineering. Born and educated in Taiwan, he completed his B.S. in Civil Engineering at National Taiwan University before moving to the United States to further his education. He holds an M.S. in Civil and Environmental Engineering from Stanford University and a Ph.D. in Energy, Environmental and Chemical Engineering from Washington University in St. Louis. During his doctoral studies, he was honored as a McDonnell International Scholar. Following his Ph.D., Professor Hsiao was appointed to a prestigious NRC postdoctoral position at the National Personal Protective Technology Laboratory, part of the National Institute for Occupational Safety and Health under the CDC, USA. His research focuses on a range of critical topics within environmental engineering, including the measurement, monitoring, and control of particulate matter; particle instrumentation and characterization; nanoparticle generation and physics; aerosol and cloud microphysics; and the toxicity of PM and nanoparticles/ultrafine particles. Professor Hsiao's contributions to science and education have been recognized with numerous awards. Recently, in 2022, he received both the Research Achievement Award and the Teaching Excellence Award from the College of Engineering at National Taiwan University. His commitment to research was highlighted in 2018 when he was awarded the Distinguished Young Scholar Research Proposal from the Ministry of Science and Technology in Taiwan to investigate the effects of particle morphology on CCN activation ratio and hygroscopicity. An active participant in the international scientific community, Professor Hsiao has served on the International Advisory Board for the 21st Conference on Nucleation & Atmospheric Aerosols and as a member of the International Advisory Committee for the 11th International Aerosol Conference. He is also the Vice President of the Taiwan Association for Aerosol Research since 2022 and has been an editorial board member for the Journal of Hazardous Materials Letters since 2020. Professor Hsiao's editorial roles include serving as the editor of Aerosol and Air Quality Research since 2017 and as guest editor for special issues on long range transported air pollutants. His ongoing affiliation as a Graduate Faculty Member at Virginia Commonwealth University since 2016 further underscores his commitment to advancing environmental engineering education globally.

Abstract

Urban aerosols significantly impact air quality, visibility, and human health in densely populated areas. Traditional air quality standards, primarily focused on mass concentrations of $PM_{2.5}$ and PM_{10}, may not adequately represent true environmental and health risks. Key aerosol properties such as particle size distribution (PSD), chemical composition, hygroscopicity, optical properties, lung-deposited surface area (LDSA), and oxidative potential (OP) play crucial roles in determining their effects. In terms of visibility impairment, fine particles in the accumulation mode (0.1–1 μm) are the primary contributors due to their efficiency in scattering and absorbing light. Factors such as high particulate nitrate levels, hygroscopic growth, and specific PSDs can significantly increase the aerosol extinction coefficient (b_{ex}□), leading to reduced visibility even when overall $PM_{2.5}$ concentrations have improved. The mass scattering efficiency (MSE) of aerosols is influenced by chemical composition and volatile components, highlighting the need to consider these factors independently of total PM mass. Ultrafine particles (UFPs, <100 nm), although less impactful on visibility, pose significant health risks. Due to their small size, UFPs can penetrate deep into the respiratory system and translocate to other organs, potentially leading to pulmonary inflammation, cardiovascular diseases, and neurodegenerative disorders such as Alzheimer's and Parkinson's diseases. Traffic emissions, including both exhaust and non-exhaust sources like brake and tire wear, are major contributors of UFPs in urban environments. The shift towards electric vehicles may reduce tailpipe emissions but could inadvertently increase non-exhaust emissions, including iron-containing magnetic particles that catalyze the production of reactive oxygen species (ROS) and contribute to oxidative stress. Traditional PM mass metrics overlook the significance of UFPs due to their negligible contribution to total mass. Measuring UFPs using instruments like Scanning Mobility Particle Sizers (SMPS) is often impractical due to cost and complexity. In this context, lung-deposited surface area (LDSA) emerges as a valuable physical indicator. LDSA accounts for the surface area of particles likely to deposit in the respiratory tract, providing a more relevant metric for assessing exposure to UFPs. It bridges the gap between particle number concentration and mass concentration, offering a practical alternative for

evaluating the health impacts of aerosols where detailed PSD measurements are unavailable. Oxidative potential (OP), a chemical indicator measuring the capacity of particles to generate reactive oxygen species, complements LDSA by providing insight into the chemical toxicity of aerosols. The chemical composition of aerosols, particularly the presence of polycyclic aromatic hydrocarbons (PAHs) and metals, independently influences OP. Photochemical aging processes transform primary pollutants into more redox-active compounds, such as quinones and nitro-PAHs, enhancing aerosol toxicity regardless of particle size. Observations have shown that decreases in PAH concentrations due to photochemical reactions correlate with increases in OP, emphasizing the importance of chemical transformations in assessing health impacts. We call for a multidimensional approach to urban aerosol characterization. By independently evaluating LDSA as a physical exposure metric and OP as a chemical toxicity metric—alongside PSD, chemical composition, hygroscopicity, and optical properties—we can gain a comprehensive understanding of aerosol impacts on air quality, visibility, and human health. Utilizing LDSA provides a cost-effective means to assess the health risks associated with UFPs, while OP offers detailed insights into chemical-related toxicity. Recognizing the limitations of mass concentration-based air quality standards, there is a pressing need for regulatory strategies that incorporate advanced metrics like LDSA and OP. By integrating these indicators, we can more accurately estimate health risks and develop targeted strategies to mitigate the adverse effects of urban air pollution. Such an integrated assessment is essential for effective urban air quality management, allowing addressing both the physical and chemical dimensions of particulate matter to protect public health and improve environmental conditions.

Advancing Atmospheric Chemistry to Improve Air Quality and Human Health

Wednesday, November 6, 2024, 11:00 - 11:30

Professor Balasubramanian
Department of Civil and Environmental Engineering
National University of Singapore (NUS)

Biography

Professor Balasubramanian (Bala) is a tenured Professor in the Department of Civil and Environmental Engineering at National University of Singapore (NUS). He has established an internationally recognized research program in Atmospheric Chemistry at NUS. The main goal of his interdisciplinary research is to advance understanding of environmental issues on scales ranging from local to global, and to develop cost-effective technologies to mitigate these impacts. He has carried out his collaborative research projects in several countries. He has recently led a multi-national, multi-institutional collaborative project to provide new insights into assessment and mitigation of human exposure to airborne particles in diverse urban microenvironments. Results of his work help to formulate regulatory policies to tackle complex air pollution problems. His work also addresses several aspects of climate change including its mitigation and adaptation. Prof Bala's research has resulted in more than 280 papers in scholarly journals with an H-index of 88 and 24,300 citations, 22 book chapters and 1 book. He is a highly cited researcher. He has delivered numerous plenary and keynote lectures in international conferences. He has received many research awards including "Alan Berman Research Publication Award (Department of the Navy (USA))", "Highly Cited Research Article Award (Elsevier)" and "PROSE (Professional and Scholarly Excellence) Award". He has also received numerous teaching awards. He has been recognized among top 100 scientists in Asia based on his research contributions (Asian Magazine, 2017). He is a Lead Author for the United Nations Environment Program (UNEP)'s 6th Global Environment Outlook Report. He is a member of the Science Panel of the Asia-Pacific Clean Air Partnership (APCAP), appointed by UNEP. He is Vice-President of IUAPPA (International Union of Air Pollution Prevention and Environmental Protection Associations). He is an Elected Fellow of the Royal Society of Chemistry. Prof Bala is an Editor of Aerosol and Air Quality Research and on the editorial board of several international journals including Atmosphere and Scientific Reports. He is currently holding the title of Keppel Professor in Sustainability Solutions (Endowed Chair Professorship) in recognition of his international reputation.

Abstract

Air pollution represents one of the most critical human health issues we face today. The World Health Organization (WHO) reported that approximately 7 million premature deaths occur worldwide every year due to human exposure to air pollutants in both outdoor and indoor environments. To tackle air pollution problems, it is important for us to understand the chemical behaviour, fate, transport, transformation of air pollutants, and their adverse effects on environmental and human health by conducting field measurements and fundamental laboratory studies together with chemical transport models. Atmospheric chemistry integrates these activities and thus plays an important role in formulating air pollution control policies as well as in developing technological solutions. We have carried out extensive research over the years in Southeast Asia to study urban and regional air quality problems with an emphasis on the size and composition of atmospheric particles and gas-to-particle conversion processes. We have also characterized air pollution exposure for epidemiological and toxicological research and quantified the effectiveness of various mitigation strategies. This presentation will discuss the most important scientific advances in recent years in the field of atmospheric chemistry based on our work and offer suggestions for future research to address emerging air quality challenges.

Investigating the Levels of Indoor and Outdoor Particulate Matter In Six Southeast Asian Cities

Wednesday, November 6, 2024, 11:30 - 12:00

Prof. Anil Namdeo
Department of Geography and Environmental Sciences
Northumbria University, United Kingdom

Biography

Anil Namdeo is Professor of Air Quality and Net Zero in the Department of Geography and Environmental Sciences, Northumbria University, Newcastle. He is a Chartered Environmentalist and a Chartered Scientist. He is a Fellow of the Royal Meteorological Society, UK and a Fellow of the Institute of Air Quality Management, UK. Anil is a member of Department for Environment, Food and Rural Affairs (Defra) Air Quality Expert Group (AQEG) and a member of the UK's Civil Aviation Authority's Sustainability Panel. Anil was a member of the NICE (National Institute for Health and Care Excellence) Public Health Advisory Committee on Air Pollution (Outdoor Air Quality and Health) which developed guidelines for outdoor air quality and health. Anil has been appointed as a UKRI Reginal Air Quality Champion (East and North East of England).

Anil has special research interests in air quality (monitoring, modelling and management) and health. His research focuses on environmental and sustainability assessments of land-use, transportation and other developmental policies. He has led and contributed to several UK and international projects on air quality and sustainability. Anil is actively engaged in international research projects and collaborations and has close links with academics and researchers in EU, USA, Mexico, Brazil, Canada, India, China, Thailand, Vietnam, Indonesia, Malaysia, Hong Kong, Egypt, Kenya and Tanzania.

He recently led the Mexico City and Newcastle Partnership on Health and Air Pollution Research and Engagement (MANAPRE) and Clean Air for Delhi Through Interventions, Mitigations and Engagement (CADTIME) projects. His current ongoing projects include: Impact+ (environmental Index Promoting Assessment and Circular Transparency in fashion); Nuna (Effective mitigation and adaptation to changing ground conditions for resilient coastal futures); ETHOS (Co-developed environmental solutions to mitigate the impact of temperature extremes on the Health of vulnerable populations); and In2Air (the impact of 'net-zero' household energy intervention on indoor air quality, occupant self-reported general health and wellbeing, and household energy use).

Abstract

Air pollution remains one of the major threats to human health and wellbeing. Particulate matter (PM) exposure is harmful to human health. Some of the highest levels of PM levels are in ambient and indoor air globally are found in Asian cities, more

specifically in Southeast Asia. The WHO has recently issued new air quality guidelines tightening the standards for PM2.5 and NO2. The WHO has called for the air quality community to play a key role in monitoring health risks from air pollution, synthesizing the evidence, providing the tools and resources to support decision-making. The global nature of the challenge calls for gathering more data and generating more evidence on how various constituents of PM (size and number) vary

geographically and temporally as a function of meteorology, sources, and dispersion of PM across a range of microenvironments. In this presentation, we report the findings of a pan southeast Asian study of simultaneous monitoring of particle size concentrations and particle number concentrations (PNC) in six cities, namely, Bandung (Indonesia), Bangkok (Thailand), Hanoi (Vietnam), Kuala Lumpur (Malaysia), Singapore, and Yangon (Myanmar). A common monitoring and quality assurance protocol was developed and adopted by each participating institution. Identical equipment (Particles Plus Model EM7301 for indoor monitoring and Particles Plus Model EM10000 for outdoor monitoring) were used, simultaneous indoor and outdoor monitoring was conducted at one-minute interval. PNC were recorded for six size channels, viz. 03., 0.5, 1.0, 2.5, 5.0 and 10.0 µm. We examined and compared factors impacting air quality in these cities. Our analysis has shown a great degree of variability in PM mass concentrations and PNCs across six cities, clearly demonstrating the influence of geographic location, temperature and relative humidity, and the presence of emission generating activities both indoors and outdoors. Except Hanoi, all locations indicated indoor/outdoor ratios >1 for PM2.5 indicating higher outdoor PM levels. Bandung PM2.5 levels were approximately five times higher than other five cities, indicating the presence of high PM generating activities, mainly traffic, in the city. PNC for PM0.3 was highest (three time higher than other cities) in Bandung, again indicating the significance of traffic's (mainly two-wheelers) contribution to ultrafine particles. PNC for larger particles (PM5 and PM10) was highest at Yangon indicating the influence of wind-blown and resuspended dust (from road surfaces and dry land). It was observed that there was a good correlation between relative humidity and PNCs. The study also evaluated the performance of Particles Plus series of indoor and outdoor PM monitors. The equipment delivered consistent and reliable high-quality performance in a wide range of operating conditions. The type of information generated by this study is key to inform public policies to better manage traffic and air quality (both indoor and outdoor), and consequently public health. We believe that the results of this research can help other cities in designing air quality monitoring and management strategies.

Symposium 5:
Sustainable Climate Action

Potential Impacts on Air Pollutants and Future Climate I Southeast Asia
Tuesday, November 5, 2024, 15:00 - 15:30

Emeritus Prof. Selahattin İncecik
President of the International Union of Air Pollution Prevention & Environmental Protection Associations (IUAPPA)

Biography

Emeritus Professor Selahattin Incecik has been President of the International Union of Air Pollution Prevention & Environmental Protection Associations (IUAPPA) since November 2017. A highly experienced atmospheric and environmental scientist accustomed to working with governments and organizations nationally and internationally. His research encompasses urban air quality and climate change; air pollution and climate interactions; air quality management and modeling; atmospheric boundary layer processes; and the interaction and feedback between surface ozone and the corresponding precursors. By now, Prof. Incecik has supervised eight Ph.D. and six MSc theses in meteorology, atmospheric sciences, and environmental sciences. Dr. Incecik has worked as an international scientist since 1986 in academia and non-governmental organizations. He obtained his PhD degree at ITU, Türkiye, and he followed his postdoctoral studies at Pennsylvania State University, USA. His academic and industrial work was conducted within collaborative scientific groups based in Europe, the USA, and Asia. He was an expert reviewer of the Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC), 2012, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, and IPCC Climate Change 2013, The Physical Science Basis in Working Group I. He was Certified by Bestowing awards for his contribution to the IPCC Special. Report as the lead author. Prof. Incecik's contribution to the 2007 NOBEL PEACE PRIZE-WINNING UN IPCC Climate Change with a Special Report on Chemical and Radiative Effects of Halocarbons and Their Replacement Compounds" in Safeguarding the Ozone Layer and the Global Climate System in the Working Group I as lead author.

Abstract

Air pollution and climate change are closely linked, as all major pollutants have an impact on the climate and most share common sources with greenhouse gases. Both air pollution and climate change can have an impact on each other, and both can directly or indirectly affect health. The future climate is expected to be more stagnant. A weakened global circulation and a declining frequency of mid-latitude cyclones are projected. According to the World Health Organization, Southeast Asia is one of the most polluted regions in the world. Nearly all of the region's population lives in areas that exceed safe air quality guidelines. Furthermore, Southeast Asia, like many parts of the world, is currently experiencing significant climate changes, and these changes are very likely to increase in the future. While climate change may affect how primary pollutants are dispersed, particularly particulate matter, it can also exacerbate the production of secondary pollutants such as surface ozone. Future changes in ozone precursor emissions will be the result of complex interactions between photochemistry, transport mechanisms, and climate change. Therefore, a gradual reduction of pollutant emissions will improve air quality while reducing the negative consequences of climate change based on scenarios in the future. Policies on the Short-lived climate pollutants (SLCPs) are important in this regard. This review summarizes the source distributions, seasonal variations, transport mechanisms, and climate change of major pollutants and their local emissions in Southeast Asia. This study examines the distribution of tropospheric ozone and local NOx emissions, along with PM2.5, and explores the connections between climate change and air pollution, taking into account potential future changes in emissions. The results are based on future regional climate forecasts employing the IPCC emission scenarios.

Emissions, Health Impacts And Cost Of Illness Reductions And Energy Transition Scenarios In Indonesia

Tuesday, November 5, 2024, 15:30 - 16:00

Prof. Dr. Budi Haryanto
Director, Research Center for Climate Change
Universitas of Indonesia

Biography

Budi Haryanto is currently a Professor of Environmental Health Science and the Director of the Research Center for Climate Change at the University of Indonesia. He is also part of the colloquium on environmental health for the Indonesian Environmental Health Association since 2019. Dr. Haryanto is currently a member of, among others, the International Association of Doctors for the Environment, the International Epidemiology Association, the International Society for Environmental Epidemiology, and the Board of Directors for the Pacific Basin Consortium for Environment and Health. He has produced numerous research in the field of climate change and health, most recently studying the impact of haze on children's health in Indonesia, climate change and adaptation capacity development for the vulnerability of Dengue Fever in Indonesia, and fiscal policies to address air pollution from road transport in cities and improve health. He has also contributed to several studies, recently published the Resurgence COVID-19 in Indonesia: Response to the Critical Waves of Pandemic, The Impact of Air Pollution on Gut Microbiota and Children's Health, and Prevalence and association of blood lead levels with low IQ in children aged 2-9 years in West Bangka. Dr. Haryanto received his Ph.D. and Masters of Science in Public Health in Epidemiology from the University of Indonesia in 2008 and 1993, respectively. His Master of Science Degree in Epidemiology was obtained from the University of California in the USA.

Abstract

Motor vehicle emissions significantly contribute to air pollution in cities like Jakarta, where traffic is a dominant part of daily life. Key pollutants, including particulate matter (PM) and carbon monoxide (CO), consistently exceed safety thresholds. Recent studies show that over 43% of air pollutants in Jakarta stem from low-quality transportation emissions, which have severe health consequences. These include rising cases of respiratory problems, chronic non-communicable diseases, and premature deaths, placing an economic burden of IDR 1.8 trillion annually on Indonesia. To address this, adopting EURO 4/6 fuel standards, proven to reduce pollution in many global cities, is crucial. By gradually implementing EURO 4 standards, studies predict notable health improvements. A small reduction in air pollution-related pneumonia cases of 0.3% is expected in 2024 with 10% adoption of EURO 4. By 2025, as implementation increases to 34%, pneumonia cases could drop by 8.4%. With 66% adoption in 2026, the reduction in pneumonia cases is expected to reach 20.1%. Finally, full implementation of EURO 4 standards by 2028 is projected to result in a 32.2% decrease in pneumonia cases. These figures underscore the clear health benefits of transitioning to cleaner emissions standards, demonstrating how stricter fuel policies can significantly improve public health and reduce the economic burden of air pollution in Jakarta and beyond. Keywords: Fuel emission, air pollution, EURO 4 scenarios, pneumonia impacts. cost of treatment

Indoor Environment And Climate Impacts On Children's Health

Tuesday, November 5, 2024, 16:00 - 16:30

Prof. Dr. Jamal Hisham Hashim
Honorary Professor
Professor of Environmental Health
Universiti Selangor

Biography

Prof. Dr. Jamal Hisham Hashim is a Honorary Professor of environmental health at Universiti Selangor and Universitas Diponegoro. He is also the director of Provenue Corporation Sdn. Bhd. which specialises in health risk and impact assessment. He was formerly a research fellow at the United Nations University-International Institute for Global Health (UNU-IIGH) and Malaysia's first appointed Professor of Environmental Health at the National University of Malaysia (UKM). Prof. Dr. Jamal obtained his PhD in environmental health from the University of Michigan. He taught, conducted research and consultancy in environmental and occupational health at UKM and UNU-IIGH for 36 years, and supervised a total of 14 PhD students. His research interests are mainly on the health effects of heavy metals, pesticides, solvents, air pollution, risk assessment, and recently, climate change. He has been the principal and co-investigator of 19 research projects and has over 410 publications and presentations to date, including 104 full articles in refereed and indexed journals. He is an editor of the Environmental Analysis, Health and Toxicology and Frontiers in Occupational Health journals. He has been engaged as an environmental health consultant in over 90 local and overseas projects, primarily in the area of environmental health impact and risk assessment. Prof. Dr. Jamal has also been consulted by the World Health Organization, International Atomic Energy Agency, Risk Science Institute and the Institute of Medicine in the U.S., the governments of Malaysia, Cambodia, Indonesia and Saudi Arabia on various environmental health issues. He is a registered environmental impact assessment consultant with the Department of Environment, Malaysia, a member of the Chartered Institute of Environmental Health in the U.K., an honorary fellow of the Academy of Occupational and Environmental Medicine Malaysia and a council member of the Asia Chapter of the International Society for Environmental Epidemiology. He sat on the Scientific Expert Panel of the National Disaster Management Agency (NADMA), and currently chairs the Thematic Working Group of Environmental Health Experts under the National Environmental Health Action Plan (NEHAP).

Abstract

Children are a vulnerable group of the population when it comes to environmental threats. Two of those threats which can have significant outcomes on children's health are indoor environment and climate change. According to the WHO, nearly 1 million children die from pneumonia each year, and half of these deaths are due to indoor and outdoor air pollution. Each year, indoor and outdoor air pollution kill about 570,000 children. Climate change can disrupt weather patterns, leading to more frequent and more intense extreme weather events, unpredictable water availability, exacerbating water scarcity and contaminating water supplies. Such impacts can drastically affect the quantity and quality of water that children need to survive. According to UNICEF, about 436 million children live in areas of high or extremely high water vulnerability, which is a combination of water scarcity and low levels of drinking water service. How climate change will ultimately influence outdoor and indoor environment and air quality and their impacts on children is highly probable, but less studied. As for indoor environment, the combination of poor indoor air quality and climate influenced factors such as temperature, humidity, allergens and pathogens can prove a real heath challenge to children, especially those living in the hot tropics. This present will explore the current science on how indoor environment and climate can impact on children's health.

Regional Cooperation as Key to Addressing Air Pollution and Climate Change in Asia

Tuesday, November 5, 2024, 16:30 - 17:00

Ms. Glynda Bathan-Baterina
Executive Director
Clean Air Asia

Biography

Glynda, alongside the Executive Director, leads the Clean Air Asia team, sets the organization's strategic direction, and undertakes resource mobilization. Glynda is a lawyer with more than 20 years' experience in air quality management. She was a member of the legal team which assisted the Philippine Government in drafting the Clean Air Act of 1999 Implementing Rules and Regulations. She led the implementation of the Asia Clean Fuels and Vehicles program which resulted in national policies and roadmaps for cleaner fuels and vehicles notably the Vietnam and Philippine regulations mandating Euro 4 vehicle emission and fuel standards, and Pakistan's roadmap for cleaner fuels and vehicles. Glynda holds a Master's degree in Environmental Management from the Ateneo de Manila University and University of San Francisco (joint program); and a Bachelor of Laws from the University of the Philippines.

Abstract

The presentation will focus on regional cooperation and collaborations for clean air. She will speak of the potential benefits of regional and international cooperation in achieving clean air goals based on the experience of Clean Air Asia, an international non-government organization working towards the vision of Asia without air pollution and with a stabilized climate for people and the planet. It will also present the results of Clean Air Asia's tracking of progress in air quality management in Asia including in China and Thailand, as well as the building blocks for regional cooperation to address air pollution.

A Breath of Fresh Air: Malaysia's Experience in Air Quality Management

Tuesday, November 5, 2024, 17:00 - 17:30

Dr. Hii Yii Siang
Consultant
Pakar Scieno TW Sdn Bhd

Biography

Dr. Hii Yii Siang has been actively involved in the assessment and development of strategies for managing ecosystem health. Formerly a lecturer at Universiti Malaysia Terengganu, Dr. Hii opted for early retirement in 2017. He is currently serving as a consultant at Pakar Scieno TW Sdn Bhd, the concessionaire for the Department of Environment, Malaysia. Dr. Hii plays a pivotal role in several key projects aimed at managing ecosystem health, particularly in the analysis of long-term monitoring data related to air, river, and marine environments. He is presently one of the lead consultants responsible for designing and integrating monitoring networks for air, river, and marine environments under the Environmental Quality Monitoring Network for the Department of Environment, Malaysia

Abstract

This presentation elaborates on Malaysia's strategic framework for air quality management, emphasizing its alignment with international environmental objectives, particularly the Sustainable Development Goals (SDG 2030). It outlines the foundational principles of the National Policy on the Environment and details the regulatory mechanisms established under the Environmental Quality Act of 1974, which encompasses various regulations aimed at mitigating air emissions from industrial sources, transportation, and open burning practices.

The presentation discusses key sources of air pollution in Malaysia, and provides a detailed overview of air quality trends from 2010 to 2023. Data from the Environmental Quality Monitoring Program (EQMP) indicate improvements in air quality, especially in terms of particulate matter (PM2.5) concentrations, which have been consistently below national standards since 2020.

Malaysia's strategies for air quality management are multifaceted, incorporating the deployment of Continuous Emission Monitoring Systems (CEMS), implementation of fire prevention initiatives for peatlands, and public education campaigns addressing open burning. The National Haze Action Plan is activated during periods of elevated air pollution levels to ensure coordinated responses among government entities.

Moving forward, Malaysia plans to introduce an updated Clean Air Action Plan (CAAP 2040) to address future challenges, with expanded focus areas, enhanced strategies, and improved monitoring systems to achieve better air quality standards.

Keywords: Air Quality Management in Malaysia, Malaysia Policy on the Environment, Environmental Quality Monitoring Program, Clean Air Action Plan.

Oral Presentation List

Abstract ID	Presenter	Title
#AAC24- 26	Muhamad Shahril Bin Mohd Abdullah	The Effect Of Periodic Preventive Maintenance On Hvac System To The Level Of Indoor Air Quality Parameters In One Of Public Hospital In Malaysia
#AAC24- 27	Panuganti China Sattilingam Devara (Or) Saurabh Yadav	Influence Of Biomass Burning And Fossil Fuel Emissions On Black Carbon Aerosol In Rural Haryana, India
#AAC24- 28	Hee Dong Jang	Facile Fabrication Of Silicon-Carbon Composites For Potential Energy Storage Materials
#AAC24- 30	Milad Massoudifarid	Continuous Flow Aerosol-To-Hydrosol Electrostatic Sampling With Real-Time Microfluidic Nucleic Acid Extraction For Automated Bioaerosol Detection
#AAC24- 34	Yongjie Li	Co-Photolysis Of Mixed Chromophores Affects Atmospheric Lifetimes Of Brown Carbon
#AAC24- 39	Nur Syakirah Nabilah Saipul Bahri	Synthesizing Magnetic Cellulose Nanofiber Using Spray Drying Approach
#AAC24- 42	Abdul Rohim Tualeka	Relation Concentration And Risk Characterization Of Toluene To Malondialdehyde, Cholesterol And Diabetes In Five Industries In Surabaya
#AAC24- 43	Shih-Chun Candice Lung	Assessing Peak PM2.5 And Pm1 Levels And Health Impacts With Research-Grade Low-Cost Sensors In Two Asian Countries
#AAC24- 44	Yu-Cheng Chen	Using Cluster Algorithms With A Machine Learning Technique And Pmf Models To Quantify Local PM2.5 And Metals In Taiwan
#AAC24- 46	Shih-Yu Pan	The Ecological, Inhalation Cancer Risk Assessment And Source-Attributed Profile Of Hazardous Air Pollutants (Haps) In Different Asian Cities
#AAC24- 47	Lei Li	Aerosol Component Concentration Derived By The Grasp Algorithm From Multi-Angular Polarimetric Satellite Observations
#AAC24- 53	Kin Fai Ho	Quantification And Identification Of Voc Emissions From Common Volatile Chemical Products
#AAC24- 54	Fang-Chen, Chang	Seasonal And Diurnal Variations In The Optical Properties Of Water-Soluble And Methanol-Soluble Brown Carbon And Analysis Of Water-Soluble Organic Molecular Composition In Central Taiwan
#AAC24- 55	Qianying Liu	A Comprehensive Characterization Of Empirical Parameterizations For Oh Exposure In The Aerodyne Potential Aerosol Mass (Pam) Oxidative Flow Reactor (Ofr)
#AAC24- 58	Anil Namdeo	Ambient Particulate Matter Levels In Tuktoyaktuk Hamlet In The Canadian Arctic
#AAC24- 60	Jonathan Reid	Respiratory Aerosol Emission Rates And Relationship To Exhaled Carbon Dioxide Flux For Assessing Pathogen Transmission Risk In Indoor Air
#AAC24- 61	Jonathan Reid	The Microphysics Of Surrogate Exhaled Aerosols And The Impact On The Airborne Survival Of Viruses
#AAC24- 65	Ralf Zimmermann	Wildfire Aerosols And Ship Emissions: Field-Deployable Single Particle Mass Spectrometer For Detection Of Toxicants And Climate-Relevant Compounds
#AAC24- 67	Seungwooklee	Capability Of Single Dropwise Impaction For Removing Nanoparticle Contaminants From Si Wafer
#AAC24- 68	Yu-Hsiang Cheng	Diurnal Variation Characteristics Of PM2.5-Bound Polycyclic Aromatic Hydrocarbons And Their Potential Sources In Northern Taiwan
#AAC24- 70	Wenwen Xie	Comparison Of Bioaerosols Concentration From Chinese Coast To Northwestern Pacific

Abstract ID	Presenter	Title
#AAC24- 73	Anil Namdeo	Investigating The Levels Of Indoor And Outdoor Particulate Matter In Six Southeast Asian Cities
#AAC24- 75	Sheng-Lun Lin	Ultralow Net Pcdd/F Discharge By Ash-Sludge Reintroduction Into A Novel Gasmild Treatment For Hazardous Waste Treatment
#AAC24- 77	Sasho Gligorovski	Enhanced Production Of Oxygenated Volatile Organic Compounds Through Interfacial Chemistry Of So2 With Sea Surface Microlayer
#AAC24- 78	Sasho Gligorovski	Chemical Characterization Of Aerosol Particles Produced By Ozone Reactions With Floor Cleaning Detergent
#AAC24- 79	Jicheng Feng	3D Nanoprinting Of Dynamic Colors
#AAC24- 80	Jicheng Feng	Configured Electric Fields For Programmable 3D Nanoprinting
#AAC24- 81	Chueh Jung Hou	Effects Of Indoor Air Purifying Technology Intervention On Urinary Heavy Metals And Health In Asthmatic Patients In An Industrial Area
#AAC24- 83	Thaseem Thajudeen	Machine Learning Based Retrieval And Prediction Of Geometric Features Of Aerosol Aggregates
#AAC24- 85	Sanggwon An	Rapid Monitoring Of Indoor Airborne Virus With High Air Flowrate Electrostatic Sampling And Pcr Analysis
#AAC24- 87	Teruya Maki	Fluorescent Sensors And Dna Metagenomes Targeting The Urban Bioaerosols Changed Suddenly During Asian-Dust Season
#AAC24- 89	Tan Ke Ning	The Effects Of Air Purifier Intervention On Cytokines In Blood Of Asthma Patients In Industrial Area
#AAC24- 92	Man-Yan Cheng	Evaluation Of Air Purifiers On Bioaerosols In Households And Health Effects Among Asthmatic Patients In An Industrial Area
#AAC24- 97	Nur Faseeha Suhaimi	Exploring The Link Between Indoor Air Quality And Sick Building Syndrome Symptoms Among Students In Malaysian University Classrooms
#AAC24- 98	Wenshuai Li	Daytime And Nighttime Aerosol Soluble Iron Formation In A Coastal City In Eastern China
#AAC24- 99	Thi-Cuc Le	Development Of Composite Filtration Systems For Controlling Secondary Particle Emission From Vacuum Street Sweepers
#AAC24- 101	Yik-Sze Lau	The Coupling Of A High-Efficiency Aerosol Collector With Electrospray Ionisation Orbitrap Mass Spectrometry For The Real-Time Chemical Characterisation Of Fine And Ultrafine Particles
#AAC24- 102	Ralf Zimmermann	Real-Time Detection Of Hazardous Dusts From Narcotics And Explosives Using Single-Particle Mass Spectrometry
#AAC24- 104	Tawatchai Charinpanitkul	Facile Production Of Mwcnts From A Mixture Of Methane And Ethane Using Nimo/Mgo Catalyst
#AAC24- 105	Wahyu Diah Proborini	Assessment Of Associated Metal Contents On Airborne Microplastics
#AAC24- 106	Balint Alfoldy	Optical Properties Of Wood Combustion Emitted Particles Determined By The New, 9 Aethalometer
#AAC24- 108	Po-Kai Chang	Spatial And Temporal Variation Of Traffic-Related Pm In An Urban Area: Implications For Public Health
#AAC24- 109	Leung Chin Wai	Chemical Characterization And Source Apportionment Of Water-Soluble Organic Nitrogen (Wson) In PM2.5 In Hong Kong
#AAC24- 110	Corie Indria Prasasti	Analysis Of Indoor Air Quality On Children'S Allergic Rhinitis Symptoms In Surabaya City

Abstract ID	Presenter	Title
#AAC24- 112	Perapong Tekasakul	Quartz Crystal Microbalance Frequency Response To Deposition Of Nanoaerosols
#AAC24- 113	Lu Qi	Effect Of Secondary Organic Aerosol Formation Pathways On Health Effects
#AAC24- 114	Jonathan Symonds	Studying Droplet Dispersion With Aerosol Flame Photometry
#AAC24- 115	Ralf Zimmermann	Photochemical Aging Of Emissions From Euro6 Gasoline Cars Or From Wood Combustion Increases The Observed Adverse Effects In Air Liquid Interface-Exposed Human Lung Cell Models
#AAC24- 116	Masaru Kubo	Spray-Synthesis Of Hierarchical Porous Hkust-1 Using Soft-Template
#AAC24- 118	Jun Wang	Aerosol Emissions From Desktop Laser Cutting And Engraving Of Various Common Materials
#AAC24- 119	Jun Wang	Monitoring Of Protection Factor For Aerosols Filtering Respirators Using Optical Particle Sensors
#AAC24- 120	Jun Wang	Airborne Plastic Emission Dynamics During High Speed Fdm 3D Printing
#AAC24- 124	Thaseem Thajudeen	Understanding The Spatial And Temporal Variation Of Cooking-Emitted Particles In Distinct Zones
#AAC24- 129	Younghyun Lee	Investigation Of Changes In The Physicochemical Characteristic Of Black Carbon Particles Using An Oxidation Flow Reactor
#AAC24- 132	Dongwoo Kim	Evaluating The Influence Of Black Carbon Inclusion On The Mixing State Of Atmospheric Aerosols Based On In-Situ Raman Spectroscopy
#AAC24- 141	Doheon Kim	Deep Learning Integrated Soft Sensor Technology For Real-Time Monitoring Of Culturable Indoor Bioaerosols
#AAC24- 145	Jaeho Oh	Prediction Of Bioaerosol Number Concentration From Electrical Currents Of Thermal-Lyzed Bioaerosol
#AAC24- 146	Jaeho Oh	Determination Of Effective Density Of Pm1 Size Distribution Via Pre-Measured Smps Data
#AAC24- 148	Rajasekhar Balasubramanian	Investigation Of Cyclists' Exposure To Black Carbon In Ambient Air
#AAC24- 149	Rajasekhar Balasubramanian	Personal Exposure To Airborne Particulate Matter While Cooking: Evaluation And Mitigation Strategies
#AAC24- 151	Muhammad Aiman Bin Mohd Nor	Reconstructing Three-Dimensional Flow From Two-Dimensional Velocities Using The Predictor-Corrector Method
#AAC24- 152	Rachmi Layina Chimayati	Assessing The Impact Of Scr And Dpf Technology On Vocs And Pahs Emissions In Ldv
#AAC24- 154	Thi-Thuy-Nghiem Nguyen	Big Data Analysis And Machine Learning Of O3 Pollution In Taiwan
#AAC24- 161	Imran Shahid	Exploring The Variability And Health Impacts Of Air Pollutants In Indoor Microenvironments
#AAC24- 167	Atsushi Matsuki	Application Of Environmental Magnetism On Atmospheric Aerosols
#AAC24- 168	Po-Yen Chien	Chemical Characterization And Sources Of Dry And Wet Deposition And Hazardous Air Pollutants In A Large Industrial Zone In Southern Taiwan.
#AAC24- 169	Po-Yen Chien	Study On Emission Characteristics Of Static Emissions From Large Vessels

Abstract ID	Presenter	Title
#AAC24- 171	Jason Blake Cohen	Emissions Of Bc Estimated Using Multiple Remotely Sensed And Surface Observations In Tandem
#AAC24- 172	Muhamad Shahril Mohd Abdullah	Airborne Hazards: A Comprehensive Review Of Aerosol Contaminants In Hospital Environments And Their Impact On Health
#AAC24- 174	Atul Kumar Srivastava	Source Apportionment And Absorption Characteristics Of Aerosols At Delhi, An Urban Megacity Over The Western Indo-Gangetic Plain
#AAC24- 176	Hiroshi Okochi	Occurrence, Behavior, Fate, And Health Impact Of Airborne Microplastics (13) : Current Status Of AMPs Research In Japan
#AAC24- 179	Ying I. Tsai	Aerosol Size Distribution And Chemical Characterization Associated With Persistent Free Radicals From Incense Burning In Taiwan And Thailand
#AAC24- 180	Ainur Balqis	Occurrence, Physical Characteristics, And Driving Factors Of Indoor Airborne Microplastics In Daycare Centers
#AAC24- 184	Dr. Sarvan Kumar	Variability Of The Optical And Radiative Characteristics Of Aerosols Over The Indo-Gangetic Plain: A Case Study Of Kanpur
#AAC24- 188	Khan Alam	Anthropogenic Emissions Of Aerosol Over An Urban Environment Of Peshawar: Air Quality And Climatic Implications
#AAC24- 189	Oluwagbayide Samuel Dare	Impact Of Indoor Air Quality On Residents Health In Ilaro, Ogun State Nigeria
#AAC24- 196	Amgalan Natsagdorj	Chemical Composition Of PM2.5 And New Particle Formation Fin Ulaanbaatar, Mongolia
#AAC24- 197	Abdullah Al Nayeem	Particulate Matter Concentration Over Bangladesh: Ranking Of 64 District Towns And A Land-Use-Based Analysis
#AAC24- 202	Moustapha Kebe	Source Apportionment And Assessment Of Air Quality Index Of PM2.5–10 And PM2.5 In At Two Different Sites In Urban Background Area In Senegal
#AAC24- 203	Steven Soon-Kai Kong	Modeling East Asian Dust Storm Episode Associated With A Typhoon In Western Pacific.
#AAC24- 204	Wu, Hsiang-Ying	Investigation Of The Characteristics Of Volatile Organic Compounds And Ozone Formation Potential In The Atmosphere Of Urban Areas
#AAC24- 208	Zailina Binti Hashim	Strategy And Action Plan For Reduction Of Emissions From Agriculture, Biomass And Open Burning In Malaysia.
#AAC24- 209	Cenyan Huang	Vocs Emission Characteristics And Their Health Impacts Of Furniture Manufacturing: A Case Study In Central China
#AAC24- 213	Oliver F. Bischof	Harmonized Monitoring Of Ultrafine Particles In Ambient Air In Europe: Achievements And Proven Solutions
#AAC24- 215	Najihah Zainol Abidin	Aerosol Emissions From Electronic Cigarettes: Health Risk Assessment Of Aldehydes And Heavy Metals
#AAC24- 220	Nur Shahidah Bt Mohd Nazri	Sustainability Program: Indoor Air Quality (Iaq) Assessment Inside A Selected Department At A Healthcare Facility In Kuala Lumpur, Malaysia
#AAC24- 222	Jui-Hsin Hsu	Synergy Of Satellite, Air Quality Station And Low-Cost Sensor To Study PM2.5 And O3 Variations During The 2024 Kpex / 7-Seas Campaign
#AAC24- 229	Jonathan Symonds	Improving The Accuracy Of Particle Penetration Measurements Through High Efficiency Air Filter Media Using An Aerodynamic Aerosol Classifier
#AAC24- 231	Tomoya Tamadate	Modeling Of The Vapor Uptake On Ion Under Various Electric Fields
#AAC24- 233	Norhidayah Binti Abdull	A Review Of Characterization, Driving Factors, And Health Risk Of Indoor Microplastics

Abstract ID	Presenter	Title
#AAC24- 235	Maryam Rahmani	Advanced Air Quality Forecasting Using Temporal Lstm (Tlstm) Model
#AAC24- 237	Shi-Ya Tang	Chemical Mass Closure Of Hourly PM2.5 And Visibility Impairment At Two Sites In Southern Taiwan
#AAC24- 239	Wang Yize	Occurrence, Behavior, Fate, And Health Impact Of Airborne Microplastics (24) : Airborne Microplastics In Cloud Water
#AAC24- 243	Olga B Popovicheva	Seasonal And Source-Dependent Biomass Burning Impact On The Northernmost European Megacity: From Winter To Summer
#AAC24- 244	Wen-Chi Huang	Weather Regimes And Atmospheric Stability Associated With High PM2.5 Days In Douliu City, Taiwan
#AAC24- 246	Konstantinos Eleftheriadis	Mitigating Aerosol Emissions From Transport Sources In Urban Hotspots, The Mi-Trap Project.
#AAC24- 247	Siti Khairunnisa Binti Yusof	Concentration And Transport Mechanism Of Fungal Aerosol In Indoor Daycare Centers
#AAC24- 248	Sudarmaji	Analysis Of Risk Factors In The Physical Environment And Air In The House With Cases Of Pneumonia In Children
#AAC24- 250	Retno Adriyani	Indoor Air Quality Assessment Of Daycare Centers In Surabaya, Indonesia
#AAC24- 251	Masao Gen	Rapid Hydrolysis Of No2 At High Ionic Strengths Of Deliquesced Aerosol Particles
#AAC24- 253	Chengxi Yao	Numerical Study On Optimization Of Hazardous Gas Distribution In Cleanroom During Preventive Maintenance Of Semiconductor Process Equipment
#AAC24- 255	Yu-Lun Tseng	Spatiotemporal Variation And Chemical Fingerprint Of PM2.5 At Kaohsiung Coastal And Offshore Island Sites In Southern Taiwan
#AAC24- 256	Yueh-Chen Wang	Evaluation Of The Atmospheric Boundary Layer Structure Effect On Air Quality Using The Micro-Pulse Lidar
#AAC24- 259	Nandhakumar S K	Effect Of Climate Forcing Parameters On Coastal Regions Due To Maritime Aerosols
#AAC24- 264	Piyush Kumar Ojha	Evaluation Of Era5 Datasets On Atmospheric Convection With Radiosonde Observation Over East Coast Of India.
#AAC24- 266	Shreya Dubey	Toxicity Of Fine Particles Of Traffic Origin: Effect Of Different Driving Conditions And Fleet Characteristics
#AAC24- 269	Harish Phuleria	Polycyclic Aromatic Hydrocarbons From Vehicles: Characteristics And Associations With The Browning Of Atmospheric Organic Carbon
#AAC24- 271	Dwi Rasy Mujiyanti	Enhancement Of The Plasma-Catalytic For Co2 Conversion Over Monometallic Catalyst Deposited On Zeolite
#AAC24- 273	Rain Martin Valencia	Characterization Of Settled Atmospheric Microplastics Inside A University In Manila, Philippines
#AAC24- 275	Harish C. Phuleria	Are We Safe Inside Our Cars? Understanding The Toxicity Of In-Cabin Particulate Matter
#AAC24- 276	Mehrzad Roudini	Developments For Saw-Based Aerosol Generation: Miniaturized, Cost-Efficient, Mass-Producible And Reproducible Systems
#AAC24- 277	Shahzada Amani Room	Chemical Composition And Oxidative Potential Of Different Sized Particles In Various Regions Of Taiwan
#AAC24- 278	Yusuke Fujii	Development Of A Gaseous Ammonia Sampling System Using Counter-Current Flow Tube

Abstract ID	Presenter	Title
#AAC24- 279	Yanlin Zhang	Important Contributions Of Natural Gas To Atmospheric Nitrate Aerosols In China
#AAC24- 281	Olga B Popovicheva	Black Carbon In The Siberian And Central Arctic
#AAC24- 282	Poong-Mo Park	Integrating Filterable And Condensable Particulate Matter In Measurement And Analysis
#AAC24- 283	Weijun Li	Microphysical Properties Of Atmospheric Black Carbon Particles: Measurements, Modeling, And Impacts
#AAC24- 284	Weijun Li	Microscopic Analysis Of Phase Separation In Fine Ambient Aerosol Particles
#AAC24- 285	Saifi Izhar	Effect Of Emission Sources And Size On Carbonaceous Aerosol Optical And Isotopic Characteristics
#AAC24- 286	Jiahui Ma	Insights Into The Impacts Of Haze And Sandstorms On Bacterial Community Structure And Pathogenicity
#AAC24- 287	Yu Song	Realizing High-Fidelity Dust Loading Simulation Of Nonwoven Filter Media With Advanced Particle Technology
#AAC24- 288	Tsai-Jung Yen	Exploring The Causes And Trends Of PM2.5 And O3 In High Pollution Potential Areas: A Case Study Of Pingtung, Linyuan, And Chaozhou
#AAC24- 289	Kan Huang	Compositions, Sources And Formation Processes Of Atmospheric Aerosols In The Marine Atmosphere Of Coastal China
#AAC24- 290	Annisa Fillaeli	C-Doped Biobr Nanoparticle In Tuning High Efficiency Photocatalytic No To No3 - Conversion
#AAC24- 293	Charles Lo	Review Of Aerosol Geoengineering For Mitigation Of Global Warming
#AAC24- 294	Charles Lo	Carbon Capture'S Role In Net Zero Emissions
#AAC24- 295	Noor Haziqah Bte Kamaludin	Multiple Principal Component Analysis (M-Pca) Of Microfiber Exposure On Lung Impairment Among Textiles Workers In Selangor
#AAC24- 297	Cindy Patricia Yosika	Effectiveness Filtering Of PM2.5 With Hepa Filter And N95 Mask Filter On Fan In Motor Vehicle Testing
#AAC24- 298	Meera Harara	Initial Results From Regional Photochemical Modelling With Cmaq In The Abu Dhabi Emirate
#AAC24- 300	Yan-Lin Zhang	The Impact Of Forest Fires In The Eastern European Plain On Light-Absorbing Carbonaceous Aerosols In Moscow'S Atmosphere
#AAC24- 302	How-Ran Chao	The Negative Impact Of High PM2.5 And Glucose Levels On Wound Healing And Antioxidant Genes In Lung Epithelial Cells And The Potential Effects After Intervention Of The Chinese Herbal Medicine, Guilu Erxian Jiao
#AAC24- 305	Laili Fitria	Skyline To Skyfall: Mapping Taipei'S Urban Sprawl And Multi-Air Pollution Risk Assessment Through Remote Sensing
#AAC24- 306	Anwar Khan And Charles Lo	A Real-Time PM10 And PM2.5 Monitoring System For Construction And Demolition Sites To Improve Air Quality In New Delhi
#AAC24- 309	Harshita Baranwal	Contrasting Nature Of Absorbing Aerosols Over Indo-Gangetic Plain
#AAC24- 312	Arantzazu Eiguren-Fernandez	Field Evaluation Of An Affordable Community Condensation Particle Counter

Abstract ID	Presenter	Title
#AAC24- 313	Norhidayah Binti Abdull	Prediction Of PM2.5 Emission And Health Impact From Cooking Activity
#AAC24- 314	Professor Sheng-Hsiu Huang	Development Of A Smart Respirator
#AAC24- 315	Chih-Wei Lin	Study On Performance Test Methods Of Air Cleaners
#AAC24- 316	Chih-Wei Lin	Experimental Study On Optimal Cadr Filter Thickness Of Air Purifiers
#AAC24- 317	Wangyanyan	Effects Of Pahs By Biomass Combustion On Soil
#AAC24- 318	Hong Wang	The Application Study Of The Revised Improve Atmospheric Extinction Algorithm In Atmospheric Chemistry Model Focusing On Low Visibility Prediction In Eastern China
#AAC24- 320	Ki-Joon Jeon	Airborne Nanoplastics And Their Potential Toxicity
#AAC24- 331	I-Hsuan, Wu	Emission Characteristics Of Fuels With Different Sulfur Contents
#AAC24- 332	Zarifah Binti Shahri	A Comprehensive Bibliometric Analysis Of Airborne Microplastics: Indoor And Outdoor Environment In Industrial Area
#AAC24- 333	Barlin Das	Spatial Heterogeneity In Aerosols Chemical Composition And Implications To Physico-Optical Properties Over North East India
#AAC24- 334	Amrendra Kumar Singh	Assessing Air Pollution And Health Risks: A Five-Year Study Of Particulate Matter Deposition In Delhi
#AAC24- 335	J. Carlos Caroca	Ultrafine Particle Measurement Campaign In The City Of Graz Using An Avl Cpc
#AAC24- 336	Muhammad Aiman Bin Mohd Nor	The Effect Of Fluid Compressibility On The Flow Behavior In A Small Cyclone Separator
#AAC24- 338	Ernie Syazween Junaidi	Application Of Multiple-Path Particle Dosimetry (Mppd) Model In Aged-Specify Schoolchildren Airways Exposed To Ambient Particulate Matters In Malaysia
#AAC24- 339	Hyungjincho	Characteristics Of New Particle Formation And Cloud Condensation Nuclei In The Arctic
#AAC24- 340	Anjanay Pandey	PM2.5 Bound Chemical Characterization And Source Apportionment Analysis During Stubble Burning Period In Punjab: Implications For Delhi'S Air Quality
#AAC24- 341	Dr. Alok Sagar Gautam	Key Characteristics Of New Particle Formation Events At A High-Altitude Site In Tehri Garhwal, Uttarakhand, In The Western Himalayan Region, India
#AAC24- 345	Xin Duan	The Impact Of Indoor Plants On Classroom Air Quality And Student Health
#AAC24- 348	Nur Syafiqah Binti Abd Hakim	Air Pollution As A Factor Influencing Epiphytic Lichen And Algal Biodiversity In Selected Urban And Suburban Environments In Malaysia
#AAC24- 350	Kavita Patnaik	A 1-D Model To Retrieve The Vertical Profiles Of Minor Atmospheric Constituents For Cloud Microphysical Modelling
#AAC24- 353	Jost Valentin Lavric	Enhancing Urban Air Quality Monitoring With Low Footprint Smart Stations: An Example From Bangkok, Thailand
#AAC24- 354	Muhammad Firdaus Bin Abdul Halim	Performance Of Nanocellulose Fibre Reinforced Starch Biopolymer Composites
#AAC24- 355	Yusuf Jameel	Novel Approach To Sustainable Material Fabrication: Graphene-Filled Green Epoxy Nanocomposites

Abstract ID	Presenter	Title
#AAC24- 356	Shumin Liang	Multidimensional Insights Into The Formation Of C2-3 Organosulfates In Ambient PM2.5
#AAC24- 357	Jonathan Symonds	A Particle Counter For Both Nano And Multi-Micron Sized Particles
#AAC24- 359	Nur Syafiqah Binti Abd Hakim	Air Pollution As A Factor Influencing Epiphytic Lichen And Algal Biodiversity In Selected Urban And Suburban Environments In Malaysia
#AAC24- 365	Anssi Arffman	Characterization And Field Testing Of A New Oxidation Flow Reactor (Dofr)
#AAC24- 368	Neha Shukla	Explore The Impactof PM2.5 On Pre-Teen Schoolchildren In &Amp;Quot;Manchester Of The East , Kanpur, India
#AAC24- 371	Vaishali Jain	Fine-Gridded PM2.5 Prediction With Low-Cost Sensor Network And Machine Learning Techniques
#AAC24- 372	Prerna Thapliyal	Land Use Land Cover, Population Distribution, And Geographic & Seasonal Variations Influencing Carbonaceous Aerosol Concentrations In The South-Asian Region
#AAC24- 373	Selahattin İncecik	Short Term Forecasting Of Ozone Levels In Rural Areas Of The Biga Peninsula Using A Photochemical Model
#AAC24- 375	Asad Abbas	Magnetically Tuned Graphene Oxide Nanocomposites For Advanced Filteration Technology
#AAC24- 377	Richa Singh	The Himalayan Aerosol-Climate Interplay And Its Effects On Weather Patterns And Ice Mass Balance
#AAC24- 378	Shangrong Wu	Combustion Emission Of Waste Biomass Pellet From Spend Coffee Grounds
#AAC24- 384	Prof Turki M. A. Habeebullah	The Impact Of Extreme Weather Events On Atmospheric Aerosols In Ksa – Analyzing The Anomalies And Their Driving Factors
#AAC24- 387	Yu-Ting Chang	The Effects Of PM2.5 And High-Glucose Exposure On The Toxicity In A549 Lung Cancer Cells
#AAC24- 388	Henrik Hof	Study Of Aerosol Size Distribution - Comparison Of Vulcanic Ashes And Sahara Dust And Its Spatial Variety On La Palma Island
#AAC24- 389	Henrik Hof	Measurements Of Airborne Fine Dust And Ultrafine Particles At A Seaport For Source Identification
#AAC24- 391	Debayan Mandal	Chemistry Of Water-Soluble Organic Matter In Different Indoor Locations Inside An Academic Campus
#AAC24- 392	Lim Fang Lee	Health Risk Assessment Of Heavy Metals In Household Dust: Associations With Daily Activities Among Residents In Kampar, Malaysia
#AAC24- 394	Yiran Li	A Convertible Condensation Particle Counter Using Alcohol Or Water As The Working Fluid
#AAC24- 398	Yuka Uchida	Research On Safe Nebulizer Inhalation Therapy Using Clean Booth - Clinical Research -
#AAC24- 401	Chia C. Wang	Water Plays Multifunctional Roles In The Soa Formation In Ozonolysis Of Monoterpenes: Combined Vuv Photoelectron Spectroscopy, Mass Spectrometry And Dft Studies
#AAC24- 403	Wan Nurdiyana Wan Mansor	Engine Performance And Combustion Of Biodiesel Produced From Local Used Frying Oil Using Potassium Hydroxide (Koh) As A Catalyst In A Single Cylinder Diesel Engine
#AAC24- 404	Justin Sentian	Recent Spatial And Temporal Analysis Of Aerosol Optical Depth Analysis Over Malaysian Borneo
#AAC24- 409	Arnis Asmat	The Impact of Urbanisation Factors on Urban Air Quality Using Geographically Weighted Regression (GWR) Analysis

Abstract ID	Presenter	Title
#AAC24- 410	Norhayati Mahyuddin	Optimizing External Flow Domain Dimensions in CFD Simulations for Enhanced Natural Ventilation and Pollutant Control in Hospital Buildings
#AAC24- 411	Nur Faseeha SUHAIMI	DNA Methylation as an Epigenetic Signature of Children's Exposure to Traffic-Related Air Pollution in Klang Valley, Malaysia

Poster Presentation List

List of Accepted Posters (*As per 31st October 2024*)

No	Category	ID	Title & Presenter
1	Aerosol and Air Pollution in South Eastern Asia Countries	20	Time Series Analysis PM2.5 Concentration for Capital City Dhaka from 2016 to 2023 ***Marziat Rahman***
2		25	Temporal Analysis of Particulate Matter Concentration in Petaling Jaya ***Nur Atikah Abd Rahman***
3		50	Peculiar Impact of Diwali Festival-2023 on Surface and Columnar Aerosol Features over A Rural Site in North India ***Panuganti China Sattilingam Devara***
4		107	First-time Revelation of Ultrafine Particles (UFPs) and Particle Number Size Distributions (PNSDs) in a Tropical Industrial-Harbor-Urban Area ***Tse-Lun Chen***
5		153	Major Chemical Components in PM2.5 to Cause the Summer Haze in Northeast Asia: Case Studies of Beijing and Seoul ***Nakyung Kim***
6		163	Impact of Tourism on Air Quality and Squall-Induced Rainfall Chemistry in Siem Reap, Cambodia ***Mutsumi Ohhama***
7		221	The Movement and Dispersal of Air Pollutants in Bukit Rambai, Melaka and Muar, Johor, Malaysia and It's Associated Health Effects ***Noor Aniza Ibrahim***
8		386	Trends in Aerosols at Lulin Atmospheric Background Station, Taiwan ***Shantanu Kumar Pani***
9		397	Temporal Variability of Atmospheric Pollutants Associated with Meteorological Parameters in the Himalayan Foothills of Uttarakhand, India ***Amar Deep***
10		408	Evaluating PM10 and PM2.5 Concentration and Air Pollution Index of Malaysian Borneo ***Salwa Naidin***
11	Aerosol Chemistry	121	Development of Artificial Control Methods for Chemical Composition of Particulate Matter ***Hiroaki Tonai***
12		122	Surface Tension Measurements for Examining the Size-Dependent Surface Tension of Microdroplets ***Rikuto Minamikawa***
13		123	Impacts of Aerosol Nutrients on Ocean Biogeochemistry: A Case Study in the Subtropical Western North Pacific ***Tey Cheng Yi***
14		159	Long-term Trends of Aerosols and Gases in the Atmospheric Boundary Layer on Mt. Fuji and Applications of IoT Sensors ***Asahi Homma***
15		160	Formation of Nitric and Nitrous Acids via Nitrogen Dioxide Interaction on Snow and Ice Surfaces ***Arisa Hinoshita***
16		165	Influence of Organic Matter from Algae on Cloud Condensation Nucleus Characteristics of Sea Spray Aerosol ***Yoko Iwamoto***
17		178	Aerosol Liquid Water (ALW) of Organic Aerosol (OA) and Their Chemical Characteristics in Northeast Asia During the Late Autumn ***Siyun Lee***
18		200	Source Apportionment of PM2.5 Episodes in the Taichung Metropolitan Area, Taiwan ***Ming-Tung Chuang***
19		223	Heterogeneous Kinetics of the OH-Initiated Degradation of Lignin Pyrolysis Products: An Experimental Approach ***Kosuke Seguchi***
20		241	Ionic-Strength and pH Dependent Reactivities of Ascorbic Acid and Cysteine Toward Ozone in Microdroplets Studied by Aerosol Optical Tweezers ***Yuan-Pin Chang***
21		310	Quantification of Black Carbon Soot Particles and Source Interpretation using Aethalometer and SEM–EDX for Achieving SDGs ***Ranjit Kumar***
22		337	Enhancing Air Quality through Stricter Regulations on Ship Fuel Oil in East China ***Meng Wang***

No	Category	ID	Title & Presenter
23	Aerosol Exposure and Health Effects	22	Oxidative Stress Induction Ability of PM2.5 in Cities in Eastern and Western Japan ***Yuji Fujitani***
24		29	The Impact of PM2.5 and Climatic Variations on COPD ***Hsiao-Chi Chuang***
25		32	Associations between Short-term PM2.5 Exposure and Blood Indicators Related to Anemia (BIRA) in Healthy Subjects ***Dinh Chi Thien***
26		45	Relationship between Toluene Concentration and RQ Toluene with Neurotoxic ***Shinta Arta Mulia***
27		56	Development of Methods for Measuring Endotoxins in Atmospheric Particles and Estimation of Their Origins ***Shoya Manabe***
28		63	Novel Concepts for Toxicity Evaluation of Aerosol Particles: Openable Cyclone and Water-Soluble Filter ***Tomoaki Okuda***
29		76	Toxicity Comparison of A549 and THP-1 Cells in Response to Endotoxins in Aerosol Particles ***Diqing Gong***
30		82	Evaluation of the Effects of the Air Purifier Intervention on Air Pollutants at Homes of Preterm Infants and Health Effects of Family Members Living Together ***Chia Chi Cheng***
31		84	Particle Concentration and Size Distribution of Welding Fumes During Laser-Welding Operation of Stainless Steel: A Case Study ***Maromu Yamada***
32		96	Airborne Influenza Virus in Daycare Centers ***Chia Yi Lin***
33		111	Evaluation of Surface Collection Efficiency of Polycarbonate Membrane Filters by SEM Observation for Application in Occupational Health ***Hiroko Ogata***
34		117	The Effects of Air Purifier Intervention on MicroRNA in Blood of Asthma Patients ***Wei-Chen,Lin***
35		130	Airborne Nanoplastics and their Potential Toxicity ***Ki-Joon Jeon***
36		177	The Cellular Toxicity and Chemical Composition of Fine Particulate Matter Collected in India, China, and Japan ***Liu Yang***
37		194	Spatial Analysis of Air Quality Index in Niger Delta Region of Nigeria: Identifying Hotspots and Health Implications ***Felix Paul***
38		199	Assessment of Particulate Matter and Bioaerosol Exposure Close to Quarrying Areas in Southeastern Nigeria ***Imoh Dominic Ekpa***
39		211	Exploring the Cellular Impact of Size-Segregated Cigarette Aerosols: Insights into Indoor Particulate Matter Toxicity and Potential Therapeutic Interventions ***Hsiufang Fan***
40		272	Modeling Residential Outdoor PM2.5 Exposures in Urban Areas ***Aditi Khode***
41		303	Chromosomal Damage and S-PMA Metabolite Excretion in Traffic Personnel Exposed to Ambient Levels of Benzene ***Noor Fatihah Mohamad Fandi***
42		164	Size Distribution of Particulate Matter and its Health Effects among Adults During the Forest Fire in South Sumatra, Indonesia ***Doni Hikmat Ramdhan***
43		400	Relationship between Toluene Concentration, Toluene RQ and Liver Function of Workers Exposed to Toluene ***Putri Ayuni Alayyannur***
44		416	Health Risk Assessment of Particle Deposition in Schoolchildren's Respiratory Airway ***Ernie Syazween Junaidi***
45	Aerosol Instrumentation	24	BioCascade: Size-Fractionated Collection of Viable Airborne Pathogens ***Arantzazu Eiguren-Fernandez***
46		91	Coupling of Photoionization Mass Spectrometry to Thermal Optical Carbon Analysis (EC/OC-Measurement) for Rapid PM Characterization ***Ralf Zimmermann***

No	Category	ID	Title & Presenter
47		125	Study on the Performance of Dilution Devices for Measuring High-Concentration Nano Particles Emitted in Manufacturing Process ***Jiwoo Jung***
48		205	Development and Validation of Single-Stage NBI and Five-Stage NMCI Samplers for PM1.0 Concentration and Mass Distribution ***Le Thi Cuc***
49		330	Vertical Distribution of Black Carbon and its Interaction with the Atmospheric Boundary Layer as Observed by Tethered Balloon Payloads along the Brahmaputra Valley of North East India ***Manasi Gogoi***
50		346	AQ Guard Smart System & MyAtmosphere a Sensor Network Ready Solution for PM, Gases, UFP and BC ***Henrik Hof***
51		363	Performance Improvement of Beta Attenuation Monitor ***Chih-Wei Lin***
52		364	A Low-cost Technology for APCD Performance Monitoring ***Chih-Wei Lin***
53	Aerosol Modeling	52	Decreasing Trends in PM2.5 and BC Concentrations Observed on Central and Western Japanese Islands ***Yayoi Inomata***
54		69	Impact of MEMD on Air Quality Prediction Accuracy: A Longitudinal Study ***Chin Yu Hsu***
55		352	Development and Optimization of Machine Learning Models for Predicting Aerosol Size Distributions from Meteorological Data ***Aman Deep Vishwkarma***
56		385	Health Impact Assessment of PM2.5 Emission Reduction Measures in Southeast Asia ***Didin Agustian Permadi***
57		257	Estimation of Optical Properties for BC and BrC in PM2.5 during Winter in Ulaanbaatar, Mongolia ***Jeonghee Kwon***
58		358	Optical Properties of Fresh and Photochemically Aged Dark Brown Carbon ***Shu-Wen You***
59	Aerosol-Climate Meteorology	339	Characteristics of New Particle Formation and Cloud Condensation Nuclei in the Arctic ***Hyungjincho***
60	Airborne Microplastics	93	Observation of Airbornr and Sub-100 μm Marine Microplastics in the Open Ocean Near Japan and on Chichijima Island ***Moene Komatsu***
61		133	Occurrence, Behavior, Fate, and Health Impact of Airborne Microplastics (12): Behavior of AMPs in Urban and Mountain Forests ***Hikaru Nitta***
62		301	Human Responsive Biomarkers of Airborne Microfibers Exposure: Evaluation and Analysis for Health and Environment ***Nur Aimi Dalilah Ismeth Al-Hafiz Joshua***
63	Bioaerosol	33	Physicochemical Characteristics of Atmospheric Particles in Urban Region of India ***Shailendra Pratap Singh***
64		62	Seasonal Variations in Community Structures and Ice-Nucleation Levels of Airborne Microorganisms in Forest Area ***Tamiya Yukino***
65		219	Airborne Bacterial and Fungal Communities and their Sources in Coastal Region ***Tian Chen***
66		262	Prediction of Indoor and Outdoor Airborne Microbial Levels ***Jeong Hoon Byeon***
67		280	Characterization and Health Risk Assessment of Size-Segregated Fungal Bioaerosols in and Around a Sugar Mill in India ***Swati Tyagi***
68		296	Marine Biological Aerosol: Observation, Simulation and Characterization ***Senchao Lai***
69		321	Airborne Bacterial and Fungal Communities and their Sources in Coastal Region ***Tian Chen***
70	Climate Change, Air Modeling, Meteorology	270	Researching Trends in Air Quality Standardization Activities ***Muhyun Jung***
71		381	Evaluating Traditional and Flash Droughts in India: Historical Trends and Future Climate Projections ***R. Bhatla***

No	Category	ID	Title & Presenter
72		382	Assessing Future Flood Trends in India: Impacts of Climate Change Under SSP Scenarios Using CMIP6 Framework ***Akash Vishwakarma***
73		195	Evidence of Climate Change: Understanding the Land Surface Temperature of Akwa Ibom State ***Felix Paul***
74	Emission Inventory	349	2022 Abu Dhabi Air Emission Inventory ***Mariam Al Memari***
75	Filter and Control Technology	210	All-in-one Air Pollutants Control Device for the Electrical Arc Furnace (EAF) of Steel Industries ***Seongwoo Lee***
76		297	Effectiveness Filtering of PM2.5 With HEPA Filter and N95 Mask Filter on Fan in Motor Vehicle Testing ***Cindy Patricia Yosika***
77	Indoor Air	31	Impact of Cooking Methods on Indoor Aerosol Composition: A Comparative Study of Particulate Matter (PM) and Volatile Organic Compounds (VOCs) Emissions ***Ruijie Tang***
78		94	Health Impacts of Exposure to Multi-Metal from Solid Fuel Combustion in Rural Households of Northern China ***Gu Yunxuan***
79		126	Investigating the Link between Cooking Aerosols and Nervous System and Lung Function in Humans: A Clinical Approach ***Motahareh Naseri***
80		142	Identification of Microcapsules in Personal Care Products and Health/ Environmental Impact Assessment (5): Comprehensive Analysis of VOCs by GC×GC-TOFMS ***Ryotaro Oshima***
81		185	Analysis of Airflow Effects and Droplet Transport Processes by Air Purifiers ***Aoba Kawai***
82		187	Evaluation of Indoor Air Quality during Carpet Cleaning Activities ***Sripriya Nannu Shankar***
83		217	Indoor Air Quality and Psychosocial Factors Related to Sick Building Syndromes among Office Workers in Old and New Buildings of Penang Governmental Administrative Office ***Glynn Dexter Andreas***
84		225	Effect of Household Environmental Quality and Family Habits on Respiratory Allergy Symptoms Children in Surabaya City ***Novi Dian Arfiani***
85		226	Analysis of Relationship between Formaldehyde Exposure and Physical Environmental Characteristic with Asthma Symptom in 13-14 Years Old in Surabaya Indonesia ***Rusyda Sheffani Abbad***
86		234	Characteristics of VOC Emissions from Consumer Chemical Products: A Comprehensive Review of Test Chamber Studies ***Yeonsoo Kim***
87		240	Assessment of Indoor Air Pollution in Kindergartens Located in Different Shop Office Lots ***Intan Bayani Zakaria***
88		322	Physicochemical Properties and Toxicity of Fine Particles Emitted from Grilling of Pork and Mackerel ***Yeonju Sim***
89		351	Effects of Environmental Conditions on the Generation and Dispersion of Aerosol from Flushing Toilets ***Aoba Kawai***
90		390	Assessment of Indoor Air Quality in the Public University Gymnasium Centre ***Nor Azura Sulong***
91		399	The Impact of Indoor Environmental Quality on Children's Health in Preschools: A Literature Review ***Kayrul Hidayah Mansor***
92		415	Association Between Indoor Air Quality and Respiratory Health Symptoms in Children at Daycare Centers in Petaling Jaya, Selangor ***Fahimah Hashim***
93	Local Biomass Burning	143	Source-Specific Characteristics of Light-Absorbing Black and Brown Carbon in a Rural Continental Region ***Parminder Kaur***
94		367	Combustion Emission of Waste Biomass Pellet from Spend Coffee Grounds ***Wu Shangrong***
95	Low Cost Sensor and Sensor Network	64	Initial Results from MAIA-AMOD Coordinated Experiments Conducted Over a Pristine Site in Haryana, India ***Panuganti China Sattilingam Devara***

No	Category	ID	Title & Presenter
96		128	Development of a Physics-Based Method for Calibration of Low-Cost Particulate Matter Sensors and Comparison with Machine Learning ***Manoranjan Sahu***
97		201	Production of Gas Measurement System for Steel Making Industry ***Jung Gi Min***
98		393	Real-Time Monitoring of Surface Ozone and Isoprene Concentrations from Landscape in Tropical Ecosystem (LiTE) using AiRBOX Sense Sensor ***Hartini Mahidin***
99	Nanoparticles and Nanotechnology	35	Nanostructured Soft-Magnetic Particles Prepared by One-Step Aerosol Process ***Eka Lutfi Septiani***
100		36	Analysis of Chemical Mechanical Polishing Slurries using Electrospray-Differential Mobility Analyzer-Condensation Particle Counter, Dynamic Light Scattering and AF4 ***Yu-Hsien, Wu***
101		38	Enhanced Photocatalytic Performance of TiO2 and TiO2-CuO Nanoparticulate Thin Films Fabricated via Gas-Phase Method ***Manabu Shimada***
102		127	Experimental Investigations of the Effect of Titania Nanoadditives on Fine and Ultrafine Carbonaceous Emissions during Flame Combustion of Diesel ***Anirudha Ambekar***
103		150	Experimental Study of Structural Variations in Nanoparticle Deposition Due to Deposition Conditions ***Kiwoong Park***
104		162	Experimental Investigations on Particulate Emission Characteristics of Heptane Flames with the Addition of Ferrocene Compounds ***Anirudha Ambekar***
105		304	Nanotoxic Effects of Boron Carbide Nanoparticle in an Animal model of Caenorhabditis Elegans ***How-Ran Chao***
106	Remote Sensing	370	Exploring Air Pollutants and Their Impacts on Agricultural Crop Production in Uttar Pradesh, India ***Pradeep Kumar***
107	Urban Aerosol and Air Quality	147	Molecular Composition and Source Apportionment of Organic Aerosol and Gases in The Chinese Megacity Xi'an ***Jay Slowik***
108		155	Morphology and Elemental Composition of Single Aerosols at Different Vertical Heights over a Downwind Site in Southern Taiwan ***Ming-Yu Hung***
109		157	Characteristics of PM2.5 Organic and Elemental Carbon at Two Sites in Southern Taiwan ***Yi-Hsuan Chen***
110	Urban Aerosol and Air Quality	206	Application of Vertical Sounding and Model Simulation to Investigate the Impact of Regional Circulation and Topography on Air Quality in Taiwan ***Lai Hsin-Chih***
111		212	Overview of the FRIEND Project in South Korea ***Gwi-Nam Bae***
112		224	Occurrence and in Vitro Toxicity of Tire Rubber Antioxidants and Transformation Products in PM2.5 ***Su Junrong***
113		238	Systematic Evaluation of Respiratory Health Effects Associated with Ammonia Inhalation Exposure among Ice Factory Workers ***Nur Azalina Suzianti Feisal***
114		242	Seasonal Variability, Wildfire Impact, and Toxicity Source Apportionment of PM10-Bound PAHs and N-Alkanes in Large European Metropolitan Area ***Chichaeva Marina***
115		254	The Assessment of Aerosols Originated from Construction Activities: A Case Study in Kuala Lumpur ***Afnan Ahmad***
116		260	Extraction of PM10 and PM2.5 Emission Trends from Ambient Concentrations in Delhi Using Machine Learning and Parametric Statistical Method ***Uday Suryanarayanan***
117		261	A hybrid Machine Learning Approach using Boosting Algorithm to Predict the Air Quality Index (AQI) in Uganda ***Kasagga Usama***
118		263	Detailed Regional Characterization of Ambient Airborne Aerosols in Gyeonggi, South Korea ***Muhyun Jung***
119		328	Estimation of Ammonia Emission of Agriculture Source of Korea based on LCA of Manure Flow ***Hung-Soo Joo***

No	Category	ID	Title & Presenter
120	Urban Aerosol and Air Quality	329	Characterization of Air Pollution between Youngdong and Youngseo Districts of Korea Based on the Combination of Environmental Impact Assessment Data and the Change of Ecological and Natural Map (ENM) Grade ***Roh Jung Min***
121		343	Source Apportionment by Combining High-Time Resolution Organic, Black Carbon, and Inorganic Chemical Composition Datasets ***Mohd Faisal***
122		347	Significant Formation Pathways of Nitrogen-Containing Organic Aerosols in Urban Atmosphere Revealed by Bihourly Measurements of Bulk Organic Nitrogen and Comprehensive Molecular Markers ***Xu Yu***
123		369	Two Contrasting Methods for Source Apportionment of Ambient Black Carbon in Highly Polluted Environments ***Ajit Kumar***
124		383	PM2.5 Bound PAHs Analysis and Source its Apportionment for Northeast India ***Pratibha Vishwakarma***
125		395	Exploring the Potential Association between PM10, PM2.5 and Indoor Microbiome in Urban and Suburban Schools ***Khairul Nizam Mohd Isa***
126		407	Assessing the Infiltration Factor Between Indoor and Outdoor Environments in Low-Cost Residential Housing in Kuala Lumpur ***Murnira Othman***
127	VOC and Secondary Precursors	40	Prediction of the Needs for Benzene Detox with Foods Intake Containing CYP2E1 Enzyme, Sulfation, and Glutathione at Gas Stations in Indonesia ***Bian Shabri Putri Irwanto***
128		103	Impact of Tourism on Air Quality in Siem Reap, Cambodia: Analysis of Organic Aerosols and VOCs Near the Angkor Monuments ***Haruka Tamaru***

List of Sarawak Local Booths

Explore an exciting selection of booths showcasing Sarawak's local industries, crafts, and cultural heritage. Discover unique products, learn about community initiatives, and connect with local exhibitors contributing to the region's vibrant economy.

Heliconia Craft Collection

Eko Creative Studio

PPSG, UiTM Cawangan Sarawak

Elly Loe Handcrafts

Natural Remedy

ThemuQ

Perkata Sarawak

Kuching Heart Treasurers Welfare Association

Kek Lapis Warisan Sdn Bhd

Shira Bella Enterprise (Bella S Beauty Spa & Academy)

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PALAS®

As an aerosol technology expert, Palas® Germany is committed to providing users with solutions for the generation, conditioning, measurement and analysis of aerosol particles. Based on the unique advantages of its own technology, Palas® developed a variety of application cases in ambient air quality monitoring, particle filtration performance testing and various scientific research fields. Palas Instruments (Shanghai) Co., Ltd. is a wholly owned subsidiary of Hong Kong Palas (Asia) Limited. As one of the global branches of Palas GmbH, it has legally obtained the Palas trademark authorized by Palas GmbH in Exclusive use rights in China and Asia.

As a company that has passed the ISO 9001:2015 quality management system certification, Palas®'s test rig solutions can execute particle filtration performance tests for filter media and filter elements according to applicable international, national and regional standards. In terms of environmental protection, Palas®'s equipment meets the requirements of multiple environmental monitoring standards (EN 15267, EN 16450, HJ653, GBZ/T 192.6, etc.) for indoor and ambient PM2.5, PM10, particle number size distribution monitoring and analysis.

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