The EANET Awareness Workshop in 2023

A focus on

VOLATILE ORGANIC COMPOUNDS
AND LOW-COST SENSORS

Event
Report

JUNE 2023

EANET
Acid Deposition Monitoring
Network in East Asia (EANET)

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"Air pollutants carry across borders. Solutions need to cross borders. Data sharing and collaboration are key. That's why alliances such as EANET are so important."

Marlene Nilsson, Deputy Regional Director, UNEP Regional Office for Asia and the Pacific

01 Overview

Due to rapid economic growth and industrialization, many countries in East Asia are still facing serious threats from air pollution and acid deposition. Globally, almost the entire global population (99%) breathes air that exceeds the World Health Organization's air quality guideline values, hindering populations' right to a healthy environment.

The Acid Deposition Monitoring Network in East Asia (EANET) was established in 2001 as a regional intergovernmental network to promote cooperation among countries in East Asia to address acid deposition problems. In 2021, at the Twenty-Second Session of the Intergovernmental Meeting (IG22), the 13 Participating Countries of the EANET agreed to expand its scope to address wider air pollution problems and launched the EANET Project Fund to encourage cooperation with partners outside of its network.

In the last 20 years, the EANET has made excellent progress in acid deposition monitoring cooperation, including on particulate matter, sulfur dioxide, nitrogen dioxide, and ozone. The Network has fostered a regional monitoring network and scientific exchange platforms that contribute to solving acid deposition and air pollution problems in East Asia.

In November 2022, the Twenty-fourth Session of the Intergovernmental Meeting (IG24) approved the first batch of "EANET Project Plans" funded through the EANET Project Fund, with an Estimated Income for Project Activities in 2023 of US$489,700, including funding from EANET, additional financial support from Japan (MOEJ) from the Republic of Korea (NIER); and in collaboration with the Asian Development Bank (ADB); and in-kind support from Japan (JARI, NIES), Mongolia, the Philippines, and Viet Nam (IMHEN, MONRE) for the implementation of 8 projects, among which two projects focusing on Volatile Organic Compounds (VOC) and Low-Cost Sensors (LCS).

In line with the efforts to facilitate the sharing of a common understanding of air quality and acid deposition issues, the EANET Regional Awareness Workshop in 2023 was organized on Tuesday, 30 May 14:00-17:00 (ICT) at the United Nations Convention Center (UNCC) in Bangkok, Thailand, and in a hybrid format, titled "EANET Regional Awareness Workshop in 2023: a focus on Volatile Organic Compounds (VOCs) and Low Cost Sensors (LCS)", as part of the Climate and Clean Air Conference: Air Quality Action Week, organized by the UN Environment Programme (UNEP) and the Climate and Clean Air Coalition (CCAC). The Workshop was held in cooperation with the Asian Institute of Technology (AIT) Regional Resource Centre for Asia and the Pacific (RRC.AP).

Opening Remarks were delivered by Ms. Marlene Nilsson, Deputy Regional Director, UNEP Regional Office for Asia and the Pacific, and the Pacific, and Closing Remarks by Dr. Shiro Hatakeyama, Director General, Asia Center for Air Pollution (ACAP).

View the event Programme and speakers bio on EANET website.

All Workshop's recordings are available online on the EANET's Secretariat YouTube channel.

02 Objective & Participants ▶▶

Objective

The EANET Regional Awareness Workshop in 2023: a focus on Volatile Organic Compounds (VOCs) and Low Cost Sensors (LCS) aimed at increasing public understanding of air pollution and acid deposition issues through the lens of experts, policymakers, and other stakeholders from the EANET region and globally. The two sessions focused on innovative and emerging topics, specifically on Volatile Organic Compounds (VOCs) and Low-Cost Sensors (LCS) related opportunities, limitations, and good practices, and generate future collaboration ideas.

Participants

The EANET Awareness Workshop in 2023 was attended online and/or in person by the EANET National Focal Points, Scientific Advisory Committee members, and other EANET members and partners, including policymakers, national researchers, and scientists mainly from the Network's 13 Participating Countries. It also welcomed representatives of partner organizations working on related issues, as well as participants joining the Air Quality Action Week in Bangkok.

129 participants joined the Workshop, 47 in person, and 82 online. 67 participants were women and 60 were men, including government officials, environmentalists, chemists, professors, students, researchers, representatives of international organizations, the private sector, and civil society.

Outside of the EANET region, participants from France, Germany, India, Maldives, Nepal, New Zealand, Nigeria, Pakistan, Sri Lanka, United Arab Emirates, and the USA joined the Workshop.

Survey Results

A survey conducted at the end of the Workshop showed that 38.9% of respondents joined an EANET event for the first time. The majority of participants were "satisfied" to "very satisfied" with the content of the Workshop and "satisfied" with the networking opportunities. Topics suggested for the next events included method calibration for ambient monitoring, SDGs, satellite imagery for monitoring, pollution mitigation measures, traffic emissions, IoT devices and integration to traditional networks, and surface ozone, among others.

The full results of the survey are available on page 14 of this report.

129
participants

67
women

15
countries
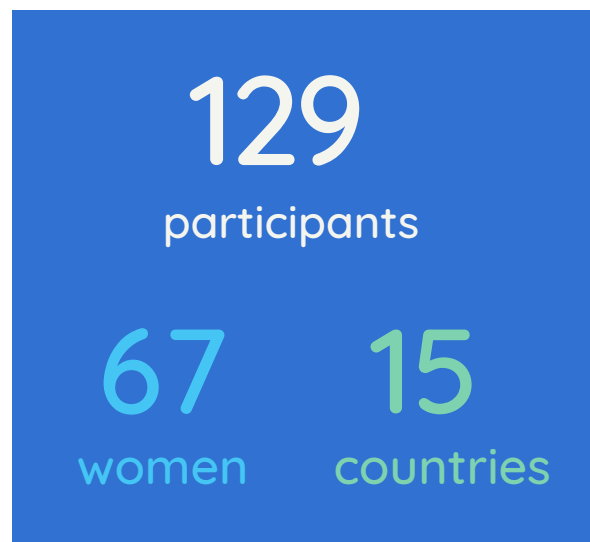
03 Importance and Challenges of VOCs Measurement and Control in East Asia

Volatile Organic Compounds (VOCs) are a large group of organic chemicals that include any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate). VOCs are emitted from a variety of sources, including motor vehicles, chemical manufacturing facilities, refineries, factories, consumer and commercial products, and natural sources (such as trees). VOCs contribute to the formation of secondary pollutants including ozone and fine particulate matter, thereby playing a significant role in air pollution, and contributing to a variety of harmful health effects.

Trends' analysis of air pollutants in Asia from 1950-2015 show that all air pollutants significantly increased over time. While some pollutants have started to decrease or stagnate in recent years such as sulfur dioxide (SO_2), oxides of Nitrogen (NO_x), Carbon monoxide (CO), and particulate matter. VOCs, on the other hand, continued to increase.

Speakers / Panelists on Volatile Organic Compounds

- **Prof. Meng Fan**, Deputy Director General for EANET, Asia Center for Air Pollution (ACAP)
- **Dr. Meihua Zhu**, Senior Researcher, Asia Center for Air Pollution (ACAP)
- **Prof. Hong Li,** Chinese Research Academy of Environmental Sciences (CRAES), China
- **Dr. Kessinee Unapumnak**, Pollution Control Department (PCD), Thailand

Read the full speakers bio on EANET website

Because of the complexity of the nature of the emission sources and the diverse chemical compositions of VOCs' different compounds, VOC emissions are more difficult to reduce than other air pollutants.

Only three countries in the EANET region, namely Japan, the Republic of Korea, and Thailand, have ambient standards for VOCs.

More work needs to be conducted on VOC monitoring, reporting, analyzing, and regulations in the region. This is why the project Promoting VOCs related Capacity Building in the EANET, supported by the Ministry of the Environment, Japan (MOEJ) has been developed and launched in 2023.

Planned to last three years, the project is the fruit of cooperation between the MOEJ, the EANET, and different government and research institutes from China, Japan, Mongolia, and the Philippines, also including experts from the Republic of Korea and Thailand. Challenges of this project will be to work in countries with economic disparities, large differences in environmental standards, as well as diverse geographical and meteorological conditions.

In Thailand, the National Ambient Air Quality Standards include VOCs, and these are the first in the ASEAN region to include it. These standards have been developed thanks to technical cooperation with the government of Japan on addressing VOC pollution. The primary focus on VOCs in Thailand is due to their health impacts and contribution to particulate matter (PM2.5).

As of 1 June 2023, Thailand has implemented a revision of its ambient air quality standards, specifically focusing on PM 2.5. The revision aligns with the new guidelines set by the World Health Organization (WHO) interim target III.

By adopting the WHO guideline values, Thailand is prioritizing public health and taking proactive measures to improve air quality management.

In China, VOC emission standards are in place and 157 cities have VOCs automatic monitoring capabilities, however, VOCs are not yet included in the Chinese National Ambient Air Quality Standards. It was highlighted that research and assessment on VOCs' contribution to air quality and their impacts on health need to be strengthened.

The Philippines faces issues with ozone and VOCs, and little work has been done so far to address VOCs, excluded from the Clean Air Act. The need to identify and understand the main sources of VOCs was highlighted, including the necessary development of VOC Air Quality Guideline Values and Air Quality Index. Emission inventories indicated that VOCs contribute significantly, mainly from the transport sector. The switch from Euro 4 to Euro 5 standards is expected to help mitigate VOC emissions in the Philippines.

During the question-and-answer session, it was noted that in Thailand, the Pollution Control Department (PCD) is responsible for monitoring VOCs in communities, and that emissions primarily come from industrial sites, such as the petrochemical area in Rayong province. A participant inquired about the Thai alert system. Improving the delay for VOC measurements and action was discussed, with the current system relying on a 24-hour average sampling period, conducted once a month. Real-time concentration measurement is not currently available. Emergency response efforts utilize continuous analyzers placed near industrial and mangrove areas. The PCD monitoring station includes public and private sector data. The AIR4THAI mobile application combines PCD and Bangkok Metropolitan Administration (BMA) data, while other provinces rely on PCD data only.

Discussion Highlights

- VOCs contribute to the formation of secondary pollutants including ozone and fine particulate matter, thereby play a significant role in air pollution, and cause harmful health effects.
- VOCs are the most increasing air pollutants in Southeast Asia.
- VOC emissions are more difficult to reduce than other air pollutants.
- Only three countries in the East Asian region, Japan, Republic of Korea, and Thailand, have ambient guidelines for VOCs.
- EANET has launched a sub-regional cooperation project on VOCs.

Key Recommendations

- Research needs to be conducted on VOC monitoring, reporting, and emission sources analysis to produce VOC Air Quality Guideline Values and Air Quality Index.
- Research and assessment on VOCs contribution to air quality and their impacts on health need to be strengthened.

04 LCS's Role in Air Quality Management in East Asia

Low-cost sensor (LCS) technology can be defined as a monitoring system for Particle matter (PM) or specific gases using various kinds of sensors. Generally, LCS are small sensors, portable, relatively cheaper than reference-level equipment, and require lower electric consumption. LCS technology has been remarkably developed in recent years and is now widely used to inform citizens on the atmospheric environment through data communication networks, or via mobile apps such as IQAir or A4Thai in Thailand, for example. However, limitations remain related to the variable performance of LCS, the lack of calibration, standardization, and quality assurance and control. According to the American Environmental Protection Agency (US EPA) LCS data do not meet the U.S. National Ambient Air Quality Standards (NAAQS) requirements, but they are useful for non-regulatory, supplemental, and informational monitoring applications.

Advantages and challenges of using Low-Cost Sensors (LCS) for air quality monitoring were presented and discussed by experts from the academia, government, NGOs, and public-private sector representatives. The advantages highlighted include the small and lightweight nature of LCS, their ability to operate without a power supply (using solar power), and their user-friendly interface, making them suitable for citizen science initiatives.

However, concerns were raised about the accuracy of the data produced by LCS, emphasizing the need for complementing traditional air quality monitoring with LCS data.

Speakers / Panelists on Low Cost Sensors (LCS)

- **Dr. Akie Yuba**, Researcher, Asia Center for Air Pollution (ACAP)
- **Prof. Kim Oanh**, Asia Institute of Technology (AIT)
- **Dr. Le Ngoc Cau**, Ministry of Natural Ressources and Environement (MONRE), Viet Nam
- **Ms. Dang Espita-Casanova**, Clean Air Asia
- **Ms. Karine Léger**, Airparif, France

Read the full speakers bio on EANET website

Maintenance and calibration issues were also mentioned, which could increase the overall cost of using low-cost sensors. Nevertheless, the panel expressed optimism that LCS technology would improve over time and could be calibrated easily with the help of AI.

With the goal to strengthen monitoring capacities of PM2.5 and Surface Ozone in Asia, the EANET launched in 2023, as part of its Project Fund Activities, the Hybrid Air Quality Monitoring Network (HAQMN) project to consider how to wisely select and use reliable LCS to be integrated with reference-level equipment for enhanced air quality monitoring. By the end of the project, guidelines will be developed to help government officials replicate this integration in their own country.

In Viet Nam, as part of the HAQMN project led by EANET, the Asia Center for Air Pollution (ACAP), and in collaboration with the Asian Development Bank (ADB), the 3-year project will expand the coverage of the monitoring network by integrating LCS to the existing network, develop guidelines and policies and share reliable data. A mobile application combining air pollution and weather data will also be developed. Over the duration of the project, until December 2024, five LCS are planned to be deployed in the city of Hao Binh, 76 Km from Hanoi, and five in Hanoi.

In the Philippines, Clean Air Asia led two projects in coordination with the Environment Management Bureau of the Philippines to deploy LCS in Manila City and Quezon City, using LCS co-located with conventional sensors. The goal of these projects is to cover areas where there are coverage gaps, including residential and vulnerable areas (such as schools and hospitals).

In Quezon City, the City Government supported the deployment of 40 sensors to fill this gap. In the case of the Manila pilot project, a sensor-specific correction factor, developed in close relation with the academia, was used to adjust the data from the LCS to be more comparable with conventional air quality monitoring results. Key takeaways from this experience were to focus first on the quality of the data, over the quantity of data sets. LCS need to be locally calibrated, integrated and collocated with conventional sensors, and require resource allocation, operation and maintenance, performance monitoring, and QA/QC.

In France, Airparif is working closely with the government and private sector to inform the public and the media on the quality of the air in the Paris region. In 2023, Airparif launched the 4th edition of its Airlab Microsensors challenge, in collaboration with the French Embassy in Thailand, and as part of the French-Thai Innovation Year. The goal of the challenge is to test LCS to provide guidance to users through independent tests led by a panel of international experts, with the objective to evaluate the performance of microsensors based on different pollutants, categories of use, and in different environments. So far, 59 LCS and 33 companies are part of the project.

During the question-and-answer session, the panel emphasized that LCS are not meant to replace traditional air quality monitoring but rather to enhance coverage and provide better information on air quality levels in a city. A rich dataset generated by LCS was seen as valuable for policymakers, if collocated with other traditional sensors.

Other topics discussed included the associated costs beyond the initial purchase, such as data storage and IT system. The price range of LCS was mentioned to generally be between $100 and $1000 per unit, with some studies highlighting a relationship between data quality and price. Data-as-a-service subscriptions were mentioned as a sustainable option to finance LCS deployments, with technology providers loaning sensor units and offering yearly subscriptions for data access, while maintenance would be the responsibility of the city or local authorities.

The panel emphasized the need to work on standards, calibration, and common metrics for LCS. While LCS can be suitable for identifying hotspots in cities or understanding illegal industrial releases, their use for regulatory purposes would require high-tech calibration and would no longer be considered low cost. In summary, the panel discussion recognized the advantages of LCS in terms of their portability and accessibility, and powerful awareness raising tools, while acknowledging the need to address data accuracy, calibration, and integration with existing monitoring networks to ensure their reliability for various purposes.

Discussion Highlights

- LCS technology has been remarkably developed in recent years and is now widely used for citizen science.

- LCS can help fill in coverage gaps in countries with a limited number of sensors.

- Concerns are raised about the accuracy of the data produced by LCS given the wide variety of sensors and prices.
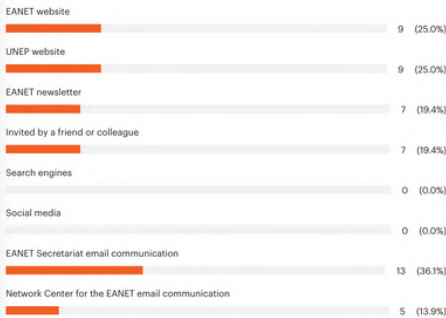
Key Recommendations

- Research needs to be conducted to develop guidelines, standards, and policies on the use of LCS.

- Research and knowledge sharing needs to be conducted on sensor-specific calibration, peer-reviewed correction factors, and QA/QC for reliable LCS data.

- Research and knowledge sharing is needed to develop guidelines on hybrid networks collocating LCS along existing monitoring networks to ensure the reliability of the data.

- Creating regional and international knowledge-sharing platforms for countries to share best practices on LCS was recommended.
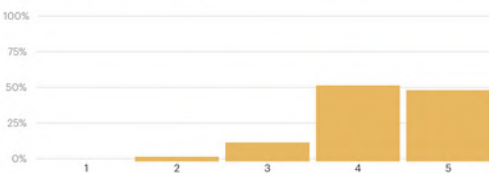
05 Survey Highlights

## "1- Is this the first EANET event you attend?"

- Yes — 14 (38.9%)
- No — 22 (61.1%)

"2- How did you find out about the EANET Awareness Workshop?"

- EANET website — 9 (25.0%)
- UNEP website — 9 (25.0%)
- EANET newsletter — 7 (19.4%)
- Invited by a friend or colleague — 7 (19.4%)
- Search engines — 0 (0.0%)
- Social media — 0 (0.0%)
- EANET Secretariat email communication — 13 (36.1%)
- Network Center for the EANET email communication — 5 (13.9%)

"3- Overall how satisfied were you with the EANET Awareness Workshop?"
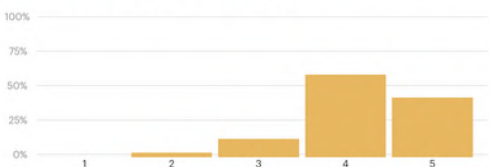
"4- How relevant did you find the content of the EANET Awareness Workshop to your work?"
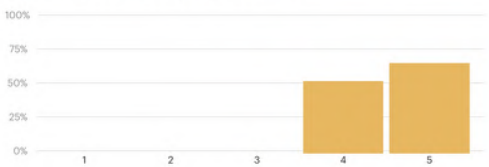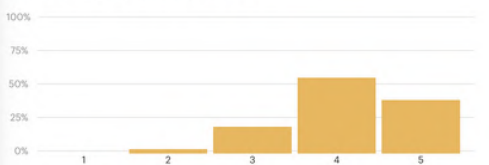
"5- How informative did you find the EANET Awareness Workshop?"
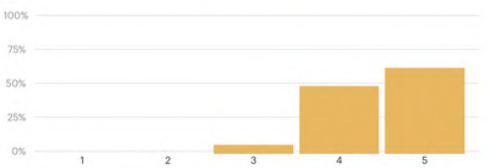
"6- Were you satisfied with the structure of the event, including lectures and panel discussions?"

"7- How satisfied were you with the opportunities for networking and sharing ideas?"

"8- Were there any technical issues that prevented you from seeing or hearing the EANET Awareness Workshop when joining online? If so, what were they?"

Unknown contact said:
"No"

Unknown contact said:
"I have a ploblem about the sound is not clear such like an echo."

Unknown contact said:
"-"

"9- Are there any topics you'd like to see covered in future EANET Awareness events?"

Unknown contact said:
"Methode calibration and validation data ambient air monitoring PM2.5 parameters"

Unknown contact said:
"I would like to cover many topics there but I extremely want to cover this topic like as sustainable development, air pollution at global threats, human health, plastic waste management, urban water pollution et, all. "

Unknown contact said:
"Low cost sensor PM2.5"

Unknown contact said:
"air pollution monitoring using satellite images."

Unknown contact said:
"PM, Ozone, and measures in combating air pollution"

Unknown contact said:
"Environmental issues in mega-cities, especially traffic emissions"

Unknown contact said:
"Integration and validation of the iOT devices data and the standardized monitoring data on air quality monitoring results "

Unknown contact said:
"The accuracy of Low cost sensor for air quality monitoring. "

Unknown contact said:
"surface ozone"

Unknown contact said:
"How to implement Low-cost sensor in a monitoring network with reliability and sustainability data?"

Unknown contact said:
"Indonesian air quality monitoring network system"

"10- Do you have any other comments or feedback?"

Unknown contact said:
"
"Thank you for a great workshop. Great presentation style with lots of opportunities to ask questions and talk about real life examples which all made for a really enjoyable and informative workshop." And best thing is can participate in vartual mode."

Unknown contact said:
"the workshop is very well and bring more understand about VOC, which I am caring about it. Thank a lot."

Unknown contact said:
"I look forward to be in touch with the EANET activities on line, which is an advantage of the contemporary people. Thanks in advance!"

Unknown contact said:
"I have glad to your whole team members how they informed me to this world wide workshop at online mode at without fee.
Thanks a lot for give a chance to participate in this workshop.
"

4.3
Average satisfaction rating on a scale of 5

4.6
Average relevance rating on a scale of 5

4.5
Average informative rating on a scale of 5

We thank you for your ongoing support

EANET

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Network in East Asia
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