Hub of Talents on Air Pollution and Climate

HTAPC Newsletter

Issue 12, January 2025

Highlights

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Accomplished Activities of Hub of Talents on Air Pollution and Climate (HTAPC)

Issue 12

Seminar on "Understanding the Health Impacts of $PM_{2.5}$ Pollution"

On January 8, 2025, the Hub of Talents on Air Pollution and Climate (HTAPC), under the National Research Council of Thailand (NRCT) and the Ministry of Higher Education, Science, Research, and Innovation (MHESI), organized a seminar titled **"Understanding the Health Impacts of PM_{25} Pollution."** The event was held at the Central Science, Research, and Innovation Information Center, 1st Floor, NRCT Building 8, with both in-person and online participation via Zoom Meeting and Facebook Live streaming. The seminar was honored by the presence of Dr. Wiparat De-Ong, Director of the National Research Council of Thailand (NRCT), who delivered the opening remarks and represented NRCT in highlighting the organization's commitment to supporting research and innovation funding in alignment with the country's key strategic plans. She also emphasized NRCT's ongoing dedication to addressing air pollution issues, particularly the persistent challenge of fine particulate matter (PM_{25}).

The seminar commenced with a session on **"The PM_{25} Pollution Situation in Thailand"**, presented by Dr. Supat Wangwongwatana, Director of HTAPC. He noted that, although PM_{25} levels have shown a declining trend at the national level over the past decades (1997–2023), Bangkok continues to experience critical pollution periods between January–May and November–December. This is primarily due to major pollution sources such as the increasing number of vehicles each year, combined with topographical and meteorological factors that contribute to the accumulation of particulate matter. Following this, the discussion transitioned to **"Health Impacts of PM_{25} Pollution"**, led by Assoc. Prof. Dr. Boonrat Tasaneeyatrivej from the Faculty of Medicine Siriraj Hospital. He highlighted that PM_{25} is a significant risk factor for cardiovascular diseases, chronic obstructive pulmonary disease (COPD), and respiratory disorders. The most vulnerable groups include young children, pregnant women, individuals with pre-existing conditions, outdoor workers, and the elderly. A particularly critical aspect of the discussion was the **impact on young children**. Asst. Prof. Dr. Ratchaneewan Sinitkul from the Faculty of Medicine Ramathibodi Hospital pointed out that children inhale a higher volume of air relative to their body weight compared to adults—approximately 333 ml/kg/min for young children while 100 ml/kg/min for adults. This increased exposure affects their development and respiratory system, potentially leading to asthma and cognitive developmental delays. Lastly, Ms. Naiyana Chaitiemwong from the Department of Health, Ministry of Public Health, discussed **"Mitigation Measures for Health Impacts of PM_{25} Pollution."** She emphasized the ministry's role in public education, pollution reduction initiatives, preventive health measures, and strengthening healthcare services to systematically manage air pollution-related health concerns. Additionally, participants shared their opinions and recommendations on wearing well-fitted face masks, avoiding outdoor activities when pollution levels exceed safety standards, and using air quality forecasts for proactive planning. These measures can help create a safer environment and promote public health, particularly for vulnerable groups.

Academic Consultation and Feedback Meeting on "Managing Meteorological Factors to Address $PM_{2.5}$ Pollution"

On January 16, 2025, the Hub of Talents on Air Pollution and Climate (HTAPC), under the National Research Council of Thailand (NRCT), Ministry of Higher Education, Science, Research, and Innovation (MHESI), organized a consultative meeting on the topic of **"Managing Meteorological Factors to Address the PM_{25} Pollution Problem."** The meeting was held at the Prof. Sanya Dharmasakti Conference Room, Building 2, 2nd Floor, NRCT Headquarters, and was also attended by participants online via Zoom Meeting.

The meeting was presided over by Dr. Supat Wangwongwatana, Director of HTAPC, who delivered the opening remarks. He outlined the center's objectives, which focus on advancing knowledge in air pollution and climate, training personnel, and conducting related research. Additionally, he introduced the establishment of five specialized academic groups, namely: Emission Sources and Control, Impacts of Air Pollution, Meteorology and Air Pollution Dispersion, Wildfires and Open Burning, and Air Pollution Management. The main discussion of the meeting centered on meteorology and the dispersion of air pollutants, with contributions from experts from the Department of Royal Rainmaking and Agricultural Aviation, academic institutions, and air pollution researchers. The participants deliberated on strategies for managing meteorological factors to mitigate the PM_{25} issue within the framework of the Department of Royal Rainmaking and Agricultural Aviation mission. Furthermore, the meeting emphasized the integration of interdisciplinary knowledge and research collaboration among agencies to achieve tangible results in addressing PM_{25} pollution while enhancing the operational efficiency of the Department of Royal Rainmaking and Agricultural Aviation in tackling this critical environmental challenge.

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NRCT Talk: "Where Does Dust Come From? Science, Research, and Innovation Have the Answers"

On January 22, 2025, the Hub of Talents on Air Pollution and Climate (HTAPC), under the National Research Council of Thailand (NRCT), Ministry of Higher Education, Science, Research, and Innovation (MHESI), organized an NRCT Talk on the topic **"Where Does Dust Come From? Science, Research, and Innovation Have the Answers"** at the Central Science, Research, and Innovation Information Center, 1st Floor, NRCT Building 8. The event was also accessible online via Zoom Meeting and broadcasted live on Facebook Live.

The session was inaugurated by Dr. Wiparat De-Ong, Director of NRCT, who emphasized the critical importance of addressing PM2.5 pollution, given its adverse effects on public health. She highlighted NRCT's continued support for research and technological advancements in air pollution surveillance. Following this, Dr. Supat Wangwongwatana, Director of HTAPC, provided insights into key factors affecting air quality, namely pollutant emissions from various sources and meteorological conditions, which are interrelated and must be considered collectively. He also discussed geographical and air shade, such as mountain ridges and basin-like terrains, which influence the accumulation of particulate matter. Additionally, he introduced the HYSPIT Model, which tracks air mass movement retrospectively and analyzes it in conjunction with hotspot data from both domestic and international sources. Mr. Charoon Laohalertchai, researcher and former director of the Northern Meteorological Center, further elaborated on critical meteorological factors, including wind speed and direction, atmospheric stability, ventilation layers, and topography—elements that are inherently uncontrollable.

The discussion also proposed air pollution mitigation strategies, emphasizing the need to address emission sources as a primary approach, given that meteorological factors are uncontrollable. Key recommended measures included: Adjusting fuel quality standards to reduce pollutant emissions, Alleviating traffic congestion to minimize vehicle-induced air pollution, Establishing Low Emission Zones (LEZ) to regulate pollutant emissions in specific areas, Promoting electric-powered public transportation to reduce reliance on fossil fuels, Utilizing agricultural waste for alternative purposes to prevent open burning. This event played a crucial role in raising public awareness and served as a vital platform for the exchange of scientific knowledge and technological solutions, fostering sustainable $PM_{2.5}$ pollution management.

Training on Air Pollution Management for Bangkok (Session 2) Title: "Air Pollution and Air Quality Management"

On January 23, 2025, the Hub of Talents on Air Pollution and Climate (HTAPC), under the National Research Council of Thailand (NRCT), Ministry of Higher Education, Science, Research, and Innovation (MHESI), organized the second training session on air pollution management in Bangkok under the theme **"Air Pollution and Air Quality Management"** at the Kensington Ballroom, 5th Floor, The Berkeley Hotel, Pratunam.

This training aimed to enhance the knowledge and skills of Bangkok personnel, enabling them to manage air quality effectively and utilize data to support the development of appropriate policies. The session began with the topic **"Where Does Dust Come From?"**, followed by an analysis and assessment of the current $PM_{2.5}$ situation in Bangkok. It then covered **the draft Clean Air Act**, emphasizing the importance of legislation in controlling pollution sources. The training also **addressed transboundary haze pollution and the reduction of agricultural burning**, discussing the causes of transboundary haze and strategies for its prevention.

Additionally, participants were introduced to **$PM_{2.5}$ measurement using low-cost sensors, including guidance on sensor usage**, data calibration techniques, and limitations of their application. Another key topic covered Bangkok's $PM_{2.5}$ reduction measures and strategies to mitigate emissions from the transportation sector. **Practical approaches for $PM_{2.5}$ management** were presented, along with policy recommendations for 2025, including year-round measures and emergency measures during peak pollution periods. The final session focused **on the analysis and assessment of Bangkok's current $PM_{2.5}$ situation**, incorporating the application of air quality data, meteorology, mixing layer height, hotspot data, and the HYSPLIT model to track air mass trajectories and $PM_{2.5}$ dispersion. These applications were demonstrated using real-world scenarios to support monitoring, surveillance, and preventive measures to protect public health.

Concentration of $PM_{2.5}$ Trapped in the Atmosphere in Bangkok Metropolitan Region During 2-31 December 2024

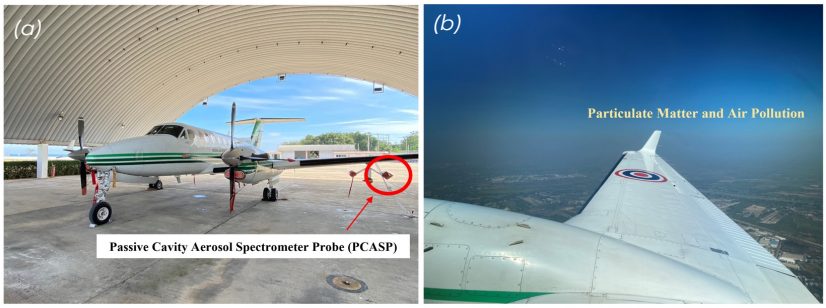

Figure 1 (a) Super King Air 350 aircraft used for measuring the size and concentration of dust particles and the particle sensor measuring about 0.1-3 micrometers. (b) The distribution characteristics of dust particles in the Bangkok and surrounding areas on December 21, 2024, at 11:00 A.M.

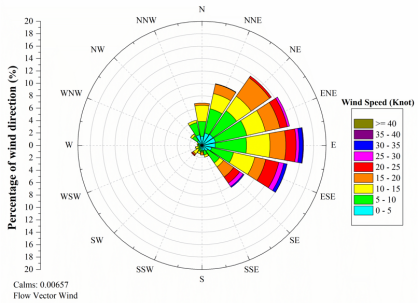

Figure 2 Wind speed and wind direction at ground level up to 10,000 feet, Bangkok, by SKA aircraft, December 2024

From the measurement by the Super King Air 350 aircraft on December 2-31, 2024, as shown in Figure 1, when considering the wind speed and wind direction at the ground level to 10,000 feet around Bangkok, it was found that the wind direction was mostly northeast, east, and southeast, with the wind direction mostly in the range of 30-120 degrees, along with the wind speed mostly at 5-15 knots (green and yellow), with the wind speed of 5-10 knots accounting for 25 percent and the wind speed of 10-15 knots for 19 percent, respectively (Figure 2). This shows that in December, Thailand was influenced by the northeast monsoon, which brought cold and dry air masses from China to Thailand.

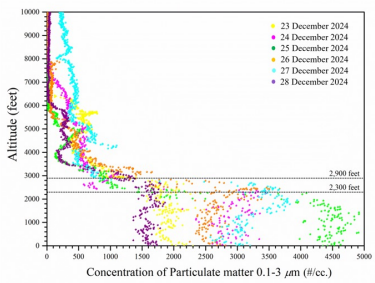

Figure 3 Examples of concentration and distribution of particles of 0.1-2.5 microns at 0-10,000 feet of altitude in the Bangkok metropolitan region during 23-28 December 2024

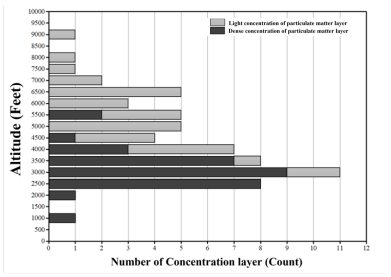

Figure 4 Block layer of dust particles with a size of 0.1-2.5 microns at a height of 0-10,000 feet in the Bangkok and surrounding areas, 2-31 December 2024

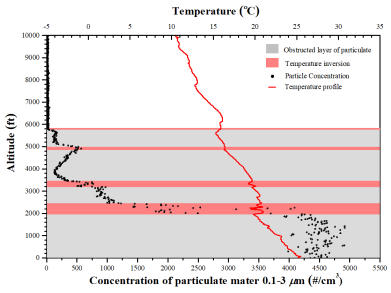

Figure 5 The dust concentration and temperature at various altitudes in the Bangkok region, based on observations obtained by the SKA aircraft on December 25, 2024, between 11:00 and 11:18 a.m.

Figure 3 shows the concentration and distribution of $PM_{2.5}$ particles in the Bangkok Metropolitan Region (BMR) . It was found that the heights where $PM_{2.5}$ was trapped were 2,300 feet and 2,900 feet, respectively, which trapped $PM_{2.5}$ that affects health in the BMA, with a concentration of 1,500-5,000 #/cc. It was found that on December 25, 2024, this highest concentration was 4,900 #/cc, and the lightest concentration was 1,500 #/cc on December 28, 2024. When considering the dust block layer in the atmosphere as shown in Figure 4, it was found that the number of times the dust block layer of 0.1-2.5-micron size occurred from December 2-31, 2024. The height of the dust block layer of $PM_{2.5}$ in the Bangkok metropolitan region was in the range of 1,000-9,000 feet (light gray, dark gray), with the majority found at 3,000 feet, 2,500 feet, and 3,500 feet, respectively. When considered together with the measured $PM_{2.5}$ concentrations, it was found that 3,000 feet was the height where the dust barrier layer occurred most frequently, with a dust barrier with a high concentration or dense dust particles (dark gray) occurring 9 times and a dust barrier with a low concentration or light dust particles (light gray) occurring 2 times. In conclusion, most of the $PM_{2.5}$ accumulated in the Bangkok and vicinity area was blocked at an altitude of 2,500-3,500 feet, which is consistent with the $PM_{2.5}$ dust concentration values at the surface station.

Figure 5 shows the relationship between the height of the atmosphere and the concentration of 0.1-3-micron particulate matter and the temperature at different altitudes from the ground level to 10,000 feet. The dust particles disseminated throughout the Bangkok Metropolitan Area (BMA), measuring 0.1-3 microns in diameter, were observed at altitudes ranging from 0 to 5,800 feet (gray), exhibiting high concentrations from ground level up to 2,400 feet, with an average concentration of 4,500 (#/cm^3) (December 25, 2024). When studying the temperature profile (red line) that generally decreases with elevation, it was determined that temperature inversion layers appeared at many altitudes: 2,000-2,400, 3,200-3,500, 4,800-5,000, 5,800-5,900, and 8,000 feet. Nevertheless, the layer of temperature inversion that prevents particulate matter less than 3 micrometers in diameter clearly shows that the BMA will be between 2,000 and 2,400 feet above land surface level. It is evident that the temperature inversion that takes place at various elevations is correlated with the concentration of dust particles trapped in the atmosphere.

Department of Royal Rainmaking and Agricultural Aviation

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We cordially invite you to join us

Hub of Talents on Air Pollution and Climate

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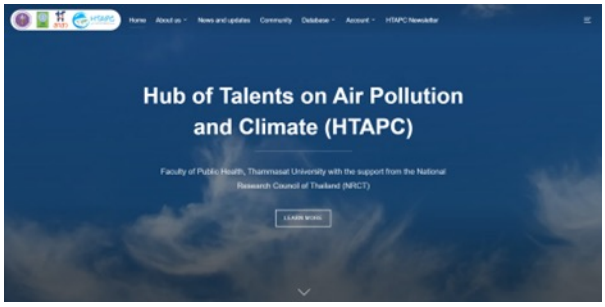

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Monthly Newsletter

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