

The Role of **CMU** CHIANG MAI UNIVERSITY

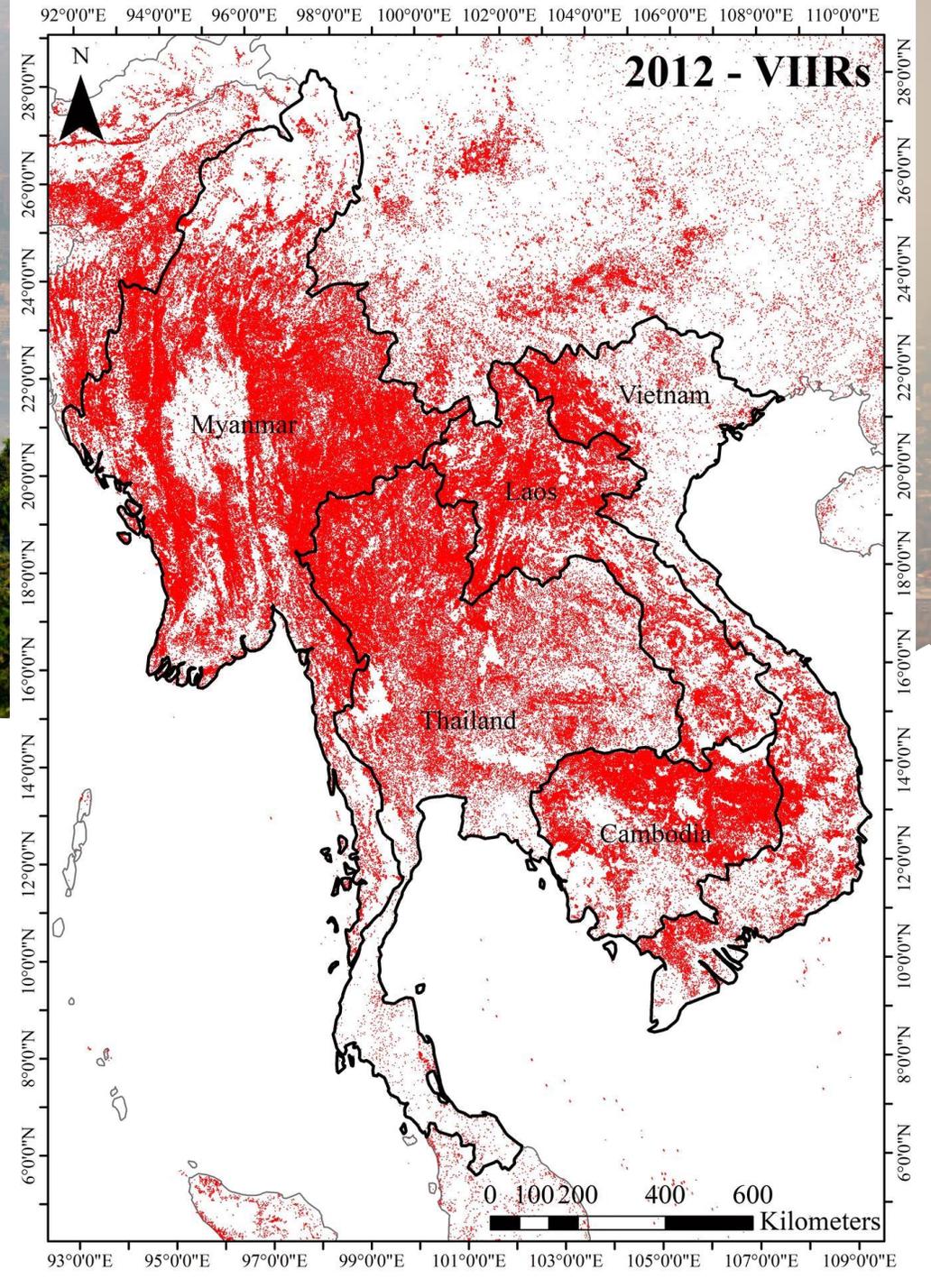
in Supporting Air Pollution Management through Research and Innovation

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Academic Center for Air Pollution in Northern Thailand ,
Environmental Science Research Center Faculty of Science, Chiang Mai University



CHIANG MAI VIEW



SKY OVER CHIANG MAI CITY, PM2.5 CONCENTRATION, AND SAMPLES OF FINE PARTICULATE MATTER

1 FEB 2024



6 MAR 2024



7 MAR 2024



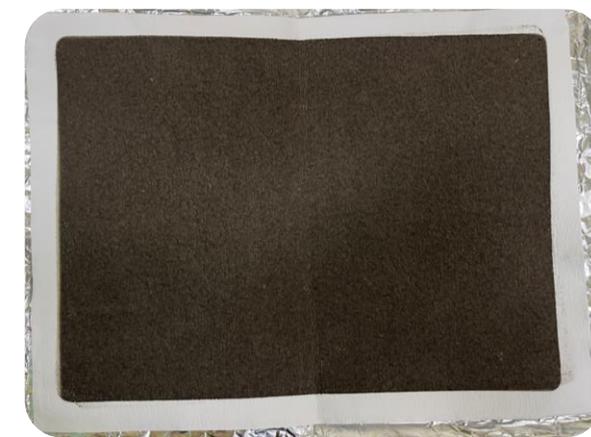
15 $\mu\text{g}/\text{m}^3$



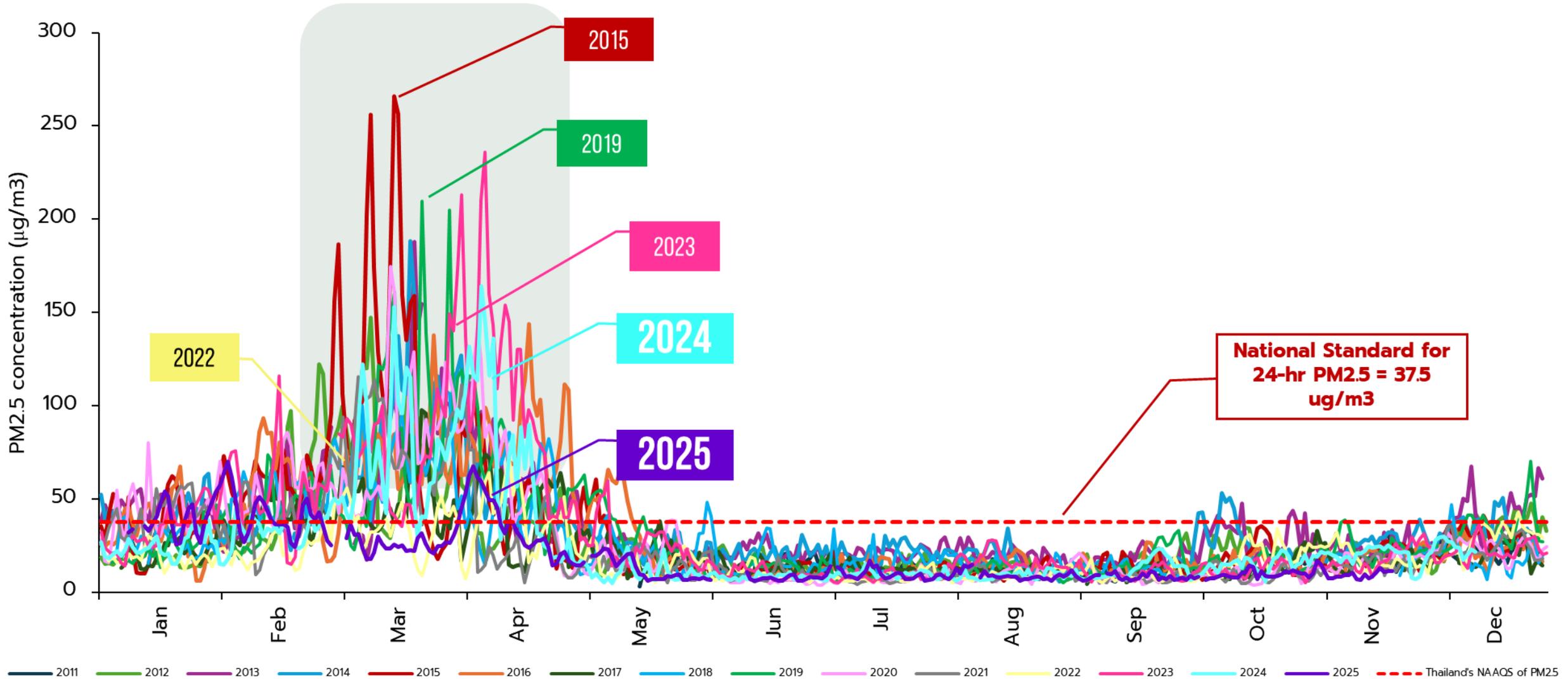
94 $\mu\text{g}/\text{m}^3$



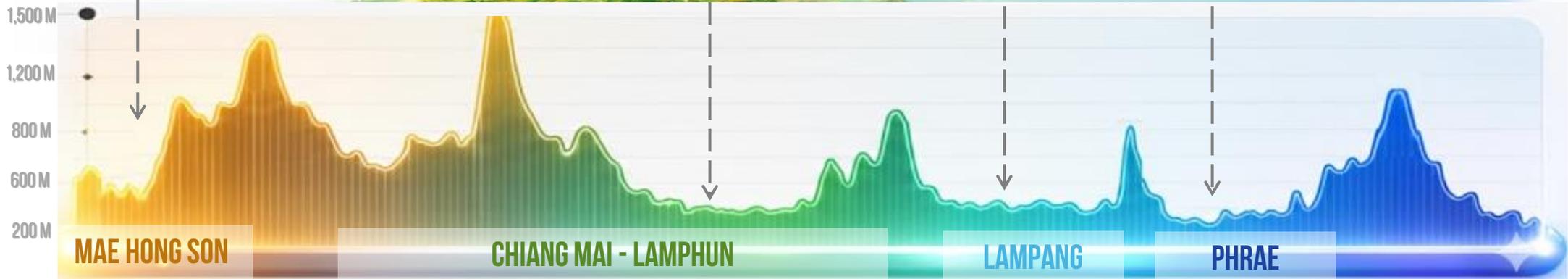
122 $\mu\text{g}/\text{m}^3$



DAILY PM_{2.5} CONCENTRATIONS IN CHIANG MAI CITY (2011 – 2025)



Source : Pollution Control Department (PCD) at Chiang Mai 36t station



ORIGIN OF PM_{2.5} IN CHIANG MAI CITY

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Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv





Chemical composition and origins of PM_{2.5} in Chiang Mai (Thailand) by integrated source apportionment and potential source areas

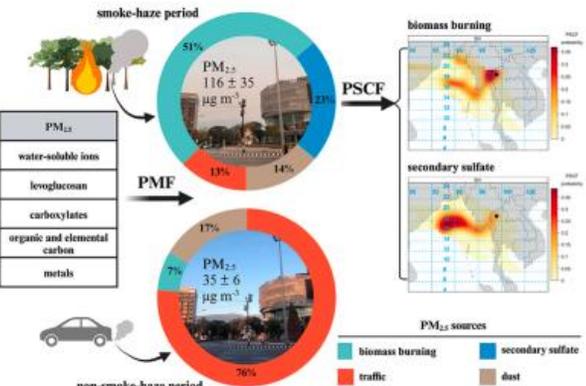
Sarana Chansuebsri^a, Petr Kolar^d, Pavidarin Kraisitnitikul^a, Natthanit Kantarawilawan^a, Nuttipon Yabueng^{a,b}, Wan Wiriya^{a,b}, Duangduean Thepnuan^c, Somporn Chantara^{a,b,*}

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^c Department of Chemistry, Faculty of Science and Technology, Chiang Mai Rajabhat University, Chiang Mai, 50300, Thailand
^d Department of Earth and Environmental Sciences, The University of Manchester, Manchester, United Kingdom

HIGHLIGHTS

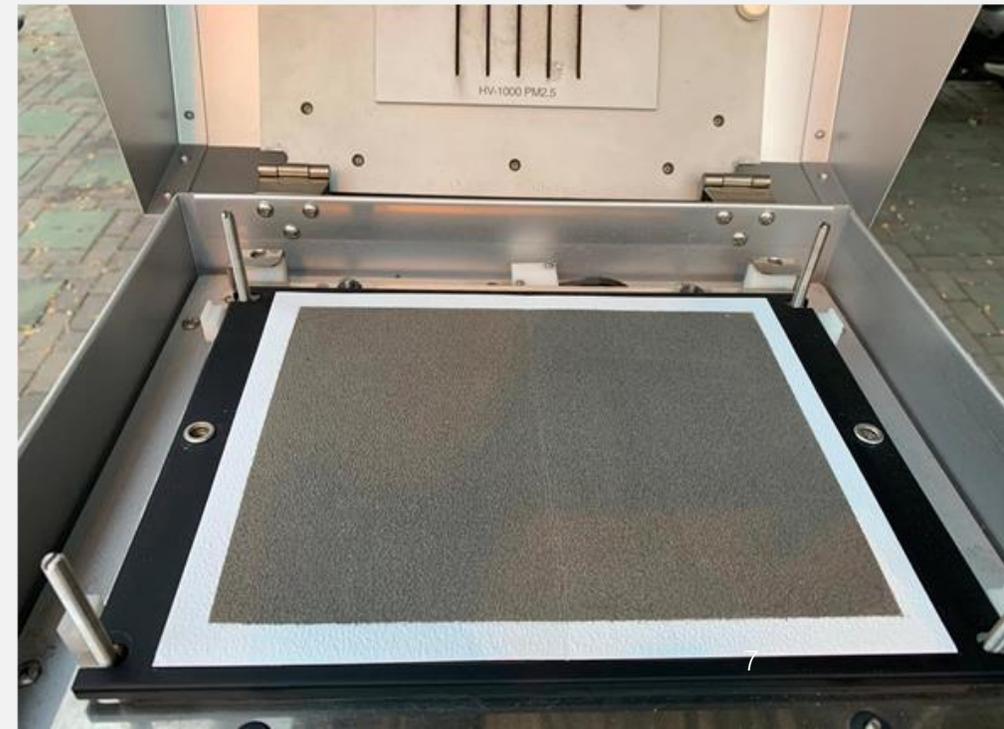
- Biomass burning contributed up to 51% of PM_{2.5} during the smoke-haze (SH) period.
- The main source area of biomass burning was along the Thai-Myanmar border.
- Up to 23% of transboundary pollution from India contributed during the SH period.
- Traffic emissions contributed to 76% of PM_{2.5} during the non-smoke-haze period.

GRAPHICAL ABSTRACT



The graphical abstract illustrates the source apportionment of PM_{2.5} in Chiang Mai. It features two donut charts: one for the smoke-haze period (PM_{2.5} 116 ± 35 µg m⁻³) and one for the non-smoke-haze period (PM_{2.5} 35 ± 6 µg m⁻³). The smoke-haze period chart shows biomass burning (51%), secondary sulfate (23%), traffic (14%), and dust (12%). The non-smoke-haze period chart shows traffic (76%), secondary sulfate (17%), and dust (7%). A table lists PM_{2.5} components: water-soluble ions, levoglucosan, carboxylates, organic and elemental carbon, and metals. Two maps show potential source areas for biomass burning and secondary sulfate, with a color scale for PM_{2.5} concentration. A legend identifies the sources: biomass burning (green), secondary sulfate (blue), traffic (red), and dust (brown).

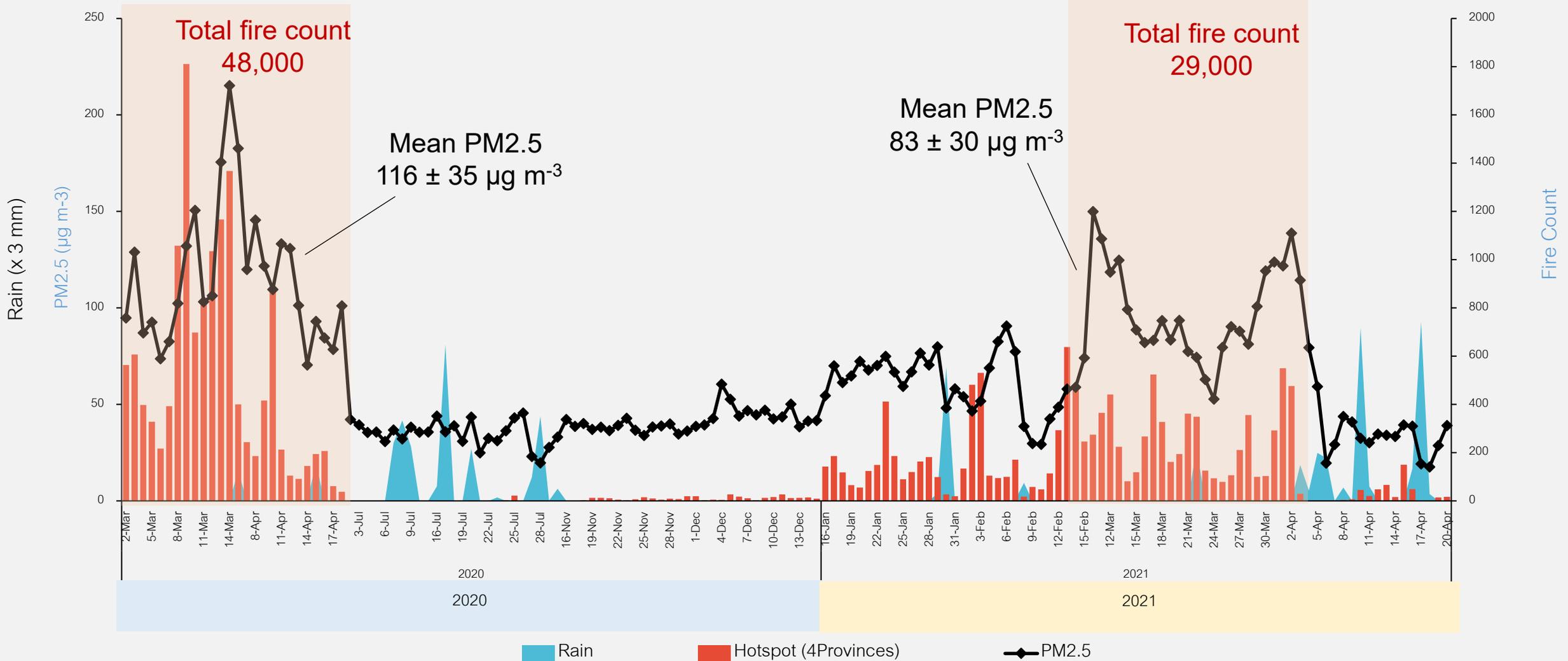
ANALYSIS OF PM_{2.5} SOURCE PROFILE



Temporal Variation:
Chiang Mai City
(smoke haze and
non-smoke haze
periods 2020)

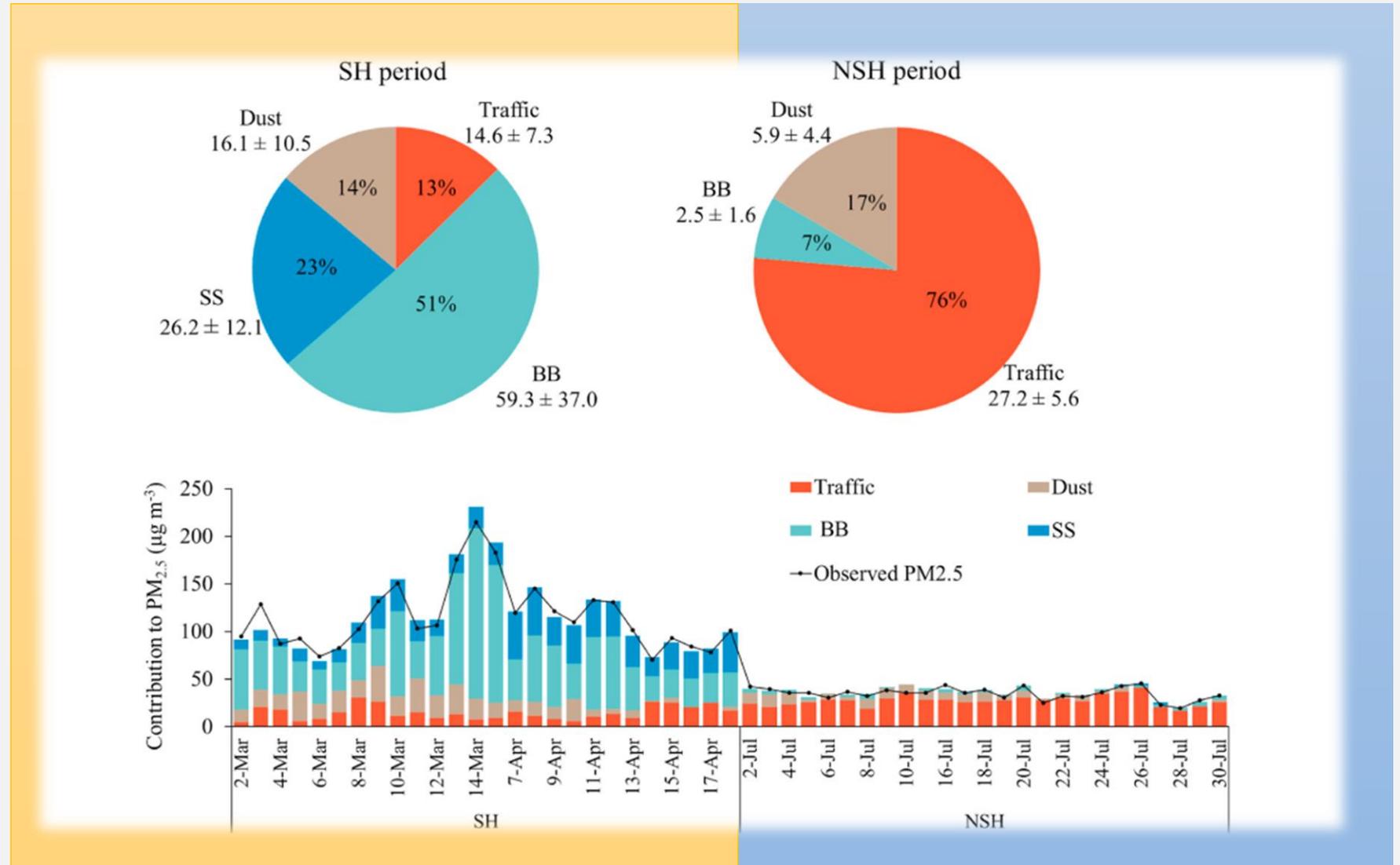
OVERALL SITUATION

PM_{2.5}, FIRE COUNTS AND RAIN AMOUNT (MM)

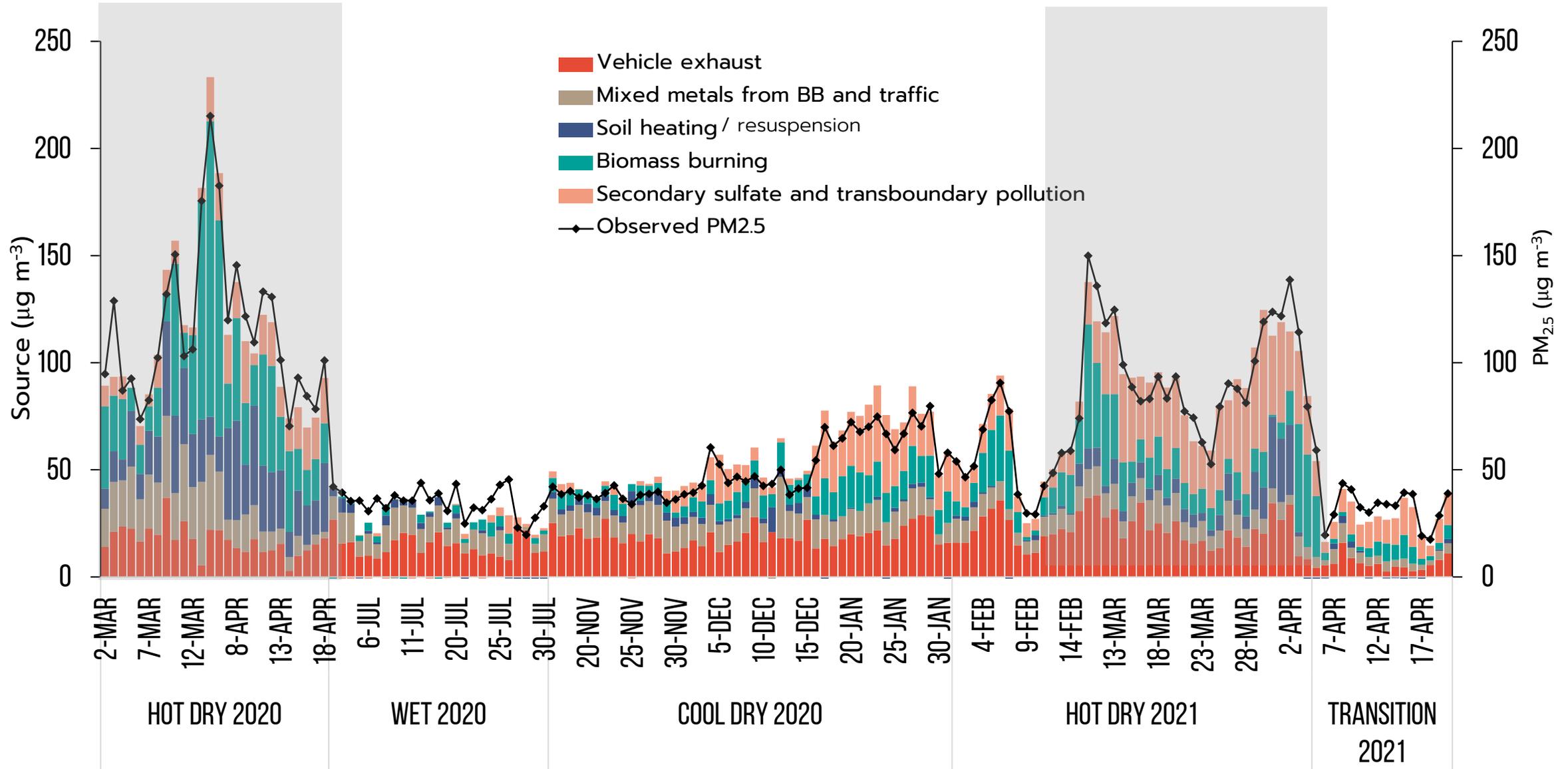


- A dataset of 51 samples with 23 species from 2020 was the input for positive matrix factorization (PMF).

- BB (Biomass Burning)
- SS (Secondary Sulphate)
- Dust
- Traffic



TIME SERIES OF THE SOURCE CONTRIBUTION



PSCF FOR THE PMF-RESOLVED SOURCES

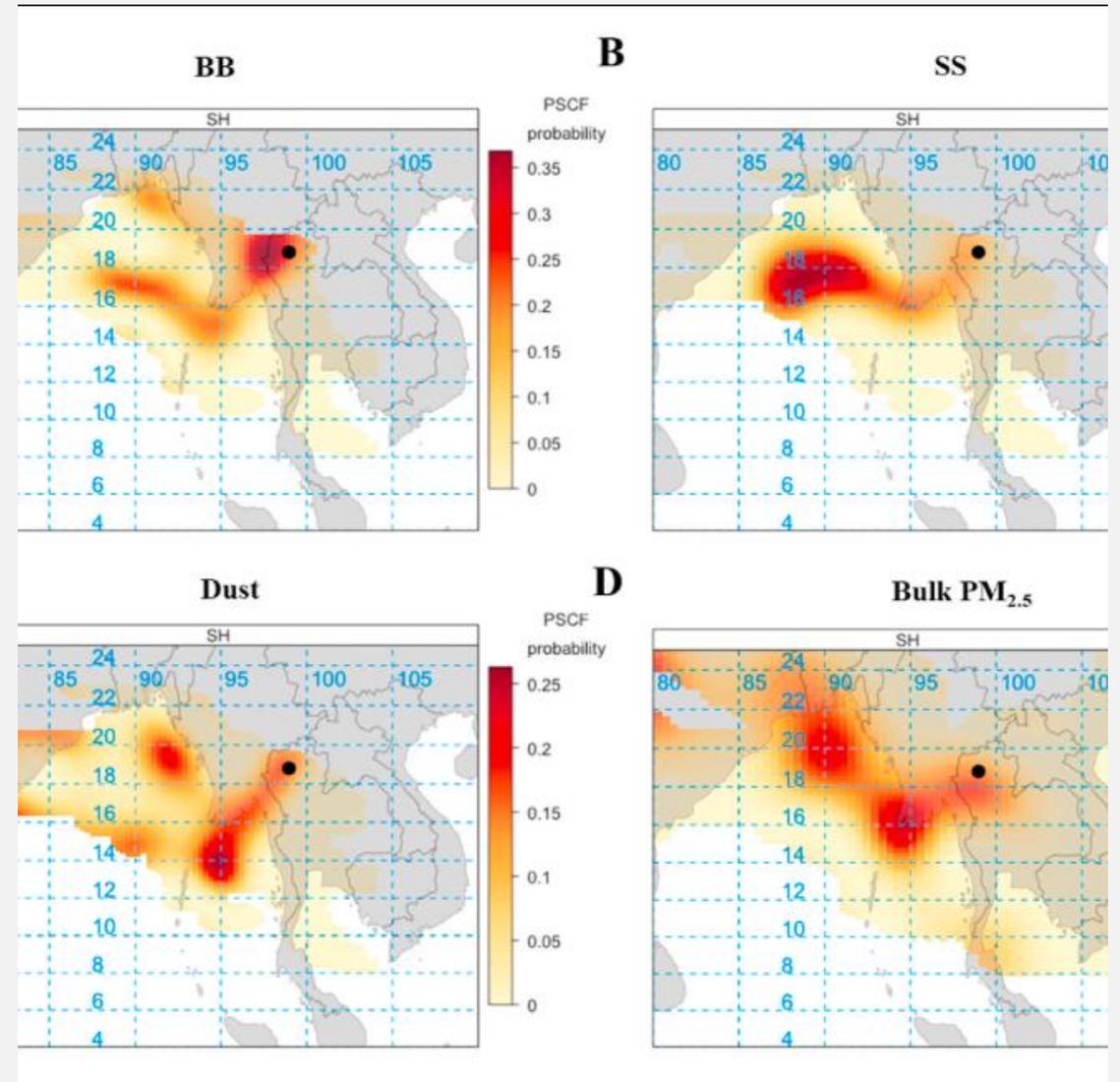
The duration of BWTs was 120 hours (5 days).
 The starting altitude was 500 m above ground level.

The most prominent potential source area of BB was along the Thailand-Myanmar border.

The origin of SS (or its precursors) was in Indian continent.

PM_{2.5} might have both a short-range source in Thailand and a long-range source.

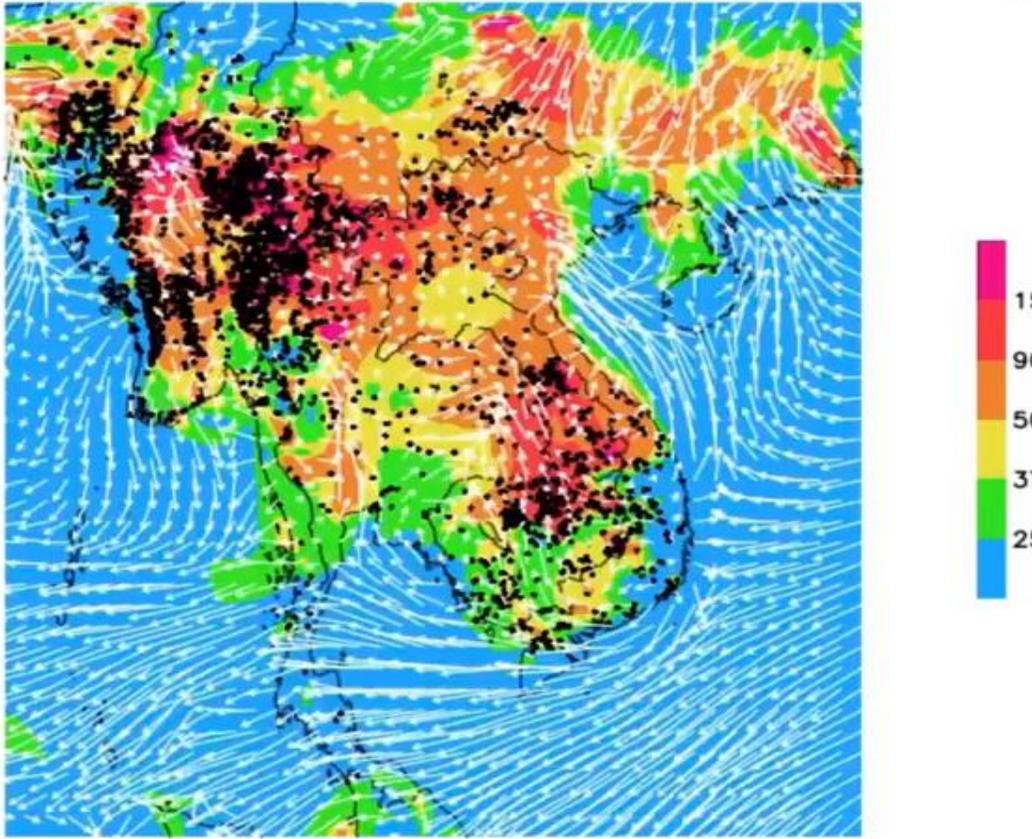
Potential source contribution function (PSCF)





SOURCE REDUCTION / MANAGEMENT

PM2.5 (ug/m3) Concentration [2021030601]



FIRE MANAGEMENT SYSTEM FOR BIOMASS BURNING



PLATFORM

- 1 **เว็บไซต์พลิเคชัน**
- 2 **โมบายแอปพลิเคชัน**
- 3 **LINE OFFICIAL ACCOUNT**





SOURCE-CONTROL SCENARIOS FOR MANAGEMENT OF AIR POLLUTION IN CHIANG MAI PROVINCE



SCENARIOS FOR PM2.5 MANAGEMENT

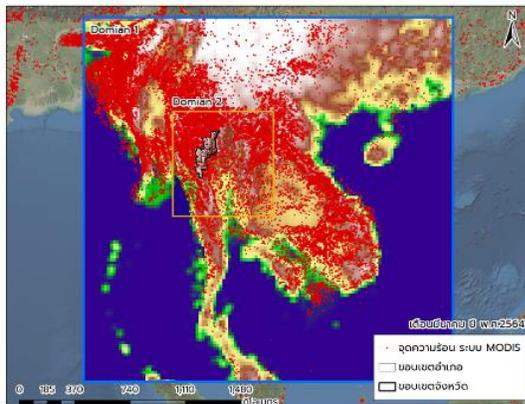
Model : WRF-Chem
Period : 1 January-30 April 2019
Scenario : 0 % / 50 % / 100%

SCENARIO

01



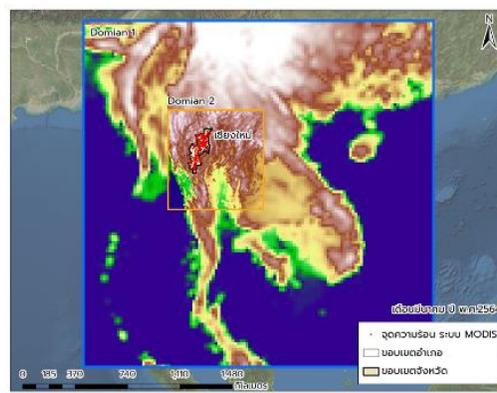
TRANSBOUNDARY



02



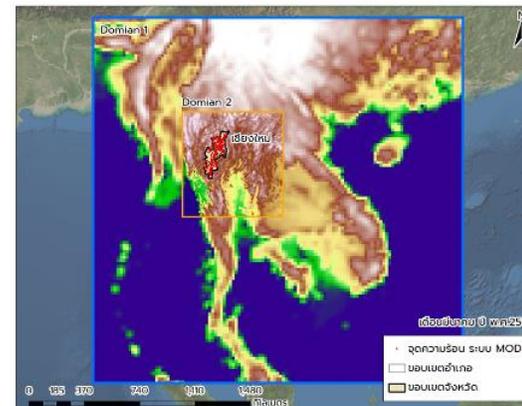
AGRICULTURE



03



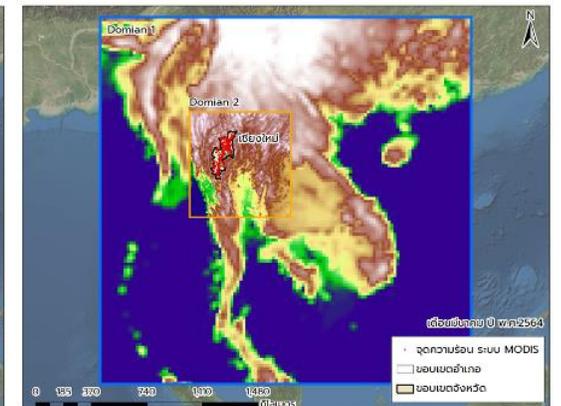
FOREST



04



TRANSPORT



RESULTS

POLICY SYNTHESIS

 SOURCE	MODEL 50% REDUCTION OF SOURCE EMISSION METHOD PM2.5 REDUCTION	 BRAINSTORMING
-------------------	--	--------------------------

TH-AiM : Thailand - Air Pollution Management
MISSIONS: 5T PRINCIPLES

KEY MANAGEMENT MEASURES

 TRANSBOUNDARY	50% fire hotspot reduction outside CM	30-40 % (13-33 $\mu\text{g}/\text{m}^3$)	Policy planning for upper SEA
 FOREST	50% fire hotspot reduction in forest area in CM	17-30 % (10-17 $\mu\text{g}/\text{m}^3$)	<ul style="list-style-type: none"> • Waste/ biomass management • Law enforcement
 AGRICULTURE	50% fire hotspot reduction in agricultural area in CM	12-27 % (10-12 $\mu\text{g}/\text{m}^3$)	
 TRANSPORT	50% emission reduction from transportation in CM	7-12 % (4-5 $\mu\text{g}/\text{m}^3$)	<ul style="list-style-type: none"> • Environmentally friendly public transportation

T1 **TRANSBOUNDARY BIOMASS MANAGEMENT**

- Create PM2.5 monitoring network
- Manage biomass residue
- Create Emission Inventory

T2 **TERRITORIAL FOREST ZONING**
Manage protected forest area based on data

- Reduce burning, identify repetitive burning areas
- Understanding the fire ecology of forests
- Fire prevention: firebreaks and buffer zones

T3 **TRANSFORMING AGRICULTURAL WASTE MANAGEMENT**

- Highland: Managing agricultural practices; Promoting Low-Fire Crop Types (coffee, tea, and cocoa, fruit trees), Agroforestry Systems,
- Lowland: Reduce burning/waste management
- Supporting businesses in integrated biomass management for energy, industrial processes, or other sustainable purposes.

T4 **TRANSPORTATION ECO-FRIENDLY**

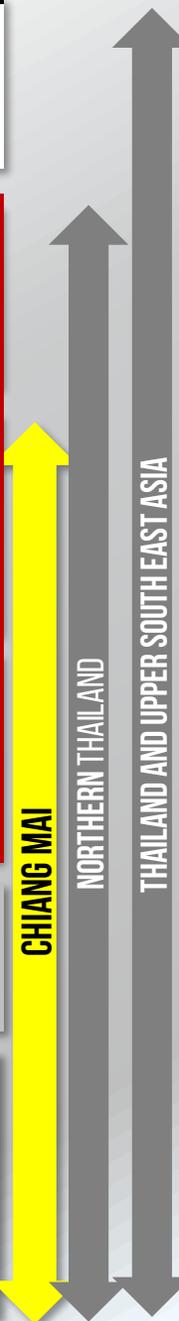
- Environmentally friendly public transportation

SUPPORTING FACTORS

- Related Air Pollution**
- Public awareness
 - Budget analysis
 - Database
 - Organization/ human resources

T5 **TRANSFORMATION OF GOVERNMENT AGENCIES**

- Developing governmental agencies for air pollution management: building a skilled workforce, ensuring adequate budget allocation, and establishing robust data management systems.





REDUCING FOREST BURNING IN NORTHERN THAILAND THROUGH INNOVATION AND PARTICIPATORY POLICIES FOR TARGETED PM2.5 MANAGEMENT

Assoc. Prof. Dr. Somporn Chantara

Environmental Science Research Center Faculty of Science, Chiang Mai University





Paisit Panichkul

Chiang Mai University
 Head of Project Group



Assoc. Prof. Dr. Aranya Siriphon
Chiang Mai University

Head of Project Group

FOREST FIRE REDUCTION



Reducing PM2.5 Pollution from the Forestry Sector and Ensuring Effective and Participatory Forest Fire Management

COMMUNITY BASED PROJECTS

1

Community database management to support community-based participatory fire management



Asst. Prof. Dr. Phonpat Hemwan



2

Utilizing Methodical Fuel-Management Tools for Strategic Forest Fire Prevention and PM2.5 Mitigation in Upper Northern Thailand



Dr. Prapatsorn Pansompong



3

Scaling up the development of Payment for Ecosystem Services (PES) to reduce Burned Area and PM2.5 Haze through Participation in Model Communities 5 provinces with high level of wildfire areas.



Sunit Shrestha



NATURAL-RESOURCES BASED PROJECT

4

Community-Integrated Forest Restoration for Sustainable Livelihoods and Ecosystems



Asst. Prof. Dr. DIA PANITNARD SHANNON



BIG DATA INTEGRATION

1

Utilization of Big data to support operations for single command decision-making planning to solve PM2.5 (Phase 2)



Assoc. Prof. Dr. Rattasit Sukhahuta



2

Satellite fire-hotspot reporting combined with team tracking to improve fire-control efficiency using the Fireman platform



Asst. Prof. Dr. Phonpat Hemwan



1

Proactive Joint Network Plan' for enhancing the efficiency of PM 2.5 pollution management in Chiang Mai, Mae Hong Son, Lamphun, and Lampang Provinces



Asst. Prof. Dr. Phaothai Sin-ampol



2

Formulating Rules and Mechanisms for Efficient Fire Management to Reduce Fire Usage in Forest Fire Control Areas



Paisit Panichkul



3

Community-Engaged Water Management for Sustainable Fire Hotspot Reduction in Forest Areas



Asst. Prof. Dr. CHITCHOL PHALARAKSH

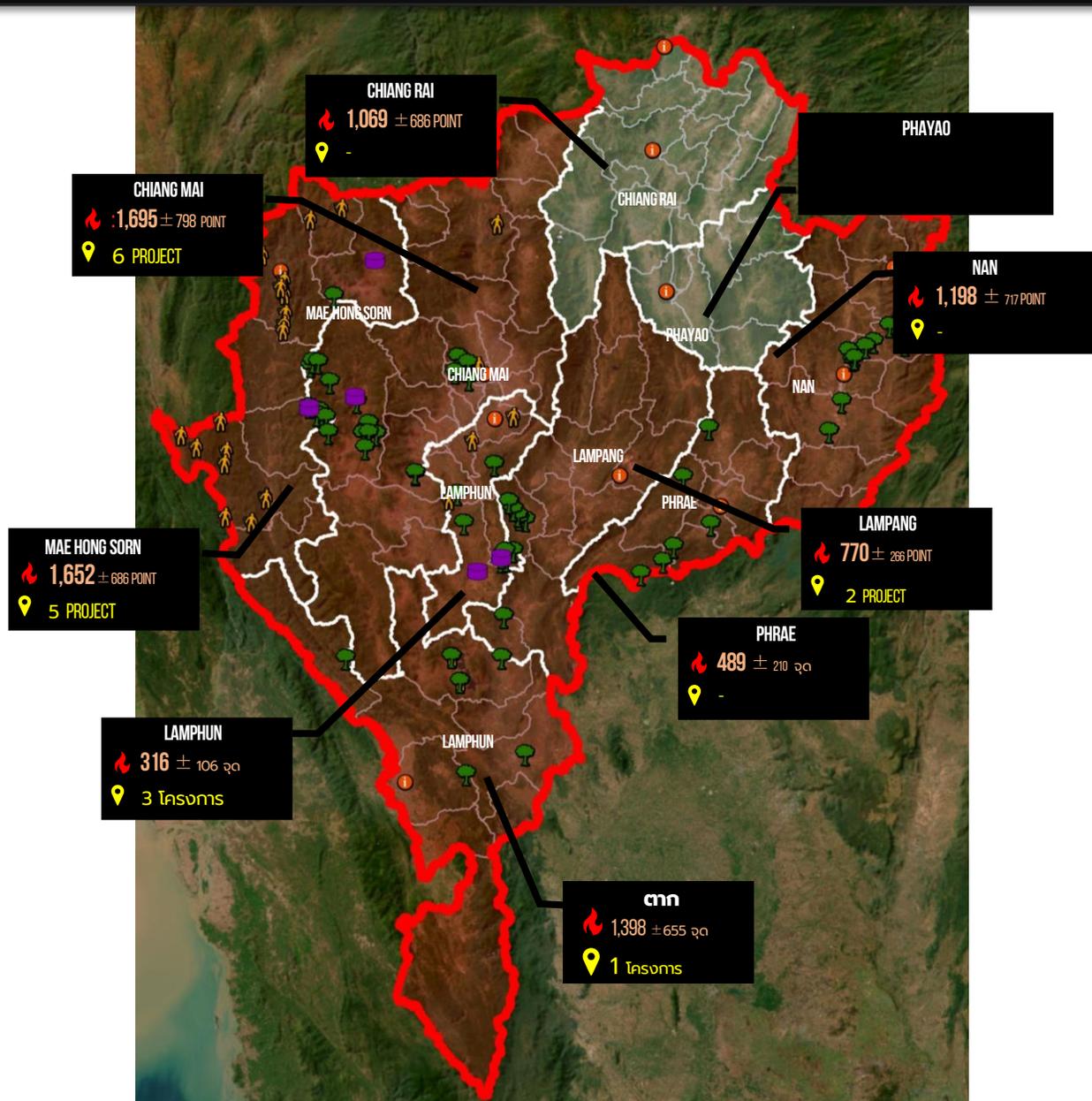


POLICY AND PROACTIVE COMMUNICATION



Enhancing Efficiency, Innovation, and Proactive Communication in Provincial Policy Plans to Manage PM2.5 in Upper Northern Thailand: Mae Hong Son, Lampang, Chiang Mai, and Lamphun

Overview of Progress and Average Hotspot Data (MODIS) in the Implementation Areas



DATA-BASED IMPLEMENTATION AREA

9 Northern Provinces (Upper North Region)
Chiang Mai, Chiang Rai, Lamphun, Lampang, Mae Hong Son, Phayao, Phrae, Nan and Tak



Data Analysis

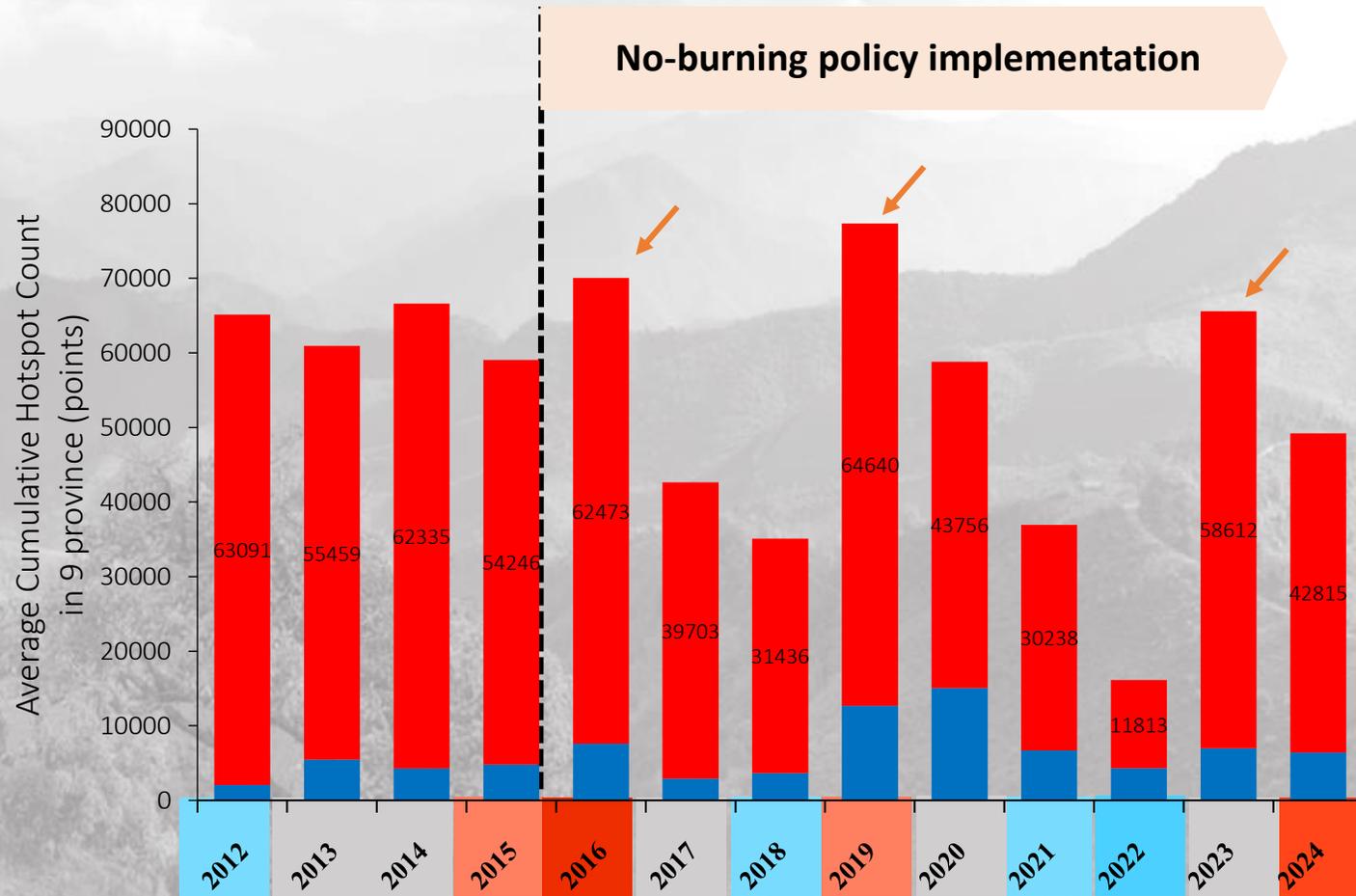


FIELD-BASED IMPLEMENTATION AREA

- Field Implementation – 4 Western Northern Provinces: Mae Hong Son, Chiang Mai, Lampang, and Lamphun
- Tak Province
- Field Activity – Forest Fire Reduction
- Field Activity – Big Data Integration
- Field Activity – Policy and Proactive Communication



VIIRS



No-burning policy implementation

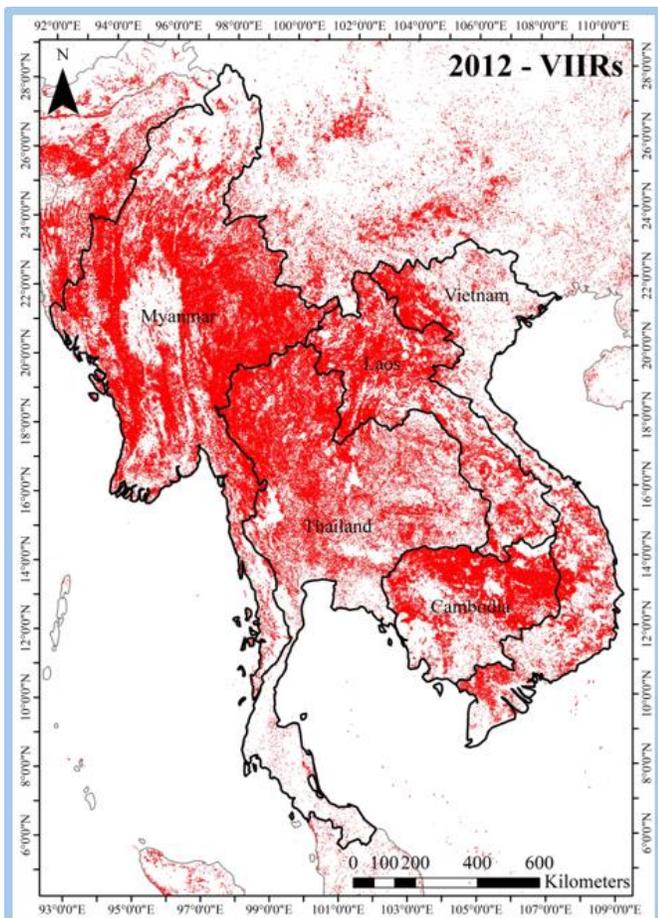
9 provinces in NT

Fire hotspot count varies each year, influenced by key factors such as burning control measures and climate patterns.

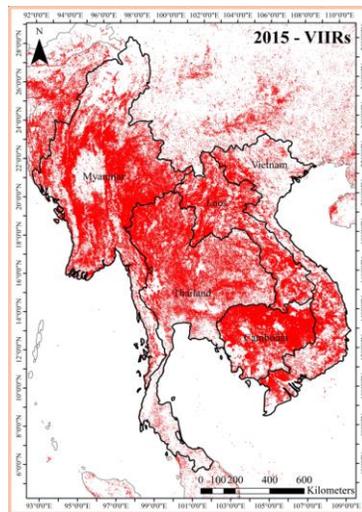
Neutral La Niña El Niño

 Non-Smoke Haze Period (May - Jan)
 Smoke Haze Period (Feb - Apr)

Baseline: Fire Hotspots (Mean \pm SD)

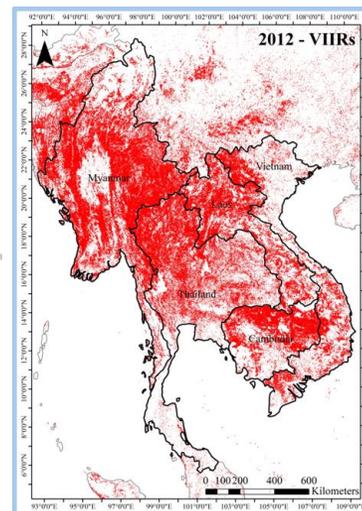


Thailand : 163,193 \pm 55,365
Upper Northern Thailand: 66,403 \pm 23,120
 14 year average (2012 -2015)



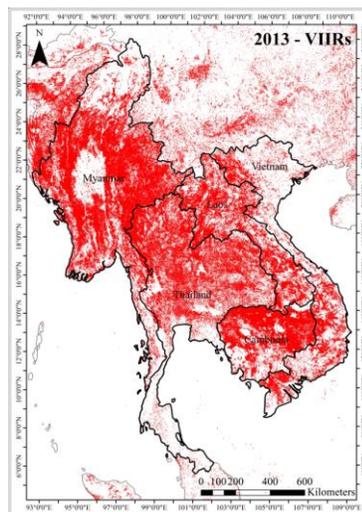
El Niño
(2015, 2016, 2018, 2023)

UNT: 71,367 \pm 20,509



La Niña
(2012, 2020, 2021, 2022)

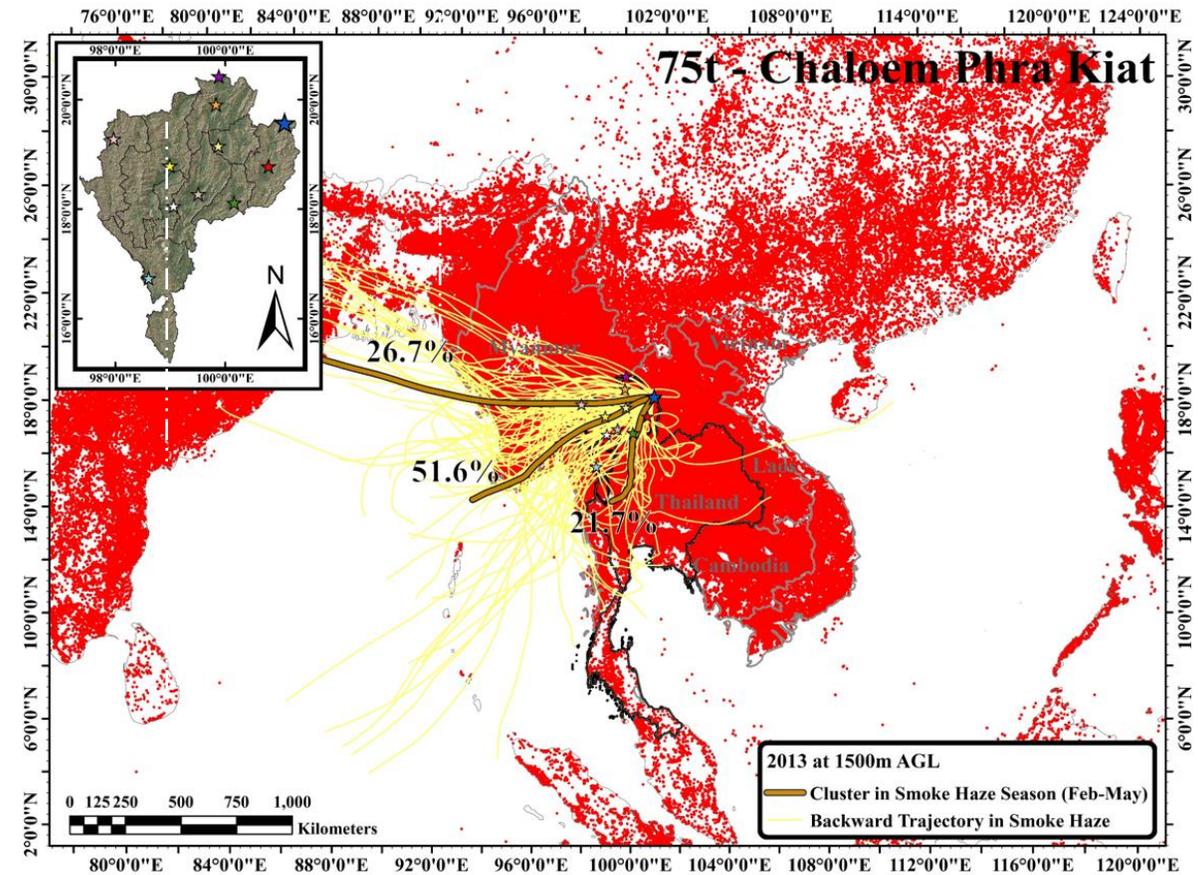
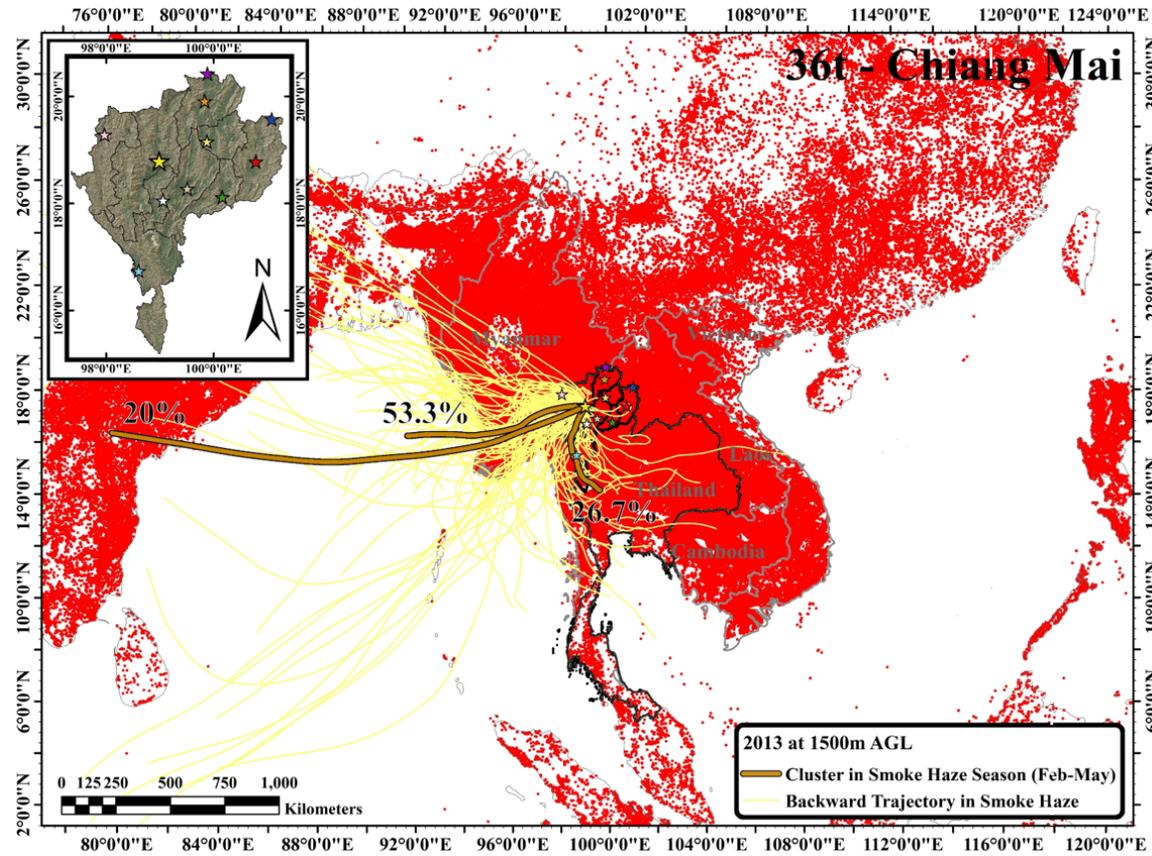
58,981 \pm 33,315



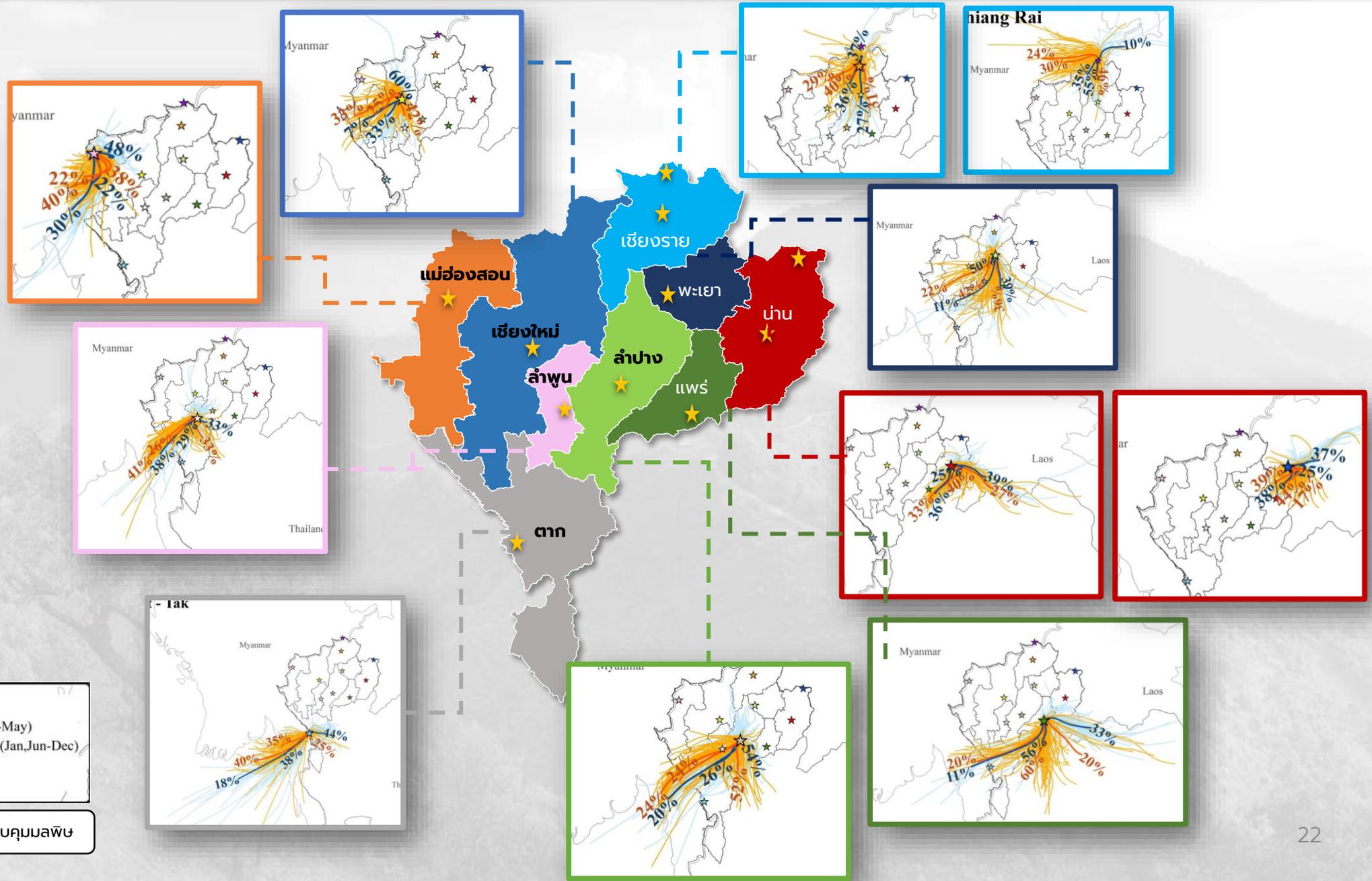
Neutral
(2013, 2014, 2017, 2019, 2024, 2025)

68,041 \pm 20,111

24-hr BWT arriving at 1500 m above ground



Air Mass Trajectories arriving at each air quality monitoring station in 9 provinces in 2024



24h-BWT at 10m AGL

- Cluster in Smoke Haze Season (Feb-May)
- Cluster in Non-Smoke Haze Season (Jan, Jun-Dec)
- Smoke Haze Season
- Non-Smoke Haze Season

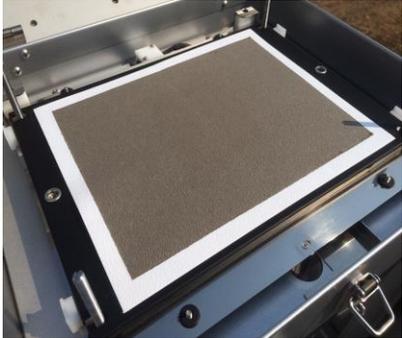
★ สถานีตรวจวัดค่าฝุ่นของกรมควบคุมมลพิษ

A photograph of a monitoring station on a rooftop at night. The station is a dark metal structure with a glass-enclosed upper level containing various sensors and a camera. The background shows a dark sky with some light trails and a mountain range. The overall color scheme is dark blue and black.

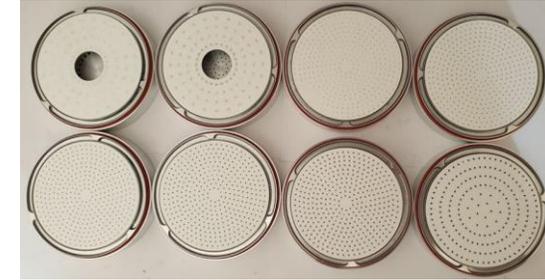
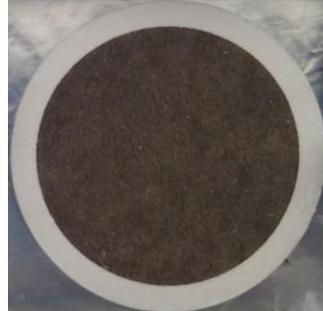
CMU-AQ MONITORING STATION

CMU  **ESRC**
CHIANG MAI UNIVERSITY FACULTY OF SCIENCE Environmental Science Research Center
Chiang Mai University

Sampling Equipment for ambient PM_{2.5} and submicron PM



Low volume air sampler (PQ 200)



Cascade impactor

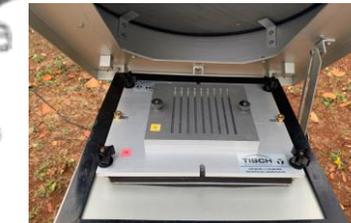
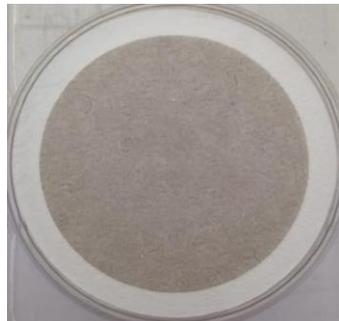
**Analysis of aerosol chemical composition
 (PAHs, Water Soluble Ions, Metals)**



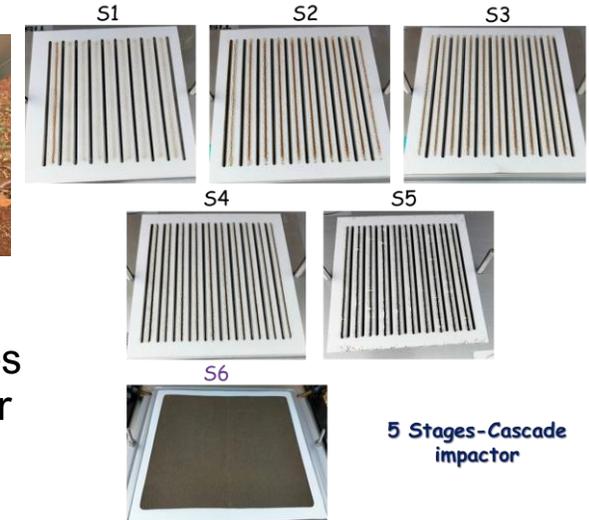
High Volume Air sampler



Mini volume air sampler



High Volume Air Sampler – 5 stages Cascade impactor



5 Stages-Cascade impactor

ANALYTICAL INSTRUMENTS

- Analysis of aerosol chemical compositions (PAHs, Water Soluble Ions, Metals, OC-EC and Oxidative Potential (OP))
- Analysis of gas phase; VOCs and pollutant gases.



GC-MS @ Chemistry, CMU



GC-MSD-FID-TCD



Ion Chromatograph



ICP-OES @ Chemistry, CMU

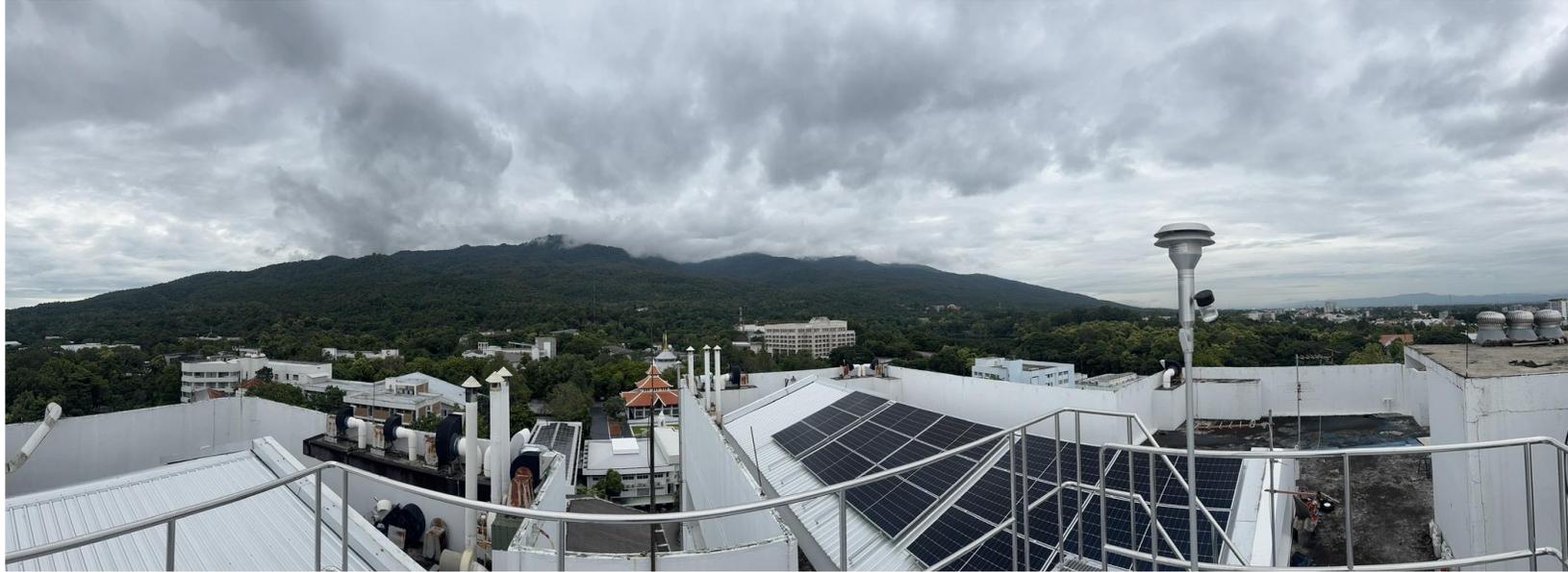


Microplate Reader



Carbon analyzer (OC-EC)

AQ Monitoring Station





Measurement Parameters

1. PM2.5 (Beta Attenuation; U.S. EPA-approved method)
2. Meteorological Parameters (WMO standard):
 - Temperature
 - Atmospheric Pressure
 - Wind Speed
 - Wind Direction
 - Rainfall
3. Gas Sensors
 - O₃ (Ozone)
 - NO₂ (Nitrogen Dioxide)
 - SO₂ (Sulfur Dioxide)
 - CO (Carbon Monoxide)
4. Black Carbon Aethalometer (AE33-7)



by CMU CHANG MAI UNIVERSITY
AirQuality

system for tracking air quality in Thailand



Interactive

Images & Messages

Display interactive data by using Infographic and text, Easy to access information anywhere, anytime



Knowledge

News&Informations

Collect Knowledge, Data, News, Projects, Activities about PM2.5



Fhasai

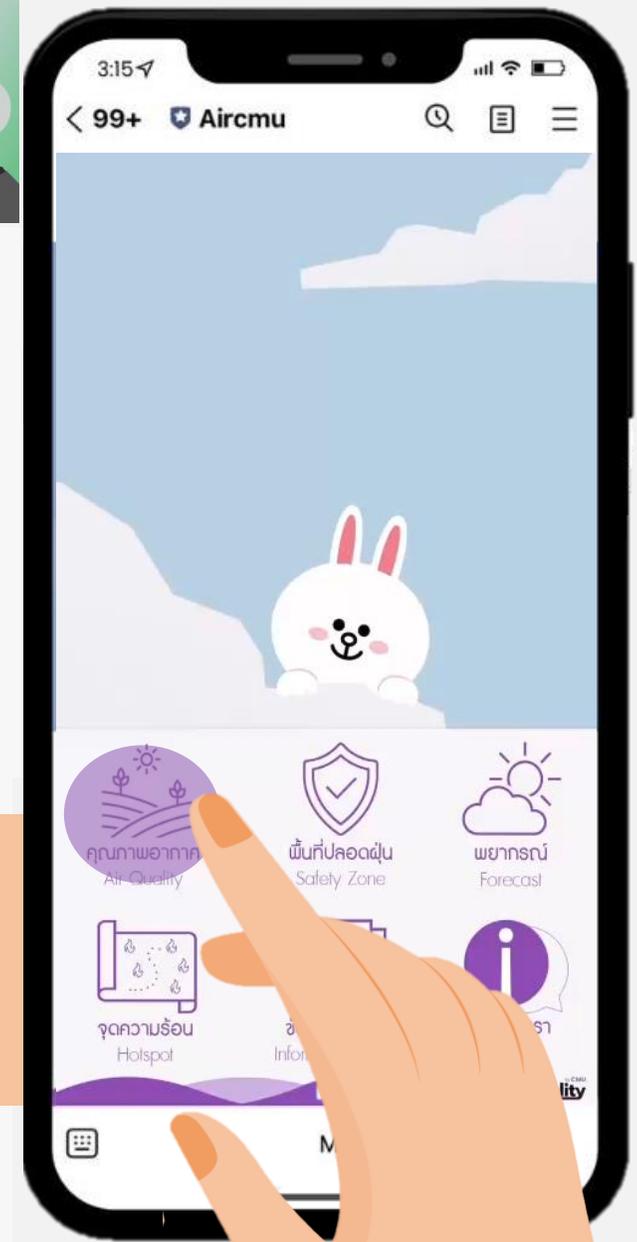
Mascot

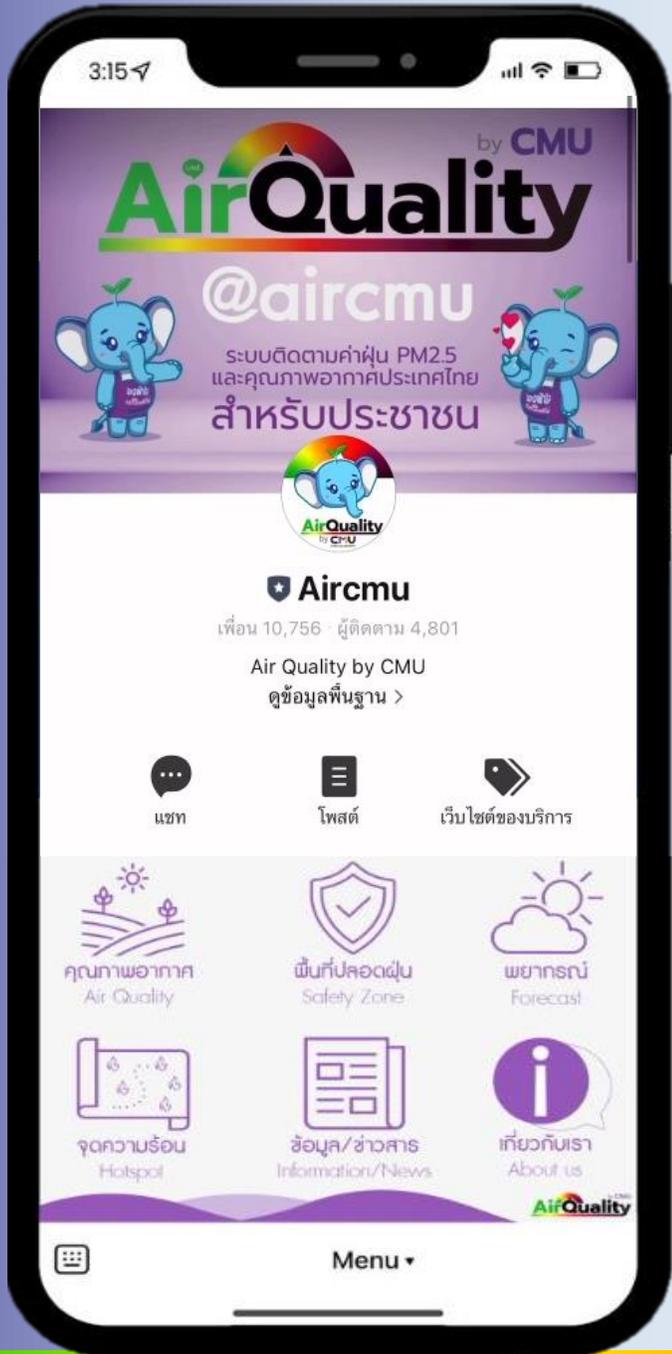
is responsible for reporting air quality information by using the user's location to report PM2.5 in every area (safety and unsafe zone) and forecasts for three days, also share hotspots, news, and many activities by Line Official Account@aircmu.



Notify PM2.5 Map

Notify PM2.5 of Thailand in Haze Season Period especially on January-April in every year make people access to information for self prevent from health effect





AirQuality by CMU
CHIANG MAI UNIVERSITY

Line ID  



 **ADD FRIEND**



Thank you for your kind attention