

SEA-HAZEMON Project

**Adisorn Lertsinsrubtavee
intERLab
Asian Institute of Technology**

STIC-ASIA: SEA-HAZEMON



UPMC
SORBONNE UNIVERSITÉS



LOW-COST REAL-TIME MONITORING OF HAZE AIR QUALITY DISASTERS
IN RURAL COMMUNITIES IN THAILAND AND SOUTHEAST ASIA



- Project PI: Dr. Mongkol Ekpanyapong, intERLab/SET, AIT and Prof. Giovanni Pau, LIP6, UPMC, France
- Project Co-PI: Prof. Nguyen Thi Kim Oanh, SERD, AIT and Prof. Isabella Annesi-Maesano, INSERM, Paris, France



- Site surveys and preliminary work done by AIT's master student demonstrating that our low-cost sensors can give reliable data.
- Designs of sensor nodes.
- AIT and UPMC — one research assistant from AIT will spend 3 months developing the SW for our Air Quality nodes.

Asi@Connect: SEA-HAZEMON@TEIN

Research Grant from 3rd Call Asi@Connect program
Supported by EU and TEIN*CC (2019-2021)



Development of real-time air quality sensor network

Large scale deployment of low-cost IoT sensors in Thailand and SEA region

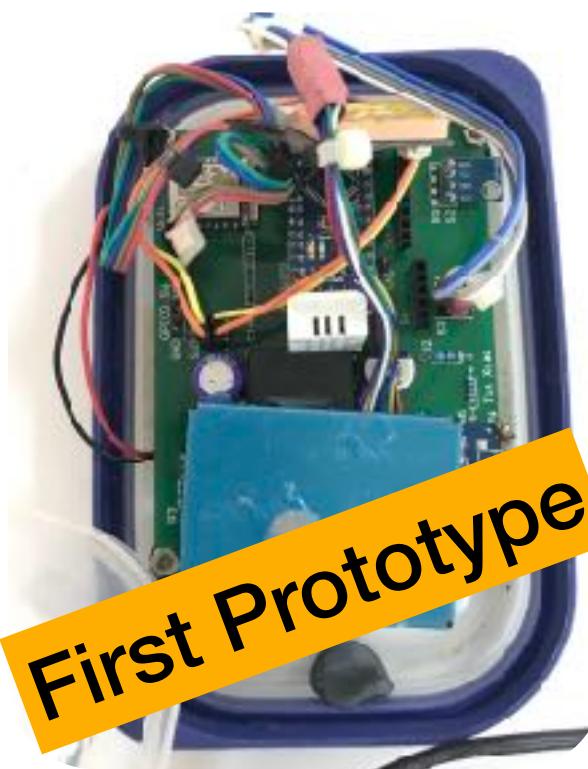
Post and Real-Time Data Analysis for environment research

Capacity building through intensive hands-on training IoT and Data analytics



Canarin Air Quality Sensor Kits

V1



First Prototype

V2



Computation Power

V3



Reliability & Validity

V4



Long Range

V5



Under
Development

2016

2017

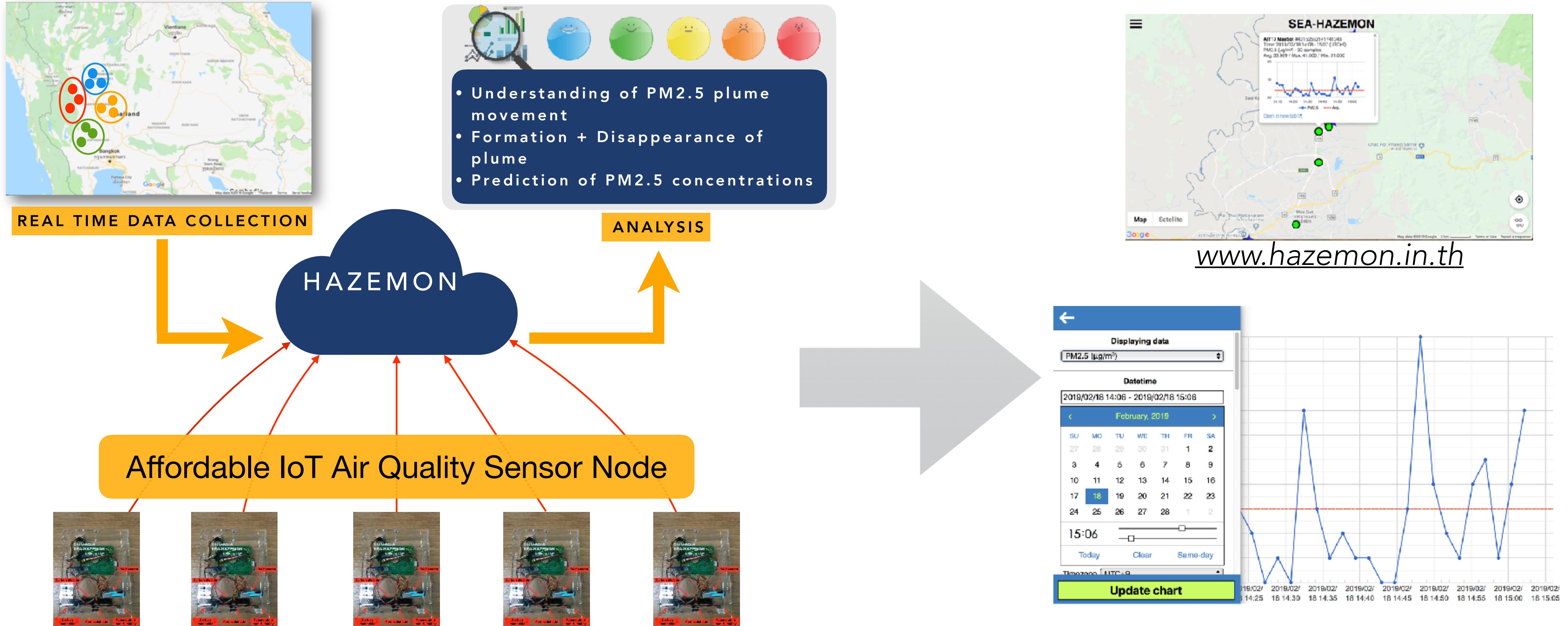
2019

2020

2022

Version	Canarin V1	Canarin V2	Canarin V3	Canarin V4	Canarin V5 (LEGO)
Sensors	PM 1/2.5/10, Temperature, Humidity, Air Pressure, GPS	PM 1/2.5/10, Temperature, Humidity, Air Pressure, GPS	PM 1/2.5/10, Temperature, Humidity, Air Pressure, GPS CO,CO2	PM 1/2.5/10, Temperature, Humidity, Air Pressure, GPS CO,CO2	PM 1/2.5/10, Temperature, Humidity, Air Pressure, GPS CO,CO2,NOX
Connectivity	WiFi	WiFi	WiFi	WiFi LoRa	WiFi, LoRa Cellular
Features	-	Web Configuration	Web Configuration Local Dashboard ActiveNDN	Web Configuration Local Dashboard	Modular, Low Power (Solar/ Battery), Portable

HAZEMON: Real Time Air Quality Monitoring Platform



Sensor Calibration

PM Sensor Calibration

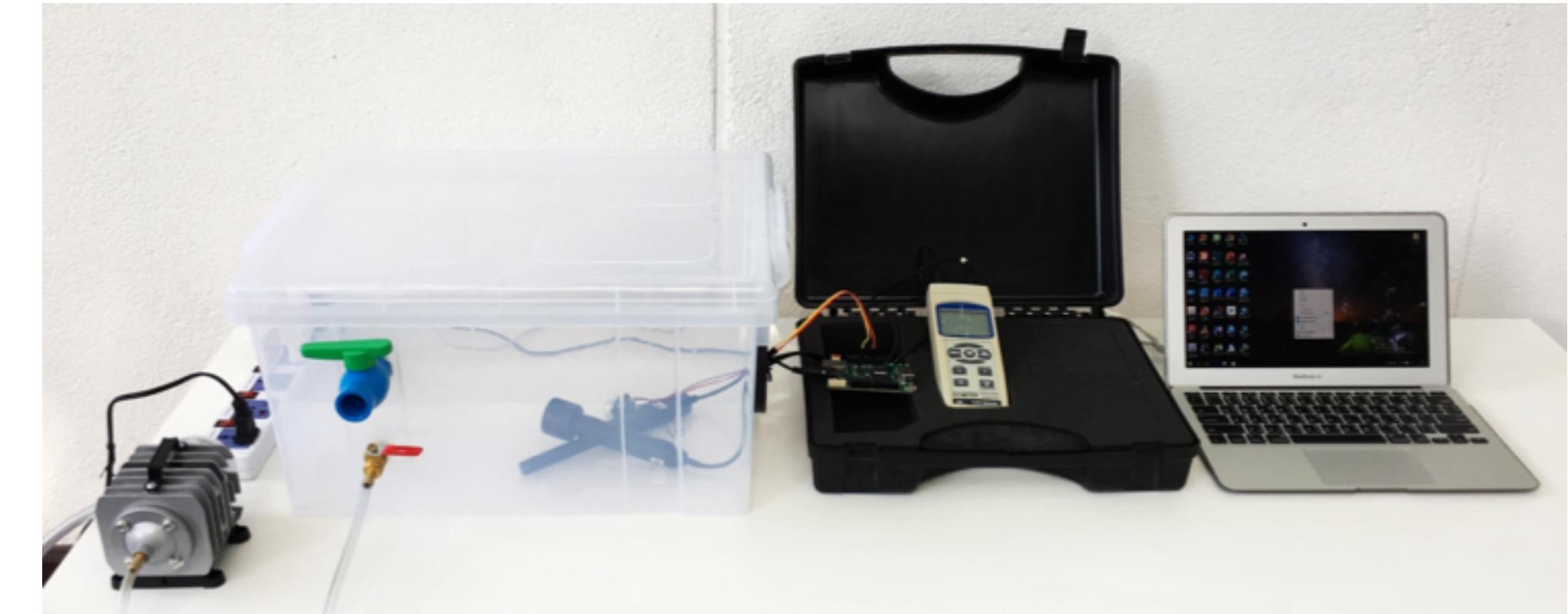


2018 Test the reading consistent between different Canarin III nodes in the lab



Incense Smoke source

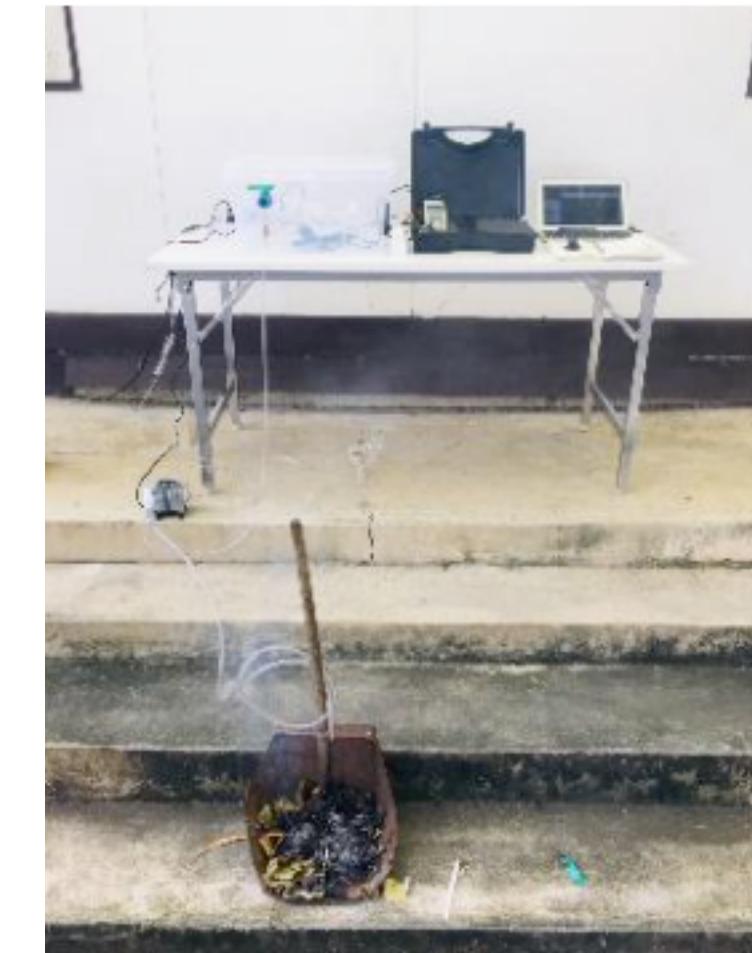
CO Sensor Calibration



2019 Calibrating CO sensor with CO meter



Incomplete Combustion Engine



Biomass Building

Canarin in Production

2020

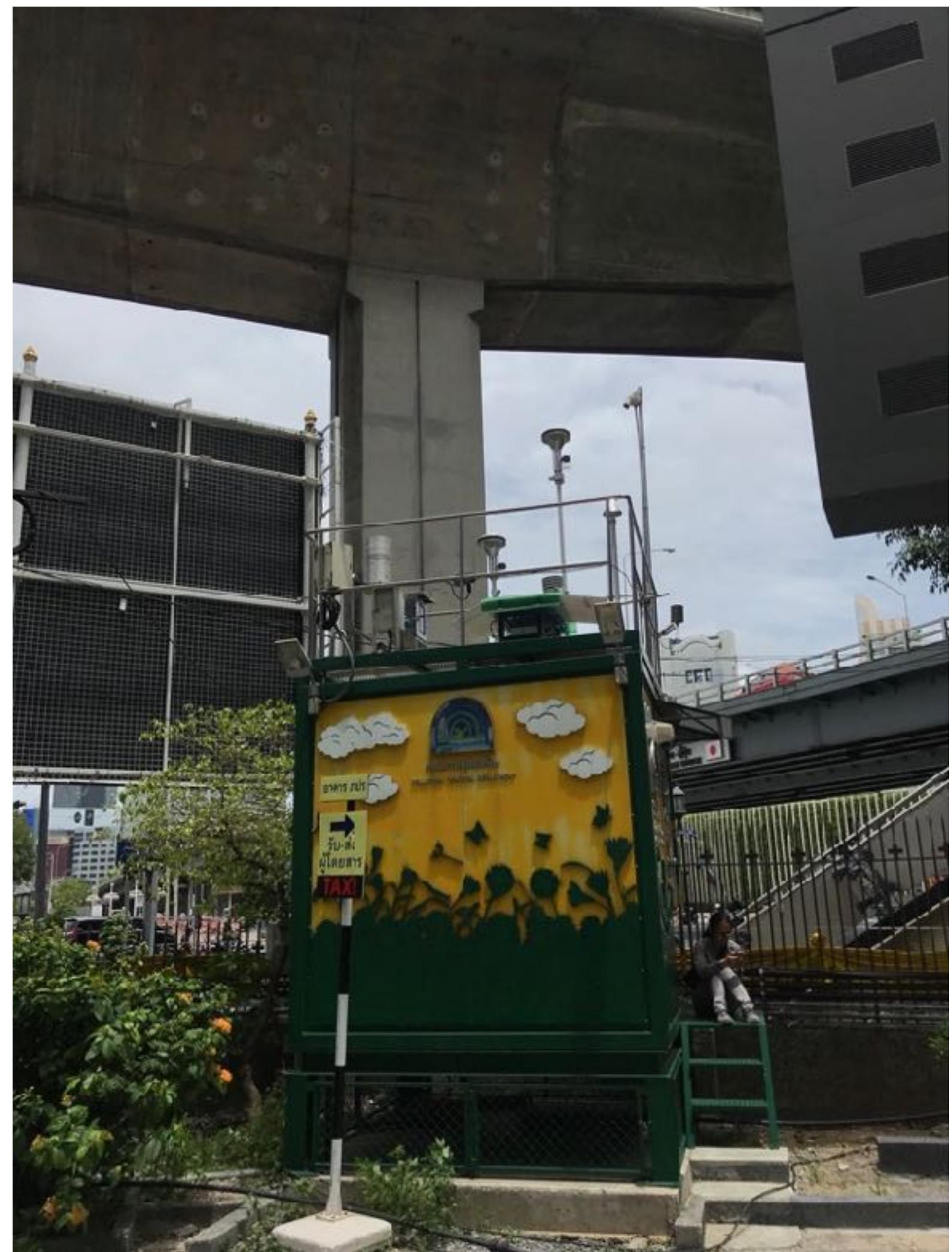
Produce Canarin V3 & V4
200+

Reliability and **Validity** are our key concerns

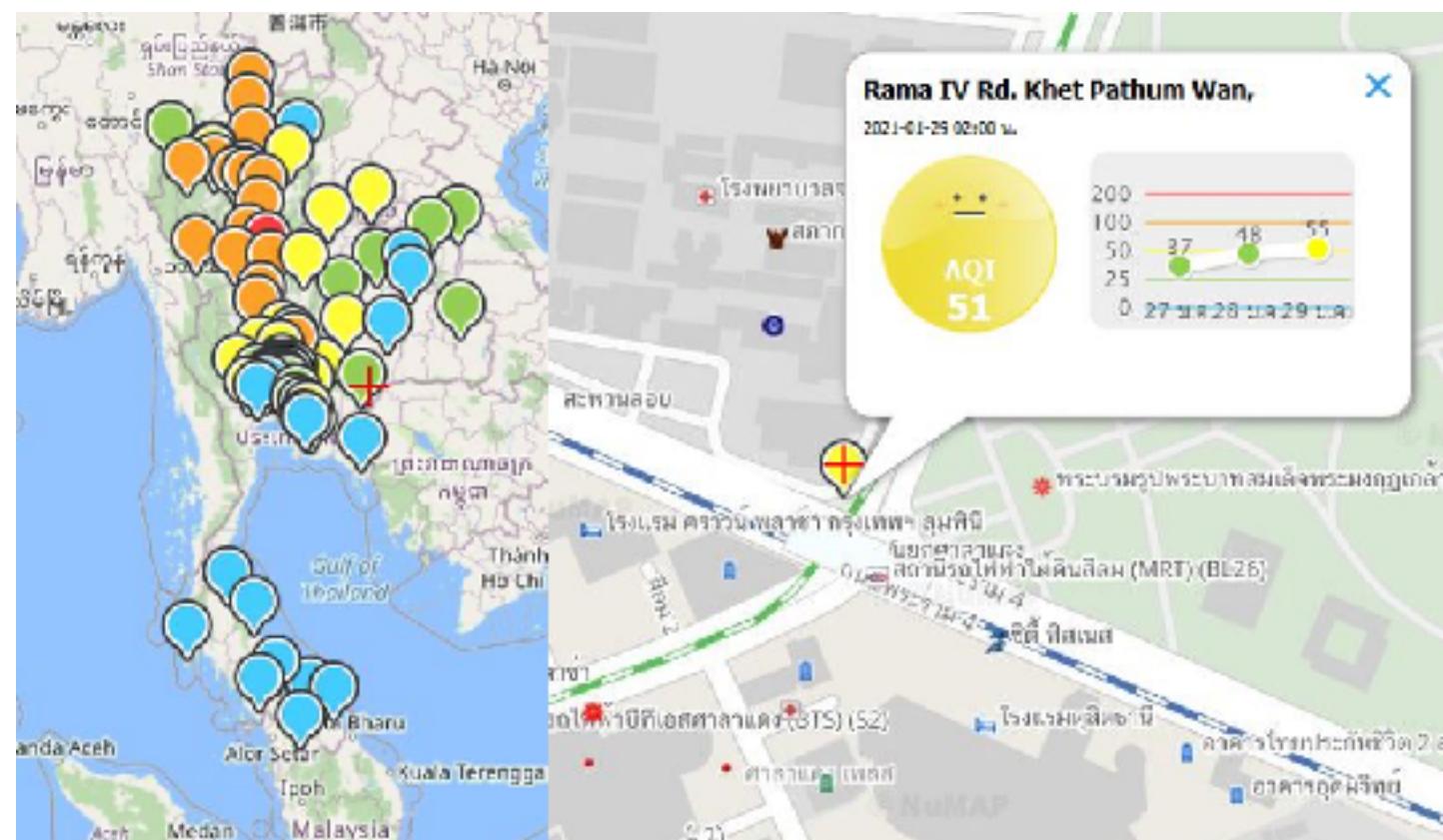
How can we assure **quality** of each canarin sensor?



Batching Test



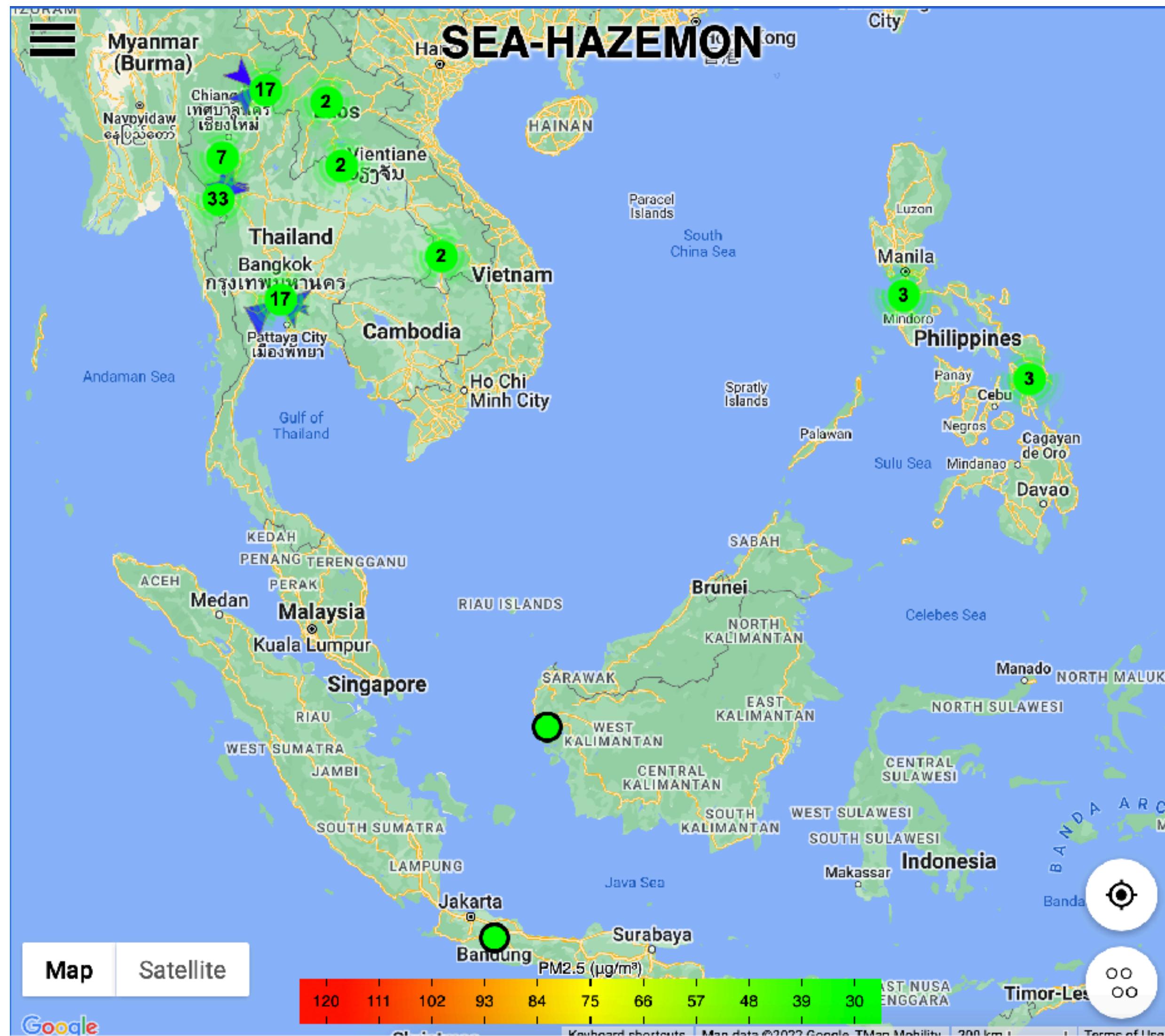
Co-location with Beta Ray Ambient Monitoring Station@ RamaIV Junction (high traffic area in BKK)



- 16 Nodes per batch
- 17 Batches including some retested nodes
- 4 Days measurement per batch while sending data every ~2min



Deployment over SEA



+80 active Nodes deployed
in Urban, rural and forest areas
(BKK, Tak, CRI, CMI, Nan,
PYO, LPG, PNB, LPN)



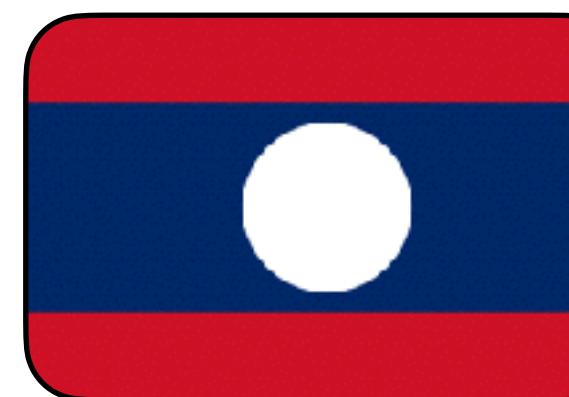
12 active Nodes deployed in
East coast, Mountain range,
Lake and Urban areas



4 active Nodes deployed in Bandung, Jambi and other 10 nodes will be deployed in university campus (IDREN)



10 Nodes to be deployed near Thai's border



Deployment

Urban area in BKK

Co-location with PCD Stations

- Din-Daeng and RamalV
- Reference data for long term observatory

Vertical Measurement

- 26 Floor, 9th Floor and Ground level at the same location (RamalV)
- 36 Floor and Ground level at Sathorn area

Other residential areas around BKK



Deployment in BKK



Canarin V3 and Wind Sensor @RamaIV PCD Station



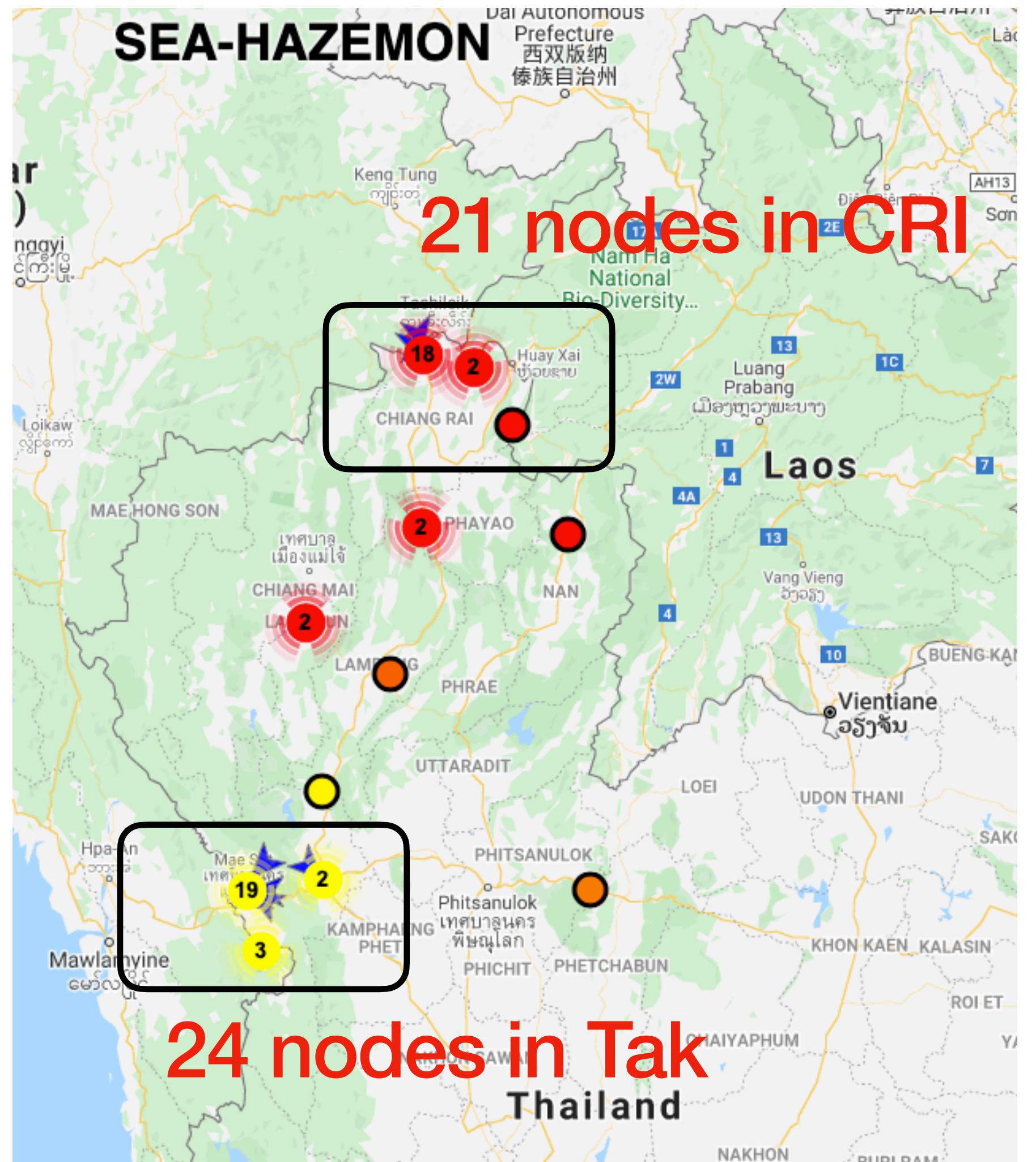
Deployment @ Sathorn Area



Deployment @ Building at Lumphini Park

Deployment

Close to Burning Area



Deployment @Doi Tung Forest Fire Control Unit



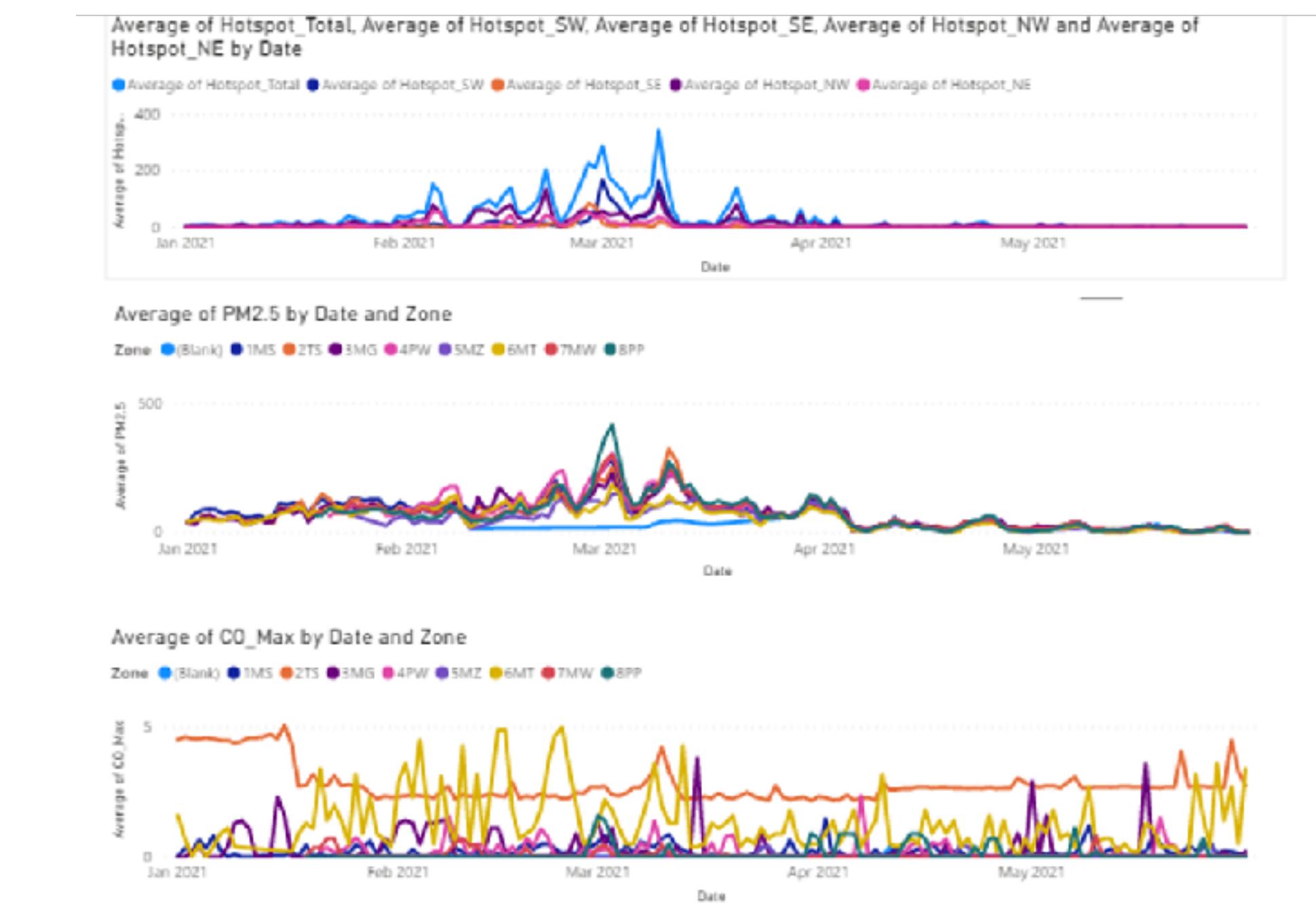
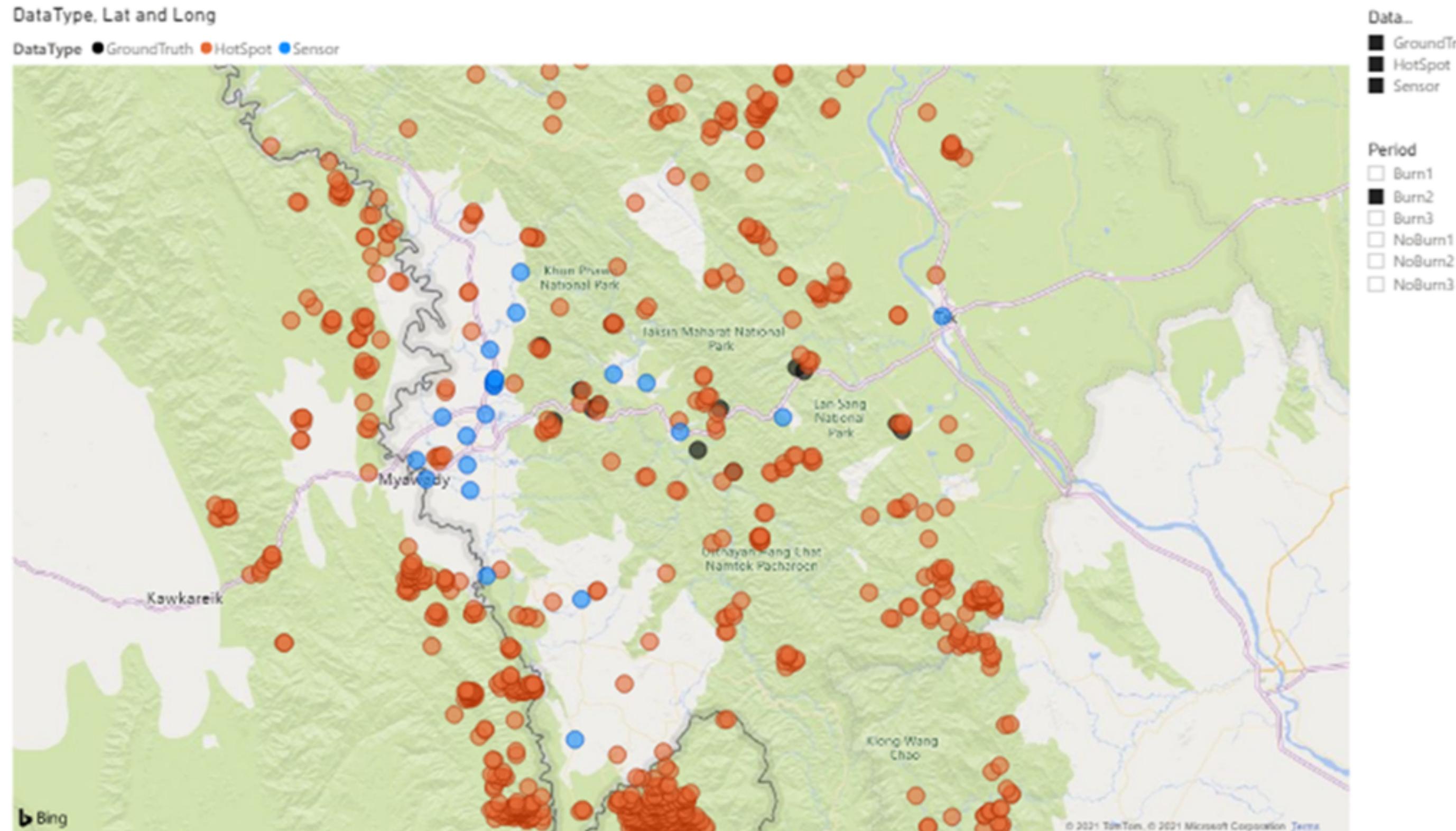
Deployment @ School in Mae Sot



Deployment @Tum Luang-Khun Naam Naang Norn Forest Park

- Targeting to affected area from forest fire and open burning
- Dense deployment in 2 base locations (Tak and Chiang Rai)
- Considering grid topology for further study on plume movement and air quality forecasting

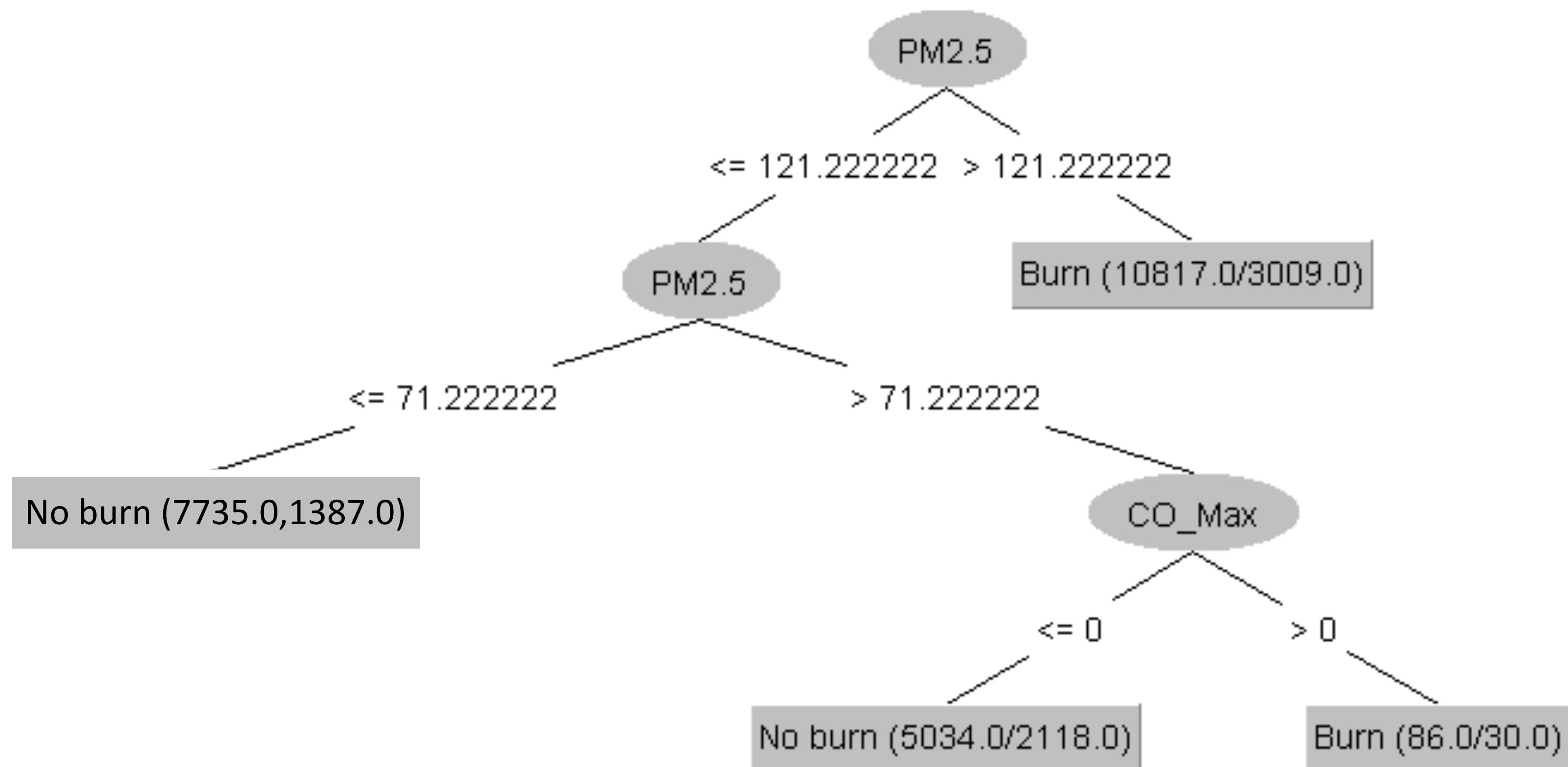
Post Data Analytics with Forest Fire Incidents



- Data Set (1 Jan - 31 May 2022)
 - Sensor Data in TAK area (22 nodes)
 - Satellite Data from (FIRMs)
 - Fire Report from local forest fire authority

Key Factors: PM2.5, CO, Hotspots, Fire events

Applying ML for Forest Fire Detection Model

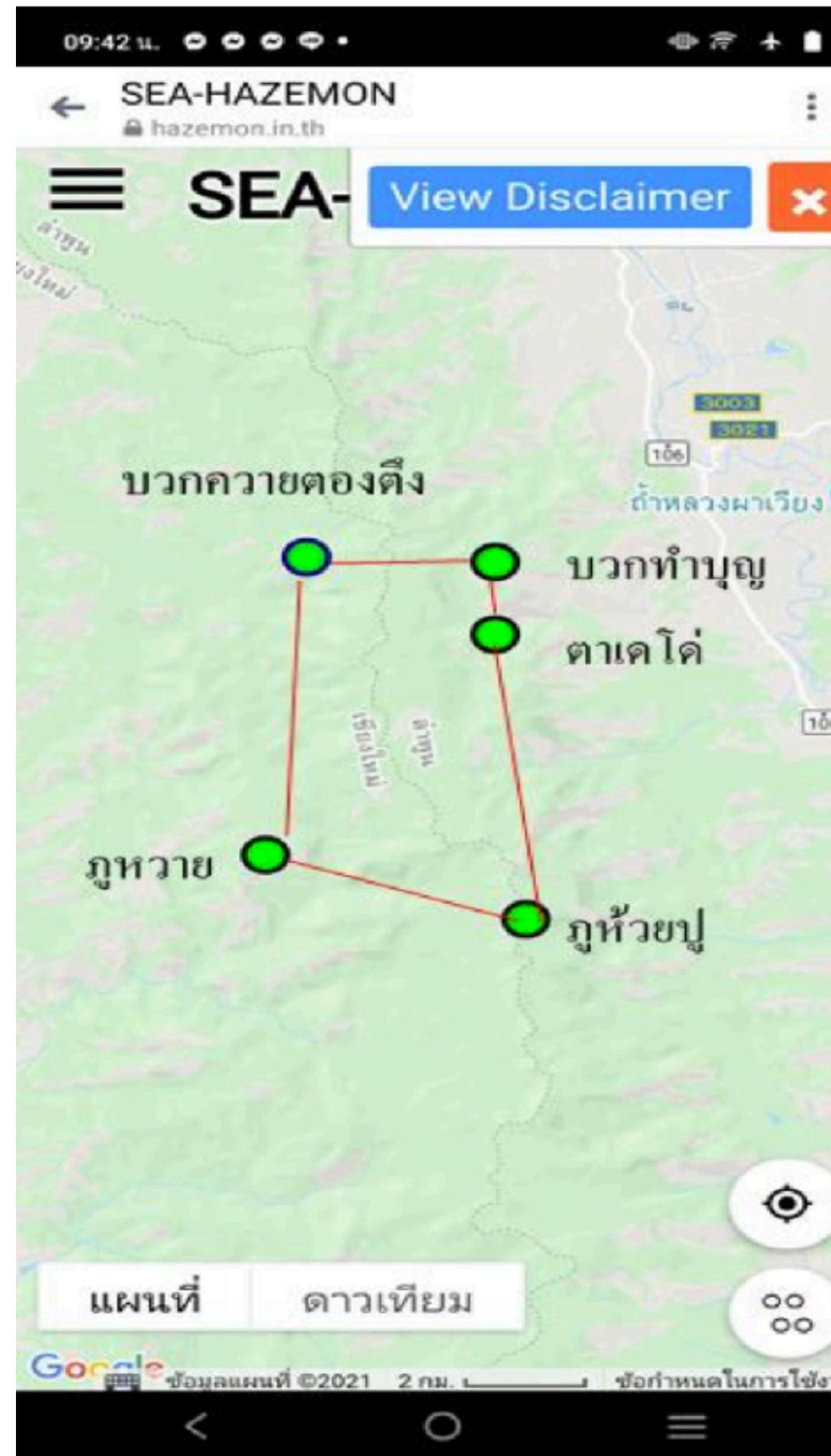


Monitor Realtime Forest Fire Incidents with PM2.5 and CO values

Accuracy ~ 70%

Forest Fire Detection Use case

Study Area : Doi Chang Pa Prae (CMI - LPN)



Deployment



Solar Harvesting Energy



Support from Local Villagers (Design and Build)

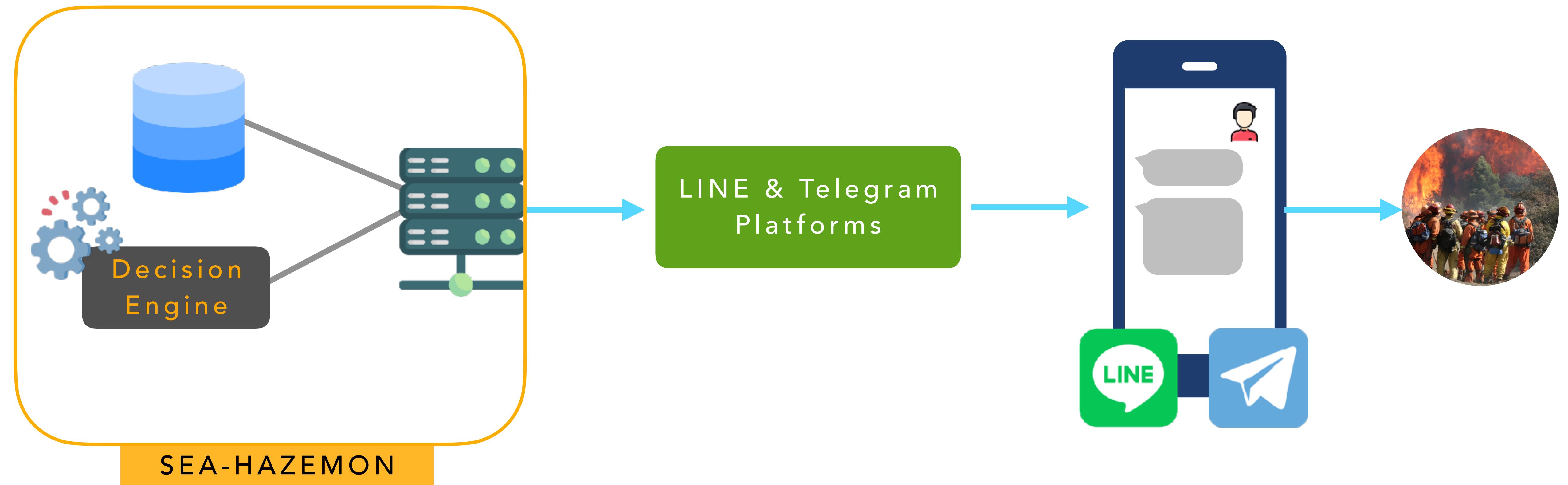


Canarin Sensor in the box



Motor Oil tray to protect insects and snakes

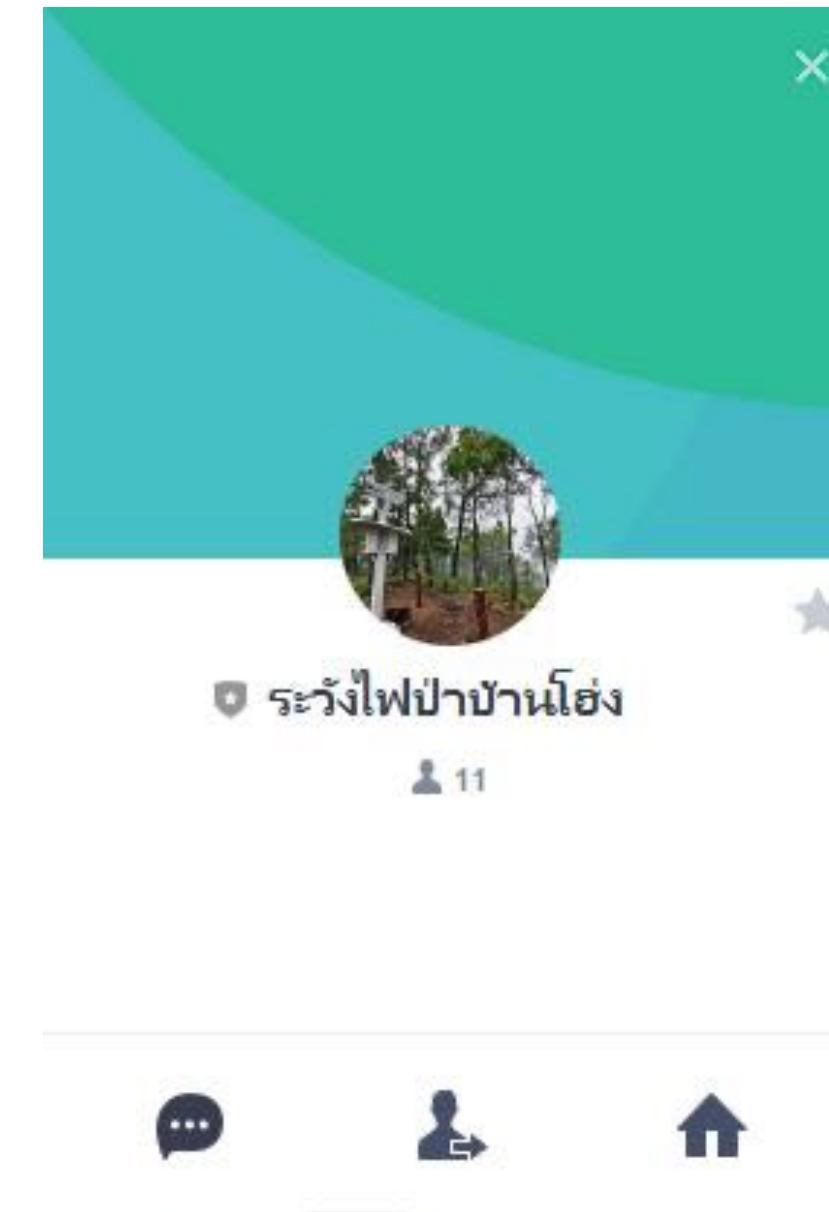
Active Forest Fire Notification System



Forest Fire Incident (5 April 2022)



Forest Fire Burning nearby Sensor Deployment Area



Alert Messages were sent to local villagers and BanHong forest fire station



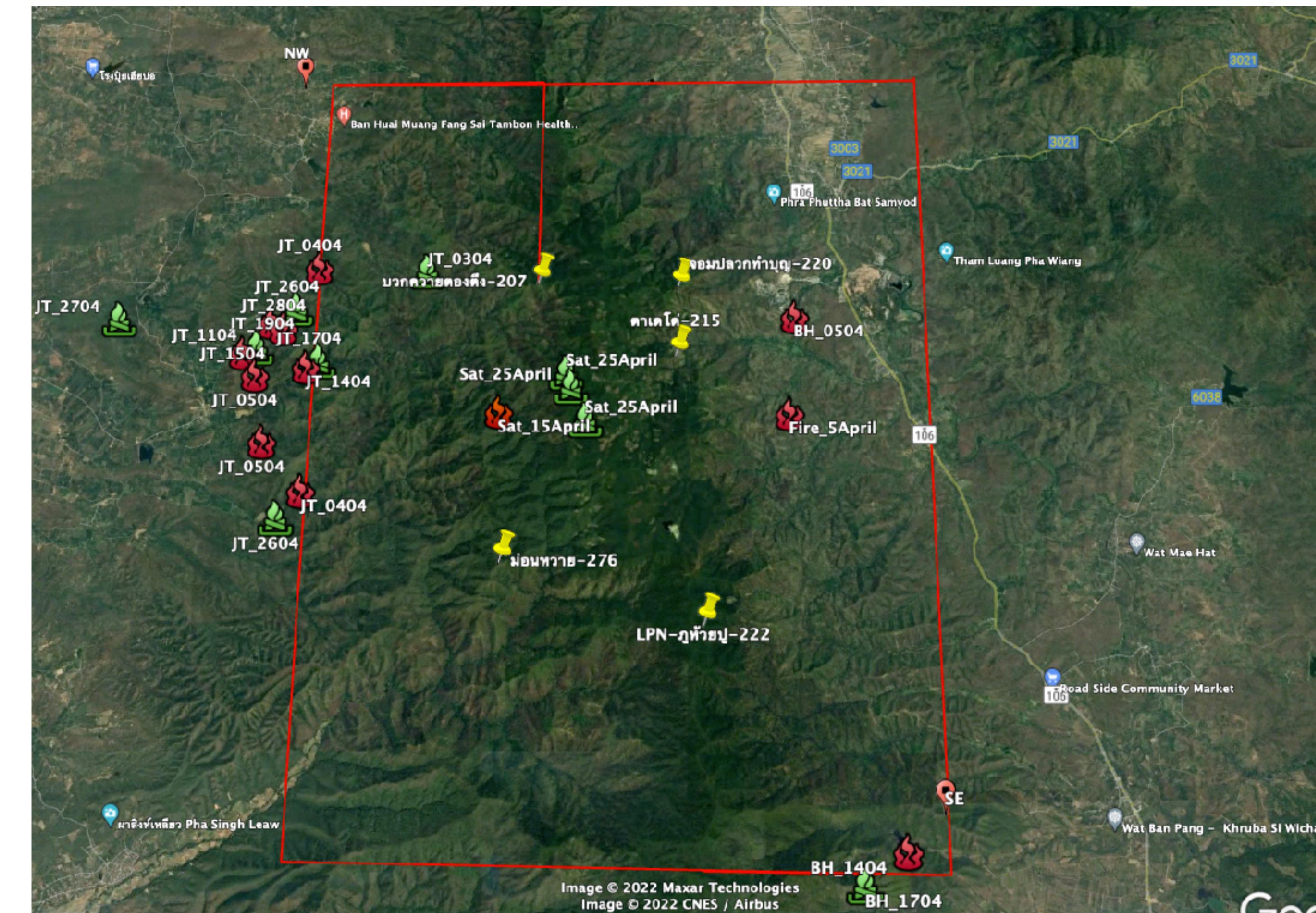
Preliminary Study

Study Area

- Ban Hong (LPN-CMI)
- 5 Sensors have been deployed
- Area - 5 km from the edge of our sensors

Data Sources (1 - 28 April 2022)

- Sensor + Fire detection model
- Ref.
 - Report from Ban Hong (BH) Fire station
 - Report from Jom Thong (JT) Fire station
 - Satellite (VIIRS) overpassing time (~12:00 - 13:00)



Evaluation Results: Confusion Matix

Actual\Predict	Detected	Not Detected
Detected	True Positive	False Negative
Not Detected	False Positive	True Negative

Actual\Predict	Detected	Not Detected
Detected	5	3
Not Detected	11	9

Precision = 0.3125

Recall = 0.625

Accuracy = 0.5

Thank you !



ส่วนควบคุมไฟป่า
สำนักป้องกันภัยจากไฟและควบคุมไฟป่า
กรมป่าไม้

