

# **SEA-HAZEMON Project**

**Adisorn Lertsinsrubtavee**  
**intERLab**  
**Asian Institute of Technology**

# STIC-ASIA: SEA-HAZEMON



## 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)



European Union



Development fo real-filed 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



**AIT**

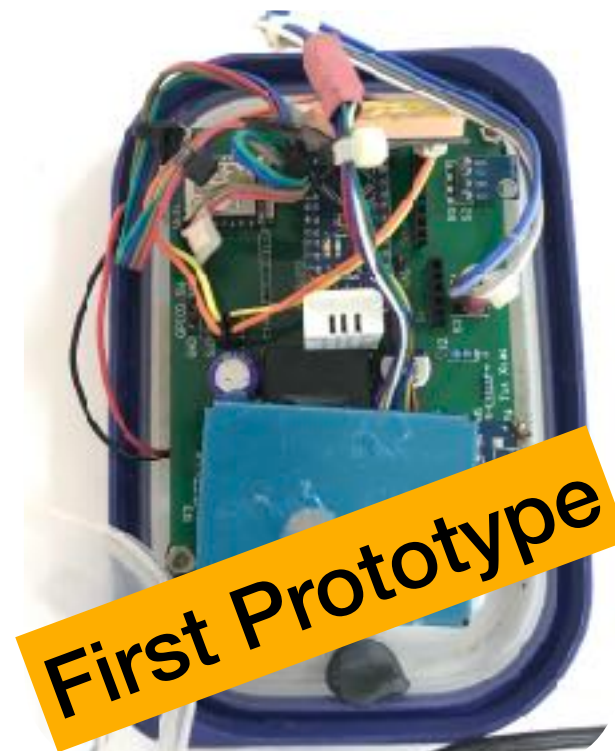


สถาบันวิจัยการ ไทย-ออสเตรีย



# Canarin Air Quality Sensor Kits

**V1**



**First Prototype**

2016

**V2**



**Computation Power**

2017

**V3**



**Reliability & Validity**

2019

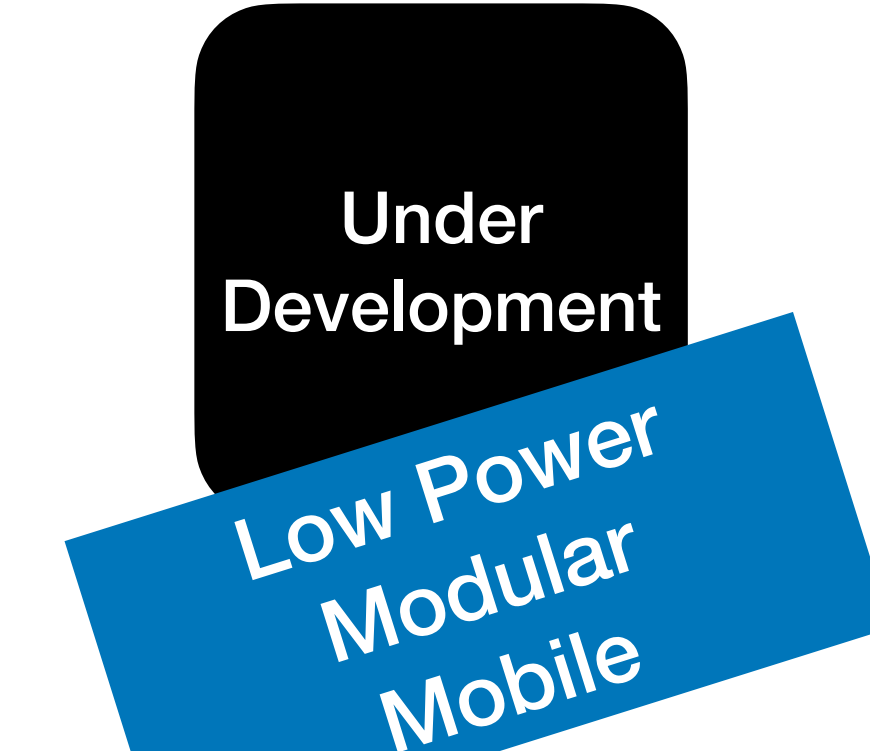
**V4**



**Long Range**

2020

**V5**



**Under Development**

**Low Power Modular Mobile**

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



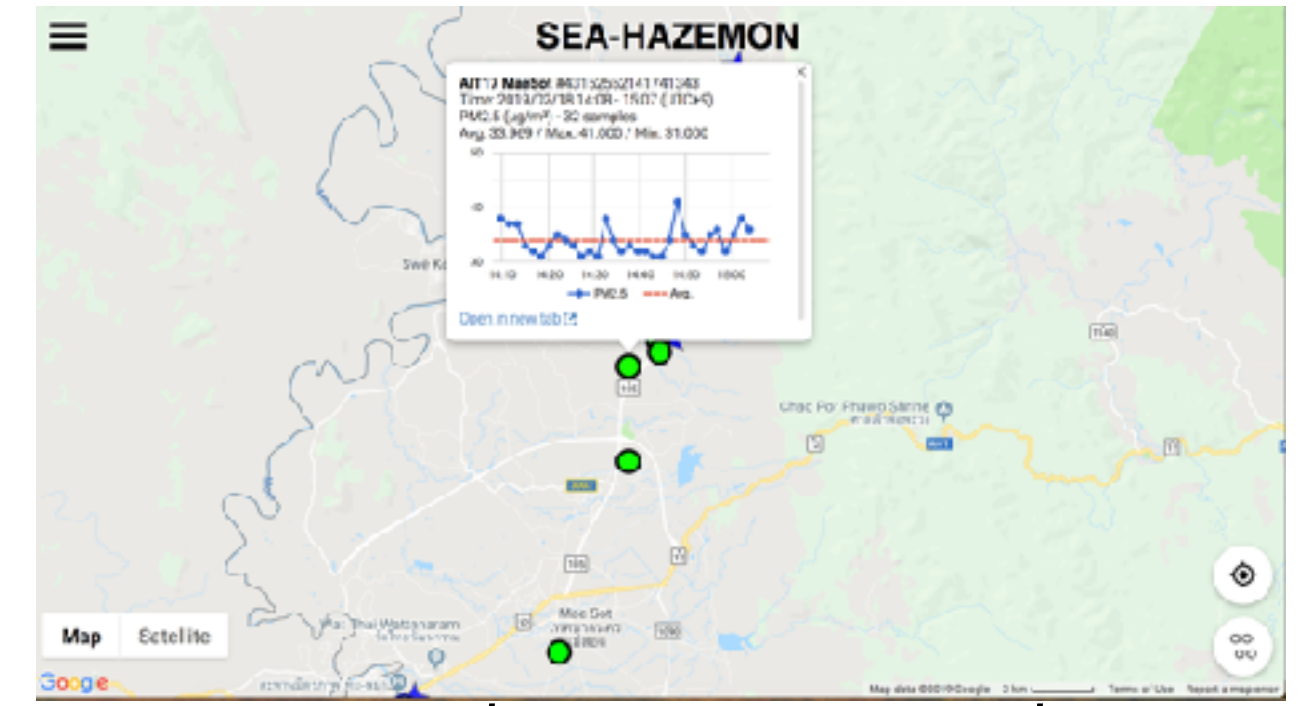
REAL TIME DATA COLLECTION

- Understanding of PM2.5 plume movement
- Formation + Disappearance of plume
- Prediction of PM2.5 concentrations

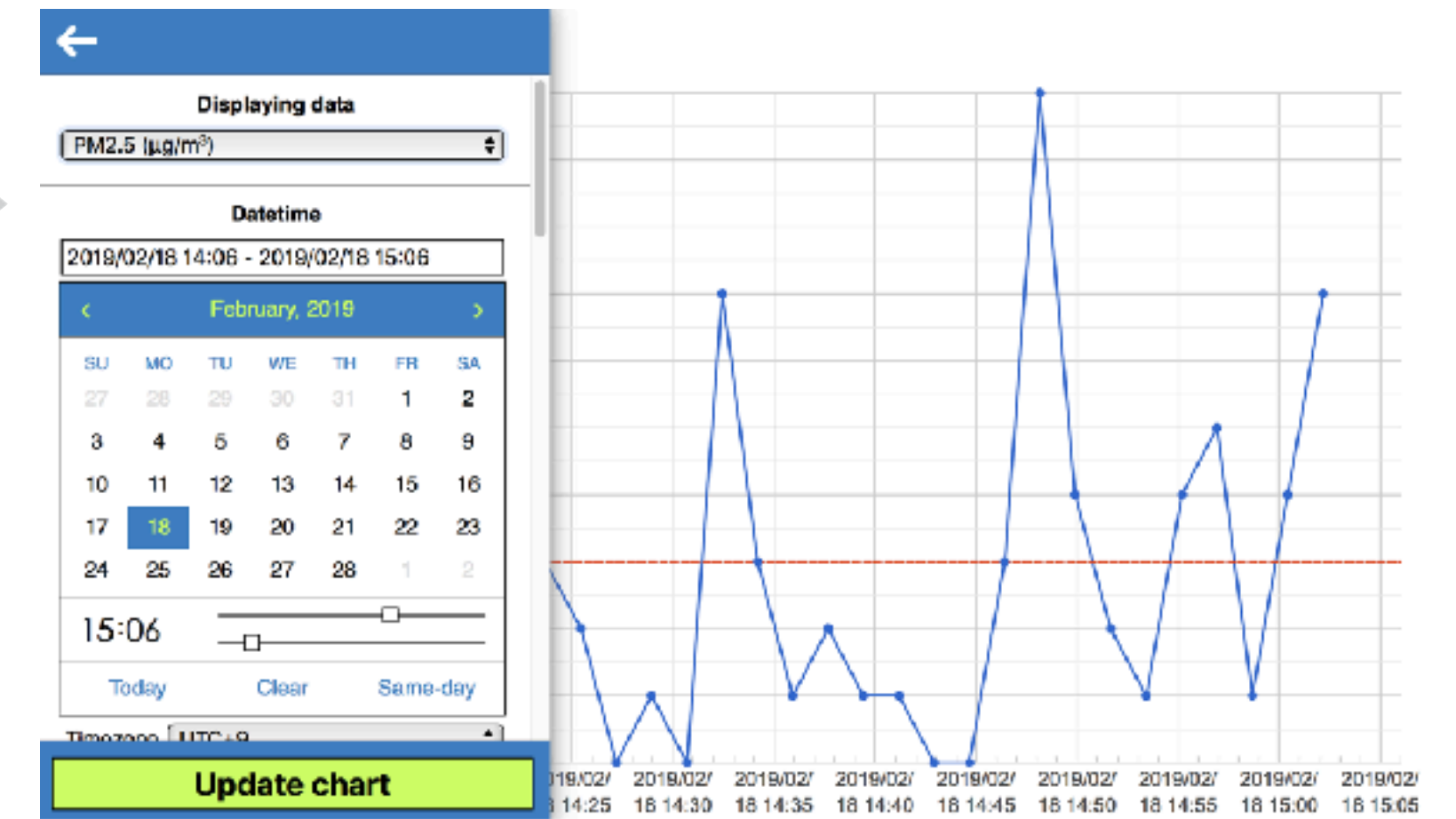
ANALYSIS



Affordable IoT Air Quality Sensor Node



[www.hazemon.in.th](http://www.hazemon.in.th)



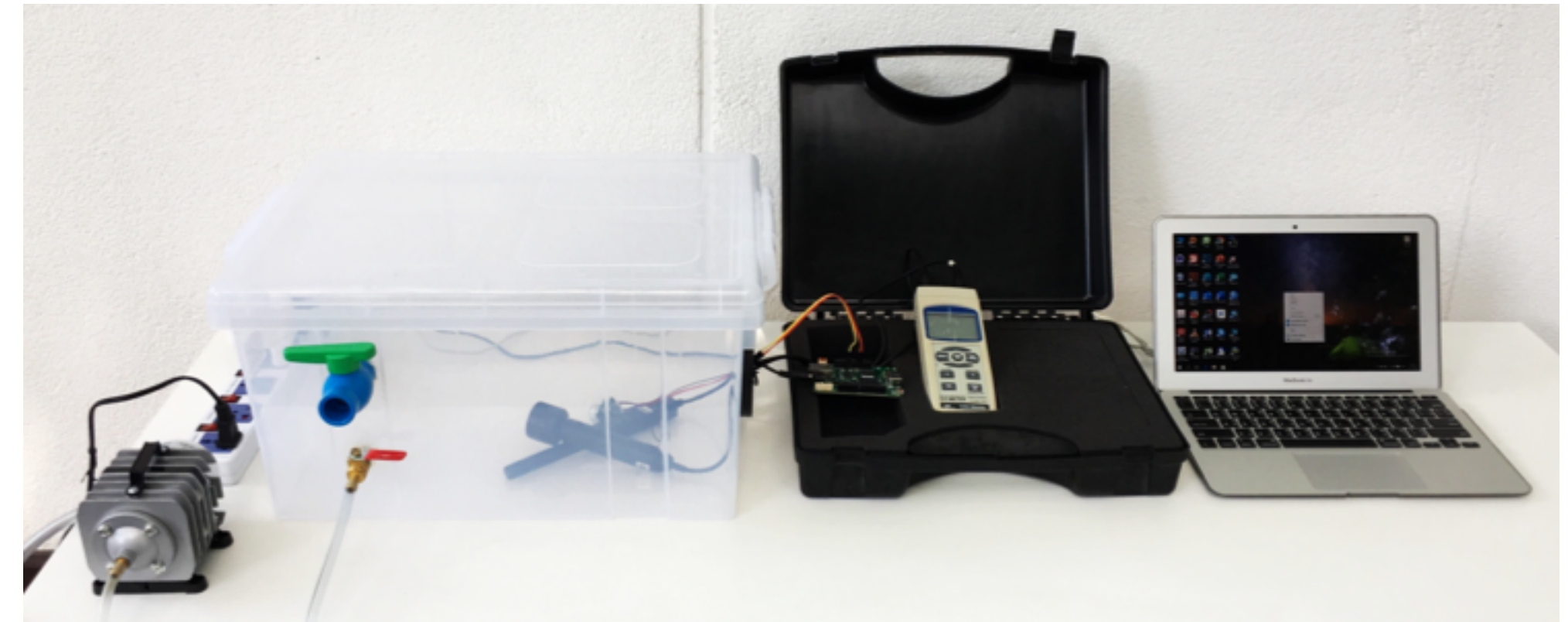
# Sensor Calibration

## PM Sensor Calibration



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

## CO Sensor Calibration



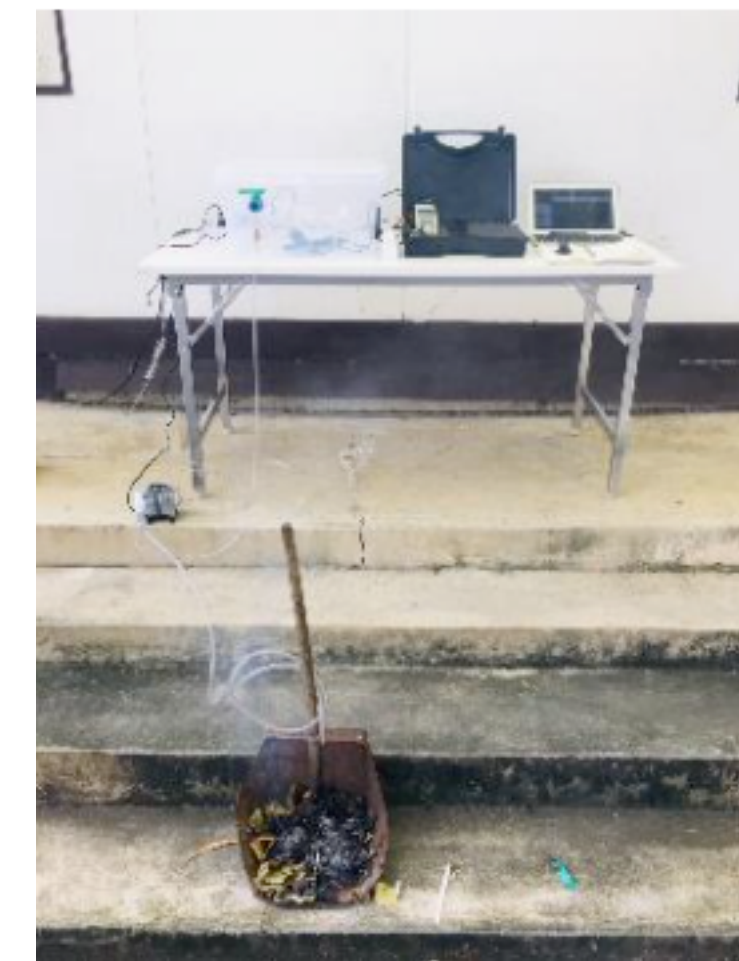
**2019** Calibrating CO sensor with CO meter



Incense Smoke source



Incomplete Combustion Engine



Biomass Building

# Canarin in Production

2020

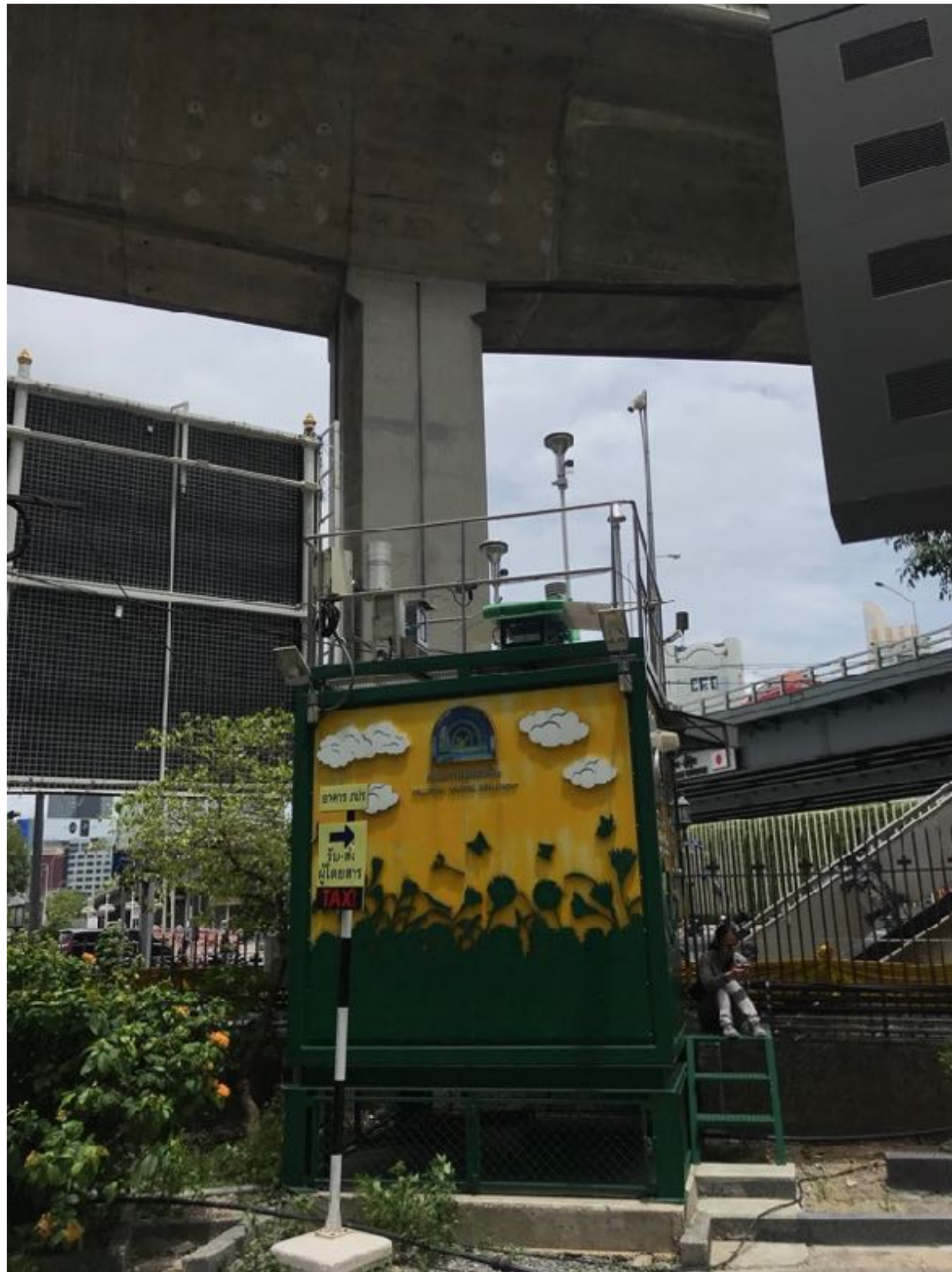
Produce Canarin V3 & V4  
200+

**Reliability** and **Validity** are our  
key concerns

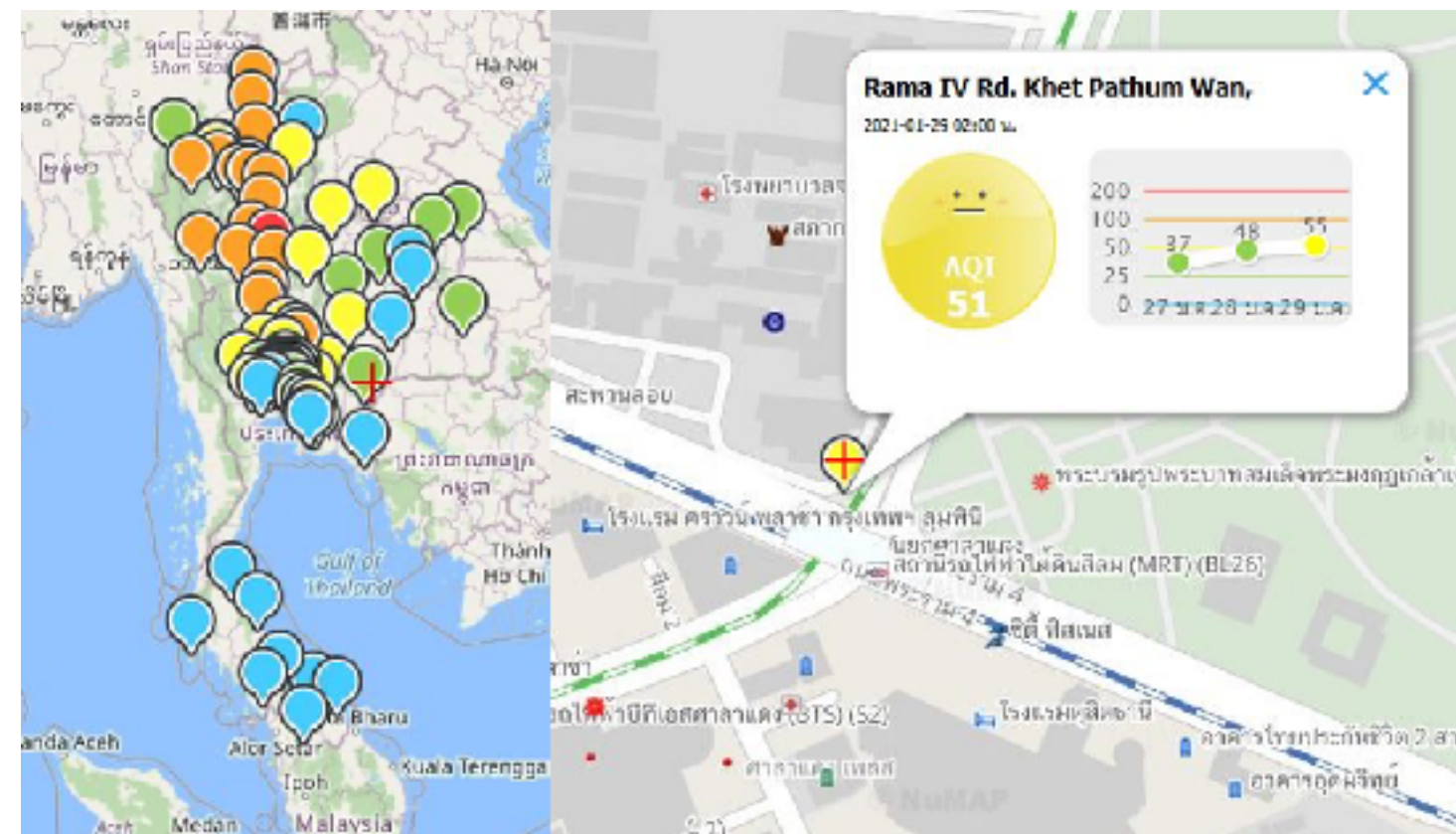
How can we assure **quality** of  
each canarin sensor?



# Batching Test



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



Source: [air4thai.pcd.go.th](http://air4thai.pcd.go.th)

16

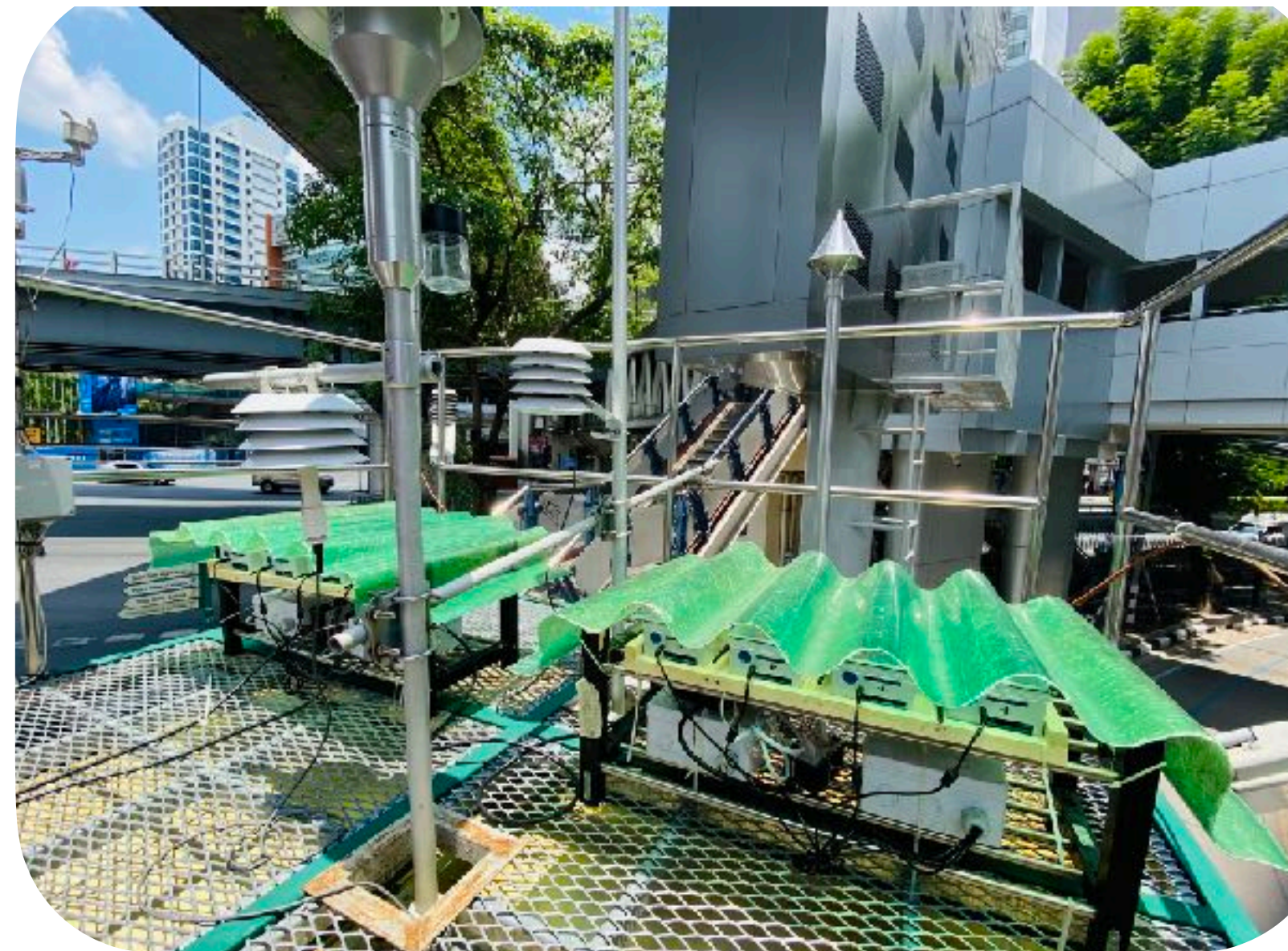
Nodes per batch

17

Batches including some retested nodes

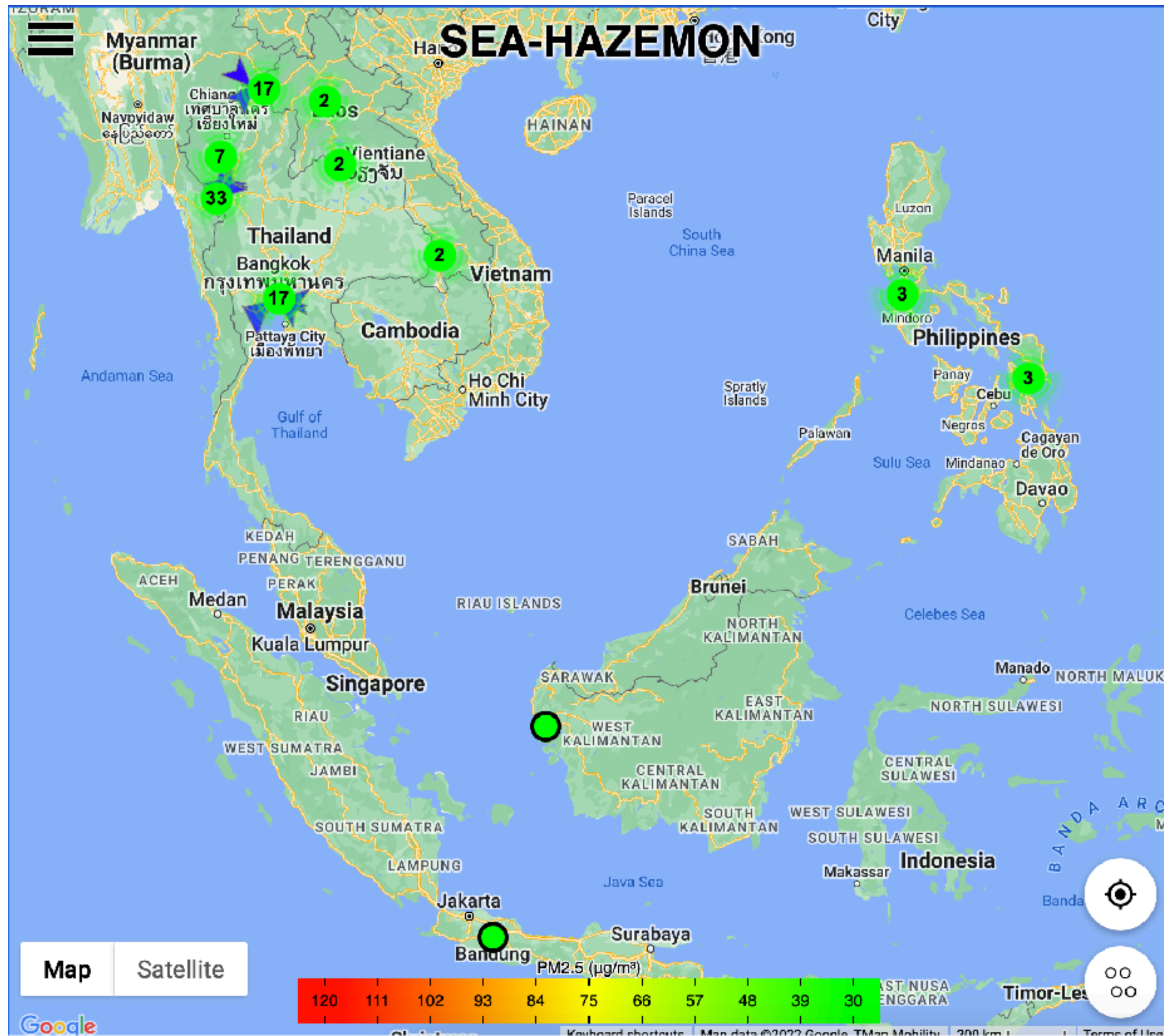
4

Days measurement per batch while sending data every ~2min





# Deployment over SEA



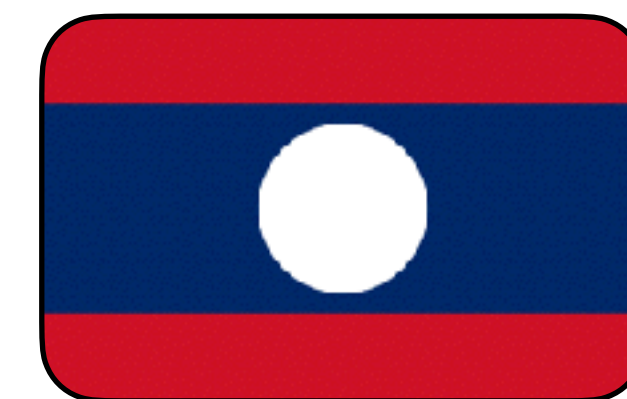
**+80** active Nodes deployed in Urban, rural and forest areas ( BKK, Tak, CRI, CMI, Nan, PYO, LPG, PNB, LPN)



**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 RamaIV
- Reference data for long term observatory

### Vertical Measurement

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

### Other residential areas around BKK



Deployment in BKK



Canarin V3 and Wind Sensor @RamaIV PCD Station



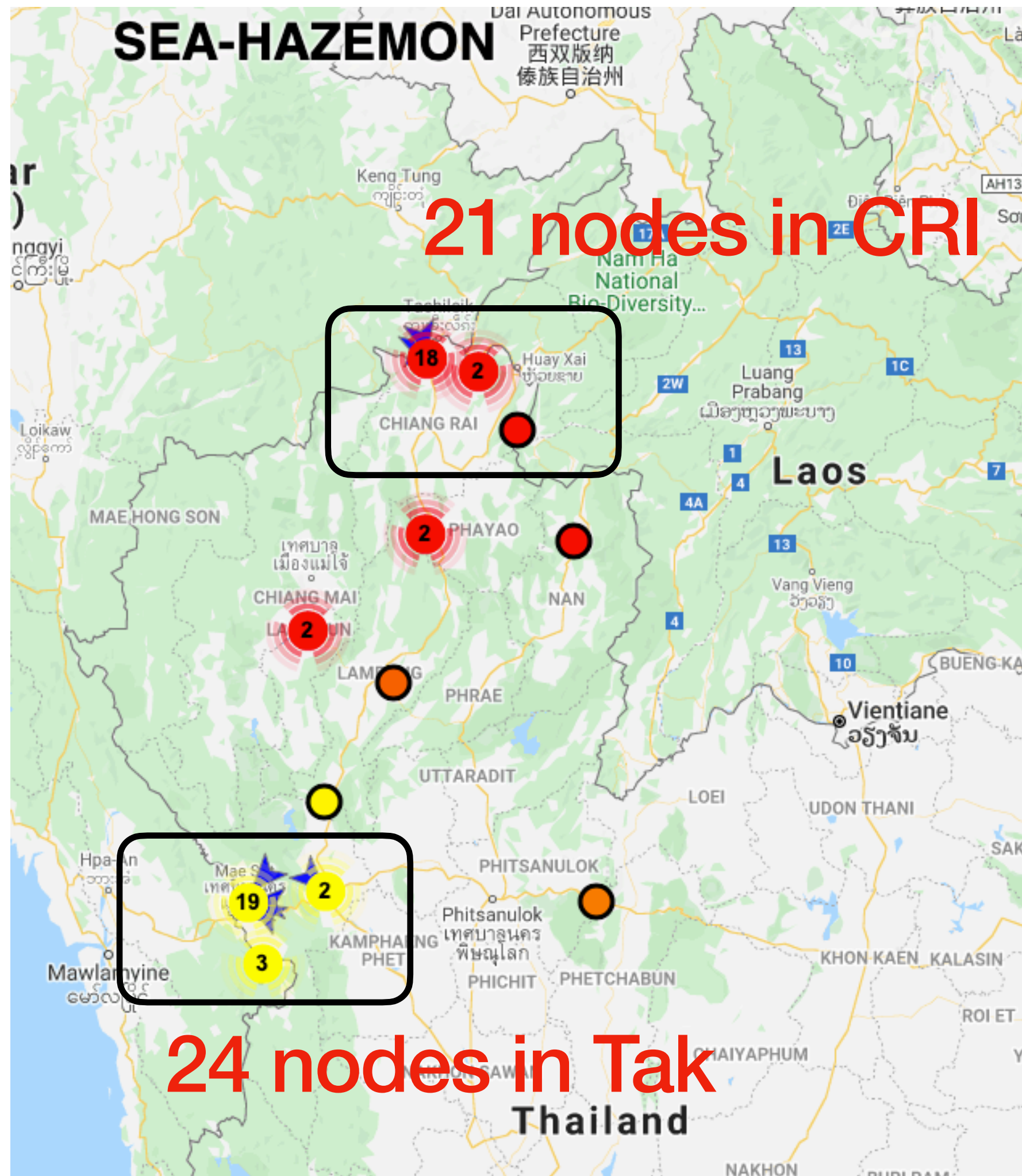
Deployment @ Sathorn Area



Deployment @ Building at Lumphini Park

# Deployment

## Close to Burning Area



Deployment @Doi Tung Forest Fire Control Unit



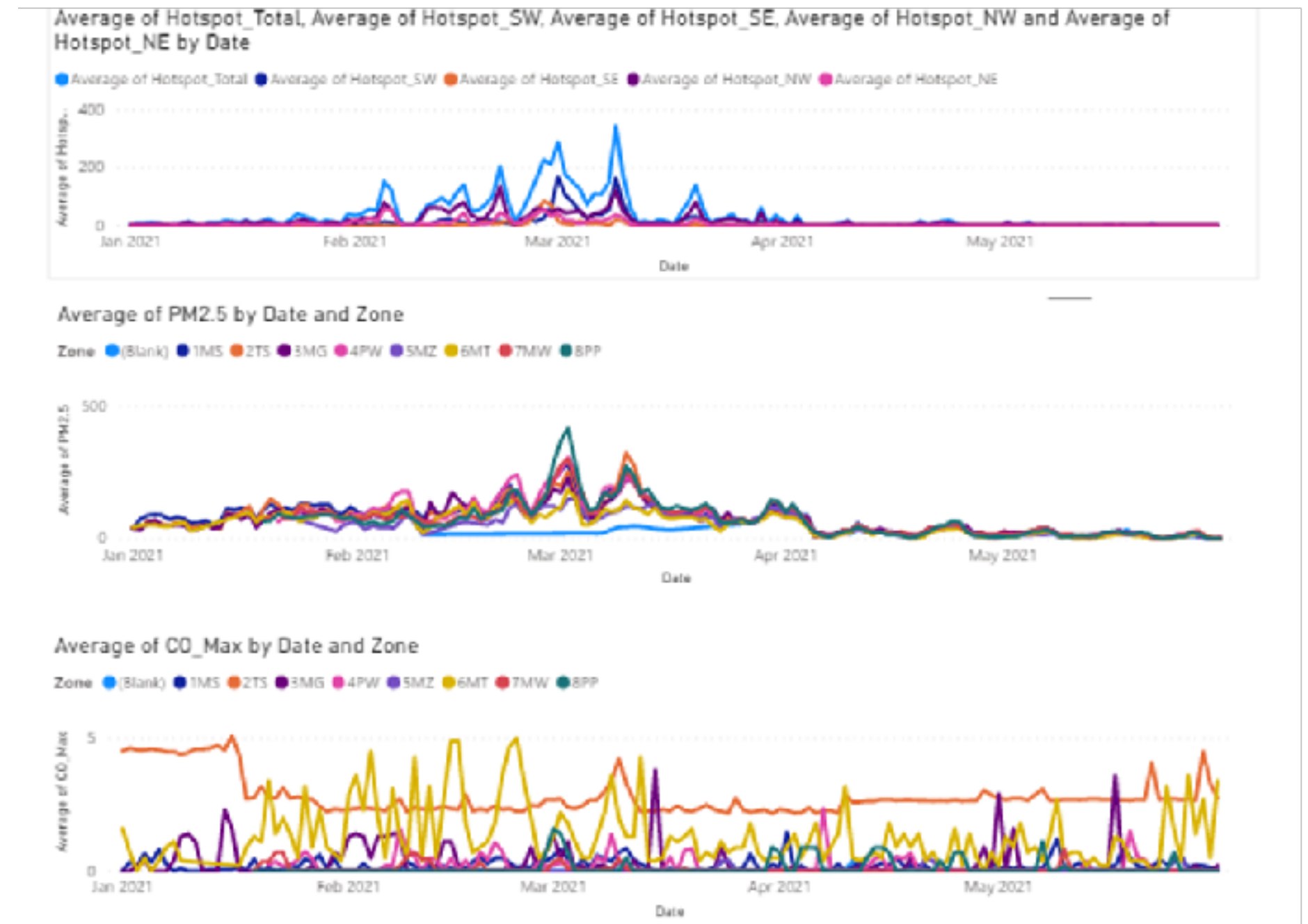
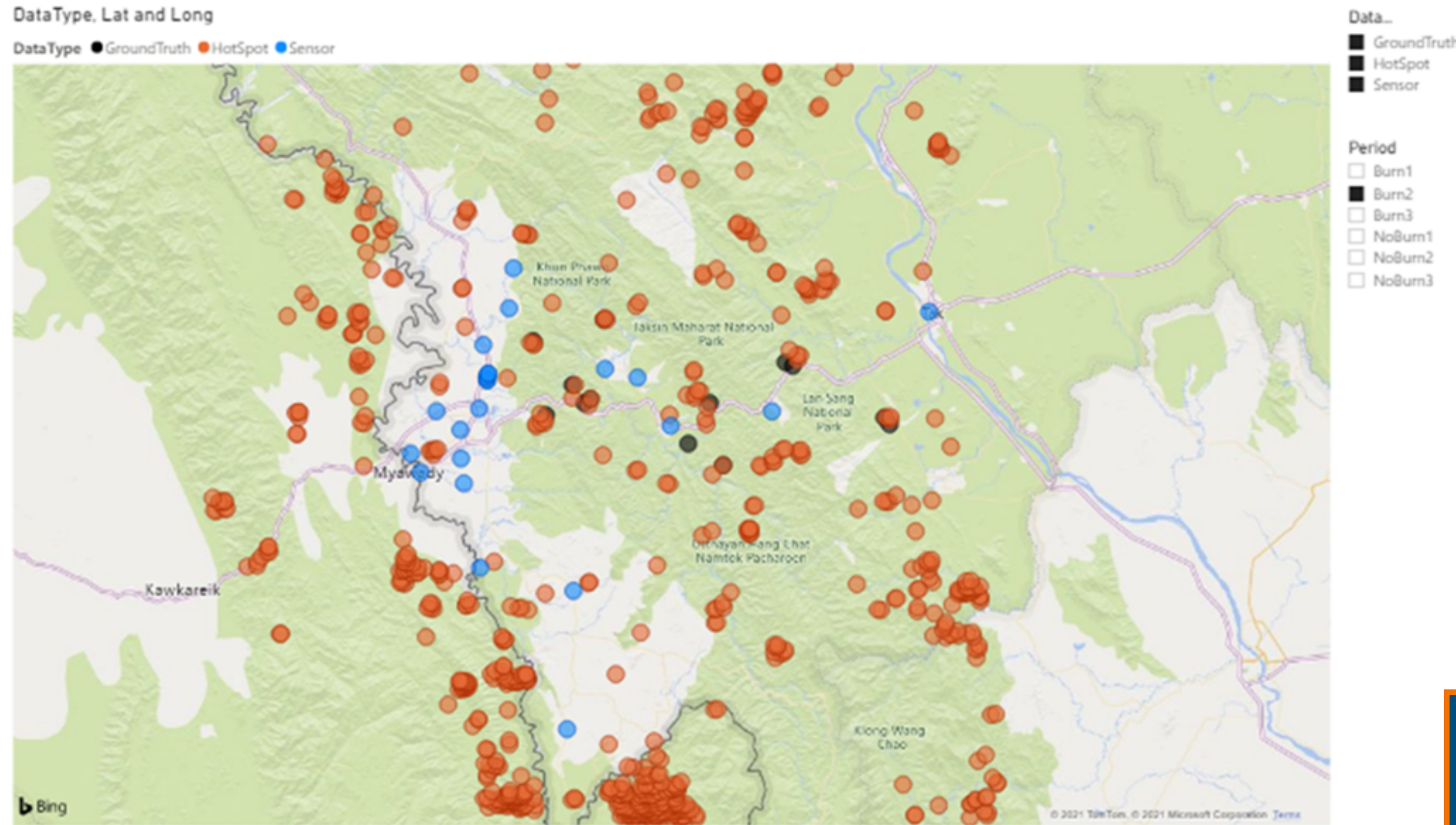
Deployment @ School in Mae Sot

- 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



Deployment @Tum Luang-Khun Naam Naang Norn Forest Park

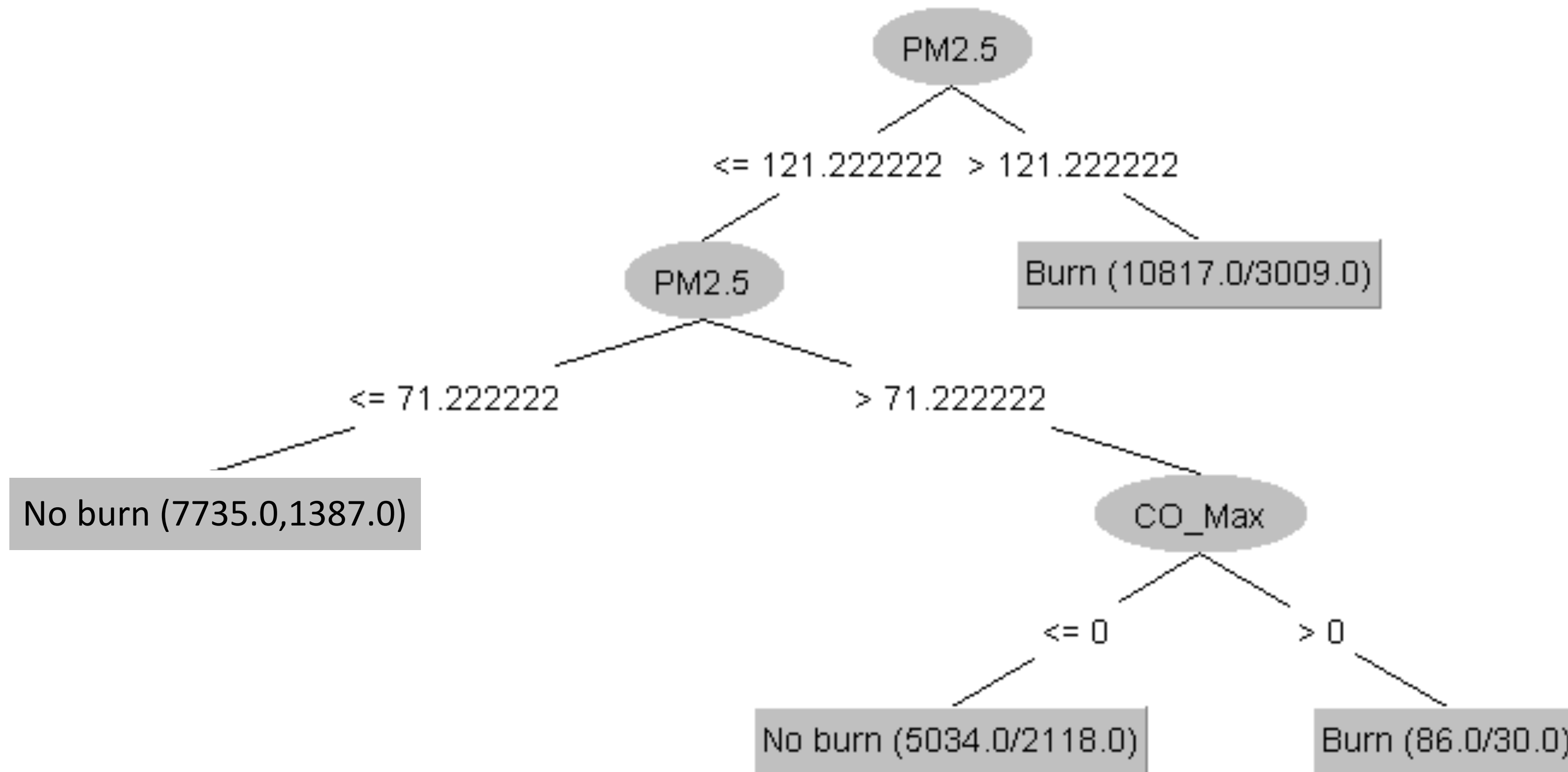
# Post Data Analytics with Forest Fire Incidents



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

- 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

# Applying ML for Forest Fire Detection Model

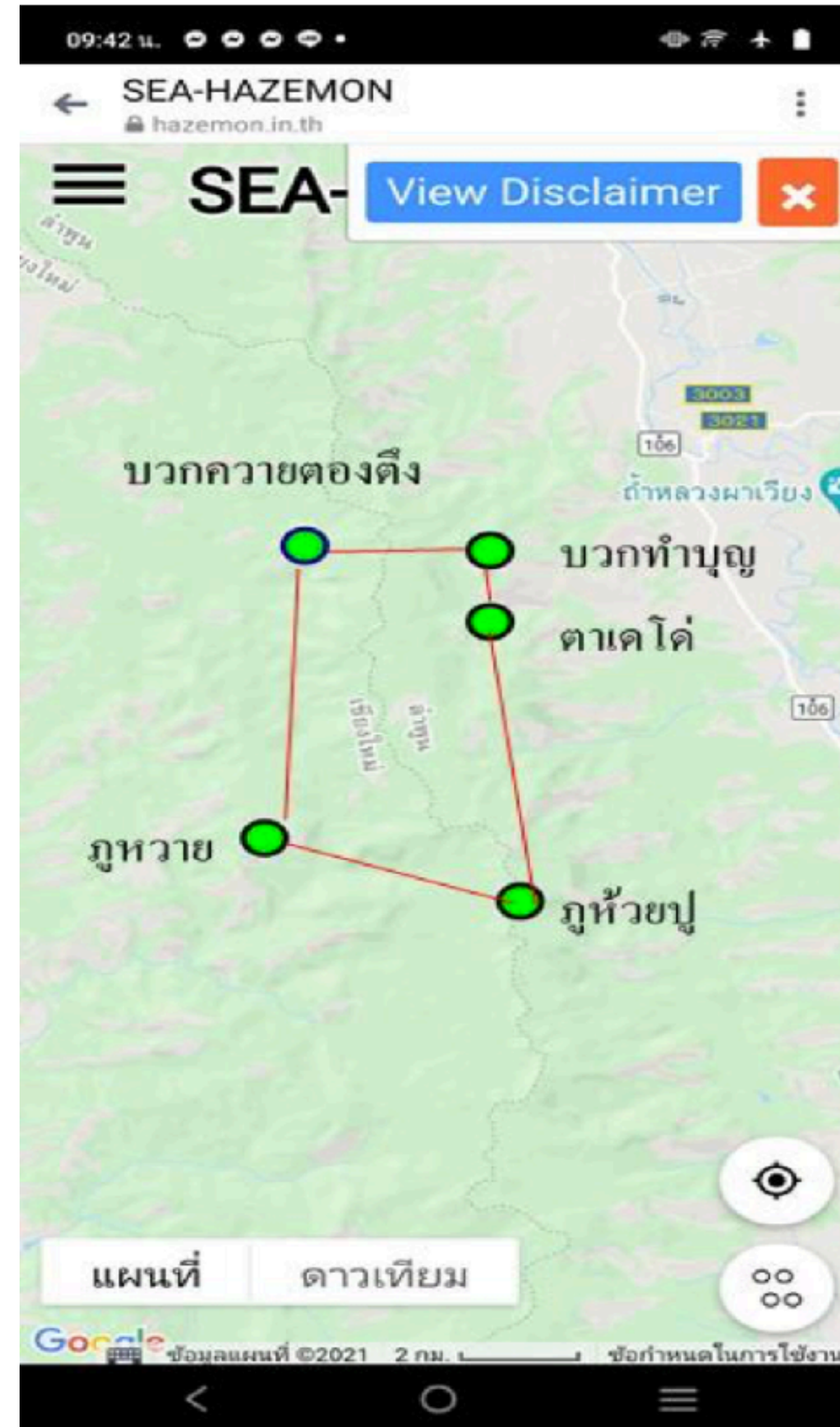
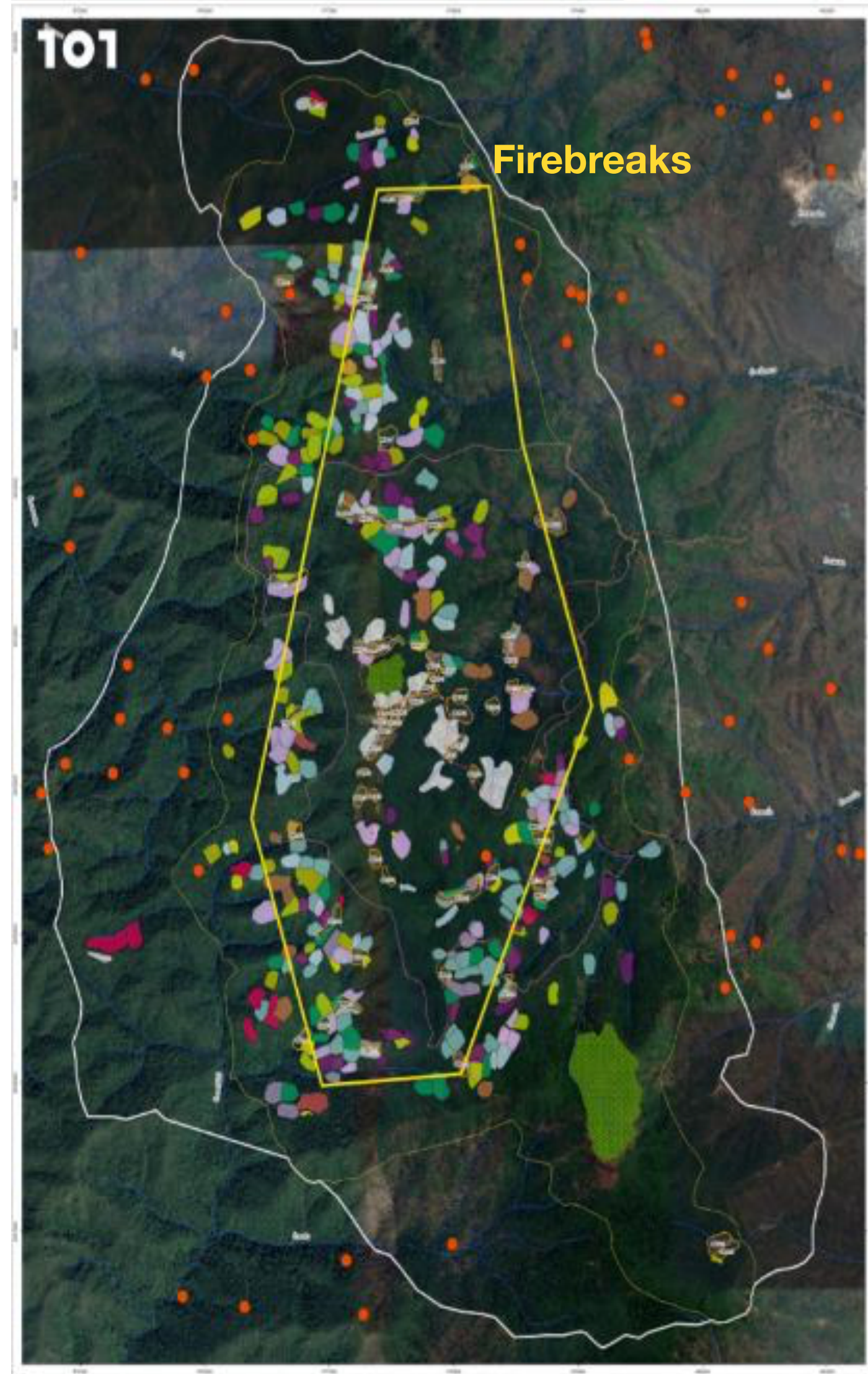


**Monitor** Realtime Forest Fire Incidents with PM2.5 and CO values

**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)



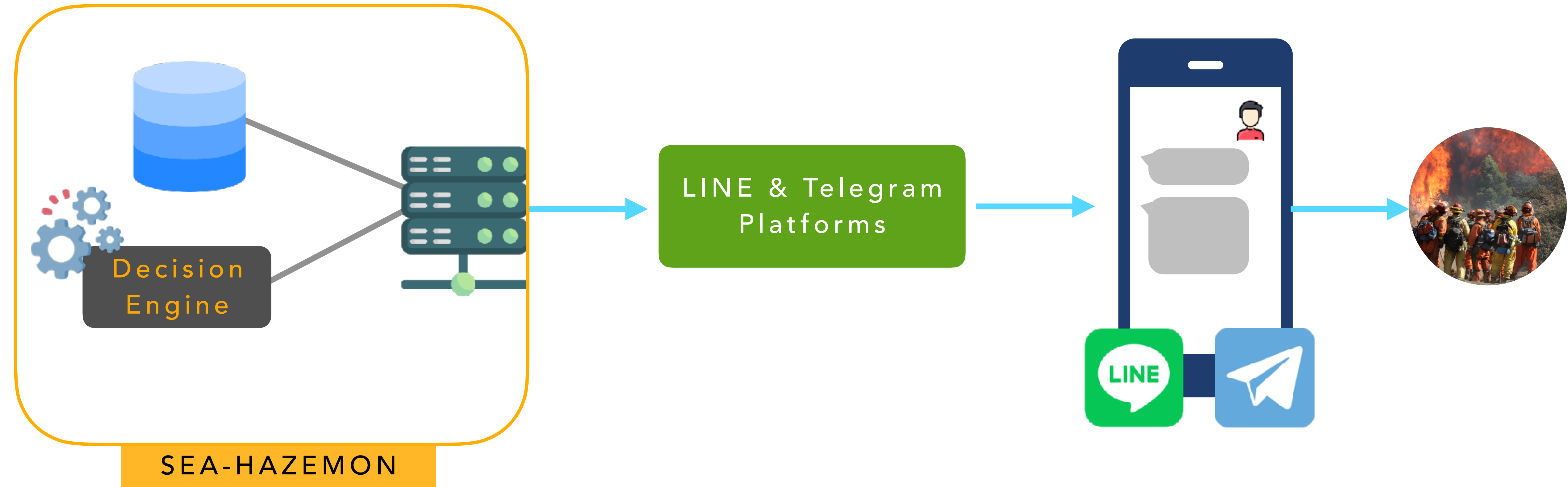
Canarin Sensor in the box



Motor Oil tray to protect insects and snakes



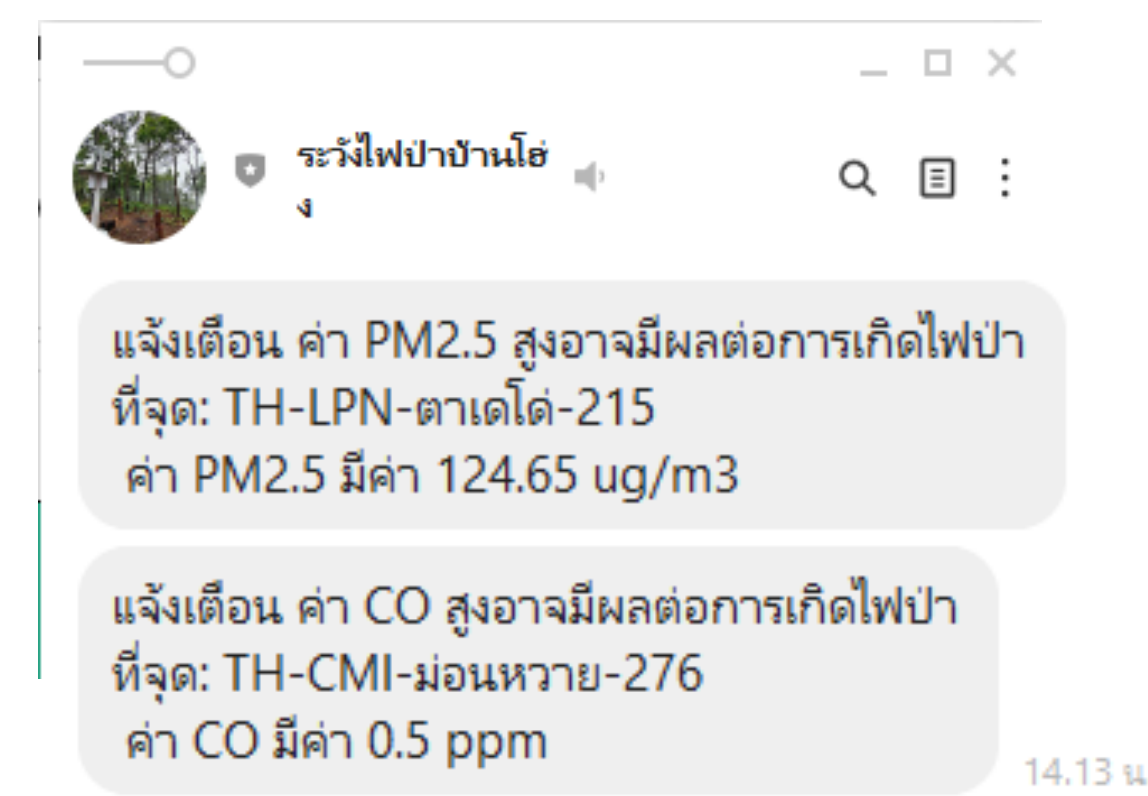
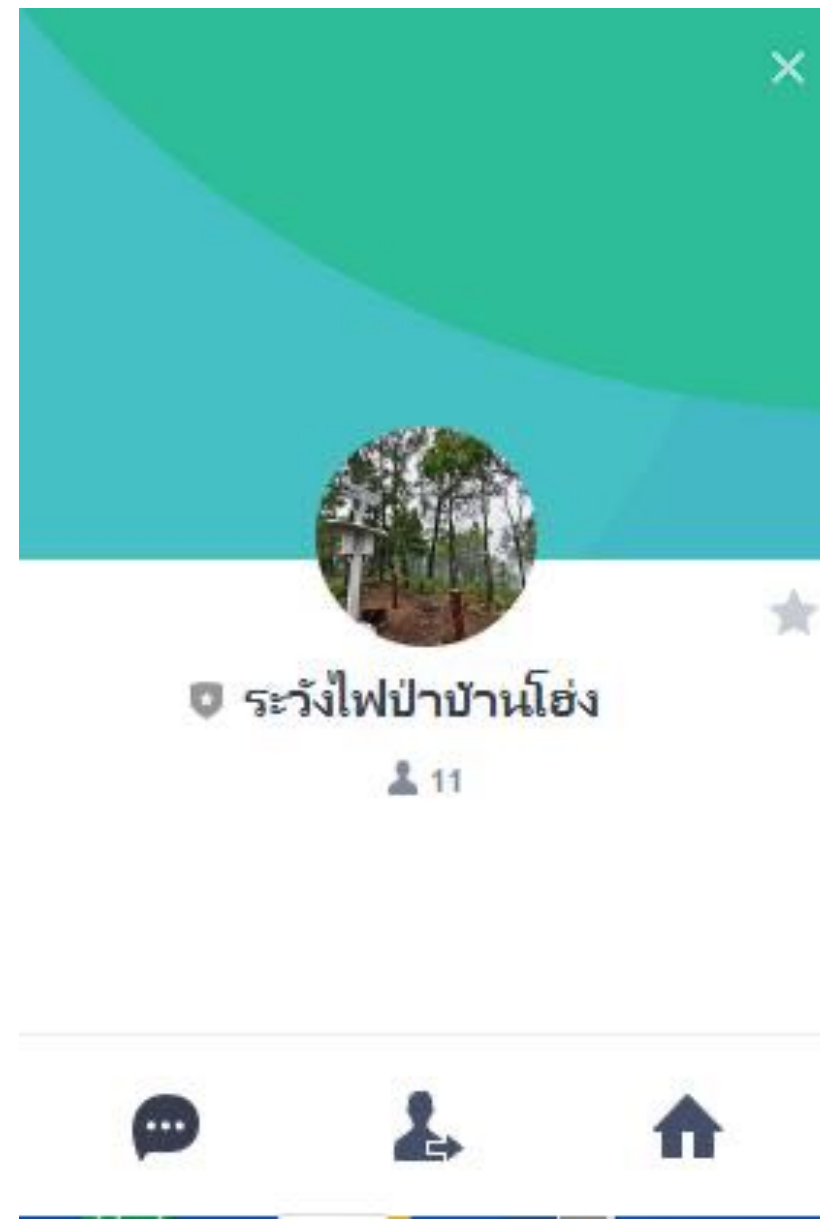
# Active Forest Fire Notification System



# 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



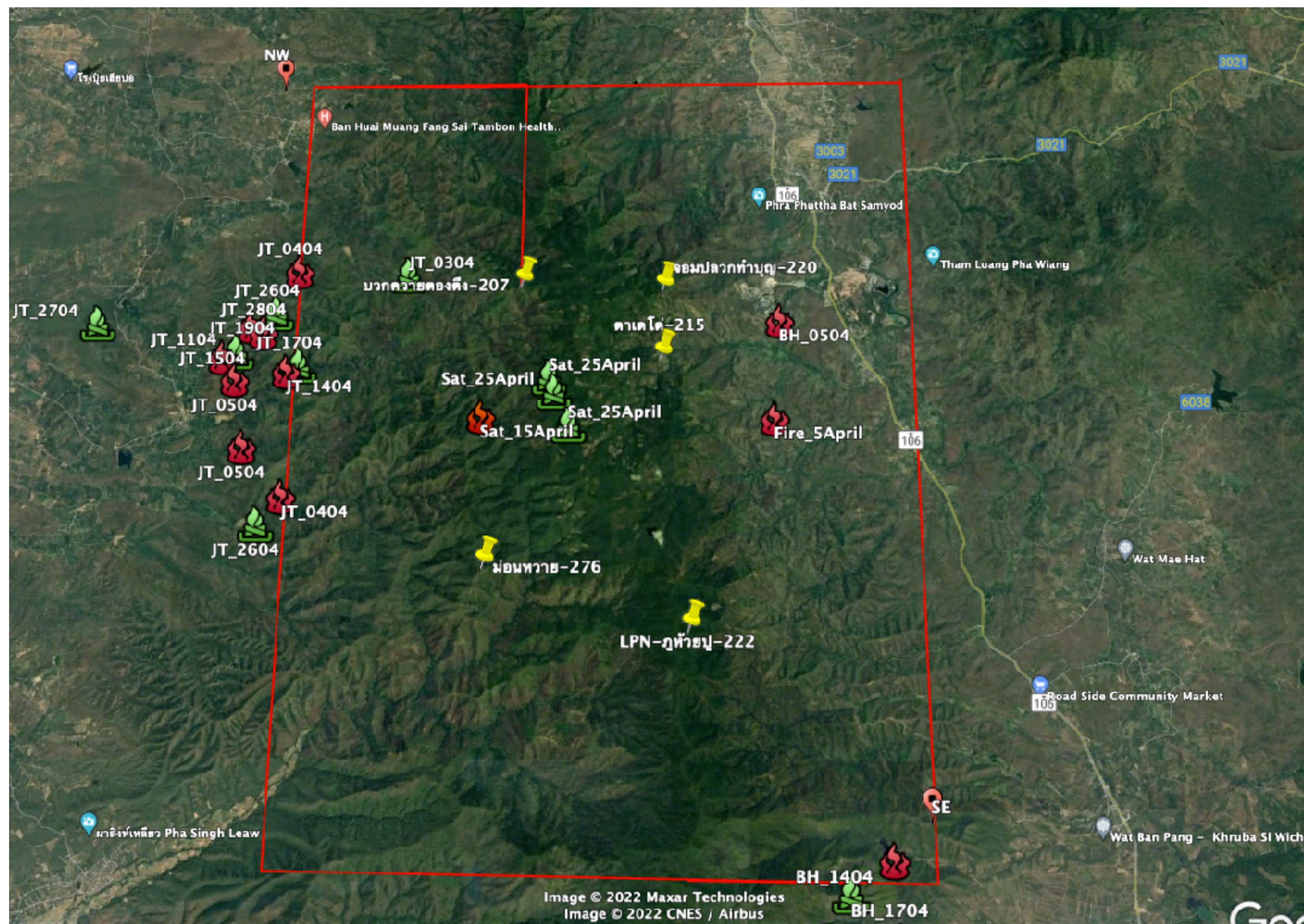
# Preliminary Study

## 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 !



ส่วนควบคุมไฟฟ้า  
สำนักป้องกันรักษาป่าและควบคุมไฟป่า  
กรมป่าไม้



European Union



IT University  
of Copenhagen

