Air quality monitoring: an ICN use case ?

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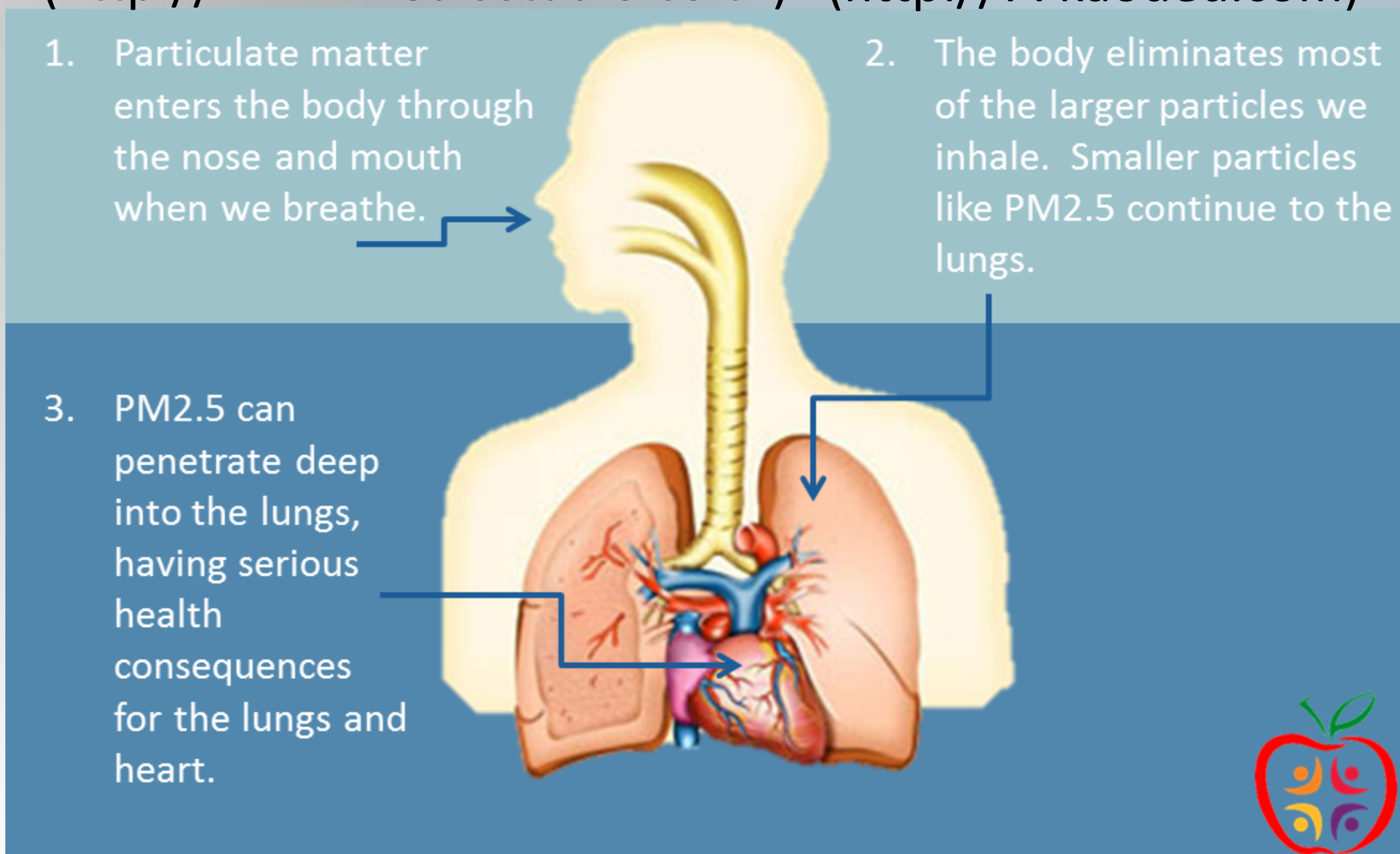
PROBLEM

(http://www.mediastudio.co.th)

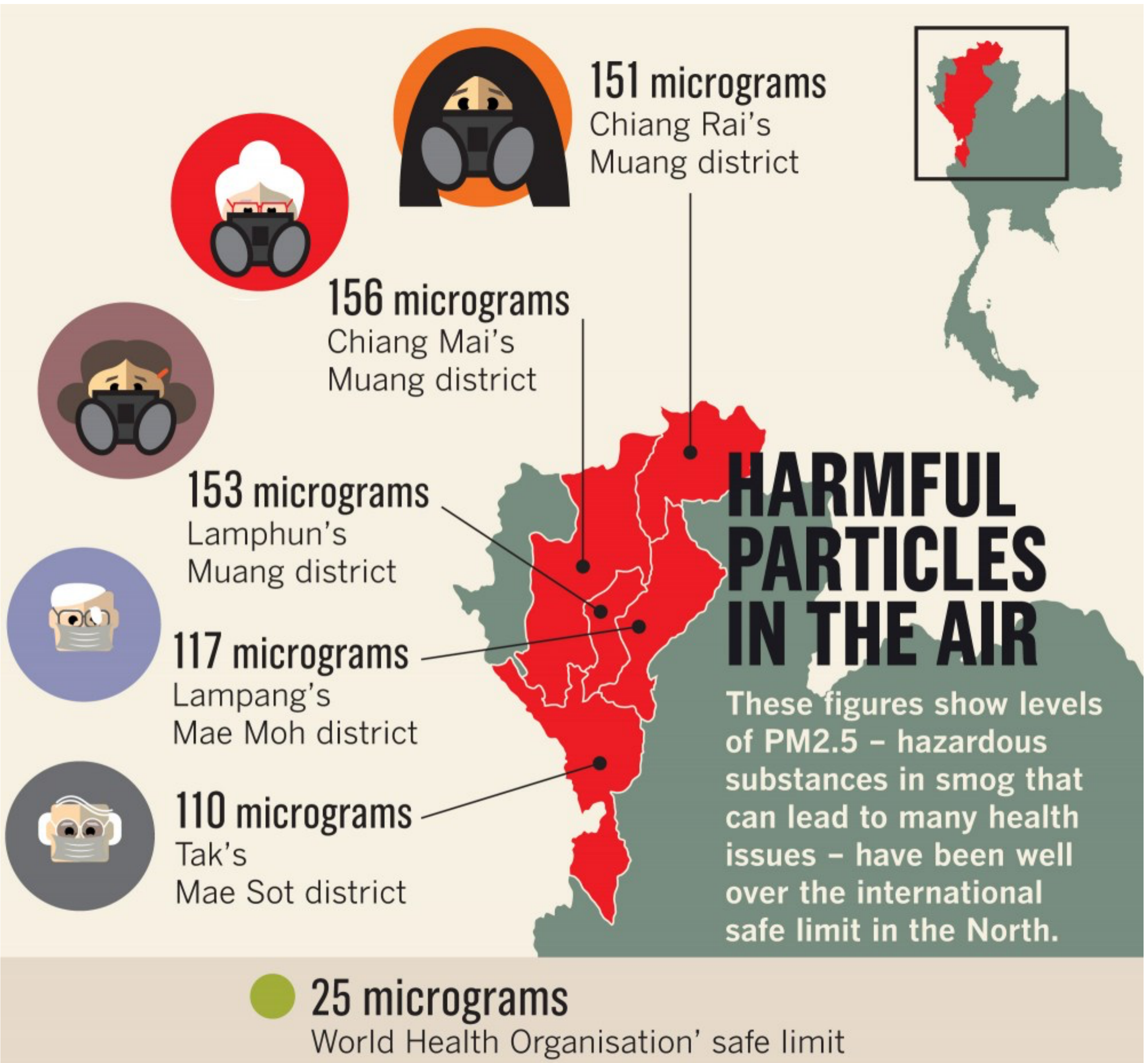
(http://77kaoded.com)



(http://www.health.utah.gov/utahair/pollutants/PM/)

In 2012, WHO estimated that: around 4.3 milli
on deaths linked to indoor air pollution while around 3.3 million deaths linked to outdoor air pollution (WHO, 2014).

Haze Crisis in Northern Thailand



Source: http://aqicn.org/

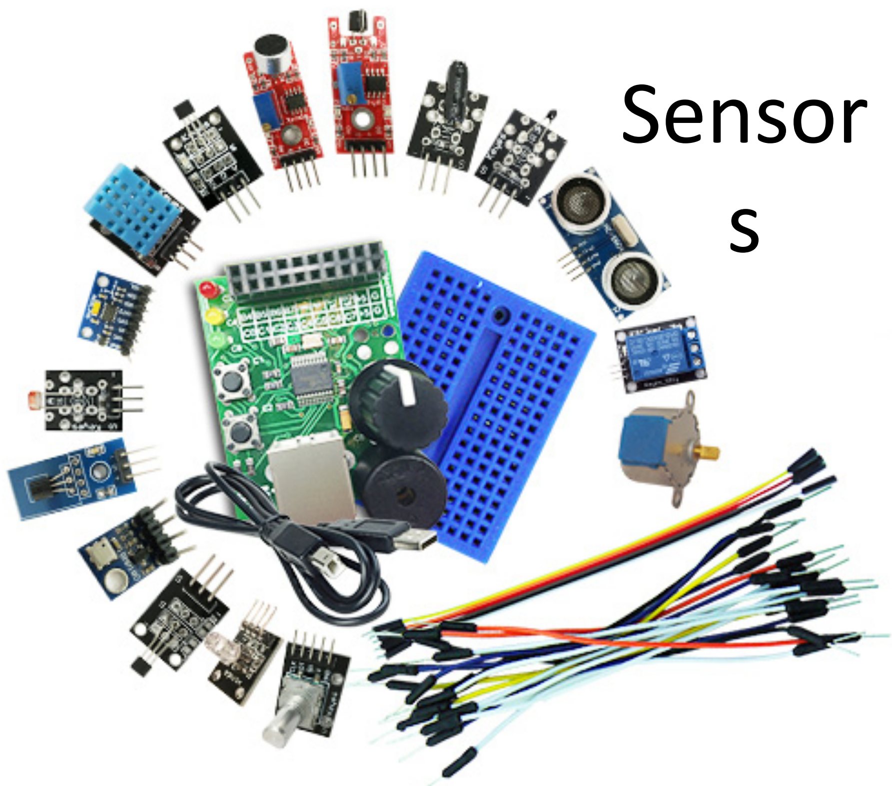
NATION GRAPHICS

Actions

- Air quality station - Pollution Control Department
- Satellite images taken twice a day only — hot spots
- Ban open burning after harvesting season For example, Mae sot, Tak (Thailand)

"60 days forbidding from open burning (10 Feb – 10 Apr 2018)"

Proposed Solution: IoT



Sensor
s

(https://www.ccsinfo.com/)

(http://www.acalbfi.com/uk/IoT)

This study focuses on the use of IoT ground level monitoring of $PM_{2.5}$ level to provide timely warning to the local communities

Why ICN/NDN?

- Names are more attractive than IP Addresses
- Decentralized: Internet availability can be intermittent - uploading data to the cloud can be disrupted and warning messages not delivered in time
- Real-time multiple data sources (Sensor DB) and, at any given time, many communities in affected area can send their queries

Step I: Can we use IoT for PM2.5 ground level monitoring?

Study area (Mae Sot, Tak)

Type of PM sensor

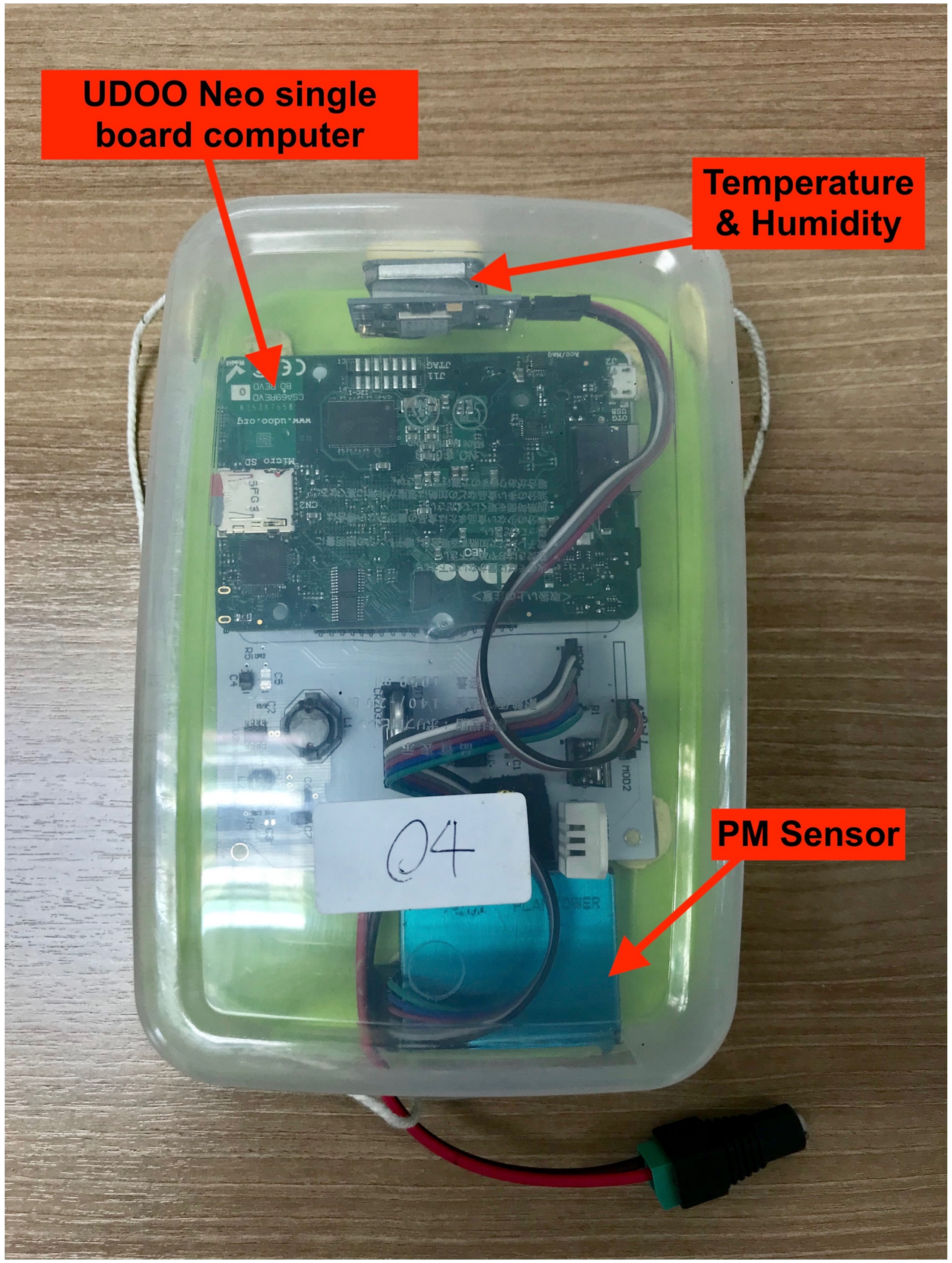
PLANTOWER PMS7003

Technical Index

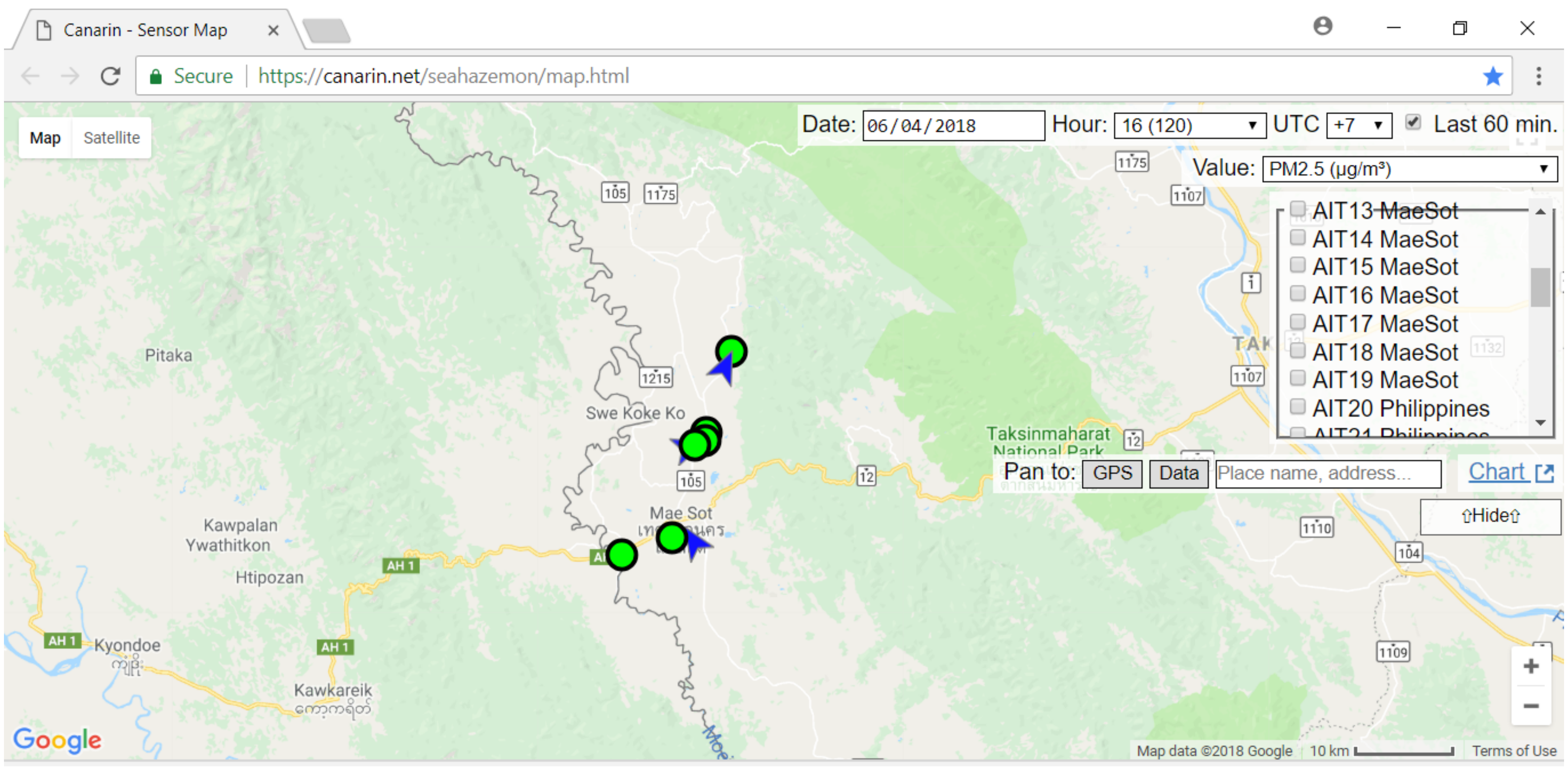
Parameter	Index	unit
Range of measurement	0.3~1.0；1.0~2.5；2.5~10	Micrometer（μ m）
Counting Efficiency	50%@0.3μ m 98%@>=0.5μ m	
Effective Range（PM2.5 standard）	0~500	μ g/m^3
Maximum Range（PM2.5 standard）*	≥1000	μ g/m^3
Resolution	1	μ g/m^3
Maximum Consistency Error (PM2.5 standard data)*	±10%@100~500μ g/m^3 ±10μ g/m^3 @0~100μ g/m^3	

Canarin Node

- IoT node: Canarin
  - UDOO Neo with 1GHz ARM Cortex-A9
  - SD Card storage
  - WiFi connection with GPS module
  - Sensors: PM1, PM2.5, PM10 and UVI

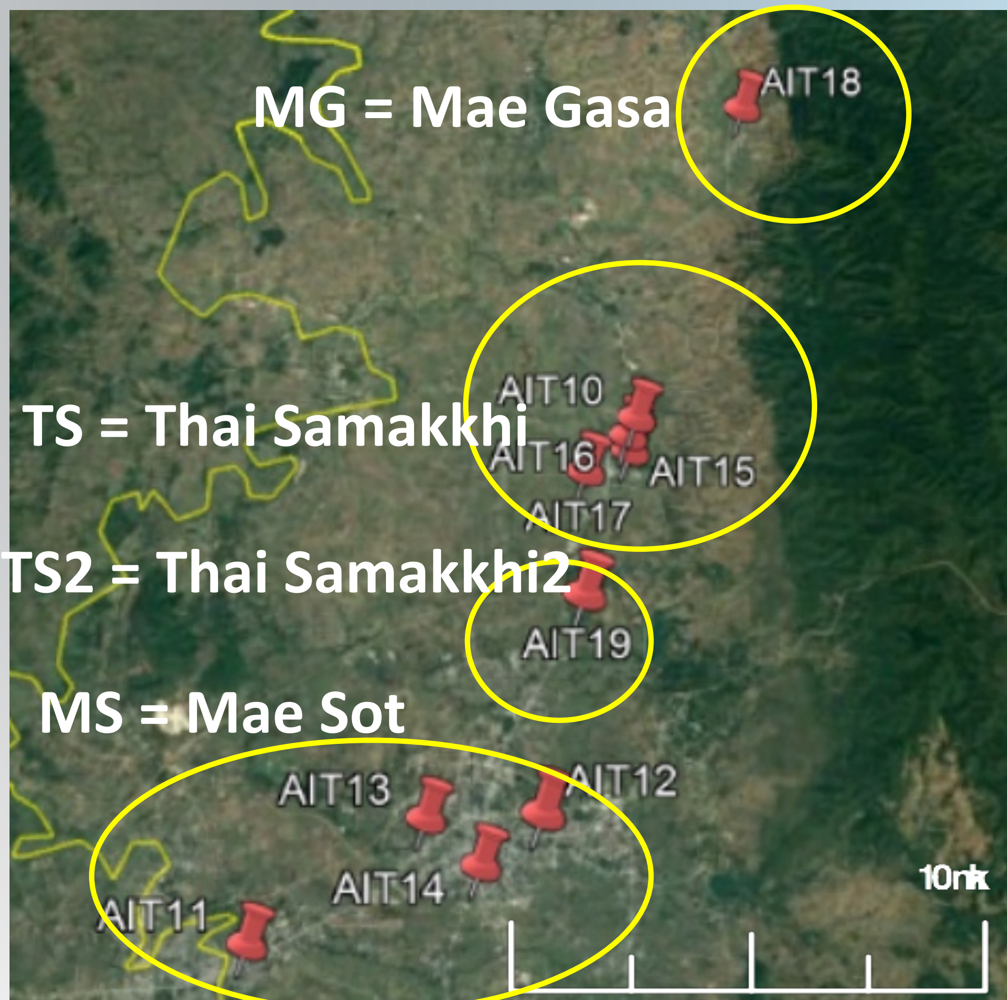


Upload data to the cloud.

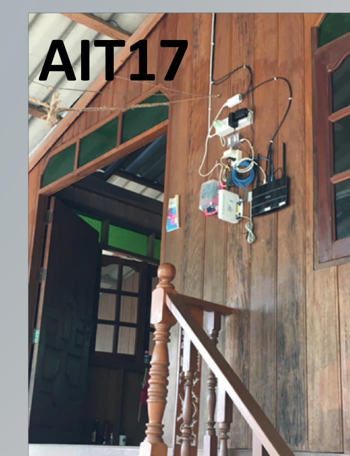


https://canarin.net/seahazemon/map.html

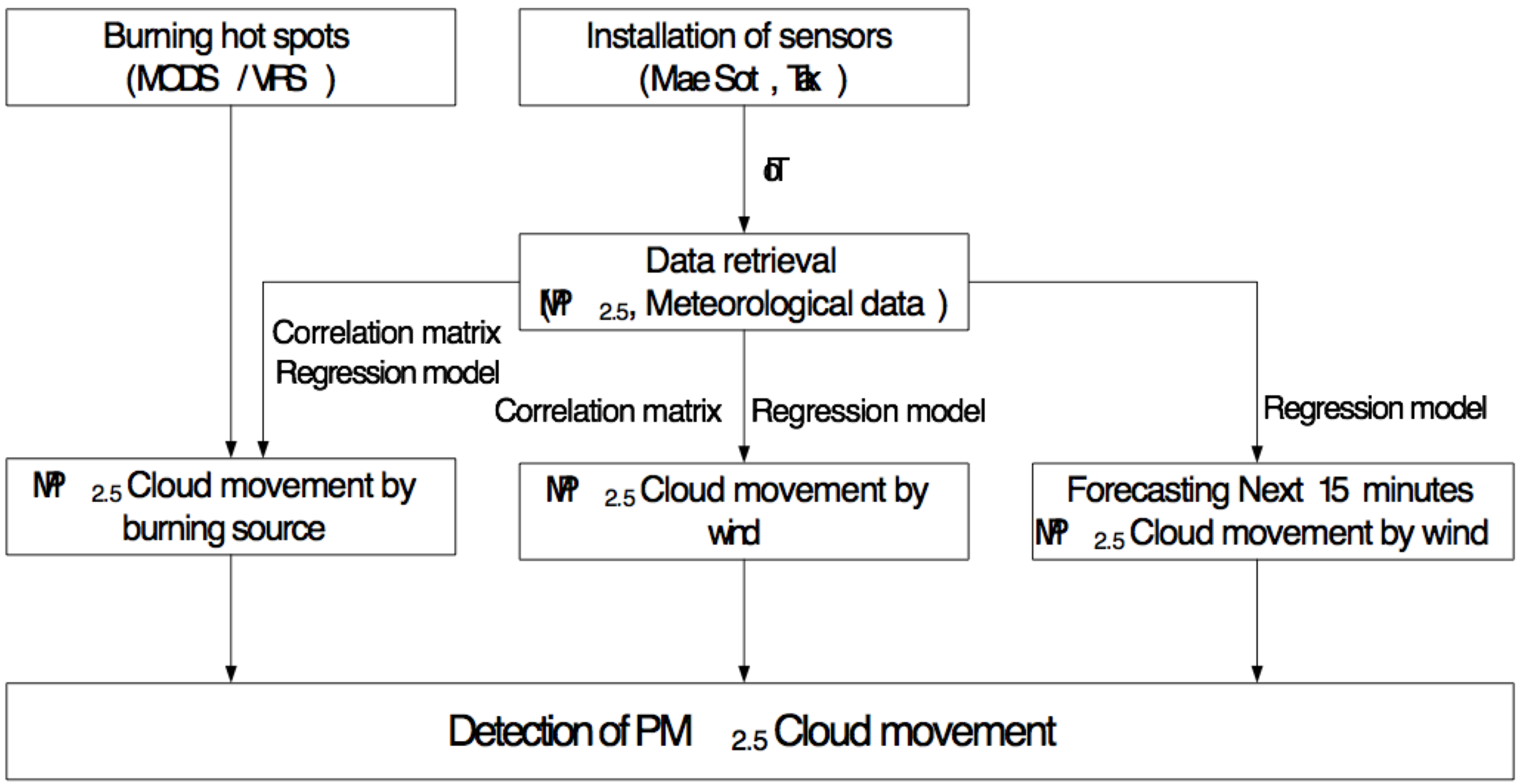
Data analysis



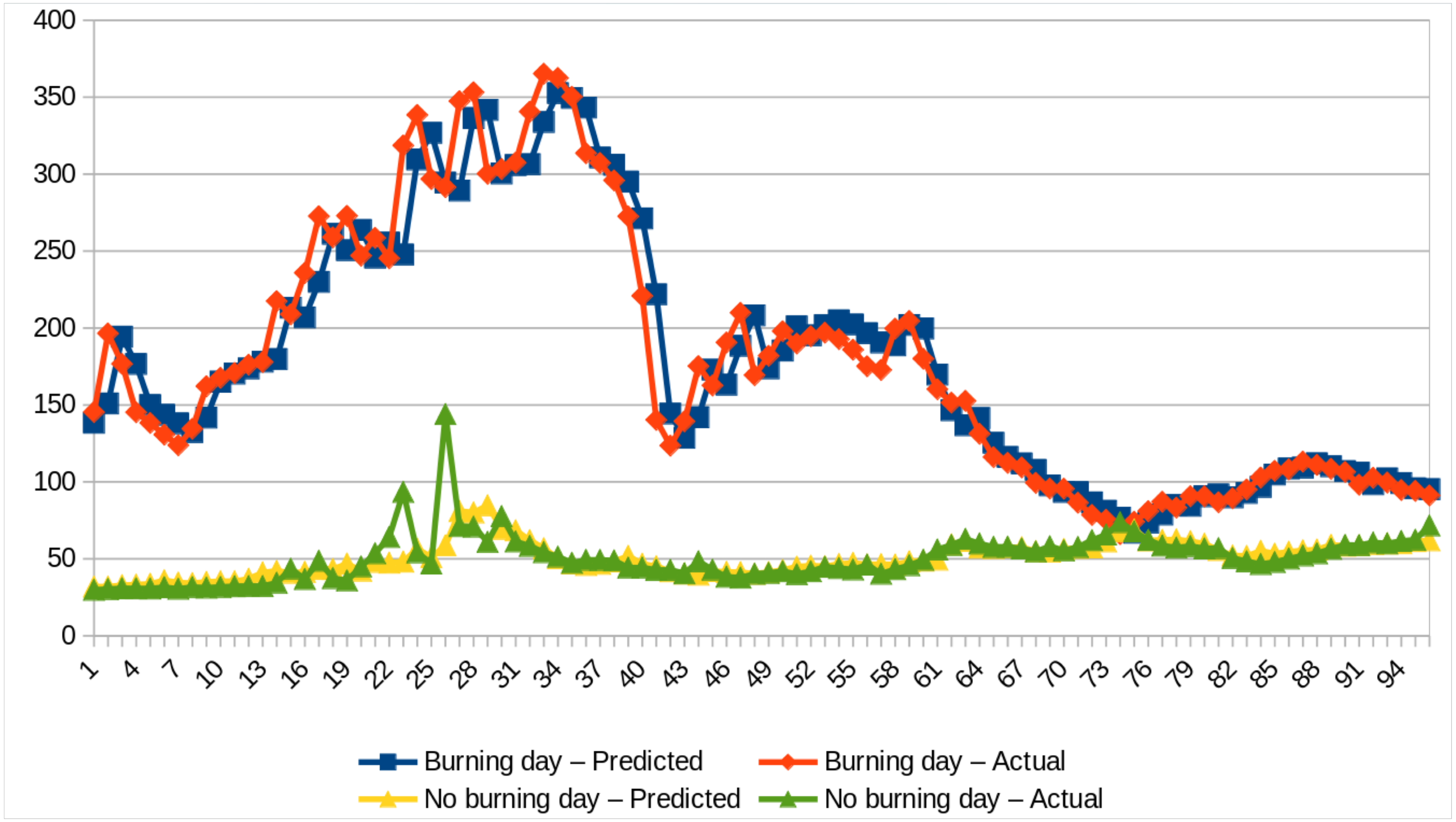
Zoning



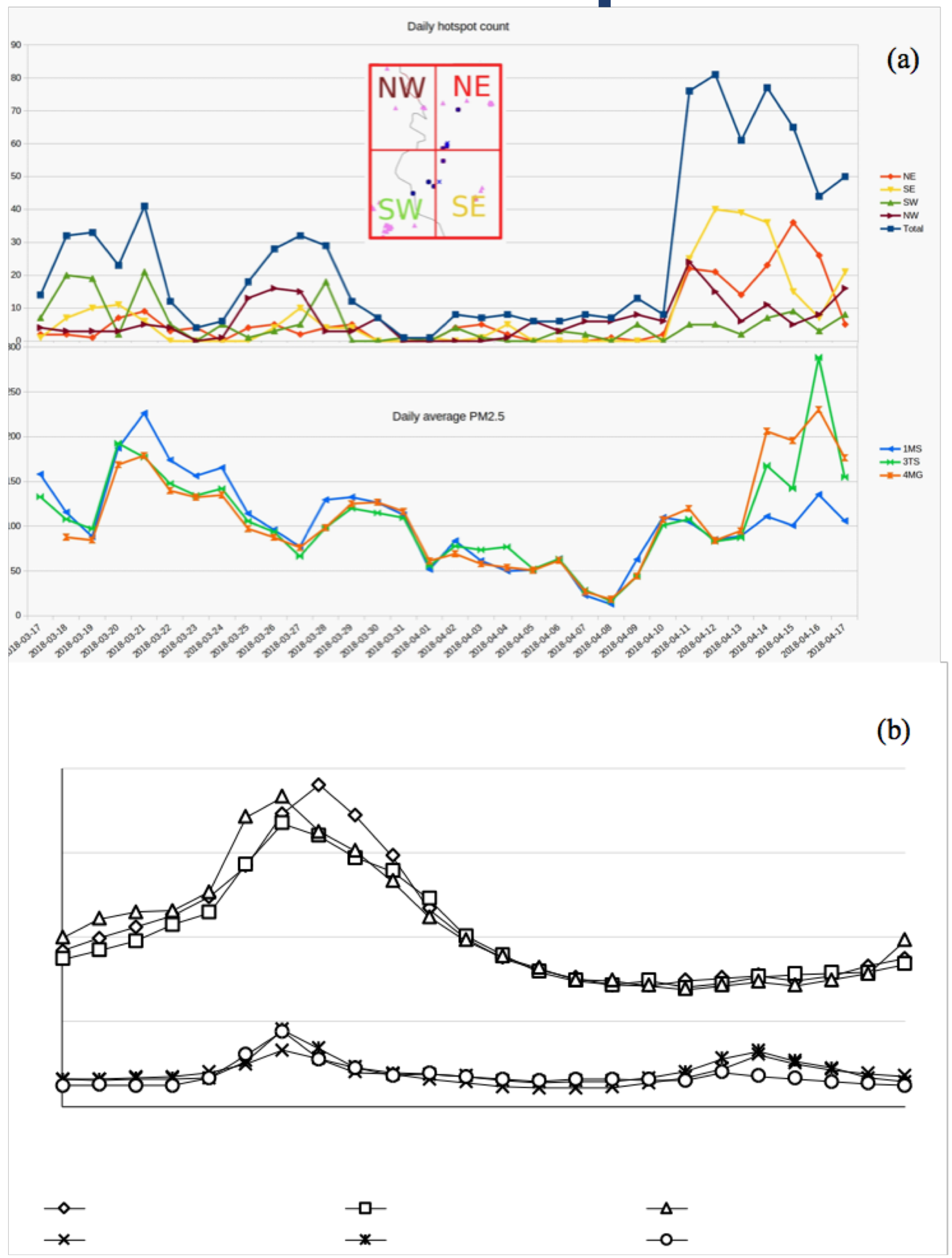
Data analysis



Burn-day(21 Mar) / No-burn(5 Apr.) day PM$_{2.5}$ actual vs. prediction @Mae Gasa



PM2.5 level vs open burning



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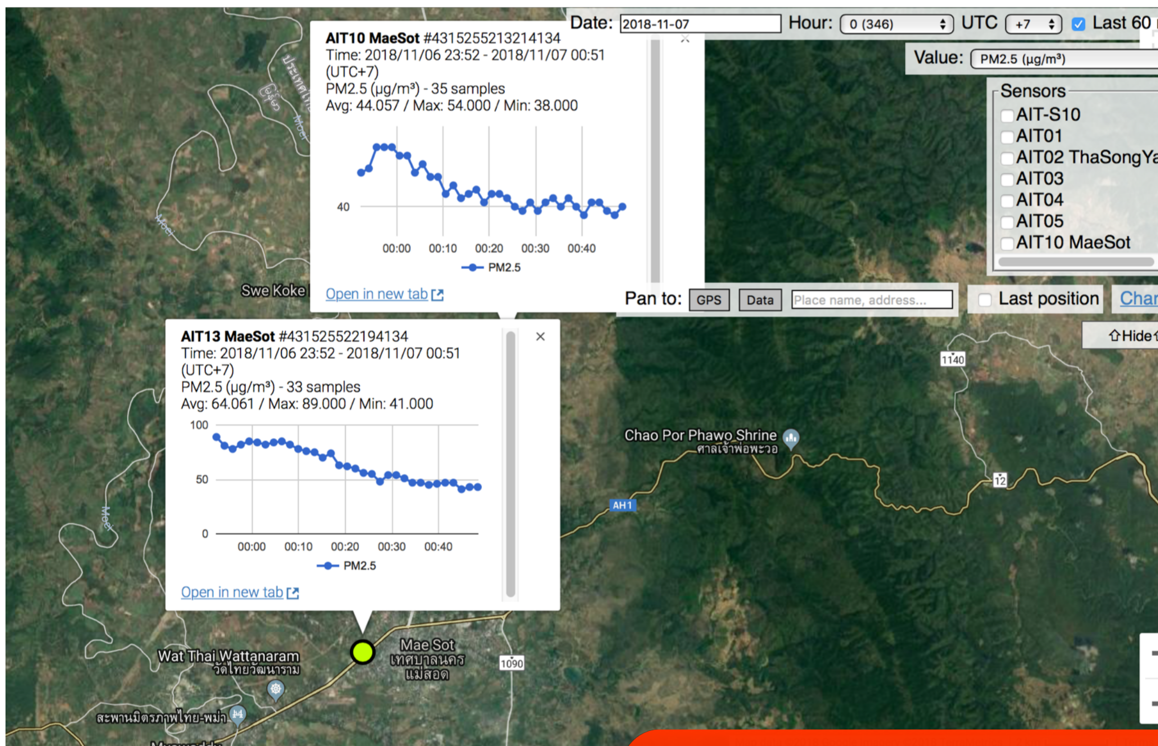
Step II: In-network computation with NDN

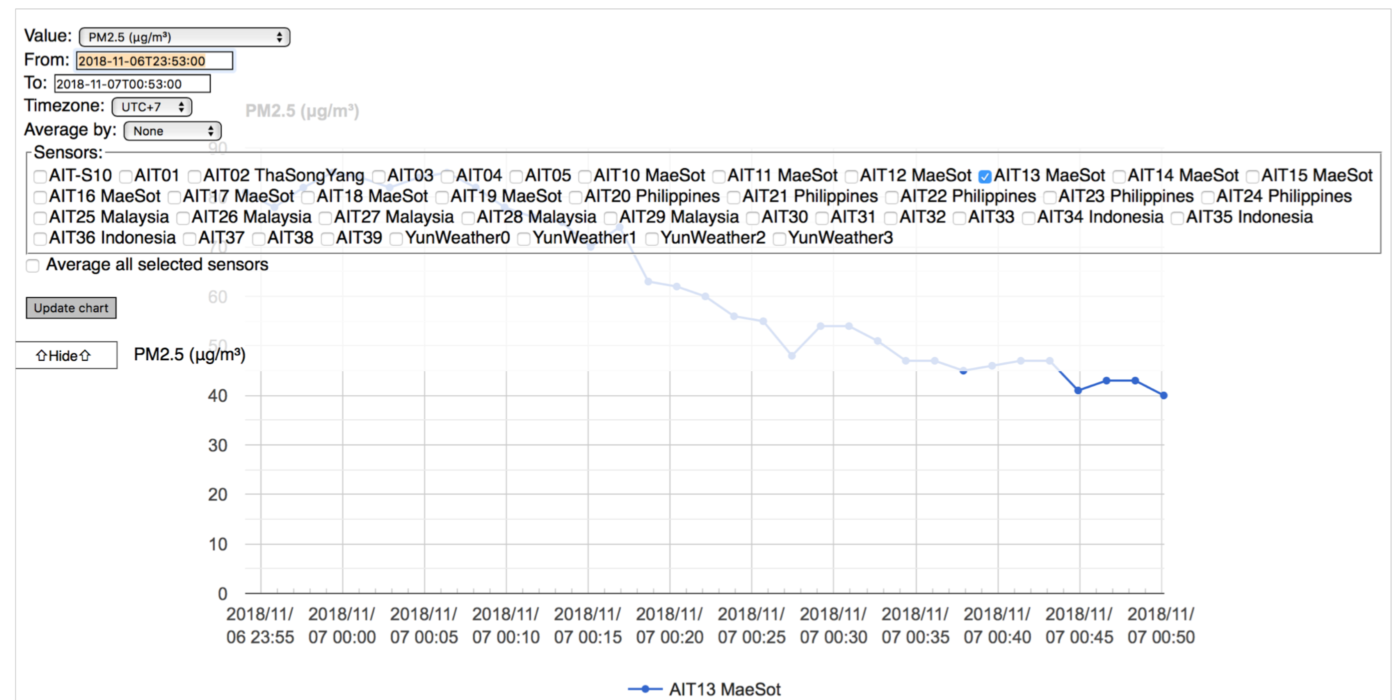
- Air-quality is meaningful for people in the affected area
- Programmable

Example:

- To search for possible sources of the fire — find higher PM reading and compute path towards sources of fire
- To predict PM level in community X, X sends interests for PM streams from neighbouring sites as well as wind direction information to feed into its prediction model

Using IoT for ground level monitoring and detection





PM detection & real-time warning

ultimately with sufficient coverage, we should be able to characterise haze from agricultural burning or forest fire

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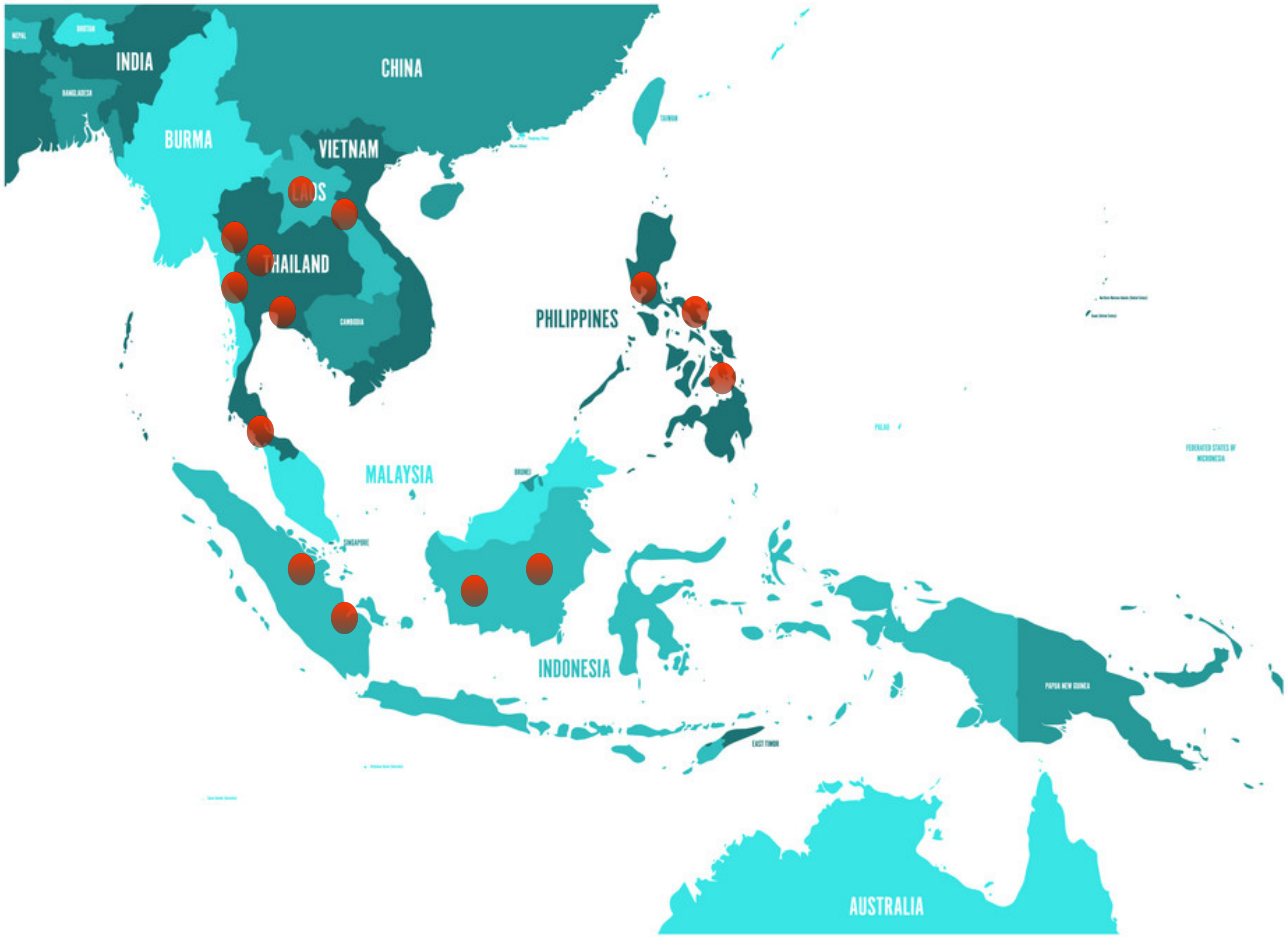
Future plan: SEA-HAZEMON

- ScaleUp the network
- Deploy Canarin node in 4 countries
  - Thailand
  - Laos
  - Philipines
  - Indonesia



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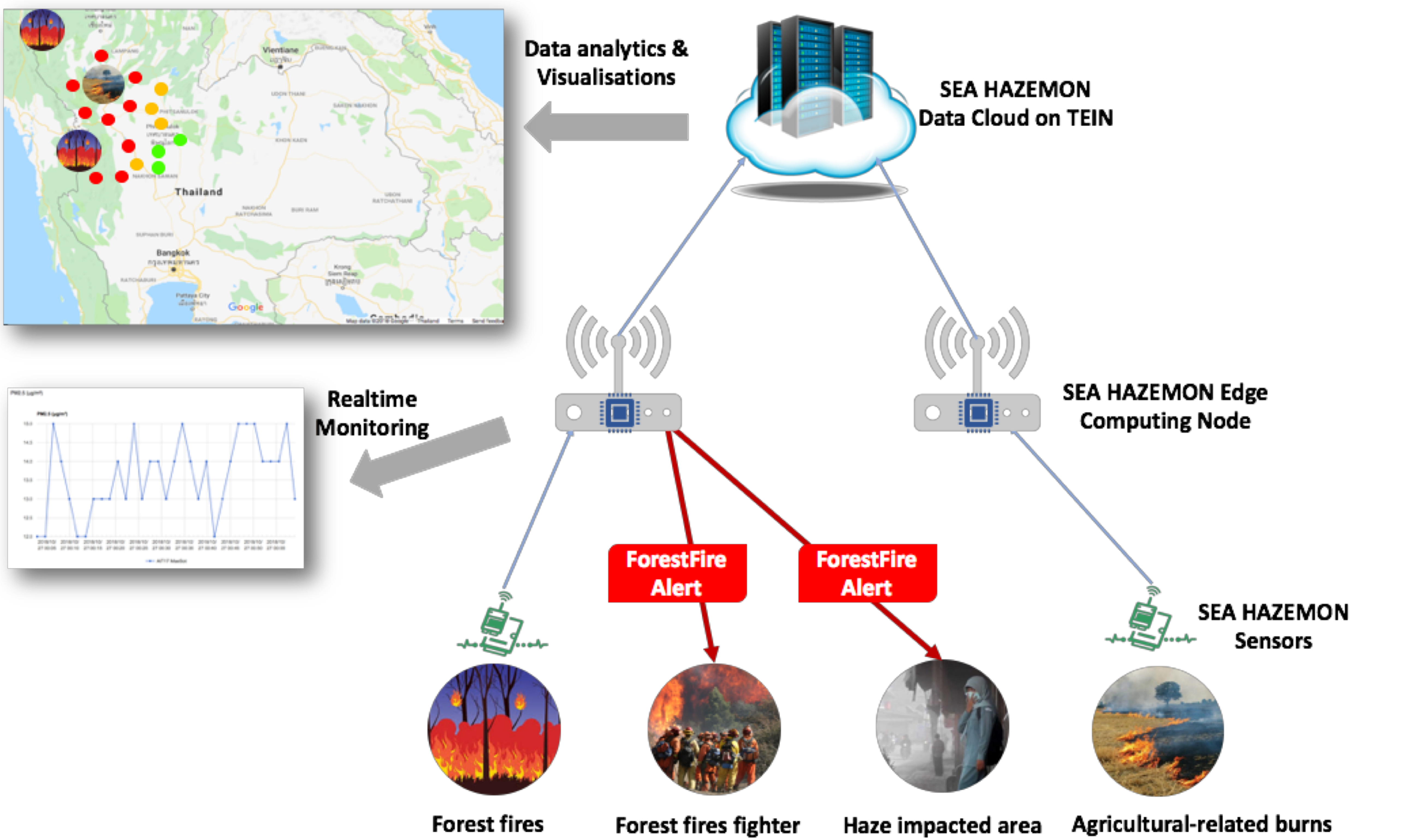

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