Geospatial Modelling for Estimation of PM 2.5 in Thailand

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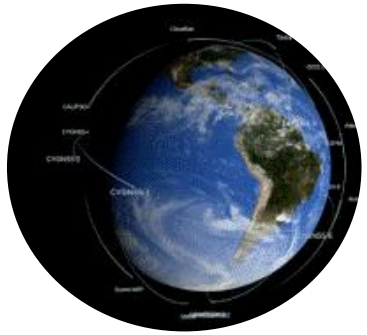
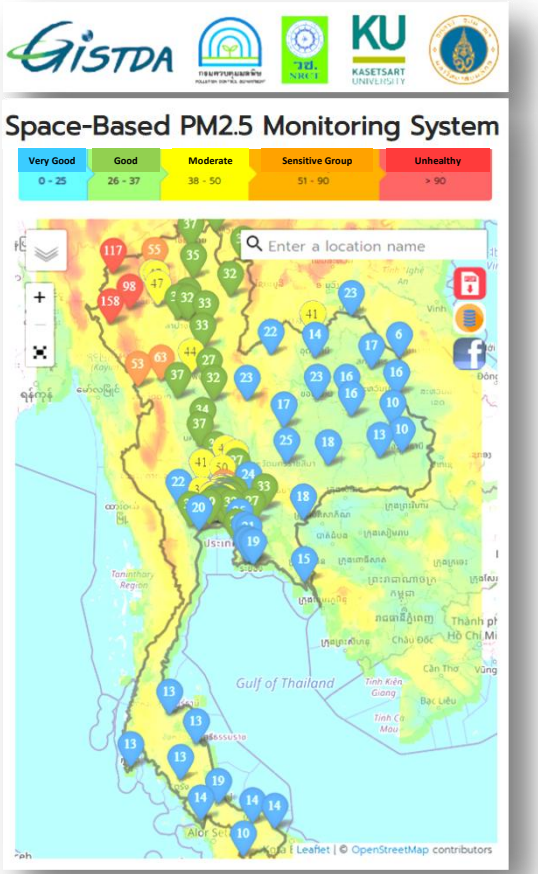
The 6th AOGEO Workshop will be held in person in Macau, China from May 29-31, 2023





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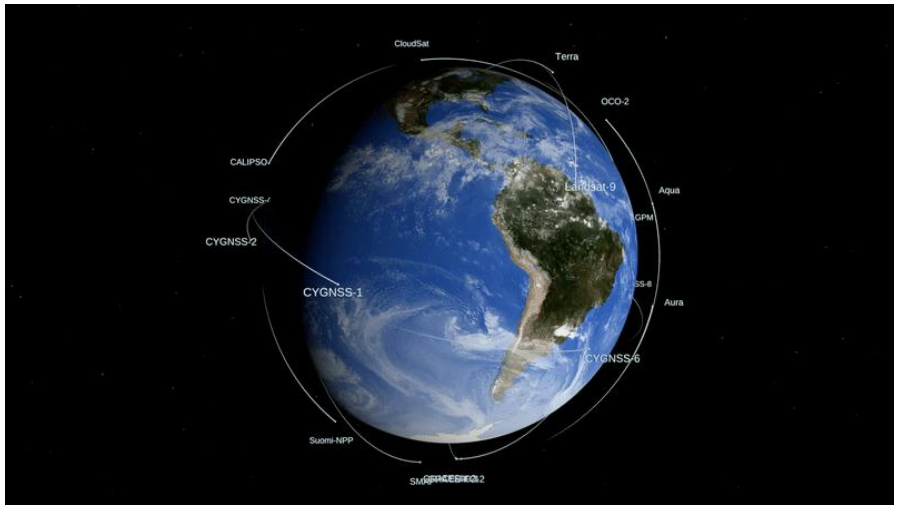
Introduction

To solve the PM2.5 problem, it needs to integration in many sectors for access the geospatial database which a continuous, up-to-date and reliable for all sectors can understand in the overview of situations that occur and use this data to support the implementation.

As we know the distribution behavior of aerosol depends on the weather such as air temperature, air movement. And these are limitations that cannot be install the ground weather and air pollution measurement station in every square kilometer.

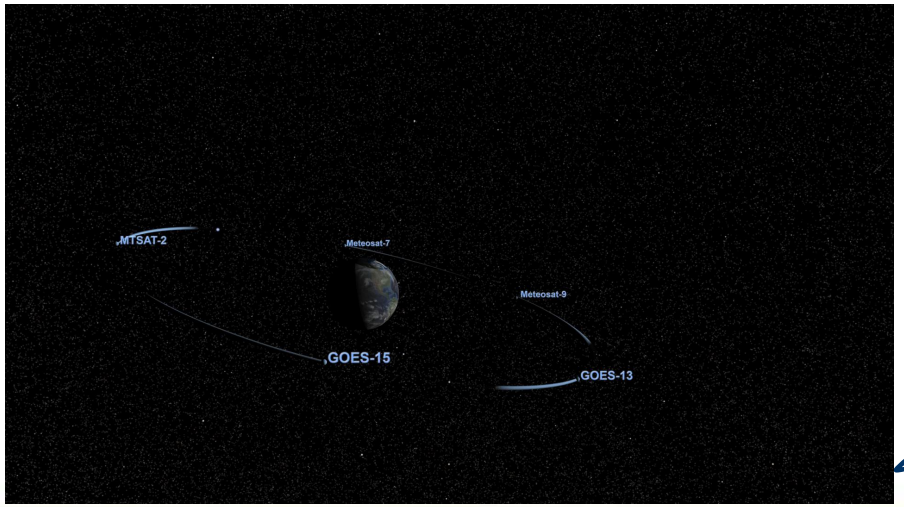
Satellite

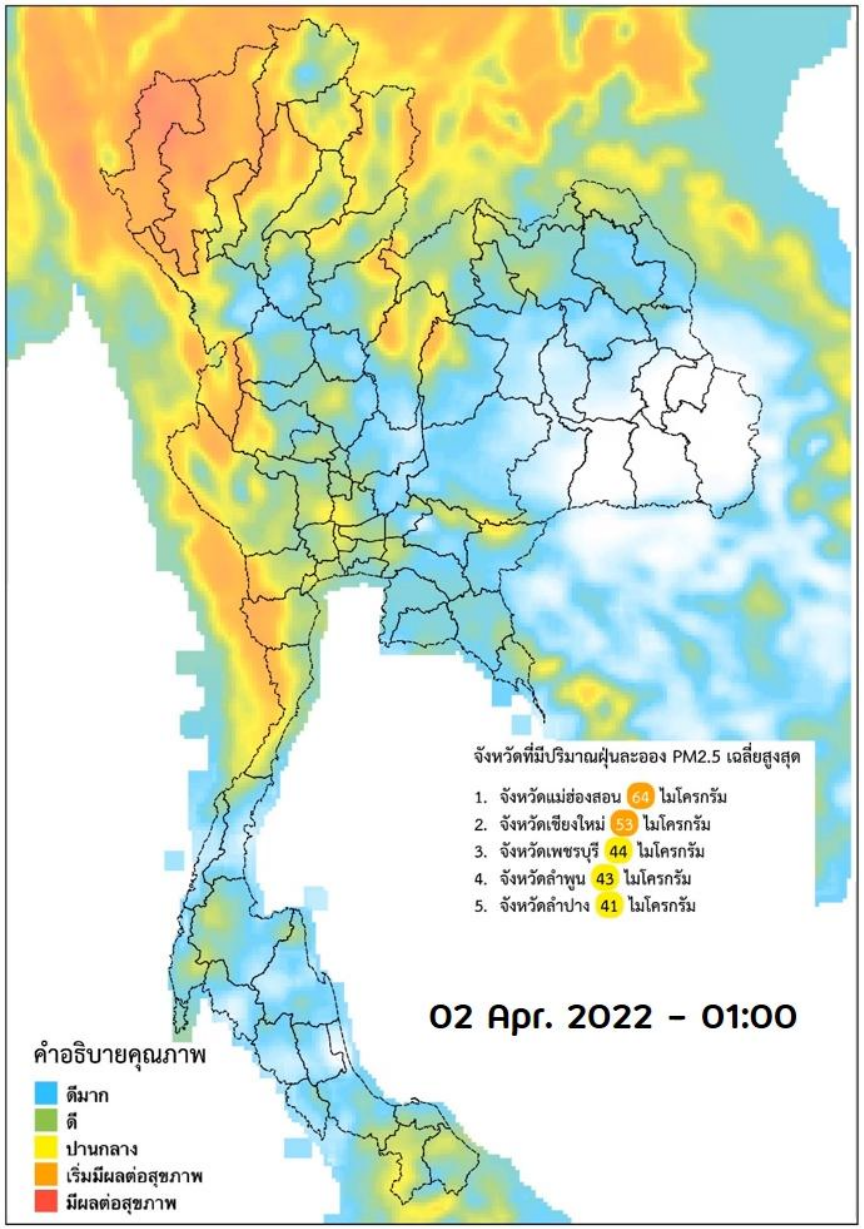


Satellite data could be used to estimate the PM2.5 in near real-time providing air quality index on hourly basis.

It could be used to support the analysis of PM2.5 estimation due to the limitation of ground-based measurements.

Satellite data can also be examined to study dust movement for monitoring the cross-border pollution.





Objective

Study, collect and analyze satellite imagery, geospatial data, ground-based measurements and other PM2.5- related physical factors

Assess near-real time concentrations of PM2.5 at hourly basis over Thailand

Provided geo-spatial data service which is accessible via online platform.

Methodology

1. Data Collected

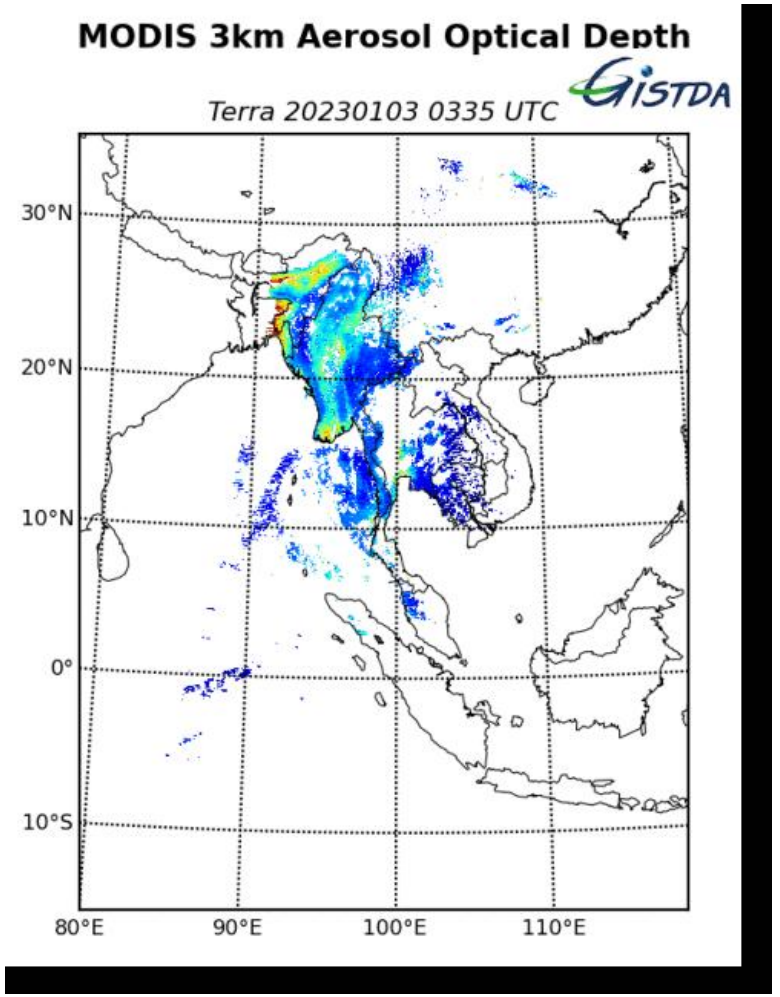
1.1

AOD data in hourly from Himawari satellite

AOD data in daily from MODIS satellite

2017-present

AOD data from Himawari satellites downloaded and processed are hourly averages per grid which conform to the particulate matter measurements according to Pollution Control Department guidelines with a spatial resolution of approximately six square kilometers.



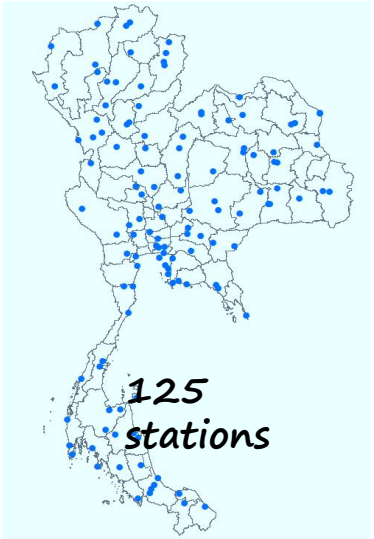
Methodology

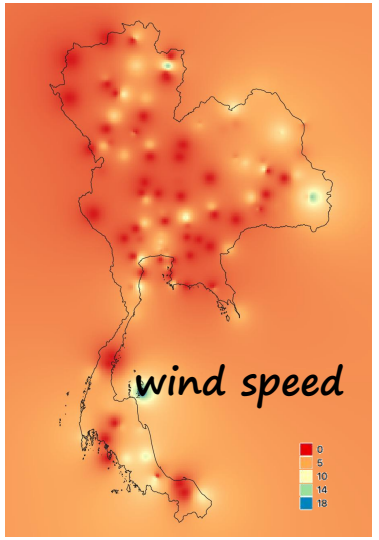
1. Data Collected

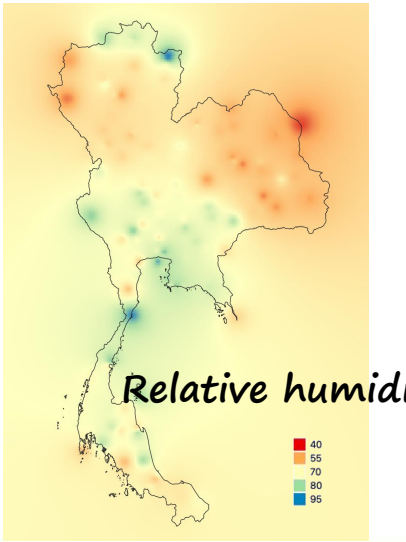
1.2

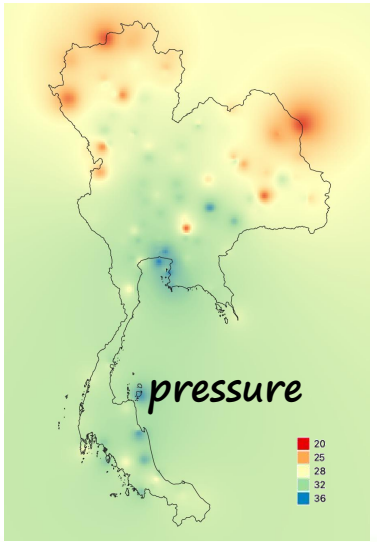
API Measurement results and weather forecast from Thai Meteorological Department

wind speed, relative humidity, barometric pressure from a 3-hour web service (data in XML format) from 125 stations across the country are downloaded and processed to generate raster grid data.







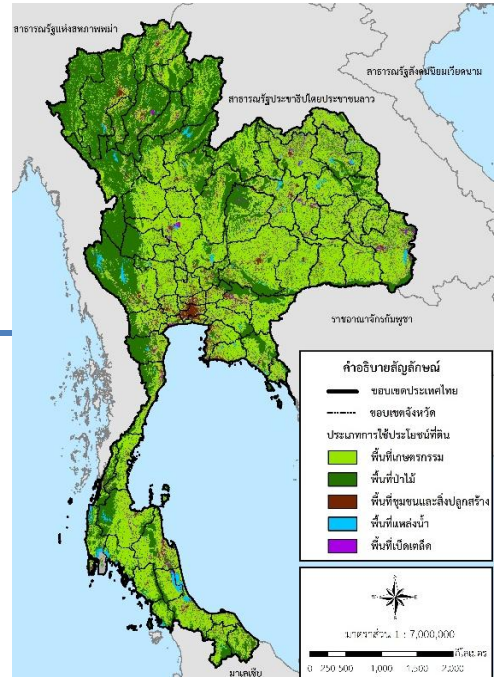


Methodology

1. Data Collected

1.3 Landuse

Landuse data from Suomi NPP

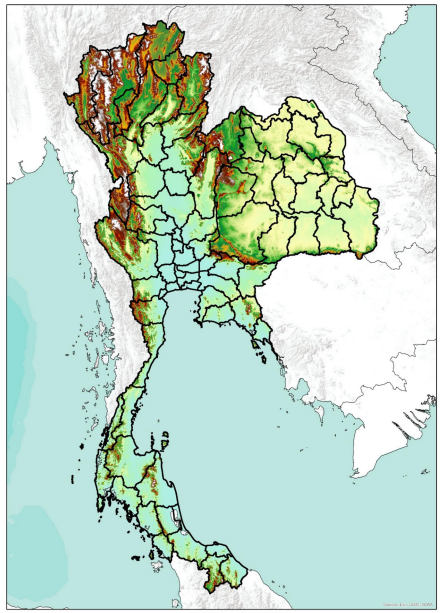


The latest 3-year annual **NDVI** data from the Suomi NPP satellite, calculated from the weekly NDVI average, were used to create a baseline data with a pixel resolution of 1 square kilometer for the representation of land use.

1.4 SRTM

The topographic data from SRTM

(Shuttle Radar Topography Mission)

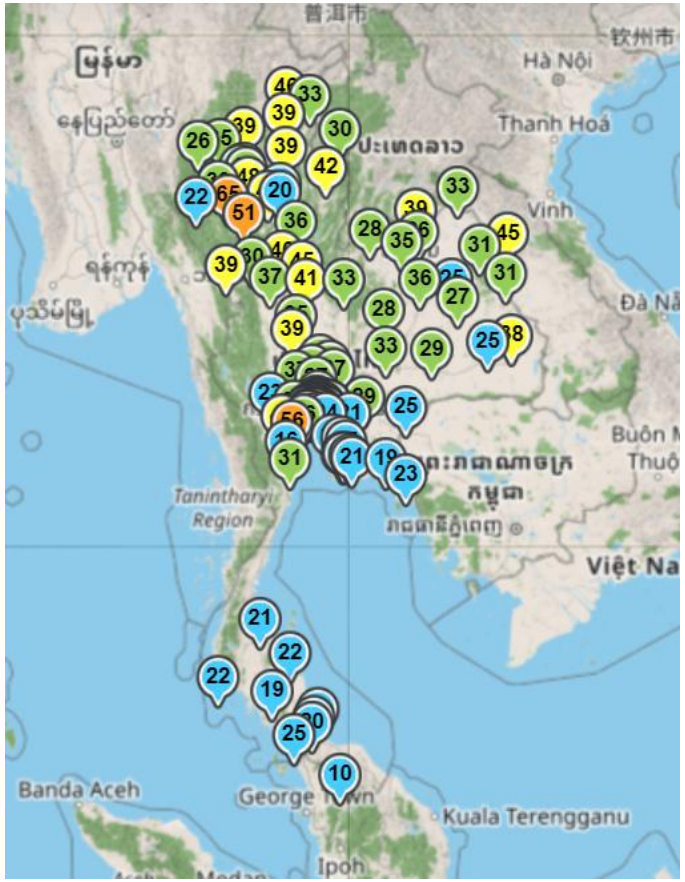


Methodology

1. Data Collected

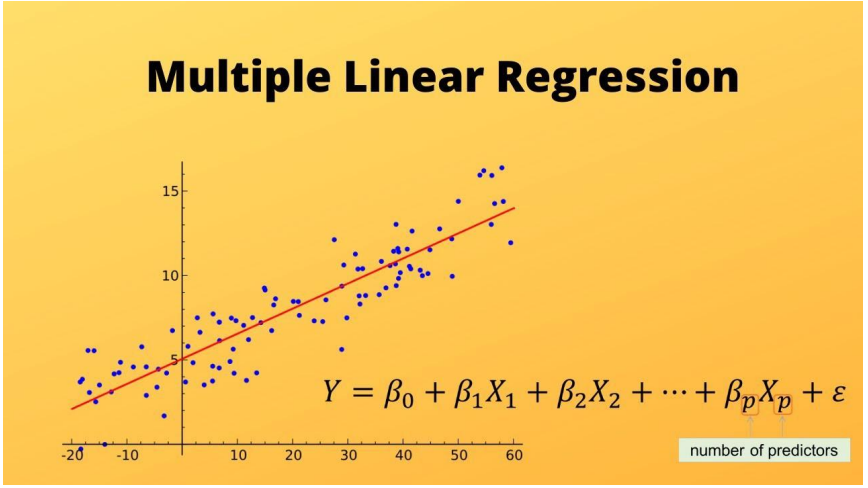
1.5

PM2.5 data ground stations in hourly from Pollution Control Development



Methodology

2. Modelling



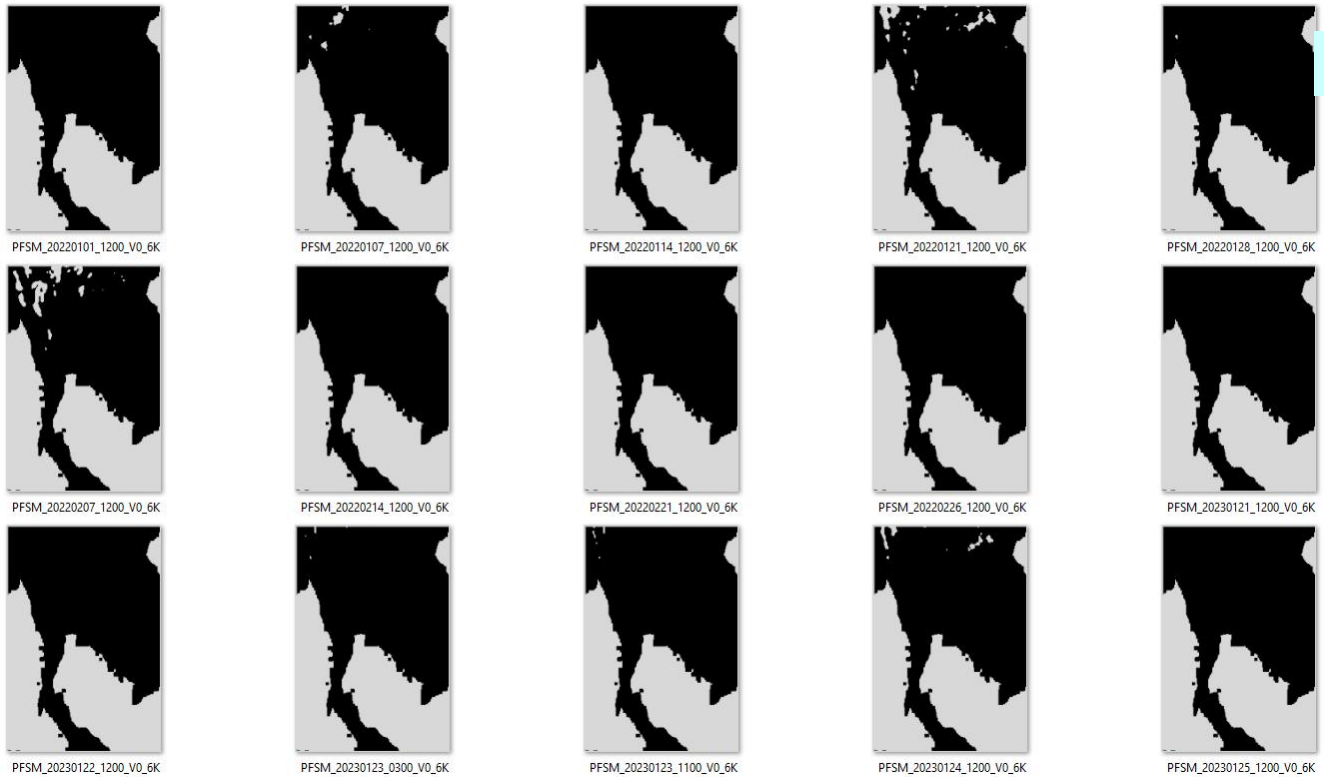
The parameter data and PM2.5 data from the monitoring station will be matched to form a multiple linear equation as follows:

$$PM2.5_{land} = a_0 + a_1 \cdot AOD + a_2 \cdot NDVI + a_3 \cdot SRTM + a_4 \cdot PRES + a_5 \cdot WIND + a_6 \cdot RHUM$$

PM2.5	=	Estimation PM2.5
AOD	=	Aerosol Optical Depth
NDVI	=	Normalize Difference Vegetation Index
STRM	=	Shuttle Radar Topography Mission
PRES	=	Barometric Pressure
WIND	=	Wind Speed
RHUM	=	Relative humidity

Result

The multiple linear regression equation is regenerated every hour for use in PM2.5 mapping.



Example of calculate equations in 1 hour

$$PM2.5_{land} = a_0 + a_1 \cdot AOD + a_2 \cdot NDVI + a_3 \cdot SRTM + a_4 \cdot PRES + a_5 \cdot WIND + a_6 \cdot RHUM$$

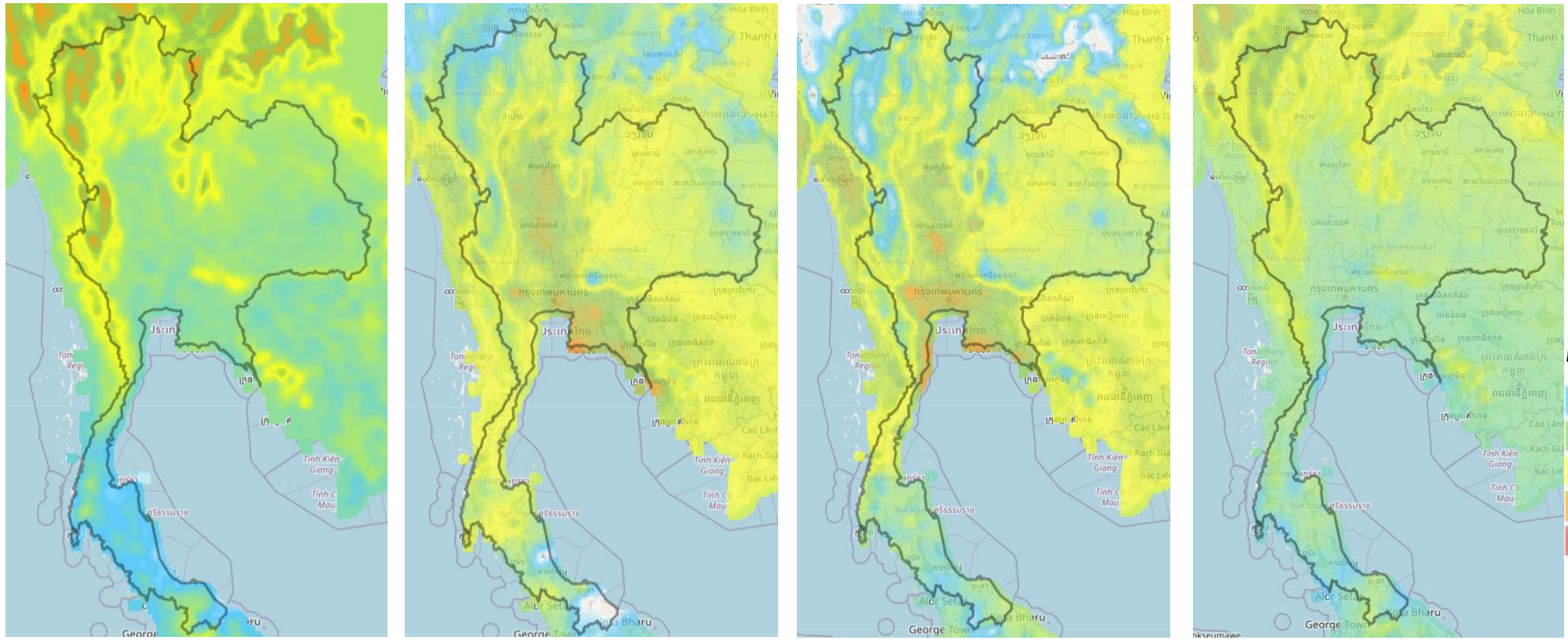
a0= 31.0404067878
a1_AOD= 43.92815684914
a2_ndvi= -4.25136169996
a3_strm= -0.00921149603447
a4_pres= -0.456481791836
a5_wind= 0.260637585647
a6_rhum= -0.0706085981246
a_r2=0.4514688721334491

Result

PM2.5 Mapping

Example of hourly PM2.5 mapping from multiple regression equation

Symbols are different colors that comply with Thai standards set by Thailand's Pollution Control Department.



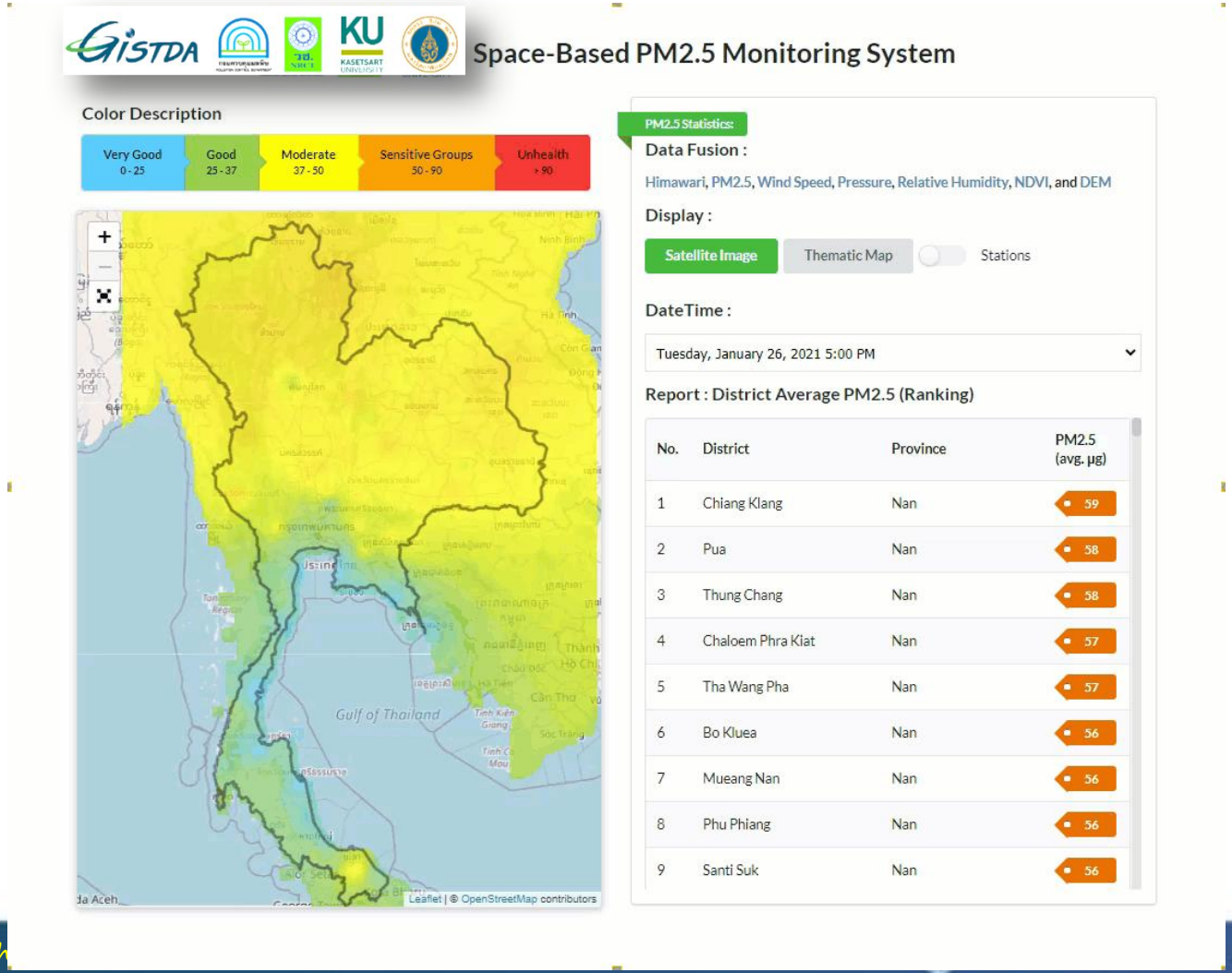
Platform Service

Geospatial data for PM2.5 management platform aimed to study, collect and analyze satellite imagery, geospatial data, ground-based measurements and other PM2.5- related physical factors then utilized to assess near-real time concentrations of PM2.5 at hourly basis over Thailand.

The output from this project also provided geo-spatial data service which is accessible via online platform

The Platform for the Management of PM2.5

Web Application http://pm25.gistda.or.th

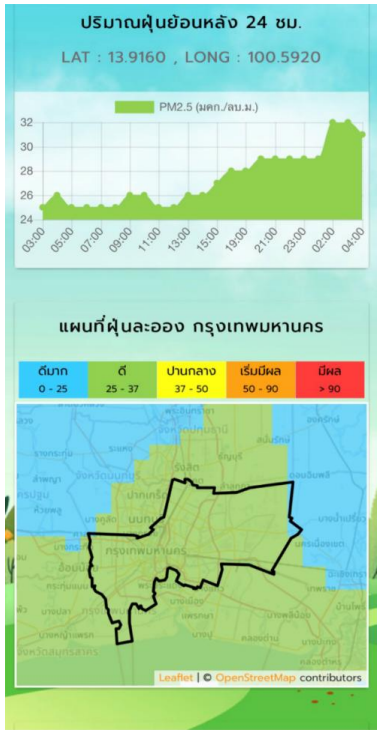


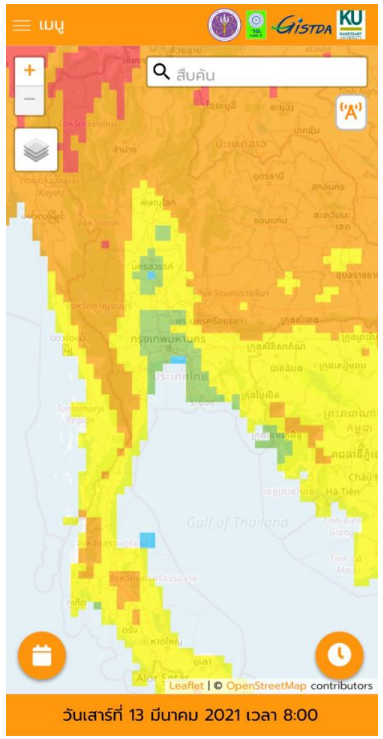
No.	District	Province	PM2.5 (avg. µg)
1	Chiang Klang	Nan	59
2	Pua	Nan	58
3	Thung Chang	Nan	58
4	Chaloem Phra Kiat	Nan	57
5	Tha Wang Pha	Nan	57
6	Bo Kluea	Nan	56
7	Mueang Nan	Nan	56
8	Phu Phiang	Nan	56
9	Santi Suk	Nan	56

Platform for the Management of PM2.5 will show the near real time PM2.5 in hourly from integrated by himawari data and ground station of PM2.5 and other PM2.5- related physical factors that can accessible via online platform on web application as http://pm25.gistda.or.th

The Platform for the Management of PM2.5

Mobile Application (Old Version)

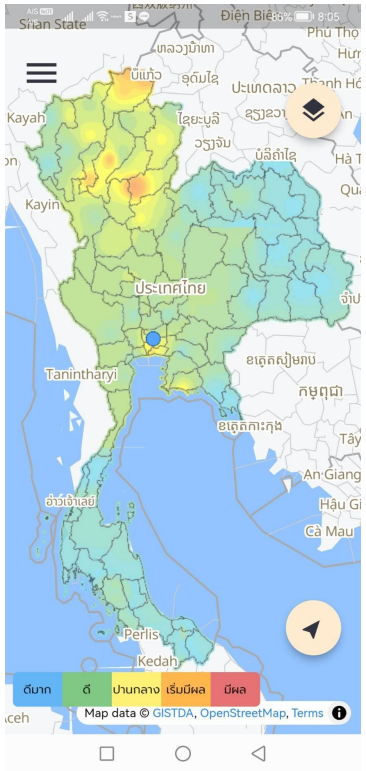




And also , on mobile application in both iOS and Android which “เชคฝุ่น”

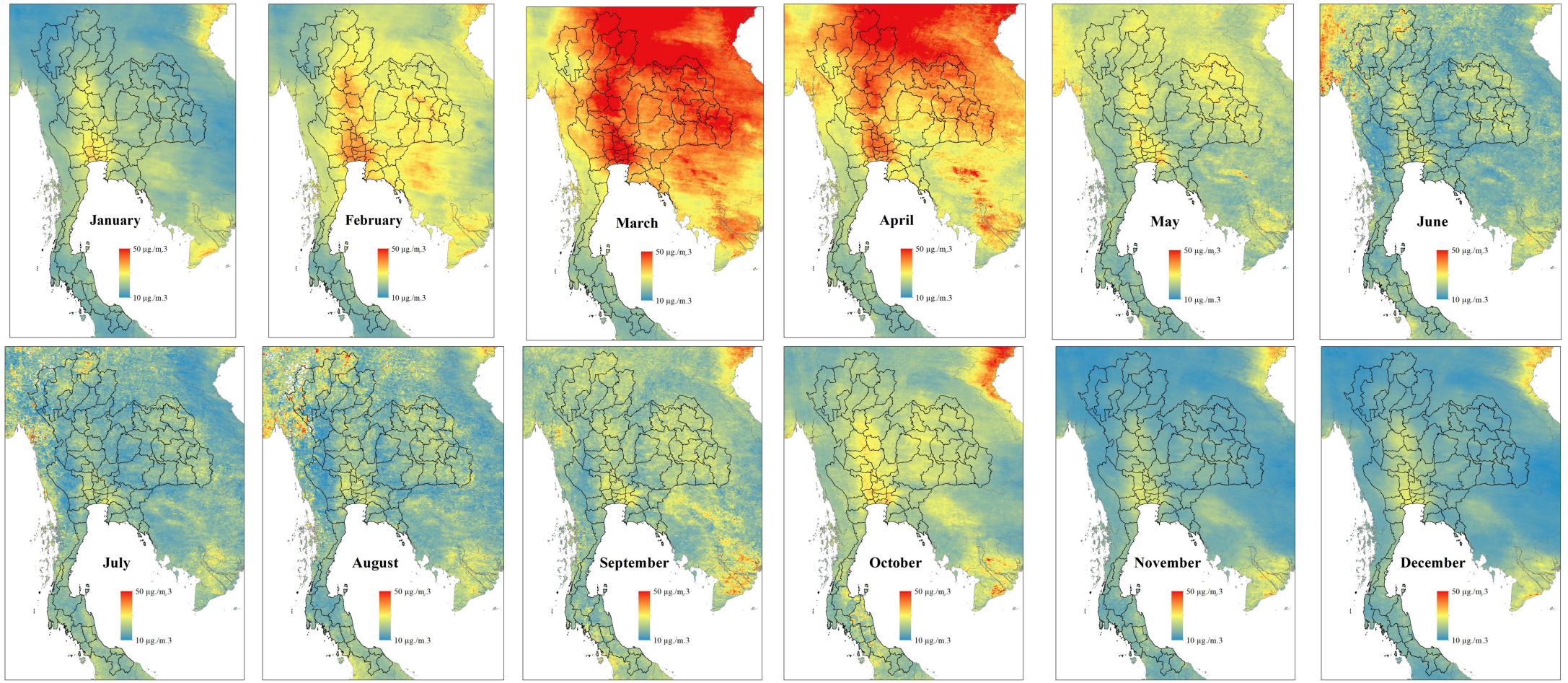
The Platform for the Management of PM2.5

Mobile Application (New Version)



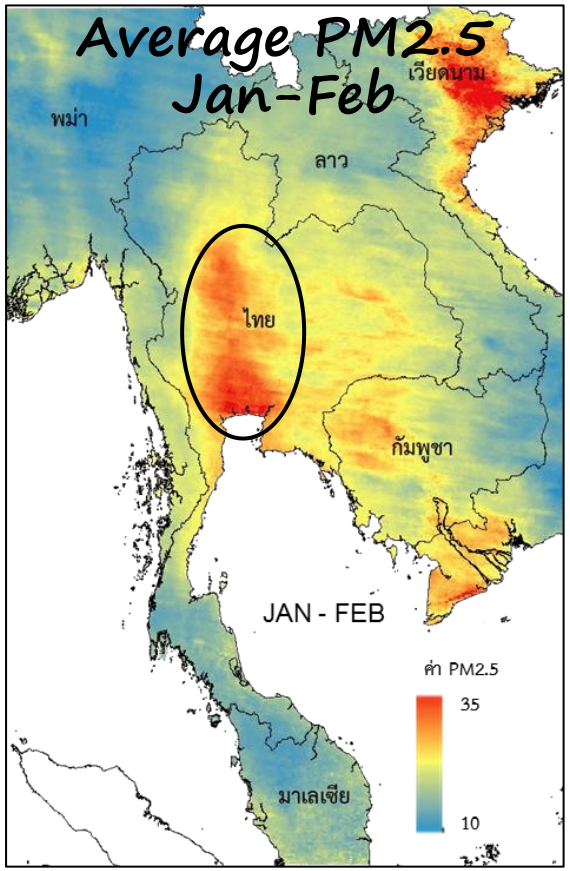
And also , on mobile application in both iOS and Android which “เชียงใหม่ฝุ่น”

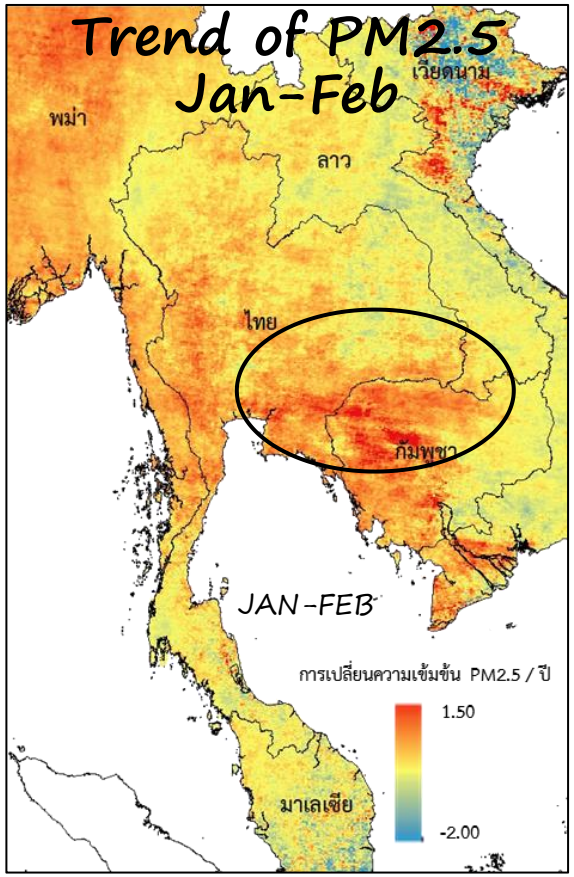
The average monthly of PM2.5 from MODIS 2002-2021

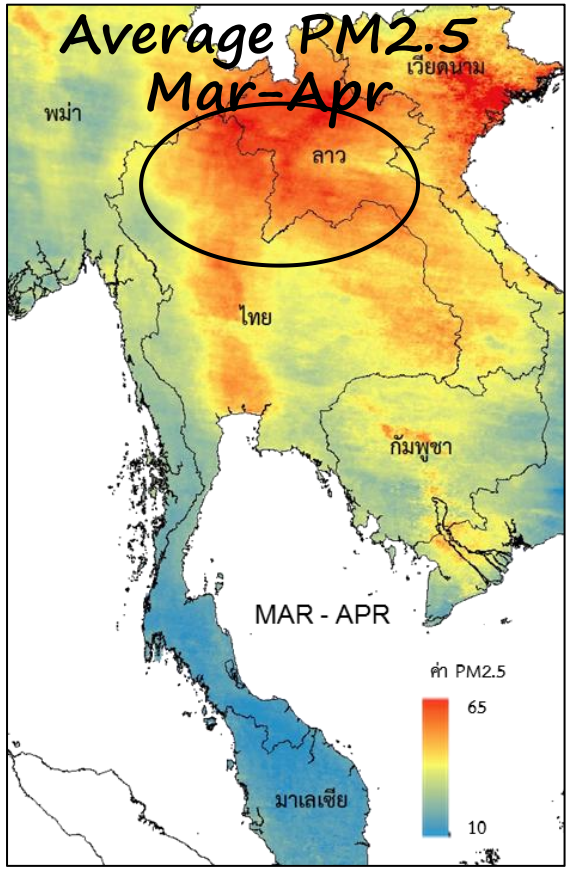


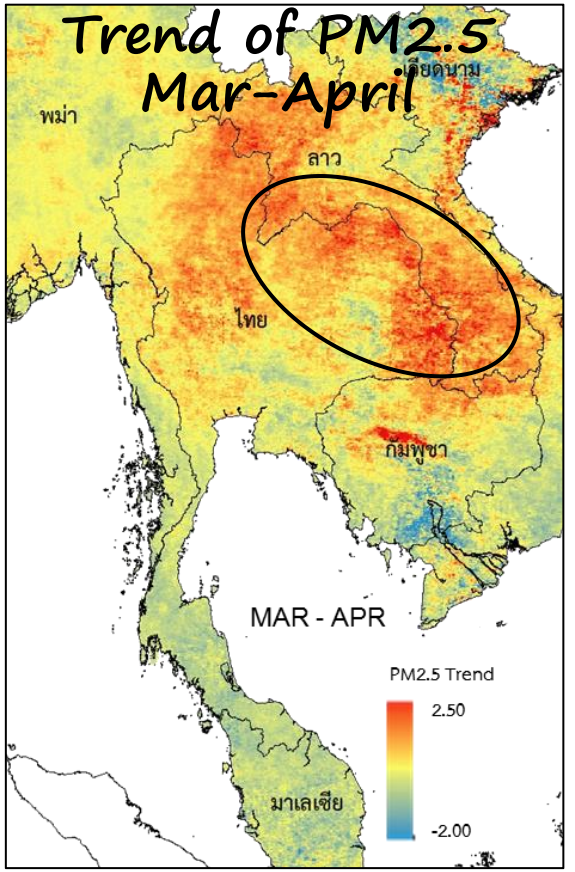
In addition, the analysis of PM2.5 data from MODIS average monthly in 20 years
The average monthly in 20 years show that the PM2.5 is high concentration during the dry season, especially March-April

The average and trend of PM2.5 in dry season 2002 - 2021









When analyzed the data during January and February in 20 years, it found that PM2.5 was high concentration in the central region and there was an increasing trend high concentration in the eastern region and border country areas.

And also found that during March and April, PM2.5 was high concentration in the northern and there was an increasing trend of PM2.5 in northeastern regions, especially along the border.

Thank you
FOR YOUR ATTENDTION

http://pm25.gistda.or.th
&
Mobile Application “เช็คฝุ่น”

woranut@gistda.or.th