GEOSPATIAL MODELLING FOR ESTIMATION OF PM 2.5 IN THAILAND

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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 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 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 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:

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

- **PM2.5** = Estimation PM2.5
- **AOD** = Aerosol Optical Depth
- **NDVI** = Normalize Difference Vegetation Index
- **SRTM** = 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.

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

Example of calculate equations in 1 hour

\[ a_0 = 31.0404067878 \]
\[ a_1_{AOD} = 43.92815684914 \]
\[ a_2_{NDVI} = -4.25136169996 \]
\[ a_3_{SRTM} = -0.00921149603447 \]
\[ a_4_{PRES} = -0.456481791836 \]
\[ a_5_{WIND} = 0.260637585647 \]
\[ a_6_{RHUM} = -0.0706085981246 \]
\[ a_{r^2} = 0.451468872133491 \]
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.

Legend
- Excellent (0-25)
- Satisfactory (26-37)
- Moderate (38-50)
- Unhealthy (51-90)
- Very Unhealthy (>91)
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://pm.gistda.or.th

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

And also, on mobile application in both iOS and Android which “เช็คฝุ่น”
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.
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 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 ATTENTION

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

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