An Analysis of Particulate Matter of the Size 2.5 Microns and Public Health in Mae Hong Son, Thailand and a Review of Air Quality Legislation

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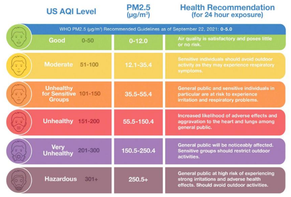
Overview

In partial completion of the requirements necessary to graduate from Millersville University's Honors College, an undergraduate thesis was created to analyze particulate matter of the size 2.5 microns (PM2.5) in Mae Hong Son, Thailand and assess the implications on public health. Further, this project seeks to review international and national air quality legislation to understand what preventative measures are being taken to reduce the likelihood of future air quality events. The data collected for this project spans four years (2020 through 2023) during the biomass burning season (February through April) and was gathered from a surface station and satellite imagery.



Methods

Using data collected from IQAir and Greenpeace, the months with the average highest levels of PM2.5 were determined. Then, data was collected from the National Resources and Environment Office in Mae Hong Son, Thailand using the data produced by their surface instrument, which provided PM2.5 measurements every three hours. This was displayed on the Air Quality Explorer platform, and the results were derived from various instruments (NASA's VIIRS and MODIS) on board NASA's AQUA, TERRA, and GEOS satellites.

To visualize the transition from the start to the end of the burning season, AOD satellite imagery was collected from NASA's AQUA and TERRA satellites, as provided by NASA's Earth Observing System Data and Information System.

Together, this data worked to establish a baseline for the severity of PM2.5 levels experienced in Mae Hong Son during the biomass burning season across the four years of data collection.

Data Summary

Year	Highest Monthly AQI Average	Lowest Monthly AQI Average	Highest Daily AQI Average	Lowest Daily AQI Average	Highest AQI Recorded	Lowest AQI Recorded
2020	132 µg/m³ (March)	73 µg/m³ (April)	260 µg/m³ (March 14)	9 µg/m³ (April 29)	355 µg/m³ (March 14 at 8:00 ICT)	1 µg/m³ (April 27 at 11:00 ICT)
2021	146 µg/m³ (March)	44 µg/m³ (February)	325 µg/m³ (March 7)	8 µg/m³ (April 28)	420 µg/m³ (March 7 at 14:00 ICT)	7 µg/m³ (February 16 at 17:00 ICT)
2022	85 µg/m³ (March)	36 µg/m³ (February)	155 µg/m³ (March 18)	13 µg/m³ (February 19)	263 µg/m³ (March 18 at 2:00 ICT)	5 µg/m³ (March 22 at 20:00 ICT)
2023	145 µg/m³ (March)	44 µg/m³ (February)	320 µg/m³ (March 30)	9 µg/m³ (February 18)	599 µg/m³ (March 30 at 11:00 ICT)	4 µg/m³ (February 18 at 11:00 ICT)

Data Collection

The data collected for this project came from the National Resources and Environment Office in Mae Hong Son, Thailand, gathered and visualized by *Air Quality Explorer*. The years 2020 through 2023 were chosen due to the lack of available data and large gaps between consecutive days of data collection. The period of interest was reliable at producing PM2.5 readings every three hours. Considering that Thailand's burning season occurs between February through April, this provides a strong explanation as to why these months were chosen to study.

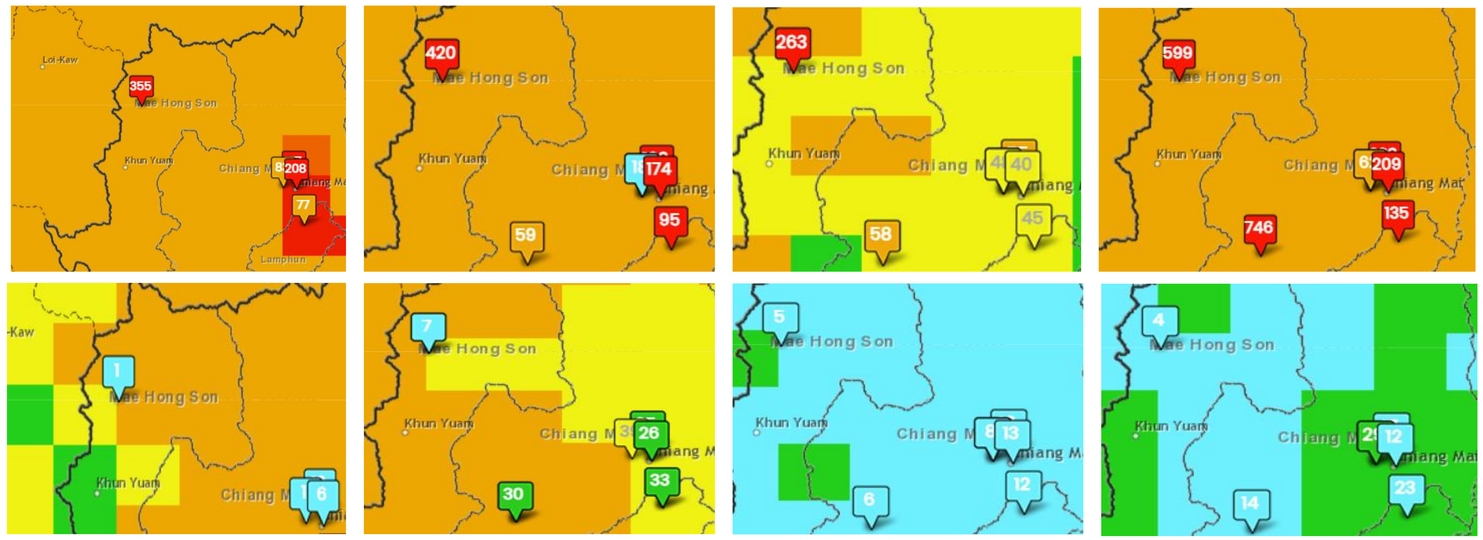
The *Air Quality Explorer* platform uses a combination of instruments to produce these air quality forecasts:

- AQUA, TERRA, and GEOS satellites
  - Instruments consisted of the Visible Imaging Radiometer Suite (VIIRS), the Moderate Resolution Imaging Spectroradiometer (MODIS), and the Air Quality Forecasts bias

Air Quality Forecast

This series of images show the highest and lowest AQI recorded in Mae Hong Son. The mapping tool on the *Air Quality Explorer* platform shows the numerical value of PM2.5 recorded in µg/m³ along with the corresponding color that relates that value to the AQI chart. This forecasting tool is great at depicting the severity of PM2.5 being experienced in the area and combines several different means of expressing AQI and PM2.5 in one interactive platform.

For the images, from left to right, the years increase, beginning with 2020 and ending with 2023. The top row consists of the days with the highest AQI recorded, and the bottom row consists of the days with the lowest AQI recorded. These images correspond to the data displayed in the data table above.



Future Work

Continuing this project, I hope to find a larger, more robust dataset to support and finetune my conclusions made. The dataset used in this experiment is limited, so it is important expand on this project to determine whether there truly is a conclusion between the burning seasons and the severity of the air quality event. Also, I think it would be interesting to explore other regions of Thailand and see how the similarities and differences compare to what is being experienced in Mae Hong Son. Expanding further, conducting research that compares Thailand to other areas of the world, such as those with good air quality, would allow for comparisons to be made regarding the level of air quality events being experienced and how legislation and air quality policies influence these differences.

As a different approach, it would be interesting to analyze meteorological conditions during the burning seasons to see the influence meteorology has on the behavior of PM2.5. Lastly, finding and conducting a statistical analysis on the data would determine whether this dataset is substantial enough for the conclusions being made in this project.

Conclusions

Overall, the analysis of PM2.5 in Mae Hong Son, Thailand reveals levels of PM2.5 that exceed the standards set by WHO, IQAir, and Greenpeace. Upon further analysis, several recordings almost double the hazardous standard of PM2.5. With this, there is great concern for the public health implications experienced in the region due to the severity of the air quality events occurring during the biomass burning season.

All in all, this project provides a unique perspective for understanding PM2.5 pollution by following an interdisciplinary approach by combining aspects of atmospheric chemistry, public health, and international and national policy.

Acknowledgements

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