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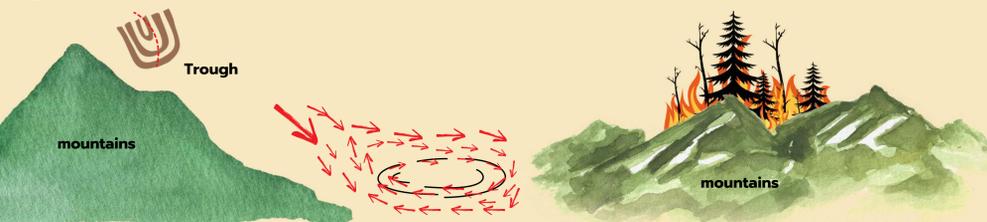
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## ABSTRACT

This study investigates the impact of meteorological factors on particulate matter 2.5 (PM2.5) pollution in Chiang Mai during the biomass burning season (Feb-Apr) from 2020 and 2024. PM2.5 concentrations exceeded the national average and were the highest in 2023. Pollution and fire hotspots had a substantial correlation ( $r = 0.59$ ,  $p < 0.01$ ), indicating that biomass burning was the primary source. Pollutants were trapped by weak winds and low mixing heights and dispersed by strong wind and humidity. Transboundary pollution from Myanmar and Mae Hong Son was shown via HYSPLIT analysis. Improving forecasts, preventing fires, and strengthening laws are important for reducing air pollution and health risks.

## INTRODUCTION

Chiang Mai experiences severe air pollution, particularly during the dry season, when PM2.5 levels rise due to biomass burning, vehicle emissions, and industrial activities. The city's valley geography worsens the situation by trapping pollutants. Additionally, meteorological factors play a significant role in the dispersion and accumulation of air pollution.



## RESULT

Table1 : The average of data analysis

Year/Factor	PM2.5 (µg/m³)	HS-unit	mixing height morning (m)	mixing height afternoon (m)	ventilation rate morning (m³/sec)	ventilation rate afternoon (m³/sec)	temperature (°C)	pressure (hPa)	precipitation (mm)	humidity (%)	wind direction	wind speed (km/hr)
2020	28.48	104.04	715.54	10,897.13	1,782.53	30,180.90	27.82	1,008.10	3.15	65.27	187.82	19.84
2021	24.96	46.54	599.93	10,715.87	1,438.77	29,082.07	27.12	1,009.50	3.24	69.11	177.04	19.30
2022	19.80	14.04					27.02	1,008.60	5.46	71.54	190.32	20.01
2023	32.82	76.10	927.14	3,092.38	10,892.94	30,342.68	27.30	1,008.26	3.41	68.10	201.18	18.08
2024	26.36	80.25	814.44	9,032.59	3,164.01	26,921.42	26.95	1,008.85	5.46	69.05	190.99	20.30
average	26.71	66.15	767.27	8,808.90	3,867.46	28,842.27	27.21	1,009.10	4.15	68.81	189.29	19.50

Table2 : Comparison of PM2.5 and Meteorological Factors Between the Smoke and Non-smoke Seasons in 2024

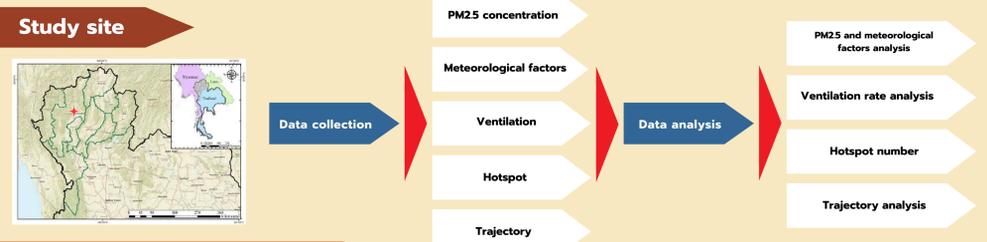
Smoke season (Feb-Apr)	PM2.5 (µg/m³)	Hotspot	Mixing height morning (m)	Ventilation rate morning (m³/sec)	Temperature (°C)	Pressure (hPa)	Precipitation (mm)	Humidity (%)	Wind direction	Wind speed (km/hr)
Average	63.96	143.61	362.47	1233.34	29.24	1009.23	0.17	61.39	177.00	20.41
SD	23.78	136.70	495.11	1816.18	3.04	3.69	1.46	45.51	87.86	5.21
Max	163.96	613.00	2100.00	12600.00	35.40	1028.47	13.20	71.00	300.00	37.00
Min	14.96	2.00	30.00	60.00	23.20	1001.93	0.00	41.00	10.00	11.00

Non-smoke season (May-Dec)	PM2.5 (µg/m³)	Hotspot	Mixing height morning (m)	Ventilation rate morning (m³/sec)	Temperature (°C)	Pressure (hPa)	Precipitation (mm)	Humidity (%)	Wind direction	Wind speed (km/hr)
Average	13.27	26.76	1082.88	4184.34	26.44	1008.07	7.82	75.70	200.12	20.58
SD	13.24	78.00	358.17	2235.34	2.09	3.85	11.79	7.25	36.11	5.36
Max	89.84	482.00	3660.00	11000.00	34.70	1017.56	66.80	96.00	360.00	46.00
Min	4.64	1.00	310.00	360.00	21.35	999.69	0.00	48.00	10.00	11.00

The main factors that can influence PM2.5 concentration during smoke season compare with non-smoke season is **Hotspot, Mixing height and Ventilation rate morning, Precipitation and Humidity**

## METHODOLOGY



### 1. PM2.5 and meteorological factors analysis

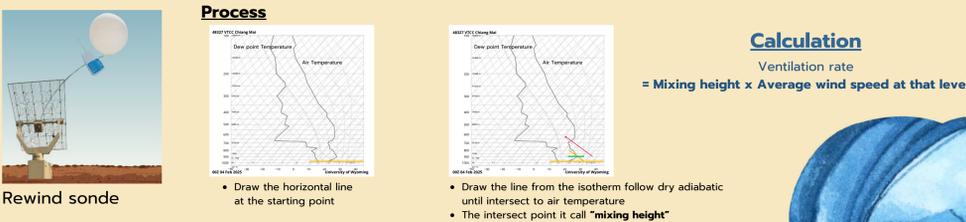
The data obtained from the PDC was collected by using a beta-ray measurement system at Yuppapraj School, Chiang Mai (36t site).

Calculate and compare with meteorological factors

Find the correlation using spss program

### 2. Ventilation rate analysis

This is a procedure for finding the mixing height and ventilation rate in the morning and afternoon by analyzing skew-T diagrams



### 3. Hotspot analysis

- Download the data from NASA FIRN
- Analysis the data by using Arc Map
- Use the output of data the calculation the hot spot

### 4. Trajectory analysis

Analyze and predict the spread of pollutants in the atmosphere. By modeling the movement of particles or gases in the atmosphere.

- Monthly calculations, select locations and use monthly and weekly data
- Joint TGS file, combine daily data to single file and convert file for modeling the movement
- Convert to line data, select data for modeling
- Cluster analysis, Modeling analysis and find the number of particles as a percentage.

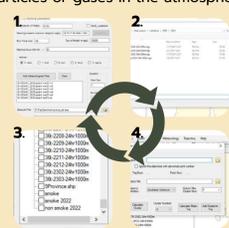


Fig1 - 2 : PM2.5 concentrations relation with meteorological factors from 2020 - 2024

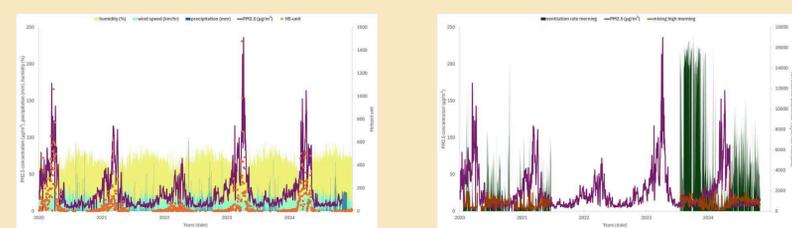
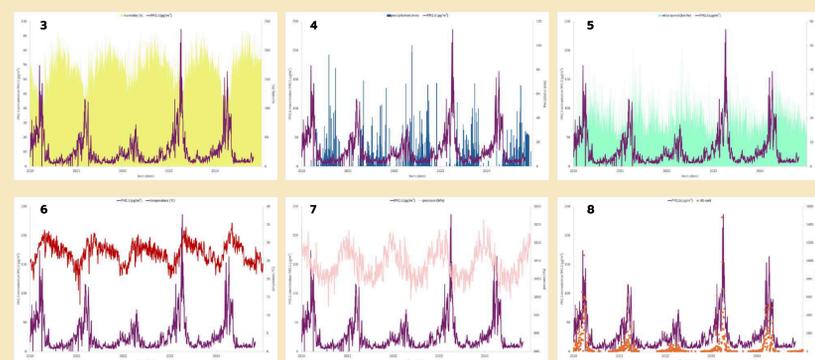


Fig3 - 8 : PM2.5 concentrations with each factors from 2020 - 2024



### Symbol

- PM2.5 concentration
- Mixing height morning
- Ventilation rate morning
- Humidity
- Precipitation
- Wind speed
- Temperature
- Pressure
- Hotspot

### Positive Correlation

- Hotspot (0.59)
- Temperature (0.18)
- Pressure (0.18)

### Negative Correlation

- Mixing height morning (-0.40)
- Ventilation rate morning (-0.31)
- Precipitation (-0.20)
- Humidity (-0.70)
- Wind speed (-0.13)

Fig9 : Hot spot number



Fig10 : The correlation between PM2.5 with Ventilation rate morning

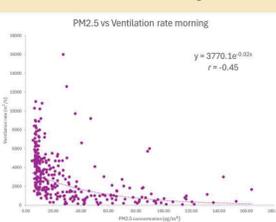


Fig11 : Pearson correlation

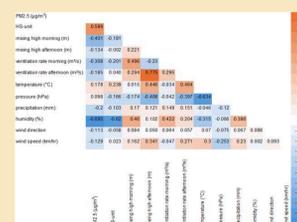
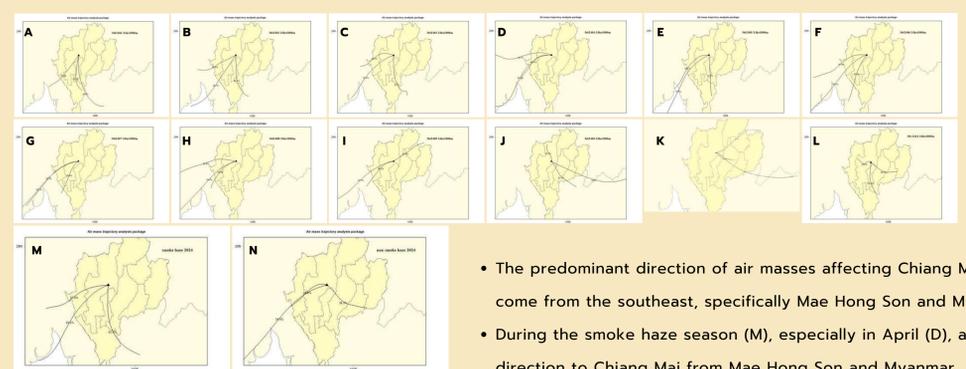


Fig12 : The air mass Trajectory of PM2.5 concentrations (A=January, B=February, C=March, D=April, E=May, F=June, G=July, H=August, I=September, J=October, K=November, L=December)



- The predominant direction of air masses affecting Chiang Mai generally come from the southeast, specifically Mae Hong Son and Myanmar.
- During the smoke haze season (M), especially in April (D), all air masses direction to Chiang Mai from Mae Hong Son and Myanmar

## CONCLUSION

- The highest PM2.5 concentration is in 2023
- The positive correlation is hotspot and the negative correlation is humidity, precipitation and wind speed Ventilation rates are high, the concentration of PM2.5 decreases.
- Mixing height and ventilation rate morning show the negative correlation with PM2.5
- The direction of PM2.5 in smoke haze season that from Southwest

## ACKNOWLEDGEMENT



## REFERENCE

University of Wyoming. (n.d). Upper air sounding data. Retrieved from 1 January to 31 July 2024, from <https://weather.uwyo.edu/upperair/sounding.html>

Life and Canvas. (n.d). Temperature changes and their effects on the ground. Life and Canvas. <https://www.lifeandcanvas.com/temp-changes-ground-effect/>