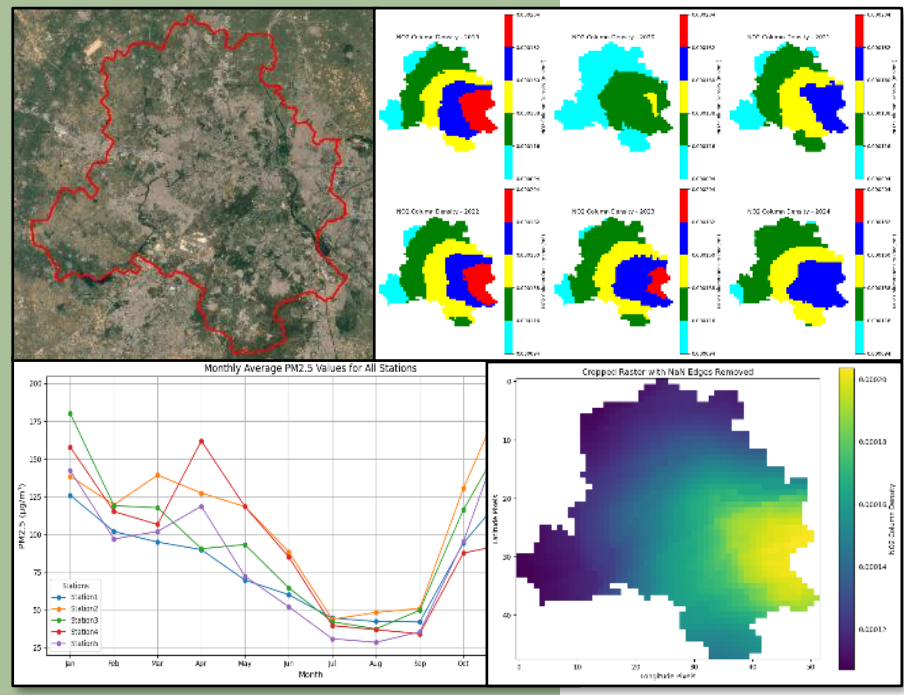
NSS JAYA PRAKASH

IIT KANPUR



ASSIGNMENT 1: ANALYSIS OF NO_2 COLUMN NUMBER DENSITY OVER DELHI USING SENTINEL 5P DATA (2019–2024)

Rasterio
Rioxarray
Geopandas

Numpy
Pandas
Matplotlib

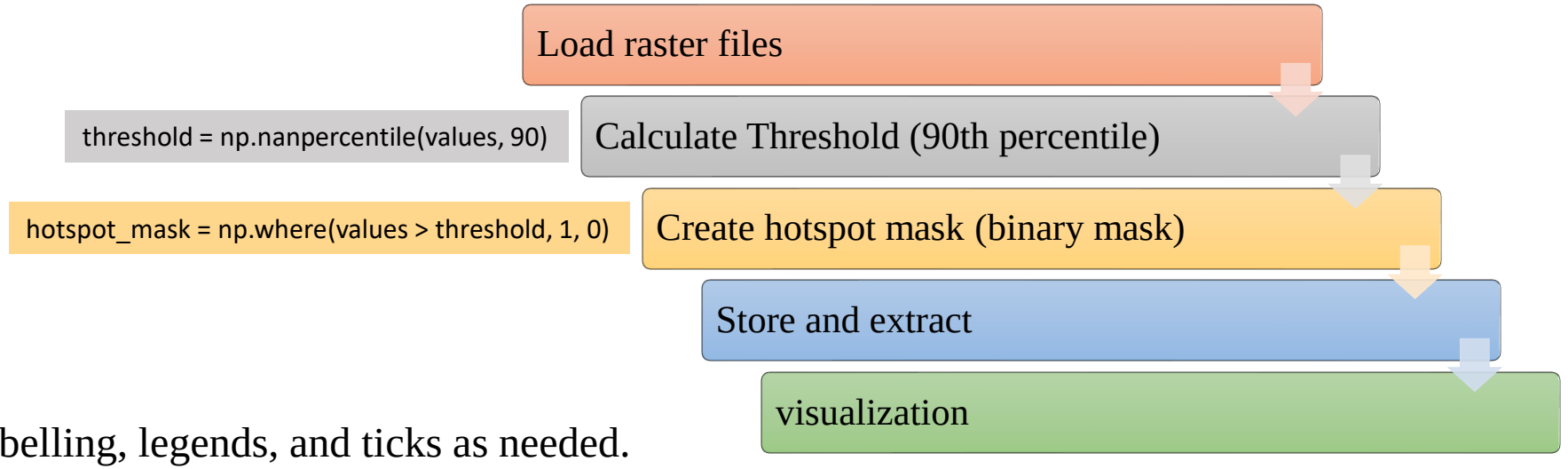
Objective:

- Create **spatial** and **temporal** plots for 'NO2_column_number_density' for all the years.
- Develop a methodology to identify NO2 **hotspots** based on the dataset.
- Derive valuable **insights** with draw from the data analyses.

Methodology:

- Data download
- Data pre-processing
- Visualization

Methodology to identify hotspot



Output:

- Results with proper labelling, legends, and ticks as needed.

Spatial Plots of NO_2 and Hotspot Analysis (2019–2024)

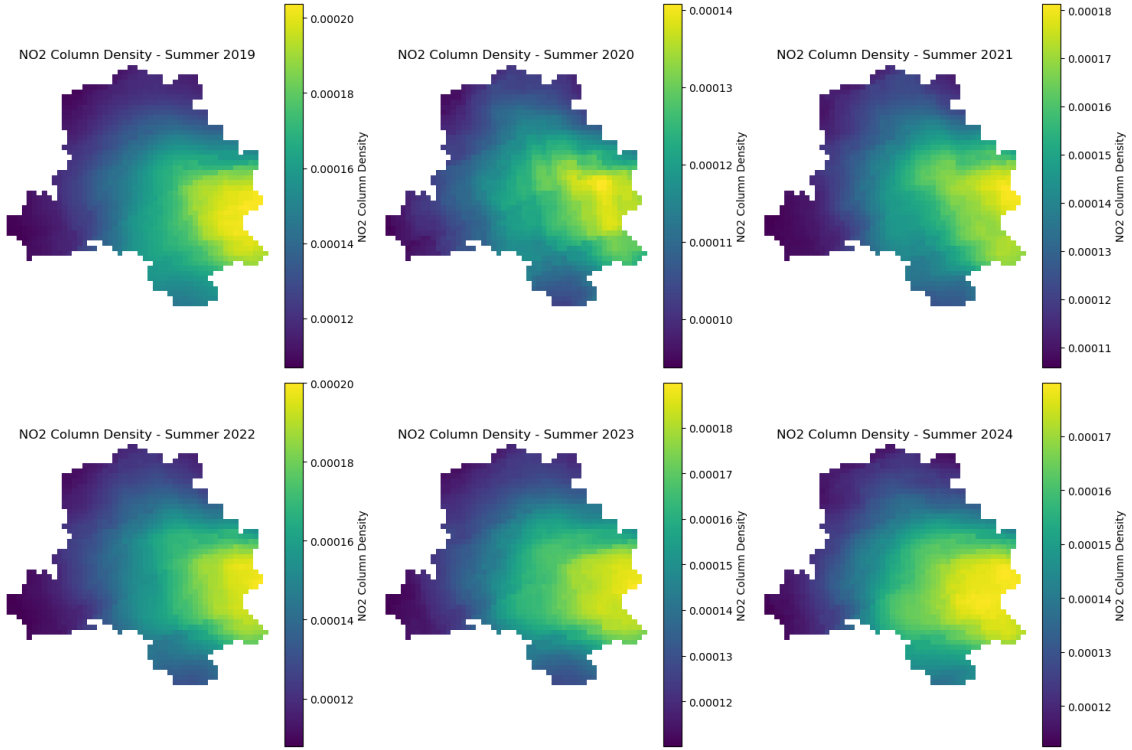


Fig: Spatial plots for 'NO2_column_number_density' over the years during summers.

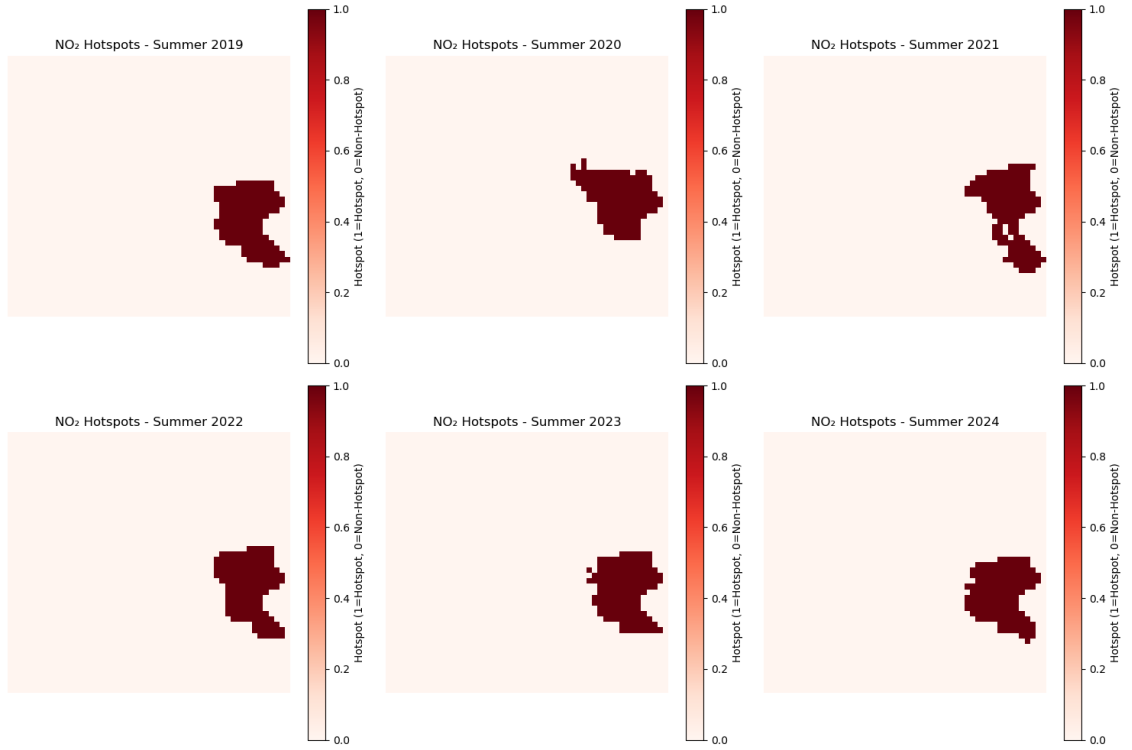


Fig: Hotspots plot for 'NO2_column_number_density' over the years during summers

Percentage Change in NO_2 Levels

Year	% Change
2019 to 2020	-22.21%
2020 to 2021	+20.38%
2021 to 2022	+5.27%
2022 to 2023	+0.07%
2023 to 2024	-0.67%

$$\text{Percent change} = \frac{\text{new value} - \text{old value}}{\text{old value}} \times 100$$

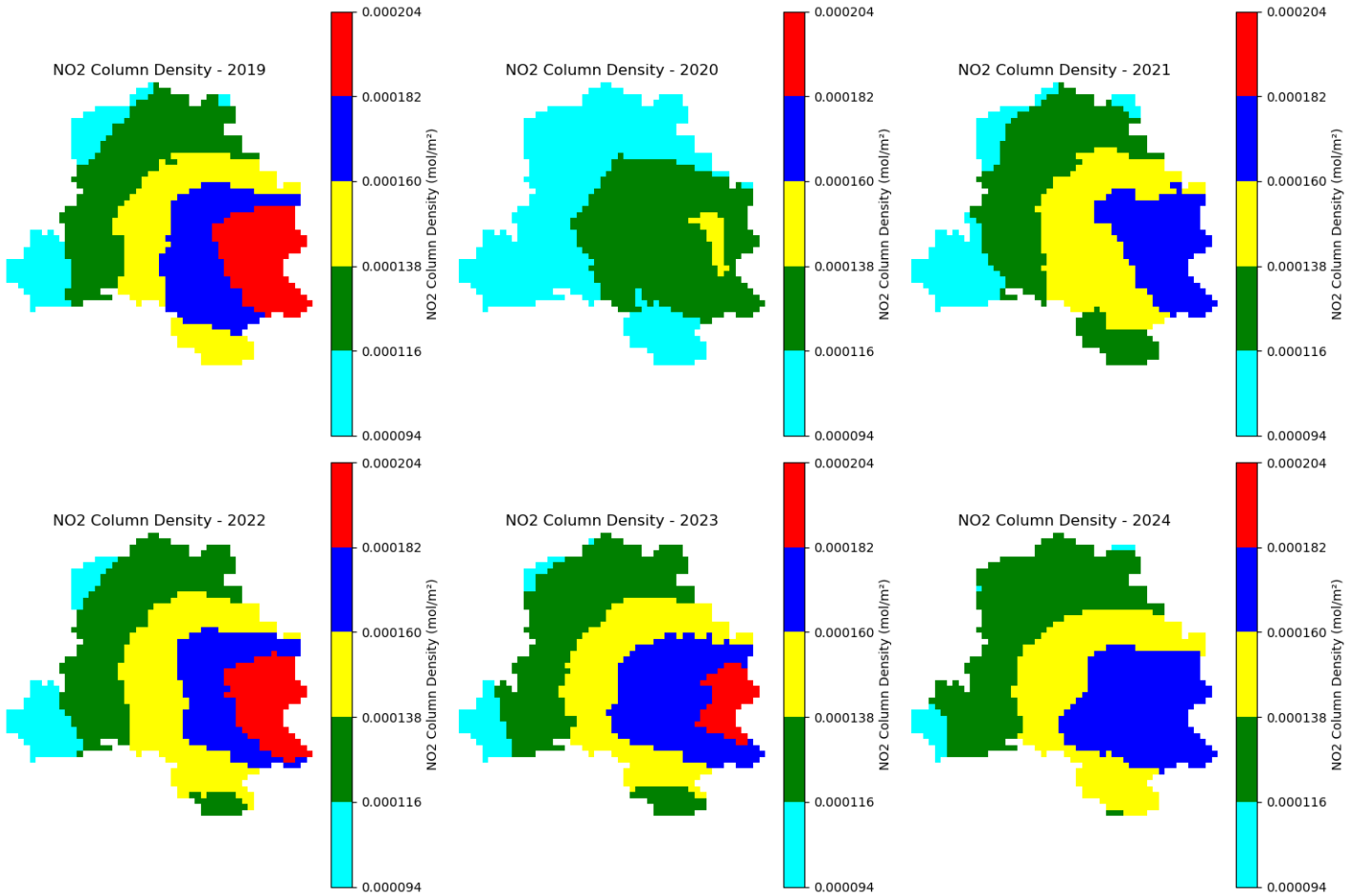


Fig: Change in NO2 level over the years during summers

ASSIGNMENT 2: AIR QUALITY ANALYSIS REPORT: COMPARISON OF WUSTL $PM_{2.5}$ AND OBSERVED $PM_{2.5}$ DATA (YEAR 2022)

NetCDF4
Sklearn

Numpy
Pandas
Matplotlib

Objective:

- Make **time series** plots comparing WUSTL PM2.5 with observed PM2.5.
- Calculate RMSE, MAPE, MAE and **R2** values.
- Derive daily, weekly and monthly **plots** comparing all 5 stations PM2.5.
- Derive valuable **insights** with draw from the data analyses.

Methodology:

- Data download
- Data pre-processing
- Visualization

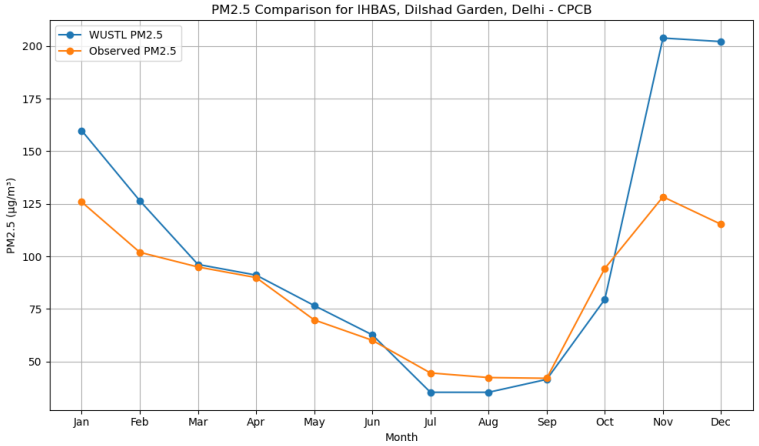
Output:

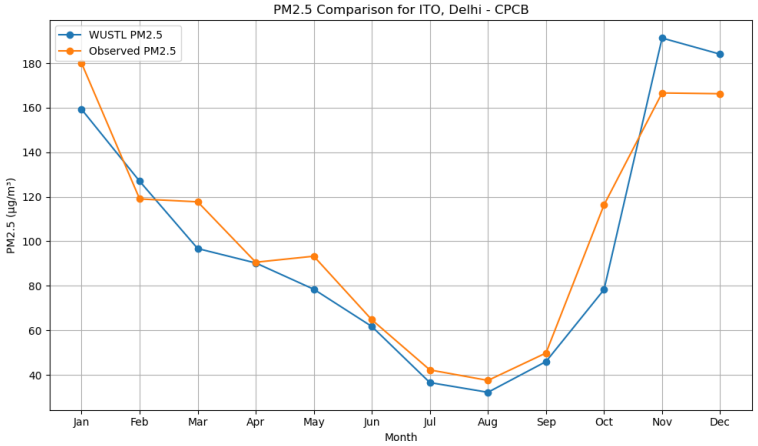
- Results with proper labelling, legends, and ticks as needed.

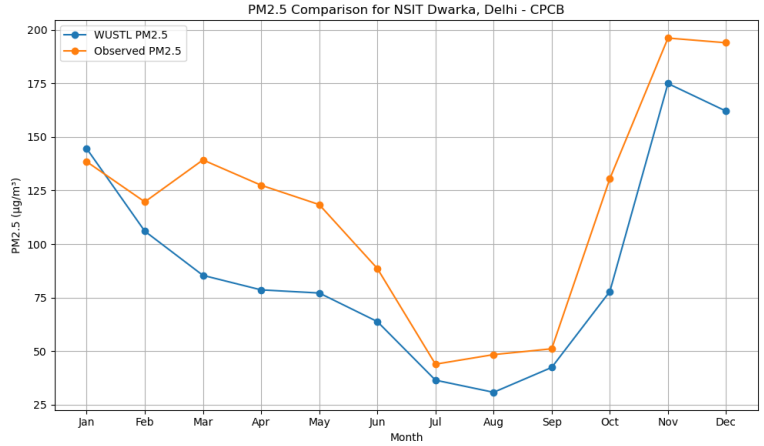
Station	RMSE	MAE	MAPE (%)	R^2
DTU Delhi - CPCB	47.065	32.081	31.873	0.324
IHBAS Dilshad Garden Delhi - CPCB	35.831	22	21.318	0.388
ITO Delhi - CPCB	17.351	13.600	12.551	0.866
NSIT Dwarka Delhi - CPCB	32.312	27.364	24.494	0.562
Siri fort Delhi - CPCB	15.826	12.771	14.347	0.895

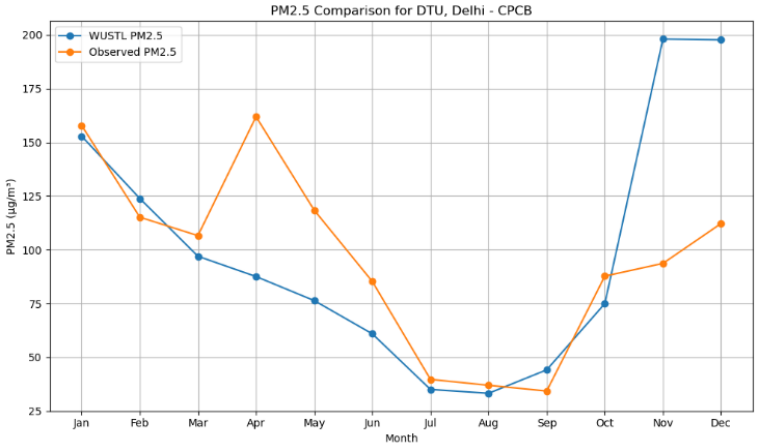
Table: Performance metrics for 5 stations

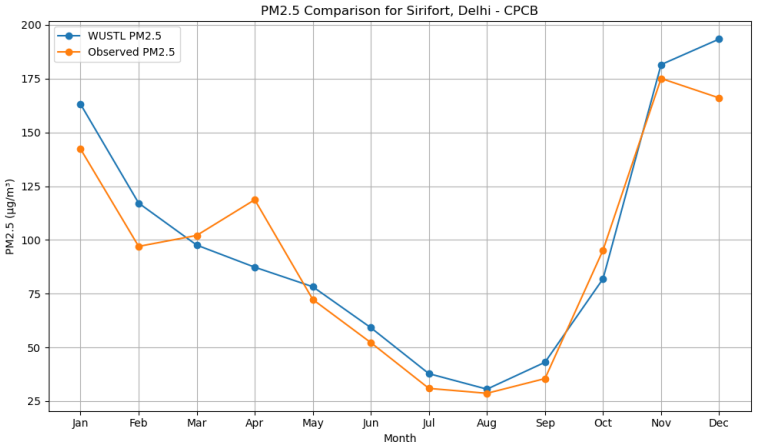
Time Series Plots: Comparing WUSTL PM2.5 data with observed PM2.5 for each station.



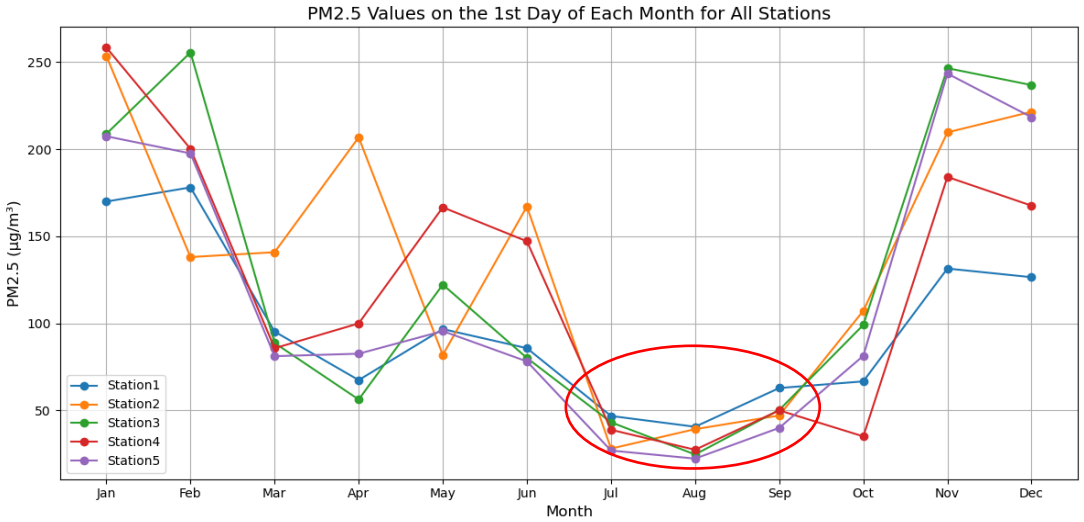


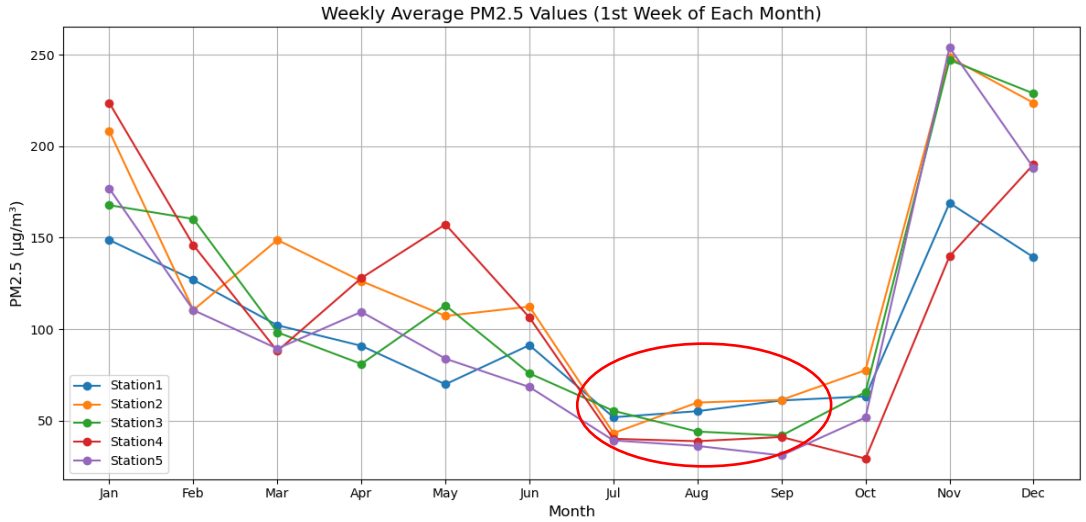


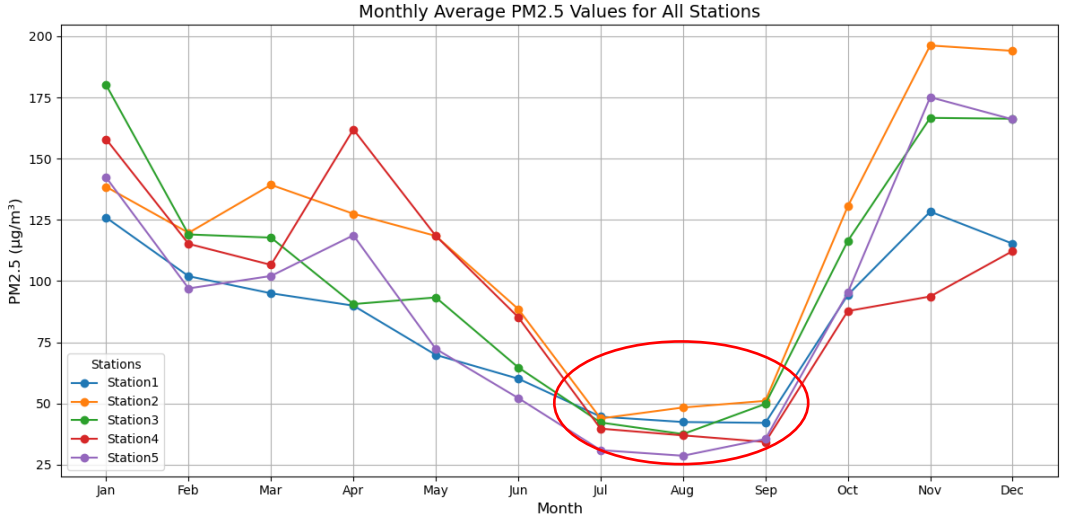




Daily, Weekly and Monthly Trends: Include the respective plots for all five stations.







Insights for Assignment 1:

- Over the years, **Higher NO_2 levels** were observed in southern and central Delhi, indicating significant pollution in these regions.
- 2020: A notable decline in NO_2 was observed due to the **COVID-19** lockdowns, which reduced industrial and vehicular emissions.
- 2020–2021: Hotspot centroids were concentrated in south Delhi. 2023–2024: Centroids shifted slightly toward **industrial zones**.

Insights for Assignment 2:

- Both WUSTL and observed PM2.5 data show similar seasonal trends, with peaks during **winter** (October–December) and troughs during the **monsoon** (July–August).
- **Station 5 (Siri fort)** shows the best alignment between WUSTL and observed data, while Station 4 (NSIT Dwarka) exhibits significant deviations, especially in winter.
- Station 5 (Siri fort, Delhi - CPCB) consistently records lower PM2.5 levels compared to other stations.