Air Quality Index (AQI) Report

Data Source: West Bengal Pollution Control Board
Station: Bhasa,2nd Campus of Asutosh College
(September 2024)

Introduction

In September, air quality across various regions often varies due to changing weather patterns, seasonal transitions, and the influence of human activities. The Air Quality Index (AQI) during this month can reflect an increase in pollutants like ozone, particulate matter ($PM_{2.5}$ and PM_{10}), and nitrogen dioxide, especially in urban areas where traffic and industrial activities are high. As summer fades and autumn approaches, the weather conditions—such as temperature changes, wind patterns, and humidity levels—play a significant role in the dispersion or accumulation of air pollutants. While some areas may experience better air quality due to milder temperatures and reduced energy consumption, others may face deteriorating air quality due to wildfires or agricultural burning, common in certain parts of the world. Monitoring the AQI in September is crucial for public health, as prolonged exposure to unhealthy air can have serious respiratory and cardiovascular effects, particularly for sensitive groups like children, the elderly, and those with preexisting health conditions.

Description of the Data

Table 1 Description of the data

AQI	$PM_{2.5}$ AVG ($\mu g/m^3$)	PM_{10} AVG ($\mu g/m^3$)	REL HUMI (%)	TEMPERATURE (°C)
30.62	18.14	30.35	76.69	26.23
35.94	21.07	35.89	82.68	30.01
45.31	26.20	45.37	84.80	31.04
53.71	31.08	53.56	89.05	31.43
88.79	50.73	88.60	96.71	32.61
48.24	27.99	48.20	85.77	30.39
15.29	8.55	15.29	5.38	1.82

Source: PCB (Station: Bhasa ,2nd Campus of Asutosh College)

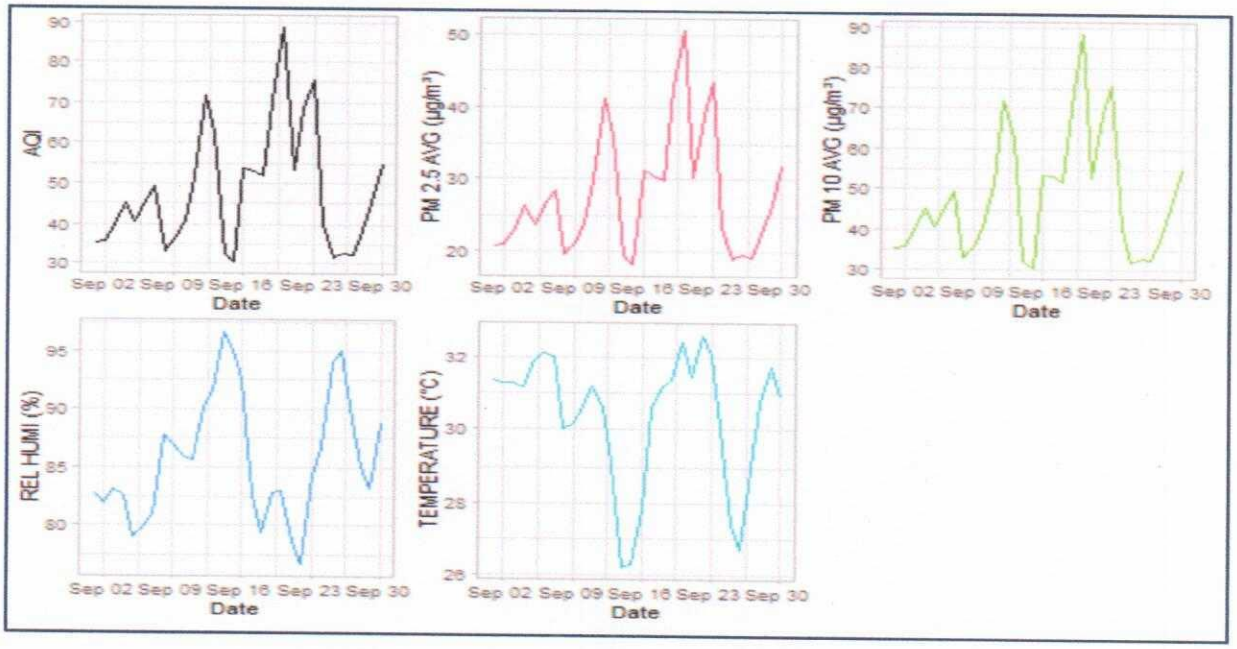
The data provided reveals a detailed snapshot of air quality and meteorological conditions for a specific period. In terms of the **Air Quality Index (AQI)**, the values range from a relatively low 15.29 to a high of 88.79, indicating fluctuations between good to moderate air quality. The highest AQI of 88.79 corresponds with the highest concentrations of both **$PM_{2.5}$** (50.73 $\mu g/m^3$) and **PM_{10}** (88.60 $\mu g/m^3$), suggesting significant pollution during this period. High AQI values like this are indicative of elevated particulate matter in the air, which can be harmful to individuals with respiratory or cardiovascular issues.

Looking at **PM $_{2.5}$** and **PM $_{10}$**, the data shows that both particulate matter concentrations tend to increase as the AQI rises. The highest recorded PM $_{2.5}$ value is 31.08 µg/m³, and the highest PM $_{10}$ value is 53.56 µg/m³, both correlating with the peak AQI of 88.79. Elevated levels of these fine and coarse particulate matter can degrade air quality and pose significant health risks, particularly for vulnerable groups.

The **relative humidity (RH)** is another key factor in understanding the air quality. RH values vary significantly, from a very low 5.38% to a high of 96.71%. High humidity is often associated with stagnant air, which can trap pollutants like PM $_{2.5}$ and PM_{10}, leading to poorer air quality. This trend is observed on days with high AQI values, where humidity is consistently high (above 80%), which likely exacerbates the concentration of pollutants in the air.

The **temperature** values in the dataset also exhibit a moderate increase, ranging from 26.23°C to 32.61°C. Warmer temperatures can contribute to the formation of ground-level ozone, a major component of smog, and can also influence the behavior of particulate matter. Higher temperatures in the dataset generally coincide with higher AQI levels, which may suggest a relationship between warm weather and elevated air pollution levels in the area.

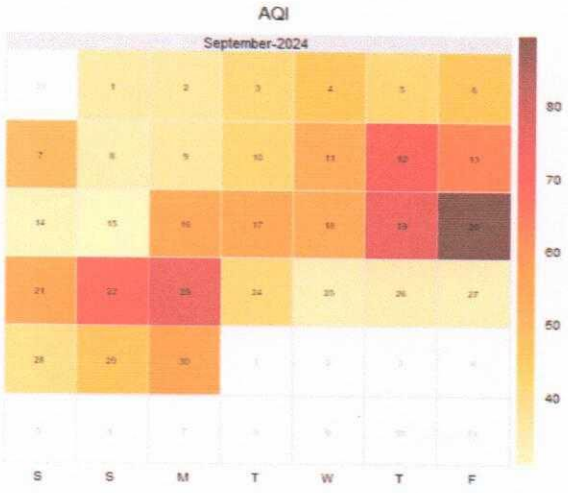
In summary, the data suggests that air quality worsens during periods of higher temperature and humidity, with significant spikes in particulate matter concentrations. The highest AQI values were recorded on days with high humidity (above 85%) and elevated temperatures, reinforcing the notion that weather conditions play a critical role in the dispersion or accumulation of pollutants in the atmosphere. The drop in AQI and pollutant levels on the final day of the dataset, with a temperature of only 1.82°C and very low humidity, indicates a possible change in weather conditions or a reduction in pollution sources.

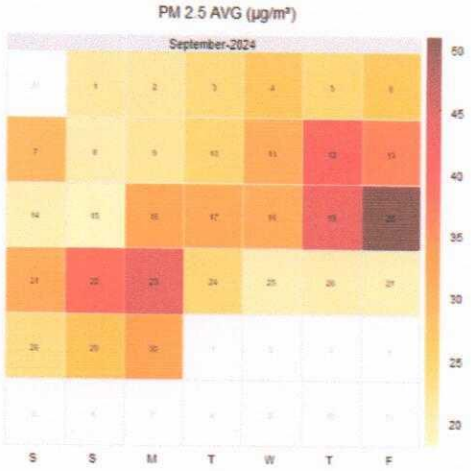


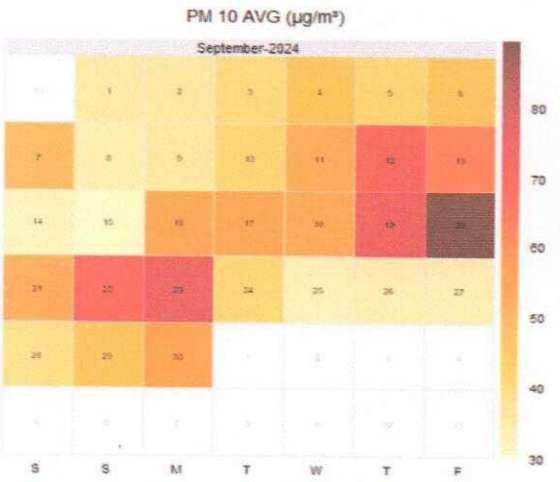
Analysis of the different variables: -

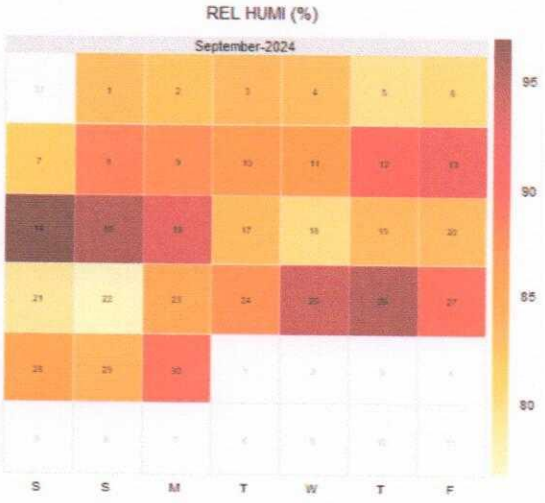
The variables AQI (Air Quality Index), PM $_{2.5}$, PM $_{10}$, relative humidity, and temperature are essential for assessing air quality and environmental conditions. AQI is a numerical scale that

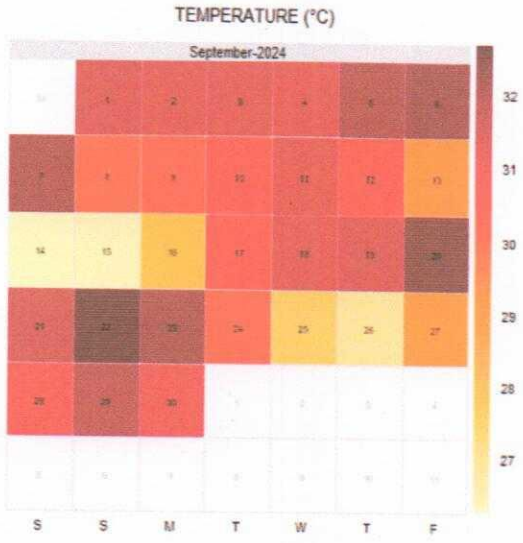
reflects the level of air pollution, helping to gauge the potential health impact of pollutants. $PM_{2.5}$ and PM_{10} represent the average concentrations of particulate matter with diameters smaller than 2.5 and 10 micrometers, respectively. These fine particles can be harmful to the respiratory and cardiovascular systems. Relative humidity measures the amount of moisture in the air, which can influence comfort levels and pollutant dispersion. Lastly, temperature affects both air quality and pollutant behaviour, with warmer temperatures potentially increasing pollutant formation and colder temperatures trapping pollutants near the surface.











The provided image contains five heatmaps showing the daily variations of the following parameters for September 2024:

1. **REL HUM (%)**: Relative humidity percentage.
2. **PM $_{10}$ AVG (µg/m³)**: Average particulate matter (PM_{10}) concentration.
3. **PM $_{2.5}$ AVG (µg/m³)**: Average particulate matter ($PM_{2.5}$) concentration.
4. **AQI**: Air Quality Index.
5. **TEMPERATURE (°C)**: Daily temperature in degrees Celsius.

General Interpretation:

- **Color Coding**: The heatmaps use a gradient from lighter (lower values) to darker colors (higher values), helping identify the magnitude of each parameter across days.
- **Daily Trends**: These heatmaps allow observation of how each parameter changes daily over the month.

Key Observations:

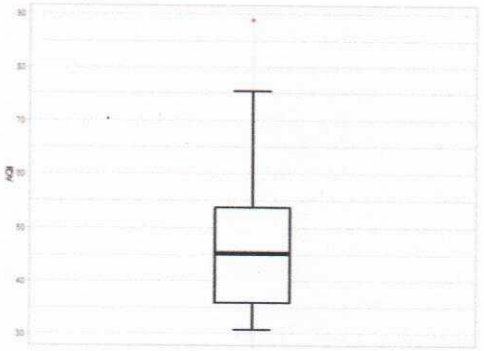
1. **REL HUM (%):**
   - Higher relative humidity (darker red) is observed during specific days, particularly in the early and mid-month.
   - It suggests periods of high moisture, which might coincide with rainfall or overcast conditions.
2. **PM $_{10}$ AVG (µg/m³):**
   - Elevated PM_{10} levels are noted around the middle and late part of the month.
   - This could indicate higher dust or particulate emissions during those days.
3. **PM $_{2.5}$ AVG (µg/m³):**
   - $PM_{2.5}$ shows a similar pattern to PM_{10} but appears to have slightly lower peak values.
   - Indicates fine particulate pollution, often linked to vehicular emissions, industrial activity, or stagnant air conditions.
4. **AQI:**
   - The Air Quality Index peaks during certain days, corresponding with the high $PM_{2.5}$ and PM_{10} levels.

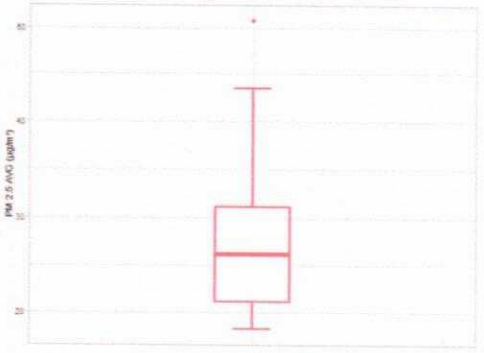
- Suggests that air quality is worse (possibly unhealthy) on these days.

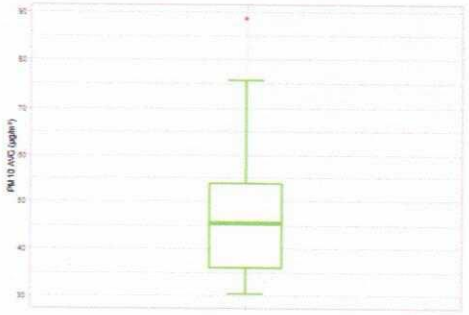
5. **TEMPERATURE (°C):**
   - Temperature is consistent, with higher values (around 31-32°C) dominating most of the days, likely reflecting typical September weather.
   - There are a few cooler days, potentially corresponding to rainy or overcast conditions that also correlate with higher humidity.

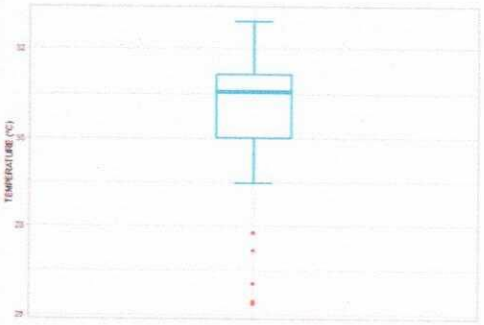
Insights:

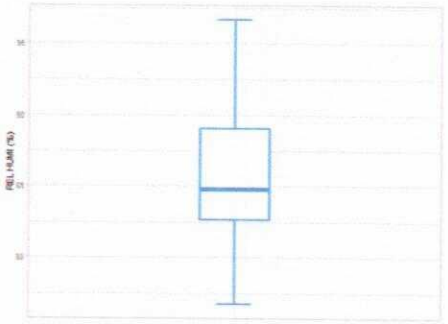
- The heatmaps suggest a relationship between **AQI, PM 2.5, PM 10**, and environmental factors like **humidity** and **temperature**.
- Peaks in particulate matter (PM_{10} and $PM_{2.5}$) often coincide with poorer AQI, indicating a direct contribution of particulate pollution to air quality deterioration.
- Relative humidity does not show a direct correlation with temperature but may be affected by weather events influencing both temperature and air pollution levels.











The box plots depict the statistical distribution of five parameters: AQI (Air Quality Index), $PM_{2.5}$ (Particulate Matter 2.5), PM_{10} (Particulate Matter 10), Temperature (°C), and Relative Humidity (%) for September 2024. Each box plot shows the median (central line in the box), interquartile range (IQR, represented by the box), and the spread of the data, including potential outliers.

1. **AQI**: The AQI plot indicates that the median value lies near 45, with a moderate spread in values. A few outliers are present above 70, suggesting occasional days with significantly higher pollution levels.
2. **PM2.5**: The $PM_{2.5}$ plot has a median close to 30 $\mu g/m^3$, with the majority of values within a narrow range. There are outliers above 45, pointing to sporadic days with higher fine particulate pollution.
3. **PM10**: The PM_{10} plot shows a wider spread compared to $PM_{2.5}$, with the median around 50 $\mu g/m^3$. There are fewer extreme outliers, and the data appear more evenly distributed.
4. **Temperature**: The temperature plot exhibits a median around 31°C, with most values within the range of 29°C to 32°C. A few outliers below 28°C suggest occasional cooler days during the month.
5. **Relative Humidity**: The relative humidity plot reveals a median near 80%, with a broad range extending from approximately 60% to 95%. This indicates considerable variability in moisture levels, potentially due to weather fluctuations.

Overall, these box plots highlight the central tendency, variability, and outliers of the environmental parameters for September 2024, reflecting a mix of typical and occasional extreme conditions.

Conclusion

The analysis of the data through heatmaps and box plots reveals significant insights into the environmental conditions for September 2024. The Air Quality Index (AQI) shows moderate pollution levels for most of the month, with occasional spikes reflecting poorer air quality, likely linked to higher PM_{10} and $PM_{2.5}$ concentrations. Relative humidity fluctuates considerably, indicating changing weather patterns, possibly due to rainfall or other meteorological events, while temperatures remain relatively stable, hovering around 31°C with minimal variation. The presence of outliers in $PM_{2.5}$, PM_{10}, and temperature data highlights specific days of unusual conditions, such as increased pollution or cooler temperatures. Overall, the data suggests a dynamic interplay between atmospheric pollutants, temperature, and humidity, emphasizing the need for continuous monitoring to understand and mitigate environmental and health impacts.

Note:

Report produced by Air Quality Monitoring System Committee

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