Air Quality Index (AQI) Report

Data Source: West Bengal Pollution Control Board
Station- Bhasa 2nd Campus of Asutosh College
(January 2026)

Introduction

The Air Quality Index (AQI) is an important indicator used to describe the condition of air in a specific area and its possible effects on human health. It was developed by the United States Environmental Protection Agency (EPA) to present complex air quality data in a simple and understandable form. The AQI converts detailed pollution measurements into a single numerical value along with color-coded categories, each indicating a different level of health risk. This system helps increase public awareness about air pollution and supports individuals in making informed decisions to protect their health.

Purpose and Importance

The main objective of the AQI is to deliver simple and easy-to-understand information about the daily condition of the air to the general public. By being aware of the AQI values, people can adopt appropriate safety measures, especially on days when pollution levels are elevated. The AQI is particularly significant for sensitive groups such as children, older adults, and individuals suffering from respiratory or heart-related illnesses, as they are more likely to experience harmful effects from poor air quality.

AQI Scale

The AQI scale ranges from 0 to 500 and is divided into six categories, each representing a different level of health concern:

- **0-50 (Good)**: Air quality is considered satisfactory, and air pollution poses little or no risk.
- **51-100 (Moderate)**: Air quality is acceptable; however, for some pollutants, there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
- **101-150 (Unhealthy for Sensitive Groups)**: Members of sensitive groups may experience health effects. The general public is not likely to be affected.

- **151-200 (Unhealthy)**: Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
- **201-300 (Very Unhealthy)**: Health alert: everyone may experience more serious health effects.
- **301-500 (Hazardous)**: Health warnings of emergency conditions. The entire population is more likely to be affected.

Discussion of the Data

The boxplot presents the distribution of five variables: **AQI, PM2.5 AVG (µg/m³), PM10 AVG (µg/m³), Relative Humidity (%)**, and **Temperature (°C)**. Each boxplot shows the median, interquartile range (IQR), whiskers (range excluding outliers), and outliers.

1. AQI

- The median AQI appears around **70–75**, indicating moderate air quality for most observations.
- The IQR (middle 50% of values) ranges approximately from **55 to 100**, showing considerable variability.
- The lower whisker is around **30–35**, while the upper whisker extends to about **170**.
- Numerous high-end outliers are visible, reaching above **250**, indicating occasional severe pollution episodes.
- The distribution is **positively skewed**, with extreme high values.

2. PM2.5 Average (µg/m³)

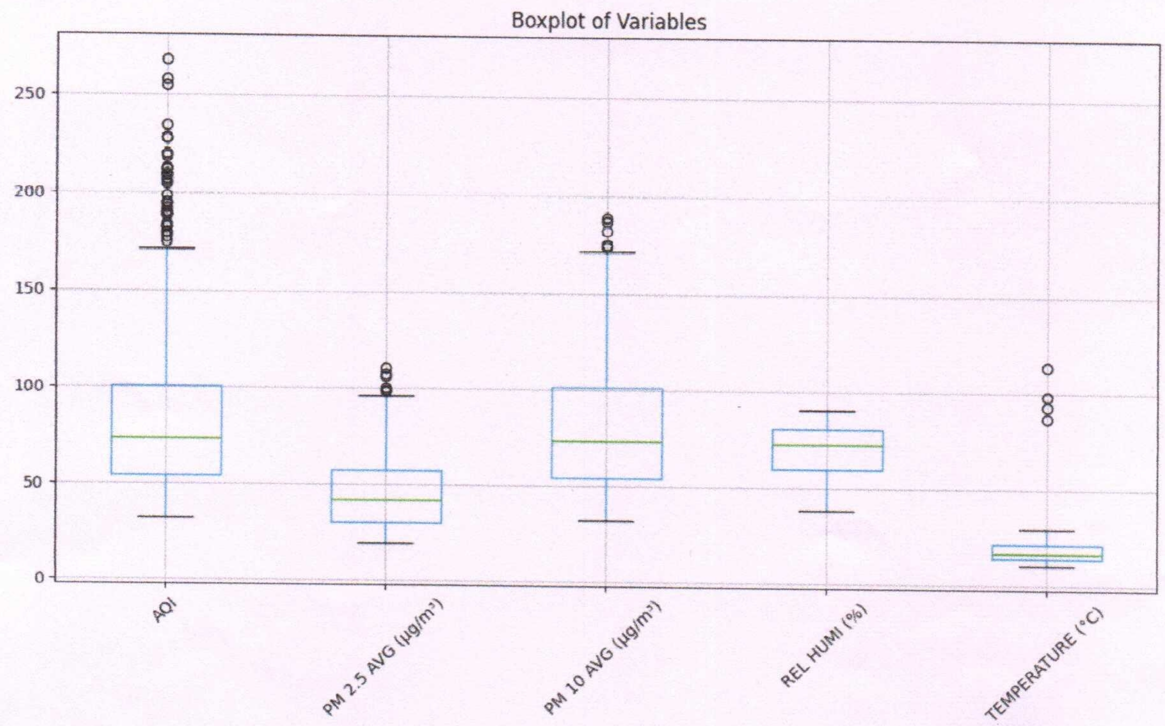
- The median is approximately **40–45 µg/m³**.
- The IQR ranges roughly from **30 to 55 µg/m³**, showing moderate spread.
- The lower whisker is near **20 µg/m³**, and the upper whisker is around **95–100 µg/m³**.
- Several upper outliers extend beyond **110 µg/m³**, indicating occasional high fine particulate concentrations.
- The distribution shows **right skewness**, similar to AQI.

3. PM10 Average (µg/m³)

- The median is around **70–75 µg/m³**, close to the AQI median pattern.
- The IQR lies roughly between **55 and 100 µg/m³**.
- The lower whisker is near **30–35 µg/m³**, and the upper whisker reaches about **170 µg/m³**.
- Outliers extend up to nearly **190 µg/m³**, indicating episodic high coarse particulate pollution.
- The distribution is also **positively skewed**.

4. Relative Humidity (%)

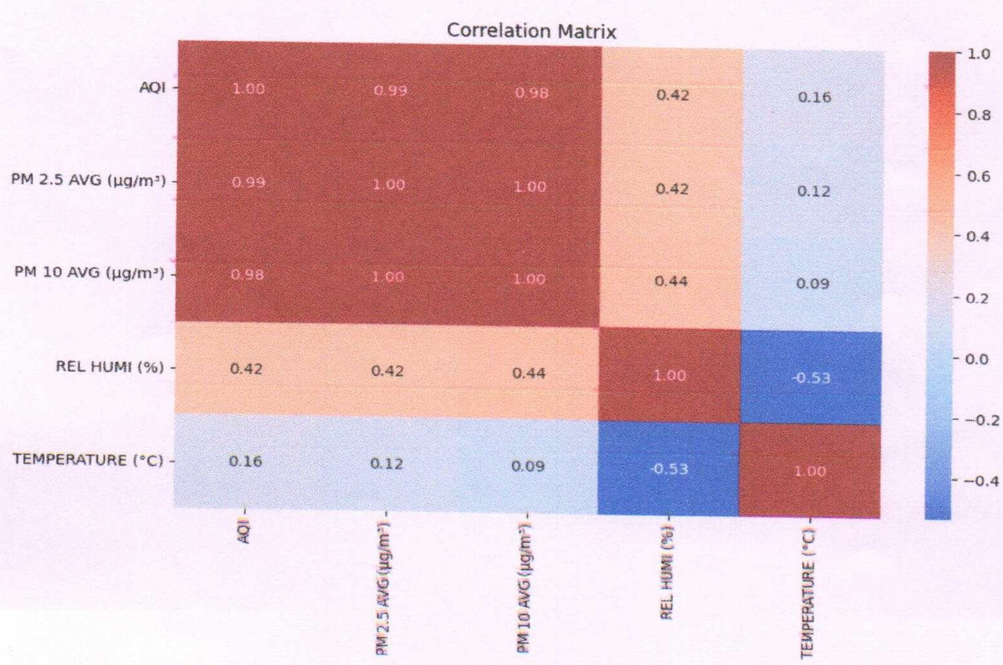
- The median humidity is approximately **70–75%**.



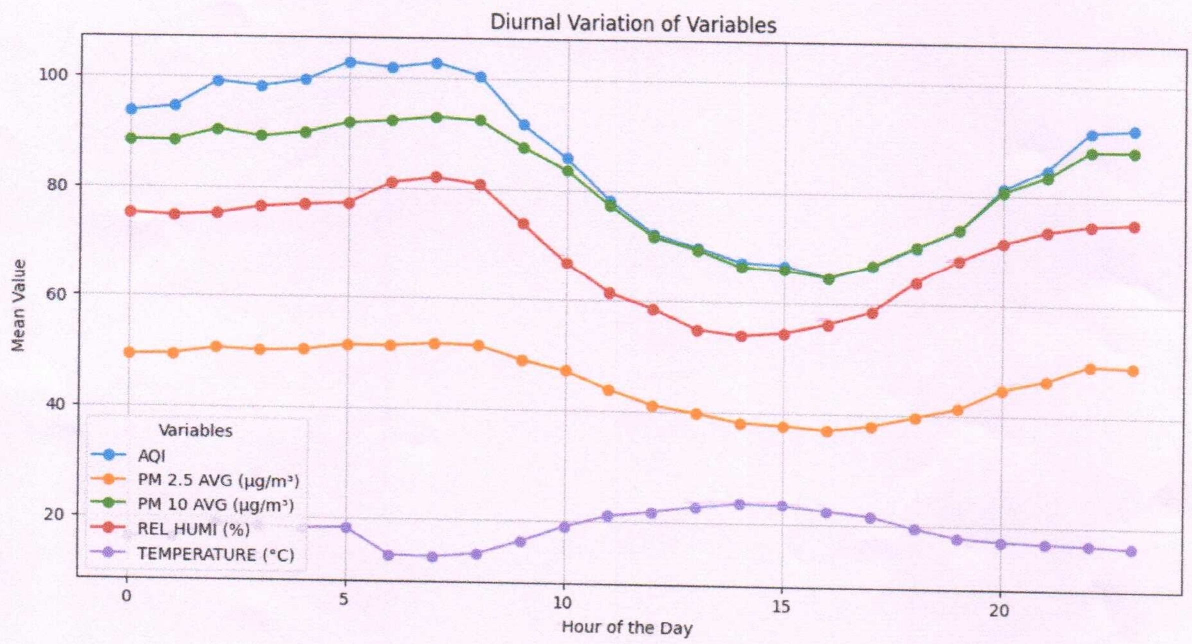
- The IQR ranges from about **60% to 80%**, indicating relatively stable humidity conditions.
- The overall range is narrower compared to pollutant variables.
- Few or no extreme outliers are visible.
- The distribution appears more **symmetrical** compared to AQI and particulate matter.

5. Temperature (°C)

- The median temperature is around **17–18°C**.
- The IQR is relatively small, approximately **14–20°C**, showing limited variability.
- The whiskers range from about **10°C to 30°C**.
- A few higher outliers (above **90–110°C**) appear in the plot, which likely represent data entry errors or extreme anomalies, as such temperatures are unrealistic for ambient air.
- The distribution is slightly **right-skewed**.



The correlation matrix illustrates the relationships among AQI, PM2.5, PM10, relative humidity, and temperature. The results show an extremely strong positive correlation between AQI and particulate matter concentrations, with AQI correlating at 0.99 with PM2.5 and 0.98 with PM10. Additionally, PM2.5 and PM10 exhibit an almost perfect positive correlation (1.00), indicating that both pollutants vary together and likely originate from similar sources or atmospheric processes. Relative humidity demonstrates a moderate positive correlation with AQI (0.42), PM2.5 (0.42), and PM10 (0.44), suggesting that higher humidity levels may be associated with increased pollutant concentrations. In contrast, temperature shows only a weak positive relationship with AQI (0.16), PM2.5 (0.12), and PM10 (0.09), indicating a limited direct influence on pollution levels. Notably, relative humidity and temperature display a moderate negative correlation (–0.53), reflecting their typical inverse atmospheric relationship. Overall, the analysis indicates that particulate matter is the primary driver of AQI variations, while meteorological factors exert a secondary influence.



The image presents a **diurnal (hourly) variation graph** of five variables—AQI, PM2.5, PM10, Relative Humidity, and Temperature—plotted against the 24 hours of the day. The x-axis represents the hour (0–23), and the y-axis shows the mean values of each variable.

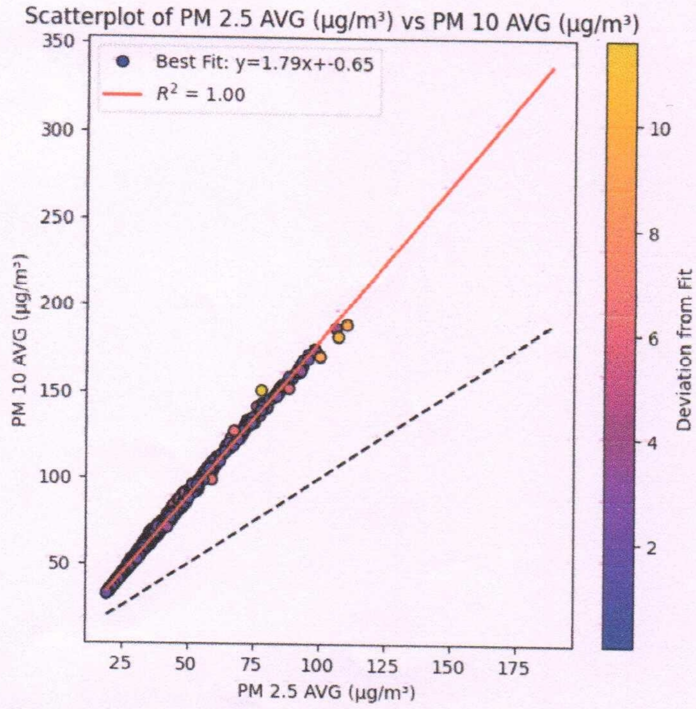
The graph reveals a clear **daily cyclical pattern** in air quality and meteorological parameters. AQI values are relatively high during the early morning hours (around 0–7 AM), peaking at approximately 6–7 AM. After this peak, AQI steadily declines through late morning and reaches its lowest levels in the afternoon (around 2–4 PM). From evening onwards, AQI begins to rise again, showing another increase during nighttime hours. This pattern suggests morning accumulation of pollutants, likely due to lower atmospheric mixing and possible traffic emissions, followed by improved dispersion during midday.

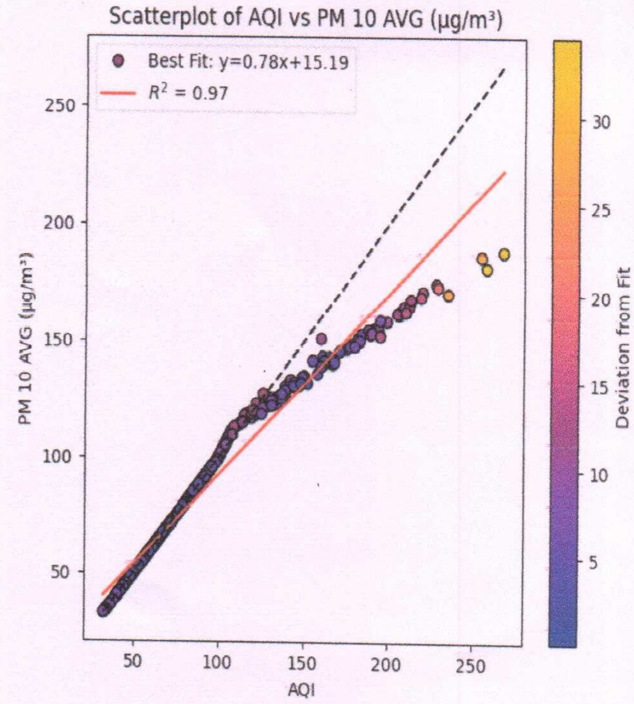
PM2.5 and PM10 follow a pattern almost identical to AQI, confirming their strong influence on overall air quality. Both pollutants show higher concentrations in the early morning, decrease during midday and afternoon, and increase again in the evening. PM10 values remain consistently higher than PM2.5 throughout the day, but their trends are closely synchronized.

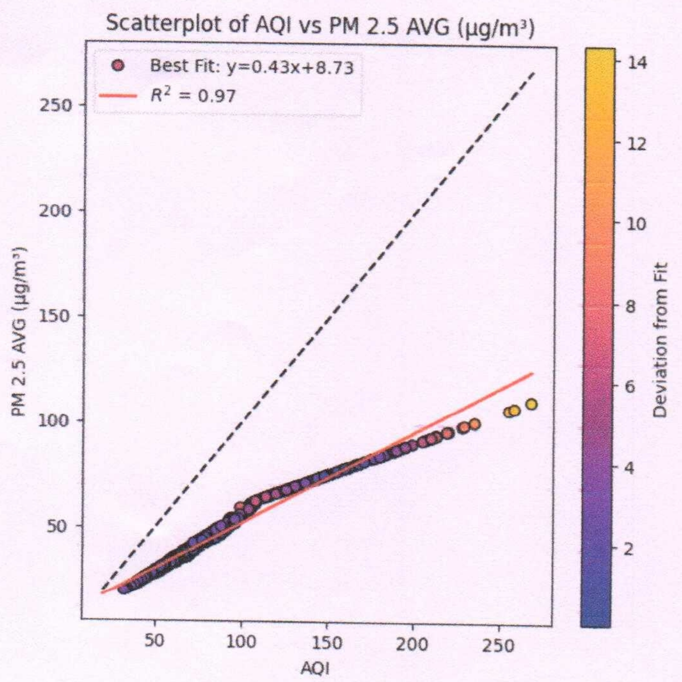
Relative humidity displays a somewhat similar trend to AQI in the early hours, remaining high in the morning, decreasing gradually toward the afternoon, and rising again in the evening. The lowest humidity values occur during the mid-afternoon period. This pattern may contribute to changes in pollutant concentration, as humidity can influence particle behavior and atmospheric stability.

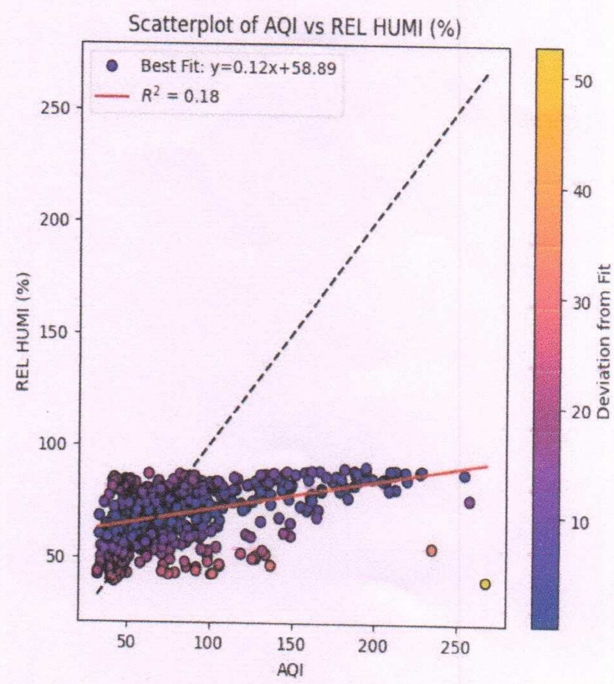
In contrast, temperature shows an **inverse pattern** compared to humidity and pollution levels. It is lowest during early morning hours, increases steadily through late morning, and reaches its maximum during mid-afternoon (around 2–3 PM). Afterward, temperature gradually declines into the evening and night. This inverse relationship between temperature and humidity aligns with typical atmospheric behaviour.

Overall, the figure indicates that **air pollution levels are highest during early morning and nighttime hours and lowest during the afternoon**, likely due to variations in atmospheric mixing height, temperature, and human activity patterns. The synchronized movement of AQI, PM2.5, and PM10 further confirms that particulate matter is the dominant factor influencing daily air quality fluctuations



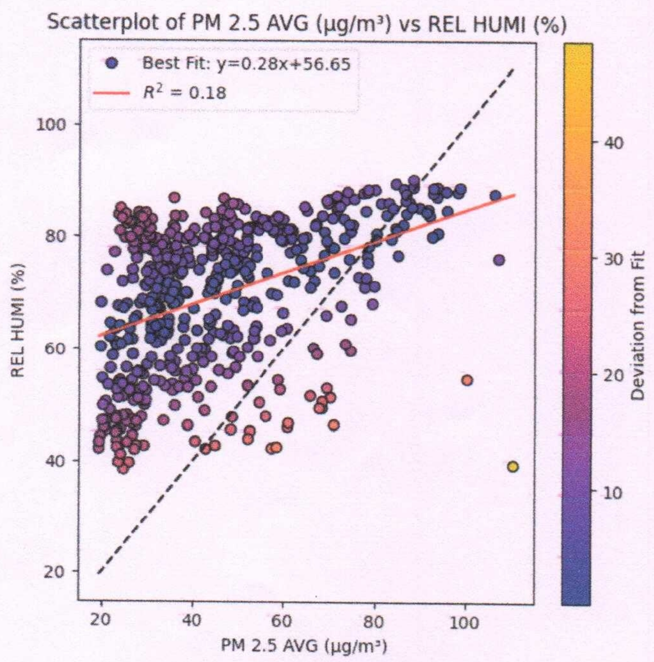


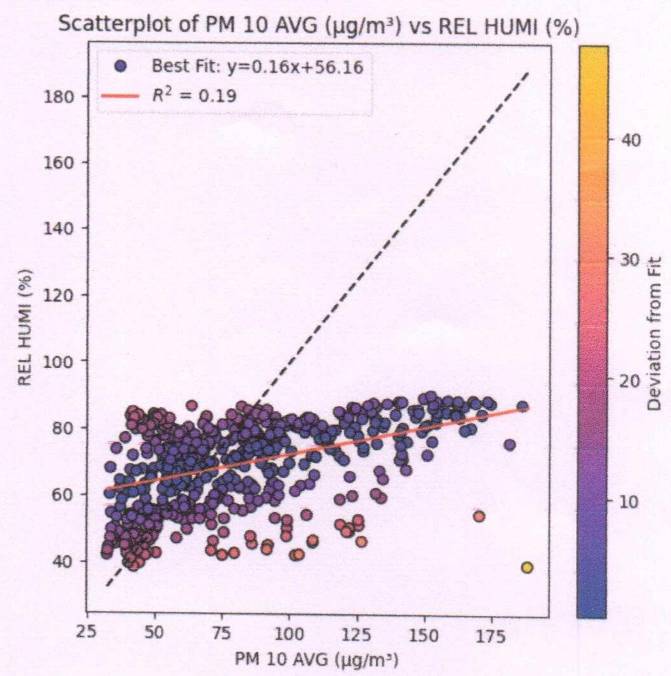


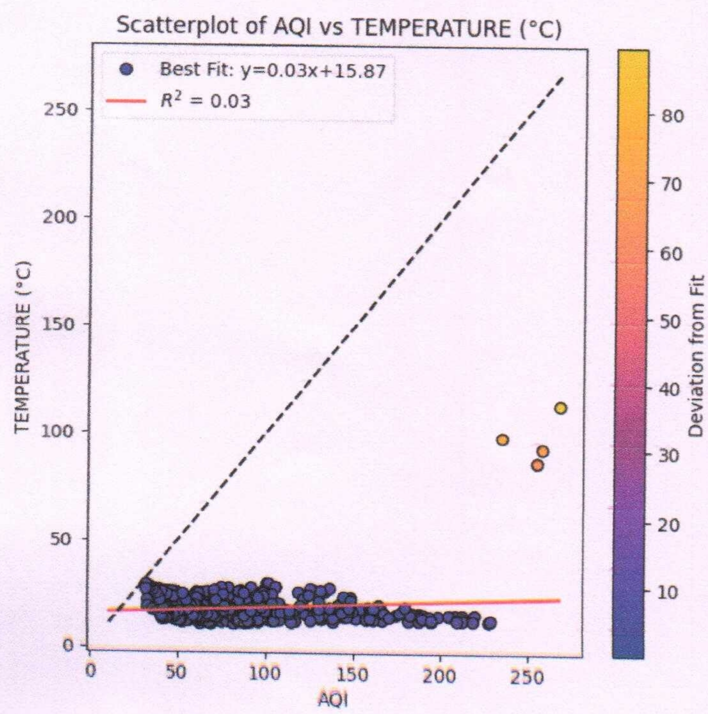


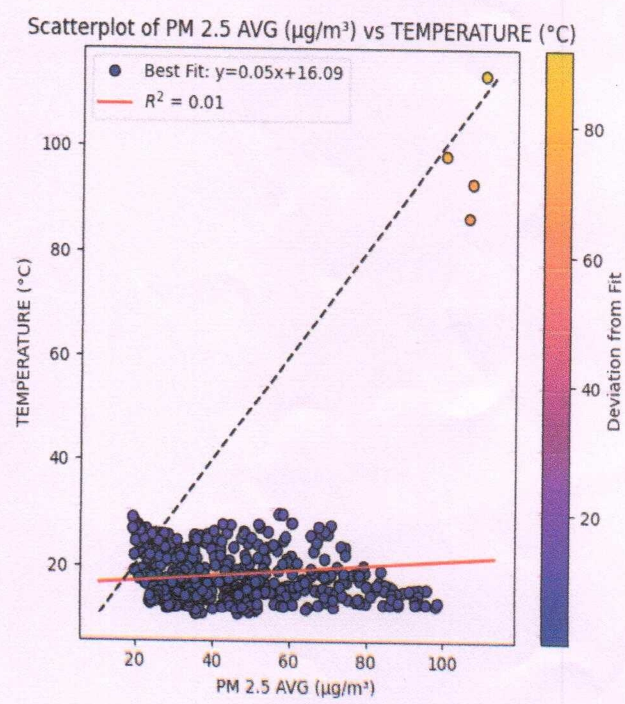
The provided image illustrates the relationships between air quality markers—PM 2.5, PM 10, and AQI—alongside environmental factors like relative humidity. The first plot (top left) reveals a **near-perfect linear correlation** ($R^2 = 1.00$) between PM 2.5 and PM 10, indicating that as fine particulate matter increases, larger particulates follow a strictly proportional rise according to the equation $y = 1.79x - 0.65$. This suggests these pollutants likely share a common source in this dataset. Similarly, the plots comparing **AQI to PM 10** (top right) and **AQI to PM 2.5** (bottom left) both show very high correlations ($R^2 = 0.97$), confirming that particulate matter concentrations are the primary drivers of the Air Quality Index scores shown here.

In contrast, the final plot (bottom right) shows a **weak relationship** ($R^2 = 0.18$) between AQI and relative humidity. While there is a slight upward trend in the fit line ($y = 0.12x + 58.89$), the data points are widely scattered, suggesting that humidity levels do not reliably predict air quality in this specific context. Across all four charts, the color-coded "Deviation from Fit" scale highlights that while the particulate-based models are highly accurate, the humidity model suffers from significant variance, making it the least dependable metric for atmospheric forecasting in this group.









The second set of scatterplots explores the relationships between particulate matter (PM 2.5 and PM 10), environmental variables like **relative humidity** and **temperature**, and the overall **Air Quality Index (AQI)**. In the top two charts, both PM 2.5 and PM 10 show weak positive correlations with relative humidity ($R^2 = 0.18$ and $R^2 = 0.19$, respectively), suggesting that while higher humidity levels are somewhat associated with higher particulate concentrations, the relationship is highly variable and lacks strong predictive power. The equations for these fits, $y = 0.28x + 56.65$ for PM 2.5 and $y = 0.16x + 56.16$ for PM 10, indicate a gentle upward trend where humidity levels generally cluster between **40% and 90%** across most pollutant ranges.

The bottom two charts reveal an even more significant lack of correlation when analyzing temperature. The relationship between **AQI and temperature** ($R^2 = 0.03$) and **PM 2.5 and temperature** ($R^2 = 0.01$) is essentially flat, with the vast majority of data points clustered at low temperatures below **30°C** regardless of how high the air pollution levels climb. Interestingly, both temperature plots show a few extreme outliers on the far right where temperatures appear to spike toward **100°C** as air quality worsens; however, given the extremely low R^2 values, these are likely anomalous data points rather than a representative trend. Overall, these visualizations demonstrate that while particulate matter levels are closely linked to one another, they are not strongly dictated by humidity or temperature in this specific dataset.

Conclusion

The data from both sets of scatterplots leads to the conclusion that particulate matter concentrations ($PM_{2.5}$ and PM_{10}) are the definitive drivers of the **Air Quality Index (AQI)** in this dataset, while environmental factors play a negligible role. The near-perfect correlation ($R^2 = 1.00$) between $PM_{2.5}$ and PM_{10} suggests they originate from the same pollution sources, and their high R^2 values of 0.97 against the AQI confirm that monitoring these particles provides a highly accurate prediction of overall air safety.

Conversely, environmental variables such as **Relative Humidity** and **Temperature** show very weak to non-existent correlations with air quality metrics, with R^2 values ranging from a low of 0.01 to a maximum of only 0.19. The scatterplots indicate that while humidity shows a slight, inconsistent positive trend with pollutant levels, temperature remains almost entirely static across the majority of AQI readings. Ultimately, this analysis proves that for this specific environment, atmospheric conditions like heat and moisture are poor predictors of pollution, whereas measuring particulate matter remains the only reliable method for determining air quality.

Note

Report produced by Air Quality Monitoring System Committee

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