Air Quality Index (AQI) Report

Data Source: West Bengal Pollution Control Board
Station: Bhasa,2nd Campus of Asutosh College
(January_2025)

Introduction

The Air Quality Index (AQI) of South 24 Parganas, a district in West Bengal, reflects the air pollution levels in the region. The AQI is calculated based on the concentration of key pollutants, including particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3).

South 24 Parganas, with its mix of urban, suburban, and rural landscapes, is influenced by both natural and anthropogenic factors. Industrial emissions, vehicular pollution, agricultural activities, and brick kilns contribute to air quality fluctuations. Additionally, the Sundarbans, a significant portion of the district, plays a vital role in absorbing pollutants and mitigating the impact of air pollution.

Regular monitoring and effective pollution control strategies are essential to safeguard public health and maintain ecological balance in this diverse region.

Description of the Data

STATISTICS	AQI	$PM_{2.5}$ AVG ($\mu g/m^3$)	PM_{10} AVG ($\mu g/m^3$)	REL HUMI (%)	TEMPERATURE (°C)
Min.	85.5	49.53	85.53	66.12	17.68
1st Qu.	110.38	61.18	107.22	74.74	19.66
Median	118.5	64.69	114.39	76.23	20.2
3rd Qu.	145.15	73.29	130.32	78.36	21.37
Max.	192.9	87.86	154.81	84.4	26.78
Mean	128.93	67.12	118.36	76.19	20.7
St. d.	27.96	9.85	17.45	3.94	2.05

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

. **AQI Categories and Range:**

1. **Good (0-50):**
   - Air quality is considered satisfactory, posing little or no risk to the general population.
2. **Moderate (51-100):**
   - Air quality is acceptable; however, there may be a concern for sensitive groups, such as individuals with respiratory issues.
3. **Unhealthy for Sensitive Groups (101-150):**
   - People with pre-existing health conditions, the elderly, and children may experience health effects, while the general public is unlikely to be affected.
4. **Unhealthy (151-200):**
   - Everyone may begin to experience health effects, with more serious effects for sensitive groups.
5. **Very Unhealthy (201-300):**
   - Health warnings are issued as the risk of health effects increases for everyone.
6. **Hazardous (301-500):**
   - Emergency conditions; the entire population is likely to experience severe health effects.

Significance of AQI Monitoring:

Monitoring AQI is essential for public health management, as it helps authorities implement pollution control measures and issue health advisories to protect vulnerable populations.

The table provides a statistical summary of Air Quality Index (AQI) and related environmental parameters, including $PM_{2.5}$ (particulate matter with a diameter of 2.5 micrometers or smaller), PM_{10} (particulate matter with a diameter of 10 micrometers or smaller), Relative Humidity (REL HUMI %), and Temperature (°C).

1. Descriptive Statistics:

- **Min. (Minimum)**: The lowest observed value for each parameter.
- **1st Qu. (First Quartile)**: The value below which 25% of the data falls.
- **Median (50th Percentile)**: The middle value when the data is sorted.
- **3rd Qu. (Third Quartile)**: The value below which 75% of the data falls.
- **Max. (Maximum)**: The highest observed value.
- **Mean**: The average value.
- **St. d. (Standard Deviation)**: A measure of the spread or dispersion of the data.

2. Air Quality Index (AQI):

- **Min (85.5)** indicates the best air quality observed.
- **Max (192.9)** indicates the worst air quality recorded.
- **Mean (128.93)** suggests the average air quality is in the "Unhealthy for Sensitive Groups" category.
- The **Standard Deviation (27.96)** shows that there is moderate variability in the AQI values.

3. $PM_{2.5}$ ($\mu g/m^3$):

- Particulate matter that can penetrate deep into the lungs and cause respiratory issues.
- **Min (49.53)** to **Max (87.86)** shows a range from moderate to high pollution levels.
- **Mean (67.12)** indicates average PM2.5 levels that exceed safe limits set by WHO (25 $\mu g/m^3$ for 24-hour exposure).
- **Standard Deviation (9.85)** reflects moderate fluctuation.

4. PM_{10} ($\mu g/m^3$):

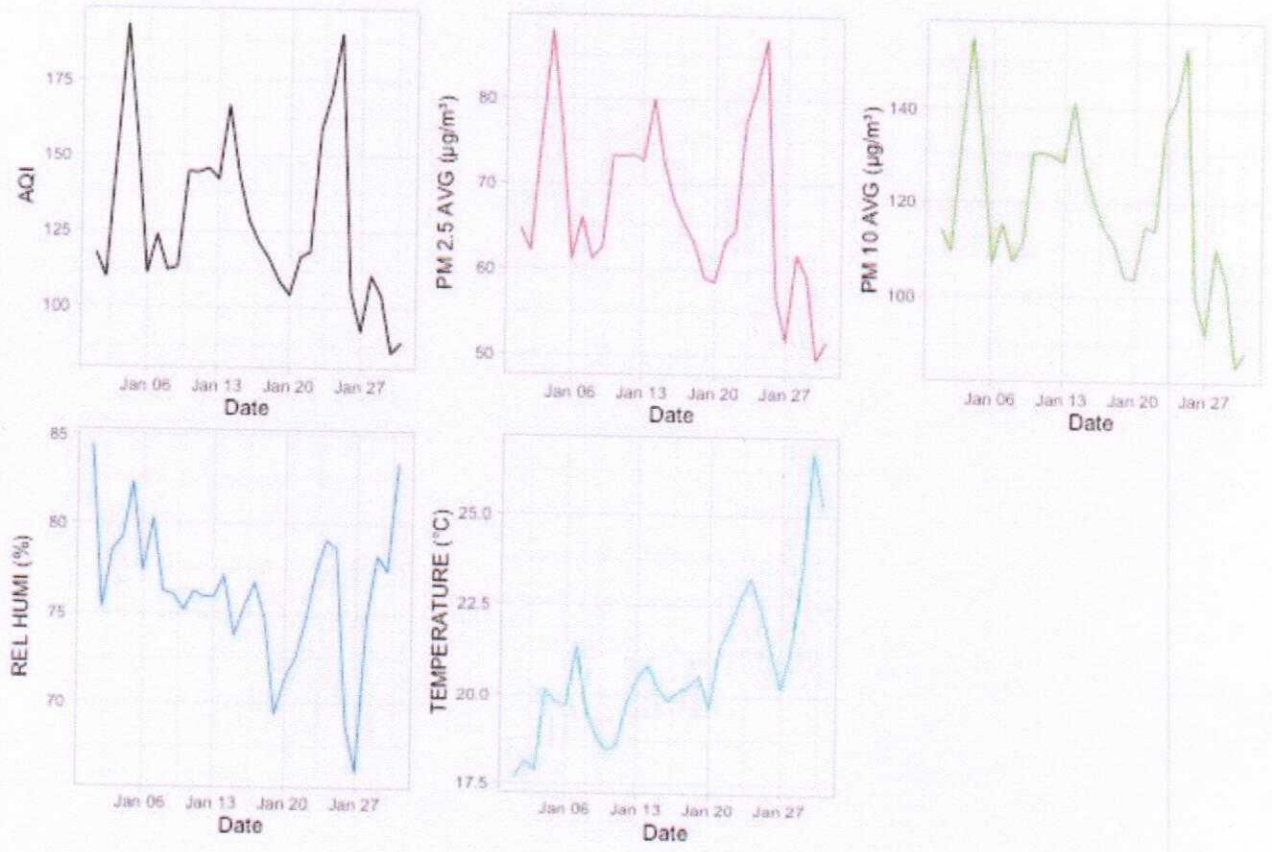
- Larger particulate matter that can affect the respiratory system.
- The values range from **85.53 (Min)** to **154.81 (Max)**.
- The **Mean (118.36)** exceeds the WHO limit (50 $\mu g/m^3$ for 24-hour exposure).
- **Standard Deviation (17.45)** shows a moderate spread of data.

5. Relative Humidity (%):

- Reflects moisture in the air.
- **Min (66.12%)** to **Max (84.4%)** indicates a consistently high humidity environment.
- **Mean (76.19%)** suggests relatively humid conditions.
- **Standard Deviation (3.94%)** shows little variability.

6. Temperature (°C):

- **Min (17.68°C)** to **Max (26.78°C)** shows a moderate temperature range.
- **Mean (20.7°C)** indicates mild weather conditions.
- **Standard Deviation (2.05°C)** suggests minor fluctuations in temperature.



The graph consists of four individual line charts showing trends over time (in January) for different air quality and environmental parameters:

1. **AQI (Air Quality Index)**
    - The AQI fluctuates significantly throughout January, with noticeable peaks and dips. High AQI values indicate poor air quality, while lower values represent better conditions. The pattern suggests varying pollution levels, potentially influenced by weather conditions and human activities.
    - **PM $_{2.5}$ Average (µg/m³) :**
    - PM $_{2.5}$, which consists of fine particulate matter that can penetrate deep into the lungs, shows a similar fluctuating trend. Peaks correspond to

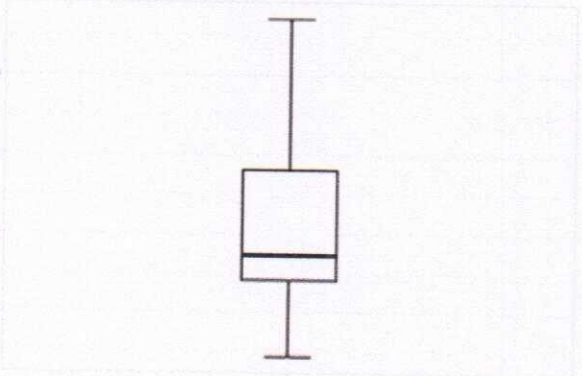
high pollution episodes, while dips indicate temporary improvements in air quality.

2. **PM10 Average (µg/m³)**
   - PM_{10}, which includes coarser particles, also varies over time. The pattern resembles that of $PM_{2.5}$, but the concentration levels are higher. This is typical, as PM10 includes both fine and coarse particles from sources like dust and construction activities.
3. **Relative Humidity (%)**
   - The humidity levels show fluctuations, with higher values earlier in the month and some dips around mid-January. Increased humidity can influence pollutant dispersion and contribute to haze formation.

4. **Temperature (°C)**

   - The temperature gradually increases toward the end of the month, with some fluctuations. Temperature changes can affect the atmospheric boundary layer, impacting pollutant dispersion and accumulation.

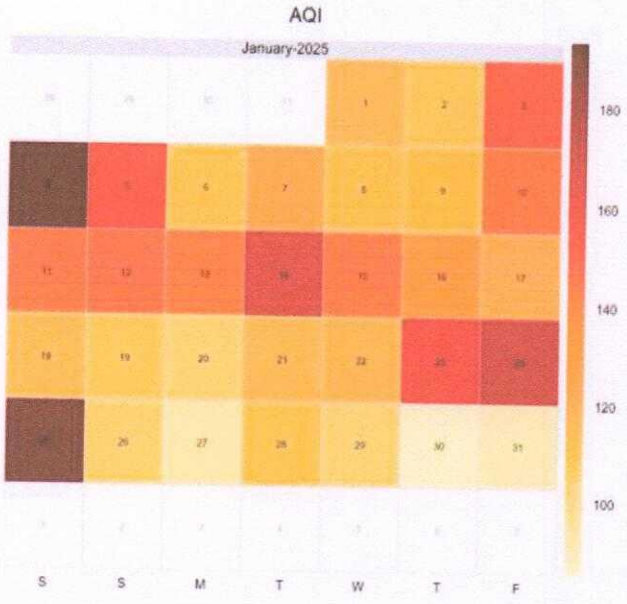
Overall, the graphs indicate a complex interaction between air quality parameters and weather conditions, with notable variability throughout the month.



The diagram is a box plot, which is commonly used in statistics to visualize the distribution of data. Here's an interpretation:

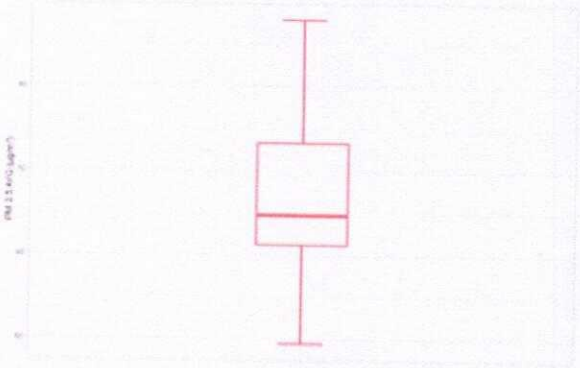
1. **Median (thick line inside the box):** Represents the middle value of the dataset, indicating the central tendency.
2. **Interquartile Range (IQR, the box itself):** The box spans from the first quartile (25th percentile) to the third quartile (75th percentile), representing the middle 50% of the data.
3. **Whiskers (lines extending from the box):** These extend to the minimum and maximum values within 1.5 times the IQR from the quartiles. Values beyond this range are considered outliers.
4. **Outliers (if any):** Points that fall outside the whiskers are considered extreme values and are typically shown as individual dots.

In this case, the plot shows the distribution of AQI (Air Quality Index), with the median around 125, an IQR between approximately 110 and 150, and whiskers extending to around 100 and 180. This indicates some variability in AQI values.



The heat map visualizes the Air Quality Index (AQI) for January 2025. Here's an interpretation:

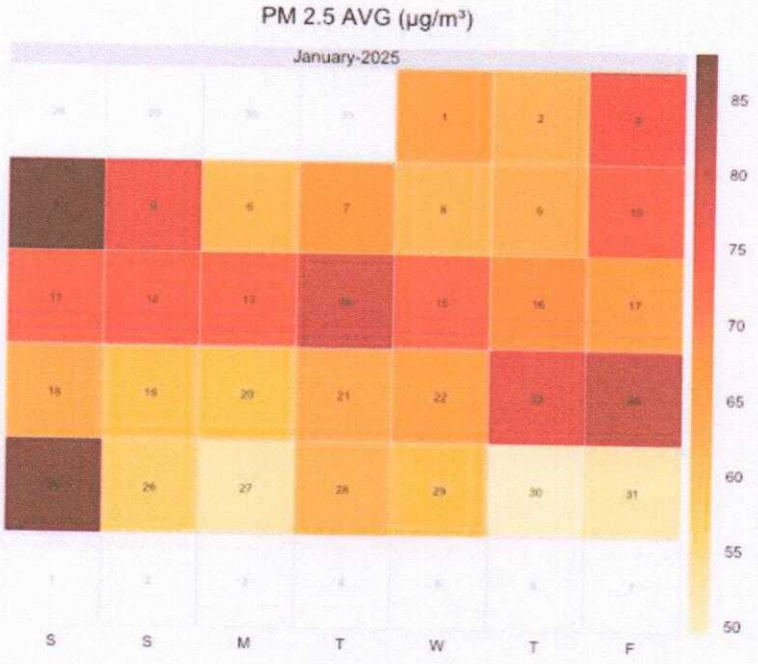
1. **Color Gradient:** The color intensity ranges from light yellow (indicating lower AQI values) to dark red (indicating higher AQI values). Higher AQI values signify poorer air quality.
2. **Calendar Format:** The heat map is organized by days of the week (Sunday to Saturday), allowing you to observe daily AQI variations throughout the month.
3. **Patterns and Trends:**
   - Higher AQI values (darker red) are concentrated around the 4th, 5th, 14th, 23rd, and 25th of January, suggesting spikes in pollution on these days.
   - Lighter yellow days, especially towards the end of the month, indicate relatively better air quality.
4. **Potential Influences:** The spikes might be due to factors like traffic patterns, industrial activity, or weather conditions.



This is a box plot representing the average PM2.5 concentration (in micrograms per cubic meter, $\mu g/m^3$). Here's the interpretation:

1. **Median (bold horizontal line within the box):** Represents the middle value of PM2.5 concentrations, indicating the central tendency of the data.
2. **Interquartile Range (IQR, the box itself):** Spans from the first quartile (25th percentile) to the third quartile (75th percentile), showing the middle 50% of the data.
3. **Whiskers (lines extending from the box):** Represent the minimum and maximum values within 1.5 times the IQR from the quartiles. This captures the spread of most data points.
4. **Outliers (if present):** Any points outside the whiskers would be considered outliers, but this plot does not show any.

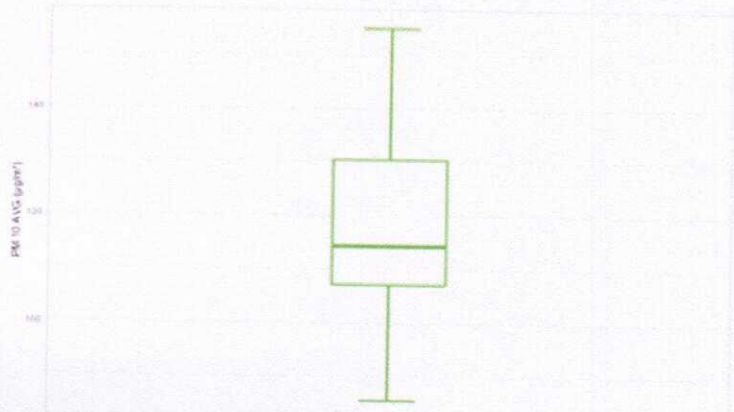
In this plot, the median is around 60 µg/m³, the IQR ranges between approximately 60 and 70 µg/m³, and the whiskers extend from about 50 to 85 µg/m³. This suggests moderate variability in PM2.5 levels, with some higher concentrations.



This heat map illustrates the average PM2.5 concentration (in µg/m³) for January 2025. Here's the interpretation:

1. **Color Gradient:** The scale ranges from light yellow (lower PM2.5 levels) to dark red (higher PM2.5 levels), indicating pollution intensity.
2. **Calendar Format:** The heat map is structured as a monthly calendar, with each cell representing the daily average PM2.5 concentration.
3. **High Pollution Days:** Notably, the 4th, 11th, 14th, 23rd, and 25th of January show dark red, indicating PM2.5 levels above 80 µg/m³, which reflects poor air quality.
4. **Moderate Pollution Days:** Many days in the middle of the month (e.g., 6th-10th and 15th-22nd) are shaded in orange and yellow, showing moderate PM2.5 levels.
5. **Relatively Cleaner Days:** Towards the end of the month (26th-31st), the colors are lighter, indicating lower PM2.5 levels, around 55-60 µg/m³.

This visualization helps identify trends and potential pollution hotspots, which can be useful for air quality management and health advisories.



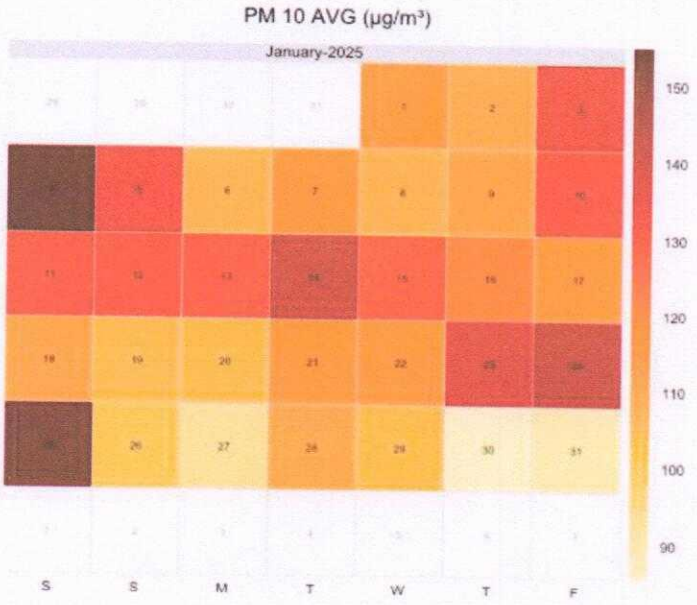
This box plot illustrates the average PM10 concentration (in micrograms per cubic meter, µg/m³). Here's the interpretation:

1. **Median (bold horizontal line inside the box):** This

represents the middle value of the dataset, around 120 µg/m³.

2. **Interquartile Range (IQR, the box itself):** This spans from approximately 110 µg/m³ (25th percentile) to around 130 µg/m³ (75th percentile), covering the middle 50% of the data.
3. **Whiskers (lines extending from the box):** These lines show the data range within 1.5 times the IQR, stretching from approximately 95 µg/m³ to 145 µg/m³.
4. **Outliers (not present in this plot):** If there were extreme values outside the whiskers, they would be marked as separate points.

This distribution suggests that the PM10 levels are relatively stable, with a moderate spread and no extreme outliers.

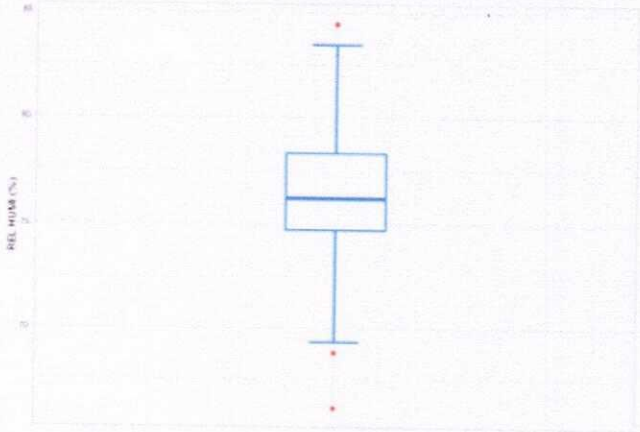


This heatmap displays the average PM10 concentration (in µg/m³) for January 2025. Here's the interpretation:

1. **Color Gradient:** The color intensity ranges from light yellow (indicating lower PM10 levels) to dark red (indicating higher concentrations). The legend on the right shows that the range spans from approximately 90 µg/m³ to over 150 µg/m³.
2. **Weekly Pattern:** Higher PM10 levels are observed around weekends (e.g., 4th, 5th, 14th, 23rd, and 25th), suggesting possible human activities like traffic or industrial emissions contributing to higher pollution levels.
3. **Temporal Trend:** There is a gradual decline in PM10 concentration towards the end of the month, with the lightest shades appearing from the 28th to the 31st.
4. **High Pollution Days:** The darkest red cells (e.g., 4th, 14th, and 25th) indicate the most polluted days, with concentrations exceeding 150 µg/m³.
5. **Low Pollution Days:** The lightest cells towards the end of the month indicate days with concentrations around 90-100 µg/m³, which are relatively lower.

This visualization effectively highlights the variability in air quality throughout the month and identifies periods of concern for mitigation strategies.

This box plot illustrates the distribution of relative humidity (REL HUMI %) over a specific period. Here's the interpretation:



1. **Median and Quartiles:**
   - The bold horizontal line within the box represents the median humidity, which is around 75%.
   - The box spans from the first quartile (25th percentile) to the third quartile (75th percentile), indicating the interquartile range (IQR).
2. **Whiskers and Outliers:**
   - The whiskers extend to the minimum and maximum values within 1.5 times the IQR from the quartiles.
   - The red dots represent outliers, which are data points that fall outside this range. These outliers suggest occasional spikes or drops in humidity, which could be due to sudden weather changes or localized factors.
3. **General Distribution:**
   - The data shows moderate variability, with the bulk of the data concentrated between approximately 72% and 80% humidity.

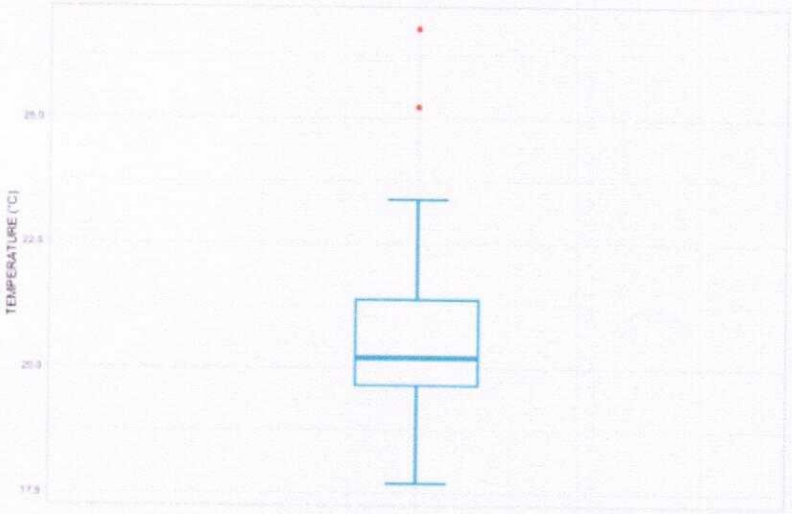
This plot helps in understanding the central tendency and spread of relative humidity, along with identifying any extreme values.

This heatmap illustrates the relative humidity (REL HUMI %) for January 2025. Here's the interpretation:

1. **Color Gradient:** The color scale on the right indicates the range of relative humidity percentages, from lighter shades representing lower humidity (around 68%) to darker shades representing higher humidity (up to 84%).
2. **Temporal Pattern:** The highest humidity levels are observed on January 1st and 5th, as indicated by the darkest red colors. These values exceed 80%, suggesting a humid environment at the start of the month.
3. **Lower Humidity Periods:** Around January 19th to 27th, the lighter shades indicate lower humidity levels, dropping to around 68-72%.

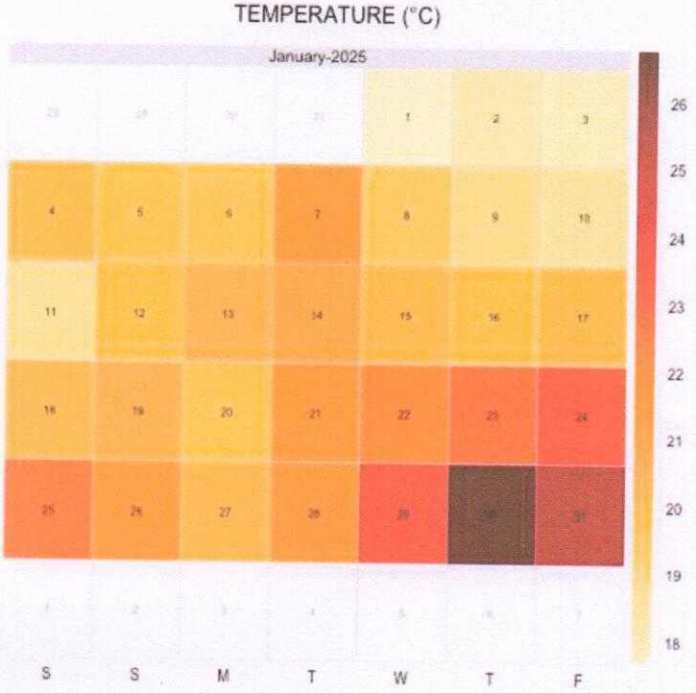
4. **Fluctuation Trend:** The pattern shows alternating periods of high and low humidity, which could be influenced by weather patterns or other environmental factors.

This heatmap effectively highlights the daily variation in humidity over the month, which is helpful for identifying trends and potential anomalies.



This box plot represents the distribution of temperature (°C). Here's the interpretation:

1. **Median (Central Line in Box):** The median temperature is around 20°C, indicating the central value of the dataset.
2. **Interquartile Range (Box):** The box spans from approximately 19°C to 22.5°C, representing the middle 50% of the data (between the first and third quartiles).
3. **Whiskers (Lines Extending from the Box):** The whiskers show the range of typical data points, extending from around 17.5°C to 23.5°C.
4. **Outliers (Red Dots):** The red dots above the upper whisker indicate outliers, which are temperatures above 25°C. These are values that deviate significantly from the rest of the data.
5. **General Trend:** The data is fairly symmetrical with a few extreme high-temperature outliers.



This heatmap shows the daily temperature (in °C) for January 2025. Here's the interpretation:

1. **Color Gradient:** The color scale on the right indicates that lighter colors represent lower temperatures (around 18°C), while darker colors indicate higher temperatures (up to 26°C).
2. **Temperature Distribution:** The early part of the month (1st to 10th) is

dominated by lighter shades, indicating cooler temperatures. As the month progresses, the colors gradually shift to darker shades, reflecting a temperature rise.

3. **Temperature Peaks:** The 30th and 31st of January are marked with the darkest shades, indicating the highest temperatures of the month, around 26°C.
4. **Moderate Periods:** Mid-month shows a balance between warm and cooler days, with moderate temperatures around 20-22°C.

This pattern suggests a gradual warming trend throughout the month. Let me know if you'd like further analysis or a comparison with other datasets

Conclusion

The statistical analysis of air quality and weather parameters for January 2025 reveals notable trends. The Air Quality Index (AQI) averages at 128.93, with a maximum of 192.9, indicating poor air quality that poses potential health risks, especially for sensitive groups. The high standard deviation of 27.96 reflects significant fluctuations in air quality throughout the month. Similarly, the PM 2.5 and PM 10 levels, averaging 67.12 $\mu g/m^3$ and 118.36 $\mu g/m^3$ respectively, exceed safe thresholds, with peaks reaching 87.86 $\mu g/m^3$ and 154.81 $\mu g/m^3$. This indicates a high concentration of particulate matter, which can adversely affect respiratory health. The relative humidity, with a mean of 76.19% and a range from 66.12% to 84.4%, suggests a consistently moist atmosphere, with limited variability as indicated by the standard deviation of 3.94. The temperature remains moderate, averaging 20.7°C, with fluctuations between 17.68°C and 26.78°C, and a standard deviation of 2.05, showing relatively stable thermal conditions. Overall, the data highlights a humid and moderately warm environment, but with alarming levels of air pollution that necessitate targeted mitigation strategies to protect public health

Note:

Report produced by Air Quality Monitoring System Committee

Name of the members	Signatures
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