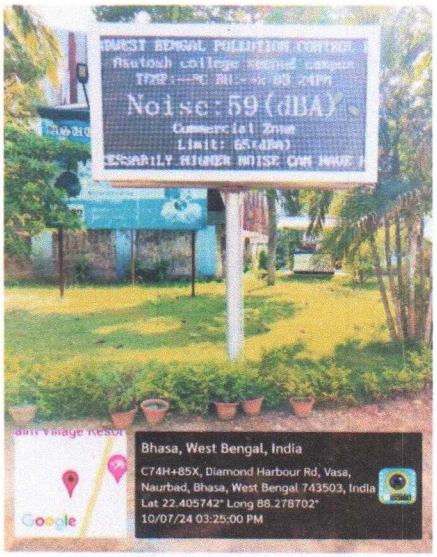
Air Quality Index (AQI) Report

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

In July, the Air Quality Index (AQI) is particularly significant due to a confluence of factors that can impact air quality. High summer temperatures and extended daylight hours lead to increased solar radiation, which can intensify the formation of ground-level ozone—a major component of smog. This ozone formation is driven by the reaction of sunlight with pollutants like nitrogen oxides (NOx) and volatile organic compounds (VOCs), which are more prevalent during summer months due to higher temperatures and increased vehicular and industrial activity.



Urban areas often experience elevated AQI levels due to increased traffic and the use of air conditioning, which can contribute to both ozone formation and increased emissions of pollutants. Moreover, the combination of these factors can lead to high AQI readings, prompting health advisories and emphasizing the need for public awareness and precautionary measures.

Monitoring AQI during July is crucial for understanding these seasonal and environmental impacts on air quality. It enables communities to take appropriate actions to reduce exposure to harmful pollutants, such as limiting outdoor activities during high pollution periods and implementing measures to reduce emissions.

Description of the Data

Table 1 Description of the data

July					
	AQI	$PM_{2.5}$ AVG ($\mu g/m^3$)	PM_{10} AVG ($\mu g/m^3$)	RELATIVE HUMIDITY (%)	TEMPERATURE (°C)
Min.	32.12	18.95	32.12	79.75	28.13
1st Qu.	37.16	21.71	37.14	84.55	30
Median	43.75	25.24	43.83	87.15	30.57
3rd Qu.	54.29	31.03	54.13	89.33	30.91
Max.	60	34.64	60.03	93.54	32.48
Mean	45.13	26.19	45.09	86.89	30.44
St. d.	9.37	5.24	9.35	3.41	1.02

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

The dataset provided offers a detailed summary of air quality and environmental conditions during the month of July, based on several metrics including Air Quality Index (AQI), $PM_{2.5}$ (Particulate

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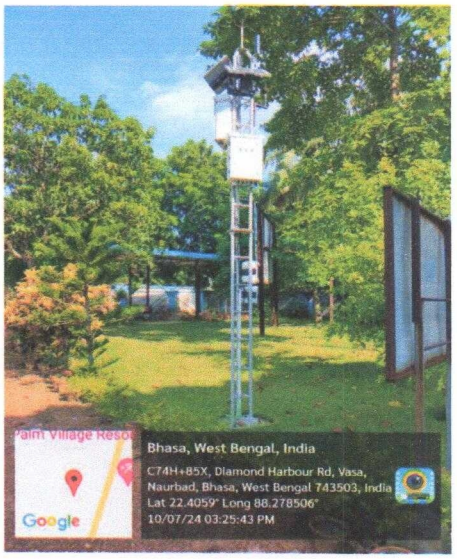
Matter with a diameter of 2.5 micrometers or less), PM $_{10}$ (Particulate Matter with a diameter of 10 micrometers or less), relative humidity, and temperature. Below is a breakdown of the interpretation:

1. Air Quality Index (AQI)

- **Range**: The AQI ranges from a minimum of 32.12 to a maximum of 60, with a mean value of 45.13.
- **Interpretation**:
  - **Min/Max**: The lowest AQI value recorded was 32.12, and the highest was 60. This indicates that during the month of July, the air quality fluctuated between 'Good' and 'Moderate' levels according to the AQI scale. A lower AQI suggests cleaner air, while higher values indicate higher levels of air pollutants.
  - **Quartiles**: The 1st quartile (25th percentile) of 37.16 and 3rd quartile (75th percentile) of 54.29 suggest that 50% of the AQI readings fall between these values, indicating most of the month experienced air quality that was on the lower end of the 'Moderate' level.
  - **Mean**: The mean AQI of 45.13 implies that the average air quality during July was relatively moderate.



  - **Standard Deviation (St. d.)**: The standard deviation of 9.37 shows that there was some variability in AQI readings, but not extreme.

2. PM $_{2.5}$ Concentration (µg/m³)

- **Range**: PM $_{2.5}$ values ranged from 18.95 µg/m³ to 34.64 µg/m³, with a mean of 26.19 µg/m³.
- **Interpretation**:
  - **Min/Max**: These values indicate that particulate matter concentrations were generally moderate, with some variation. Higher PM $_{2.5}$ levels typically indicate poorer air quality and potential health risks.
  - **Quartiles**: The 1st quartile value of 21.71 µg/m³ and the 3rd quartile value of 31.03 µg/m³ suggest that the middle 50% of readings were in the moderate range.
  - **Mean**: A mean of 26.19 µg/m³ suggests that on average, PM $_{2.5}$ levels were moderate, with potential health concerns for sensitive groups.
  - **Standard Deviation**: The standard deviation of 5.24 indicates moderate variability in PM $_{2.5}$ levels.

3. PM $_{10}$ Concentration (µg/m³)

- **Range**: PM $_{10}$ levels ranged from 32.12 µg/m³ to 60.03 µg/m³, with a mean of 45.09 µg/m³.
- **Interpretation**:
  - **Min/Max**: The minimum and maximum values show a range from low to moderately high particulate pollution.
  - **Quartiles**: The 1st quartile of 37.14 µg/m³ and the 3rd quartile of 54.13 µg/m³ indicate that most readings fall within this range, consistent with moderate air quality.

- **Mean**: The mean PM $_{10}$ level of 45.09 µg/m³ reflects a consistent moderate level of larger particulate matter.
- **Standard Deviation**: A standard deviation of 9.35 suggests variability similar to AQI.

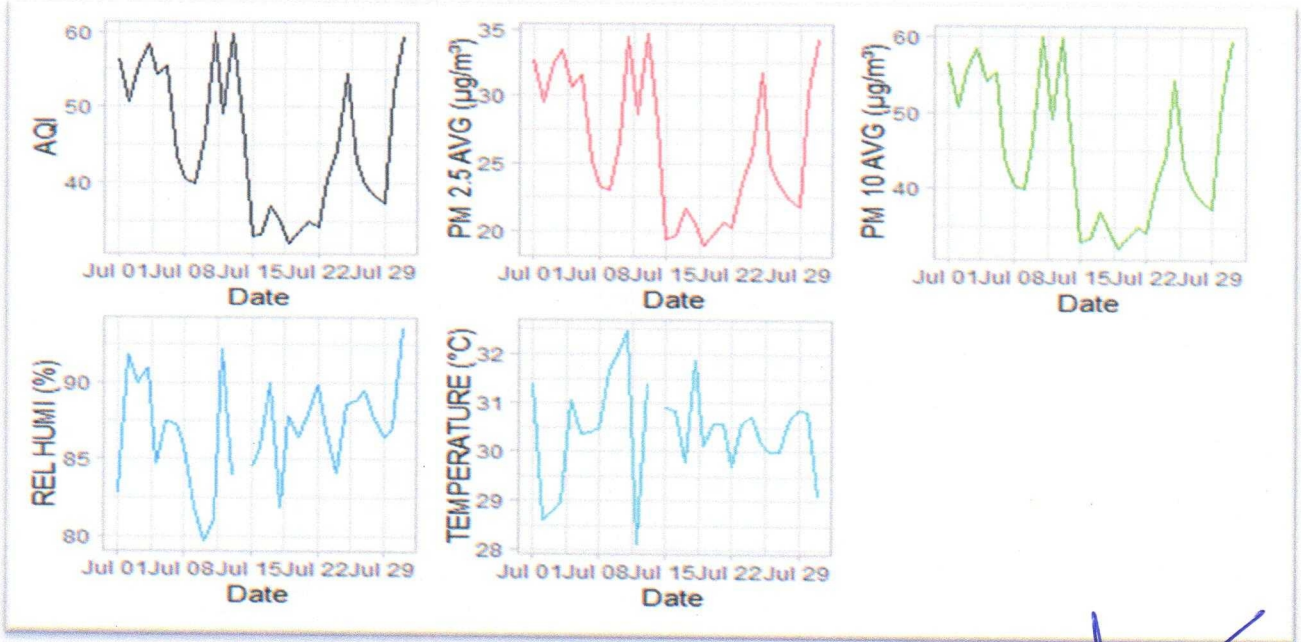
4. Relative Humidity (%)

- **Range**: Relative humidity varied from 79.75% to 93.54%, with a mean of 86.89%.
- **Interpretation**:
  - **Min/Max**: The minimum relative humidity was 79.75%, while the maximum was 93.54%, indicating generally high humidity throughout July.
  - **Quartiles**: The 1st quartile of 84.55% and the 3rd quartile of 89.33% show that most of the humidity readings were between these values.
  - **Mean**: A mean relative humidity of 86.89% suggests consistently high moisture content in the air, which is typical for humid months.
  - **Standard Deviation**: A lower standard deviation of 3.41 indicates that the humidity levels were fairly stable, with little fluctuation.

5. Temperature (°C)

- **Range**: Temperatures ranged from a minimum of 28.13°C to a maximum of 32.48°C, with a mean of 30.44°C.
- **Interpretation**:
  - **Min/Max**: The minimum and maximum temperatures suggest that July was a warm month with temperatures staying relatively consistent.
  - **Quartiles**: The 1st quartile temperature of 30°C and the 3rd quartile temperature of 30.91°C show that temperatures were generally stable, with slight daily variations.
  - **Mean**: The mean temperature of 30.44°C indicates that the average temperature was around 30°C, typical of warm summer conditions.

Standard Deviation: The standard deviation of 1.02°C suggests very low temperature variability, with the month being consistently warm. The data for July indicates moderate air quality with AQI values mostly within the 'Moderate' range, accompanied by moderately elevated levels of particulate



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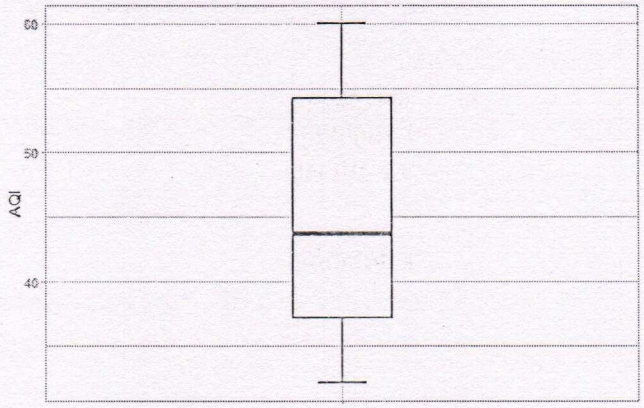
matter ($PM_{2.5}$ and PM_{10}). High humidity levels persisted throughout the month, which is typical for monsoon conditions, and temperatures were consistently warm, ranging from about 28°C to 32°C. The standard deviations across all parameters indicate moderate to low variability, suggesting stable weather and air quality conditions during the month.

The diagram consists of five-line graphs, each representing the temporal variation of different environmental parameters observed from July 1st to July 29th. Below is a detailed interpretation of each graph:

1. **AQI (Air Quality Index):**
   - The black line graph displays the daily variations in AQI, with values oscillating primarily between 40 and 60.
   - There are notable fluctuations throughout the month, with some peaks reaching slightly above 60, indicating poorer air quality, and some troughs dipping close to 40, indicating relatively better air quality.
   - The overall pattern suggests periodic changes in air pollution levels, possibly influenced by varying weather conditions, traffic patterns, or other environmental factors.
2. **$PM_{2.5}$ AVG (Particulate Matter 2.5 Micrometers):**
   - The red line graph shows the average daily concentration of PM 2.5 particles, which are fine inhalable particles with diameters generally 2.5 micrometers and smaller.
   - The concentrations range between 25 $\mu g/m^3$ and 35 $\mu g/m^3$, with several fluctuations indicating changing levels of fine particulate matter in the air.
   - There are distinct periods where PM 2.5 levels decrease significantly, followed by sharp increases, which may be linked to specific events or changes in atmospheric conditions that affect particulate dispersion or generation.
3. **PM_{10} AVG (Particulate Matter 10 Micrometers):**
   - The green line graph illustrates the average daily concentration of PM 10 particles, which are inhalable particles with diameters that are generally 10 micrometers and smaller.
   - The PM 10 levels fluctuate between 40 $\mu g/m^3$ and 60 $\mu g/m^3$, with the graph showing a series of peaks and troughs.
   - These variations could be associated with factors like dust storms, vehicular emissions, construction activities, or other sources of coarse particulate matter.
4. **REL HUMI (Relative Humidity):**
   - The blue line graph depicts the daily variations in relative humidity, measured as a percentage.
   - The relative humidity values predominantly range between 80% and 95%, indicating consistently high humidity throughout the period.
   - The graph shows several peaks reaching close to or above 95%, suggesting very humid conditions, possibly influenced by weather patterns such as rainfall or coastal proximity. The drops in humidity, although not very steep, reflect drier intervals, likely during warmer parts of the day or when weather systems change.
5. **TEMPERATURE (°C):**
   - The cyan line graph represents the daily variations in temperature, with readings fluctuating between 28°C and 32°C.
   - The graph shows a slight upward trend in temperature as the month progresses, particularly noticeable towards the end of July.

- The temperature variations appear relatively consistent, with some daily fluctuations indicating typical diurnal temperature changes. The increase in temperature could be related to seasonal shifts or specific weather events such as heatwaves.

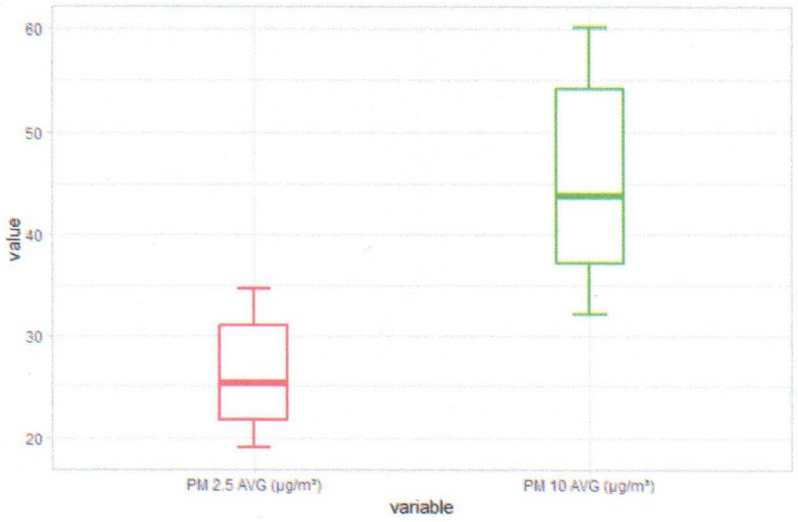
The box plot provided represents the distribution of **Air Quality Index (AQI)** values over a certain period. Here's a systematic quantitative analysis of the data:



- **Median (Central Tendency):** The thick horizontal line within the box indicates the median AQI value, which is approximately 45. This suggests that half of the AQI values are below 45, and half are above it.
- **Interquartile Range (IQR):** The box spans from the lower quartile (25th percentile) to the upper quartile (75th percentile), representing the middle 50% of the data. The AQI values within this range are between approximately 40 and 55, indicating a moderate level of variability in the data.
- **Whiskers and Range:** The whiskers extend from the box to the minimum and maximum values, which appear to be around 35 at the lower end and 60 at the upper end. This shows the full spread of the data, including potential outliers.
- **Symmetry and Skewness:** The box plot appears to be relatively symmetrical, with the median line slightly closer to the bottom of the box. This suggests a slightly positively skewed distribution, where the data may have a slight tendency towards higher AQI values.
- **Potential Outliers:** No significant outliers are apparent as the whiskers seem to cover all data points, indicating that the data is relatively well-distributed without extreme deviations.

In summary, the AQI values are distributed between approximately 35 and 60, with a median value of around 45. The data shows moderate variability, with a slight positive skewness, indicating a tendency towards higher AQI values in this period.

The box plot provided compares the distributions of **PM $_{2.5}$ and PM $_{10}$** average concentrations (in µg/m³) over a specific period. Here's a systematic quantitative analysis:



PM $_{2.5}$ AVG (µg/m³):

1. **Median (Central Tendency):**
    - The median PM $_{2.5}$ concentration is approximately 25 µg/m³, represented by the thick horizontal line within the box.
2. **Interquartile Range (IQR):**
    - The IQR, represented by the box, spans from approximately 23 to 30 µg/m³. This indicates that the middle 50% of the data is within this range, showing moderate variability in PM $_{2.5}$ concentrations.
3. **Whiskers and Range:**
    - The whiskers extend from the box to the minimum and maximum values, which are about 20 µg/m³ and 34 µg/m³, respectively. This shows the full range of PM $_{2.5}$ concentrations observed during the period.
4. **Symmetry and Skewness:**
    - The box plot for PM $_{2.5}$ is relatively symmetrical, indicating a balanced distribution of values around the median without significant skewness.

PM $_{10}$ AVG (µg/m³):

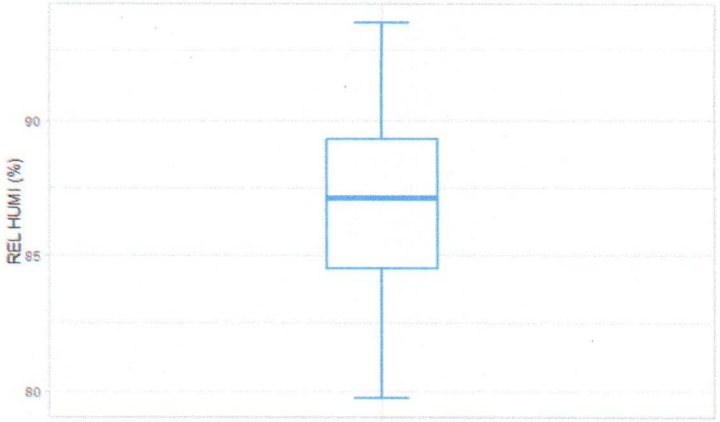
1. Median (Central Tendency):
    - The median PM $_{10}$ concentration is approximately 50 µg/m³, which is significantly higher than the median PM $_{2.5}$ concentration.
2. Interquartile Range (IQR):
    - The IQR for PM $_{10}$ spans from approximately 45 to 55 µg/m³, indicating a broader range of variability compared to PM $_{2.5}$.
3. Whiskers and Range:
    - The whiskers for PM $_{10}$ extend from around 40 µg/m³ to 60 µg/m³, showing that PM 10 concentrations have a wider range and higher maximum values compared to PM $_{2.5}$.
4. Symmetry and Skewness:
    - Similar to PM $_{2.5}$, the PM $_{10}$ box plot appears relatively symmetrical, indicating a balanced distribution of data around the median.

Comparative Analysis:

- **Concentration Levels:** PM $_{10}$ concentrations are consistently higher than PM $_{2.5}$ concentrations. The median PM $_{10}$ value (50 µg/m³) is nearly double that of PM $_{2.5}$ (25 µg/m³), reflecting the larger particle size and greater presence of PM $_{10}$ in the air.
- **Variability:** PM $_{10}$ concentrations show a slightly broader range and higher variability than PM $_{2.5}$, as evidenced by the wider IQR and the range extending from 40 to 60 µg/m³.
- **Range:** Both PM $_{2.5}$ and PM $_{10}$ have a similar degree of spread within their respective ranges, though PM 10's range is shifted upward to higher concentrations.

The box plots illustrate that PM $_{10}$ concentrations are consistently higher and more variable than PM $_{2.5}$ concentrations. The median PM $_{10}$ level is about double that of PM $_{2.5}$, indicating that larger particulate matter is more prevalent in the environment during this period. Both distributions are relatively symmetrical, suggesting a balanced spread of values around their respective medians without significant outliers.

The boxplot presents the distribution of **relative humidity (%)** for a given period, likely July 2024, based on the context provided by the previous images.



Key Statistical Insights:

1. **Median Relative Humidity:**
    - The median value of relative humidity is approximately 86%, as indicated by the line within the box. This suggests that half of the days observed had a relative humidity below this value, and half had a relative humidity above it.
2. **Interquartile Range (IQR):**
    - The box represents the interquartile range, which spans from the 25th percentile (lower quartile) to the 75th percentile (upper quartile). In this plot, the IQR for relative humidity is from approximately 83% to 89%.
    - This range indicates that the middle 50% of the data lies between these two values, highlighting a moderate spread in the central data points.
3. **Whiskers:**
    - The whiskers extend from the quartiles to the minimum and maximum values that are not considered outliers. In this case, the lower whisker reaches down to approximately 80%, and the upper whisker extends up to around 91%.
    - These whiskers indicate the overall spread of the data, showing that most of the humidity values fall between 80% and 91%.
4. **Range of Values:**

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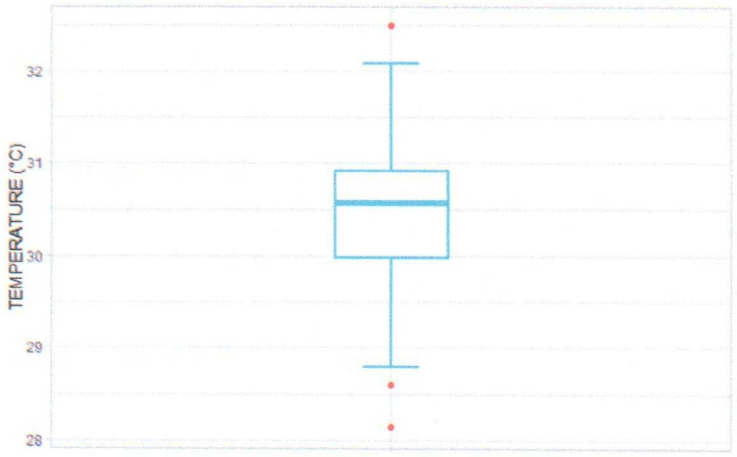
- The entire range of relative humidity values is from about 80% to 91%, showing that there is some variability in humidity, but the extremes do not deviate widely from the central values.

Overall Interpretation:

The boxplot demonstrates that the relative humidity during the period analyzed is generally high, with most values clustering around the mid to upper 80% range. There are no extreme outliers, suggesting a relatively consistent humidity level across the period. The central tendency is slightly above the median, indicating that the higher end of the humidity spectrum is more frequently observed. The overall variation, as indicated by the whiskers, is moderate, showing that the humidity levels fluctuated but stayed within a relatively narrow band.

The box plot presented here illustrates the distribution of **temperature** data (in °C) for the month of July, providing a statistical summary of the data points.



Quantitative Analysis:

1. **Central Tendency (Median):**
   - The median temperature, represented by the line inside the box, is slightly above 30°C. This indicates that half of the observed temperatures were above this value, and half were below. The median is often used as a measure of central tendency, particularly in skewed distributions.
2. **Interquartile Range (IQR):**
   - The box itself represents the interquartile range (IQR), which covers the middle 50% of the data. The lower bound of the box (Q1) is around 29.7°C, and the upper bound

(Q3) is around 31°C. This shows that the central 50% of the temperature values lie within a narrow range of approximately 1.3°C. The relatively tight IQR indicates a consistent temperature pattern, with most days falling within this range.

3. **Whiskers and Extreme Values:**

   - The whiskers extend to the minimum and maximum values that are not considered outliers. The lower whisker reaches down to just below 29°C, and the upper whisker extends to about 32°C. These whiskers represent the range within which most of the temperature data lies, excluding outliers.

   - There are a few outliers marked by red dots, which lie beyond the whiskers. These outliers include temperatures slightly above 32°C and slightly below 28°C. These values represent the most extreme temperature observations for the month and indicate days with significantly different weather conditions compared to the rest of the month.

4. **Spread and Skewness:**

   - The spread of the box and whiskers suggests a slight skewness in the data. The whisker on the lower end is slightly longer than the one on the upper end, indicating a minor left skew (negatively skewed distribution). This could suggest that lower temperatures were slightly more common or that there were a few days with significantly lower temperatures pulling the distribution in that direction.

Conclusion:

The box plot indicates that July experienced relatively stable and consistent temperatures, with most values clustered between 29.7°C and 31°C. The presence of a few outliers indicates occasional extreme temperature events, but overall, the month was characterized by moderately warm weather. The slight skew towards lower temperatures could be indicative of specific weather patterns that brought cooler conditions on some days, potentially due to rainfall or cloud cover, which are common in monsoon-affected regions.

Note: Report produced by Air Quality Monitoring System Committee

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Name of the members	Signatures
Dr. Debasmrity Mukherjee (Nodal Officer) Dept. of Geography	Debasmrity Mukherjee. 13/8/24.
Dr. Bidisha Maitra Sen (Dept. of IFF)	Bidisha Maitra Sen. 13/08/24.
Sri Debabrata Chanda (Dept. of Geography)	Debabrata Chanda
Dr. Sudip Dasgupta (Dept. of Geography)	Sudip DasGupta 13/8/24
Dr. Shramana Roy Barman (Dept. of Environmental Science)	Shramana Roy Barman 13/8/24
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Signature of Principal

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