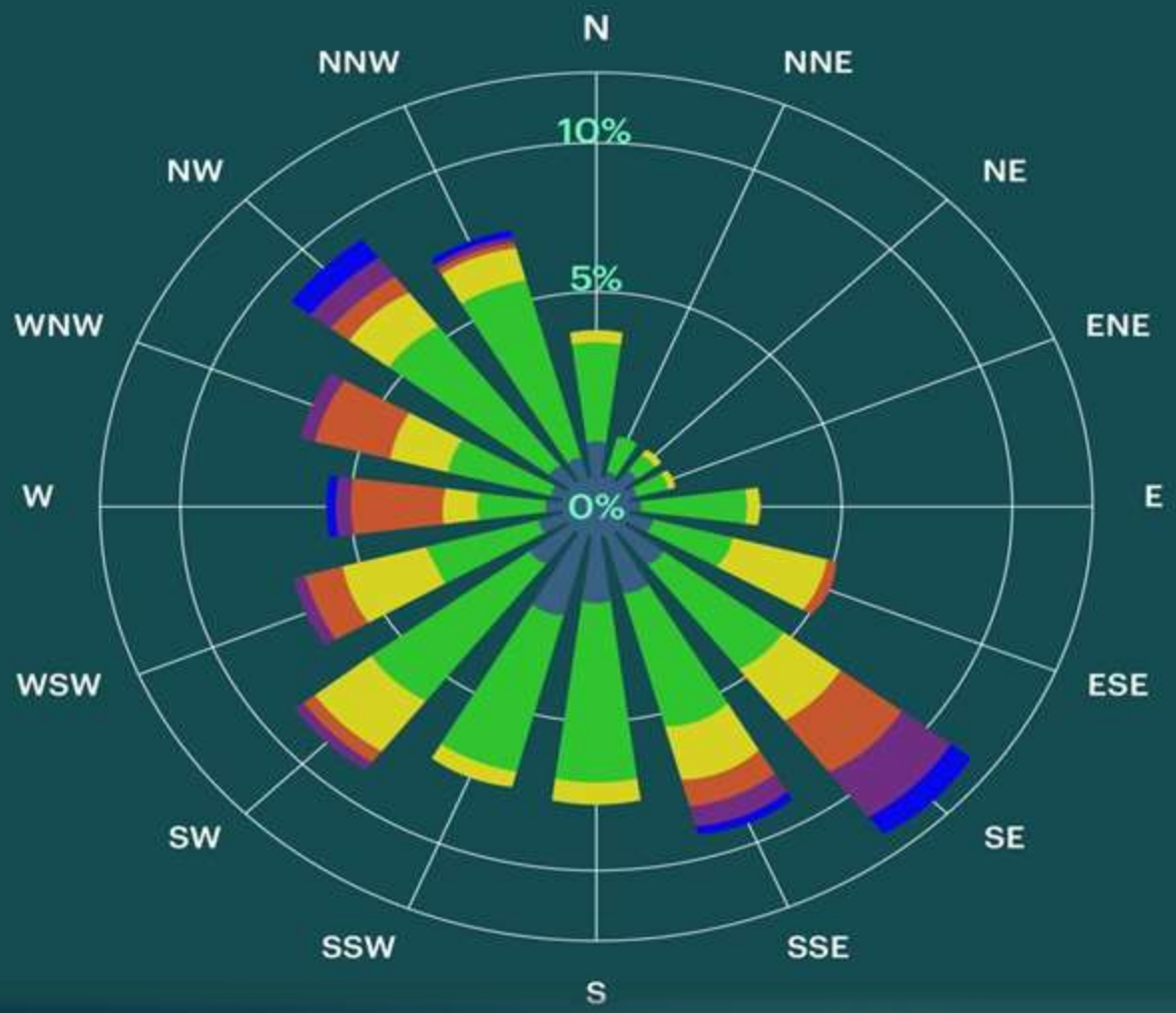
# PROJECT ON THE TOPIC




# WIND ROSE DIAGRAM

## USING WRPLOT VIEW SOFTWARE

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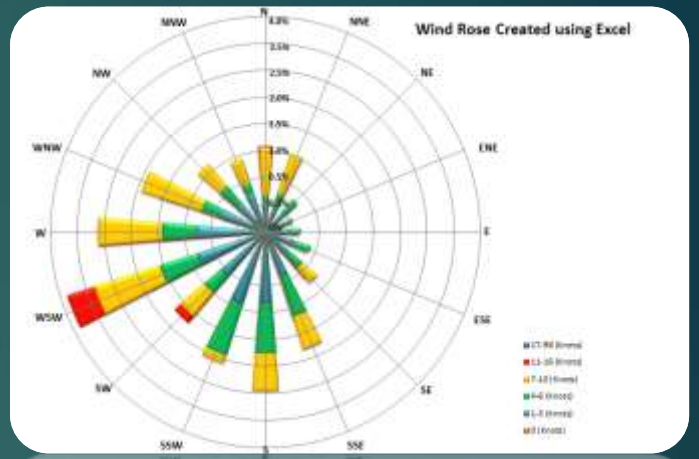
# INTRODUCTION



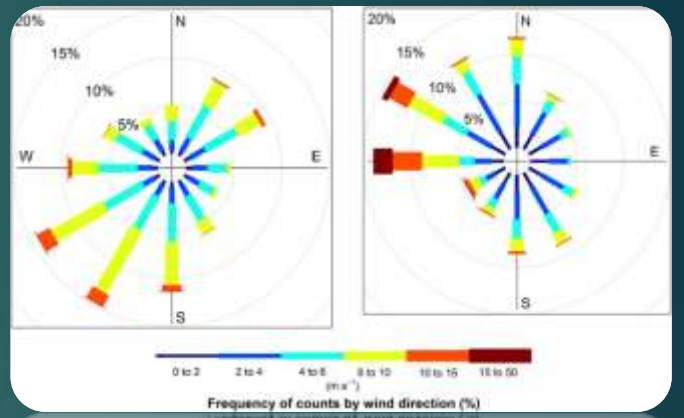
- **Definition**:
  - A wind rose is a circular diagram that shows the distribution of wind speed and direction at a particular location over a specified period. The diagram's spokes represent different wind directions (e.g., North, East, South, West), with the length of each spoke proportional to the frequency of wind from that direction.
- **Structure**:
  - Typically, wind roses have 16 or 32 directional bins, and each bin is further divided into segments representing wind speed ranges.
- **Applications**:
  - **Meteorology**: Helps in predicting weather patterns and planning meteorological studies.



# INTRODUCTION

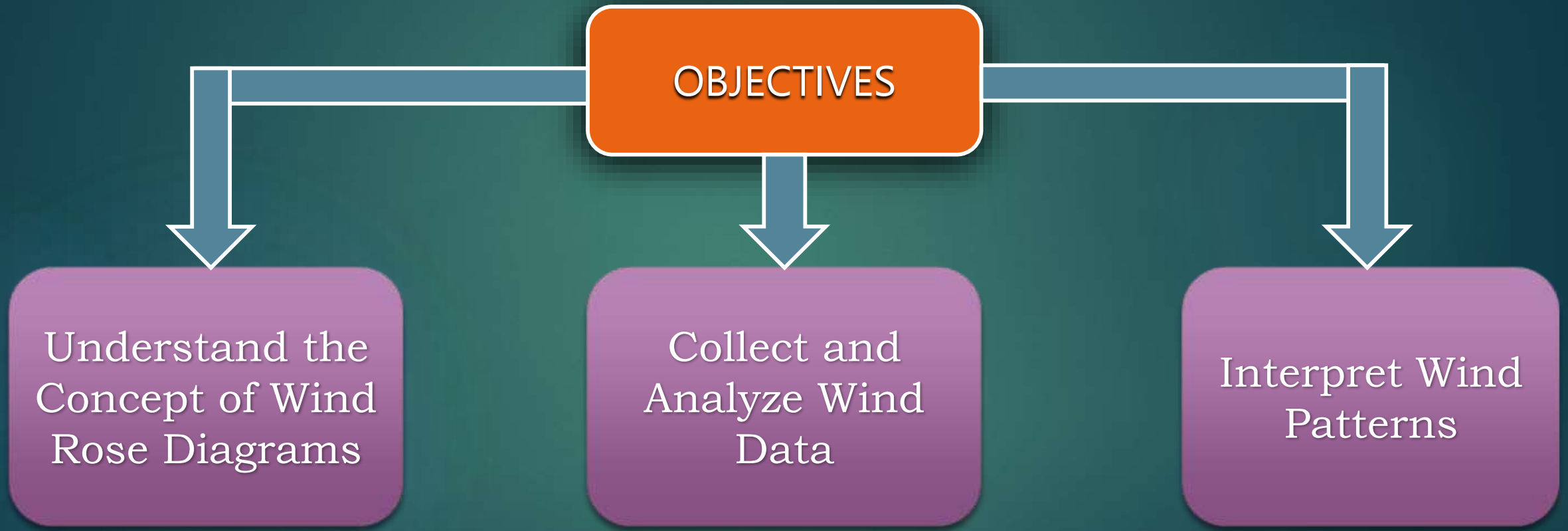


- **Applications**:
  - **Environmental Science** : Used to analyze pollutant dispersion, assess air quality, and plan industrial site locations.
  - **Renewable Energy** : Critical for identifying optimal locations for wind farms.
- **Importance:**
  - **Air Quality Management** : Understanding wind patterns aids in managing air quality by predicting the movement of pollutants.
  - **Wind Energy** : Helps in evaluating the potential of wind energy resources by identifying areas with consistent wind patterns.
  - **Urban Planning** : Assists in designing buildings and urban areas to optimize ventilation and minimize wind-related issues.



# INTRODUCTION





# LITERATURE REVIEW



- **Origin and Development:**
  - **Early Uses:** Wind roses were originally used by sailors to understand prevailing wind patterns essential for navigation.
  - **Evolution:** They have evolved into complex tools used to analyze wind speed, frequency, and direction, essential for modern environmental and meteorological studies.
- **Modern Applications:**
  - **Meteorology:** Wind roses help summarize wind patterns, aiding in weather predictions and studies.
  - **Urban Planning and Architecture:** They are used to design cities and buildings, optimizing natural ventilation and reducing energy use.
  - **Environmental Impact Assessments:** Wind roses predict pollutant dispersion and assist in planning industrial site locations.

# METHODOLOGY



**a. Data Collection:**

**1. Data Sources**:

- **Meteorological Departments**: Obtain historical and real-time wind data from government meteorological services.
- **Online Databases**: Access global datasets from platforms like NOAA (National Oceanic and Atmospheric Administration) and MeteoBlue.
- **Environmental Monitoring Stations**: Use data from local air quality monitoring stations if available.

**2. Data Parameters**:

- **Wind Speed**: Measured in meters per second (m/s) or kilometers per hour (km/h).
- **Wind Direction**: Typically recorded in degrees from true north (e.g., 0° for north, 90° for east).
- **Time Frame**: Define a specific period for analysis, such as a month, season, or year.

# METHODOLOGY



3. **Data Format**:
- **CSV/Excel**: Ensure data is in a format suitable for processing and visualization, such as CSV or Excel files.
- **Metadata**: Include any relevant metadata, such as the height of wind measurements.

**b. Data Processing:**

1. **Software Tools**:
- **Python**: Use libraries such as Pandas for data manipulation and Matplotlib or Seaborn for visualization.
- **R**: Utilize packages like open air for analyzing and plotting wind data.
- **MATLAB**: Offers specialized toolboxes for wind data analysis.
- **WRPLOT View**: A user-friendly software specifically designed for creating wind rose diagrams.

# METHODOLOGY



2. **Data Cleaning**:
   - **Missing Values**: Identify and handle missing data using interpolation or exclusion.
   - **Anomalies**: Detect and correct or remove outliers that could skew results.
   - **Normalization**: Standardize wind speed data if needed to compare with other datasets.

3. **Data Analysis**:
   - Calculate frequency distributions of wind speed and direction.
   - Prepare datasets for visualization by categorizing wind speeds into ranges (e.g., 0-5 m/s, 5-10 m/s).

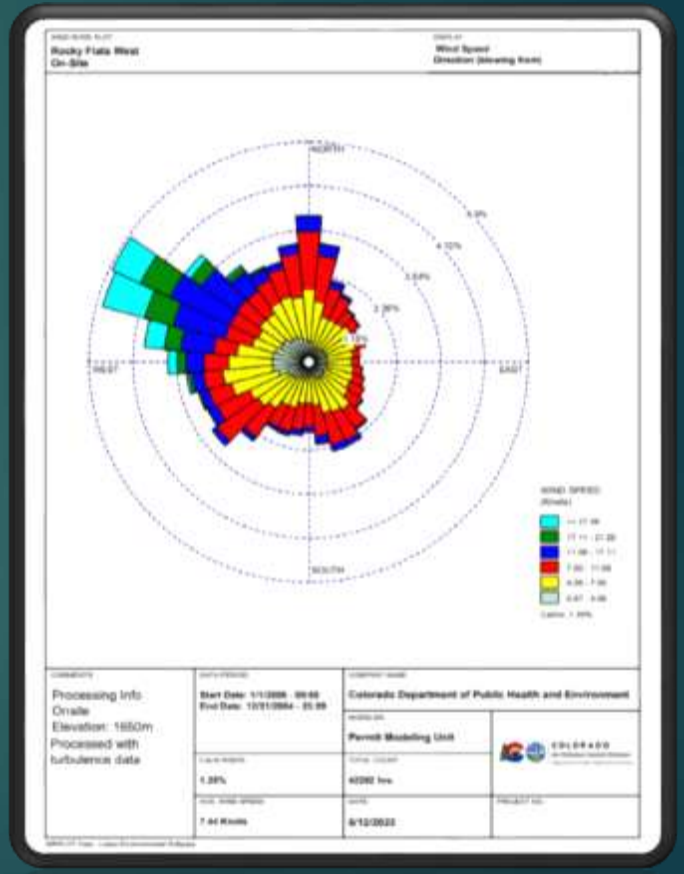
# METHODOLOGY



**c. Wind Rose Diagram Creation:**

1. **Tool Selection**:
   - Choose a tool based on familiarity, data size, and specific project requirements.
   - We will use WRPLOT View as it offers simplicity and quick results.

2. **Diagram Generation**:
   - Use software to plot the wind rose, customizing aspects like the number of directional bins, color schemes, and scaling.
   - Generate diagrams for different periods to capture seasonal or temporal variations.



# PROCEDURE



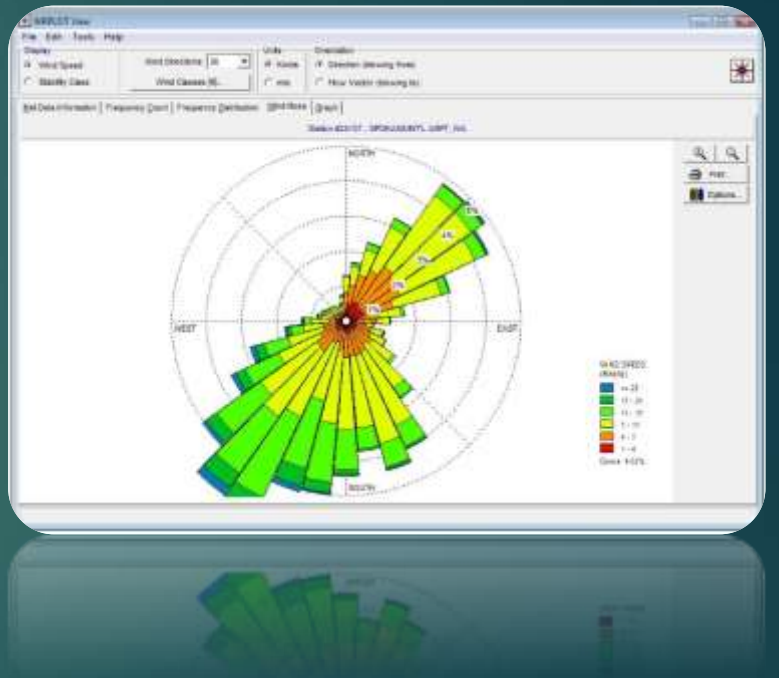
1. Obtain the hourly averaged meteorological data (Time of measurement, wind speed and wind direction).
2. In the observation table write down the number of times the wind flows in the range of speed in their respective directions.
3. Find the frequency of wind flow by segregating the wind speed in specified range in the 16 different direction.
4. Plot the value on a graph with direction indicated and concentric circle (where concentric circle indicates the frequency of the wind).
5. Use different shades for different speed ranges to differentiate it.

# PROCEDURE



Application of software for the wind rose plot :

- Surface meteorological data from the weather monitoring stations or any other sources are used for plotting the wind rose diagrams through the WRPLOT View software.
- WRPLOT View is a fully operational wind rose program for your meteorological data.
- It provides visual wind rose plots, frequency analysis, and plots for several meteorological data formats.
- A wind rose depicts the frequency of occurrence of winds in each of the specified wind direction sectors and wind speed classes for a given location and time period.

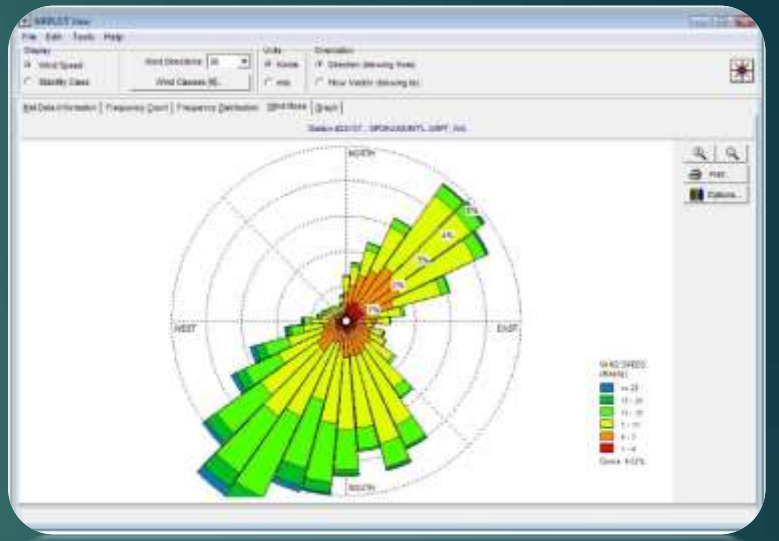


# PROCEDURE



Application of software for the wind rose plot :

- Meteorological input to the WRPLOT View is required in SCRAM file format.
- Hourly surface meteorological data are required to create a 28-character record also known as the SCRAM format.
- The SCRAM format can be processed directly by WRPLOT View.



The variables used by WRPLOT View from the SCRAM record include the following :

- Surface Station Number: The WBAN number identifying the NWS surface observation station.

# PROCEDURE



The variables used by WRPLOT View from the SCRAM record include the following :

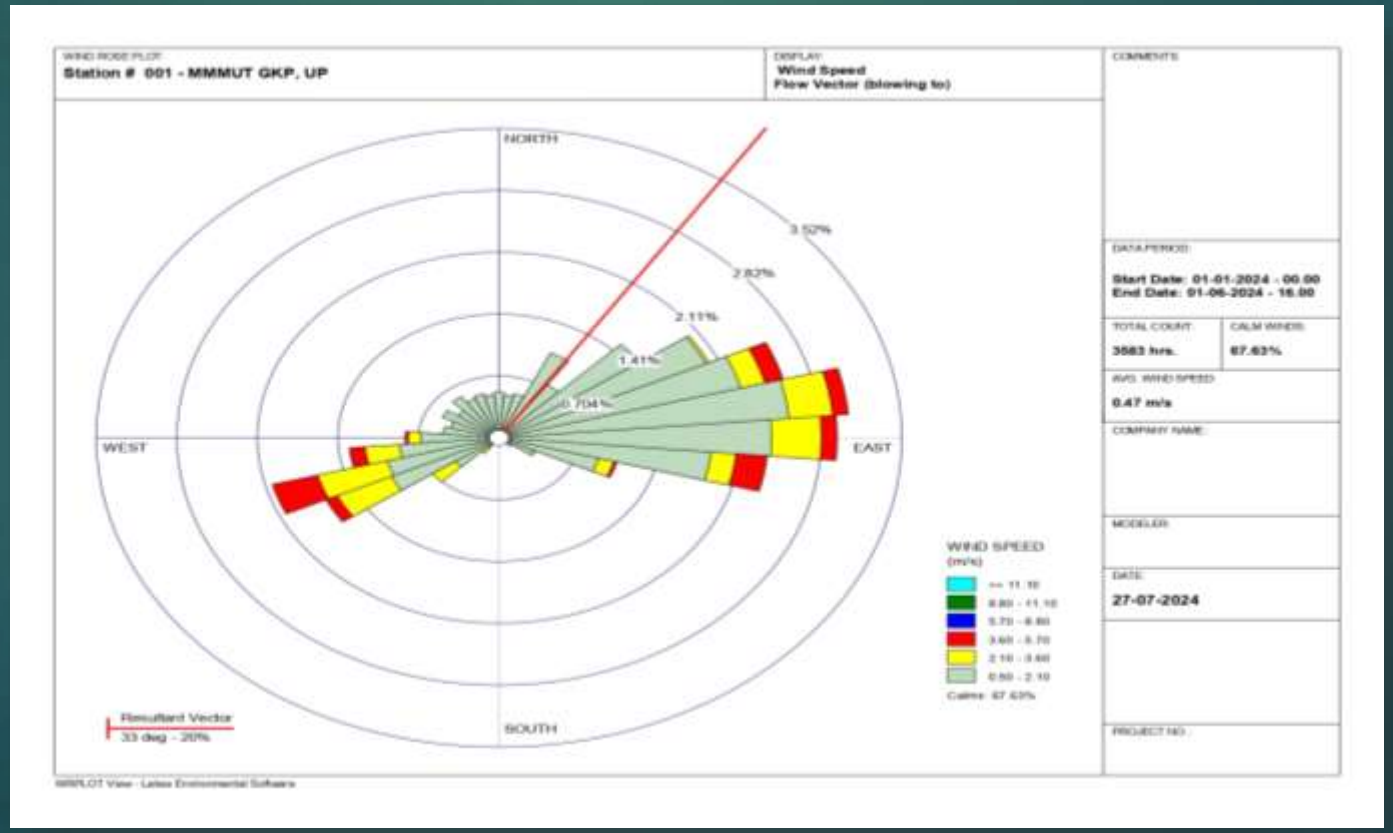
- Year, Month and Day of Record: Identifies the year, month and day during which the meteorological data were observed. Only the last two digits of the year are reported.
- Hour: Identifies the hour of the meteorological data observation. Hour is based on the 24-hour clock and is recorded as 00 through 23.
- Ceiling Height: The height of the cloud base above local terrain which is coded in hundreds of feet.
- Wind Direction: The direction from which the wind is blowing, based on the 36 point compass, e.g. 09=East, 18=South, 27=West, 36=North, 00=Calm.
- Wind Speed: The wind speed measured in knots (00=Calm).
- Dry Bulb Temperature: The ambient temperature measured in whole degrees Fahrenheit.

# OBSERVATION



We have plotted the Wind Rose diagram for 5 different region and analyses the wind data :

1. Madan Mohan Malaviya University of Technology, Gorakhpur – UPPCB :



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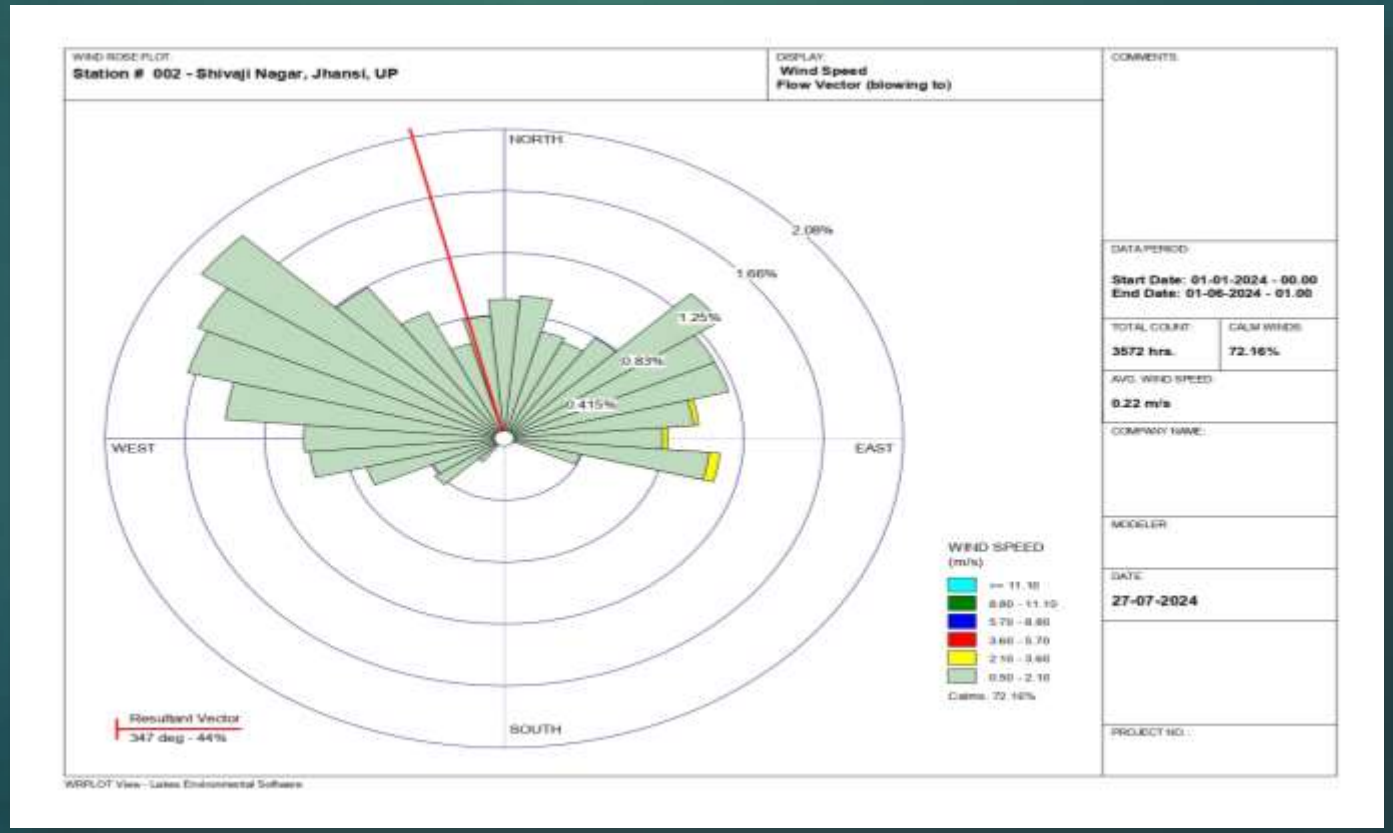
2. Shivaji Nagar, Jhansi – UPPCB :



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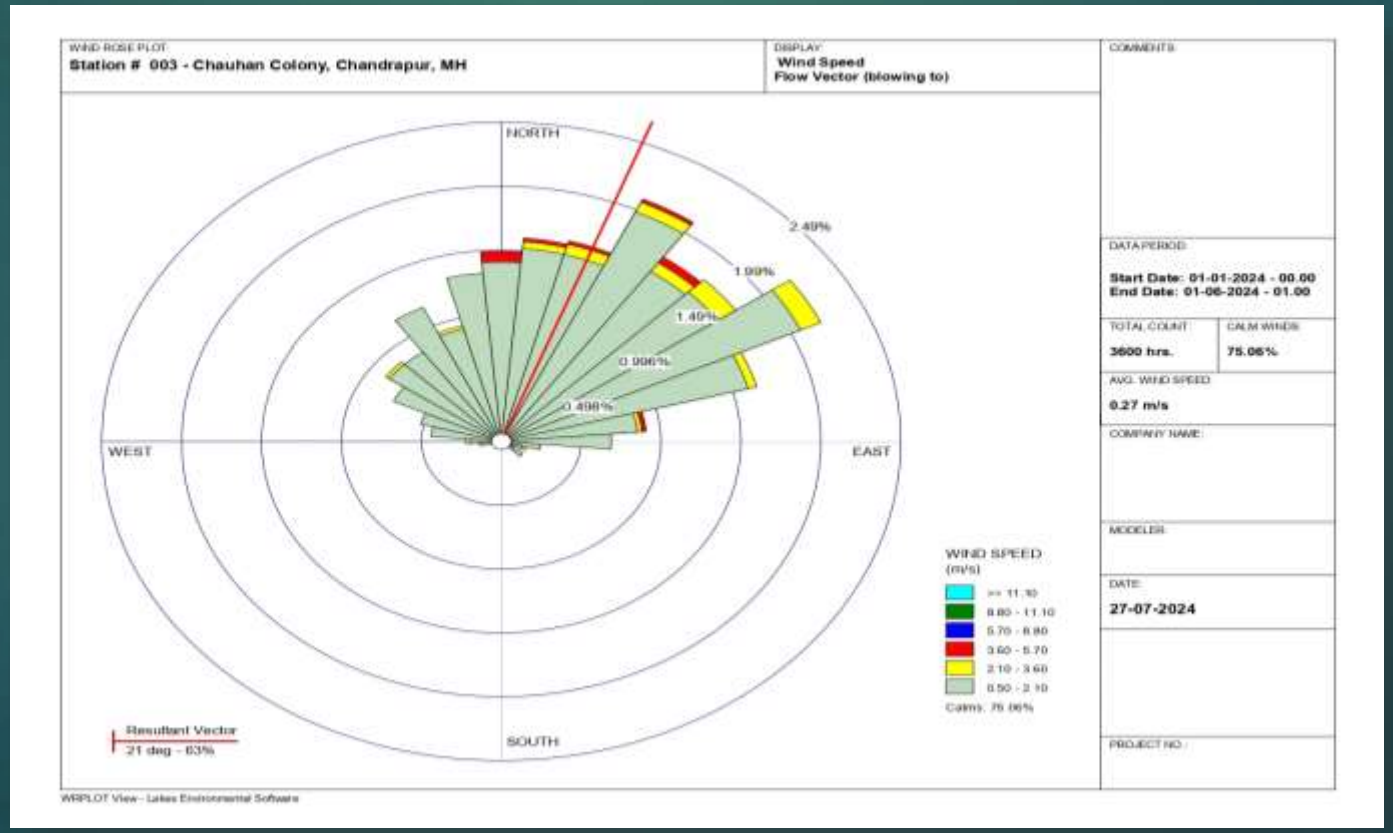
3. Chauhan Colony, Chandrapur – MPCB :

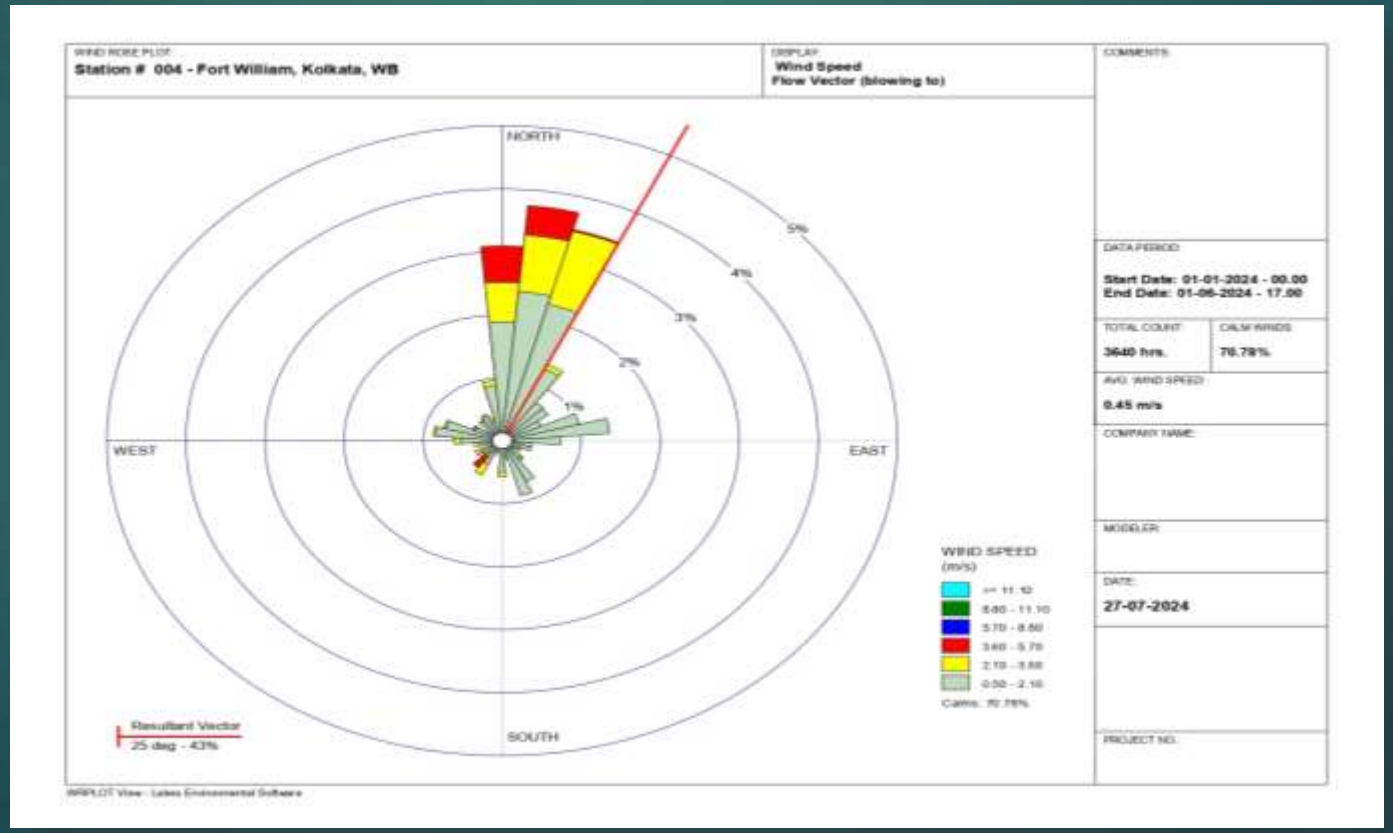


# OBSERVATION



We have plotted the Wind Rose diagram for 5 different region and analyses the wind data.

4. Fort William, Kolkata – WBPCB :

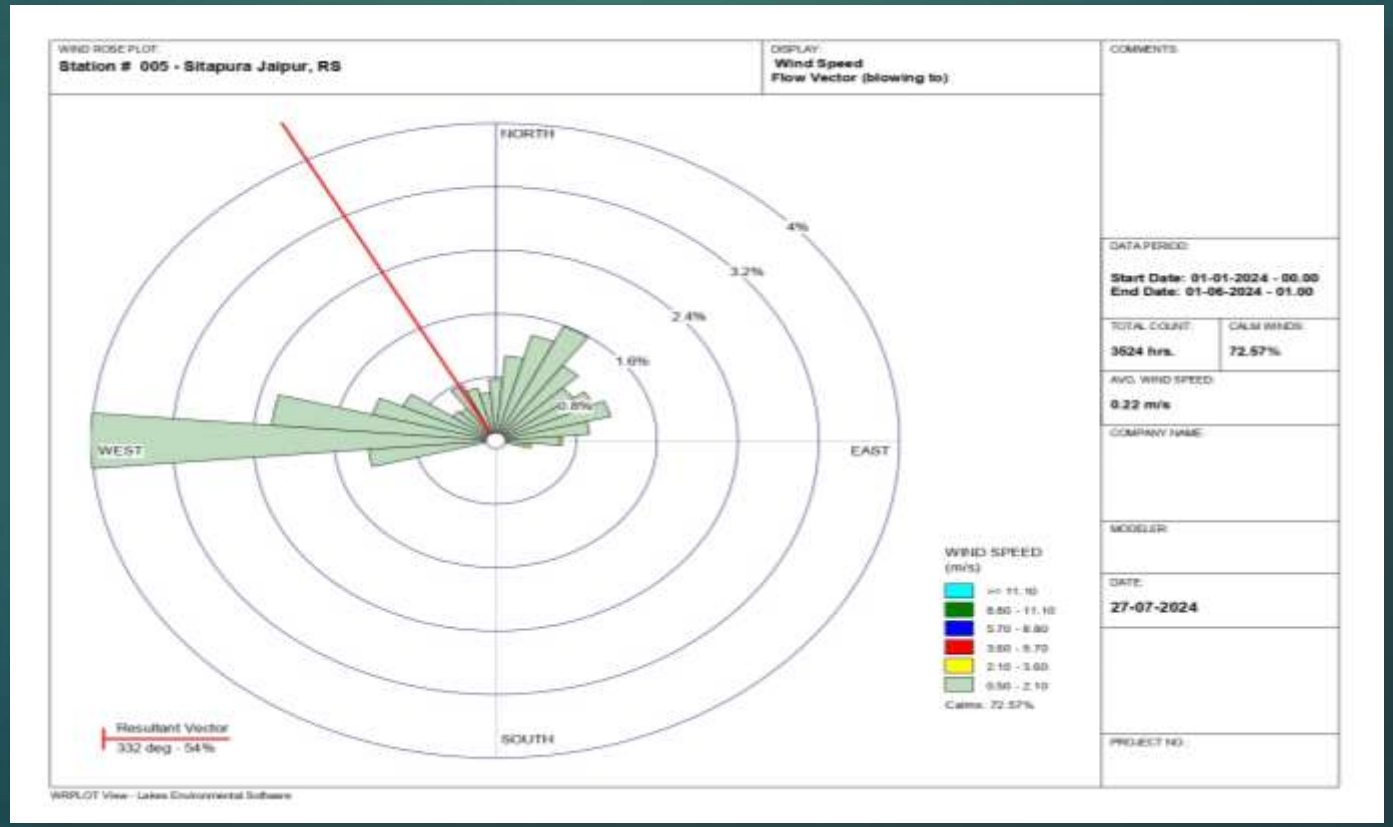


# OBSERVATION



We have plotted the Wind Rose diagram for 5 different region and analyses the wind data.

5. RIICO Sitapura, Jaipur – RSPCB :



# RESULT



1. Madan Mohan Malaviya University of Technology, Gorakhpur – UPPCB :

   a) The prevailing wind direction in the upwind direction is 33°- 20%
   b) Percentage calm period (WS < 1 m/s) is 67.63%

2. Shivaji Nagar, Jhansi – UPPCB :

   a) The prevailing wind direction in the upwind direction is 347°- 44%
   b) Percentage calm period (WS < 1 m/s) is 72.16%

3. Chauhan Colony, Chandrapur – MPCB :

   a) The prevailing wind direction in the upwind direction is 21°- 63%
   b) Percentage calm period (WS < 1 m/s) is 75.06%

# RESULT



4. Fort William, Kolkata – WBPCB :

   a) The prevailing wind direction in the upwind direction is 25°- 43%
   b) Percentage calm period (WS < 1 m/s) is 70.78%

5. RIICO Sitapura, Jaipur – RSPCB :

   a) The prevailing wind direction in the upwind direction is 332°- 54%
   b) Percentage calm period (WS < 1 m/s) is 72.57%

# CONCLUSION



The analysis of wind rose diagrams for five different locations reveals key insights into prevailing wind patterns and the proportion of calm periods, which are significant for environmental planning and management:

1. **Madan Mohan Malaviya University of Technology, Gorakhpur :**
   - **Prevailing Wind Direction:** The predominant wind direction is between 33°, occurring 20% of the time.
   - **Calm Periods:** There is a significant percentage of calm periods (windspeed less than 1 m/s), accounting for 67.63% of the time. This indicates that for more than two-thirds of the time, winds are either very light or absent, which may affect pollutant dispersion and air quality.

2. **Shivaji Nagar, Jhansi :**
   - **Prevailing Wind Direction:** The primary wind direction is 347°, observed 44% of the time.
   - **Calm Periods:** Calm conditions prevail 72.16% of the time. This high percentage suggests a stable air environment with limited natural ventilation, impacting heat dispersion and air pollution accumulation.

# CONCLUSION



**3. Chauhan Colony, Chandrapur :**

- **Prevailing Wind Direction:** Winds most frequently blow from 21°, comprising 63% of observations.
- **Calm Periods:** Calm conditions are extremely high at 75.06%, indicating that there is very little wind activity, which can lead to issues with stagnation and pollution build-up in this area.

**4. Fort William, Kolkata :**

- **Prevailing Wind Direction:** The prevalent wind direction is 25°, occurring 43% of the time.
- **Calm Periods:** The calm period percentage is 70.78%. This reflects a relatively static atmospheric condition that can hinder the dispersion of airborne pollutants.

**5. RIICO Sitapura, Jaipur :**

- **Prevailing Wind Direction:** Winds predominantly come from 332°, which is observed 54% of the time.
- **Calm Periods:** There is a calm period for 72.57% of the time. Such a high percentage of calm conditions can be problematic for air quality management as pollutants may not be dispersed effectively.

# IMPLICATIONS



- **Air Quality and Pollution Control :** The high percentage of calm periods across these locations suggests potential challenges in air quality management, as pollutants are less likely to disperse without significant wind activity. This underscores the importance of implementing effective pollution control measures.
- **Environmental Planning :** Understanding the prevailing wind directions and calm periods is crucial for urban and industrial planning. Structures can be designed to optimize natural ventilation based on wind patterns, and industries can implement strategies to mitigate emissions during calm periods.
- **Climate Adaptation Strategies :** These insights can inform strategies to cope with climate-related challenges, such as heat islands and localized air pollution, by enhancing urban design and vegetation placement to improve air circulation.

# REFERENCES



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Thank you