3. SODAR (Sound Detection and Ranging) System

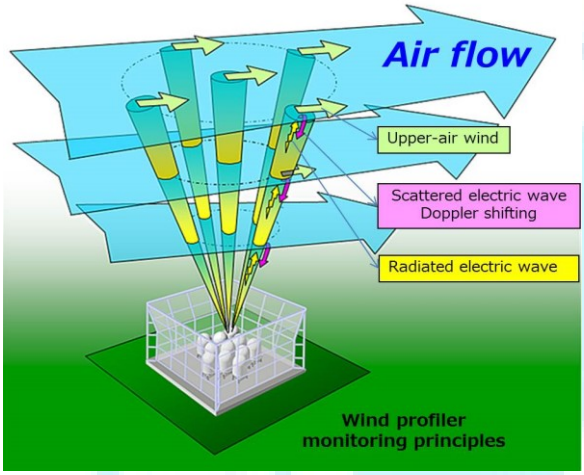
Recently, the SODAR (Sound Detection and Ranging) system facility, designed and developed by CSIR–Advanced Materials and Processes Research Institute (AMPRI), Bhopal, was inaugurated at the India Meteorological Department (IMD), Delhi.

SODAR (Sound Detection and Ranging) System - Overview

Definition - SODAR is a remote sensing system designed to measure and analyse the atmosphere. It primarily assesses wind speed, wind direction, and temperature gradients at different altitudes above ground level.

Analogy to RADAR - While RADAR uses radio waves for detection, SODAR employs sound waves, making it particularly suited for atmospheric studies.

Significance - It provides critical information for meteorology, wind energy planning, aviation safety, pollution monitoring, and research on atmospheric dynamics.



Working Principle of SODAR

1. **Sound Waves Emission -** SODAR emits high-frequency sound waves, usually in the audible to ultrasonic range, into the atmosphere. These waves propagate vertically from a ground-based unit.
2. **Reflection and Scattering -** As the sound waves encounter atmospheric turbulence, temperature gradients, or wind shears, they are scattered back toward the system. The returning waves are detected and analyzed by the device.
3. **Doppler Shift Analysis -** The system calculates the frequency change (Doppler shift) in the returned sound waves. This shift is directly proportional to the velocity of moving air particles, allowing the measurement of wind speed and direction at multiple heights.
4. **Vertical Profiling -** SODAR creates a vertical profile of the atmosphere, giving detailed information on how wind speed and direction change with altitude. Typical measurements range from tens of meters up to several kilometers, depending on the system and environmental conditions.

Applications of SODAR

Meteorology & Weather Forecasting - Detects wind patterns, vertical wind shear, and atmospheric stability. Assists in storm tracking and predicting severe weather phenomena.

Wind Energy Sector - Evaluates wind resources for wind turbine site selection. Provides precise wind speed and direction data at turbine hub heights, optimizing energy production.

Environmental Pollution Monitoring - Assesses atmospheric turbulence and air movement near industrial areas or urban regions. Helps understand pollutant dispersion patterns, aiding environmental planning.

Aviation Safety - Detects wind shear and sudden changes in wind speed/direction during takeoffs and landings. Enhances flight safety, particularly in challenging weather conditions.

Oceanography & Marine Studies - Used in coastal and offshore regions to study wind-ocean interactions. Supports modeling of wave patterns, currents, and coastal climate dynamics.

Advantages of SODAR

Non-Invasive - Operates without physically contacting the atmosphere, ensuring environmental safety.

Real-Time Data - Provides immediate wind and temperature profile information, crucial for dynamic monitoring.

Cost-Effective - Less expensive than LIDAR and simpler to maintain.

Vertical Coverage - Capable of measuring wind profiles up to several kilometers, depending on system

specifications and weather conditions.

Limitations of SODAR

Environmental Sensitivity - Performance is affected by weather factors such as rain, fog, humidity, and temperature fluctuations.

Range and Resolution Constraints - Compared to LIDAR or RADAR, SODAR has a more limited measurement range and lower resolution.

Noise Interference - Urban or industrial noise can sometimes interfere with the accurate detection of sound waves.

Conclusion

SODAR is a crucial tool for atmospheric monitoring and research, bridging the gap between ground-based observations and advanced remote sensing technologies. Its ability to provide vertical wind profiles in real-time makes it invaluable for weather forecasting, wind energy development, aviation safety, and environmental monitoring. Despite limitations like sensitivity to weather and noise, SODAR remains a cost-effective, safe, and efficient system for diverse atmospheric applications.

Source - https - //www.pib.gov.in/PressReleasePage.aspx?PRID=2172158

P.L. RAJ IAS ACADEMY
SINCE 2008
MAKING YOU SERVE THE NATION