AWS , ARG , AGRO AWS AND ASG (Surface Instrument Division)

Surface Instruments Division, O/o the Head, Climate Research and Services, IMD, Pune

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

SURFACE OBSERVATION SYSTEMS

- The observations of weather parameters such as air temperature, relative humidity, atmospheric pressure, rainfall, wind speed, wind direction etc. are being taken in India Meteorological Department at conventional observatories since establishment of the department in 1875.

- At present a network of 559 surface observatories comprising of departmental and non-departmental observatories caters to the need of operational weather forecasting.

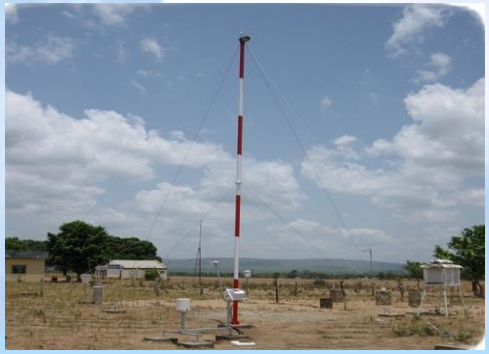
- For continuous monitoring of weather systems such as cyclones, western disturbances, thunderstorms and monsoon etc. over continental India the conventional network of observatories is not adequate.

- In view of this a network of automatic weather stations was envisaged so that human intervention can be minimized.

MANUAL VERSUS AUTOMATIC

- The data from these surface observations are used to **make forecasts, give warnings of phenomena that are harmful for the national economy, study the climate and changes in it, and provide information about the weather directly to organizations**.

- A complete manual weather station **to enable accurate daily weather readings to be obtained**.
  - Instruments include maximum thermometer, minimum thermometer, Kew pattern masons hygrometer, a sheathed earth thermometer, a copper raingauge and a handheld anemometer
- An automated weather station is **an automatic version of a traditional weather station**. They can be single-site or part of a weather network.



AUTOMATION

- The concept of automation of meteorological observations and their dissemination is not new to the meteorological fraternity.

- The automation began way back in 1877 when Dutch meteorological instruments designer Olland developed telemeteograph on suggestion of Buys Ballot.
- Similar attempt was made in Belgium but the concept could not flourish at that time due to high production and maintenance cost involved.

- U. S. Navy sponsored development of Automatic Weather Station (AWS) with radio communication in 1940's.
- This AWS was developed by the U. S. National Bureau of Standards.
- This perhaps was the first AWS in operation.
- Since then, development of AWS has undergone phenomenal changes.

- With the advancement in technology especially with the advent of microprocessor technology in 1960ies the concept of AWS in its modern form brought revolution in meteorological observations

AUTOMATION IN INDIA

- The history of AWS in India can be traced back to 1974-75 when first experiment was carried out to relay meteorological data through India's first polar orbiting satellite "Aryabhatta".
- In the year 1979-80, India Meteorological Department (IMD) conducted a pilot experiment with Indian Space Research Organization (ISRO) to operate a small network of Data Collection Platforms (DCP) via polar orbiting satellite "Bhaskara" (SEO).
- The data transmitted were received at the Earth Station located at Shriharikota Rocket Range.
- These initial experiments though more of academic interest helped IMD to get insight into the technical details of DCPs and experience of operating the network of DCPs in hostile environment.
- Subsequently, IMD established a network of 100 DCPs across India. Satisfactory performance of DCP installed in oppressive weather conditions of Antarctica was reported. However, due to system design limitations overall network performance was unsatisfactory both in terms of data reception and quality.

Continue…

- In 1997, the network of 15 state of-the-art microprocessor/ microcontroller based AWS was established in Test and Evaluation mode.
- IMD developed the algorithms for computerized monitoring of performance of this AWS network.
- The deviations of AWS data from the co-located synoptic surface observatory data were within acceptable limits during 1998-2005 and thus AWS network performance was satisfactory.
- It was therefore decided to expand and upgrade the network of AWS under the project “Replacement of obsolete DCP network with AWS and establishment of data receiving Earth Station at Pune”.
- In the year 2006-07, the network of 125 AWS has been established across India.
- In the year 2008-12, the network of 550 AWS has been established across India.
- In the year 2009-2016. the network of 1350 ARG have been established across India.
- In the year 2020-2022, the network of 200 Agro AWS have been established across India.
- In the year , 2021-2023, the network of 400 AWS is under progress.

AWS (AUTOMATIC WEATHER STATION)

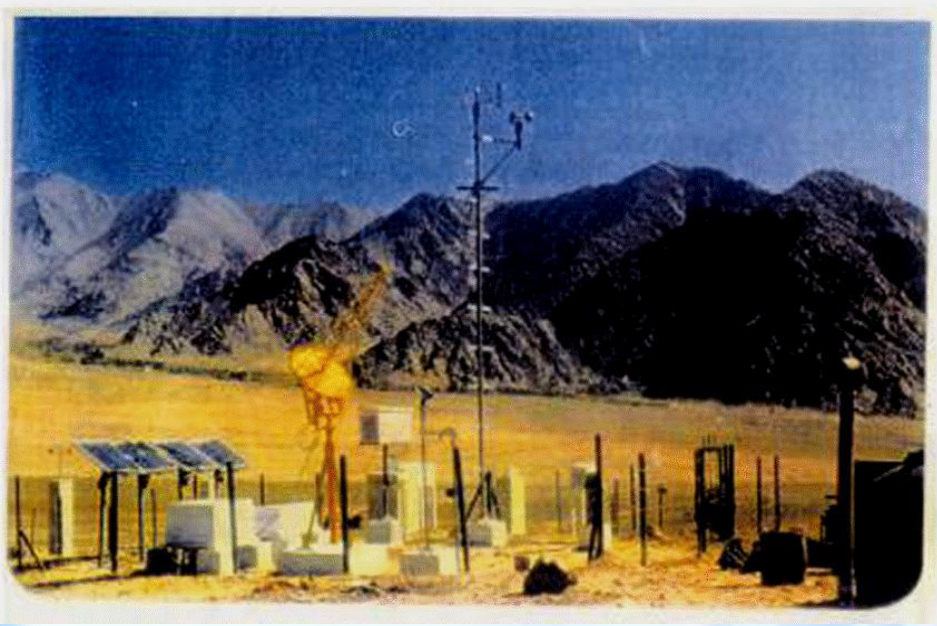
SURFACE OBSERVATION SYSTEMS (AUTOMATIC WEATHER STATION)

- An automated weather station is **an automatic version of a traditional weather station**. They can be single-site or part of a weather network.

- Automatic weather stations are the worldwide standard for climate and boundary-layer meteorology.

- An automatic weather station is an automated version of the traditional weather station, either to save human labour or to enable measurements from remote areas.

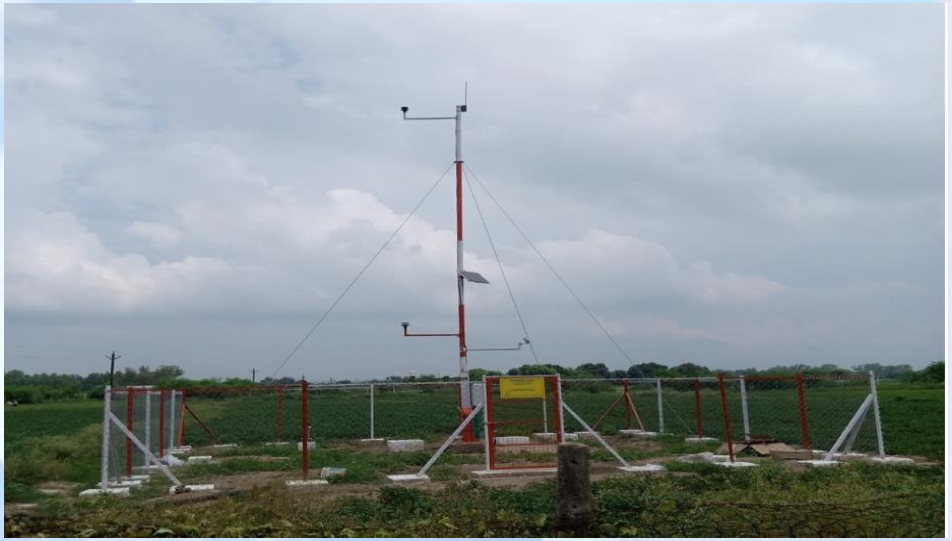
- A general classification could include stations that provide
  - Record data in real time
  - record data for non-real-time or off-line analysis.



DCP Network (1980)

AWS NETWORK (2007)

AWS NETWORK (2022)



AGRO AWS NETWORK (2022)

TYPES OF AWS

- Real-time AWS: A station providing data to users of meteorological observations in real time, typically at programmed times, but also in emergency conditions or upon external request.
  - Typical real-time use of an AWS is the provision of synoptic data and the monitoring of critical warning states such as storms and river or tide levels.

- Off-line AWS: A station recording data on site on internal or external data storage devices possibly combined with a display of actual data.
  - The intervention of an observer is required to send stored data to the remote data user.
  - Typical stations are climatological and simple aid-to-the-observer stations.

Kinds of automatic weather station

- There are kinds of weather stations:

➢ **Home weather stations, otherwise known as Personal weather stations**.

✓ Personal weather stations may be operated solely for the enjoyment and education of the owner, while some owners share their results with others.
✓ They do this by manually compiling data and distributing it, distributing data over the Internet, or sharing data via amateur radio.
✓ The Citizen Weather Observer Program (CWOP) is a service which facilitates the sharing of information from personal weather stations

➢ **Professional weather stations**. **Specialty weather stations**

✓ A variety of land-based weather station networks have been set up globally.
✓ Some of these are basic to analyzing weather fronts and pressure systems, such as the synoptic observation network, while others are more regional in nature, known as mesonets.

PERSONAL WEATHER STATION

- A personal weather station is a set of weather measuring instruments that you can install at your own home or business.
- ✓ The number of instruments can vary, but most personal weather stations include instruments to **measure temperature, relative humidity, pressure, rain fall, and wind speed and direction**.

PROFESSIONAL WEATHER STATION

- The Professional weather station is an arrangement of Maximum instruments that measure wind speed and direction, outside temperature, atmospheric pressure, inside temperature and relative humidity, time of day, along with instrument mounting panel.

Advantages and Disadvantages of AWS

- **Disadvantages**
- The main disadvantage of an automatic weather station is that **it removes the observer from the real elements being measured**, and so the experience of what -5ºC temperatures or 30 knot winds feel like, is lost.
- Loss of data due to communication.
- Loss of data due to theft of instruments.
- Loss of data due to no maintenance at field site.
- Loss of data due to power supply issues at filed site.

- **Advantages**
- Automated weather stations measure all the important surface weather observations. They also offer accurate forecasting options.
- These stations are better than traditional ones because they **provide accurate and frequent readings, have low power requirements, and can operate practically anywhere**.

Network of Surface observation system

- Meteorological and hydrological ground-based observations are collected by the **World Meteorological Organization** (WMO) through a global network of 8,000+ weather stations.
- Rainfall and temperature data provided by the WMO stations are considered most accurate closer to these station locations.
- WMO recommends certain densities of rain gauge stations to be followed for different types of catchments.
- For small mountainous regions with irregular precipitation, **25 km2 per station** is recommended.
- According to the same WMO guidelines, the density falls to 10 – 20 km2 per station in urban areas.
- AWS for synoptic and climatological networks.

- Microscale (less than 100 m) for agricultural meteorology, for example, evaporation;
- Toposcale or local scale (100–3 km), for example, air pollution, tornadoes;
- Mesoscale (3–100 km), for example, thunderstorms, sea and mountain breezes;
- Large scale (100–3 000 km), for example, fronts, various cyclones, cloud clusters;
- Planetary scale (larger than 3 000 km), for example, long upper tropospheric waves.

AWS for synoptic and climatological networks

- From synoptic meteorology and climatological research, to hydrology and urban meteorology our fixed AWS for a range of applications.

- ✓ Triangular Galvanized mast with Guy wires or Tiltable pole mast
- ✓ Electronics enclosure
- ✓ Mains or solar powering
- ✓ Local and remote communications
- ✓ Sensors
- ✓ Mounting accessories
- ✓ Optional data display software

LAYOUT OF AWS

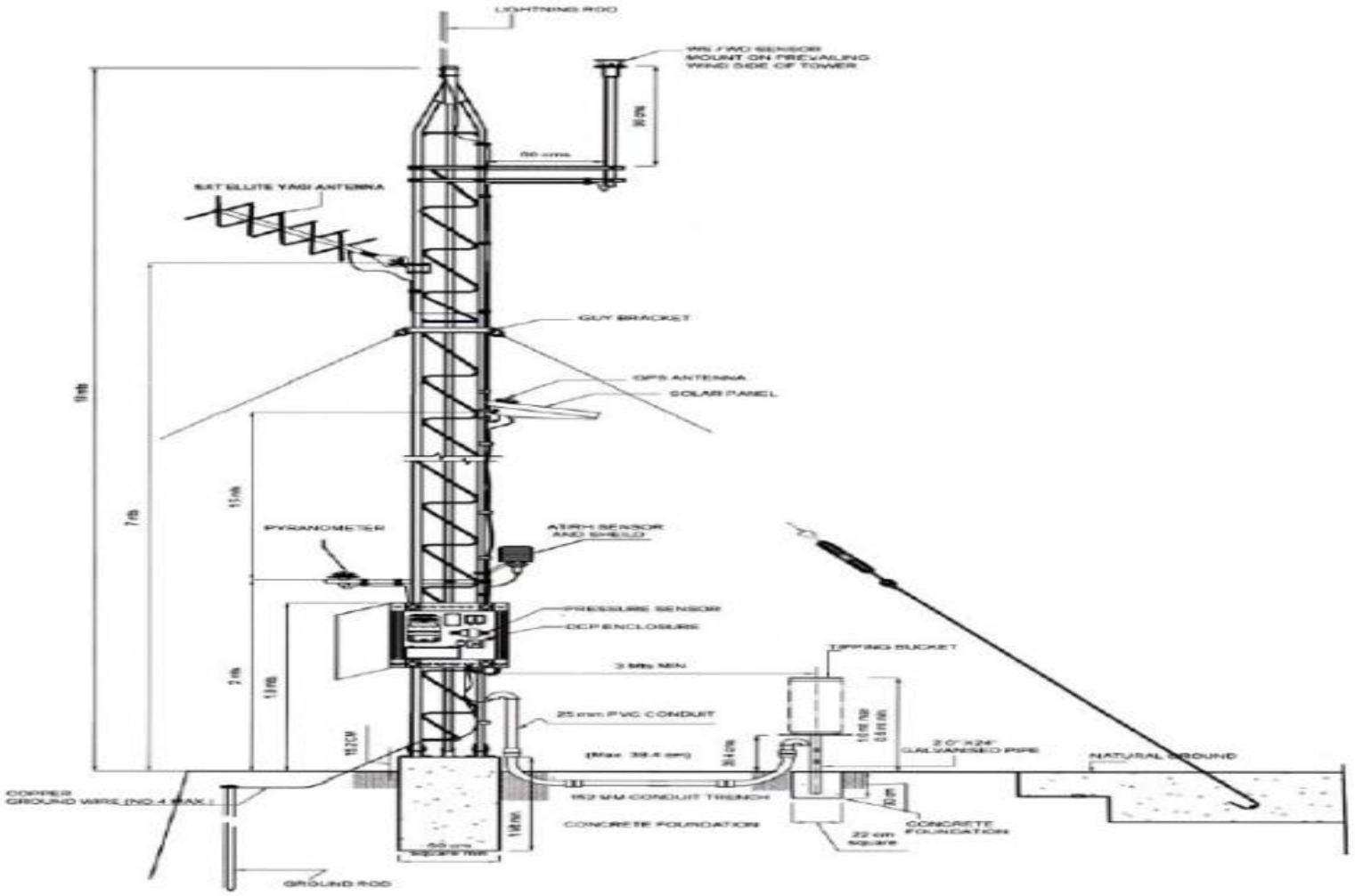


Figure Typical site layout of AWS.

Requirement of AWS as per WMO

- Definition of AWS: According to the World Meteorological Organization(WMO), an AWS is defined as a “meteorological station at which observations are made and transmitted automatically”.

- Automatic weather stations are used for increasing the number and reliability of surface observations.

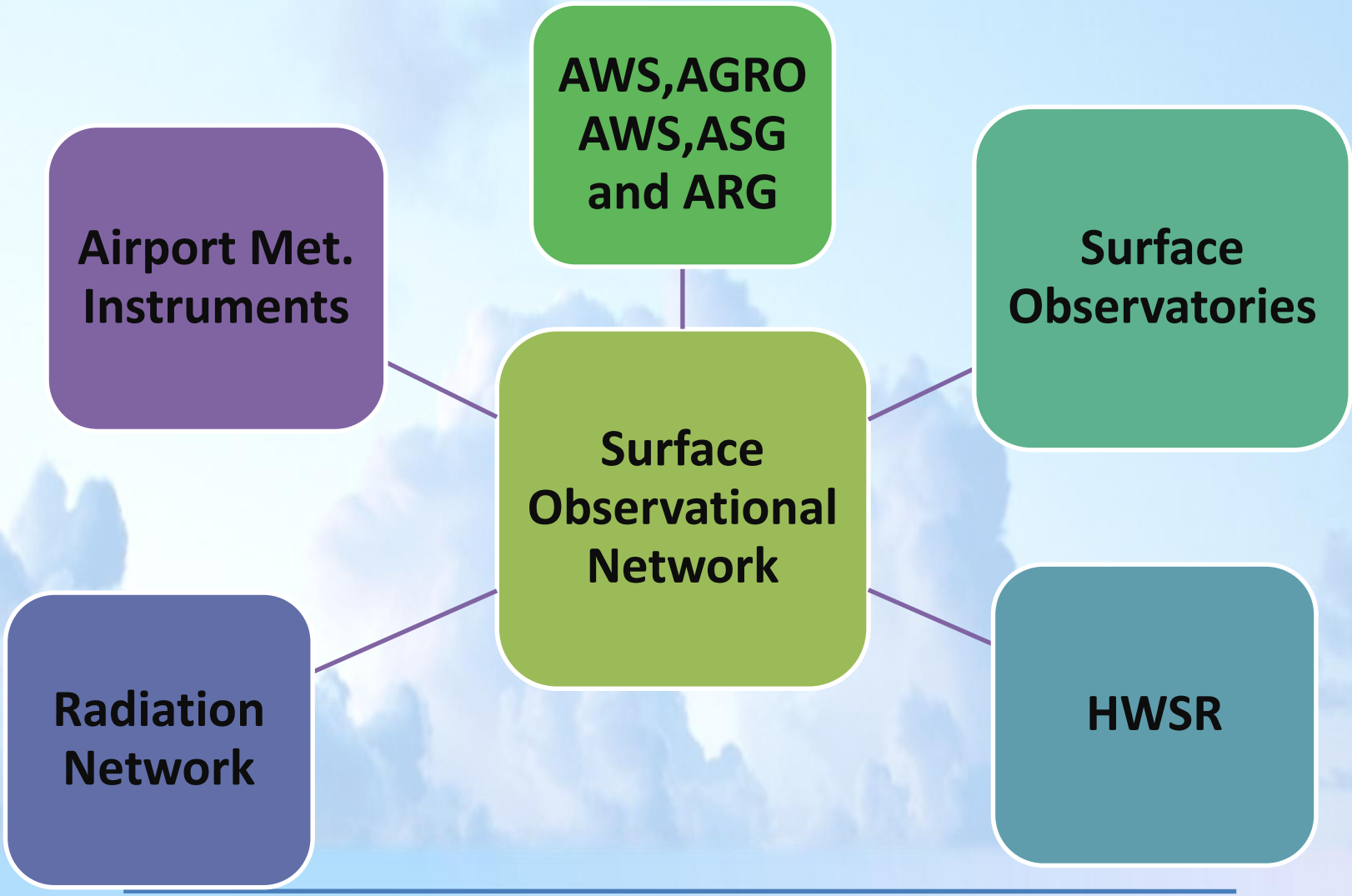
This is achieved by:

a) Increasing the density of an existing network by providing data from new sites and from sites that are difficult to access and inhospitable.
b) Supplying, for manned stations, data outside the normal working hours.
c) Increasing the reliability of measurements by using sophisticated technology and modern, digital measurement techniques.
d) Ensuring the homogeneity of networks by standardizing the measuring techniques.
e) Satisfying new observational needs and requirements.
f) Reducing human errors.
g) Lowering operational costs by reducing the number of observers.
h) Measuring and reporting with high frequency or continuously.

WMO guidelines on Automatic Weather Stations

- When considering the introduction of new AWS instrument systems, Meteorological Services should:
  - Introduce into service only those systems that are sufficiently well documented so as to provide adequate knowledge and understanding of their capabilities, characteristics and any algorithms used.
  - Retain or develop sufficient technical expertise to enable them to specify system requirements and to assess the appropriateness of the capabilities and characteristics of such systems and algorithms used therein.
  - Explore fully user requirements and engage users in system design of AWSs.
  - Engage users in validation and evaluation of the new automated systems.
  - Engage manufacturers in the system assessment and need for improvements in performance.
  - Develop detailed guides and documentation on the systems to support all users.
  - Develop adequate programmes for maintenance and calibration support of the AWSs.
  - Consult and cooperate with users, such as aeronautical authorities, throughout the process from AWS design, to implementation, to operational use.
  - Develop and apply reporting methods formational use to accommodate both observations generated by traditional and automated systems.

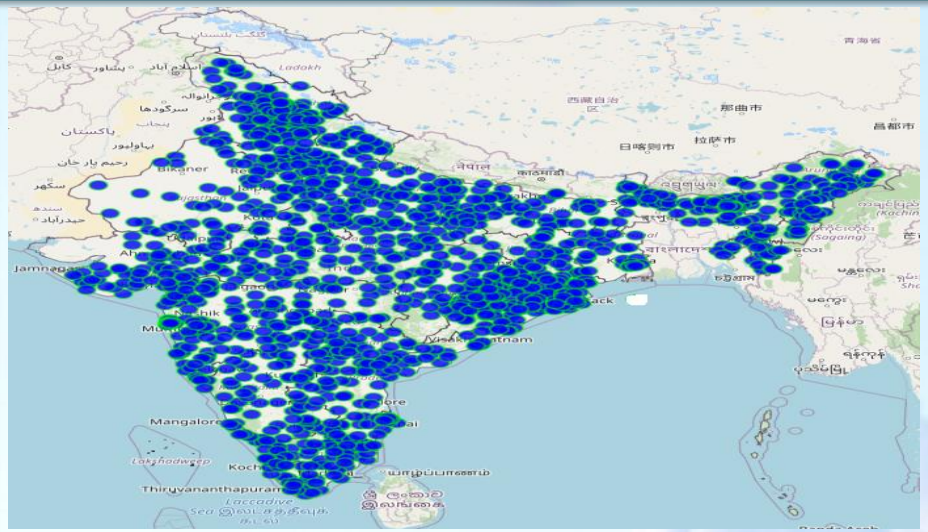
Surface Observational Networks

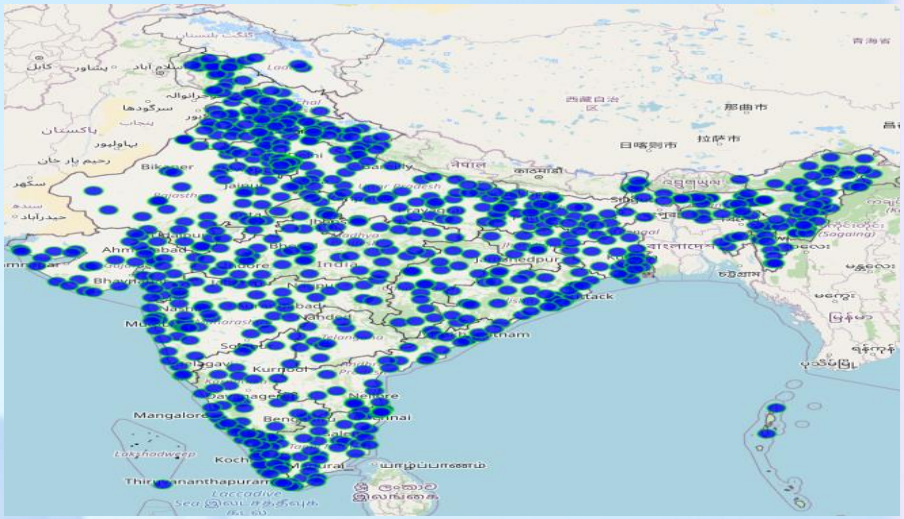


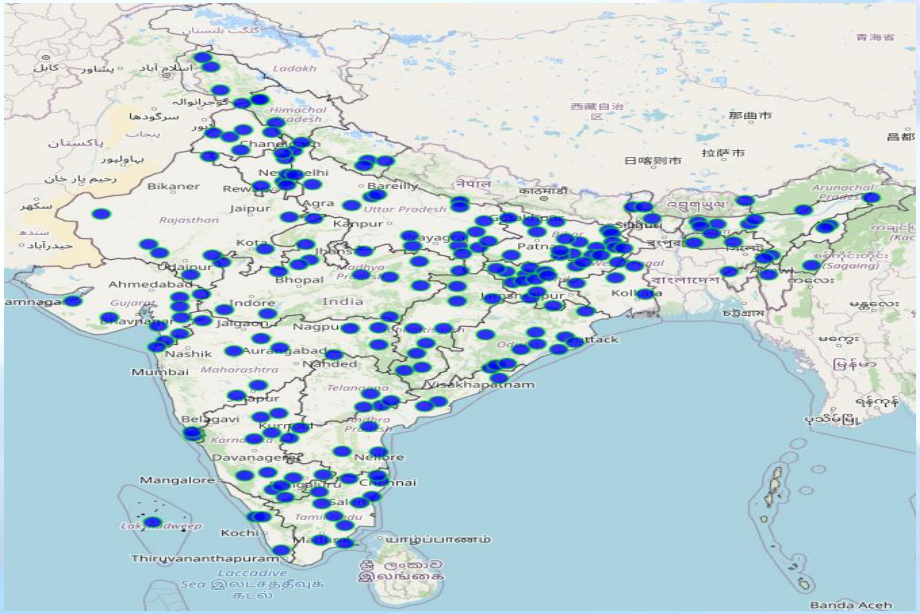
The Challenge of Network Monitoring

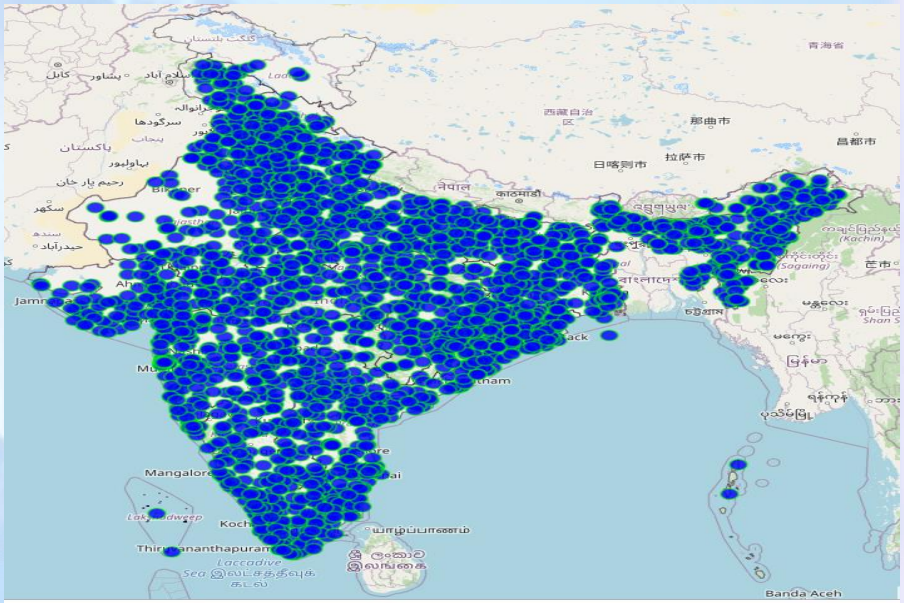
- Data from all network stations are being received automatically at central data receiving system.
- Maximum uptime of network stations → round the clock monitoring of network stations.
- Monitoring of nationwide network of stations is a mammoth task and warrants automation.

IMD NETWORK









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Thank you !