

An overview of Observational Practices in Pakistan

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ABSTRACT

The Pakistan Meteorological Department (PMD) is both a scientific and a service department, and responsible for providing meteorological service throughout Pakistan to wide variety of interest and for numerous public activities and projects which require weather information. PMD, at the time of its establishment in 1947, inherited only 15 Meteorological Observatories from the Central Meteorological Organization then operating in the Subcontinent. The Department has now over hundred Manual Weather Observing Station (MWOS) and nearly 37 Automatic Weather Observing Stations (AWOS), spatially distributed over the country. In the present paper, an overview of the observational practices in Pakistan has been discussed. It includes; classification of stations, general requirement of meteorological stations, instrumental requirement, site and exposure of the instruments, standardization of instruments, types of standard instruments, general requirements of instruments and procedures for standardization.

1. INTRODUCTION

The Pakistan Meteorological Department, at the time of its establishment in 1947, inherited only 15 Meteorological Observatories from the Central Meteorological Organization then operating in the Subcontinent. The Department with its continuous efforts has improved weather forecasting capabilities by expanding the network of meteorological observatories, developing methods of observation, improving telecommunication facilities and forecasting techniques. The Department has now over hundred Manual Weather Observing Station (MWOS) and 37 Automatic Weather Observing Stations (AWOS), figure-1, spatially distributed over the country.

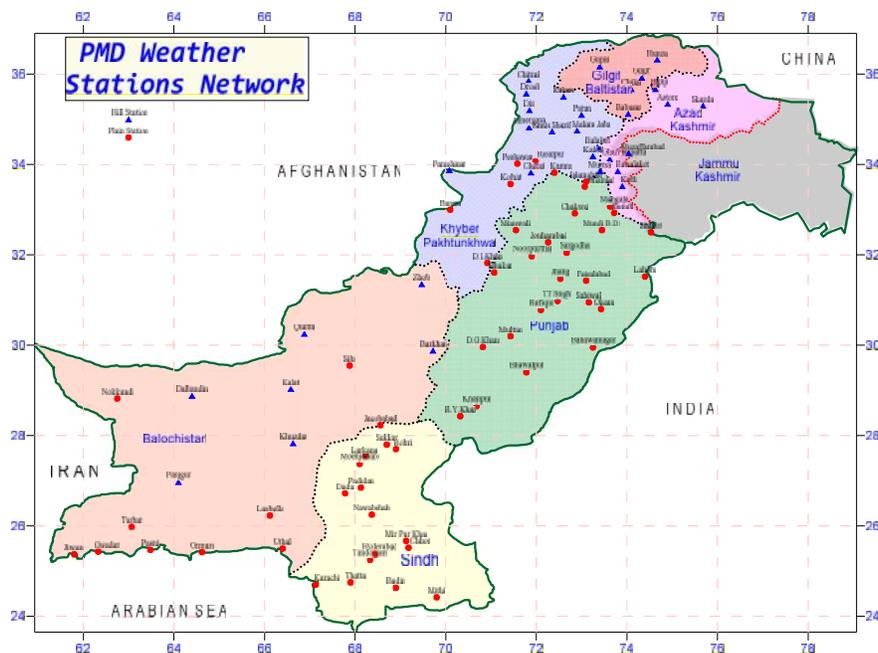


Figure-1: PMD MWOS & AWS Network

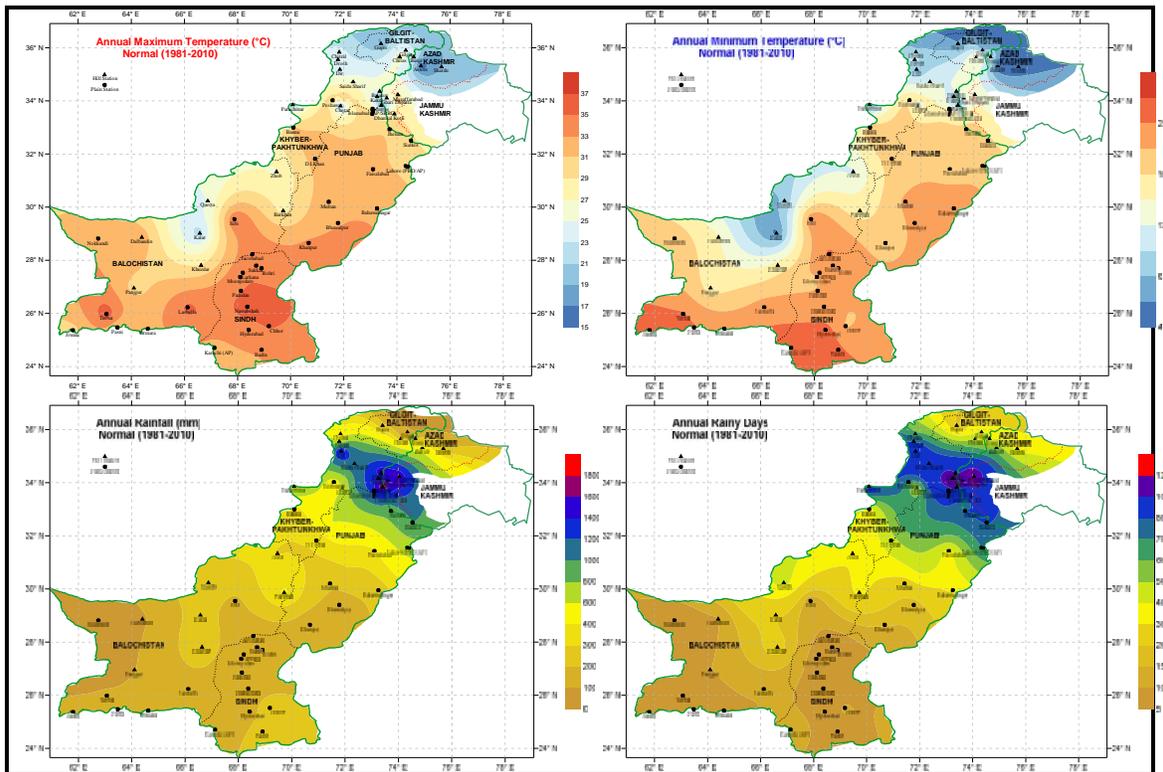


Figure-2: Pakistan's Normal rainfall and temperature pattern

2. METEOROLOGICAL OBSERVING STATIONS

Classification of Stations:

Meteorological observing stations are places at which the observation of one or of several Met elements is carried out; they are classified according to the following main categories; Synoptic Stations:

- a. Surface; Land Stations (Principal or ordinary) and Sea Stations (Mobile or Fixed ship)
- b. Upper Land – Land Stations (Radio Sonde, PBO's)
- c. Climatological Stations (Principal and ordinary Precipitation Stations)
- d. Agriculture Met Stations (Principal or ordinary Stations for specific purpose)
- e. Aeronautical Meteorological Stations (Aeromet)
- f. Special Stations (Measurement of radiation, ozone etc)

Pakistan Meteorological Department divided the surface stations into two branches:

- a. Stationery land stations
- b. Mobile surface observatories.

The Stationery Land Stations are sub-divided into five classes depending upon the equipment and functions. Each of these is of two types reporting and non-reporting observatories.

- a. Reporting Observatories:-Those observatories which transmit / pass their synoptic observatories to forecasting offices are called reporting observatories.

- b. **Non-reporting Observatories:** Those observatories which record the synoptic observations but do not transmit the same to any forecasting office, they submit their observations by monthly returns are called non-reporting observatories.

The five classes of the Meteorological surface observatories are as follow:

a. Class-I Observatories:

These observatories are provided with:

- i. Barograph
- ii. Thermograph
- iii. Hair hygograph
- iv. Self recording rain gauge
- v. Sun Shine recorder
- vi. Cambridge recorder

- The eye reading equipment which is the same as for second and third class observatories and is given under instrumental equipment.
- Autograph instruments for recording Pressure, Temperature, Humidity, Wind, Rainfall and Sun Shine.
- At least two of the special thermometers for recording grass minimum, wet maximum, wet minimum and solar radiation temperature.

Class-I observatories take synoptic observations at least eight times daily at the standard UTC hours i.e. 0000, 0300, 0600, 0900, 1200, 1500, 1800, 2100.

b. Class-II Observatories:

These observatories are provided with the eye reading equipment only and record daily at least three (3) synoptic observations at standard hours 0000, 300 & 1200 UTC.

- i. Barometer (Mercury Aneroid)
- ii. Maximum Thermometer
- iii. Minimum Thermometer
- iv. Dry Bulb
- v. Wet Bulb
- vi. Anemometer
- vii. Wind Vane
- viii. Rain Gauge + Measuring glass
- ix. Observing watch
- x. Stevenson Screen.

c. Class III Observatories:

These observatories are equipped with a set of the eye reading equipment and record synoptic observations only once or twice a day (03, 12)

d. Class IV Observatories:

These observatories record observation either once or twice a day at standard synoptic hours (00, 1200.....) and are equipped with an in complete set of meteorological eye reading instrument mentioned in the classes described above.

e. Class V Observatories:

These are not equipped with any meteorological instruments but record non-instrumental observations once or twice a day at the standard synoptic hours.

The mobile surface observatories are of two main types.

- i. Ships observations
- ii. Mobile land observatories working with the army.

The ships observatories are of two classes

- i. Selected Ships: Merchant or Naval equipment with full eye reading Marine Met equipment and barograph.
- ii. Supplementary Ships: (Merchant or Naval) not provided with full set of eye reading Marine Met equipment.

Stations' Network

Type of Observing Stations

- a. Observatories for synoptic purpose
- b. Observatories for climatological purpose
- c. Observatories for agromet purpose
- d. Observatories for special purpose

3. GENERAL REQUIREMENT OF WEATHER STATIONS

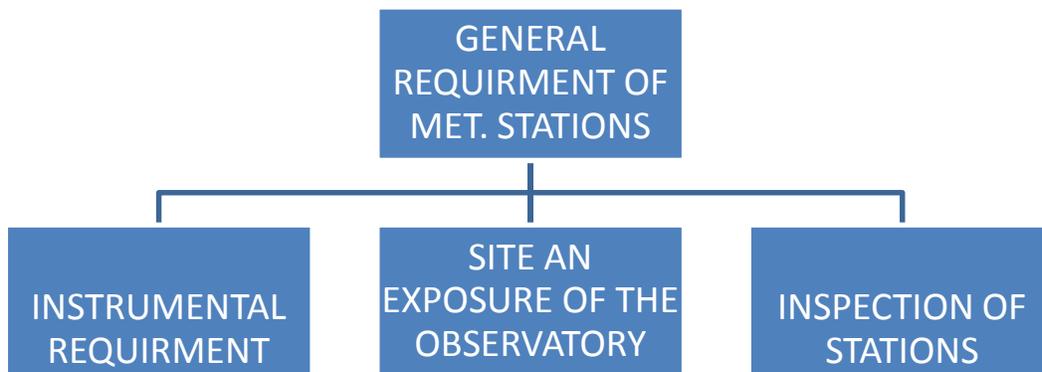


Figure-3

Instrumental Requirement:

It is very important to equip the climatological or synoptic observatory with the following instruments.

- i. Dry and wet bulb thermometers
- ii. Maximum an Minimum thermometers
- iii. Steven Sean's Screen
- iv. Rain gauge
- v. Barometer
- vi. Barograph
- vii. Anemometer
- viii. Wind vane

Further desirable additions in equipment in case of synoptic / climatological stations are:

- i. Thermograph
- ii. Hygrograph
- iii. Sun Shine recorder
- iv. Psychrograph

- v. Set of recording rain gauge
- vi. Grass minimum thermometer
- vii. Eraporimeter
- viii. Nephoscope
- ix. Dew gauge
- x. Icing accumulation meter

Site and Exposure of Instruments:

The exposure of meteorological Instruments are significant factor in the measurement of some meteorological elements and, therefore, in order that observations at different stations may be comparable, the exposures must be similar.

- i. A plot of level ground covered with short grass and about 9x6 meter in size in satisfactory for enclosure.
- ii. Enclosure of instruments should be away from the immediate influence of trees and building.

Site Selection for Observatory:

It is very important to consider the following points before selection of the site.

- i. Do not select the site close to steep slopes, ridges, cliffs etc for observatory.
- ii. Low land area can not be chosen for establishment of observatory.
- iii. It is also important to avoid the immediate vicinity of large building at the time of selection of site.
- iv. High and level surface is compare with vicinity should be selected for observatory purpose.

Inspection of Stations:

The synoptic land stations and principal climatological stations should be inspected not less than once every two years. The main objects of such inspections are to ascertain.

- i. That the exposure of instruments in the best obtainable.
- ii. That the instruments are of approved pattern, in good order and verified against standard when necessary.
- iii. That there is uniformity in the methods of observation and in procedure for reduction of observations.
- iv. That the observers are competent to carry out their duties.

Type of Observation:-

In general, the estimation or measurement of the elements comprising a surface synoptic observation should be made in as short a period of time as possible.

Actual Time of Observation:

- i. In case of surface synoptic observation, the actual time of observation is the time at which the Barometer is read.
- ii. In case of upper air observation, the actual time of observation is the time at which the balloon is actually released.
- iii.

Standard Time of Observation:

A time define in detail in the WMO technical regulation for making Meteorological observations is called slandered time of observation and is denoted by GMT (Greenwich Mean Time) or UT (Universal Time).

Time of Surface Observation:

Surface synoptic observation should be taken at 0000, 0600, 1200 and 1800 GMT with the intermediate observation at 0300, 0900, 1500, 2100 GMT. Atmospheric pressure obs. (Barometer reading) should be taken at exactly the standard time for the surface synoptic observation. The observation of Meteorological elements, except pressure should be taken within the ten minutes preceding this time.

Time Of Upper Air Observation:

The standard times of upper air synoptic observation are the main synoptic times 0000, 0600, 1200, 1800 when only two upper air observations can be made daily they should be taken at 0000 and 1200 UT.

4. STANDARDIZATION OF INSTRUMENTS**Definition of Standard of Measurement:**

The word "Standard" and other similar terms are frequently used to describe various instruments, methods, scales, etc. A uniform terminology (nomenclature) for standard of measurement has become necessary because of their increased use in modern technological development.

A unit of measurement is a quantity taken as of a magnitude one, in terms of which other quantities of the same kind are measured. A standard is the concrete physical form of a unit. This unit of length is a meter (metric system deduced by France) and the standard length is the international "meter bar" kept at Sevres, France.

Standard Method:

It is a method of re-production of the unit of measurement making use either of fixed values of certain properties of bodies or of physical constants.

5. TYPES OF STANDARD INSTRUMENTS:**Standard Instrument:**

An instrument or device to define, maintain or re-produce the unit of measurement in order to transmit it to other instrument or devices.

Collective Standard:

The term collective standard refers to a group of instruments, which together serve as standard. The value of collective standard is the arithmetical mean calculated from the values furnished by the various instruments.

Primary Standard:

A standard instrument which possesses the highest degree of precision (accuracy).

Secondary Standard:

A standard instrument and the value of which is fixed by direct or indirect comparison with primary standard or by a standard method.

Reference Standard:

A standard instrument for the verification of other standards of the same order of precision (accuracy)

Working Standard:

A standard instrument for the verification of a reference standard or for the verification of ordinary instruments. The order of accuracy is the same as that of the reference standard.

Traveling Standard:

A portable standard instrument which may be carried from one place to other place and still retain its calibration.

International Standard:

A standard instrument recognized by international agreement as the basis for all other standard of the given quantity.

Regional Standard:

A standard instrument designated by regional agreement as the standard for the region.

National Standard:

A standard instrument designated by a country as the standard for its territory.

6. GENERAL REQUIREMENTS OF INSTRUMENTS

The most important requirements of meteorological instruments are;

- i. Reliability
- ii. Accuracy
- iii. Simplicity of design
- iv. Convenience of operation and maintenance
- v. Strength of construction.

With regard to (i) and (ii) it is more important that an instrument should be able to maintain a known accuracy over a long period under operating conditions.

Simplicity and convenience of operation and maintenance are important because most meteorological instruments are in continuous use year in and year out and may be situated far away from good repair facilities.

Robust construction is especially desirable for those instruments which are wholly or partially exposed to the weather.

7. Procedures for Standardization:

In order to control effectively standardization of Met instrument on National / International scale, a system national and regional standard had adopted by WMO. In general regional standard are designated by regional association and National standard by the individual country. However it is specified that the instruments designated as regional and national standard should be compared at least one's in every ten years. Just like traveling standard. It is not essential for the instruments used as traveling standard to pass the accuracy of primary and secondary standard but however traveling standard should be sufficiently robust and can not be change calibration during the transportation. Similarly the instrument in operational use should be periodically compared directly/ indirectly with the national standard. Comparison of instruments within a service should be done at the time when instrument are issued to the station and after that during each periodical inspection of the station instrument should be calibrated by touring official portable standard. Instrument used the inspector should be check again the standard instrument of the service before and after tour of the stations.

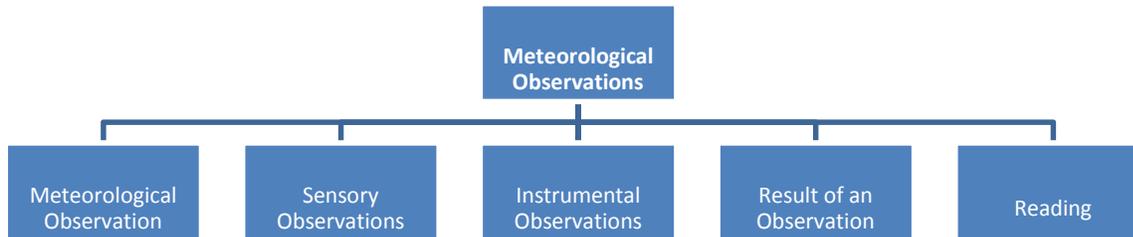


Figure-4

- i. **Meteorological Observation:-** Evaluation or measurement of one or more meteorological elements is called meteorological observation.
- ii. **Sensory Observation:-** An Observation taken by an observer without the use of a measuring instrument but estimated by experience only.
- iii. **Instrumental Observations:-** An observation made with the help of one or more measuring instruments or sensor indicator system is called the instrumental observation. Provided that the measuring instruments or system should be installed under the specified conditions. (Exposure condition)
- iv. **Result Of An Observation:-** The result of an observation is the numerical value of parameter (quantitative result) or the description and classification of a phenomenon (qualitative result)
- v. **Reading:-** The information presented to an observer by an instrument where as the act of an observer in noting.

8. TYPES OF OBSERVATIONS

Synoptic Observation:

At principal land station, surface synoptic observations should be made of the following elements; present and past weather, wind direction and speed; amount type and height of base of cloud visibility; air temperature, humidity and atmospheric pressure, At ocean weather stations and at a selected ship station, additional elements observed include; ship's course and speed, Sea Temp, period and height of waves, sea ice.

Climatological Observations:

At a principal climatological station observation should be made of all or most of the following elements, weather, wind; amount; type and height of base of cloud, visibility, Air Temp:(including maximum, minimum) humidity, atmospheric pressure, precipitation, snow cover, sunshine, soil temp.

Agricultural Meteorological Observation:

At agricultural meteorological station, the observations should be made of the following elements, humidity and temp; of the air on different levels; soil temp; soil moisture at various depths of the ground; turbulence and mixing of air in the lower layer, hydrometeors and other moisture balance factors; sun shine and radiation and also observations of a biological nature Phonological observations; observation of growth of yield of plant and animal products, of direct weather; damage and of damage cause d by diseases and pests.

Special Observations:

The observing program at special stations should depend on the purpose for which the station established.