

Chapter 2

Agro-meteorological Observatory

Abstract A Meteorological observatory is an area where all the weather instruments and structures are installed. The chapter gives a description of a meteorological observatory, different types of agro-meteorological observatories classified by the World Meteorological Organization (WMO). The chapter gives an insight into the type of instruments required and the frequency of observations for these observatories. The site selected for the establishment of Agro-meteorological Observatory should satisfy some basic requirements. The chapter gives in detail the pre-requisites for the establishment of agro-meteorological observatory and the recommended layout of observatory. The time of observation of different parameters and the order in which the observations are taken is also discussed. Local Mean Time (LMT) is based on the average length of a solar day. It is a timekeeping method using the Sun's movements across the sky. In order to explain Local Mean Time, a few other terms need to be understood. Other terms associated with the Local Mean Time have been discussed. The chapter gives details of the Local Mean Time and the calculation of Local Mean Time of a location.

Keywords Meteorological observatory • Instruments • Layout Observations

2.1 Meteorological Observatory

An area where all the weather instruments and structures are installed is a Meteorological observatory. The instruments and structures are and exposed for measuring weather phenomena. Depending upon the type of instruments installed and frequency of observations recorded, there are 6 classes of meteorological observatories. These are Class A, B, C, D, E and F. Class A, B and C observatories are provided with both manual and self-recording instruments. The frequency of observations for Class A observatory is three times a day, twice a day for Class B observatory and once a day for Class C observatory.

In order to record weather records, meteorological observatories are installed near aerodromes, middle of the cities and in remote areas.

2.2 Agro-meteorological Observatories and Their Classification

Agro-meteorological observatories are established for observation and recording of meteorological as well as biological parameters of crops using different instruments. According to World Meteorological Organization (WMO 2003), every agro-meteorological station belongs to one of the following classes:

Principal Agro-meteorological Station

A Principal Agro-Meteorological Station provides detailed simultaneous meteorological and biological information and its established where research in agricultural meteorology is carried out.

Requirements:

a. Essential instruments

1. Maximum and minimum thermometers.
2. Wet and dry bulb thermometers.
3. Soil thermometers.
4. Grass minimum thermometer.
5. Rain gauge (ordinary and self- recording).
6. Wind vane and anemometer.
7. USWB. Open pan evaporimeter.
8. Sunshine recorder.
9. Assmann psychrometer.
10. Dew gauge.
11. Thermo hygrograph.
12. Soil moisture equipment.
13. Solar radiation instruments.

b. Optional instruments

1. Lysimeter.
2. Thermopile sensing elements for short and long wave net radiation.
3. Potentiometer.
4. Micro voltmeter.

Ordinary Agro-meteorological Station

An ordinary agricultural meteorological station provides, on a routine basis, simultaneous meteorological and biological information and may be equipped to assist in research into specific problems.

Requirements:**a. Essential instruments**

1. Maximum and minimum thermometers.
2. Wet and dry bulb thermometers.
3. Soil thermometers.
4. Grass minimum thermometer.
5. Rain gauge (ordinary).
6. USWB open pan evaporimeter.
7. Assmann Psychrometer.

b. Optional instruments

1. Sunshine recorder.
2. Dew gauge.
3. Self-recording rain gauge.
4. Thermo-hygrograph.

An Auxiliary Agro-meteorological Station

An Auxiliary Agro-Meteorological Station provides meteorological and biological information. The meteorological information may include such items as soil temperature, soil moisture, potential evapotranspiration, duration of vegetative wetting, and detailed measurements in the very lowest layer of the atmosphere. The biological information may cover phenology, onset and spread of plant diseases, and so forth.

Requirements:**a. Essential instruments**

1. Maximum and minimum thermometers.
2. Dry bulb and wet bulb thermometers.
3. Ordinary rain gauge.

b. Optional instruments

1. Wind vane and anemometer.
2. Dew gauge.

Agricultural Meteorological Station for Specific Purposes

This is a station set up temporarily or permanently for the observation of one or several variables and/or specified phenomena.

2.3 Site Selection for Agro-meteorological Observatory

The site selected for the establishment of Agro-meteorological Observatory should satisfy the following basic requirements.

1. The site should be representative of the crop-soil-climate conditions of the area. Representatively of a measurement is the degree to which it describes reliably the value of some parameter (for instance, humidity or wind speed) at a specified space scale for a specified purpose (WMO 2001).
2. It should be located at the center of the farm.
3. The site should be free from water logging.
4. It should have easy accessibility during the rainy season.
5. The site should be away from any permanent irrigation sources and tall structures like buildings, hillocks and trees.
6. The site should not have extreme topography and it should be well exposed.
7. The site of a weather station should be fairly level and under no circumstances should it lie on concrete, asphalt, or crushed rock. Wherever the local climate and soil do not permit a grass cover, the ground should have natural cover common to the area, to the extent possible.
8. Obstructions such as trees, shrubs and buildings should not be too close to the instruments.
9. Sunshine and radiation measurements can be taken only in the absence of shadow during the greater part of the day; brief periods of shadows near sunrise and/or sunset may be unavoidable.
10. Wind should not be measured at a proximity to obstructions that is less than ten times their height.
11. Tree drip into rain gauges should not be allowed to occur.

2.4 Recommended Layout of Observatory

The dimensions for an observatory are a length of 55 m and width of 36 m and the longer side running South–North. The ground plan for an agro-meteorological observatory is given in Fig. 2.1. The periphery should be fenced with barbed wires to prevent cattle trespass. There should be a gate at appropriate site. All tall instruments should be installed at the northern side of the observatory to avoid shade effect.

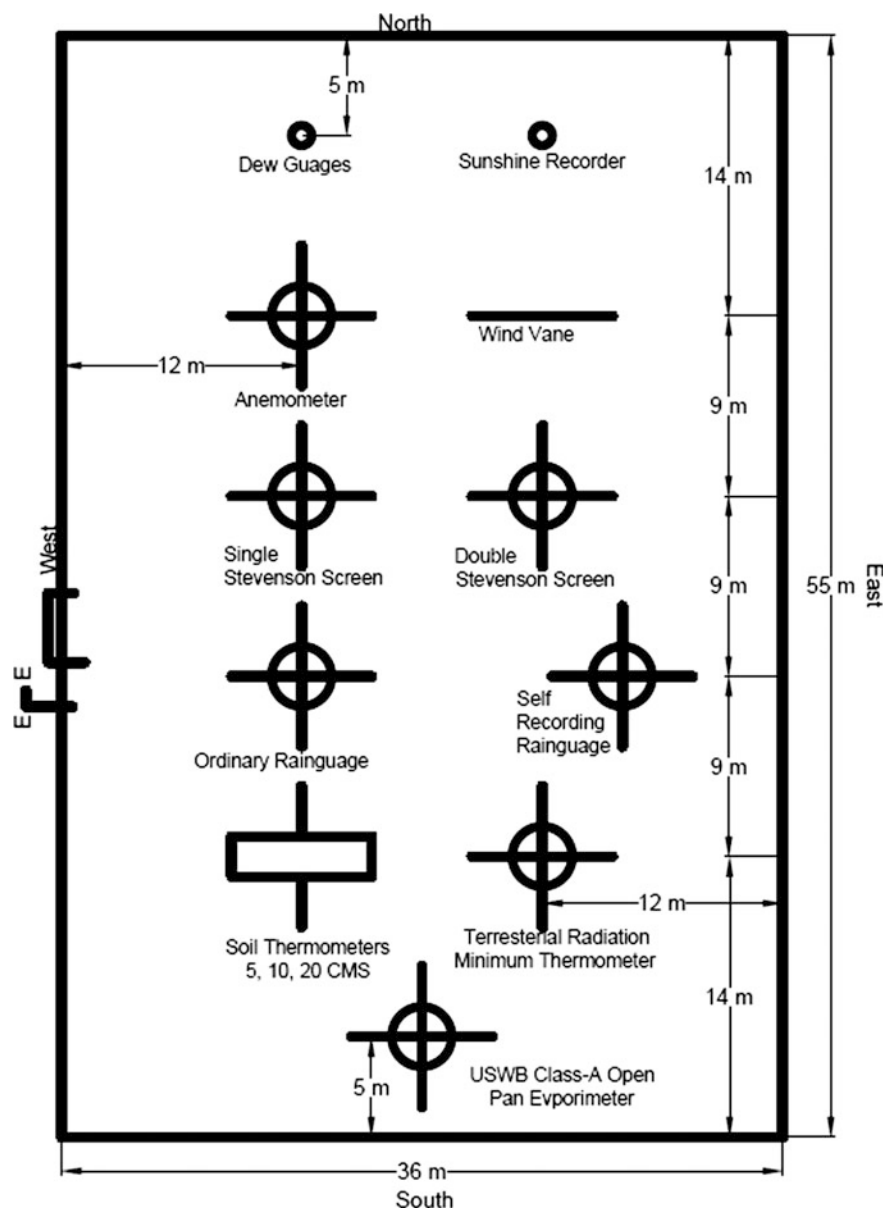


Fig. 2.1 Layout of agro-meteorological observatory

2.5 Time of Observation

Regular surface observations are taken at 0530, 0830, 1130, 1430 1730, 2030 and 2330 h IST at Class I observatories. Morning and afternoon observations refer to 0830 and 1730 h IST observations, respectively. But, agro meteorological observations are taken at 0700 and 1400 h LMT, which when converted into IST. Rainfall and evaporation observations are taken at 08.30 h. Indian Standard Time (IST) and 14.00 h LMT. The setting of automatic instruments like thermograph, hydrograph, evaporigraph and barographs etc. are done at 08.30 h IST.

2.6 Order of Observations

The instruments at the observatory should be read in the following order commencing from 10 min preceding the hour

- (1) Wind instruments,
- (2) Rain gauge,
- (3) Thermometers and
- (4) Barometer.

Non-instrumental observations (e.g. clouds, visibility etc.) should be taken in the interval of 5 min between the first and second readings of the anemometer or if that is not possible, before commencing the instrumental observations.

2.7 Local Mean Time

Local Mean Time (LMT) is based on the average length of a solar day. It is a timekeeping method using the Sun's movements across the sky. In order to explain Local Mean Time, a few other terms need to be understood.

Apparent Solar Time/True Solar Time

A slight variation in the length of solar days is caused due to the rotation of the earth. This implies that the speed of true solar time is not constant. True or apparent solar times shown by means of a sundial.

Mean Solar Time

The length of a mean or average solar day, i.e. 24 h is the Mean Solar. It moves at a constant speed. Local Mean Time is the Mean Solar Time for a specific location on Earth. Places sharing same longitude have the same Local Mean Time.

2.8 Calculation of Local Mean Time

The Local Mean Time corresponding to Indian Standard Time (IST) varies from place to place depending upon longitude of a place. The longitude $82^{\circ} 30'$ E passing through Allahabad is called Indian Standard Time longitude. Here the IST and LMT are same. To get IST of a corresponding LMT of a place the following formula can be used.

$$IST = LMT + 4(\lambda_S - \lambda_L)$$

where,

LMT 7:00 h.

λ_S Standard time longitude i.e., $82^{\circ} 30'$ E for India passing through Allahabad.

λ_L Longitude of the station for which local time is calculated.

For traversing the distance between two longitudes, the earth takes nearly 4 min. So the 4 is taken as the multiplication factor for the difference.

Example

The longitude of Srinagar is 74.8° . The time of observation (i.e. IST) at Srinagar corresponding to 07:00 and 14:00 h LMT can be calculated as:

$$\begin{aligned} IST &= 07:00 + 4(82.5 - 74.8) \\ &= 07:00 + 00:04 (7.7) \\ &= 07:00 + 00:31 \\ &= 07:31 \text{ (approx.)} \end{aligned}$$

and,

$$\begin{aligned} IST &= 14:00 + 4(82.5 - 74.8) \\ &= 14:00 + 00:04 (7.7) \\ &= 14:00 + 00:31 \\ &= 14:31 \text{ (approx.)} \end{aligned}$$

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