Practical Manual

on

Climate Science

FNR 316 (2+1)

Dr. Pavan Kumar
Dr. Rajiv Nandan

2020

College of Agriculture
Rani Lakshmi Bai Central Agricultural University
Jhansi-284003

Syllabus FNR 316 (2+1):

Study of temperature instruments, pressure instruments, humidity instruments, wind instruments, rain instrument and wind rose. Solar radiation instruments with pyranometer. Layout of an Agromet observatory and types. Measurement of wind and evaporation. Measurement of sunshine hours. Measurement of soil temperature and dew. Estimation of greenhouse gases into atmosphere.

Name of Student.....

Roll No. .....

Batch.....

Session.....

Semester.....

Course Name: .....

Course No. : .....

Credit.....

Published: 2020

No. of copies: ……..

Price: Rs.

CERTIFICATE

This is to certify that Shri./Km. .....ID No.....has completed the practical of course.....course No. ..... as per the syllabus of B.Sc. (Hons.) Forestry ..... semester in the year.....in the respective lab/field of College.

Date: Course Teacher

INDEX

Practical No. 1

Objective: To study temperature instruments.

Material required:……

……

……

……

Temperature instruments:……

……

……

……

……

Thermometer ……

……

……

……

……

……

……

……

Dry bulb thermometer……

……

……

……

……

……

……

……

……

……

……

Wet bulb thermometer……

……

……

……

……

……

……

……

……

……

Thermograph ……

……

……

……

……

……

……

……

……

……

……

Infra-red thermometer……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations: Record temperature from different thermometers…….……..……

Date	Time	Temperature		Test reading at the Time of setting	
		Maximum (°C)	Minimum(°C)	Maximum(°C)	Minimum(°C)

……

……

……

Conclusion: ……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 2

Objective: To study pressure instruments.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

Mercury barometers:……

……

……

……

……

……

……

……

……

……

Fortin's barometer:……

……

……

……

……

……

……

……

……

……

Kew pattern barometer:…….....……

……..……

……..……

……..……

……..……

……..……

……..……

Aneroid barometers:…….....……

……...…….……..……

……..……

……..……

……..……

……..……

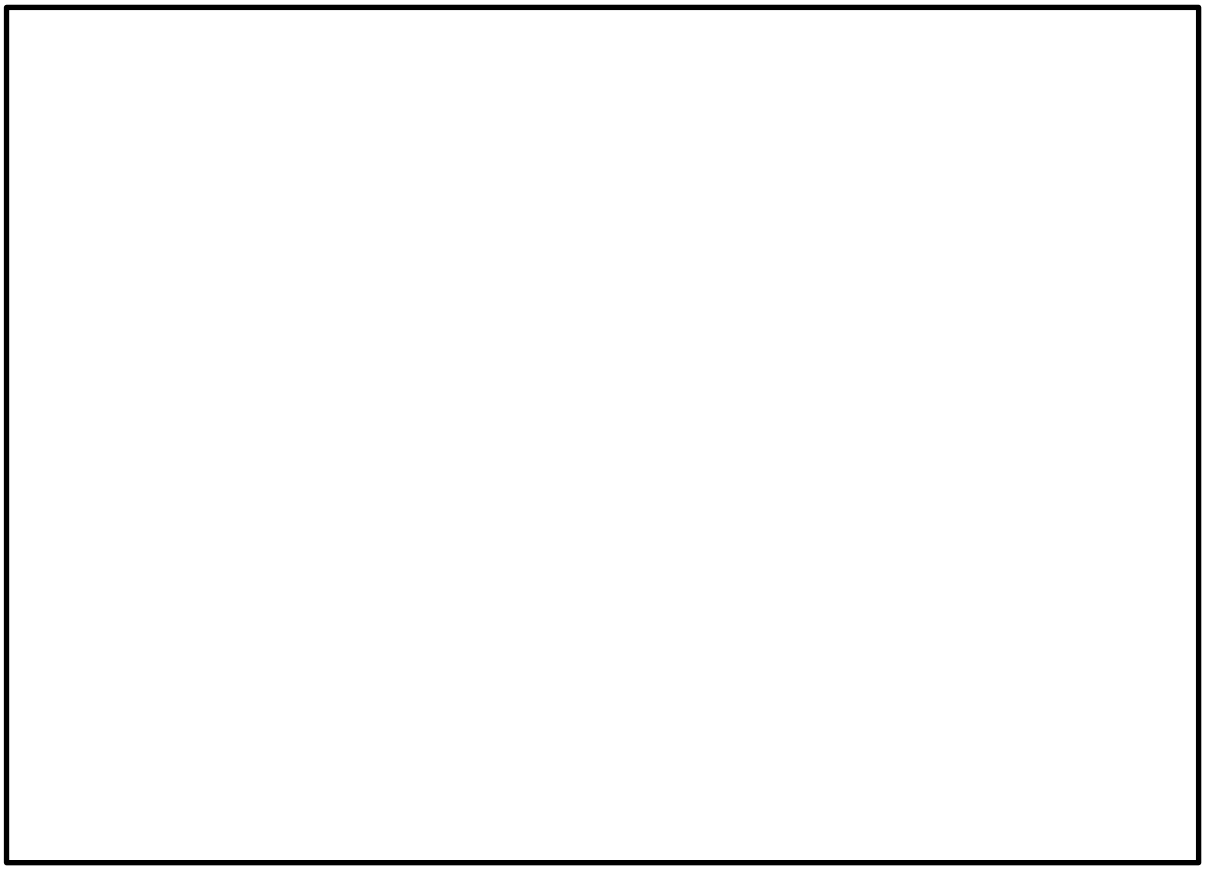
……..……

……..……

……..……

……..……

Draw the neat sketch of Fortin's barometer:…….....……..……..……



Practical No. 3

Objective: To study humidity instruments.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

Combination of dry and wet bulb thermometers……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Hair hygrometers……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Raino Table:……

1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 4

Objective: To study wind instruments.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

Wind instruments:……

……

……

……

……

……

……

……

……

Anemoscope:……

……

……

……

……

……

Aerovane:……

……

……

……

……

……

……

Wind vane:……

……

……

……

……

……

……

……

……

……

……

……

Anemometer:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Reading of wind vane at the time of observation:……

……

……

……

……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 5

Objective: To study rain instruments.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

Practical No. 6

Objective: To study wind rose.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

Practical No. 7

Objective: To study solar radiation instruments with pyranometer.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

Pyranometers:……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

……

……

……..……

……

Location	LAT	LONG	a	b

……..……

……..……

Conclusion:……..…

……..

……..

……..

……..…

……..……

……..……

……..……

……..……

……..……

……..……

……..……

……..……

……..……

……..……

Practical No. 8

Objective: To Layout of an Agromet observatory and types.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Types of general observatories:……

……

……

……

……

……

……

……

……

……

……

……

Agro-meteorological observatories:

Essential instruments:

Criteria for site selection:

……

……

……

……

……

……

……

……

Hours of observation:……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

……

……

Conclusion:

……

……

……

……

……

……

……

Practical No. 9

Objective: To measure wind.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

Wind Instruments:……

……

……

……

……

……

……

……

……

Anemoscope:……

……

……

……

……

Aerovane:……

……

……

……

Wind vane:……

……

……

……

……

……

……

Anemometer:……

……

……

……

……

……

……

……

……

……

……

Reading of wind vane at the time of observation:…….……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion: ……

……

……

……

……

……

……

Practical No. 10

Objective: To measure evaporation.

Material required: ……

……

……

Factors affect the rate of evaporation:……

……

……

……

……

……

……

……

……

Measurement of evaporation observations:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Description of pan evaporimeter: ……

……

……

……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion: ……

……

……

……

……

……

……

Practical No. 11

Objective: To measure sunshine hours.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

Description of sunshine recorder:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Record cards:……

……

……

……

……

S. No.	Name of card	Type of card	Time of use	Remarks
1				
2				
3				
4				
5				

……

……

……

……

……

Observation:……..

……..

……..

……

……

……

……

……

……

……

……

……

……

……

……

……

Discussion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion: ……

……

……

……

……

……

……

……

……

Practical No. 12

Objective: To measure soil temperature.

Material required:

Procedure:

……

……

……

Observation:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 13

Objective: To measure dew.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

……

……

……

……

……

……

……

……

……

……

……

Glashier factor for dry bulb temperature:……

Dry bulb temp °C	Glashier factor	Dry bulb temp °C	Glashier factor

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 14

Objective: To estimate greenhouse gases (water vapour and CO_2) into atmosphere.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Greenhouse gases:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

Location	water vapour	carbon dioxide

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Practical No. 15

Objective: To estimate greenhouse gases (CH_4 and NO_2) into atmosphere.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Greenhouse gases:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

Location	Methane	Nitrous oxide

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Conclusion:

Practical No. 16

Objective: To estimate greenhouse gases (O_3 and CFC_{11}) into atmosphere.

Material required: ……

……

……

Procedure:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Greenhouse gases:……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

Observations:……

Location	Ozone	Fluorinated gases

……

……

……

……

……

……

……

……

……

……

……

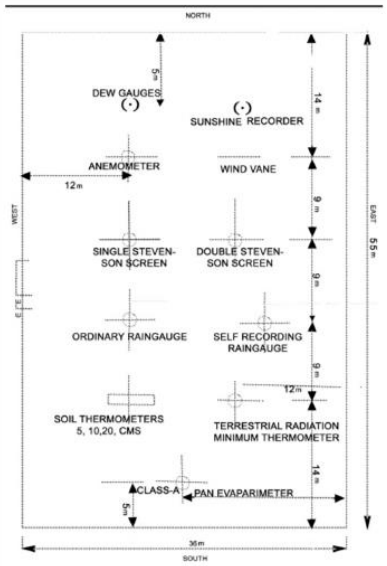
……

……

……

Conclusion:

Layout of agro-meteorological observatory

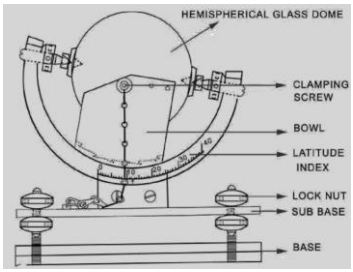


An observatory is a specially designed station or place where the regular and simultaneous records of the weather data are made by physical measurements using various techniques, sensors, skills, recorders, instruments etc. by standard methods at hours recommended by IMD and WMO. IMD was established during 1875 with its central office at Pune which takes up this responsibility. Country is divided into 35 meteorological sub divisions. Weather affects agriculture at every stage, therefore, knowledge of crop weather relationship helps in optimizing the agricultural operations. Since meteorology and climatology are primarily observational science, adequate care has to be taken for getting most representative and accurate observations of weather parameters for their worthwhile application in weather and climate prediction. In arid and semi-arid agriculture, the weather aberrations are more as compared to the humid agriculture that adversely affect the agricultural production.

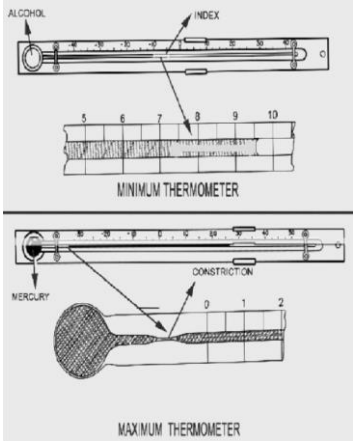
Pyrano-albedometer:

Solar radiation affects to a large extent the micro-climate thereby, the crop growth and yield. Spectral quality of sunlight intercepted by the crop canopy and light that penetrates through the canopy are other important factors determining the crop growth in the system. The measurements should enable the evaluation of the photosynthetic efficiency of the system and matching of this with alternate designs of canopy structure. The visible part of the spectrum is hot -wave radiation. The solar radiation is a combination both direct and diffused radiation. So, to measure direct solar radiation, the diffuse radiation has to be subtracted from the total incident radiation. The total incident radiation, diffused radiation and radiation reflected from various surfaces can be measured with the help of a pyrano-albedometer. When radiation is incident on the sensitive element of the instrument, it produces electric current which is measured in millivolts in the multi-voltmeter

Sunshine recorder:



The sunshine recorder consists essentially of a glass sphere, about 10 cm in diameter, mounted concentrically in a section of spherical bowl. The diameter of the bowl is such that the sun rays are focused sharply on a card held in grooves cut into the bowl. Three overlapping pairs of grooves are provided in the spherical segment in order to take cards suitable for different seasons of the year. The sunshine recorder is installed on a masonry pillar of 5 or 10 feet above the ground.

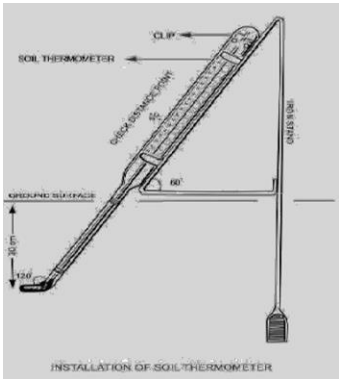


Maximum thermometer: The maximum temperature attained by air during the day is measured by a thermometer called maximum thermometer. It is a mercury-in-glass thermometer with a constriction in the bore below the lowest graduation. It allows the mercury to be forced through with rising temperature but prevent it being drawn back with falling temperatures, provided the thermometer is kept at an angle of 10° from the horizontal with the bulb downwards. It allows the mercury in one way as the constriction acts as a valve. The observer resets the thermometer after reading by holding it firmly in hand by the remote end from the bulb and swinging it briskly downwards. The range of maximum thermometer graduation is from -20°C to 55°C.

Minimum thermometer: The minimum temperature attained by air during the day is measured by using a thermometer called minimum thermometer. Minimum thermometer is a alcohol thermometer. Alcohol is sensitive for lower temperature than mercury. Within the liquid, there is a very light dumb bell-shaped glass index which moves freely within the spirit but not readily emerge from the liquid due to surface tension. The thermometer is tilted slightly so that bulb end is upward, the glass index slides along the tube until it reaches the meniscus. But when temperature rises, it remains stationary while the liquid moves ahead in the column. The range of minimum thermometer graduation is from -40°C to 50°C.

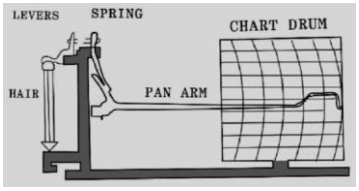
Soil thermometers:

The soil temperature is measured by soil thermometers. These are mercury –in – glass thermometers of the enclosed scale type. There is a bend of 120° angle just above the bulb, the rest of stem being straight, so that when the soil thermometer is installed at a particular depth of the soil, the bulb rests horizontally. The inclination of the stem at 120° also facilitates the reading of the scale. These thermometers have graduation for every degree Celsius and the graduation starts from the distance of 6.5 cm, 17. 5 cm and 35 cm from the bulb for the 5.15 and 30 cm depth soil thermometers, respectively. Iron stands with sloping sides at 60° to the ground surface are provided to support the thermometers at the right inclination.



Hair hygrograph:

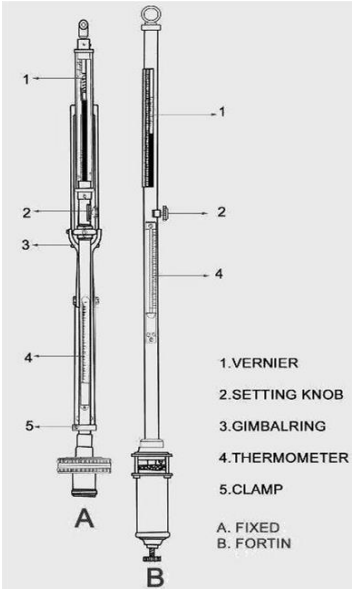
It records the continuous changes in relative humidity on graph paper during the hours of the day. When, a hygrometer is transformed into a self-recording device it is called as a hygrograph. This is used to record the relative humidity of the air continuously.



Mercurial barometers:

There are two types of mercurial barometers. A) Fortin‘s barometer B) Kew pattern barometer.

The Fortin‘s barometer is a familiar sight at most of the micro -meteorological laboratories and is an accurate one. It consists of a glass tube of uniform cross section and length, which is closed at one end. It is about one metre in length, filled with mercury and then inverted with its lower end open into a movable cistern of mercury. The cistern vessel contains mercury with a flexible leather bag and screw at its bottom. There are two scales on two sides of the tube, one in centimetres and the other in inches. For accurate readings vernier callipers is also attached. In mercury barometer, atmospheric pressure balances a column of mercury, the height of which can be precisely measured. To increase their accuracy, mercury barometers are often corrected for ambient temperature and the local value of gravity. Common pressure units include pounds per square inch; dynes per square centimetre; newton’s per square metre.

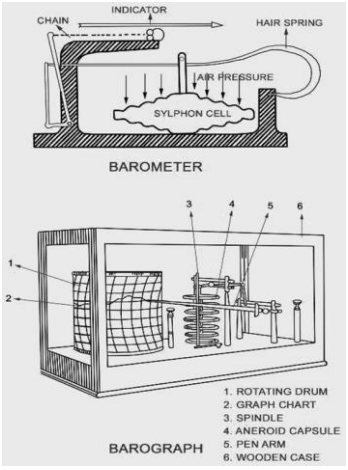


Barometer:

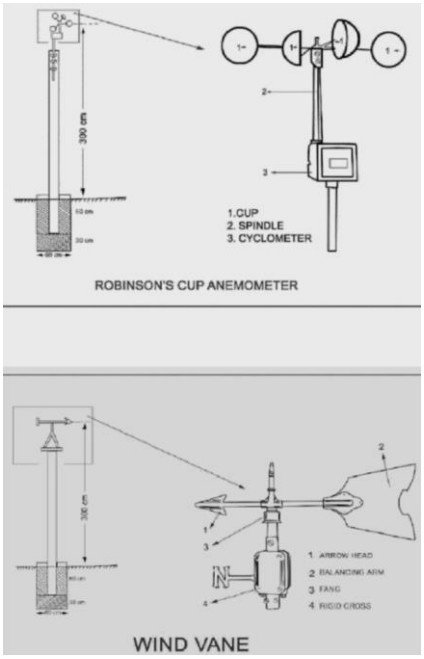
A barometer is a scientific instrument that is used to measure air pressure in a certain environment. Pressure tendency can forecast short term changes in the weather. Many measurements of air pressure are used within surface weather analysis to help find surface troughs, pressure systems and frontal boundaries.

Barograph:

A barograph is a recording aneroid barometer where the changes in atmospheric pressure are recorded on chart paper. A barograph chart is mounted on to the drum which is normally turned by clockwork. The ink trace, or barogram, on the recording paper is a visual record of changes in pressure. Today, traditional recording barographs for meteorological use have commonly been superseded (though not all) by electronic weather instruments that use computer methods to record the barometric pressure.



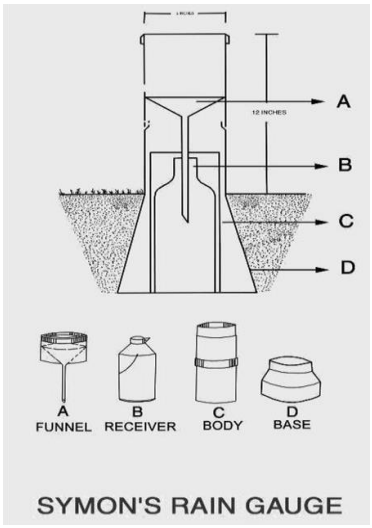
Anemometer:



An anemometer is a device used for measuring wind speed and direction. It is also a common weather station instrument. The term is derived from the Greek word anemos, which means wind, and is used to describe any wind speed instrument used in meteorology. The first known description of an anemometer was given by Leon Battista Alberti in 1450.Anemometer, device for measuring the speed of airflow in the atmosphere, in wind tunnels, and in other gas-flow applications. Most widely used for wind-speed measurements is the revolving-cup electric anemometer, in which the revolving cups drive an electric generator. The output of the generator operates an electric meter that is calibrated in wind speed. The useful range of this device is approximately from 5 to 100 knots.

In fluid dynamics, wind waves, or wind-generated waves, are water surface waves that occur on the free surface of bodies of water. They result from the wind blowing over an area (or fetch) of fluid surface. Waves in the oceans can travel thousands of miles before reaching land.

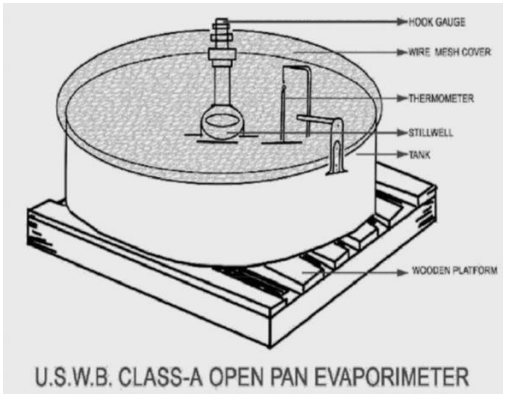
Symon's Rain Gauge:



The Indian Meteorological Department has adopted Symon's rain gauge. A glass bottle and funnel with brass rim are put in a metallic cylinder such that the top of the cylinder is 30.5 cm above the ground level. The jar measures rainfall in millimetres.

The first known rainfall records were kept by the Ancient Greeks, at around 500 BCE. People living in India began to record rainfall in 400 BCE. The readings were correlated against expected growth. In the Arthashastra, used for example in Magadha, precise standards were set as to grain production. Each of the state storehouses were equipped with a rain gauge to classify land for taxation purposes. In 1247, the Song Chinese mathematician and inventor Qin Jiushao invented Tianchi basin rain and snow gauges to reference rain, snowfall measurements, as well as other forms of meteorological data. In 1441, the Cheugugi was invented during the reign of Sejong the Great of the Joseon Dynasty of Korea as the first standardized rain gauge.

Evaporimeter:



An atmometer or evaporimeter is a scientific instrument used for measuring the rate of water evaporation from a wet surface to the atmosphere. Atmometers are mainly used by farmers and growers to measure evapotranspiration (ET) rates of crops at any field location. Evaporimeters are of two types, those that measure the evaporation rate from a free water surface and those that measure it from a continuously wet porous surface. In the first type, the level of water in a tank or pan, often sunk into the ground so that the water surface is at ground level, is measured by a micrometer gauge. After accounting for increases due to rain and decreases due to deliberate draining, the day-to-day decrease in the water level can be attributed to evaporation. In one evaporimeter of the second type, the evaporation rate is computed according to the rate of weight loss of a wet pack of absorbent material. The Piché evaporimeter uses an inverted graduated cylinder of water with a filter-paper seal at the mouth. Evaporation takes place from the wet filter paper and thus depletes the water in the cylinder, so that the rate of evaporation can be read directly from the graduations marking the water level.