Lesson - 15

Condensation and Rainfall

The water vapour present in the atmosphere is called humidity. On average there is 2% of humidity in the atmosphere. Water is present in the air in the form of water vapour or steam. Like every substance water is found in three states as solid, liquid and gas. Water vapour comes in the atmosphere through evaporation. Under favourable conditions this water vapour condenses, descends on the earth's surface in the form of rainfall, hail or snow. This surface water, flows back to sea or directly enters into the atmosphere. Some percentage of water is absorbed by plants and the rest is left in the atmosphere for evaporation. This mutual exchange of water between oceans, atmosphere and continents occurs continuously through transpiration, evaporation, condensation and precipitation.

The actual amount of water vapour present in the atmosphere is called absolute humidity. Or the total amount of moisture content actually present in a given volume of the air is called absolute humidity. Absolute humidity is different at different places on the earth's surface. The rainfall depends on the amount of absolute humidity. Absolute humidity is expressed in gram/sq metre. In the same way the proportion between the capacity of the air to hold moisture and the actual moisture present in the air at a given temperature is called relative humidity. It is expressed in percentage.

$$\text{Relative Humidity} = \frac{\text{Absolute Humidity}}{\text{Humidity Capacity}} \times 100$$

The atmospheric humidity is measured by Hygrometer.

The air with moisture content, which is equal to its capacity to hold moisture, is called saturated air. In the same way the temperature at which the air gets saturated is called 'Dew Point'.

Evaporation

The process through which water in the form of liquid or solid, changes in to gas or water vapour, is called evaporation. The atmosphere receives humidity through evaporation. Therefore the process through which the water turns into vapour is called evaporation. The amount and the intensity of evaporation depend upon speed of the wind, temperature and dryness. Evaporation is more prominent in the oceans in comparison to land mass. Generally, it requires 79 calories for one gram of ice to change into water and one gram of water requires 607 calories to change into vapour.

The maximum evaporation takes place on continents between 10° north to 10° South latitudes and in oceans between 10° to 20° latitudes in both the hemispheres. The amount of evaporation reduces towards the higher altitudes. Evaporation is not uniform at all the places. The amount of evaporation depends on (1) Temperature (2) Dryness air, (3) Extent of water in the region, (4) Clouds, (5) Velocity of the Wind.

Condensation

The process of converting water in the form of liquid or solid is called condensation. The process of condensation in the atmosphere depends on the availability of amount of the absolute humidity. The

temperature at which the air gets saturated is called Dew Point. The process of condensation begins either when the temperature drops below Dew Point or when the amount of water vapour increases. This happens under two conditions:-

(1) Decrease in the temperature

(2) Increase in humidity

The decrease of temperature is most favourable for the process of condensation.

Forms of condensation

The major forms of condensation are Dew, Frost, Clouds and Fog.

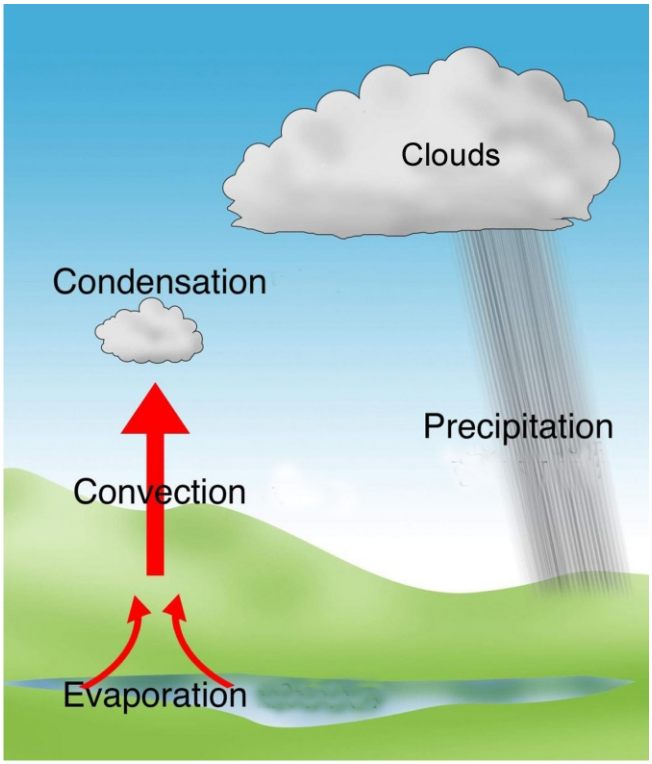

Fig.15.1 : Evaporation, Condensation, Convection and Precipitation

(1) Dew

Mostly the earth's surface gets heated during the day and cools down during the night, sometimes the temperature of the air touching surface of the earth decreases below the Dew Point. The water vapour present in the air gets condensed and is deposited in form of droplets on plant leaves and other objects. This is called Dew. The formation of the Dew depends on (1) presence of water vapour in the air (2) the temperature of the earth's surface should decrease to an extent that, it condenses the water vapour present in the air.

(2) Frost

During the condensation of water vapour in the air, when the temperature is 0°C or below it, the water vapour, instead of getting condensed into water droplets, transforms into. It is important for the formation of the Frost that the temperature of the air decreases rapidly and for a longer period of time. The sky should be clear and water vapour should be present in the air and the temperature should remain below Dew Point.

(3) Fog

Fog forms due to the condensation of water vapour near the earth's surface. The Fog reduces the transparency of the atmosphere. When the visibility on the earth's surface or in atmosphere is reduced to less than 1 km, the condensed water vapour is called Fog. The decrease in temperature below Dew point and gentle movement of wind are important for the formation of Fog. On the basis of visibility, fog is of following types- Light, Moderate, Thick and Very Dense. The visibility in the fog is measured by an instrument called Transmissometer. When the visibility is extremely low it is called Mist.

(4) Clouds

The mass of particles or ice crystals, that are formed due to condensation of water vapour at the greater heights of the atmosphere, is termed as clouds. Clouds are mostly found at the height of 12000 meters. As the formation of the clouds occurs at some height from the earth's surface, its shapes varies.

Thus on the basis of their height, density, extension and transparency, clouds are classified into following types-

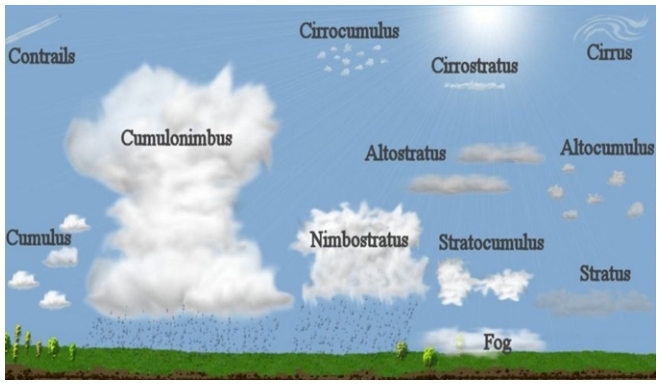

Fig. 15.2 : Types of Clouds

(i) Cirrus Clouds, (ii) Cumulus Clouds, (iii) Stratus clouds, (iv) Nimbus clouds

(i) Cirrus Clouds

They are found at the maximum height. (8000 to 12000 m). The weather remains calm and sky is clear and these clouds do not cause rainfall. They extend in the whole sky like a sheet. Due to these clouds, a halo is formed near the sun and the moon; which indicates the arrival of the cyclone.

(ii) Cumulus Clouds

These extensive and dark coloured clouds, dense and heavy. These clouds cause heavy rainfall and thunderstorms. They appear similar to a mass of cotton. Their height varies from 4000 to 7000m. Their shape resembles to a cauliflower.

(iii) Stratus clouds

These clouds are similar to Fog and are found near the earth's surface. They are in form of many layers. These clouds are formed due to convergence of two air masses of different nature in winter season in temprate zone.

(iv) Nimbus clouds

Clouds are very dense and dark. As these clouds are very dense they cause darkness and heavy rainfall. They are found nearest to the earth's surface.

Precipitation

A total amount of rainfall including drops received from snow, hail and clouds, measured by Rain gauge at a fixed place during fixed duration of time is called precipitation. The water vapour which is present in the air gets condensed and changes its form to liquid or solid state and falls on the ground, is termed as precipitation. It can be in both liquid and solid form. When the precipitation is in liquid form it is called rainfall. When the temperature is below 0°, the precipitation is in form of ice particles it is called as snowfall. Hail, snow and water, all three are included in precipitation. Generally, precipitation is understood to be as rainfall. There are two conditions important for precipitation:-

(i) Sufficient amount of water vapour in the air
(ii) The presence of such a means so that vapour laiden wind may be condensed by getting cool that leads to decrease of temperature of the air and it becomes cold

Types of rainfall

On the basis of the origin of the rainfall it is classified into following types:-

1. Convectional Rainfall
2. Orographic Rainfall
3. Cyclonic Rainfall

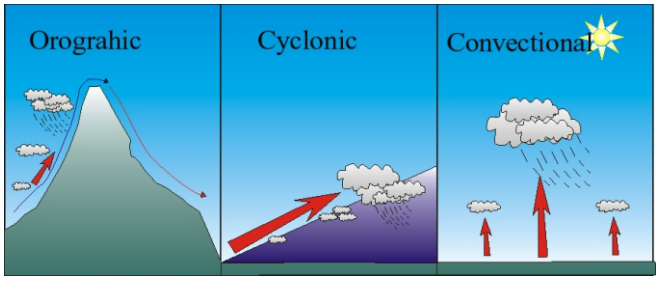

Fig. 15.3: Types of rainfall

1. Convectional Rainfall

This type of rainfall occurs almost daily in the afternoon in the equatorial regions. Due to excessive heat after getting heated. The air rises up as it becomes warm and light, the water of the oceans turns rapidly into water vapour and rises up and this process is called convectional process.

2. Orographic Rainfall

It is also called as surface rainfall. This is the most prevalent rainfall in the world in which the saturated air have to rise along the mountain to get cool. The colder air gets condensed and causes rainfall. Thus, this air rises up due to mountain barriers and causes rainfall as they cool down. The windward side of the mountain receives more rainfall than its other side. Thus this slope of the mountain that receives lesser rainfall is called as rain shadow area.

3. Cyclonic Rainfall

This type of rainfall is more common in colder regions. This type of rainfall is caused due to cyclones. The winds blow at high velocity towards the centre and rises up in a cyclone. These winds carry water vapour as they crosse oceans. When these winds come in contact with the polar cold winds, it leads to the formation of fronts. The hot and humid air gets condensed and causes rainfall.

This type of rainfall is called cyclonic rainfall. This type of rainfall does not cause heavy rains but comes in the form of gentle showers throughout the year. This type of rainfall is more prominent in temperate regions. This type of rainfall occurs during winter season in North Western parts of India.

Isohytes

The lines which are drawn to connect the areas of equal rainfall on worlds map are called Isohyets.

Rain Gauge

The instrument by which the rainfall is measured is called Rain gauge. The rainfall is measured in inches or millimetres.

Major Factors affecting rainfall

(i) Latitudes (ii) Height (iii) Prevailing winds (iv) Ocean Currents (v) Distance from the Sea (vi) Location of Land and Sea (vii) Direction of mountain ranges.

World Distribution of rainfall

The amount of rainfall received on earth's surface is different at different places. The distribution pattern of rainfall is highly uneven. At some places the amount of rainfall received is 200cms whereas at some places it is less than 20 cms. The factors that affect the distribution pattern of rainfall include, temperature , distribution of land and sea, direction of winds, direction of mountains etc. There are following six belts of rainfall on the earth,

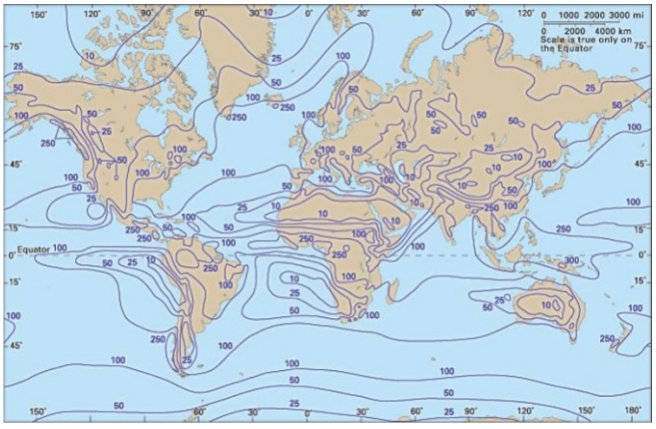

Fig. 15.4 : World Distribution of rainfall

1. Equatorial belt of maximum rainfall

It extends between 10° north and south of the equator, in both the hemispheres. It includes Amazon Valley of South America, Congo basin of Africa, coastal margins of Central America, New Guinea, eastern coastal regions of Madagascar and Philippines. This region receives rainfall between 175 cm to 200 cm. This type of rainfall is mostly convectional. The rainfall with thunder and lightning occurs in the afternoon on each day.

2. Trade wind rainfall belt

This belt extends between 10° to 20° latitudes from the equator in both the hemispheres. The rainfall occurs due to trade winds on the eastern margins. Monsoon rainfall also occurs in this zone.

3. Subtropical belt of minimum rainfall

This is zone extends between 20° to 30° latitudes in both the hemispheres. This is a high pressure belt, in which the winds descend from upper part to lower part.

Thus anticyclonic conditions prevail. The deserts of Egypt, Sahara and Thar are located in this belt. The average of yearly rainfall is about less than 25 cm.

4. Mediterranean rainfall Belt

This belt extends from 30° to 40° latitudes near the western coastal margins, in both the hemispheres. This includes California, Central Chile, south west region of South Africa , south west regions of West Australia. In this region, the rainfall occurs during winter season by Westerlies. Most of the rainfall is cyclonic. The average yearly rainfall is 100 cm. Dry summer season is the prominent characteristic of this belt, as it remains under the influence of dry trade winds during this season.

5. Mid Latitudinal belt of high rainfall

This belt extends between 40° to 50° latitude in both hemispheres. The Western margins receive more rainfall in this belt. The southern hemisphere receives more rainfall than northern hemisphere due to dominance of oceans. In this belt, the cyclonic rainfall occurs due to the convergence of westerlies and polar winds. The annual average rainfall is between 100 cms to 125 cms.

6. Polar belt of low rainfall

This belt extends from 60° latitudes to poles, in both the hemispheres. The amount of rainfall decreases towards the poles. Most of the rainfall occur in the form of snowfall. The annual average rainfall is about 25 cm.

Important points

1. Water vapour is present in atmosphere, due to which formation of clouds, rainfall, snowfall, dew, Frost, fog occurs.
2. The amount of water vapour present in the air is called humidity. It is of two types absolute and relative.
3. When the amount of water vapour present in the air is equal to the capacity it can hold, it is called saturated air. It is closely related to temperature.
4. When the water vapour changes into water or snow, it is called condensation. Dew, Frost, Fog, Mist are forms of condensation.
5. Convectional, Orographic and Cyclonic are different types of rainfall.

Exercise
Multiple choice questions

1. Which instrument is used to measure the humidity in the atmosphere?
   (A) Hydrometer
   (B) Hygrometer
   (C) Isobar
   (D) Barometer

2. Which of the following clouds are found at the maximum height in atmosphere?
   (A) Cirrus clouds
   (B) Stratus clouds
   (C) Cumulous clouds
   (D) Nimbus clouds

3. The visibility in the fog is measured by:-
   (A) Hydrometer
   (B) Transmissometer
   (C) Cubic metre
   (D) Millimetre

4. The rainfall occurring in the afternoon in equatorial regions is called-
   (A) Orographic rainfall
   (B) Cyclonic rainfall
   (C) Convectional rainfall
   (D) None of the above

5. The actual amount of water vapour present in the atmosphere is called
   (A) Evaporation
   (B) Absolute humidity
   (C) Relative humidity
   (D) Condensation

Very short type questions

6. What is humidity?
7. What is relative humidity?
8. What is cyclonic rainfall?
9. What is precipitation?
10. What is fog?

Short type questions

11. What is humidity? Describe its different types.
12. Differentiate between absolute and relative humidity
13. What is evaporation?
14. What are the different types of clouds?
15. What are Isohyets?

Essay type questions

16. Describe the major factors that affect rainfall.
17. What is condensation? Describe its various forms.
18. Explain the concept of precipitation and describe various types of rainfall.

Answer Key

1. B. 2. A. 3. B. 4. C. 5. C