

## CLOUDS

Clouds are condensed droplets of water and ice crystals. The nuclei of those droplets are dust particles. Near the surface these drops form fog and in the free atmosphere, they form clouds. Clouds have been defined as visible aggregation of minute water droplets and / or ice particles in the air, usually above the general ground level. Air contains moisture and this is extremely important to the formation of clouds. Clouds are formed around microscopic particles such as dust, smoke, salt crystals & other materials that are present in the atmosphere. These materials are called Cloud Condensation Nucleus (CCN). Without these, no cloud formation will take place. There are certain special types, known as ice nucleus, on which droplets freeze or ice crystals form directly from water vapour. Generally condensation nuclei are present in plenty in air. But there is scarcity of special ice forming nuclei. Generally clouds are made up of billion of these tiny water droplets or ice crystals or combination of both. When a current of air rises upwards due to increased temperature it goes up, expands and gets cooled. If the cooling continues till the saturation point is reached, the water vapour condenses and forms clouds. The condensation takes place on a nucleus of dust particles. The water particles individually are very small and suspended in the air. Only when the droplets coalesce to form a drop of sufficient weight, to overcome the resistance of air, they fall as rain. Clouds are considered essential and accurate tools for weather forecasting.

### Classification of clouds

Clouds are usually classified according to their height and appearance. For convenience we list them in descending order as high clouds, middle clouds and low clouds. We must exercise some caution in relying on height data. There is some seasonal as well as latitudinal variation and there is some overlapping from time to time. However, the appearances of clouds are quite distinctive for each height category. The main cloud genera are defined and described in the international cloud atlas of the WMO (1957). That can be listed according to their heights as under.

#### **A. High Clouds** (mean heights 5 to 13 km)

- i) Cirrus (Ci) = mean height 9900 m.
- ii) Cirrocumulus (Cc) = 8300 m.
- iii) Cirrostratus (Cs) = 6500 m.

#### **B. Middle Clouds** (Mean height 2 to 7 km)

- i) Altostratus (As) 4300 m.

ii) Altopcumulus (Ac) 4300 m.

**C. Low Clouds** (mean heights 0 to 2 km) (Close to earth's surface)

i) Nimbostratus (Ns) 2000 m.

ii) Stratocumulus (Sc) 500m.

iii) Stratus (St) 900-1200 m.

**D. Vertical clouds**

i) Cumulus (Cu) 1500-2000 m.

ii) Cumulonimbus (Cb) 3000-5000 m.

**Clouds with vertical development**

**1. Cirrus:** Detached clouds in the form of white, delicate filaments or white or mostly white patches of narrow bands. Those clouds have a fibrous (hair like) appearance or a delicate silky appearance or both. All the cirrus or cirro-type clouds are composed of ice crystals. Cirrus clouds have brilliant colours of sunset sunrise. These clouds do not give precipitation.



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**2. Cirro-Stratus:** Transparent whitish cloud veil of fibrous (hair like) or smooth appearance, totally or partly covering the sky and generally producing halo phenomena. This type of cloud is so thin it gives the sky a mild appearance



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**3. Cirro-cumulus:** Thin, white flakes, sheet or layer of cloud without shading. Composed of very small elements in the form of grains. This type of cloud is not common and is often connected with cirrus or cirrostratus. When arranged uniformly, it forms a .Mackerel sky.. Mackerel – is a fish which has greenish blue stripped back and silvery white belly.



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**4. Alto-stratus:** A uniform sheet of cloud. Grayish or bluish cloud frequently showing a fibrous appearance, totally or partly covering the sky Altostratus does not show halo phenomena. This type of clouds may cover all or large portions of the sky. Precipitation may fall either as fine drizzle or snow.



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**5. Alto-Cumulus:** white or grey, or both white and grey, patch, sheet or layer of cloud. Sometimes referred to as sheep clouds or Woolpack clouds.



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**6. Nimbo- Stratus:** .Grey cloud layer, often dark, the appearances of which is rendered diffuse by more or less continuously falling rain or snow, which in most cases reaches the ground. It is thick enough throughout to blot out the sun. It is a rain, snow or sleet cloud. It is never accompanied by lightening, thunder or hail. Streaks of water (rain) or snow falling from these clouds but not reaching the ground are called Virga. (Virga=Wisps or streaks of water or ice particles falling from base of a cloud but evaporating completely before reaching the ground). (Wisps=bundle as of straw).



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**7. Strato-Cumulus:** .Grey or whitish or both grey and whitish patch, sheet or layer of cloud which almost always has dark parts, composed of rounded masses, rolls, etc.



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**8. Stratus:** Generally grey cloud layer with a fairly uniform base, which may give drizzle, ice prisms or snow grains, sky may be completely covered by this type of cloud. Sun is visible through this cloud.



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**9. Cumulus:** .Detached clouds, generally dense and with sharp outlines, develop vertically in the form of rising mounds, domes or towers, of which the bulging upper parts often resembles a cauliflower. Cumulus is generally found in the dry time over land areas. They dissipate at night. They produce only light precipitation.



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**10.Cumulonimbus:** .Heavy and dense cloud, with a considerable vertical extent in the form of a mountain or huge towers. This type of cloud is associated with heavy rainfall, thunder, lightening, hail or tornadoes. The fall of a real shower and sudden darkening of the sky easily recognize this type of clouds.



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## Formation of Clouds:

Clouds are formed by condensation of moisture in the air by cooling.

1. It is due to direct cooling as they come in contact with cold surface.
2. By mixing of hot and cold air.
3. By expansion.

There are two rain forming process viz,

### 1. Warm rain process:

Rains occur when the temp is above  $0^{\circ}\text{C}$  never colder than  $0^{\circ}\text{C}$ . When larger droplets collide and absorb smaller cloud droplets. They grow larger and larger & become raindrops. This process is known as Coalescence.

### 2. Cold rain process

Occurs when the cloud temperature is colder than  $0^{\circ}\text{C}$ . Clouds are usually with ice crystals and liquid water droplets. These crystals grow rapidly drawing moisture from the surrounding cloud droplets until their weight causes them to fall. Falling ice crystals may melt and join with smaller liquid cloud droplets resulting in raindrops. If ice crystals do not melt, they may grow into large snowflakes and reach the ground as snow.

## Cloud Seeding

Cloud seeding is a type of weather modification that aims to change the amount or type of precipitation that falls from clouds by dispersing substances into the air that serve as cloud condensation or ice nuclei, which alter the microphysical processes within the cloud.

### Seeding of cold clouds

This can be achieved by two ways -

#### 1. Dry ice seeding

- Dry ice (solid carbon-dioxide) has certain specific features. It remains as it is at  $-80^{\circ}\text{C}$  and evaporates, but does not melt. Dry ice is heavy and falls rapidly from top of cloud and has no persistent effects due to cloud seeding.
- Aircrafts are commonly used for cloud seeding with dry ice.
- Aircraft flies across the top of a cloud and 0.5 – 1.0 cm dry ice pellets are released in a steady stream.
- While falling through the cloud a sheet of ice crystals is formed.

- From these ice crystals rain occurs.
- This method is not economical as 250 kg of dry ice is required for seeding one cloud. To carry the heavy dry ice over the top of clouds special aircrafts are required, which is an expensive process.

## **2. Silver Iodide seeding**

Minute crystals of silver iodide produced in the form of smoke acts as efficient ice-forming nuclei at temperatures below  $-5^{\circ}\text{C}$ . When these nuclei are produced from the ground generators, these particles are fine enough to diffuse with air currents. Silver iodide is the most effective nucleating substance because; its atomic arrangement is similar to that of ice. The appropriate procedure for seeding cold clouds would be to release silver iodide smoke into super cooled cloud from an aircraft. In seeding cold clouds silver iodide technique is more useful than dry ice techniques, because, very much less of silver iodide is required per cloud. There is no necessity to fly to the top of the cloud, if area to be covered is large.

### **Seeding of warm clouds**

#### **1) Water drop Technique**

Coalescence process is mainly responsible for growth of rain drops in warm cloud. The basic assumption is that the presence of comparatively large water droplets is necessary to initiate the coalescence process. So, water droplets or large hygroscopic nuclei are introduced in to the cloud. Water drops of 25  $\mu\text{m}$  are sprayed from aircraft at the rate of 30 gallons per seeding on warm clouds.

#### **2) Common salt technique**

Common salt is a suitable seeding material for seeding warm clouds. It is used either in the form of 10 per cent solution or solid. A mixture of salt and soap avoids practical problems. The spraying is done by power sprayers and air compressors or even from ground generators. The balloon burst technique is also beneficial. In this case gunpowder and sodium chloride are arranged to explode near cloud base, thus, dispersing salt particles.