

Clouds & Classification

Clouds are an important part of the earth's weather and climate. Clouds form when water condenses in the sky. Clouds are visible accumulations of tiny water droplets or ice crystals in the Earth's atmosphere.

How do Clouds form?

Clouds form from water in the sky. The water may evaporate from the ground or move from other areas. Water vapour may be invisible but it is always in the sky in some amount. Clouds form when an area of air becomes cooler until the water vapour there condenses to liquid form. The water will condense around dust, ice, or sea salt.

CLOUDS & THEIR FORMATION

There are five factors that can lead to air rising and cooling and clouds forming.

- Surface heating
- Orographic barrier
- Fronts
- Convergence
- Turbulence

1. **Surface heating** – This happens when the ground is heated by the sun which heats the air in contact with it causing it to rise. The rising columns are often called thermals. Surface heating tends to produce cumulus clouds.
2. **Topography or orographic forcing** – The topography – or shape and features of the area – can cause clouds to be formed. When air is forced to rise over a barrier of mountains or hills it cools as it rises. Layered clouds are often produced this way.
3. **Frontal** – Clouds are formed when a mass of warm air rises up over a mass of cold, dense air over large areas along fronts. A ‘front’ is the boundary between warm, moist air and cooler, drier air.
4. **Convergence** – Streams of air flowing from different directions are forced to rise where they flow together, or converge. This can cause cumulus cloud and showery conditions.
5. **Turbulence** – A sudden change in wind speed with height creating turbulent eddies in the air.

The range of ways in which clouds can be formed and the variable nature of the atmosphere results in an enormous variety of shapes, sizes and textures of clouds.

Why are Clouds Important?

1. They are needed for rains or snow.
2. During the nights, clouds reflect heat to the earth and keep the temperature warm.
3. During the day, clouds help in keeping the temperature cooler by shielding the sunlight.
4. Researching and studying clouds helps in understanding weather and climate.

What are the 2 main factors that will determine the type of clouds formed?

1. Temperature
2. Wind





Dew forms through the following process:

1. **Radiative Cooling:** During the night, the Earth's surface loses heat through radiation, causing the surface and the air near it to cool down. This process is especially effective under clear skies with calm winds, as clouds trap heat, and winds prevent the surface from cooling.
2. **Condensation:** If the surface temperature drops below the dew point (the temperature at which air becomes saturated with moisture), the water vapor in the air condenses into liquid water droplets on cool surfaces such as grass, leaves, or metal.
3. **Surface Deposition:** These water droplets, now condensed from the air, form what we observe as dew. This usually happens in the early morning when temperatures are lowest and relative humidity is high.

Conditions Required for Dew Formation:

- **Clear skies:** Allow radiative cooling of the Earth's surface.
- **Calm or light winds:** Prevent warm air from mixing with cooler air at the surface.
- **High humidity:** Ensures that enough moisture is present in the air for condensation to occur.
- **Surface temperature below the dew point:** Necessary for the moisture to condense into droplets.

Formation of Frost:

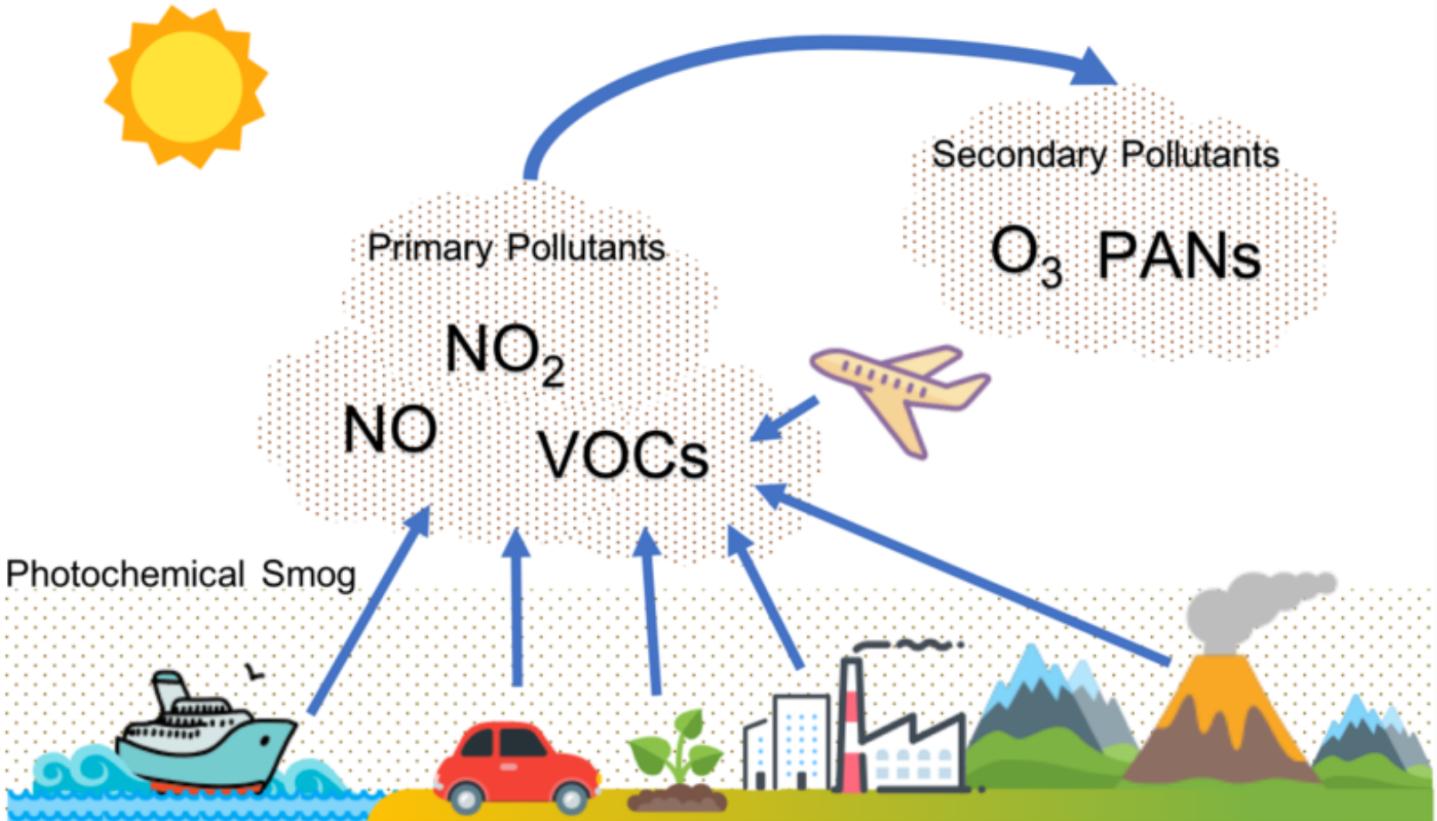
Frost forms when the temperature of the surface or objects, such as grass or cars, falls below the freezing point (0°C or 32°F), causing water vapor in the air to directly transition from gas to solid without passing through the liquid phase. This process is called **deposition**.

Formation of Fog:

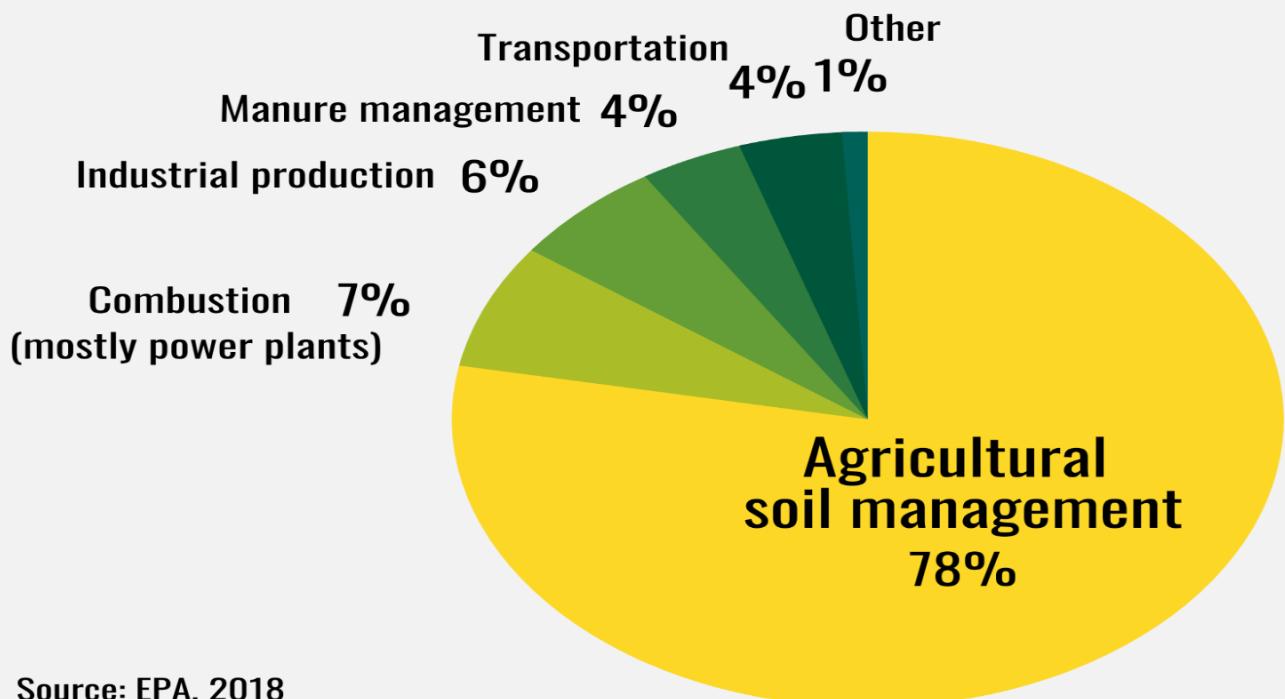
Fog forms when the air near the ground becomes saturated with moisture, and water vapor condenses into tiny droplets that remain suspended in the air. Essentially, fog is a cloud that forms at ground level.

Difference Between Mist and Fog:

- **Density:** Mist is less dense than fog, meaning it reduces visibility but not as much.
- **Visibility:** In mist, visibility is typically over 1 km, whereas in fog, visibility is less than 1 km.
- **Droplet Size:** Mist contains smaller and more widely dispersed water droplets than fog.



Nitrous Oxide Sources



How are Clouds Classified?

Clouds are classified based on 2 major factors.

1. Physical Form
2. Height at which Clouds are formed

What are the 4 major classifications of clouds based on their physical forms?

According to their altitude, stretch, density, and transparency or opaqueness clouds are classified into four types which are given below.

1. Cirrus
2. Cumulus
3. Stratus
4. Nimbus

What are Cirrus Clouds?

1. Cirrus clouds are formed at high altitudes of 8,000 - 12,000m.
2. They are detached thin clouds.
3. They have a feathery appearance.
4. They are always white.



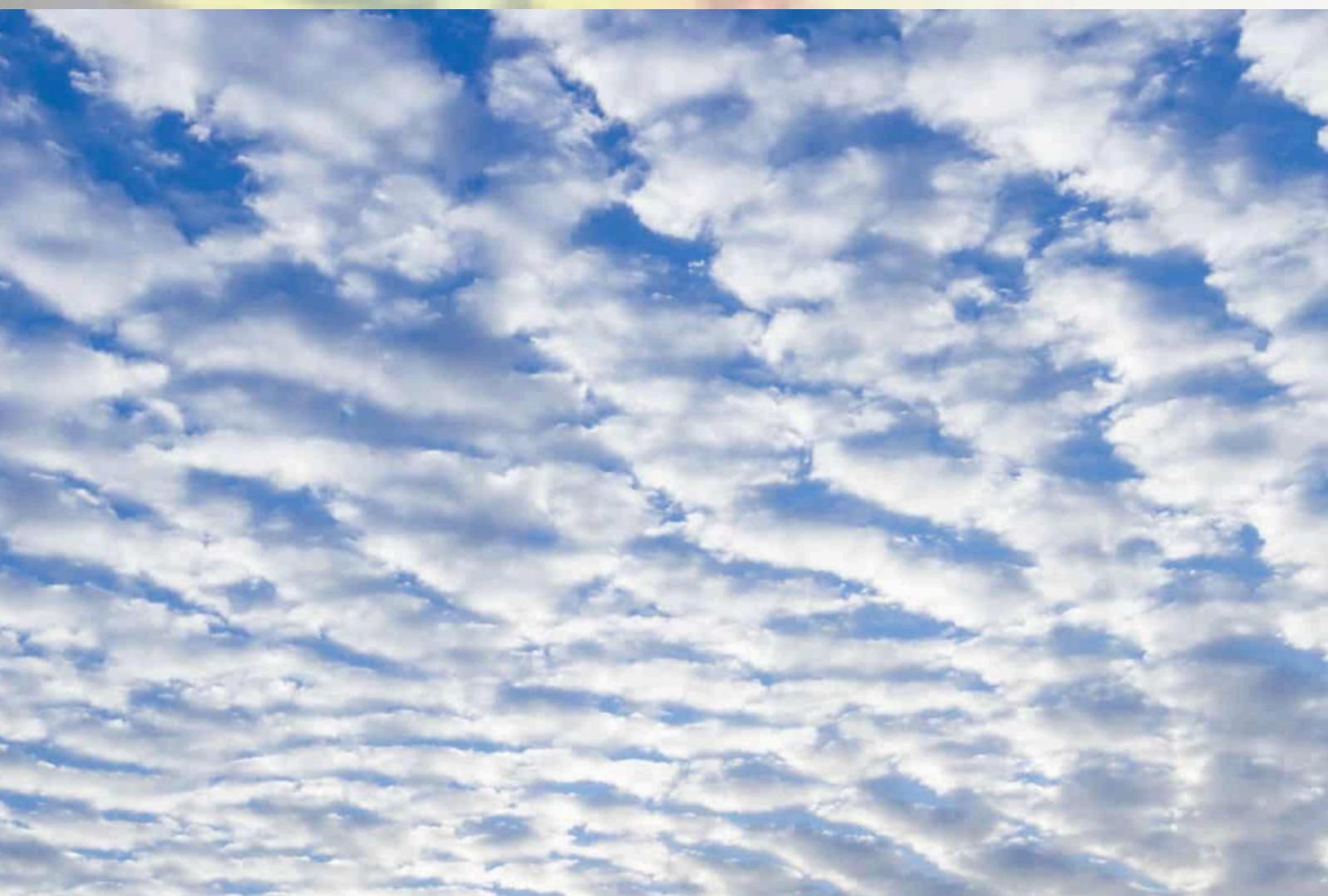
What are Cumulus Clouds?

1. Cumulus clouds are generally formed at a height of 4,000 m - 7,000 m.
2. They look like cotton wool.
3. They exist in patches and can be seen dispersed here and there.
4. They have a flat base.



What are Stratus Clouds?

1. Stratus clouds are horizontal.
2. Stratus clouds are stratified or layered clouds covering big portions of the sky.
3. These clouds are usually formed due to the mixing of air masses with various temperatures or due to loss of heat.
4. The presence of stratus clouds means chilly, overcast day.



What are the Nimbus Clouds?

1. Nimbus clouds are usually formed at lower altitudes.
2. The colour of Nimbus clouds is usually black or dark grey.
3. Nimbus clouds block the sunlight
4. These types of clouds usually cause heavy rainfall and thunderstorms.



- Which is the type of clouds that bring rainfall or snowfall?
- Clouds with the prefix “nimbo” or the suffix “nimbus” bring rainfall and snowfall. Nimbostratus clouds bring continuous rainfall or snowfall that may continue for a very long duration.
- Cumulonimbus clouds are also called thunderheads. Thunderheads produce rain, thunder, and lightning.
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Classification based on the altitude of Clouds formation

Clouds are classified based on their formation at different heights. The altitude at which certain categories of clouds form varies based on the polar region, tropical region, etc.

| Classification of clouds | Types of clouds |
|--|---|
| High clouds | <ol style="list-style-type: none">1. Cirrus2. Cirrostratus3. Cirrocumulus |
| Middle clouds | <ol style="list-style-type: none">1. Altostratus2. Altocumulus |
| Low clouds | <ol style="list-style-type: none">1. Stratocumulus2. Nimbostratus |
| Clouds with extensive vertical development | <ol style="list-style-type: none">1. Cumulus2. Cumulonimbus |

- **High-Level Clouds**

- Polar Regions - they form at altitudes of 3000 m (10,000 ft) to 7600 m (25,000 ft).
- Temperate Regions - they form at altitudes of 5000 m (16,500 ft) to 12,200 m (40,000 ft).
- Tropical Regions - they form at altitudes of 6,100 m (20,000 ft) to 18,300 m (60,000 ft).

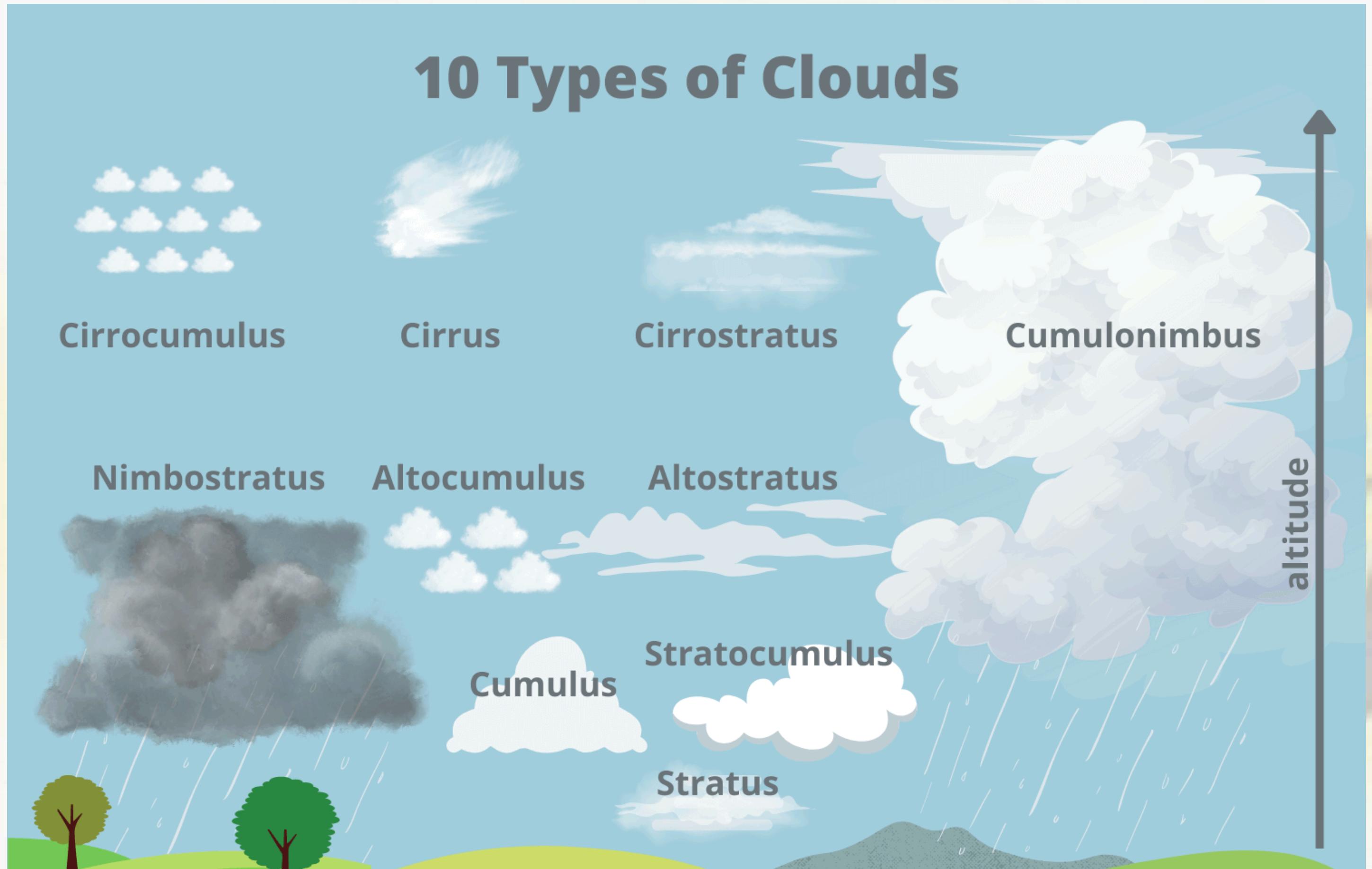
- **Mid-Level Clouds**

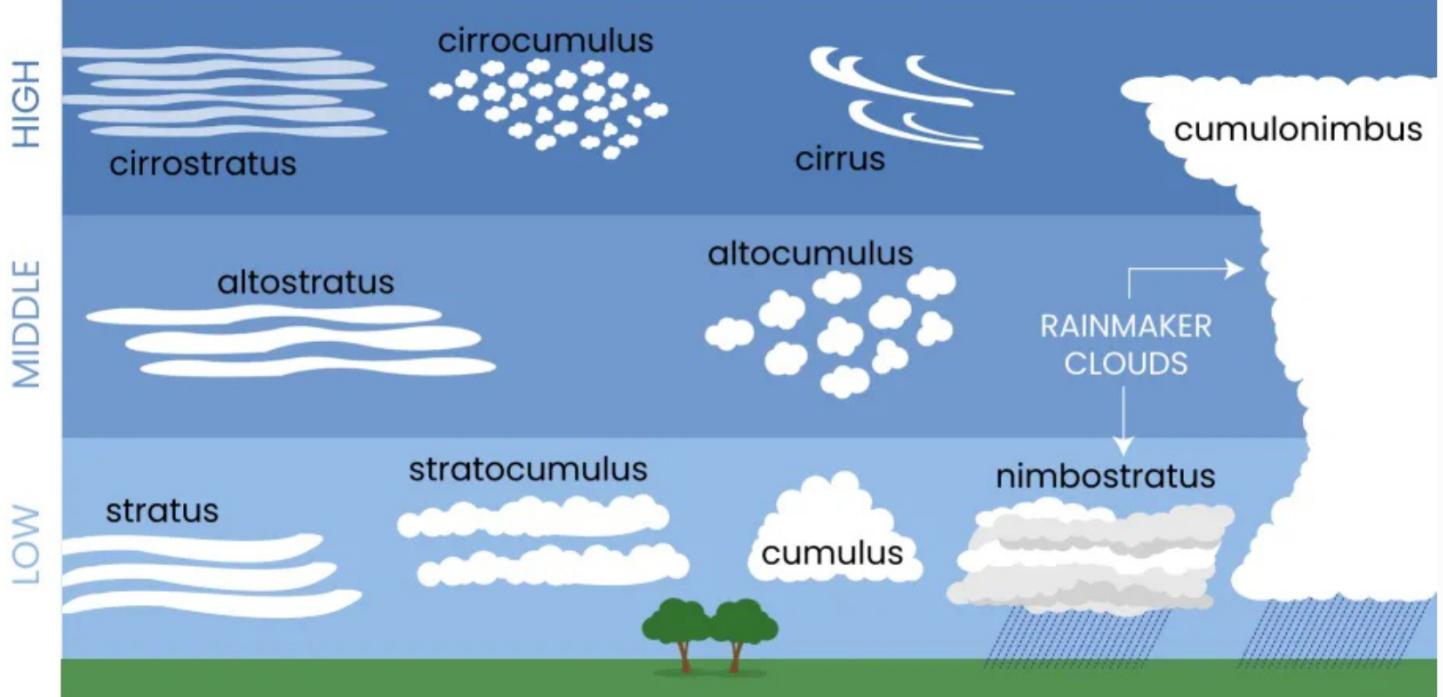
- Non-vertical clouds in the middle level are prefixed by the alto.
- At any latitude, these clouds are formed as low as 2000 m (6500 ft) above the surface.
- These clouds can be formed as high as 4,000 m (13,000 ft) near the poles
- These clouds are formed at an altitude of 7,600 m (25,000 ft) in the tropical region.

- **Low-level Clouds**

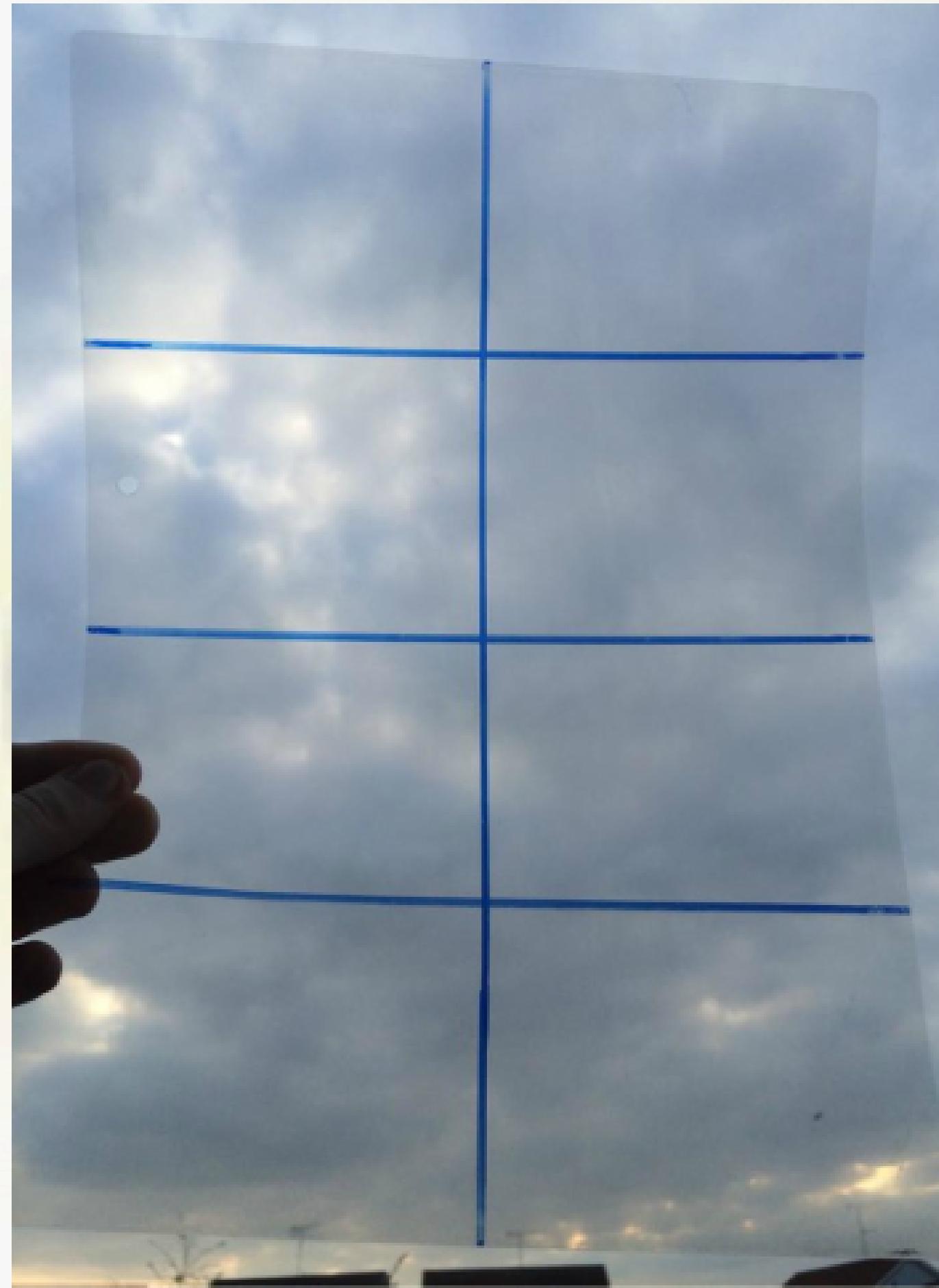
- These clouds are formed near the surface up to 2000 m (6500 ft).
- These types of clouds have no prefix.

10 Types of Clouds



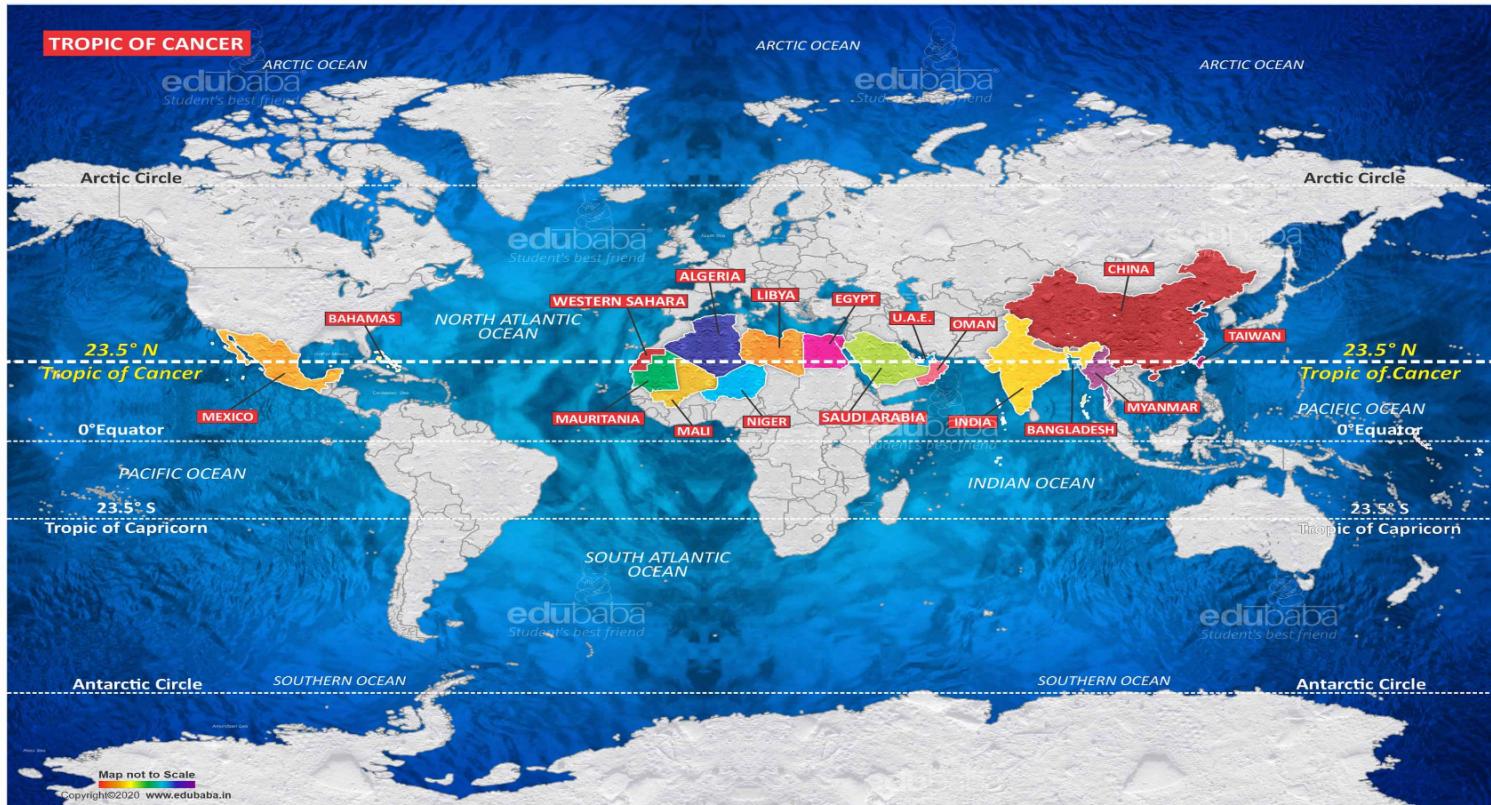


- **What is Nephology?**
- Nephology is the science of clouds, which is undertaken in the cloud physics branch of meteorology.
- **How do meteorologists measure cloud cover?**
- Oktas is the measurement unit that is used to measure the amount of visible sky that is covered by clouds.
- An okta estimates how many eighths of the sky is covered in clouds.
- The clear sky is measured as 0 oktas.
- An overcast or grey sky is measured as 8 oktas.



Cloud Cover

| Symbol | Scale in oktas (eighths) |
|--------|------------------------------|
| ○ | 0 Sky completely clear |
| ○ | 1 |
| ○ █ | 2 |
| ○ █ | 3 |
| ○ █ | 4 Sky half cloudy |
| ○ █ | 5 |
| ○ █ | 6 |
| ○ | 7 |
| ● | 8 Sky completely cloudy |
| ○ X | (9) Sky obstructed from view |



1. Question (2018): Consider the following statements about clouds:

- a. Cirrus clouds are formed at high altitudes.
- b. Cumulonimbus clouds are associated with thunderstorms.

Which of the following is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

2. Question (2020): Which of the following cloud types is most commonly associated with heavy rainfall?

- (a) Cirrus
- (b) Cumulus
- (c) Stratus
- (d) Cumulonimbus

2. Question (2015): Consider the following statements regarding **frost**:

- a. Frost forms when the dew point is below freezing point.
- b. Frost is most likely to occur on clear and calm nights.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

