

## 6. Clouds

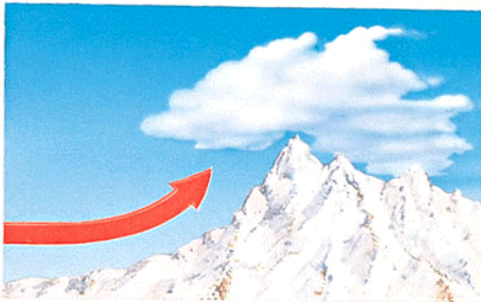
Clouds are made up of tiny droplets of water or ice crystals. Clouds form as water vapor either condenses or freezes onto minute floating particles such as dust or tiny salt particles from the sea. These cloud droplets and ice crystals are so small (with an average diameter of 0.002 cm / 0.001 in) that they stay suspended in the air. Raindrops typically have a million times more water in them and are heavy enough to fall from clouds.

### **How Clouds Form**

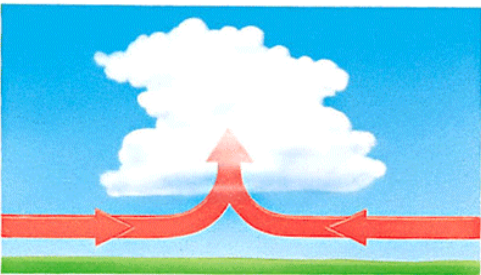
Air is always moist because it contains water vapour. Clouds form when air rising in the troposphere is cooled. The water vapour in the air condenses into a liquid. When it is very cold the water vapour freezes straight into ice crystals. We only see the water vapour when it condenses into tiny droplets, which remain suspended in the air as clouds. Clouds form in the troposphere in four main ways:



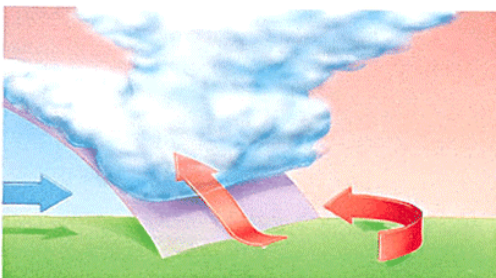
1. When the Sun warms the ground, creating thermals or rising air.



2. When air is forced to rise over mountains.



3. When air flowing in opposite directions meets and is forced upwards.



4. When a mass of cold air flows under, warmer lighter air.

## Naming Clouds

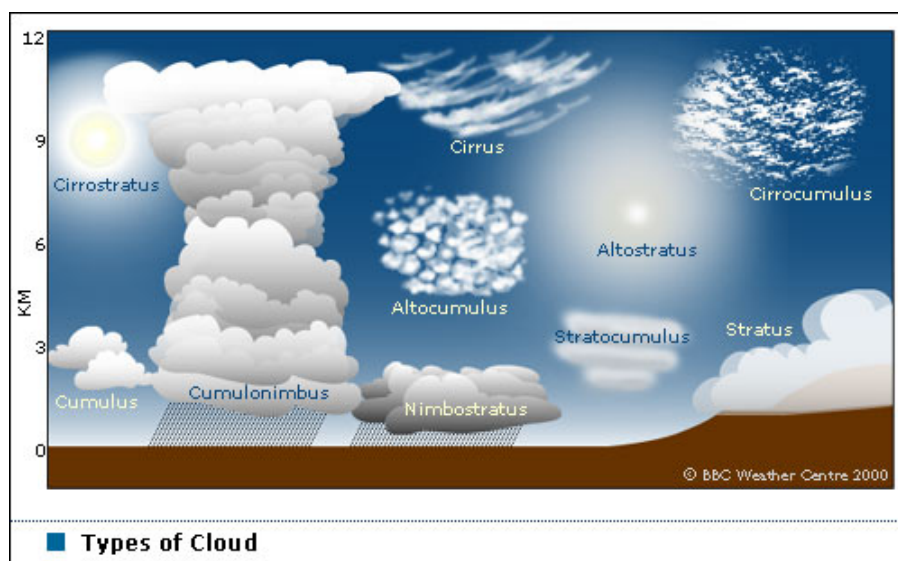
Clouds are classified using Latin words to describe how they appear to someone on the ground. High wispy clouds are called cirrus (from the Latin word for curl of hair); sheetlike clouds are called stratus (from the Latin word for layer); billowing, puffy clouds are called cumulus (from the Latin word for heap); and rain-producing clouds are called nimbus (from the Latin word for rain).

Clouds are divided into four main groups based on their height above the ground: high clouds, middle clouds, low clouds, and clouds with vertical development.

- High clouds have bases generally above 6000 m (20,000 ft). Because at high altitudes the air is thin and cold, high clouds are thin, and their names often include the prefix *cirro* (from cirrus). They are mainly composed of ice crystals.
- Middle clouds, which have names with a prefix of *alto*, (from the Latin word for high) typically have bases between 2000 m and 6000 m (between 6500 ft and 20,000 ft) above the ground. They are usually composed of a mixture of water droplets and ice crystals.
- Low clouds have bases lying below 2000 m (6500 ft). Low clouds are almost always composed of water droplets.
- Clouds of vertical development are taller than they are wide. Their bases are below 2000 m (6500 ft) while their tops may extend above the top of the troposphere.

Meteorologists divide these four main groups of clouds into ten principal cloud types.

- The high cloud group consists of cirrus clouds, which are thin and wispy; cirrostratus clouds, which are thin and sheetlike; and cirrocumulus clouds, which are small, white, and lumpy.
- The middle cloud group consists of altostratus clouds, which are gray and sheetlike; and altocumulus clouds, which are gray and puffy.
- Low clouds consist of stratus clouds, which are low, gray, and sheetlike; nimbostratus clouds, which are sheetlike and dark gray from which rain or snow is falling; and stratocumulus clouds, which are dark, low, and lumpy.
- Clouds of vertical development consist of cumulus clouds, which are small and puffy; and the giant cumulonimbus clouds, which are thunderstorm clouds with a top that may extend more than 15,000 m (50,000 ft) above the ground.





Cirrus



Cumulus



Stratus

Cloud shapes are influenced both by winds and by the shape of the Earth beneath. Turbulent winds produce different cloud shapes. Mountains often create their own special clouds. Wave motion in the atmosphere can also produce interesting visual effects.

- Lee-wave clouds - mountains often create standing waves in the atmosphere on the lee (downwind) side.



- Lenticular clouds may form at the top of each wave. These occur when air rises over mountains and remains stationary. So the clouds remain 'fixed' to the air over the mountains.
- Rotor clouds are sometimes formed by turbulent circular motions in the vertical downwind of a mountain barrier.
- Aircraft produce contrails (condensation trails) when flying through air at 30 degrees below freezing point. Water vapour condenses behind an aircraft's engines and the resulting water droplets freeze instantaneously into ice crystals.