

9. Precipitation

What is precipitation?

Precipitation is the name given to any moisture that falls from the air to the ground and includes snow, sleet, hail, and drizzle as well as rain. (However, fog, mist and haze are not precipitation.) The total amount of global precipitation in one year is 5,000 million million tonnes (tons). Although the oceans hold 97% of Earth's water, air is never completely dry; even in the mid-Sahara there is water vapour in the air. The amount of water held in the atmosphere at any time is sufficient to produce about 2.5 cm (1 in) of rain over the surface of the Earth. Humidity is the measure of the amount of water vapour in the air. It is measured as a percentage called relative humidity. The higher the percentage, the more humid it is. When it is 100%, the air is saturated. The average raindrop has a million times more water than the average cloud droplet and the fastest raindrops can fall at about 9 m/s, compared to snow which only falls at $\frac{1}{2}$ to 1 m/s.

The Water Cycle

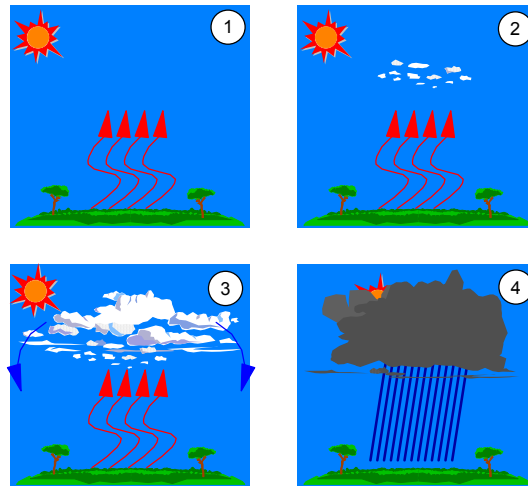
Water vapour enters the air by evaporation from features such as the oceans (which cover more than two thirds of the Earth's surface), but also from rivers, lakes and falling rain and snow. It also arises from evapo-transpiration from vegetation and in small amounts from the combustion of fossil fuels and from the depths of the Earth in volcanic gases. When air rises it cools and can release the water as precipitation - rain, snow, hail, dew, frost. The water travels back to the sea via rocks, lakes, rivers, and plants.



Types of Rainfall

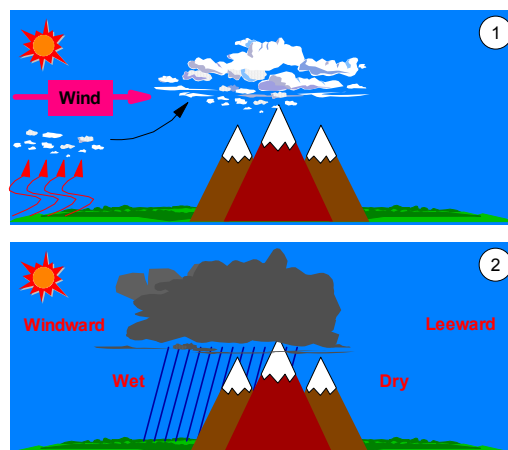
Clouds form and rain falls through one of three main processes: Convective, Orographic, or Frontal.

Convective



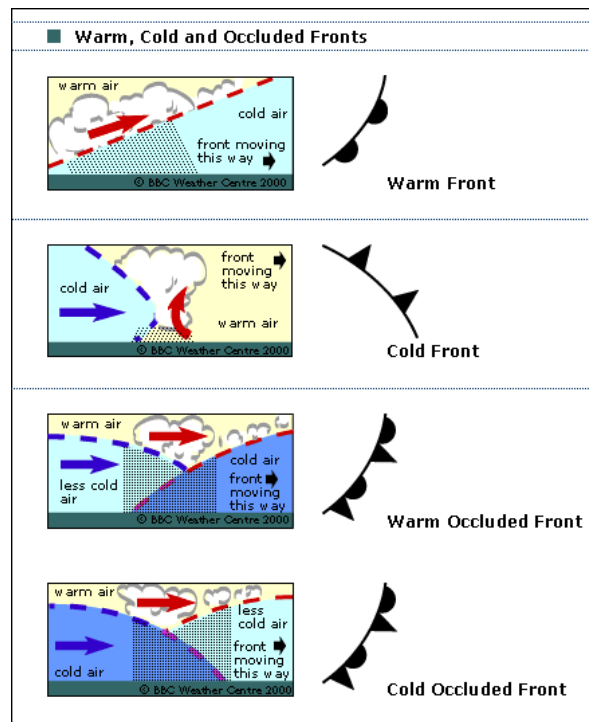
Convective rainclouds occur when air is buoyant and able to rise to the upper troposphere (1). Rising thermals of moist air are cooled and form small clouds (2). As the Sun continues to heat, more clouds form which grow bigger, expanding upward and sideways, to form larger clouds which increase in height and size (3). When the water droplets in the cloud reach a critical size at which they cannot be supported by the buoyancy of the rising air, they fall to earth as rain (4).

Orographic



Orographic rainclouds form over hills and mountains as moist air rises, expands (because of lower atmospheric pressure) and cools forming clouds (1). The rate at which the air cools is called the “lapse rate” and is about 1°C per 150 m of altitude. (Dry air has a slightly higher lapse rate than moist air.) When the air temperature reaches the dew point water droplets are formed and rain falls (2). Rain falls on the windward slopes, while the leeward side, in the rain-shadow of the mountains, remains dry (2). In the Alps this orographic process produces a dry wind on the leeward side known as the “Föhn”.

Frontal



Where air masses meet, there are well-marked boundary zones called fronts. This is where most cloud and precipitation occurs. The circulation is anticlockwise around low pressure and clockwise around high pressure systems (Buy's Ballots Law). The air flows almost parallel to the isobars but actually 10-15 degrees inwards towards the low pressure. The meeting of warm and cold air results in rain.