



## Study notes for geography topic - Water in Atmosphere

Hello guys, in our present blog we will study about water in atmosphere, Clouds, Rainfall, Oceans. Let's start our discussion then.

# Water in the atmosphere

Water is present in the atmosphere in solid, liquid as well as gaseous state. Its concentration varies from 0-4% by volume of the atmosphere depending on location and the temperature of that place. The atmosphere gets moisture from water bodies through evaporation from plants through transpiration. The 4 processes through which the atmosphere derives water are: evaporation, transpiration, condensation, and precipitation.



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Terms	Definition
Humidity	Water vapour present in the air
Absolute Humidity	Weight of water vapour per unit volume of air, expressed in terms of gram per cubic metre
Relative Humidity	The percentage of moisture present in the atmosphere as compared to its full capacity at a given temperature.
Saturated air	Air containing moisture to its full capacity at a given temperature
Dew point	The temperature at which saturation occurs in a given sample of air
Evaporation	Transformation of water from liquid to gaseous state
Latent Heat of vaporization	The temperature at which water starts evaporating
Condensation	Transformation of water vapour into water
Sublimation	Direct condensation of water vapour into solid form
Precipitation	Release of moisture from the air when it fails to hold it against the force of gravity. Can be liquid or solid
Sleet	Frozen raindrops and refrozen melted snow water. This happens when a layer of air with temperature above the freezing point overlies a sub- freezing layer near the ground.
Hailstones	Drops of rain that solidify after being released by the clouds
Smog	Mix of fog and smoke

### When does condensation take place?

- When temperature of the air is reduced to dew point with its volume remaining constant.
- When both the volume and temperature are reduced.
- When moisture is added to the air through evaporation
- When there is decrease in air temperature

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Apart from snowfall, hailstones, rainfall, etc. there are other kinds of precipitation as well. These are:

**Dew:** It is moisture deposited as water droplets on cooler surfaces of solid objects. For dew formation, dew point should be above freezing point. Ideal conditions: clear sky, calm air, high relative humidity, cold and long nights.

**Frost:** It forms on cold surfaces when condensation takes place below freezing point. Dew point should be at or below freezing point. Ideal conditions: same as those for dew formation.

**Fog and Mist:** Sudden condensation within the atmosphere (on fine dust particles) which occurs due to sudden fall in temperature. Mist contains more moisture than fog.

## Clouds

Clouds are masses of minute water droplets formed by condensation of water vapour in free air at considerable height.

### Types of clouds:

**Cirrus:** These are white, thin, detached, feathery clouds formed at 8000-12000m altitude.

**Cumulus:** These exist in patches and have flat bases. They are formed at 4000-7000m and look like cotton wool.

**Stratus:** These are layered clouds covering large portions of the sky. These are formed due to either loss of heat or the mixing of air masses with different temperatures.

**Nimbus:** These are shapeless and black or dark grey and formed at mid-levels or very near the surface. They are extremely dense and opaque to the rays of the sun. These are the four basic types of clouds. Various other clouds are formed as combinations of these four basic types:

- High clouds - cirrus, cirrostratus, cirrocumulus
- Middle clouds - Altostratus and altocumulus
- Low clouds - stratocumulus and nimbostratus

## Rainfall

Rainfall can be divided into three categories:

**a) Convectional rainfall:** This rainfall is mostly common in equatorial regions.

**b) Orographic rainfall:** This type of rainfall mostly occurs in the mountains. Warm and moist air rises and cools against the mountain causing rainfall on one side. The region lying on the leeward side receives less rainfall and is known as the rain shadow region. This occurs due to the ascent of the air forced by the mountain barrier that is across the wind direction so that the moist air is forced in obstruction to move upwards and get cooled.





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**c) Cyclonic rainfall:** This type of rainfall happens because of a tropical cyclone that is known as cyclonic rainfall. We have discussed this in the cyclone section.

There are many factors that affect the distribution of rainfall. These factors are listed below:

1. **Moisture supply:** The coastal areas receive more rainfall as compared to the continent. Equatorial and tropical regions receive more rainfall as compared to temperate areas.
2. **Ocean currents:** Warm currents bring moist air and hence cause more rainfall as compared to cold currents.
3. **Presence of mountains:** the windward side of mountains receives more rainfall as compared to the leeward side.
4. **Pressure belts:** The area of low pressure helps the formation of cyclones and hence more rainfall.

## Oceans and Straits

Ocean is defined as a water body that is mainly salty. It covers more than 70 percent of the Earth's surface. There are mainly 5 large oceans in the world. Let's learn about them in brief.

**Pacific Ocean:** It is the largest ocean. It covers more than 30% of the Earth (approx half of the water on Earth). The equator divides the Pacific Ocean into two separate parts – North Pacific Ocean and South Pacific Ocean. It spreads up to the west coast border of the America along with east Asia and Australia.

**Atlantic Ocean:** It is the second-largest ocean. It is the saltiest ocean in the world. It resembles an S-shape between the America, Europe and Africa. The Atlantic Ocean is said to have been explored by The Vikings, Portuguese and Christopher Columbus. "Atlantic" originated from the Greek god "Atlas" who carried the sky for eternity. It is situated between the Americas and European/African continents.

**Indian Ocean:** It is the third-largest ocean, with additional water on Earth's surface of about 20%. It has limited marine life as compared to other oceans due to its high temperature. It surrounds a densely populated region. It is considered to be the geologically youngest of the 5 oceans.

**Southern Ocean:** It is the fourth largest ocean. It has an extreme environment and is very less explored. It borders Antarctica and is 20,327,000 square kilometers. It extends out to 60 degrees South latitude. It has very little marine life and almost no populated areas.

**Arctic Ocean:** It is the world's smallest and shallowest ocean. Also, it is the coldest and least salty ocean. It has frigid temperatures, and very little flora & plant life. It is located at the North Pole & has polar ice. It has a wide variety of marine species including whales, jellyfish, etc.

### Straits:

It is defined as a narrow passageway connecting two large water bodies. Also called a "Channel". They are mostly shallow and not navigable. Example: Dhanushkodi Strait (between India and Sri Lanka border, merger of Indian ocean and Bay of Bengal)

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### Some Important Straits:

**Magellan Strait:** The Atlantic and the Pacific Ocean were joined by this strait at the southern part of South America.

**Hormuz Strait:** This strait is a strategic sea route as it paves way for accessing oil-rich states of West Asia. It separates Iran from Oman and joins the Arabian Sea and the Persian Gulf.

**Denmark Strait:** The strait of Denmark is located in the North Atlantic Ocean and separates Greenland from Iceland.

**Bass Strait:** This strait is a busy shipping route that separates Tasmanian island and Australia.

**Strait of Malacca:** The Strait of Malacca is a strategic water passage located between Malaysia and Sumatra islands of Indonesia. It is one of the busiest sea routes which connect the Indian Ocean and the South China Sea.

**Palk Strait:** It connects the Bay of Bengal with the Gulf of Mannar.

**Ten Degree Channel:** It separates the Andaman Islands from the Nicobar Islands in the Bay of Bengal.

**Mozambique Strait:** It lies in the Indian Ocean between Mozambique from Madagascar.

Do you know the **Strait of Malacca** (800 km) connects the Andaman Sea with the South China Sea (Pacific Ocean) is the **Longest Strait**.

We have only explored about 5% of the world's oceans. Also, Earth's longest chain of mountains, the **Mid-Ocean Ridge**, is almost entirely **beneath the Ocean**. 70-80% of the oxygen we breathe is produced by marine plants, nearly all of which are marine algae. The deepest known area of the Earth's oceans is known as the **Mariana Trench**. Also, its deepest point measures 11 km.

## Water currents

The motion of the water is defined by currents, especially in oceans and water bodies. The force of gravity, which makes the water flow downward, creates water currents. There are many factors that contribute to the strength of river currents. River currents are influenced by the volume, or amount, of water flowing in a river. The steepness of a river is called its **stream gradient**. There are two types of water currents namely:

**Surface currents:** Surface currents can flow for thousands of kilometers & can reach depths of hundreds of meters. They occur in the upper 400 meters of the ocean. These currents only account for 10 percent of the total amount of currents in the ocean, because the ocean is so much deeper in most places. These surface currents do not depend on the weather; they remain unchanged even in large storms because they depend on unchangeable factors. These currents move because of solar heating and wind. A faster current occurs in shallower water because wind physically pushes the water. As the water gets deeper, wind-driven currents move more slowly. This phenomenon causes **spiraled currents** that are often seen in the oceans and rivers.





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**Surface currents are created by three things:** global wind patterns, the rotation of the Earth, and the shape of the ocean basins. The current moves along the U.S. East Coast across the Atlantic Ocean towards Europe. The heat from the Gulf Stream keeps much of Northern Europe significantly warmer than other places equally as far north.

**Deepwater currents:** Deep currents are much slower and may take many years to traverse the world's oceans. Deepwater currents make up 90 percent of the ocean currents. Deep currents depend on water pressure, temperature, and salt content. This slow movement can be gauged by the composition of dissolved chemicals. The higher the salt content of water, the denser it is. Deep currents are caused by the interaction between temperature and water density. **Deep currents have additional implications on the global climate.** Water is both cold and very dense, the slow motion, with heavier, colder water constantly replacing warm, less salty water, causes the deep water currents. These currents cover a lot of territory. Most start at latitudes close to the poles.

**Importance:** Water currents act to neutralize the temperature difference between different areas in the oceans just like the winds do on land. Currents are important to docking and undocking boats, speeding up shipping lanes and keeping ships safe, especially in narrow waterways. Also, Water currents lead to an influx of nutritious water (water with planktons and other species at the bottom of the food chain) to places where there is less, bringing fish with it in a seasonal pattern - of great importance for marine life and the fishermen of the world. They are also moving aid search and rescue missions and environmental disaster clean-up.

Some important water (ocean currents) which are often asked are:

**North Equatorial Current (Hot & Warm):** The North Equatorial Current is a Pacific and Atlantic Ocean current. It flows east-to-west between about 10° north and 20° north.

**North Pacific Current (Warm):** The North Pacific Current (NPC) is the broad, eastward directed flow that originates from the flow of the Kuroshio Extension. It is surface intensified. **Nino Current (Warm):** develops in the central and east-central equatorial Pacific, including the area off the Pacific coast of South America. It is initially called weak & warm.

**Humboldt or Peruvian Current (Cold):** It flows from the North along the western coast of South America. It is a low salinity ocean current.

**South Indian Ocean Current (Cold):** SIOC is at about 40° to 45° S. It is one of the largest rotating ocean currents.

**Gulf Stream (Warm):** It brings warm water from the Gulf of Mexico into the Atlantic Ocean. It is a strong ocean current. It extends to the eastern coast of the United States and Canada.

**Mozambique Current (Warm and Stable):** It is fed from lower latitudes, Temperature ranges from 57 to 79 °F (14 to 26 °C) at the surface. It is one of the fastest flowing currents in any ocean. It is a relatively warm surface current of the western Indian Ocean.

**Somali Current (Cold and unstable):** It is a prominent western boundary current in the northern Indian Ocean. It also runs along the coast of Somalia and Oman in the Western Indian Ocean.

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# Tides

Water in the oceans periodically rises and falls due to the attraction of the sun and the moon. This vertical movement of ocean water is known as tides.

Factors affecting the size of Tides:

1. Location of the sun, moon and earth concerning each other.
2. Variation of distance between the sun and the earth.

Tides can be differentiated between two categories:

- **Spring tides:** these tides are generated when the sun, moon and earth all are in the same line. This happens on a new moon or a full moon day. These are often strong and have higher tides.
- **Neap tides:** these tides are generated when the sun, moon is in a right-angled position. Generally, this happens in the first and third quarter. Due to being in a right-angle position, the gravitational forces of the moon and sun neutralizes each other, producing a weak tide.

This was all about water in atmosphere. Hope you understood well.