



The term climate is the sum total of the weather conditions (including variations) a large area for a long period of time (more than thirty years). The term weather refers to the state of the atmosphere at a place and time with reference to the following elements:

- Temperature
- Humidity
- Air Pressure
- Cloudiness or Sunshine
- Precipitation (Rainfall or Snowfall)
- Wind

The weather conditions fluctuate very often within, a day. Based on the generalised monthly atmospheric conditions, the year is divided into seasons such as winter, summer and rainy season. The world is divided into a number of climatic regions. In Asia, India and other South and South-Eastern countries have monsoon type of climate. The word monsoon is derived from the Arabic word 'mausim' which literally means season. 'Monsoon' refers to the seasonal reversal in the wind direction during a year.

Regional Climatic Variation in India: Although there is an overall unity in the general climatic pattern in India, there are some perceptible regional variations.

Temperature: Temperature in the winter in North-Western mountainous regions can go down to- 45°C (at Drass in Jammu and Kashmir), while it is 22°C in Thiruvananthapuram in Kerala. Similarly, it can go upto 50°C in summer in some parts of Western Rajasthan and 20°C in Shillong. In many areas, there is a wide variation between day and night temperatures. In the Thar Desert, the day temperature may rise up to 50°C and drop down to near 15°C the same night. On the other hand, there is hardly any difference in day and night temperatures in the Andaman and Nicobar islands or in Kerala.

Precipitation: There is a wide variation observed in its amount and seasonal distribution. Precipitation in the form of snowfall occurs only in upper parts of Himalayas, the rest of the country receive; rainfall. As typical example, the annual precipitation varies from over 400 cm in Meghalaya to less than 10 cm in Ladakh and Western Rajasthan. Similarly, most of the country receive rainfall from June to September, but the Tamil Nadu coast gets most of its rain during October and November. Coastal regions experience different weather conditions from the interior regions. For example, temperature and seasonal contrast are relatively mild. The rainfall also decreases from East to West. Such differences help to create a variety in lives of people— the food they eat, the clothes they wear, the Kind of houses they used for living and so on.

Climatic Controls: Permanent factors which govern the general nature of the climate of any location on the earth are called factors of Climatic Controls. The factors of climatic controls are

- **Latitude:** The angular distance of a location from the equator in North-South direction is called latitude. Due to curvature of the earth, latitude changes the amount of solar energy received. As a result, air temperature decreases from the equator towards the poles.
- **Altitude:** It refers to the height above mean sea level. With increase of height from the earth surface, the temperature decrease and air becomes less dense. Therefore, hilly regions are cooler in





summer.

- **Pressure and Wind System:** It depends on the latitude and altitude of a place. Thus, it influences the temperature and rainfall pattern of the area.
- **Continentalty or Distance from the Sea:** The sea exerts a moderating influence on the climate. As the distance from the sea increases, the weather conditions become more extreme (high temperature and rainfall variation between seasons).
- **Ocean Currents:** Along with onshore winds, the ocean currents (warm or cold) affect the climate of coastal areas. For example, cold onshore currents bring coolness in coastal areas.
- **Relief Features:** High mountain stop cold or hot winds from reaching a location. It can also cause rain or snow if the place is on the windward side of the mountains. The leeward side of mountains are relatively dry.

Factors Affecting India's Climate

Latitude: The Tropic of Cancer (23° 30' N) divides the country into the tropical zone (South of this line) and the sub-tropical zone (North of this line). The line runs from the Rann of Kuchchh (West) to Mizoram (East). All the remaining area, North of Tropic, lies in sub-tropics. So, India's climate has characteristics of tropical as well as sub-tropical climates.

Altitude: Mountains in the North of India have an average elevation of about 6000 m, whereas on the coastal areas as well as islands, maximum elevation is about 30 m. The Indian sub-continent experiences milder winters as compared to Central Asia because of the Himalayas which prevent the cold winds from entering the sub-continent.

Pressure and Winds: The following atmospheric conditions govern the climate and associated weather conditions in India:

1. Pressure and surface winds
2. Upper air circulation
3. Western cyclonic disturbances and tropical cyclones

Pressure and Surface Winds: India lies in the region of North-Easterly surface winds. These winds originate during winter from the sub-tropical high-pressure belt of the Northern hemisphere. These winds blow South, get deflected to the right due to the Coriolis force and move towards the equatorial-low pressure region. These winds originate and blow over land and hence, carry very little moisture. Therefore, they bring no rain or very little rain. The unique feature of Indian pressure and wind conditions is its complete reversal. During winter high-pressure areas develop over the areas North of Himalayas. This causes cold dry winds blow from the area towards low-pressure area over the oceans to the South. In summer, due to high temperature, low-pressure area develops over interior Asia and over North-Western India. Air from high-pressure areas blow towards this region resulting in complete reversal of wind direction. As these winds from high pressure area of Southern Indian Ocean crosses the equator and turns right towards low pressure areas of Indian sub-continent. These winds gather large moisture while moving over the warm ocean and bring widespread rainfall over the mainland of India. These winds are known as the South-West Monsoon winds.

Upper Air Circulation and Western Cyclonic Disturbances: The upper air circulation of the region (Indian sub-continent) is dominated by a westerly flow which is governed by Jet stream. Due to their location over 27°-30° N latitude, these jet streams are known as sub-tropical westerly jet





streams. They blow south of the Himalayas, through out the year except in summer.

Western Cyclonic Disturbances and Tropical Cyclones: The Western cyclonic disturbances are weather phenomena of the winter months brought in by the westerly flow from the Mediterranean region. They usually influence the weather of the North and North-Western regions of India. Tropic cyclones occur during the monsoon as well as in October-November and are part of the easterly flow. These disturbances affect the coastal regions of the country. The westerly flow brings the Western cyclonic disturbances in the North and North-Western India. In summer, the sub-tropical westerly jet stream moves North of the Himalayas due to apparent shifting of the sun. An easterly jet stream called sub-tropical easterly jet stream, blows over peninsular India approximately over 14° N during the summer months.

The Indian Monsoon: Monsoon winds strongly influence climate of India. The monsoons are experienced in the tropical area roughly between 20° N and 20° S.

Mechanism of Monsoon: The following facts are important to understand the mechanism of the monsoons

- The differential heating and cooling of land and water creates low pressure on the landmass of India while the seas around experience comparatively high pressure.
- The Inter Tropical Convergence Zone (ITCZ) in summer season shifts its position over the Ganga plain. This is the equatorial trough normally positioned about 5° N of the equator. It is also known as the 'monsoon trough' during the monsoon season.
- The presence of the high-pressure area, East of Madagascar (approximately at 20° S over the Indian Ocean). The intensity and position of this high-pressure area affects the Indian monsoon.
- The Tibetan plateau gets intensely heated during summer, which results in strong vertical air currents and the formation of low pressure over the plateau at about 9 km above sea level.
- The movement of the westerly jet stream to the North of the Himalayas and the presence of the tropical Easterly jet stream over the Indian peninsula during summer.

Apart from the given facts, it has been noticed changes in the pressure conditions over the Southern oceans also affect the monsoons. Normally, when the tropical Eastern South Pacific Ocean experiences high pressure, the tropical Eastern Indian Ocean experiences low pressure.

But in past a few years, there is a reversal in the pressure conditions and the Eastern Pacific has lower pressure in comparison to the Eastern Indian Ocean. This periodic change in pressure conditions is known as Southern Oscillation (SO).

EL Nino Southern Oscillations (ENSO): The difference in pressure over Tahiti (Pacific Ocean, 18°S/149°W) and Darwin in Northern Australia (Indian Ocean, 12°30'S/131°E) is computed to predict the intensity of the monsoons. If the pressure differences were negative, it would mean below average and late monsoons. The EL Nino phenomenon is a feature connected with the Southern Oscillation. In this, a warm ocean current flows past the Peruvian Coast, in place of the cold Peruvian current. It occurs at the interval of 2 to 5 years. The changes in pressure conditions are connected to the EL Nino.



Hence, the phenomenon is referred to as ENSO (EL Nino Southern Oscillations).

EL Nino: This is a name given to the periodic development of a warm ocean current along the coast of Peru as a temporary replacement of the cold Peruvian current. 'EL Nino' is a Spanish word meaning 'the child' and refers to the baby Christ. As this current starts flowing during Christmas. The presence of the EL Nino leads to an increase in sea-surface temperatures and weakening of the trade winds in the region.

The Onset and Withdrawal of the Monsoon: The trade winds are steady but the monsoon winds are pulsating in nature. They are affected by different atmospheric conditions encountered by it, on its way over the warm tropical area. Starting from early June in the Southern part of the Indian peninsula, the monsoon lasts between 100 and 120 days, withdrawing by mid-September. Rainfall increases suddenly and continues for several days at the time of arrival of monsoon. This phenomenon is called as Burst of monsoon. It is different from pre-monsoon showers. Afterwards, it alternates with wet and dry spells.

Onset of Monsoon: Monsoon generally reaches the Southern tip of the peninsula during the first week of June. After striking the Southern tip, it branches into two parts- the Arabian Sea branch and 'the Bay of Bengal branch; both branches move rapidly.

- The Arabian Sea branch advances North along the Western Ghats, reaching Mumbai by about 10th of June and soon covers the Saurashtra-Kuchchh and central most part of the Deccan Plateau also.

- The Bay of Bengal branch reaches Assam in the first week of June and gets deflected towards the West by the mountain ranges, thus giving rainfall to the Ganga plains.

Both the branches again merge over the North-Western part of the Ganga plains. Delhi receives rainfall from Bay of Bengal branch by the end of June (tentative date is 29th June) and by the first-week of July, monsoon covers Western Uttar Pradesh, Punjab, Haryana and Eastern Rajasthan.

Withdrawal of Monsoon: Withdrawal or the retreat of the monsoon is a more gradual process. The process begins by early September in North-Western states. By mid-October, it withdraws completely from the Northern half of the peninsula. The withdrawal from the Southern half of the peninsula is fairly rapid. By early December, the monsoon has withdrawn from the rest of the country.

Onset and Withdrawal of Monsoon in the Indian Islands: The islands receive the very first monsoon showers from the 1st week of April to the first week of May. The withdrawal takes place progressively from North to South (in reverse direction) from the first week of December to the first week of January. By this time, the rest of the country is already under the influence of the winter monsoon.

Important Features of Monsoon: The important features of monsoon are:

1. The monsoon is also known for its uncertainties.
2. There is alteration of dry and wet spells which vary intensity, frequency and duration.
3. While it causes heavy floods in one part, it may responsible for drought in other parts.
4. Its irregular arrival and retreat (sometimes due to the effect of EL Nino), causing disruption of farming schedules and causing droughts in certain areas of the country.