

Tropical Cyclones

Tropical cyclones representing closed low pressure system generally have a diameter of about 650 kilometers, centerclockwise and clockwise air circulation in the northern and southern hemispheres respectively.

Tropical cyclones become more disastrous natural hazards because of their high wind speed of 180 to 400 kilometres per hour, high tidal surges, high rainfall intensity (highest recorded rainfall value exceeded 2000 mm per day in Philippines), very low atmospheric pressure causing unusual rise in sea level, and their persistence for several days or say about one week. The total cumulative effects of high velocities of wind, torrential rainfall and transgression of sea water on to the coastal land become so enormous that the cyclones cause havoc in the affected areas and thus tremendous loss of human lives and property is the ultimate result of such atmospheric deluge.

1. Characteristics of Tropical Cyclones

Cyclones developed in the regions lying between the tropics of Capricorn and Cancer are called tropical cyclones which are not regular and uniform like extratropical or temperate cyclones. There are numerous forms of these cyclones which vary considerably in shape, size, velocity, and weather conditions. The weather conditions of low latitudes mainly rainfall regimes are largely controlled by tropical cyclones. They are characterized by the following salient features.

1. Size of tropical cyclones varies considerably. On an average, their diameters range between 80 km and 300 km but some time they become so small that their diameter is restricted to 50 km or even less.
2. They advance with varying velocities, Weak cyclones move at the speed of about 32 km per hour while hurricanes attain the velocity of 180 km per hour or more.
3. Tropical cyclones become more vigorous and move with very high velocity over the oceans but become weak and feeble while moving over land areas and ultimately die out after reaching the interior portion of the continents. This is why these cyclones affect only the coastal area of the continents (e.g. south and south-east coasts of the USA, Tamil Nadu, Orissa and West Bengal coast of India, southern coastal regions of Bangladesh etc.)
4. The centre of the cyclone is characterized by extremely low pressure. Isobars are more or less circular but are fewer in number. This is why winds hurriedly rush up towards the centre and attain gale velocity. The air pressure at the center sometimes becomes as low as 650 millimeters.

5. Like temperate cyclones, tropical cyclones are not characterized by temperature variations in their different parts because they do not have different fronts (warm and cold fronts).
6. There are no different rainfall cells in the tropical cyclones as is the case of temperate cyclones and hence each part of the cyclones yields rainfall.
7. Tropical cyclones are not always mobile. Some times, they become stationary over a particular place for several days and yield heavy rainfall causing flood deluge and environmental disaster.
8. The tracks of tropical cyclones vary considerably in different parts. Normally, they move from east to west under the influence of trade winds. The general direction is westerly upto 15° latitude from the equator, pole-ward between 15° - 30° latitudes, and thereafter easterly. These cyclones weaken when they enter subtropical regions.
9. Tropical cyclones are confined to a particular period of the year, mainly during summer season. The frequency and affected areas of tropical cyclones are far less than those of the temperate cyclones.
10. Tropical cyclones become disastrous natural hazards because of their high wind speed of 180 to 400 km per hour, high tidal surges, high rainfall intensity (highest recorded rainfall value exceeded 2000 mm per day in Philippines), very low atmospheric pressure causing unusual rise in sea-level, and their persistence for several days or say about one week over a particular place.

2. Types of Tropical Cyclones

It may be pointed out that tropical cyclones are so varied in size, weather conditions and their general characteristics that no two cyclones are identical and therefore it becomes very difficult to classify them into certain categories. Generally, they are divided into 4 major types.

(1) Tropical disturbances or easterly waves

(2) Tropical depressions

(3) Tropical storms

(4) Hurricances or typhoons

On the basis of intensity they are divided into two principal types and 4 subtypes.

(1) Weak cyclones

(i) Tropical disturbances

(ii) Tropical depressions

(2) Strong and furious cyclones

(iii) Hurricanes and typhoons

(iv) Tornadoes.

(1) **Tropical disturbances** are migratory wave-like cyclones and are associated with easterly trade winds. They are also called easterly waves. Winds move towards centre with low speed. Though they move in westerly direction under the influence of trade winds with low velocity but they are most extensive and wide-spread and influence the weather conditions of both tropical and subtropical areas. Most of the easterly waves develop between 5° and 20° north latitudes in the western parts of the oceans. Some times, they are so sluggish that they remain stationary over an area for several days. They are associated with heavy cumulus or cumulonimbus clouds which yield moderate to heavy rainfall with thunderstorms. Some

Env... times, the easterly waves are so greatly intensified that they develop into hurricanes. Generally they develop in the Caribbean Sea and North Pacific Ocean during summer months.

- (2) **Tropical depressions** are centres of low pressure surrounded by more than one closed isobars and are very small in size. Wind velocity around low pressure centre ranges between 40-50 km per hour. Their direction and velocity are highly variable. Some times, they remain stationary at a place for several days. They usually develop in the vicinity of inter-tropical convergence (ITC) but seldom develop in the trade wind belt. Tropical depressions generally influence the weather conditions of India and north Australia during summers. After being originated in the bay of Bengal these cyclones move in north - westerly and westernly directions and reach inner parts of India. Some times, they become so strong that they yield heavy downpour resulting into severe floods.
- (3) **Tropical storms** are low pressure centres and are surrounded by closed isobars wherein winds move towards the centre with the velocity ranging between 40 to 120 km per hour. They frequently develop in the Bay of Bengal and Arabian Sea during summer season. They also develop in the Caribbean Sea and in the vicinity of Philippines. Many of these cyclones become violent and disastrous atmospheric hazards as they cause heavy rainfall and thus inundate low-lying areas of Bangladesh, delta region of West Bengal and coastal areas of Orissa, Andhra Pradesh and Tamil Nadu. The northern parts of Bay of Bengal mostly the ganga Delta plains of West Bengal, India and Bangladesh very often suffer from frequent severe cyclonic storms and resultant storm surges (tidal waves).
- (4) **Hurricanes and Typhoons.** The extensive tropical cyclones surrounded by several closed isobars are called hurricanes in the USA and typhoons in China. They are also called willy willy in Australia, cyclones in Indian Ocean, 'baguio' in Philippines, 'taifu' in Japan etc. Hurricanes are, in fact, most violent, most awesome, and most disastrous hazards of all the atmospheric disturbances. They move with average speed of more than 120 km per hour. Though hurricanes are most extensive and violent but their climatic importance is limited because of their fewer numbers and their occurrence in limited areas. Though hurricanes and temperate cyclones look similar in appearance but they may be differentiated on the following grounds :
 - (i) Hurricanes are represented by more symmetrical and circular isobars. Pressure increases sharply from the centre towards the outer margin resulting into steep pressure gradient. This is why hurricanes move with great force and high speed.
 - (ii) The rainfall occurring from hurricanes is in the form of heavy downpour and is wide spread and uniformly distributed whereas precipitation from temperate cyclones is confined to only warm and cold fronts. Warm and cold sectors are devoid of precipitation.
 - (iii) There is no temperature variation in hurricanes. They are also not characterized by different types of fronts (warm and cold fronts) and contrasting air masses as is the case with temperate cyclones.
 - (iv) There is no change in wind direction in hurricanes. Winds blow from the outer margin towards the centre and then rise upward.
 - (v) Hurricanes are not associated with anticyclones.
 - (vi) Unlike temperate cyclones they move from east to west.
 - (vii) The waves caused in the oceans due to ferocity of hurricanes are called hurricane waves

which are generally from 3-6 m in height. These storm surges inundate the coastal areas with immense loss to human health & wealth.

Necessary Conditions for the formation of Tropical Cyclones

The necessary conditions required for the formation of tropical cyclones (all types may be summarized as follows : (1) continuous supply of warm and moist air, (2) suitable source of sensible and latent heat (of condensation), (3) vertical air motion and convergence of air, (4) powerful trigger mechanism in the form of intruding low pressure system at high altitude, (5) warm water surface of the oceans (having atleast 27°C temperature) upto the depth of 60-70 meters, (6) presence of preexisting disturbances at lower altitude to be intensified and transformed into fully developed tropical cyclones, (7) higher values of coriolis force, (8) divergent circulation in upper troposphere, (9) existence of small atmospheric vortices in the intertropical convergence zone, (10) weak vertical wind shear etc.

Weather Conditions Associated with Tropical Cyclones

The arrival of tropical cyclones at a particular place is heralded by sudden merease in air temperature and wind velocity, market decrease in air pressure, appearance of cirrus or cirrostratus clouds in the sky, and emergence of high waves in the oceans. The clouds are thickened and become cumulonimbus which yield heavy rains. The clouds are also associated with thunder the lightning. On an average, a single storm yields 100 to 250 mm of rainfall but if obstructed by relief barrier it may give as heavy rains as 750 to 1000 mm. The visibility becomes zero because the sky is overcast with thick and dark thunder clouds. Such destructive conditions persist for a few hours only. The arrival of the centre or the eye of the cyclone is characterized by calm breezes, clear sky, rainless fine and settled weather, and low pressure at the centre. Such weather conditions do not persist for more than half an hour. The weather suddenly changes with the arrival of their rear portion of the cyclone as the sky again becomes overcast, wind direction changes, and pressure sharply goes up. There is heavy downpour with cloud thunder and lightning and storm becomes very severe and furious. This situation persists for several hours. Slowly and slowly the ferocity of cyclone starts declining and the weather becomes calm after the cyclone has passed off. The sea surface also become calm and clear weather sets in.

Effects of Tropical Cyclones

Tropical cyclones are very severe disastrous natural hazards which inflict heavy loss to human lives and property in terms of destruction of buildings, transport systems, water and power supply system, disruption of communication system, destruction of standing agricultural crops, domestic and wild animals, natural vegetation, private and public institutions, etc., through damages caused by high velocity winds, floods and storm surges. Table 1 to 3 depict the death toll of human life by tropical cyclones in different parts of the world.

Destructions by tropical cyclones include loss of human lives and property in terms of destruction of buildings, transport systems, water and power supply systems, disruption of communication system, destruction of agricultural crops, domestic and wild animals, natural vegetation, private and public institutions and so on. The deadliest impacts of tropical cyclones and tornadoes are on human beings.