

CYCLONES AND ANTICYCLONES



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Dear students,

In the previous episode we have seen how air masses and fronts have served as a background for a clear understanding of atmospheric disturbances. Extra tropical or temperate cyclones and anticyclones and tropical cyclones are the good examples of such disturbances. In this episode we will be presenting on the temperate cyclones and anticyclones. Atmospheric disturbances are the results of the complex process of exchange of heat between different latitude zones. Maximum disturbances are noticed in the middle latitudes. Therefore, we will discuss about the extra tropical or temperate cyclones and anti cyclones.

The episode consists of the following modules:

- 1. Cyclones and Anticyclones**
- 2. Extra tropical cyclones (Temperate Cyclones)**
- 3. Path and movement of extra tropical cyclone**
- 4. Extra tropical Anticyclones**
- 5. Types of Anticyclones:**

1. Cyclones and Anticyclones

The storms we usually associate with the word "cyclone" are large storms which occur in the tropics, and may move north into the temperate zones in the form of hurricanes or typhoons. However, cyclones can and do occur at any latitude and in any climate. Those that are born within 30 degrees of the equator (north or south of that line) are tropical cyclones. Those found above 60 degrees north or south of the equator are arctic or polar cyclones.

The cyclones which occur between 30 and 60 degree latitude are called extra tropical or temperate cyclones. Tropical cyclones that move north into the temperate zones eventually become extra tropical cyclones.

The atmospheric disturbances which involve a closed circulation about a low pressure center, anticyclone in the northern hemisphere and clockwise in the southern hemisphere are called cyclones.

There are two broad categories.

- Extra tropical cyclones
- Tropical cyclones

2. Extra tropical cyclones

We come across cloudy weather in temperate zones is a result of traveling cyclones in mid latitude zones. The term “extra tropical” “temperate” or “depressions” are used to denote the moving cyclones in the mid latitudes zones. Since the mid latitudes are the areas of convergence, where contrasting air mass gradually meet. It is there that the cyclones and anticyclones travel with westerly winds as centers for converging and rising of air produce cloudiness and precipitation. Extra tropical cyclones develop in regions lying between 30 deg to 60 deg N&S latitudes. Where polar and tropical air masses meet and form what is known as polar front. On weather map cyclone is shown as a low pressure area enclosed by number of isobars. They are circular or elliptical in shape.

Shape and size:

There is a great degree of variation in shape and size of a mid lat cyclones and anticyclones. Generally the isobars are circular and elliptical but in certain cases the isobars take the shape of the “V”. The axis of the type of depression is SW to NE direction. The diameter of the temperate cyclone varies from 160 km to 3,200 kms. But most of the cyclones have the diameters measuring 3,00 to 1500 kms. The estimated area covered by an average cyclone in US is about 1.6 million Sq Kms. The vertical extent is about 10- 12 km. Air pressure in a cyclone is lowest at the center and increases towards outer margin (as low as 940 – 930mb). The moderate cyclone may have about 1000 mb.

The air pressure in a cyclone is lowest at the center and increases towards its outer margins. The strong cyclonic circulation may have as low as 940 to 930 mbs. The pressure differences between the center and the outer margins of low may vary from 10 to 20 mbs.

3. Path and movement of extra tropical cyclone

The mid latitude cyclones are subjected to the general westerly flow of atmosphere in the temperate zone. The heavy concentration of storm tracks in the vicinity of the Aleutian and Icelandic low are the most important paths followed by the mid latitude cyclones. There is a seasonal shift of the path of cyclone and there is a altitudinal shift. During winter months opposing air masses have greater contrast and there are more number of cyclones in the mid latitude zones. And they are more intense. There is a greater variation in weather in temperate zone during winter than summer. Most of the cyclones and anticyclones in the westerly wind belt move from west to east. They “see” west in predicting the weather.

On an average the cyclones may cover a distance about 1000 km per day. Sometimes it varies from 500-2000 kms/day. The cyclones invariably move towards higher latitudes where as anticyclones originating in the mid latitudes mainly travel equator ward to the sub tropical region.

The most favorable areas for the rejuvenation of weather storms are Colorado and Alberta. Cyclones forming in Canada move south wards to the Great lake regions and then they turn towards northeast and move out in to Atlantic Ocean. Great lake regions are the strongest region in North America.

There are two major source regions in North America where the temperate cyclones originate. They are 1) Sierra Nevada regions 2) Eastern Colorado.

These storms move towards the Great lake regions and they produce heavy rain and snow. Great lake regions are the breeding place for number of winter storms because of the steep temperature gradients. The Gulf of Mexico is another region where a number of storms originate.

In central Europe the large number of winter cyclones form over the Baltic Sea.

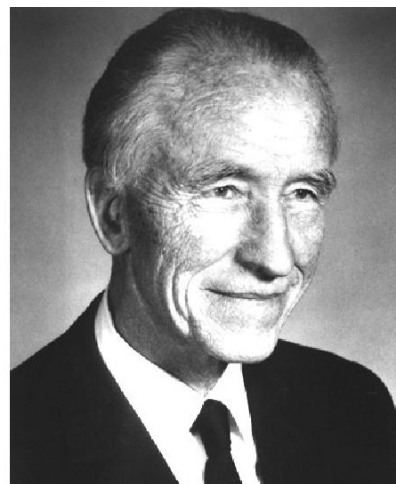
Cyclones move towards higher latitudes where as anticyclones originated in mid latitudes and travel towards equator and subtropical regions. Most of the temperate cyclones originating in north pacific off the eastern coast of Asia, move north word towards Gulf of Alaska – where they merge with Aleutian low.

Number of storms form over Mediterranean basin they move north ward reaching Soviet Union and the east as for as North India. In summer there are no temperate cyclones in the subtropical regions. In southern hemisphere the Antarctic frontal zone – storm occur all the year around.

Origin of temperate cyclones



Vilhelm Bjerknes (FATHER)



Jacob Aall Bonnevie Bjerknes (SON)

It was toward the end of the First World War that the Norwegian meteorologists Vilhelm

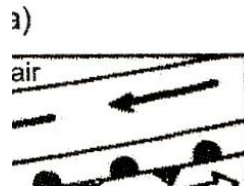
Bjerknes and his son J Bjerknes studied the structure of number of cyclones in Europe. Their efforts brought about major advances in the understanding of extra tropical cyclones. The theory that they put forth is called “the Bjerknes theory of the origin of cyclones” Cyclones according to Bjerknes form along a front where polar and tropical air masses with contrasting physical properties are moving parallel to it in opposite directions. Middle latitudes are the areas of convergence where cold polar and warm tropical air masses generally meet.

Life cycle of extra tropical cyclones

There are four stages in the extra tropical cyclones in the northern hemisphere.

1. Initial stages
2. Incipient stage
3. Mature stage
4. Occlusion stage

Initial stage



In the initial stage the polar and tropical air currents on the opposite sides of the polar front blow parallel to the isobars and the front. In the cold air mass to the north of the polar front the flow of the air is from east to west. In the warm air mass to the south of the front the flow of the air is from west to east. Therefore, the wave disturbance is produced; the front is quasi- stationary and is in perfect equilibrium.

Incipient stage

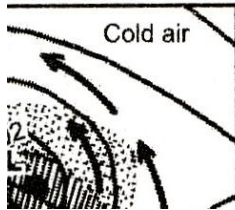


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stage wave is formed in the southerly direction and warm direction. There is an encroachment of each air mass in to the other. In this stage the isobars become almost circular

Mature stage

In the third stage the intensity of cyclone increases. The air in the warm sector starts from the south marked warm the cold air.



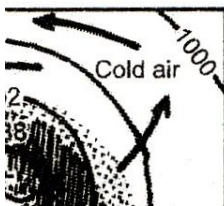
Infat, the warm air is moving in to a region previously occupied by the cold air. Each of these fronts is convex in the direction of its movements. If the rising air mass is moist, there will be condensation and precipitation along the warm as well as cold fronts.

stage the intensity of cyclone increases. The air in the warm flowing from the south west towards the cold air flowing east. Now the cyclone is fully developed. There are well and cold sectors. Warm air in this stage moves faster than

The direction of the movement is perpendicular to the warm front. The direction of the movement is perpendicular to the warm front. If the rising air mass is moist, there will be condensation and precipitation along the warm as well as cold fronts.

Fourth Stage:

In the final stage, of the cold front ultimately overtakes the warm front in the formation of an occluded front. Finally the two air masses mix a single

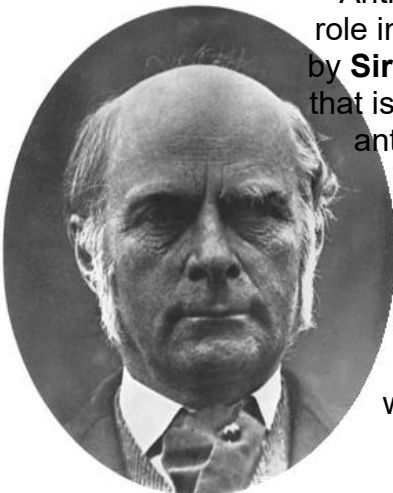


stage, of the cold front ultimately overtakes the warm front in the formation of an occluded front. Finally the two air masses mix across the front. Now the cyclone dies out. The life span of frontal cyclone is normally about five to seven days.

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1.4. Extra tropical Anticyclones



Anticyclones in the temperate regions play much less important role in the weather drama. The term “anti cyclone” was first used by **Sir Francis Galton** in 1861. It denotes an atmospheric system that is just the opposite of the cyclonic system. However, the anticyclones form one of the most important factors in weather forecasting. All the important cyclones are found over the Oceans in the vicinity of 30 N and S latitudes.

Origin and structure of anticyclones

Anticyclones are the high pressure systems around which the wind blows clock wise in the northern hemisphere and antilock wise in southern hemisphere.

There are two types of anticyclones:

Cold core anticyclones of the higher latitudes
Warm core anticyclones of the lower latitudes.

These rapidly moving anticyclones move southward towards the lower latitudes. In

North America they originate in Northern Canada and move southward and SE ward cross the central eastern United States.

In Asia they originate in the eastern part of Siberia and move towards China and Japan.

Velocity of wind and pressure gradients is never so high in cyclones. On the other hand

Anticyclones have always high winds. Anticyclones are always associated with scanty rain fall. Anticyclones do not favor condensation and cloud formation. On occasions the cold north westerly wind may produce snowfall.

The surface conditions of the anticyclone depend upon temperature of the air masses involved, humidity of air, and season of the year.

In winter, the cold anticyclones originating in snow covered sub polar regions always bring with them very cold temperature. In summer, the air of the tropical or subtropical origin produce extremely high temperatures called heat waves. The range of temperature is bound to be large.

In winter there are two regions:

North Western Canada, East central Siberia, Nevada, have the largest anticyclones. A cold Canadian anticyclone which travels from their Centre of origin to mid Atlantic states brings cold waves. In Europe there are only few anticyclones moving south ward from the peninsular of Scandinavia. The great lake regions have maximum anticyclones in summer

5. Types of anticyclones:

On the basis of the structure, storms tracks and general characteristics anticyclones are divided in to the following types.

Sub tropical high:

These anti cyclones develop in the sub tropical regions, having large areas elongated in shape and very deep in vertical extent. They are almost permanent high pressure systems positioned in the high pressure belts. These anticyclones are well developed over the oceans, where there is low pressure over the continents.

Polar continental high:

These anti cyclones form over the continental surface in winter. They are produced by traditional cooling of the earth surface. At about 2500 mts above MSL they lose their identity. They are made up of very shallow layers of cold air.

Conclusion

Extra-tropical cyclones are low pressure systems that occur in the middle latitudes. They have neither tropical nor polar characteristics. They are associated with cold, warm and occluded fronts. They derive energy from the horizontal temperature contrasts that exist in the atmosphere. They are more frequent in winter. On the other hand, tropical cyclones form in the tropics which can regenerate into extra-tropical cyclones on moving to higher latitudes; but extra-tropical cyclones never move into the tropics. Tropical cyclones derive their energy from the latent heat of condensation of the ascending moist air leading to cloud formation. Tropical cyclones originate in the summer and early autumn of each hemisphere and have isobars which are more symmetrical and circular than those in the extra-tropical ones. Tropical cyclones have calm rainless centers (eye) which are absent in extra-tropical storms.

In our next episode we will be discussing on the tropical cyclones, thunderstorms and tornadoes