

Jet Streams

- **Concept and Characteristics: -**

Jet Streams are strong, upper, circumpolar upper westerly air circulation that remains confined in a narrow belt of width of a few 100 km in the upper troposphere (Singh, 2007). Jet streams are mainly noticed in the upper troposphere at a height of between 7.5 km to 14 km and it remains confined between the poles and 20° latitudes in both the hemispheres. Jet streams primarily blow from west to east. According to World Meteorological Organization, “*The jet stream is a strong narrow current concentrated along a quasi-horizontal axis in the upper troposphere or in the stratosphere characterized by strong vertical and lateral wind shears and featuring one or more velocity maxima. This speed of the wind must be greater than 60 knots*” (Chakraborty, 2018). The origin of the jet streams can be traced back to the period of 2nd World War. When the American jet bomber fighter planes flew towards Japan from east to west, their velocity was remarkably reduced and the fuel consumption became very high. On the contrary, these jets noticed a marked increase in their velocity while they returned to their bases. It was due to an air circulation in the direction from west to east in the upper troposphere that obstructed the free movement of the planes. Since this air circulation interfered in the movement of planes, it was given the name Jet Streams. The major features of jet streams are as follows: -

1. The circulation of the jet stream remains confined between 7.5 km to 14 km in the upper troposphere.
2. The width of the jet stream is about a few hundred kilometres, length of about a few thousand kilometres and 2-4 km of depth (Singh, 2007).
3. Jet streams can be seen between the poles and 20° latitudes in both the hemispheres. They are also called circumpolar whirl as they move around the poles in both the hemispheres (Chakraborty, 2018) (Singh, 2007).
4. The velocity of the jet stream during winter season becomes twice to that of the velocity during summer season.
5. During winter, the jet stream extends up to 20° latitudes while during summer they narrow down and remains confined to the poles.

6. The vertical shear of the jet stream is about 18-36 km/hr while the lateral wind shear is about 18 km/hr. Maximum velocity of the jet stream can be as high as 480 km/hr.

- **Types of Jet Stream: -**

Jet streams can be classified under three categories and they are discussed below: -

1. *Westerly Jet Stream*- They move from west to east and act as primary controlling factors for Indian Monsoon mechanism. They can be seen in the upper troposphere in a regular manner. Meteorologists have opined that rotation of the earth, Coriolis force and differential heating and temperature contrasts are responsible for the origin of this sub-tropical jet streams (Chakraborty, 2018).
2. *Tropical Easterly Jet stream*- These branch of jet stream blows from east to west in the upper troposphere between 5° to 20° latitudes. They are formed due to intense heating up of the Tibetan plateau and are seen established over India and Africa (Chakraborty, 2018).
3. *Polar Front jet stream*- It moves from east to west in the polar cell and is the product of temperature difference between the poles and the tropical region.

- **Index Cycle of Jet Streams: -**

The period of transformation of the straight path of the jet stream into wavy and meandering path is called the index cycle and it is completed in four stages. In the First Stage (A), the jet stream is positioned near the poles and it is bounded by polar cold air mass in the north and warm westerlies in the south. The path is straight. In the Second Stage (B), the straight path gradually gets wavy and meandering leading to the formation of the Rossby Waves (Singh, 2007). With the passage of time, the jet stream increases its amplitude and extend towards the equator. The pressure gradient is north-south. In the Third Stage (C), the jet stream fully becomes meandering and is positioned near the equator. Now the pressure gradient is east-west. There is displacement of tropical air mass to poles and polar air mass to tropical areas. The Fourth Stage (D) is featured by cutting off of the meanders of jet stream from the main path due to very high meandering circulation and it gives rise to several cellular circulation of cyclonic and anti-cyclonic pattern (Singh, 2007).

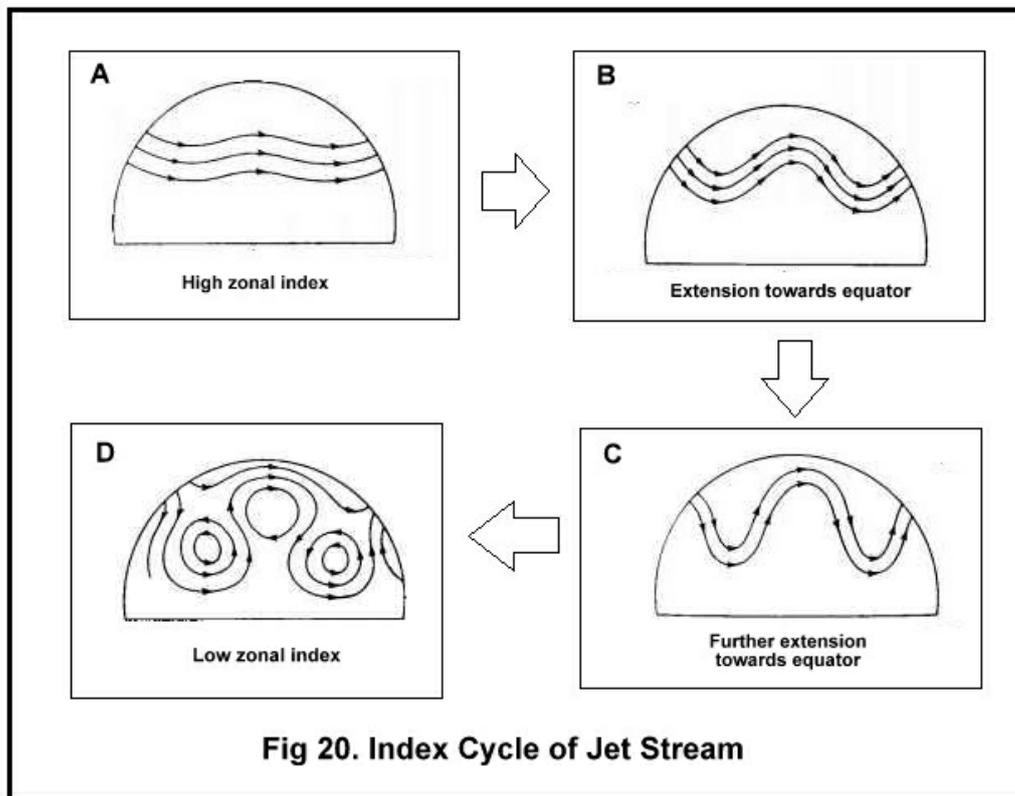


Figure: INDEX CYCLE OF JET STREAM

Significance of the Jet Stream:

Jet streams exert immense influence on daily weather conditions. When they are placed above temperate cyclones, its intensity increases. Jet streams bring about horizontal convergence and divergence in the upper troposphere. Surface weather conditions also undergo changes owing to the presence of the jet streams which again influences the form and nature of ground surface cyclones and anti-cyclones (Singh, 2007).

References: -

1. Chakraborty, P.K. and Goswami, A. (2018) General Climatology: An Introductory Approach, Balaka Publishing House, Kolkata.
2. Singh, S. (2007) Climatology, Prayag Pustak Bhawan, Allahabad.
