

Jet streams: Origin and Characteristics

Welcome students,

My name is Dixita Shingadi, Assistant Professor in Geography from Government College of Arts, Science and Commerce, Quepem-Goa.

In this module we will be learning about Jet streams, its origin and characteristics.

Learning outcomes:

At the end of this module you will be able to:

- Explain the concept of jet streams along with its formation.
- Analyze the importance of jet streams in shaping the weather patterns of the Earth.

Jet Streams

Jet streams are the fast flowing geostrophic winds which blow horizontally from west to east direction in upper part of the troposphere. They are found at an altitude of 8 to 11 kilometers. Jet streams are relatively narrow bands which follow a meandering path. These jet streams were present in the upper atmosphere since beginning, but the existence of these jet streams was traced only during the end of the Second World War. When the American bomber pilots was moving towards the Japan, they encountered a strong winds which lowered the speed of the aircraft as they were moving from east to west direction. But while coming back they notice that the speed of the aircraft has suddenly increased as they were moving from west to east direction. Hence these jet streams are very useful for the aircraft, especially the ones which are moving from west to east direction as it helps them to save their fuel. In fact these geostrophic winds are called as jet streams because they are found in the jet flying zone.

Geostrophic winds

Air always moves from high pressure to low pressure area. Due to rotation of the Earth, there is an existence of Coriolis force which also moves from west to east direction. Coriolis force leads to the deflection of winds and hence, in the northern hemisphere, the wind deflects towards its right and in the southern hemisphere; the wind deflects towards its left. Further due to intensified Coriolis force, the wind becomes parallel to the isobars and these winds are called as geostrophic winds.

Definitions

These are some of the definitions given by some of the scholars.

- According to Trewartha- “Jet streams are relatively narrow bands of stronger winds bounded by slower moving air”.

- According to Petterssen- “Jet stream is almost entirely a thermal wind and its strength is proportional to the temperature contrast through the whole layer below”.

The temperature contrast or the temperature differences between the equator and the pole is very important for the formation of jet streams.

Origin of Jet streams

The Jet streams are originated due to three forces:

- Temperature Gradient
- Pressure Gradient
- Coriolis Force

The first one is the temperature gradient between the pole and the equator. The temperature difference between the pole and the equator is the first reason for the formation of jet streams. Along with that pressure gradient and Coriolis force also play a very important role as we know that the temperature is not uniform throughout the earth surface.

As you move from equator towards the poles, the temperature decreases due to the differential amount of insulation received. Due to this temperature difference, there is a resultant pressure gradient as a result; three cells are formed in the upper atmosphere. They are Hadley cell, Ferrel cell and Polar cell. Jet streams are formed at the juncture of these any two cells. For example: subtropical jet stream is formed at the junction of air masses from equator and from 60°N latitude. When this air masses meet in the upper atmosphere, their temperature and pressure varies. Hence these air masses don't mix-up with each other and void is formed between them. This void is filled by static air. Later due to effect of Coriolis force, wind starts moving from west to east direction and jet streams are formed. Hence this is how subtropical jet stream is formed. A same phenomenon is applied for the formation of the Polar jet stream when the air masses from sub-tropical and polar area meet.

Types of Jet Streams

There are two main types of jet streams.

1. Polar jet streams:

They are the strongest due to high temperature gradient and high Coriolis force. Coriolis force is highest at the poles and zero at the equator.

2. Subtropical jet streams

They are weak due to low Coriolis force.

3. Local jet streams

There are other local jet streams like Tropical Easterly, Polar Night, Somali jet streams, etc. which plays a very important role in the weather patterns in the respective areas.

Characteristics

- Jet streams are the strong winds. Their average speed is 144kms/hours but its speed does not remain same through its internal layer. The speed of the interior part is 300 kms/hours.
- The speed of the Jet streams also changes according to seasons. During winters, it is highest i.e. in between 160 to 240kms/hrs.
- Width of the Jet streams is 160 to 480kms and its thickness is from 900 to 2150 meters.
- They are characterised by great seasonal variations. During winters, the velocity of Jet streams increases as the temperature differences are more between pole and tropics. And vice versa in a summer season.
- They follow a meandering path.
- They are circumpolar in nature as it encircles the earth.

Conclusion

Jet streams have a very close relationship with a surface weather patterns. They influence the mid-latitude weather disturbances, path followed by cyclones, distribution of precipitation by extra- tropical cyclones, etc.

Thank you.