SEMESTER-1 – NEP- MAJOR

Composed By

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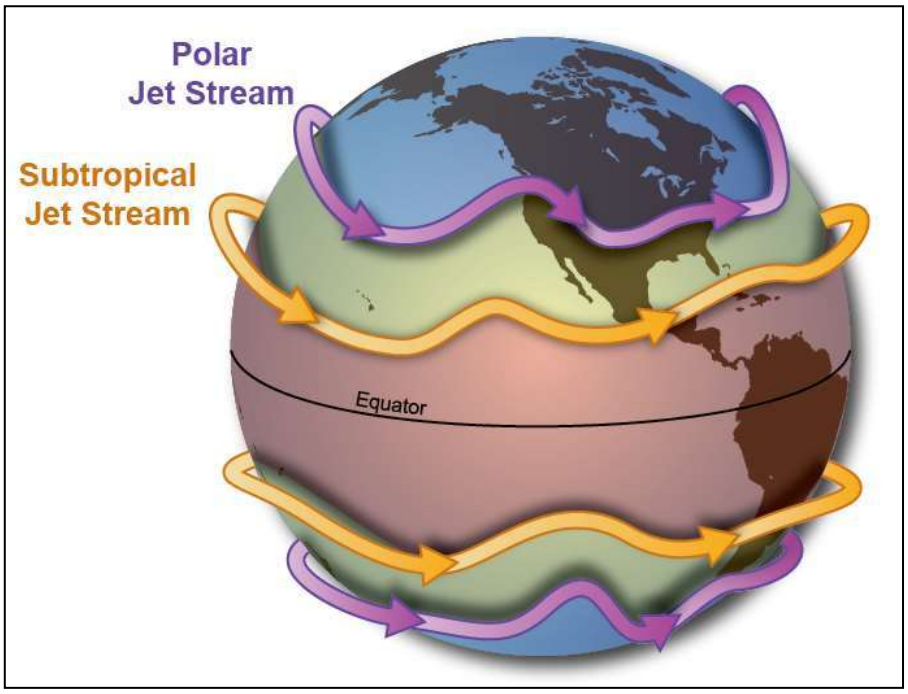
JET STREAMS

Jet streams are high speed air flow in narrow tube-like zones within the upper air westerlies and in certain other global latitude belts at high levels. The uniform flow at the upper air westerlies is frequently disturbed by the formation at large undulations called *Rossby Waves*. Associated with Rossby waves , the jet stream is a pulse like flow at air resembling a stream at water moving in a high speed . While the broad westerly current typically has speeds of 50 to 100 kms./hr. The wind speeds in a westerly jet stream is commonly 150 to 300 kms./hr. with extreme values reaching 400 kms./hr at elevation near 12 kms. These jet streams are important because cyclones often form beneath them and more or less follow the track of the jet during the span of their lifetime.

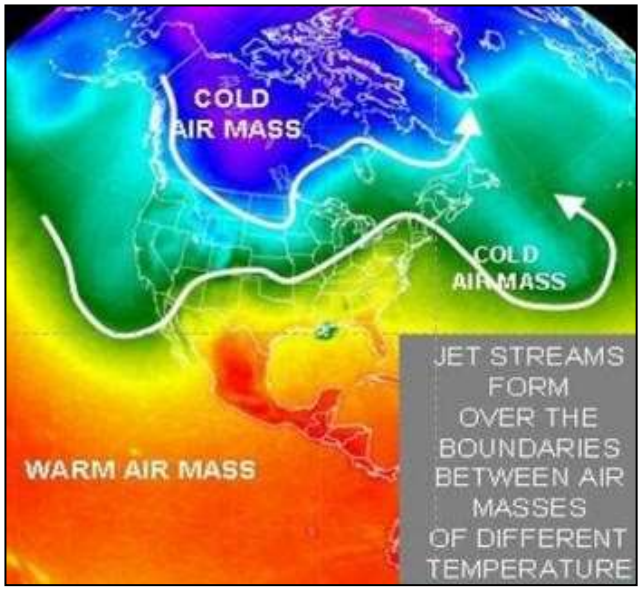


Origin of Jet Streams

Jet streams are formed above frontal zones which are relatively narrow zones through which there is a large horizontal gradient of temperature. In the atmosphere the temperature does not decrease uniformly from the tropics towards the poles; rather the decrease is concentrated within one or more narrow frontal zones. Because there is a large horizontal variation of temperature through a frontal zone, the wind speed increases with

height above it. The two major factors behind jet streams formation is Pressure gradient and coriolis force .

The adjacent figure shows the conditions of air for the formation of Jet Streams. In the figure it is found that air between 300 mb and 1000mb has a depth of 9000mb. in the northern cold air mass. and 9700m in the southern warm air mass. But in the frontal zone with its pronounced temperature variation , there is a marked decrease in thickness i.e. 300m within a horizontal distance of 400 kms. Thus on a weather map the contours showing the elevation of the 300 mb. surface would be closed packed above the frontal zone. Closely packed contours indicate that the horizontal pressure gradient force is large, which in turn implies strong geostrophic wind initiating the formation of jet stream. The frontal zone may be more than one forming more than one jet stream.



Major Jet Steams

A number of jet streams are there in the upper air westerlies namely

- Polar Front Jet Stream
- The sub Tropical Jet Stream
- And the Tropical Easterly Jet Stream

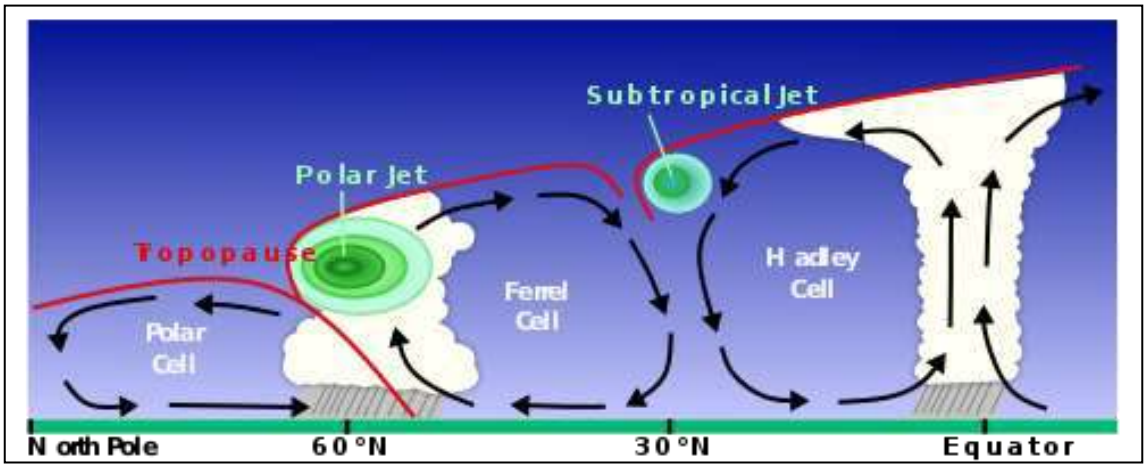
The Polar Front Jet Stream : The jet stream formed at the level of tropopause, along the polar front at the surface of contact between cold polar air mass and warm tropical air is named the polar front jet steam. The polar front jet stream is extremely important through its control of surface weather pattern or mid latitudes.

Subtropical Jet Streams: The subtropical jet stream formed in the subtropical latitude zone occupying a position at the tropopause just above the Hadley cell. Here westerly wind speed reach maximum values of 345 to 385 kms./hr.

The Tropical Easterly Jet Stream : A third jet stream system is found as even lower latitudes known as the tropical easterly jet stream which runs from east to west opposite in direction to that of the polar front and subtropical jet streams. This jet stream occurs only in the summer season and is limited to a northern hemisphere location over South-east Asia, India and Africa. This jet stream is very high in altitude, about 15 kms. and has wind speeds over 180 kms/hr. . This tropical easterly jet stream is considered by some atmospheric scientists to play a major role in the rainy summer monsoon of South-East Asia.

in general in the jet may be 120 to 150kms./hr, but in the jet maximum the speed may be 200 to 250 kms./hr.

The region of the jet maximum in which air enters is called the **entrance region** and the region from which it departs is known as the **exit region**. As an eastward moving air parcel (west wind) moves into the entrance region, it experiences a larger northward directed pressure gradient force P_H. This causes the air to depart from its previous near geostrophic balance, temporarily acquiring a slight southerly component (i.e. the air moves somewhat northward across the contours). This causes the air to speed up and the coriolis force to increase , which in turn tends to bring the wind back to a near geostrophic balance , but at the much stronger speed found in the core of the jet maximum.



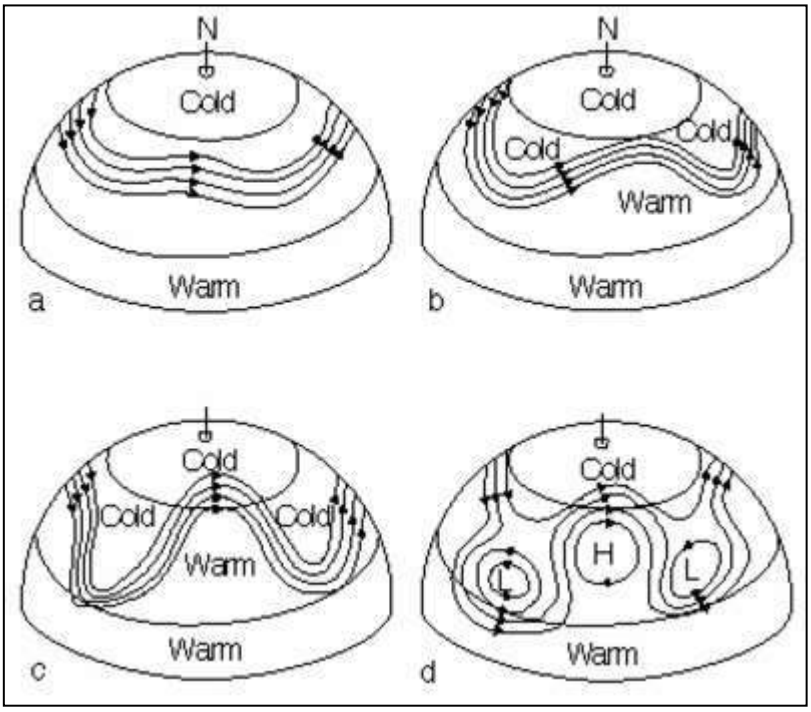
As the air leaves through the exit region , it encounters a weaker north-ward directed pressure gradient, that it again looses its approximate geostrophic balance , but in this case the coriolis force is larger. As a result the air gains a slight northern component and moves somewhat southward across the contours towards higher contour values. Its speed slows as it does so.

As the air moves across the contours in the entrance and exit regions of a jet maximum areas of convergence and divergence are produced. The convergence aloft takes place in the direction towards which the cross contours flow is moving (piling up occurs) and divergence takes place in opposite directions (spreading out occurs). Most cyclogenesis occurs underneath the area of divergence on the left side of the exit region. A secondary region of cyclone formation is found beneath the divergent area on the right side of the entrance region.

Rossby Waves

- The meandering jet streams are called **Rossby Waves.**
- Rossby waves are natural phenomenon in the atmosphere and oceans due to rotation of earth.
- In planetary atmospheres, they are due to the variation in the Coriolis effect (When temperature contrast is low, speed of jet stream is low, and Coriolis force is weak leading to meandering) with latitude.
- Rossby waves are formed when polar air moves toward the Equator while tropical air is moving poleward.
- The existence of these waves explains the low-pressure cells **(cyclones)** and high-pressure cells **(anticyclones).**

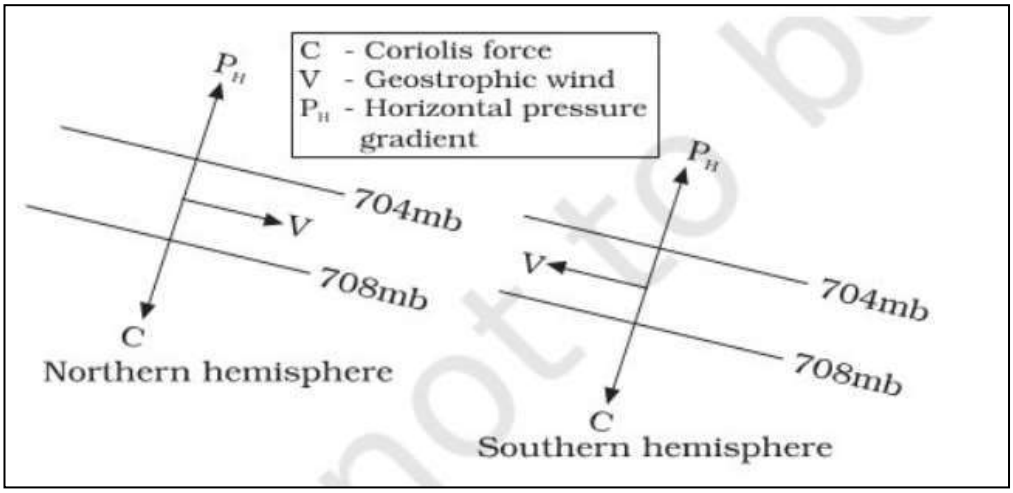
Formation of Jet Streams and Rossby Waves



Geostrophic Wind

- The velocity and direction of the wind are the net result of the wind generating forces.
- The winds in the upper atmosphere, 2 – 3 km above the surface, are free from frictional effect of the surface and are controlled by the **pressure gradient** and the **Coriolis force.**
- An air parcel initially at rest will move from high pressure to low pressure because of the Pressure Gradient Force (PGF).
- However, as that air parcel begins to move, it is deflected by the Coriolis force to the **right in the northern hemisphere (to the left in the southern hemisphere).**

- As the wind gains speed, the deflection increases until the Coriolis force equals the pressure gradient force (2 – 3 km above the ground, friction is low and winds travel at greater speeds).
- At this point, the wind will be blowing parallel to the isobars (perpendicular to Pressure Gradient Force). When this happens, the wind is referred to as **geostrophic wind.**



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https://youtu.be/VSNllMdW84w