

# Lab No. 1

## Identify the Jet Stream and Unstable Atmospheric Region

### Aims:

Analysis of the pressure level map of 300 mb, finding the jet streams, and areas of instability

### Tools:

- 1- 300 mb pressure level map. Geopotential height and wind speed
- 2- Coloring Pencils (Black, Red, Green, Blue).

### methodology:

The jet stream is a bund of long, narrow, high-speed winds that generally blow from west to east across the globe especially in the middle and upper troposphere or lower stratosphere (8 to 15 kilometers vertically). The main jet streams form near the height of the tropopause and move like westerly winds, Jet Streams characterized by strong vertical shear. Horizontal gradients in temperature lead to air motion due to the horizontal pressure gradient that drives geostrophic winds. The location and speed of the jet stream change with the seasons. during the winter, their locations are closer to the equator at a higher speed than in the summer. In the winter hemisphere, (Figure 1) shows that there are often two strong jet streams of fast west-to-east moving air near the tropopause: the **Polar Jet Stream** and the **Sub-Tropical Jet Stream**.

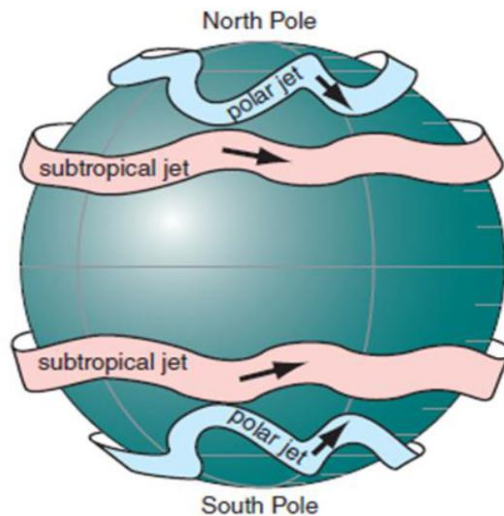


Figure 1: jet streams

## **polar jet stream**

at any height in the troposphere, you will find a horizontal temperature gradient between the colder poles and the warmer equator. the thickness between two isobaric surfaces is smaller in cold (polar) air and greater in warm (tropical) air. Inclination isobaric surfaces) in the horizontal direction, causing the occurrence of geostrophic winds. this atmosphere has a baroclinic. this baroclinicity is associated with the meridional temperature gradient that creates the westerly winds of the jet stream. As a result of this difference in temperature between tropical air and polar air, the thermal wind effect arises, which causes the polar jet stream to erupt over both hemispheres. It is an upper-level air current that circulates and meanders around the globe and plays a major role in the general circulation of the atmosphere as well as in the generation of atmospheric conditions in the mid-latitudes. The polar jet stream meanders at about 300 hPa, which transfers and distributes heat and moisture between the northern and southern hemispheres. The polar jet stream is associated with the polar front which is the boundary between the cold polar air and warm subtropical air called the polar front jet stream. The polar front is the weather

active zone which is usually on the tropical air side of the polar jet stream. The polar jet stream is characterized by:

- 1 - It is located between latitudes 50 to 60 during the winter season
- 2- It is considered a very disturbing jet stream
- 3 - meanders significantly north and south
- 4 - It is only about 5 (latitude) wide
- 5- Wind speed fluctuates greatly in this current, ranging from 25 to 100 meters per second.

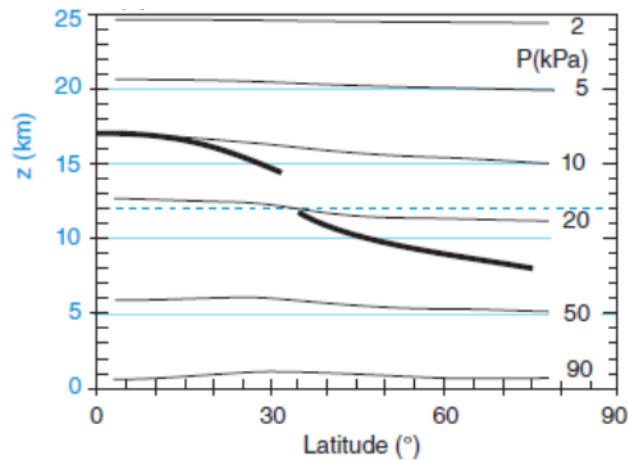


Figure 2: isobaric surfaces thickness is smaller in cold (polar) air and greater in warm (tropical) air.

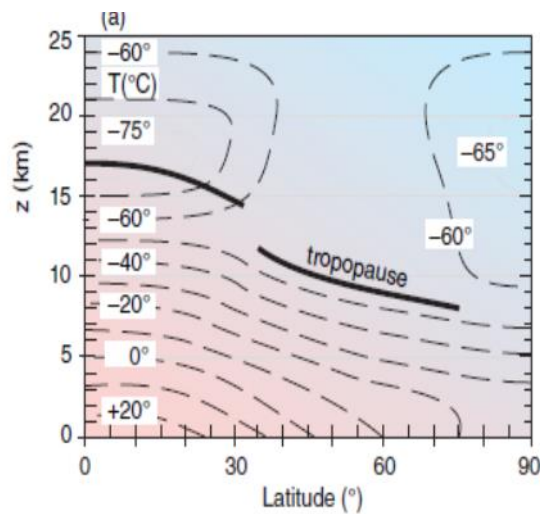


Figure 3: temperature distribution with height and latitude

### Subtropical jet stream:

When the winds diverge in the upper troposphere above the equator towards the north and south, the speed begins to increase as we move to a new latitude, north or south. This zonal wind cannot exceed  $\pm 30$  latitude due to the effect of the Coriolis force, which causes the winds to change direction and accumulate (where the Subtropical jet stream is created), this leads creates a pressure gradient that opposes the continuation of the movement towards the poles. the jet streams meander north and south, which helps to transport slow angular momentum southward and fast angular momentum northward. these meanders or synoptic-scale eddies cause mixing of zonal momentum.

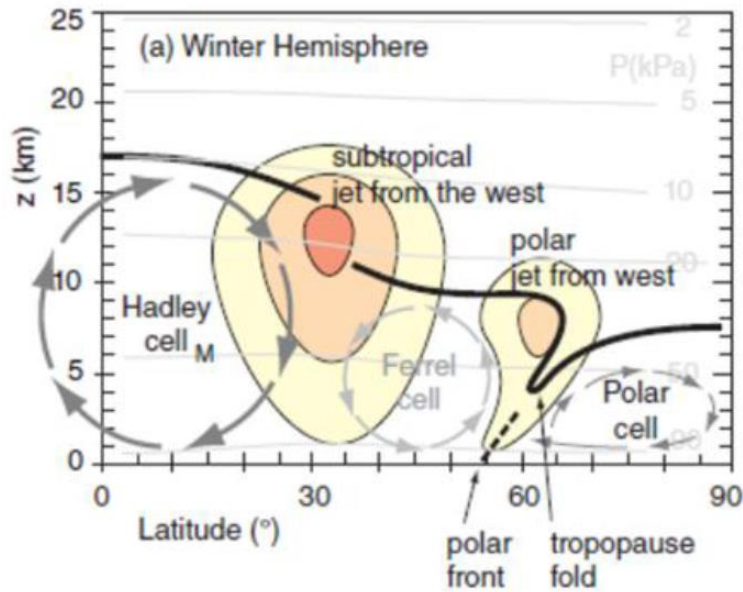


Figure 4: A profile view of the atmosphere showing the locations of the jet streams.

Sup-Tropical Jet Stream is characterized by the following

- 1 - It is located above latitude 30 during the winter season.
- 2- It is considered a very stable current
- 3- Moves with a few zigzags
- 4 - It extends over a width of approximately 1000 km, covering approximately 10 latitudes
- 5- Its speed ranges from 55 to 65 meters per second

## **Procedure:**

- 1- Draw contour lines on the map of 300 mb.
- 2- Draw the wind streamlines (dashed lines) parallel to the contour lines, and proportional to the speed value.
- 3- Jet Stream is located where contour lines are more converge and longest streamlines.

## **Discussion**

From your observation of the analyzed map:

- What is the cause of the jet stream meander, what mathematical formula can it be described?
- Which is more meandering, Polar or Subtropical Jet Stream? and why?
- According to the map shown, what do you expect to happen in maps of pressure levels less than 300 mb?