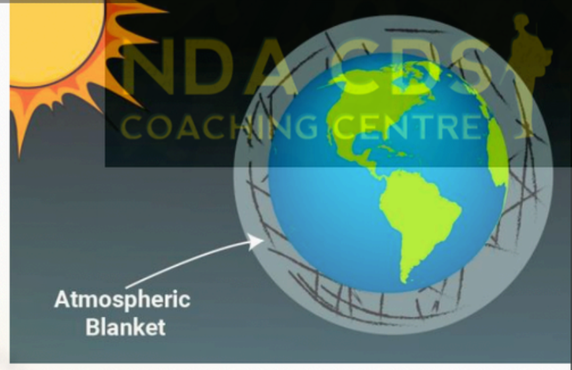
Atmospheric Pressure & Global Pressure Belts

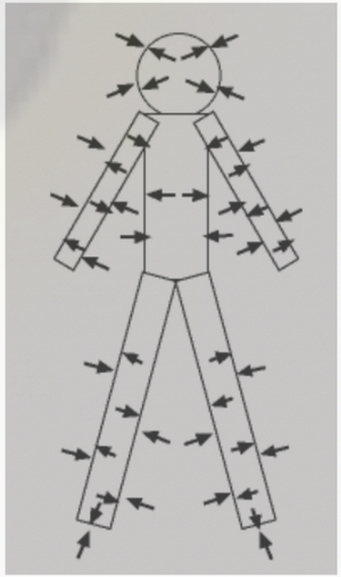
Climatology
Geography

Pressure Introduction



- Earth is wrapped in a blanket of air called the 'atmosphere', which is made up of several layers of gases.

- Air has weight and it exerts pressure.
  - Eg. – Empty bicycle tube weighs lighter than a tube filled with air & tube burst on increasing air pressure beyond a point



- Similarly, the air around us exerts pressure.
  - But we do not feel the weight of the atmosphere because we have air inside us which exerts an equal outward pressure that balances the inward pressure of the atmosphere.

Atmospheric Pressure

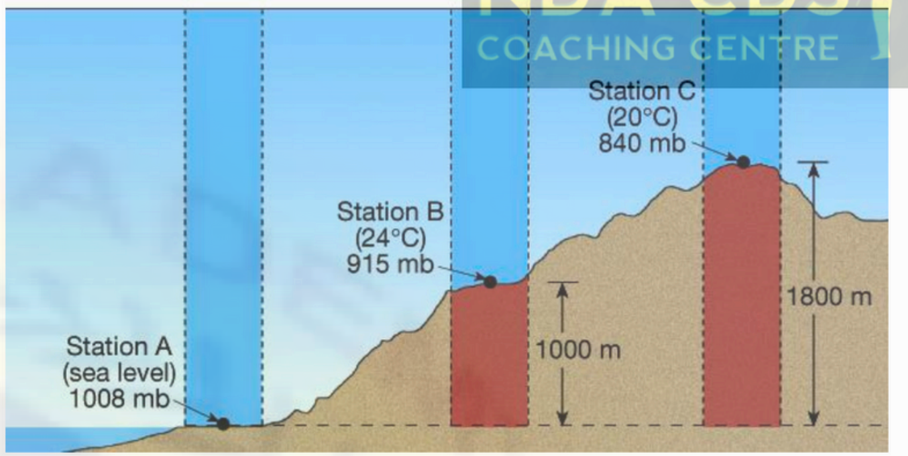
- The atmosphere is held on the Earth by gravitational pull of the Earth.
- On the surface of the earth, a column of air exerts weight in terms of pressure
- The weight of the column of air at a given place and time is called air pressure or atmospheric pressure.
- Atmospheric pressure = force per unit area.
- Atmospheric pressure is measured by an instrument called **barometer – mercury & aneroid**
- The common unit used for measuring pressure is called **millibar (mb)**.

Atmospheric Pressure Variation

- Distribution of atmospheric pressure on the surface of the earth is not uniform. It varies both vertically and horizontally.
- Thermal expansion & compression of air results in atmospheric pressure variations.
- Atmospheric pressure variations sets air in motion (from high pressure to low pressure)
- Horizontal motion of air is called wind. It redistributes heat and moisture across latitudes, thus maintaining constant temperature of planet Earth (latitudinal heat balance)

Vertical Distribution

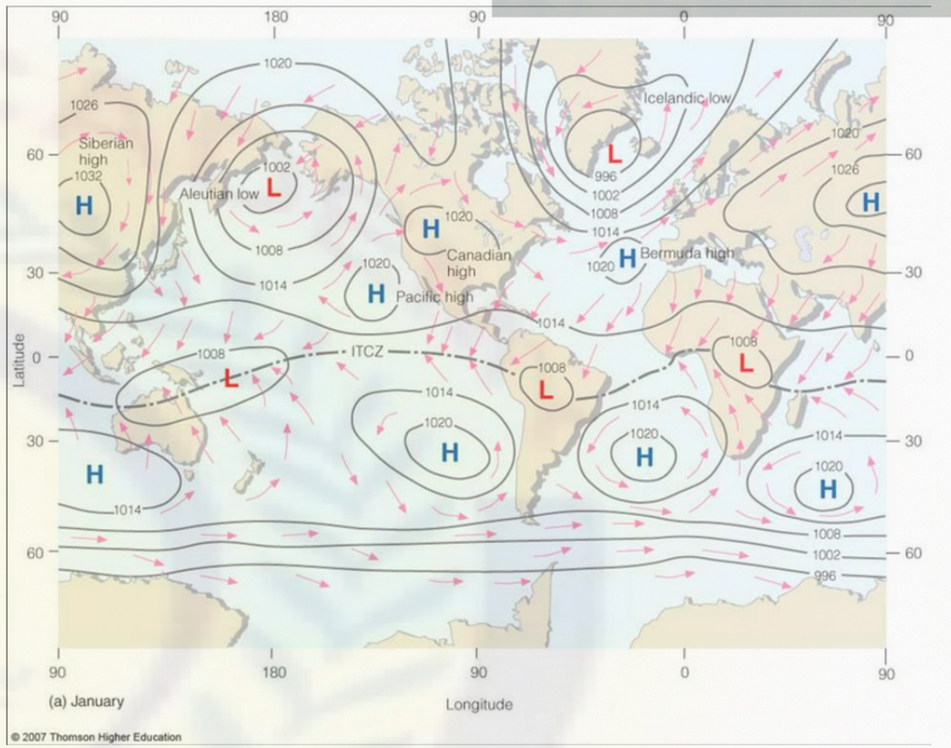
- The atmospheric pressure decreases with height.
- Due to gravity the air at the surface of Earth is denser and hence has higher pressure.
- In the air column, upper air mass compresses the lower air mass, hence lower layers are denser than upper layers & thus, exert more pressure.



Level	*Pressure in mb*	*Temperature °C*
Sea Level	1,013.25	15.2
1 km	898.76	8.7
5 km	540.48	–17. 3
10 km	265.00	– 49.7

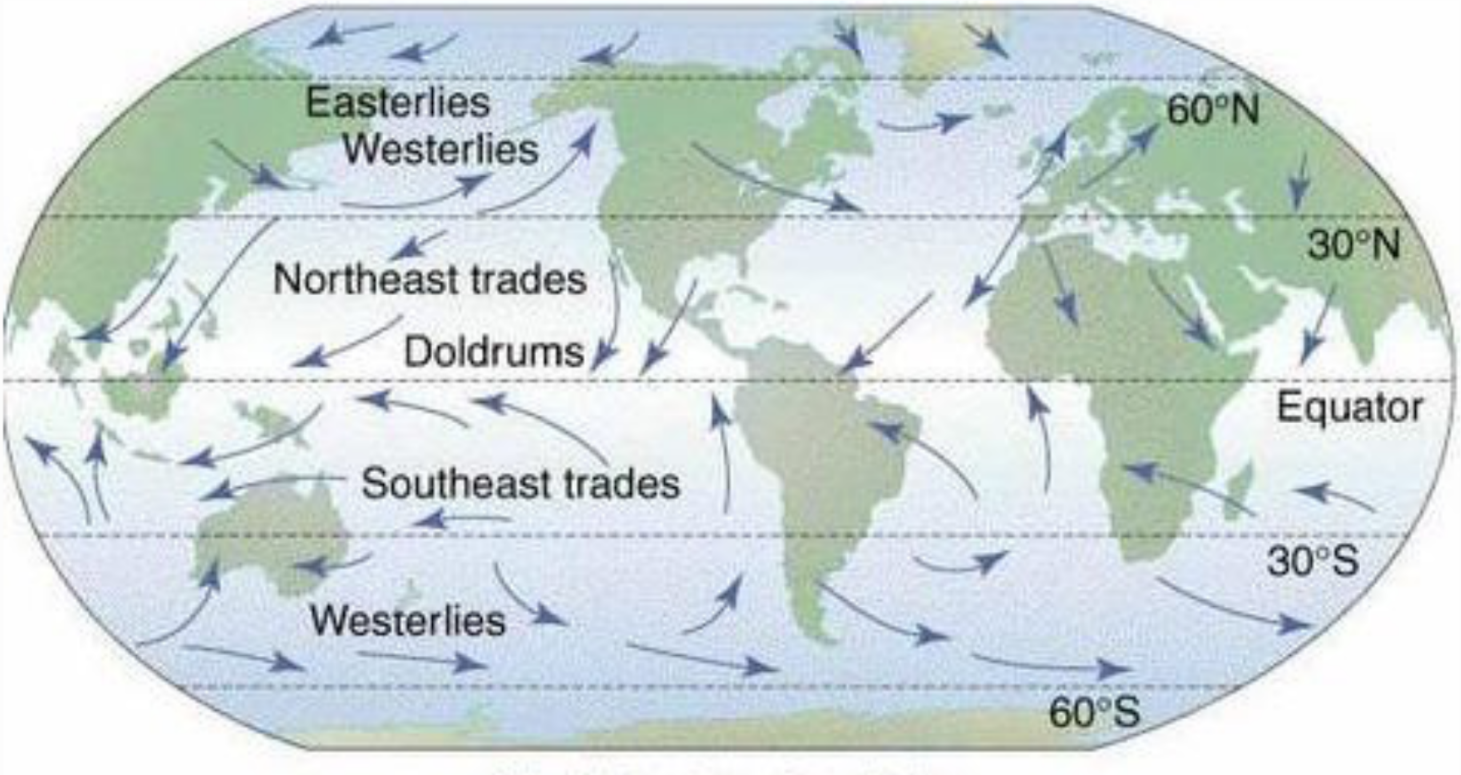
- At sea level the average atmospheric pressure is 1,013.2 millibar & decreases by around 1 mb for each 10 m increase in elevation.
- Vertical pressure gradient force is much larger than horizontal pressure gradient. But it is generally balanced by gravitational force. Hence, no strong upward winds.

Horizontal Distribution



- Distribution of atmospheric pressure over the globe is known as horizontal distribution of pressure.
- It is shown on maps with the help of isobars.

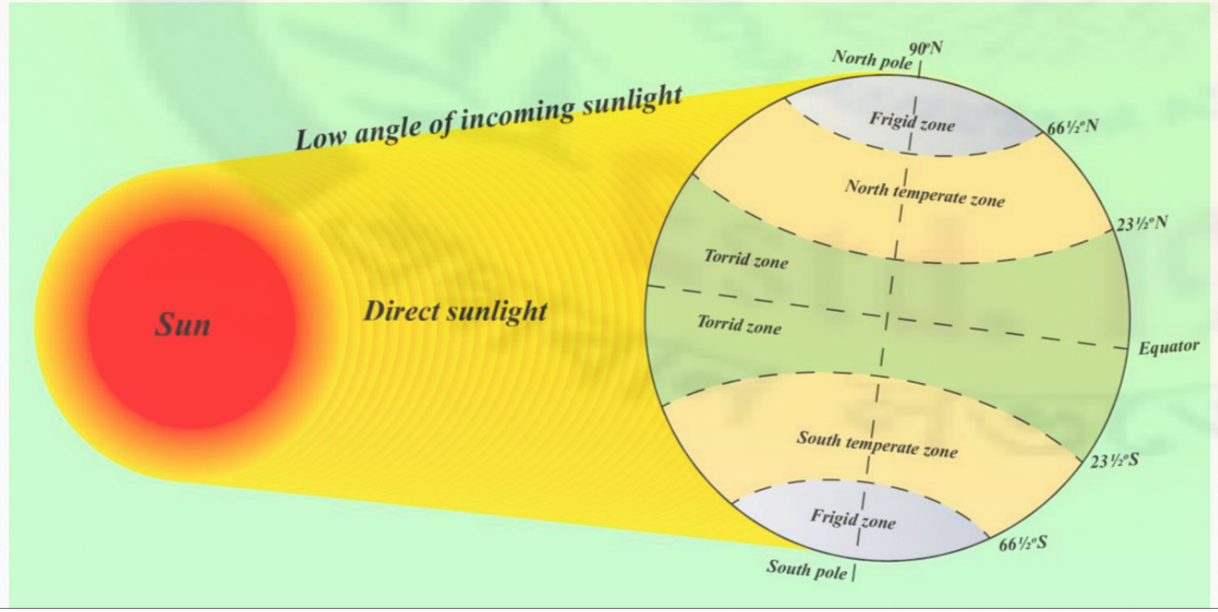
- An isobar is a line connecting points that have equal values of pressure, after being reduced to sea level.
- Close spacing of isobars expresses steep pressure gradient (change) while wide spacing indicates gentle pressure gradient.

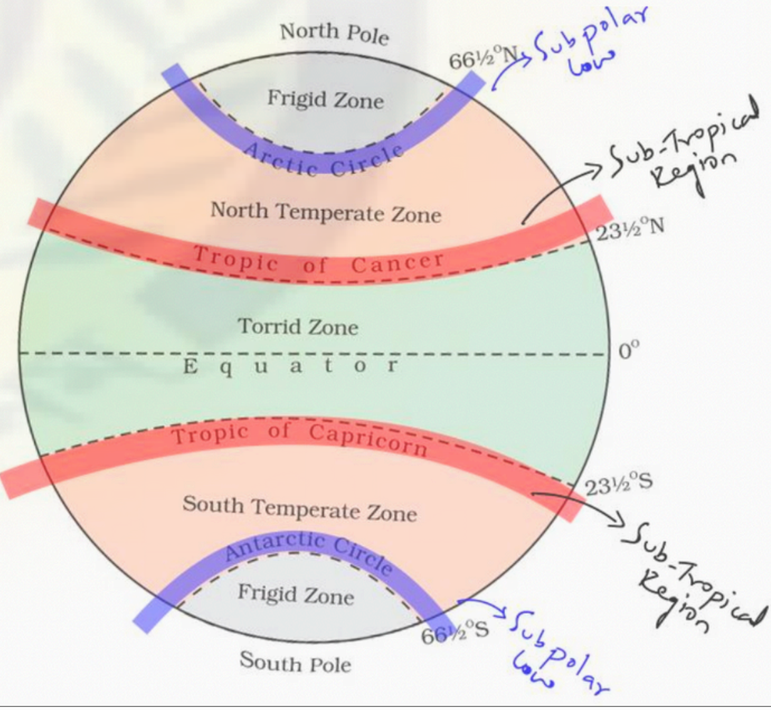


(c) Global trade winds

Pressure Belts

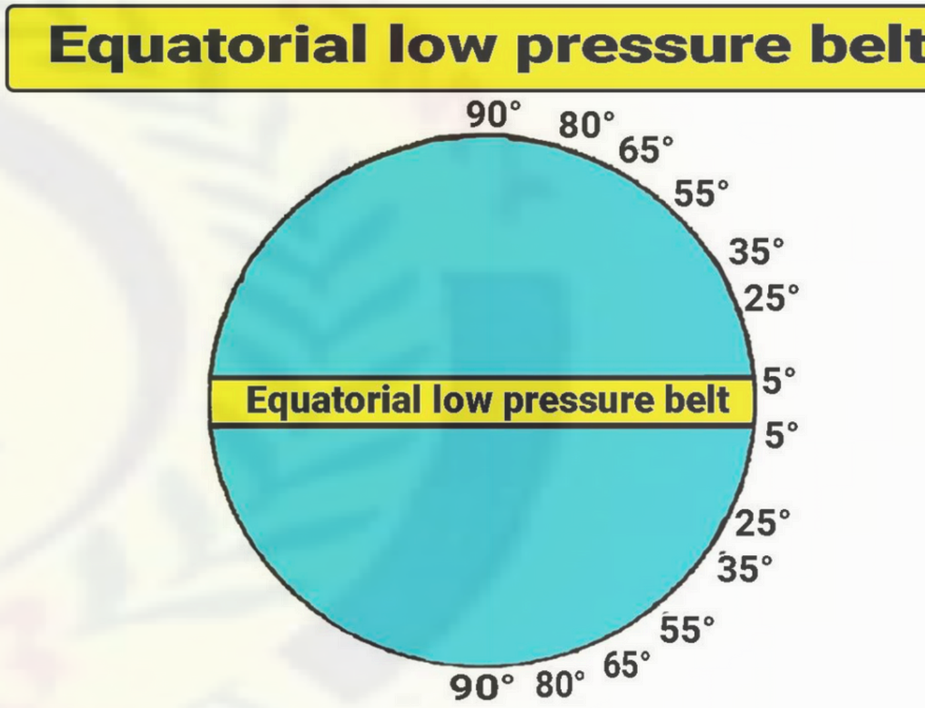
- Distinctly identifiable zones of homogeneous horizontal pressure
- Seven pressure belts:
  - Equatorial Low Pressure belt
  - Subtropical High Pressure belt – N & S hemisphere
  - Subpolar Low Pressure belt – N & S hemisphere
  - Polar High Pressure belt – N & S hemisphere





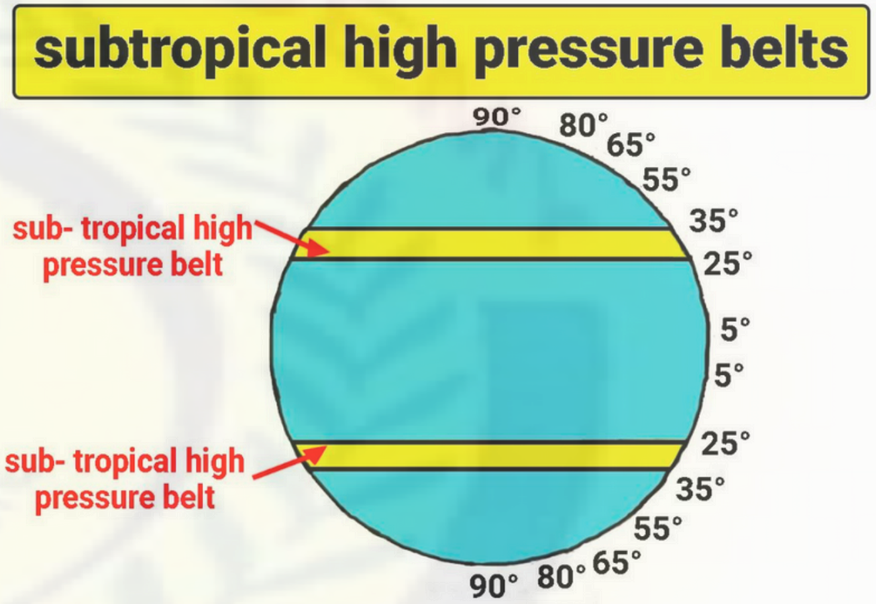
Equatorial Low Pressure Belt

- Lies between 0° to 5°N and 0° to 5°S.
- Vertical rays of the Sun – High temperature – air becomes warm and rises over the equatorial region (convection) to the top of the troposphere – results in low pressure.
- Intertropical Convergence Zone (ITCZ) lies here as trade winds of the Northern and Southern Hemispheres come together.
- (The ITCZ shifts north and south seasonally with the Sun)
- This belt is also known as the **Belt of Calms** or the **Belt of Doldrums**.



Sub Tropical High Pressure Belt

- Located between 30°N to 35°N and 30°S to 35°S.
- As the equatorial jet stream moves toward the Poles, it begins to cool and sink down at about 30° North and South of the Equator.
- Air from 60°N and 60°S also descends in the sub tropical belts.
- This creates the areas of high air pressure.
- This pressure belt is referred to as the **Horse Latitudes**.

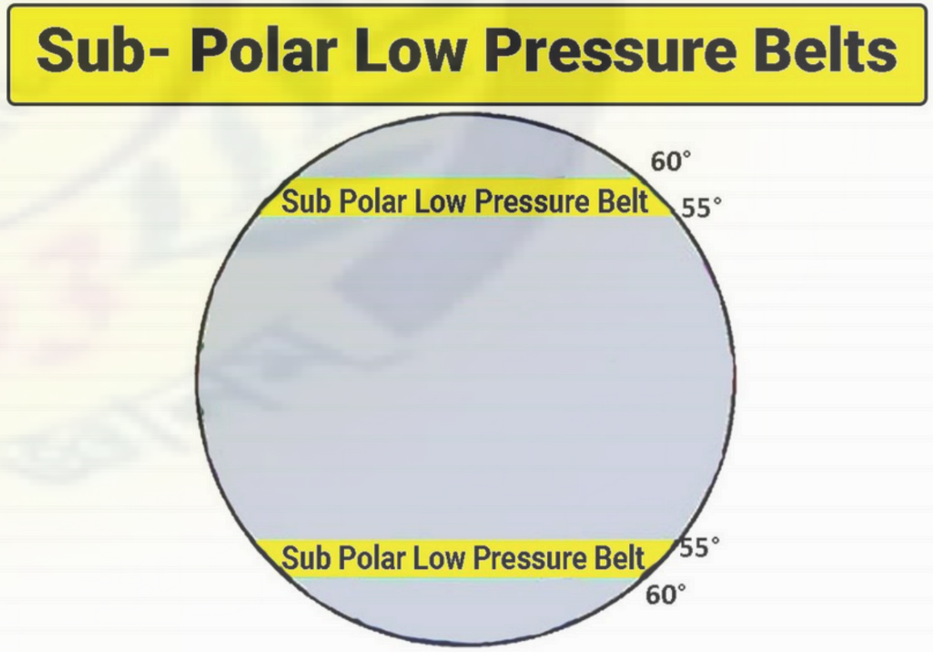


Sub-Polar Low Pressure Belt

- Located between 60°N to 65°N and 60°S to 65°S.
- Earth's Centrifugal forces operating in this region makes the air rise - creating low-pressure.
- These belts experience stormy weather and cyclonic activity especially during the winters.

Centrifugal force is the apparent outward force on a mass when it is rotated. It is maximum on Equator.

Is Equatorial LP also because of Centrifugal Force?

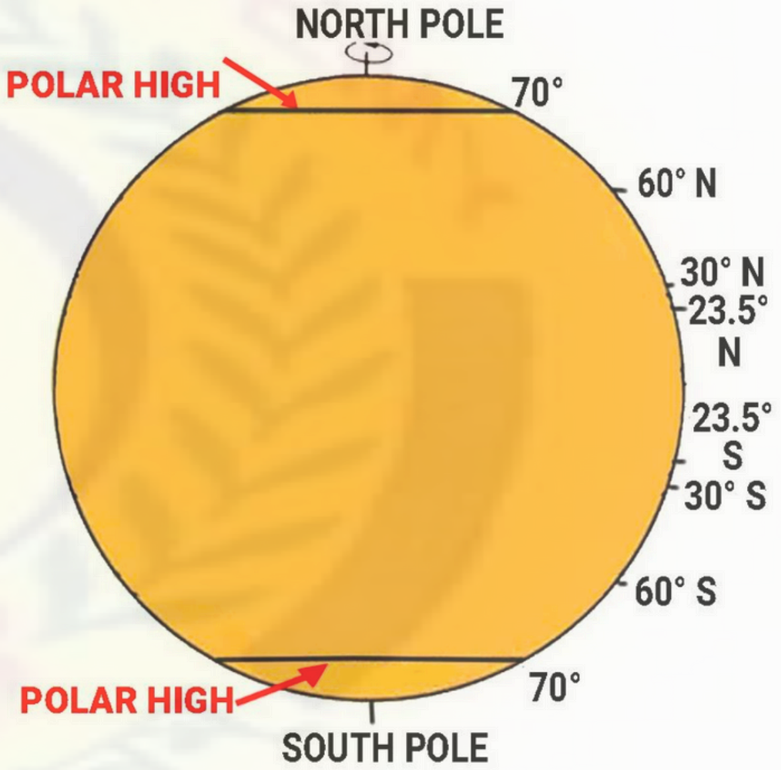


Why It Starts Acting in SPLP Belt:

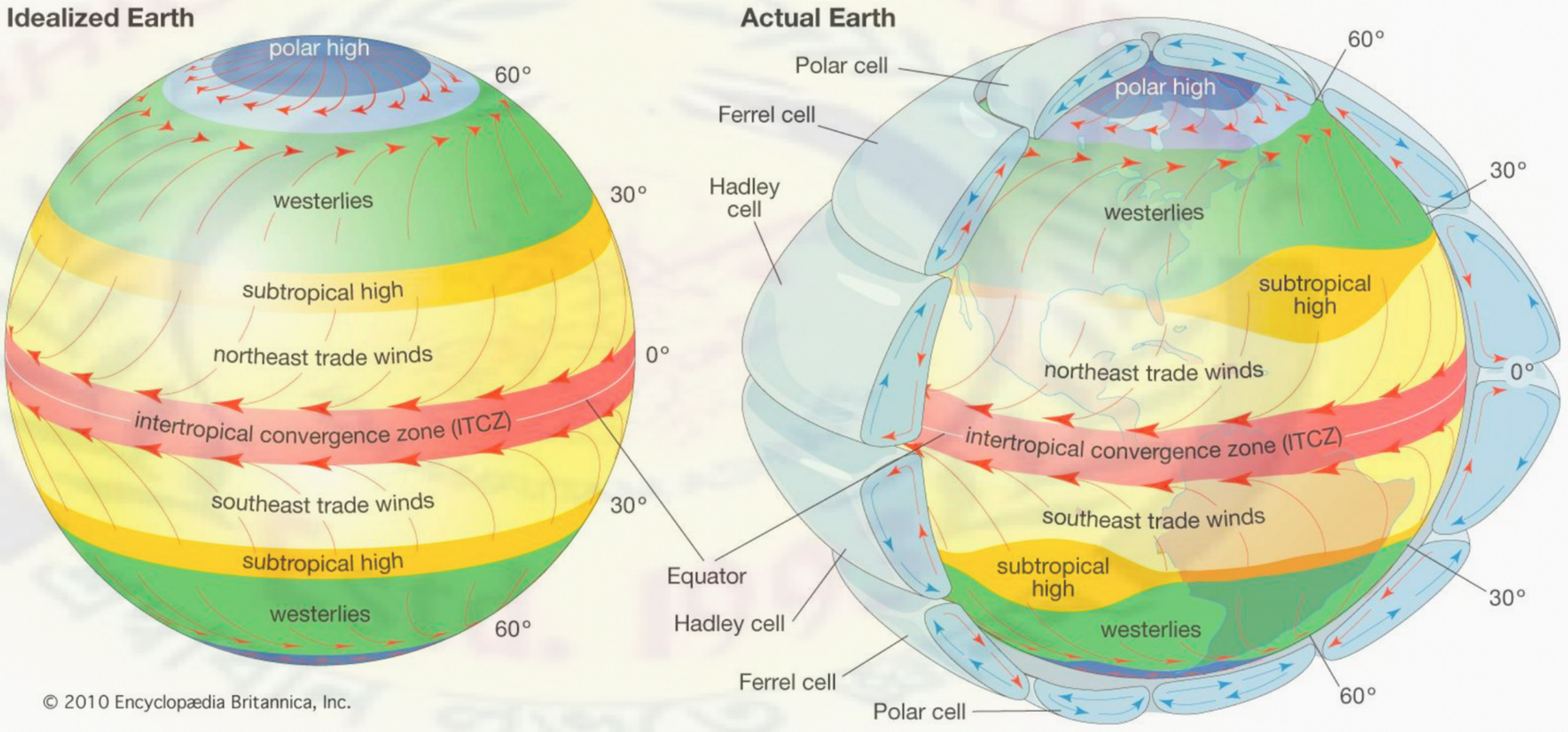
- The centrifugal force becomes significant in the SPLP belt due to the stronger rotational motion of air in cyclonic systems at these latitudes (around 60°). The Coriolis effect, which deflects winds due to Earth's rotation, is also stronger here than at the equator. This causes air to rotate more distinctly, making the centrifugal force an important factor in the balance of forces.

Polar High Pressure Belts

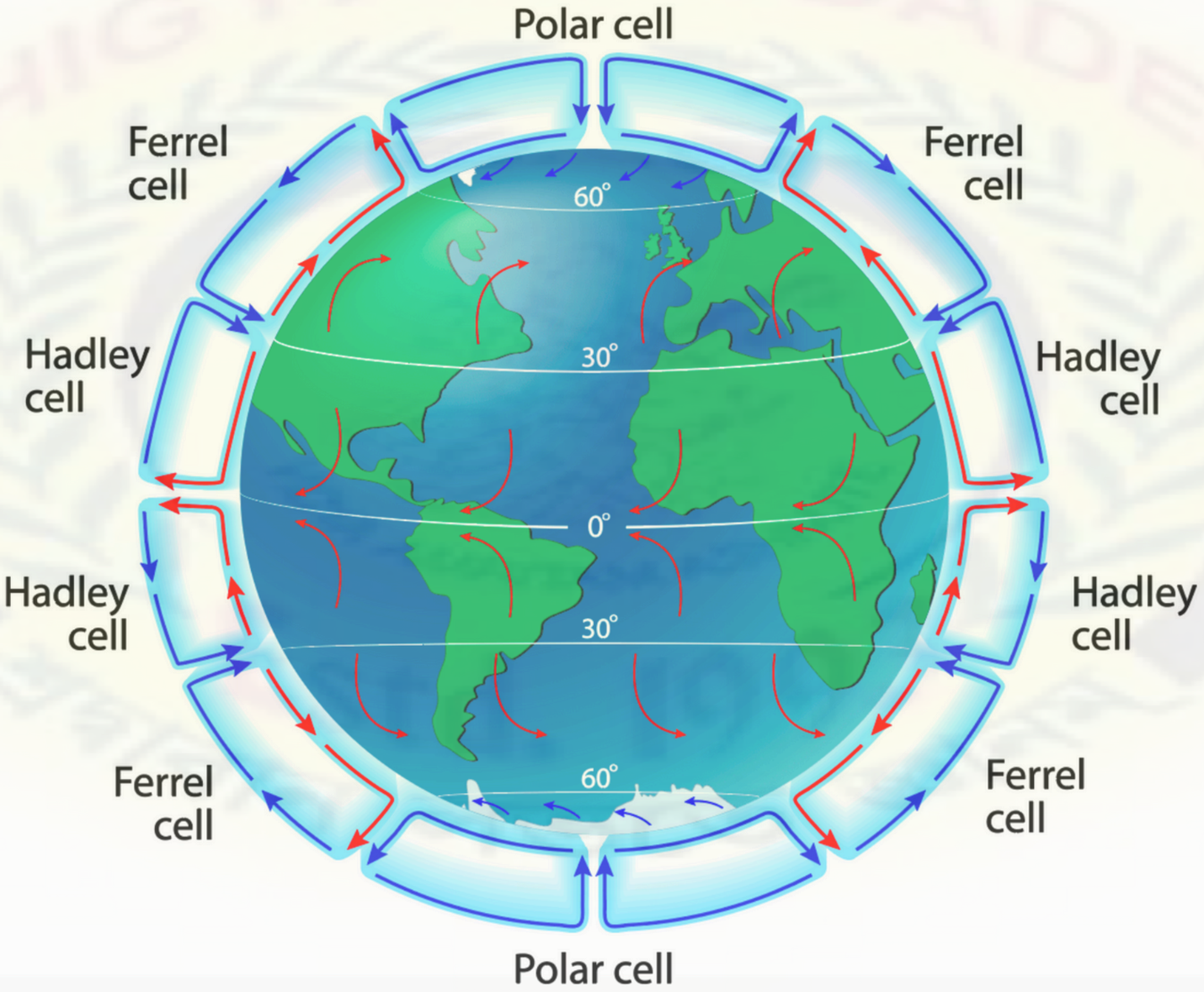
- Located between 85°N to 90°N and 85°S to 90°S.
- Polar Regions experience cold climatic conditions as the rays of the Sun are extremely slanting - the air is dense and heavy.
- Air from 60°N and 60°S also descends in the polar region.
- Thus, cold air sinks down giving rise to high pressure areas.



Global Atmospheric Circulation

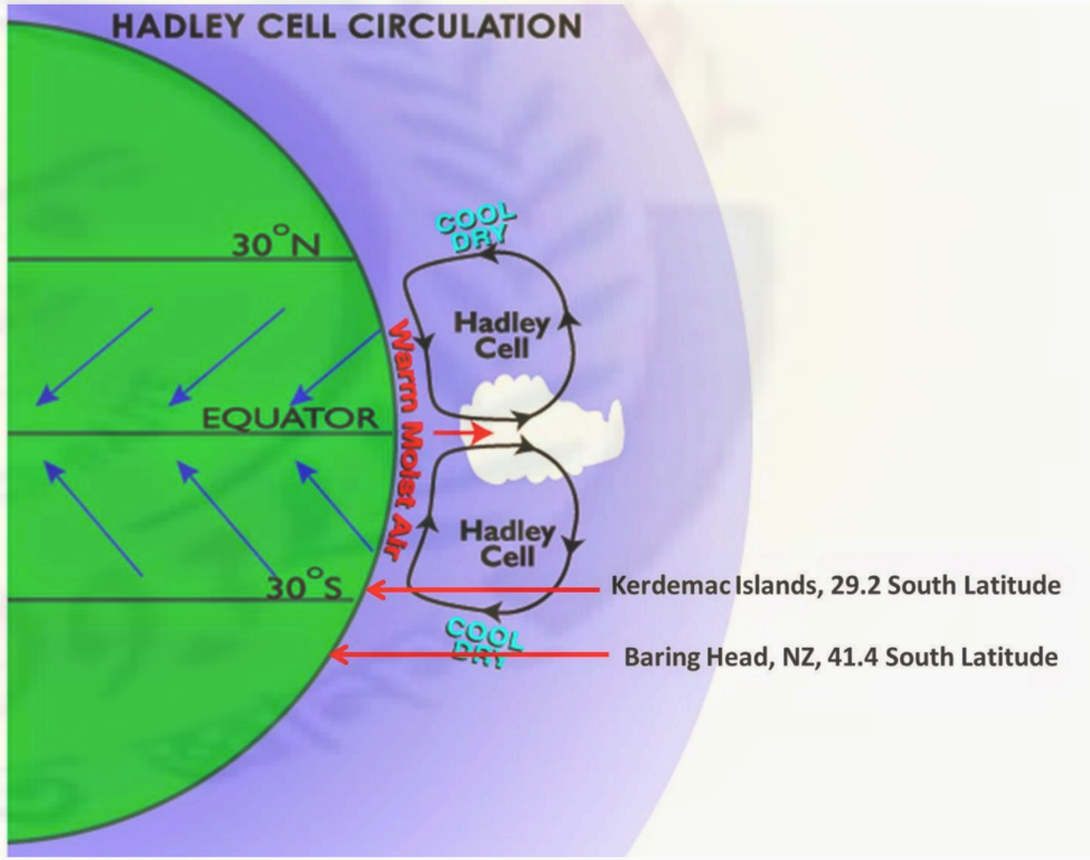


GLOBAL ATMOSPHERIC CIRCULATION



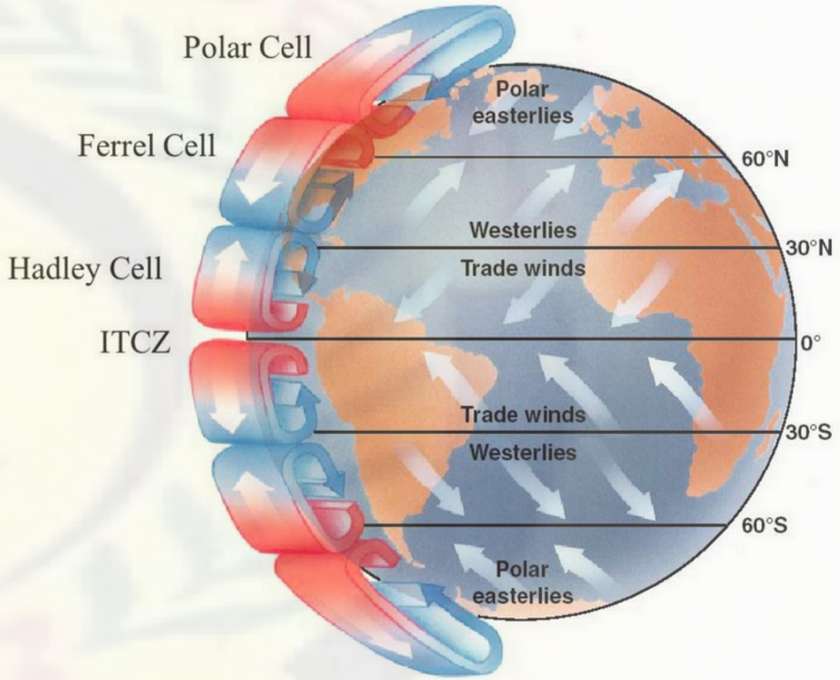
Hadley Cell

- This model was proposed by George Hadley in 1735
- It is a global scale tropical atmospheric circulation that features air rising near the Equator, flowing poleward, descending in the subtropics, and then returning equatorward.
- This circulation creates the trade winds.



Ferrel Cell

- The term was first proposed by William Ferrel in 1856
- It is a global atmospheric circulation that features part of the air rising at 60° latitude flowing towards Equator, descending in the subtropics, and then returning towards sub-polar region.
- This circulation creates the Westerlies.



Polar Cell

- It features part of the air rising at 60° latitude flowing towards Poles, descending, and then returning towards sub-polar region.
- Part of the air rising at 60° latitude diverges at high altitude toward the poles and creates the polar cell.
- This circulation creates the polar Easterlies.