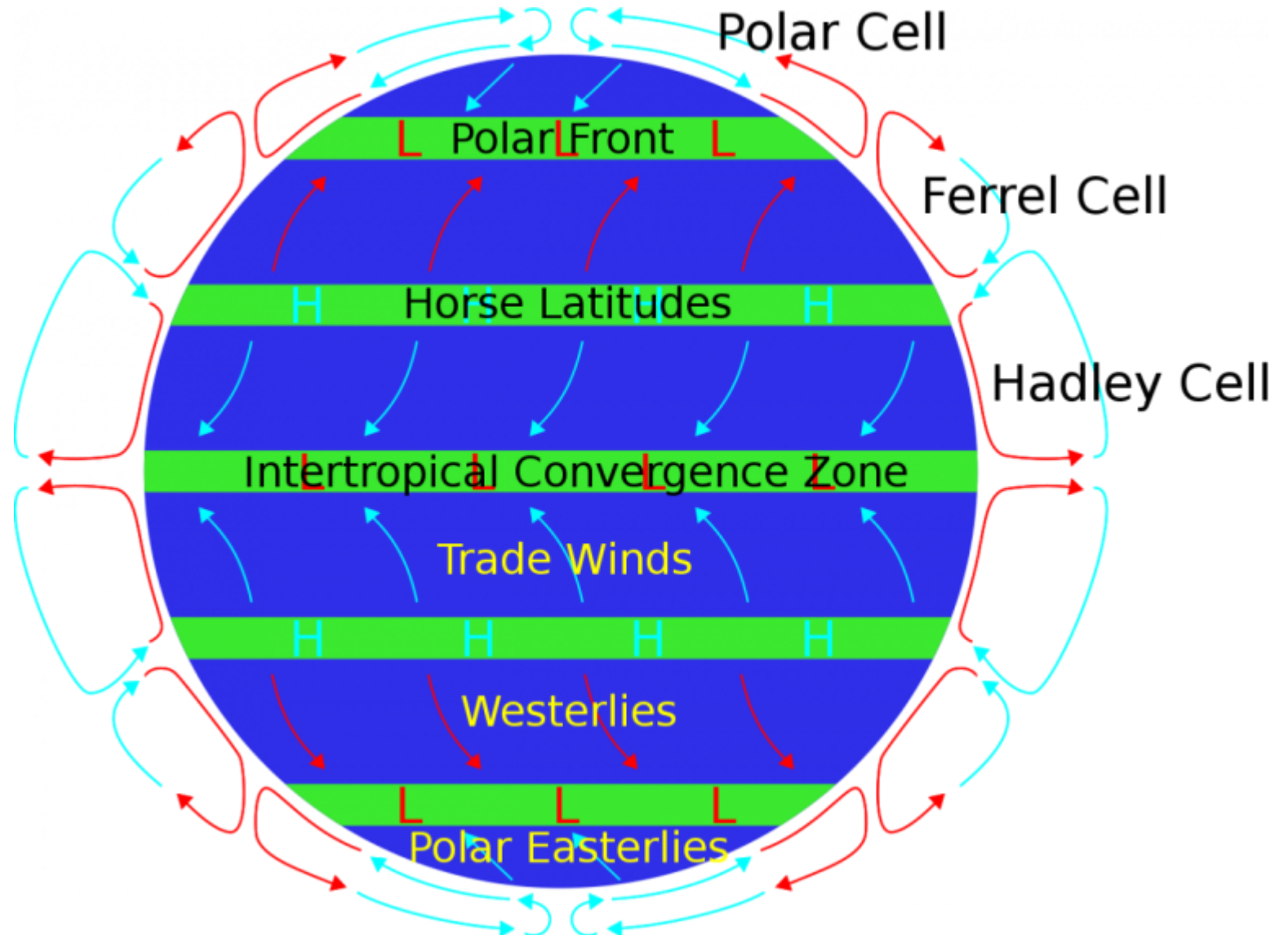


Atmospheric Circulation

Tri-Cellular Model

- The **Tricellular Model** is a **simplified explanation** of how atmospheric circulation patterns give rise to distinct weather and climatic conditions at various latitudes.
- **Cells:** Hadley cell (0-30°)
 - Ferrell cell (30-60°) and
 - Polar cell (60-90°)



Hadley cell

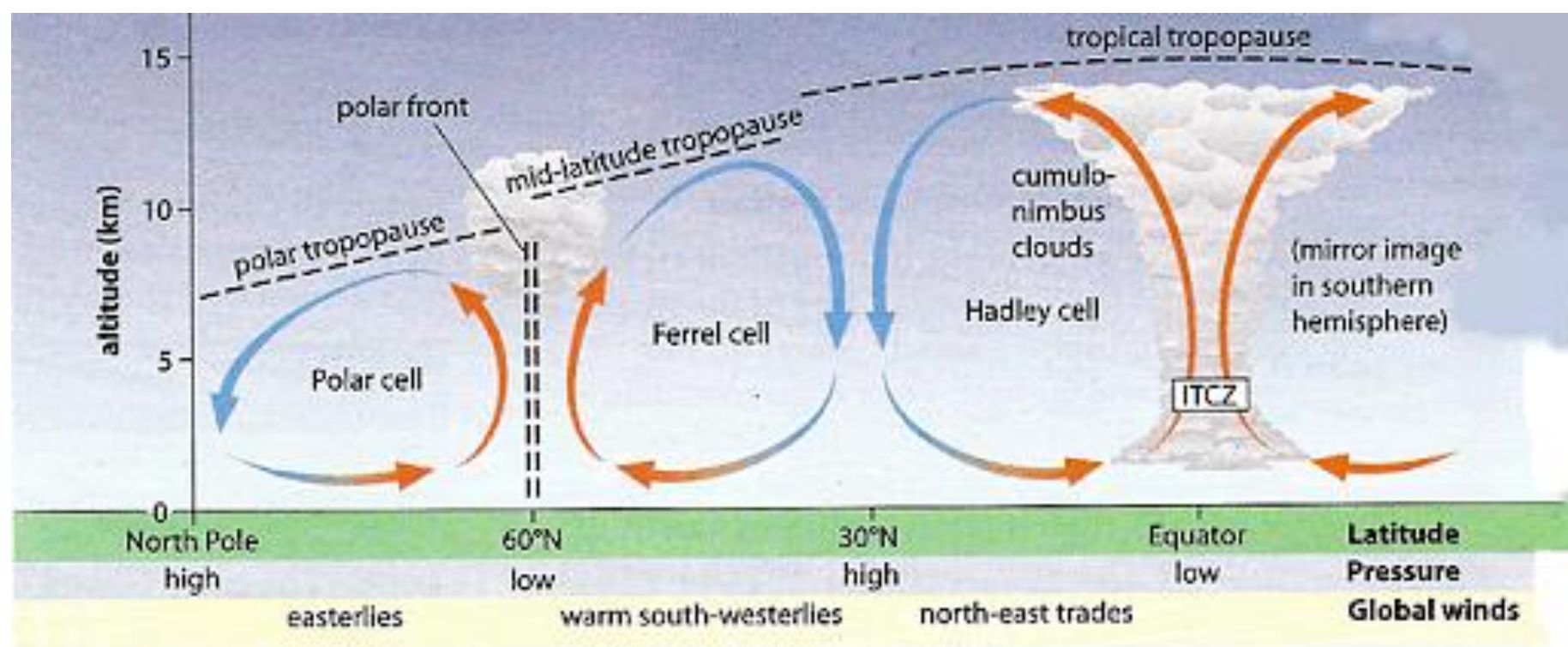
- The cell is located between **5-30 degree latitudes** in both hemispheres.
- This is a **thermally induced cell** and is the **result of intense solar insolation**.
- The **intense insolation produces rising air along the equator**.
- The rising air cools down below the tropopause and diverges towards the pole **as the anti-trade wind**.
- They lead to **upper air around 30 degrees latitude** and **sink causing the subtropical high pressure**.
- The trade wind flows from this **High Pressure toward the equator** and completes this cell.
- **It is one of the most permanent cells** and is **associated with a tropical monsoon and desert climate**.

Ferrell Cell

- This cell extends from **35 to 60-degree** latitude in both hemispheres.
- This is a **thermally indirect** cell and induced **due to dynamic forces**.
- In this cell, the **warm air is seen ascending from the polar front** and breaking through near the tropopause.
- The most important feature of this cell is that the polar front is more continuous in the middle troposphere.
- There is a **subsidence of air in the horse latitude** from the tropical as well as polar front dells.
- On the surface, the circulation is completed by the westerly wind blowing toward the poleward side.

Polar cell

- It extends **from 65 to 90 degrees in both hemispheres.**
- This is a **thermally direct cell** and is **strongest during winter.**
- There is **sinking air along the poles** which moves towards the subpolar low as **the easterly wind.**
- In the subpolar lows, the easterly and westerly interact and the air rises to complete the polar cell circulation.



Importance of Meridional circulation

Plays a vital role in the transfer of energy and in maintaining the heat budget of the earth.

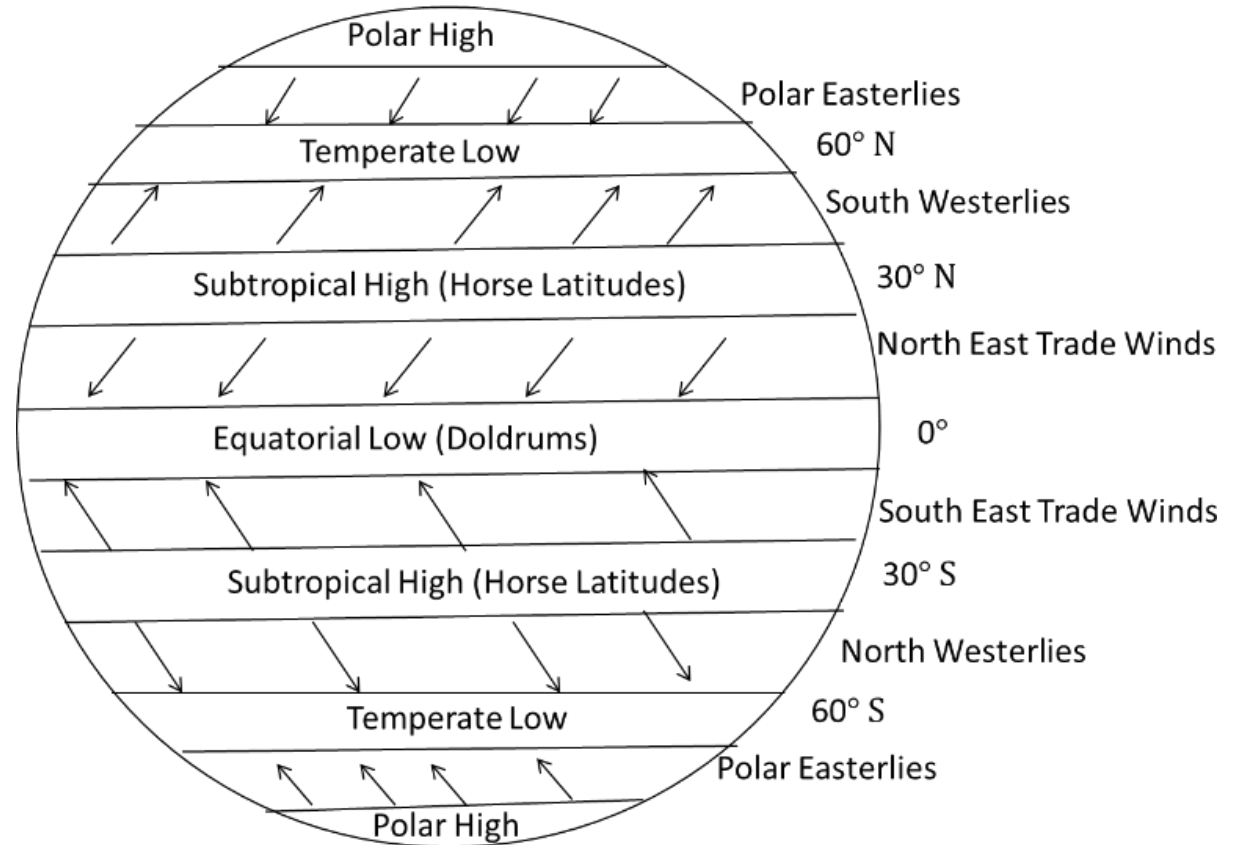
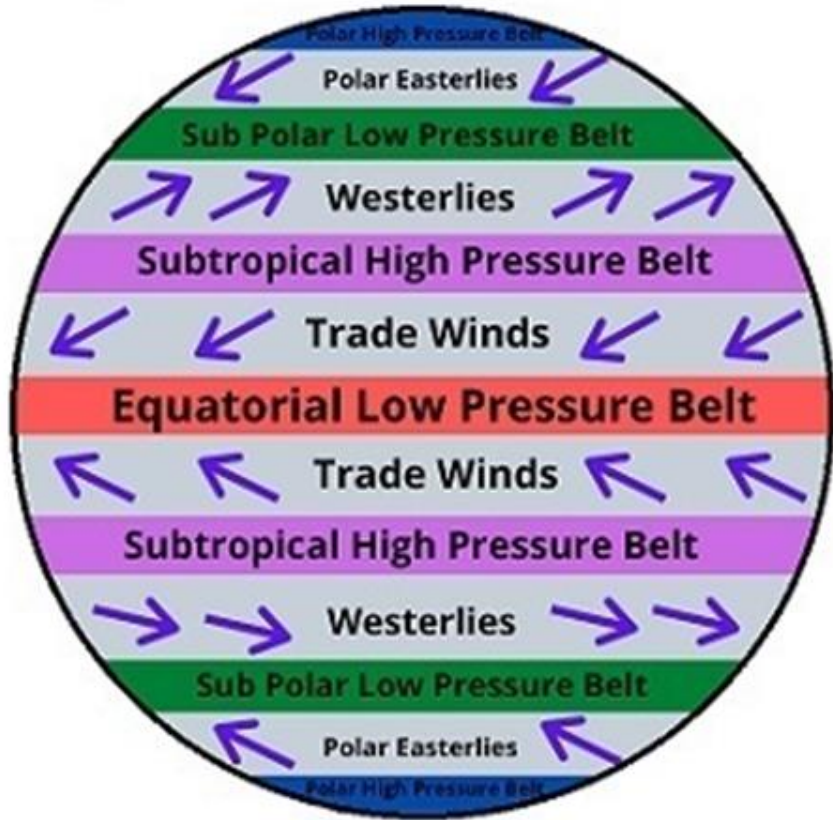
- It aids the formation of doldrums or the **inter-tropical Convergence Zone (ITCZ)**-the most important and uninterrupted belt of convergence on the surface of the earth.
- The **development of tropical cyclones, temperate cyclones, and anticyclones** is also the result of meridional circulation.
- The **tropical deserts of the world** are a manifestation of the air circulation of the Hadley cell.
- The **Phenomenon of monsoon** is also heavily influenced by the Upper air circulation and the trade wind movement.
- Thus, meridional circulation plays an important part in the **global climate and its understanding**

- This circulation is fundamental in maintaining latitudinal heat balance of earth.
- Convective currents of Hadley cells are responsible for heavy precipitation along equator regions.
- Formation of jet streams is the result of these circulation, and upper atmosphere dynamics of rotating earth.
- Temperate cyclones are formed at the polar front formed by ferrel cell and polar cell.
- Subtropical highs are responsible for creating aridity, and sustaining off shore winds and trade wind deserts.
- The interaction of easterly and westerly creates frontogenesis which influences the climate of the subpolar area.
- The tropical deserts of the world are a manifestation of the air circulation of the Hadley cell.
- The Phenomenon of monsoon is heavily influenced by the Upper air circulation and the trade wind movement.

Planetary Winds

- Planetary winds are the type of winds that blow continuously in the same direction from high-pressure belts to low-pressure belts.
- They sweep across countries and oceans.
- There are three types of planetary winds: **trade winds, westerlies, and polar easterlies.**
- **Thus, the following are the properties of planetary winds:**
 - ☐ These pressure belt-controlled winds blow in the very same direction year-round.
 - ☐ Planetary winds are frequently referred to as prevailing or constant winds.
 - ☐ Throughout the year and in a certain direction, they flow from high to low pressure over the Earth's surface and oceans.

Pressure Belts and Planetary Winds



Trade Winds (Tropical Easterlies)

- These trade winds are the winds that blow from subtropical high-pressure areas to the equatorial low-pressure belt.
- As a result, these are limited to a portion of the Earth's surface between 30°N and 30°S.
- They move through the northern hemisphere as the north-eastern trades and the southern hemisphere as the south-eastern trades.
- This deflection away from their ideal north-south direction is understood by Coriolis force and Farrel's law.
- The trade winds drop and remain stable in their origin area, but they grow humid and warmer as they approach the equator due to the moisture they gather up along the route.
- At the equator, the trade winds from both hemispheres meet and, as a result of convergence, they ascend and cause heavy rain. Along with cool ocean currents, Eastern trade winds are drier and more steady than Western ones.

The Westerlies

- These winds are also referred to as **Westerlies**, **Furious Fifties**, **Shrieking Sixties**, and **Roaring Forties**. They blow from subtropical to subpolar high-pressure bands. The southern hemisphere's westerlies are more robust and consistent than the northern hemisphere's.
- The westerlies' primary qualities can be summarised as follows:
- Winds move from subtropical highly pressurised belts to low pressure belts in the subtropics.
- In the Northern Hemisphere, the wind blows from S – W to N – E due to the Coriolis effect; in the Southern Hemisphere, the wind blows from N – W to S – E due to the Coriolis effect.
- Winds blow from lower to higher latitudes.
- Cause significant rainfall, particularly on the continents' western edges.
- Due to fewer barriers from continents, the S – Hemisphere winds are more steady in direction and blow with more force.
- They are additionally referred to as bold winds, roaring forties, furious fifties, and screeching sixties, depending on the severity of the storms in the latitudes where they blow.
- It should be mentioned that not all of the temperate zone's western coast (30° – 60°) receives year-round Westerlies due to the changing of wind belts caused by the Earth's tilt.

Polar Easterlies

- Polar Easterlies are cold, dry, persistent winds that flow from north-east to south-west in the Northern Hemisphere and from south-east to the north-west in the Southern Hemisphere. Easterlies originate in the subpolar lows' high-pressure polar zones.
- Significant characteristics include the following:
- Winds move from the polar high-pressure zone to the subpolar low-pressure zone.
- They are extremely frigid in nature. They originate in arctic regions and do not produce a lot of rain; when these winds collide with westerlies, they form cyclones.
- Brings about frequent changes in weather conditions and results in torrential rain.