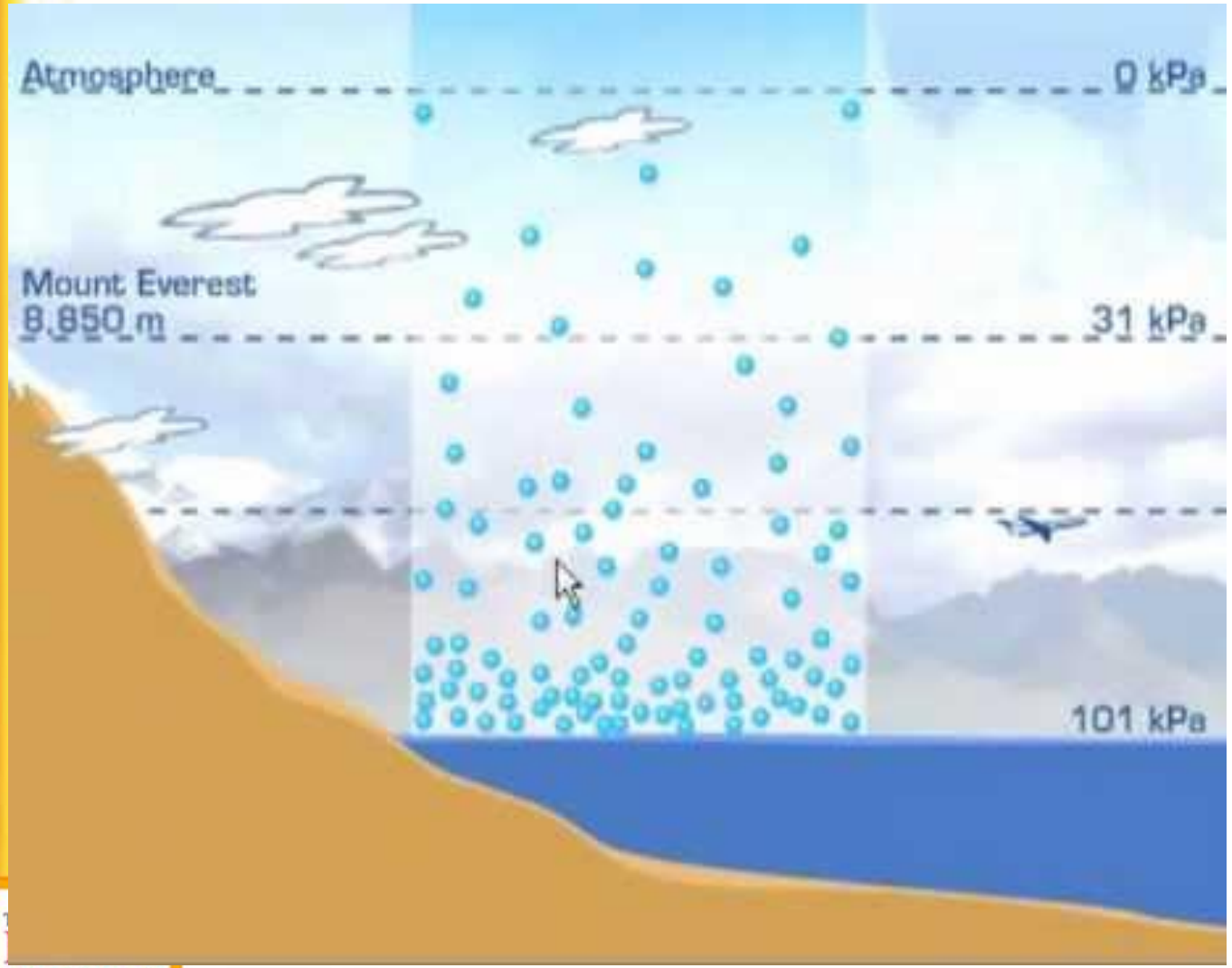
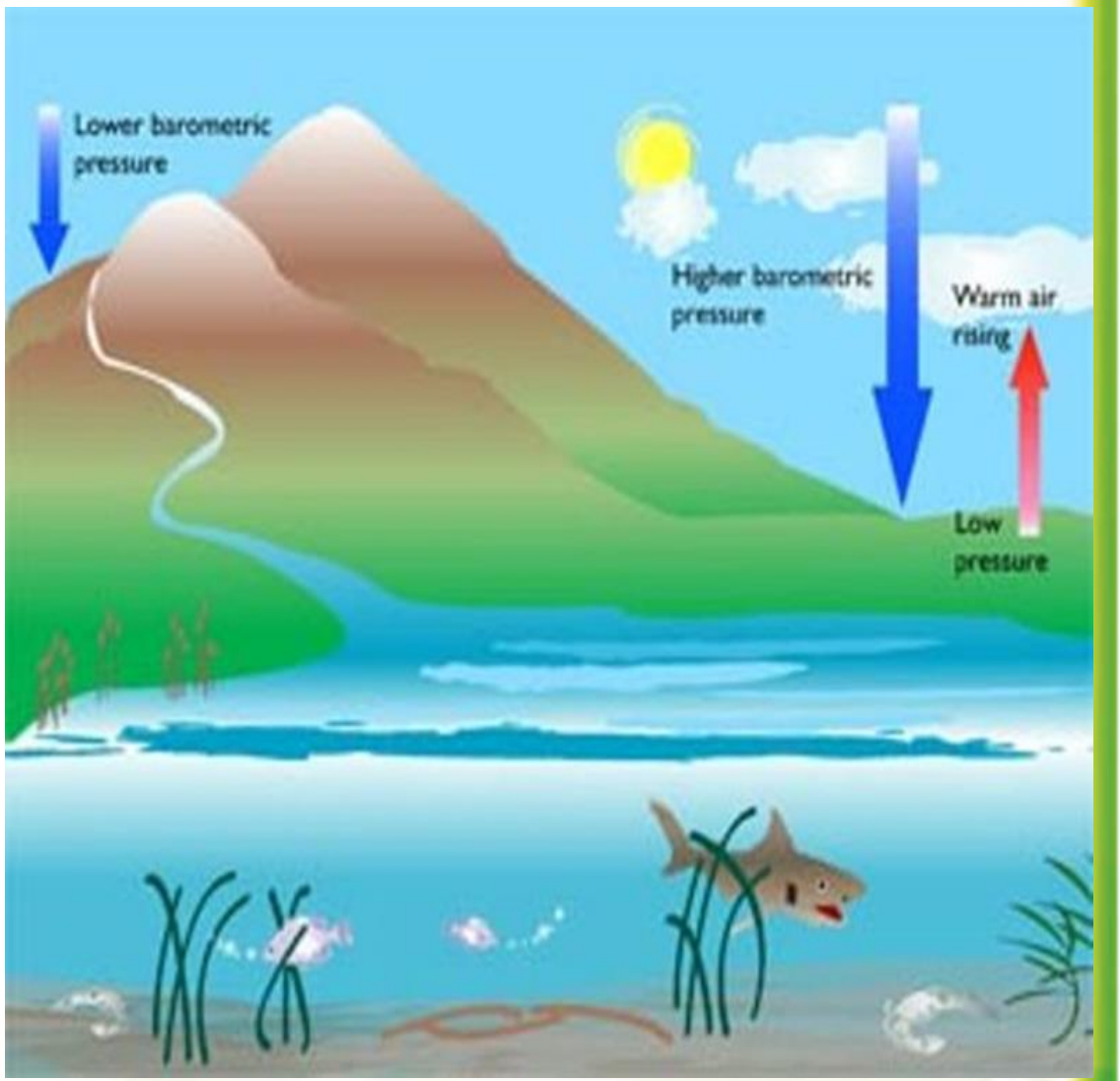
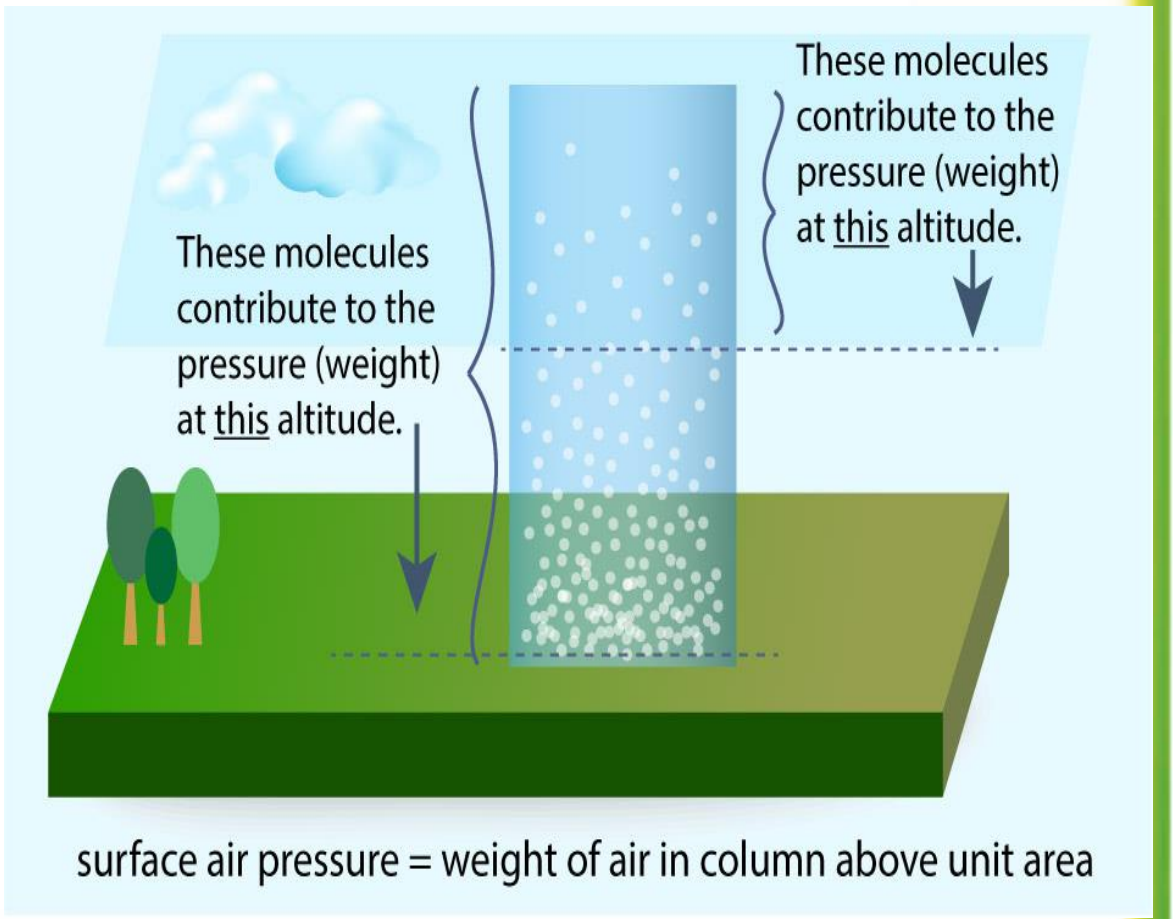
- FACULTY NAME:
  - KANHAIYA JHA
- SUBJECT:
  - GEOGRAPHY
- TOPIC NAME:
  - ATMOSPHERIC PRESSURE

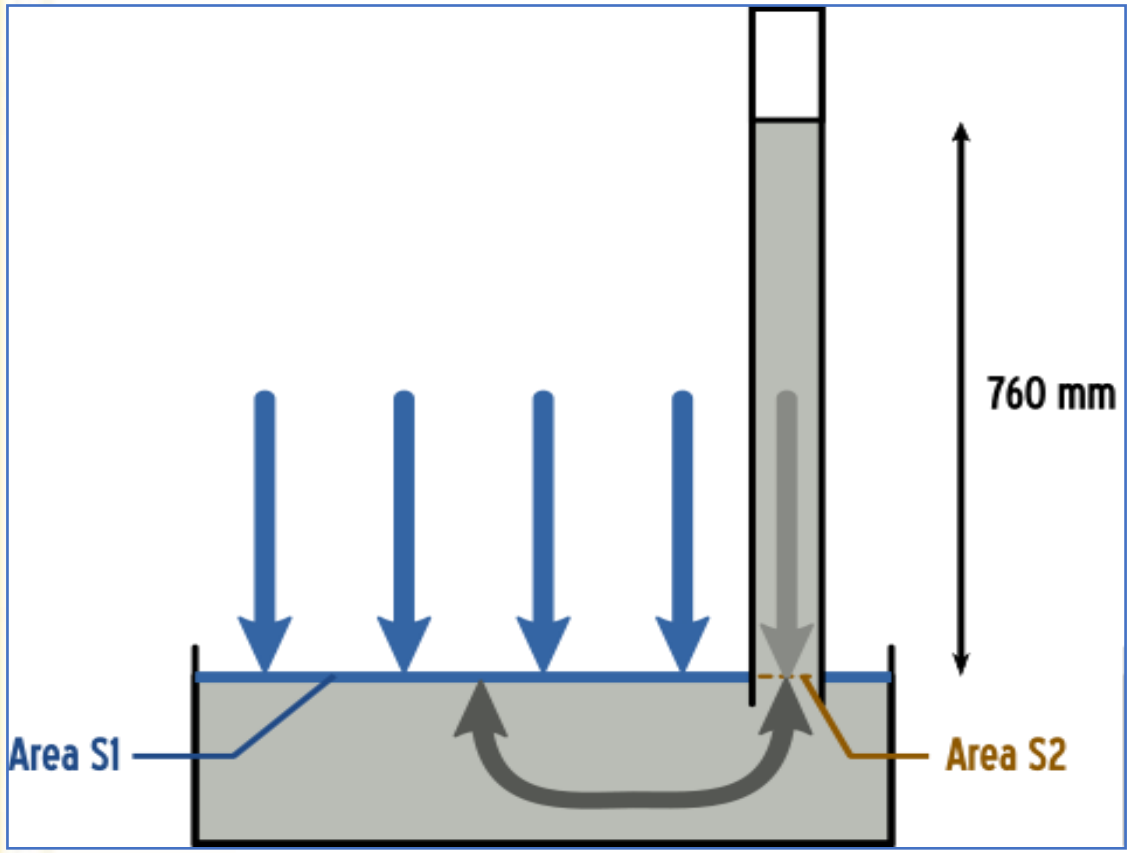

Atmosphere
0 kPa
Mount Everest
8,850 m
31 kPa
101 kPa

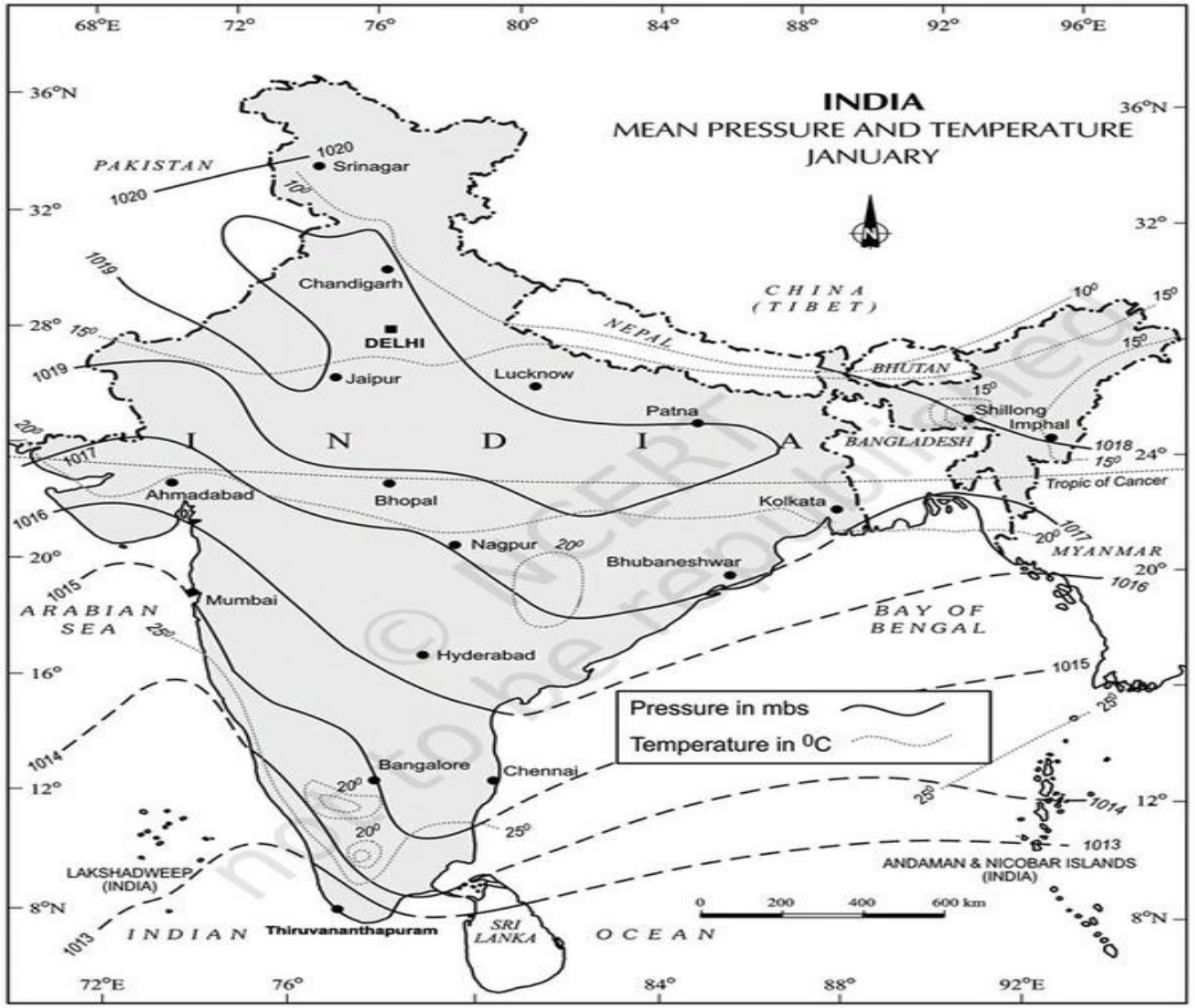

Lower barometric pressure
Higher barometric pressure
Warm air rising
Low pressure

AIR PRESSURE

- Air pressure is defined **as the pressure exerted by the weight of air on the earth's surface**.
- ***The weight of a column of air contained in a unit area from the mean sea level to the top of the atmosphere is called the atmospheric pressure.***
- Pressure is normally measured in **millibars or pascals** and it is measured with the help of a **mercury barometer or the aneroid barometer**.
- The spatial variations of pressure are depicted on maps by means of **isobars. Isobars are imaginary lines connecting places having the same barometric pressure.**

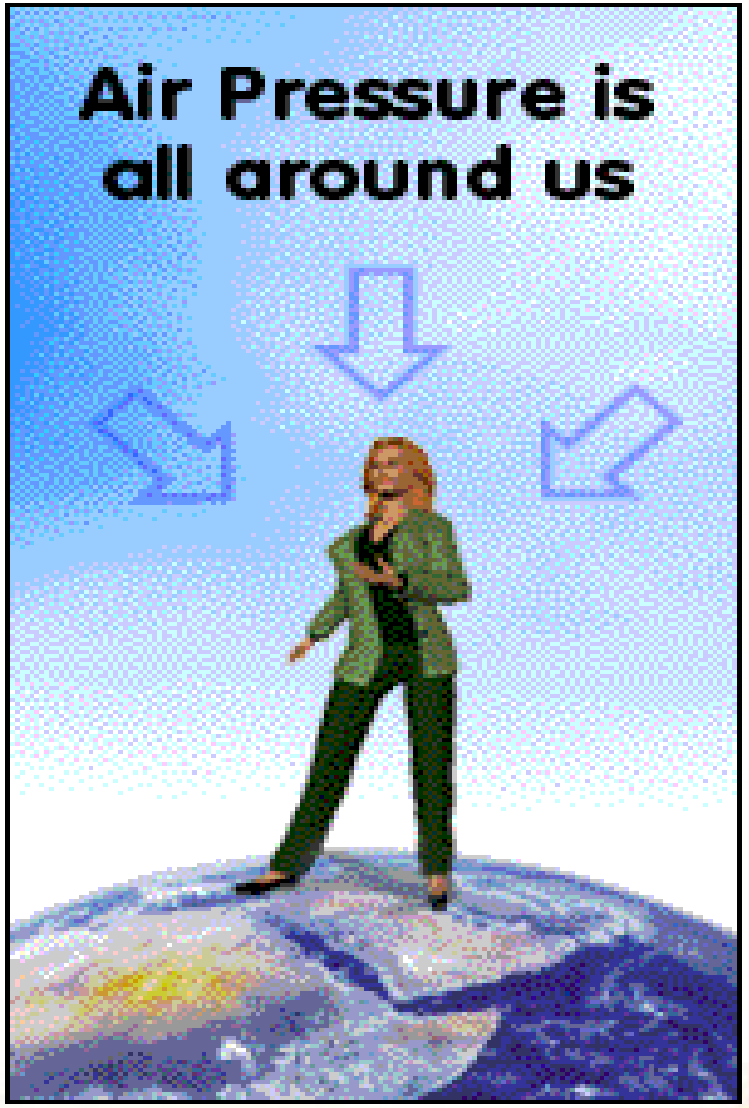


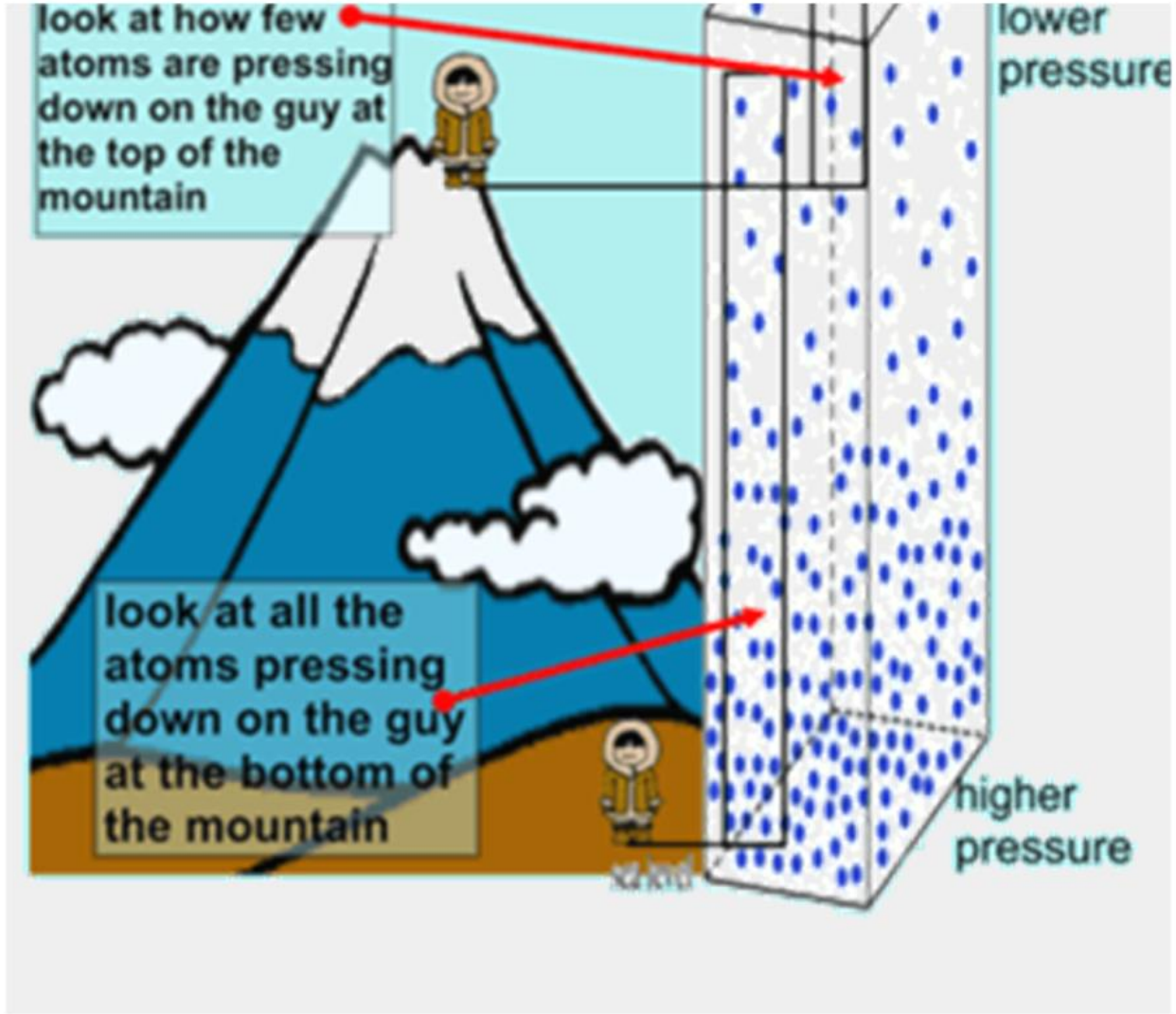

760 mm
Area S1
Area S2


INDIA
MEAN PRESSURE AND TEMPERATURE
JANUARY
Pressure in mbs
Temperature in °C
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
Srinagar
Chandigarh
DELHI
Jaipur
Lucknow
Patna
Shillong
Imphal
Ahmadabad
Bhopal
Kolkata
Nagpur
Bhubaneshwar
Mumbai
Hyderabad
Bangalore
Chennai
Thiruvananthapuram
SRI LANKA
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
LAKSHADWEEP (INDIA)
ANDAMAN & NICOBAR ISLANDS (INDIA)
Tropic of Cancer
0 200 400 600 km

Pressure dynamics

- **One millibar** is equal to the force of **one gram on a square centimeter.**
- A pressure **of 1000 millibars is equal to the weight of *1.053 kilograms per square centimeter***.
- It is equal to the weight of a column of mercury at 76 cm high.
- The air pressure **is highest at sea level and decreases with height** at the rate of **about 1 mb for each 10 m increase in elevation.**
- The **normal pressure at sea level is taken to be about 76 centimeters** (**1013.25 millibars**).
- The actual pressure at a given place and at a given time fluctuates **between 950 and 1050 millibars.**
- The atmospheric pressure decreases on an average at the rate of **about 34 millibars every 300 meters of height**.




look at how few atoms are pressing down on the guy at the top of the mountain
lower pressure
look at all the atoms pressing down on the guy at the bottom of the mountain
higher pressure

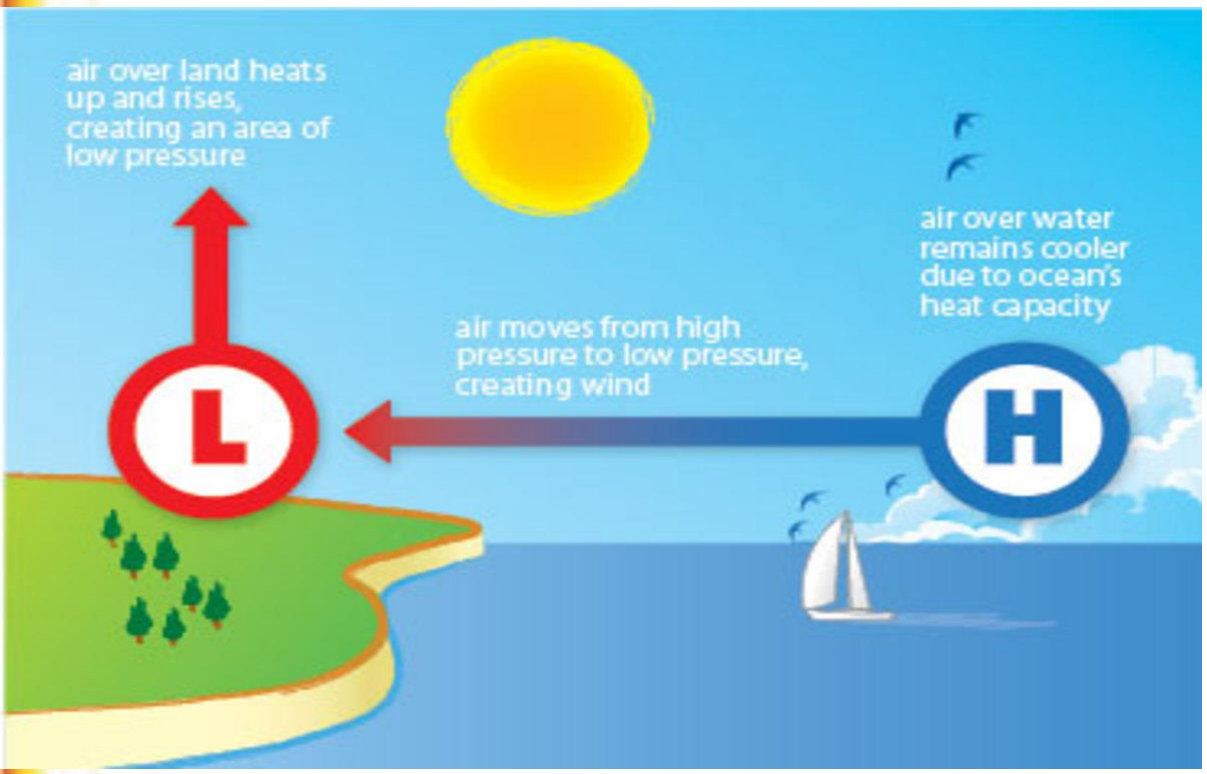
Low and high Pressure

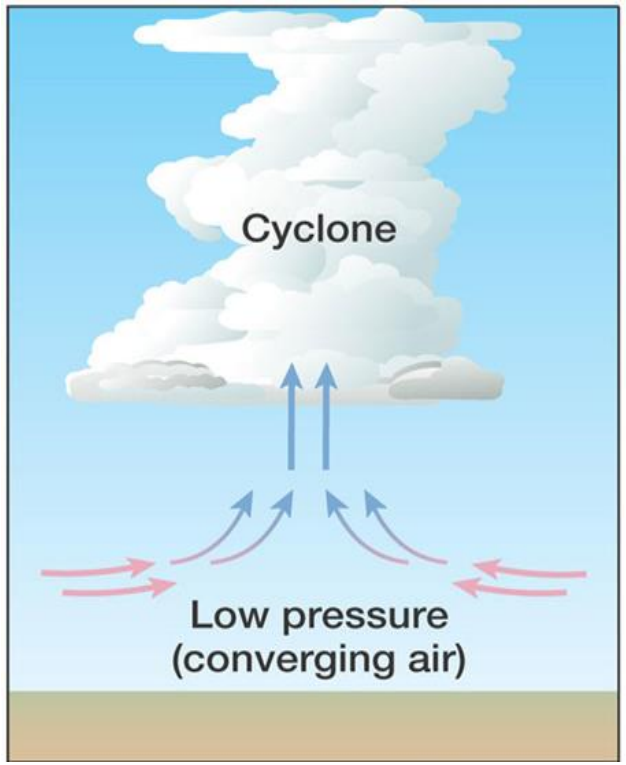
Low pressure area

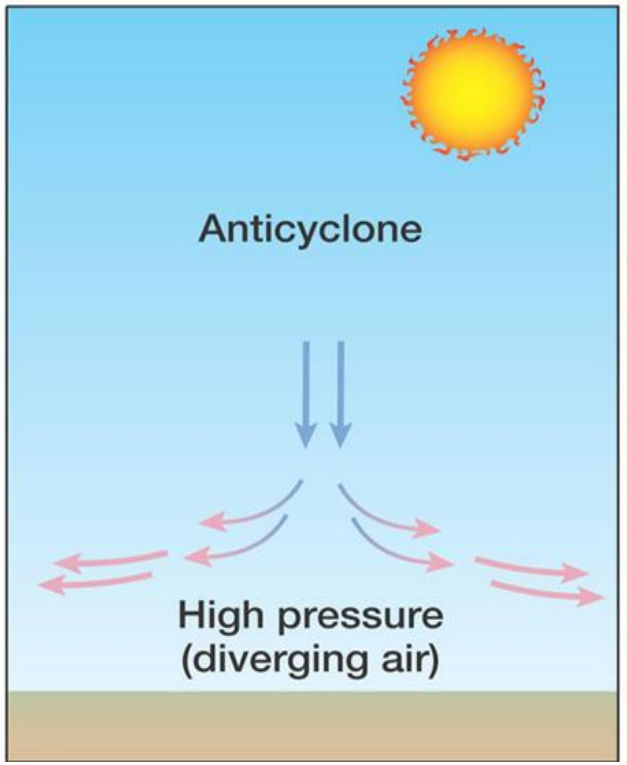
- It refers an areas where the atmosphere is relatively thin and warm.
- Due to high temperature air gets heated and rises.
- It is associated with cloudy skies and wet weather.

High pressure area

- It refers an areas where the atmosphere is relatively thick and cold. Due to lower temperature, the air becomes cold and therefore heavy.
- **Heavy air sinks and creates a high pressure area.**
- High pressure is **associated with clear and sunny skies.**

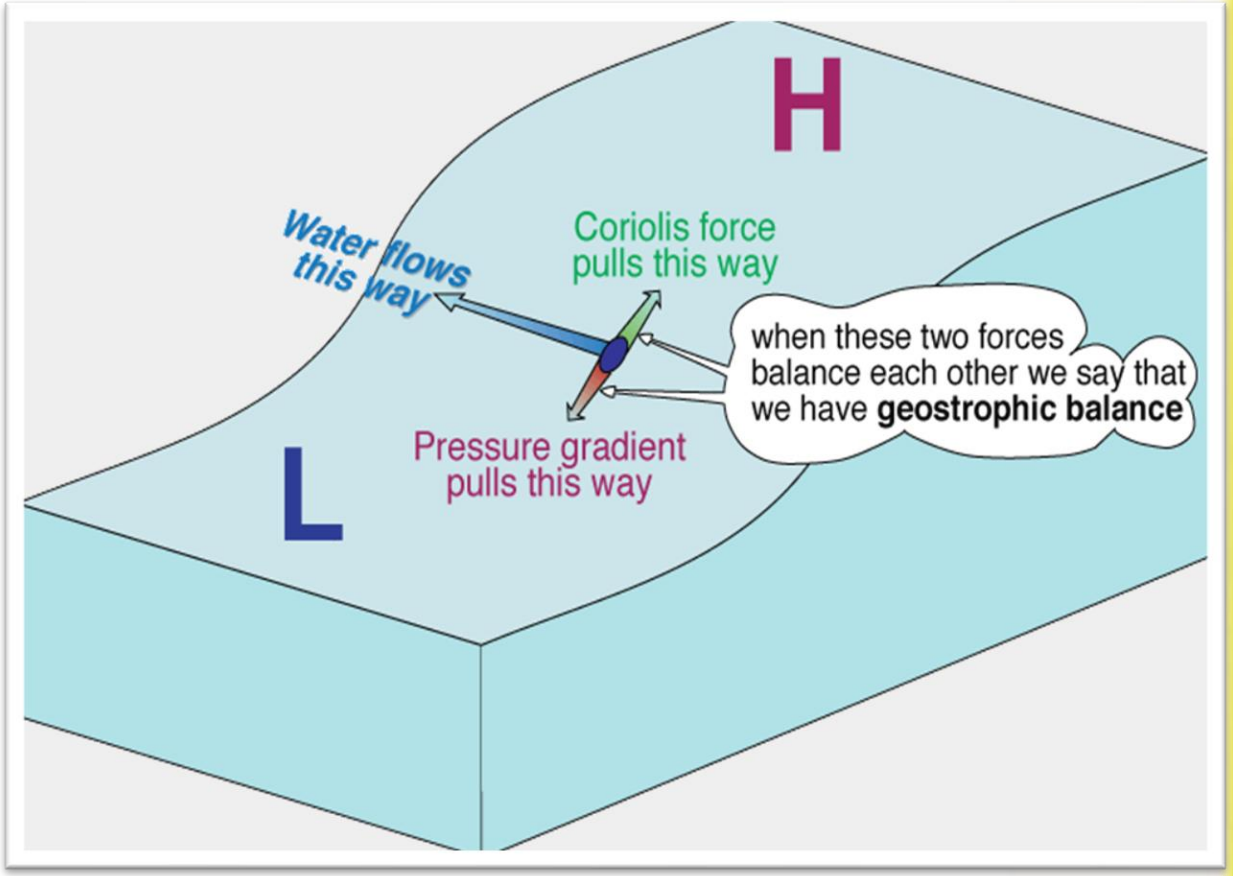

air over land heats up and rises, creating an area of low pressure
air over water remains cooler due to ocean's heat capacity
air moves from high pressure to low pressure, creating wind
L
H

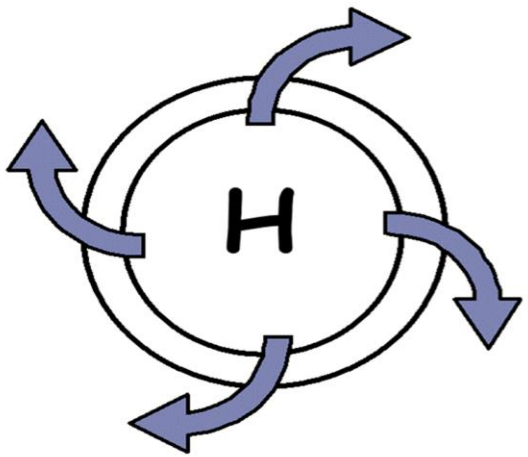

Cyclone
Low pressure
(converging air)

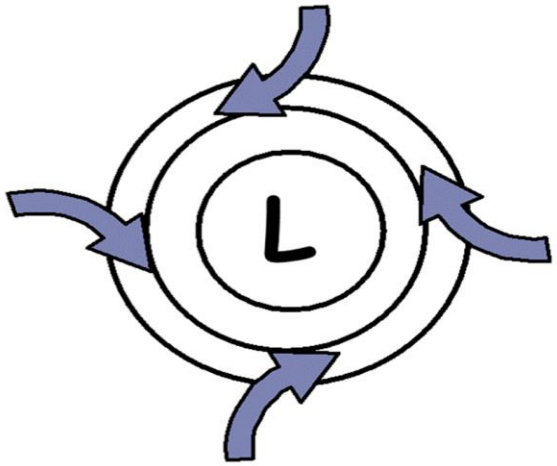

Anticyclone
High pressure
(diverging air)

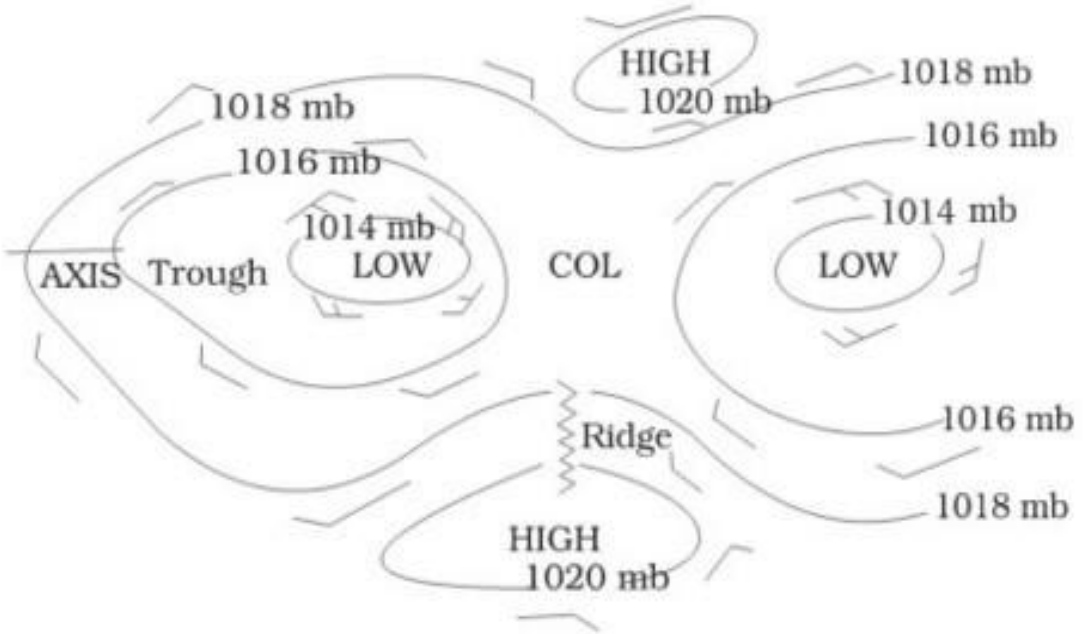
Pressure gradient

- The gradual change of pressure between different areas is known as the **barometric slope or pressure gradient.**
- The pressure gradient may thus be defined as the **decrease in pressure per unit distance in the direction in which the pressure decreases most rapidly.**
- The **closer the isobars are together, the greater the pressure gradient.**
- While widely spaced isobars indicate a **weak pressure gradient**.




H


L


HIGH
1020 mb
1018 mb
1018 mb
1016 mb
1016 mb
1014 mb
1014 mb
AXIS
Trough
LOW
COL
LOW
Ridge
1016 mb
1018 mb
HIGH
1020 mb

Horizontal Distribution of Pressure

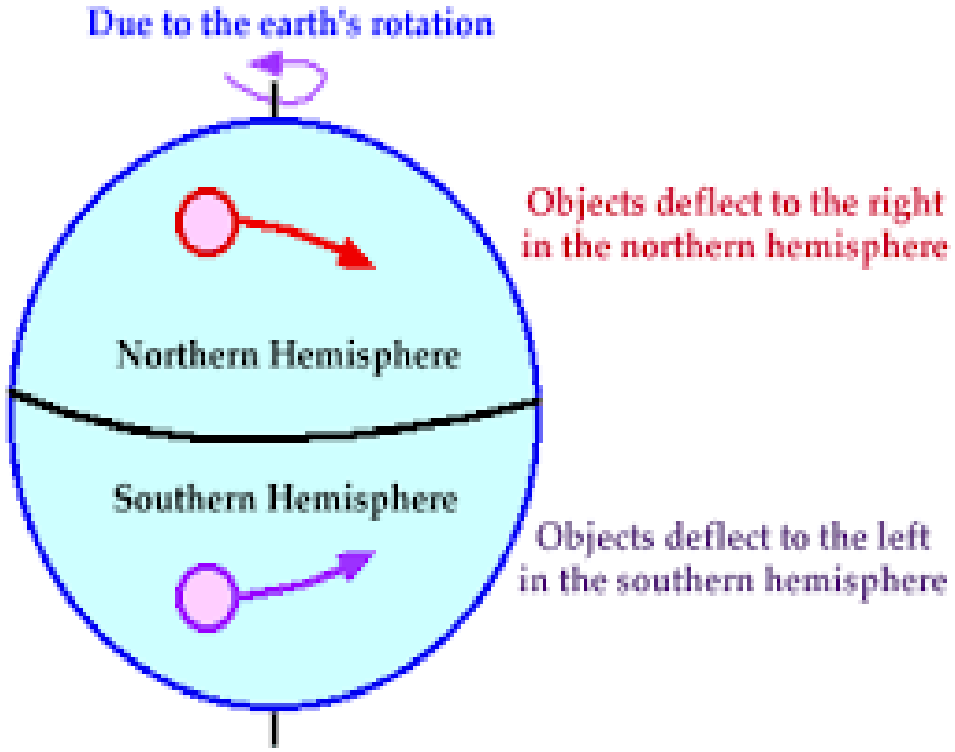
- Horizontally the distribution of **air pressure is influenced by the thermal and dynamic factors.**

Thermal Factors

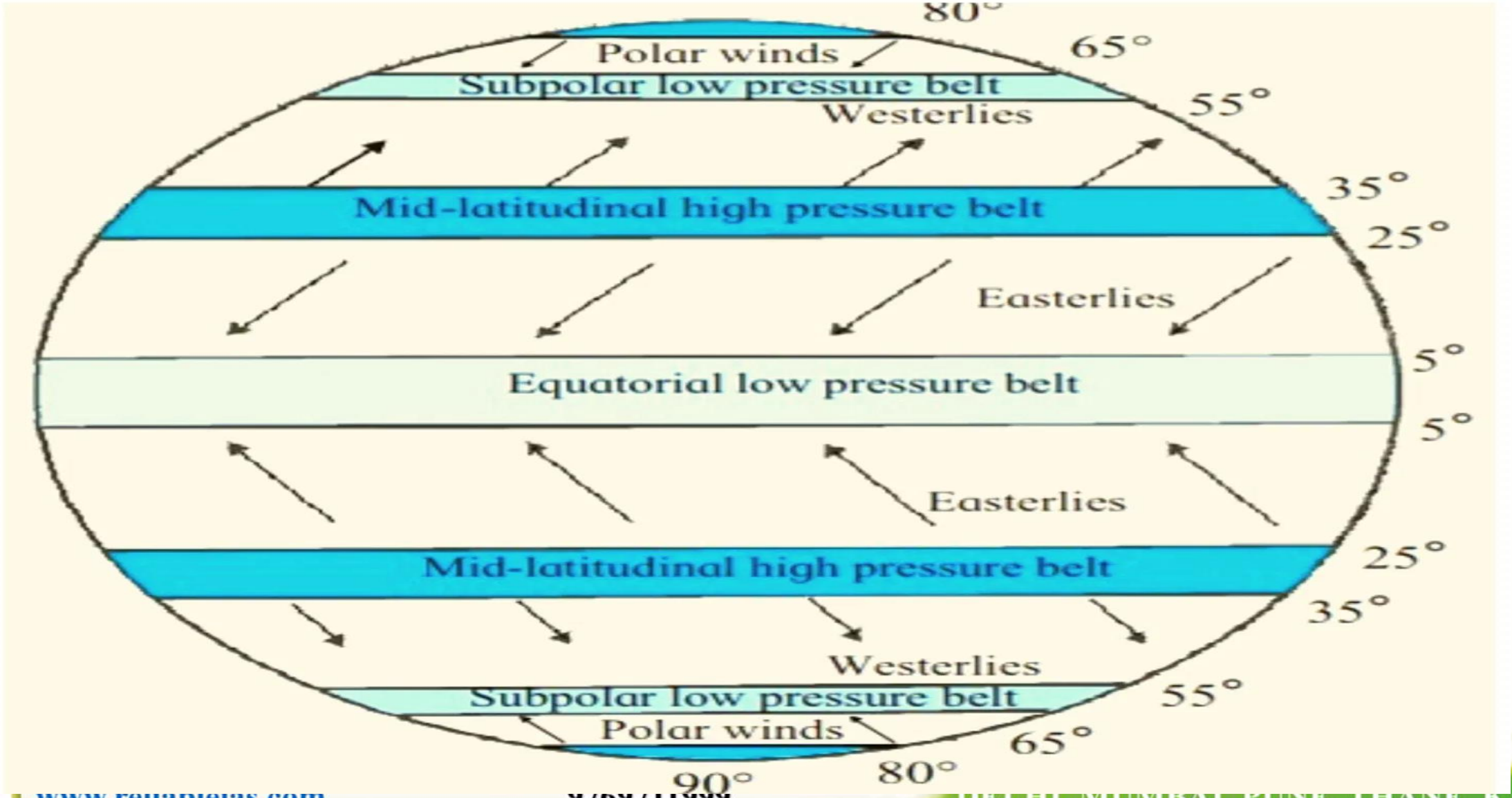
- When air heats, it expands and, hence, density decreases. Due to it **air moves upward or sideward.**

Dynamic Factors

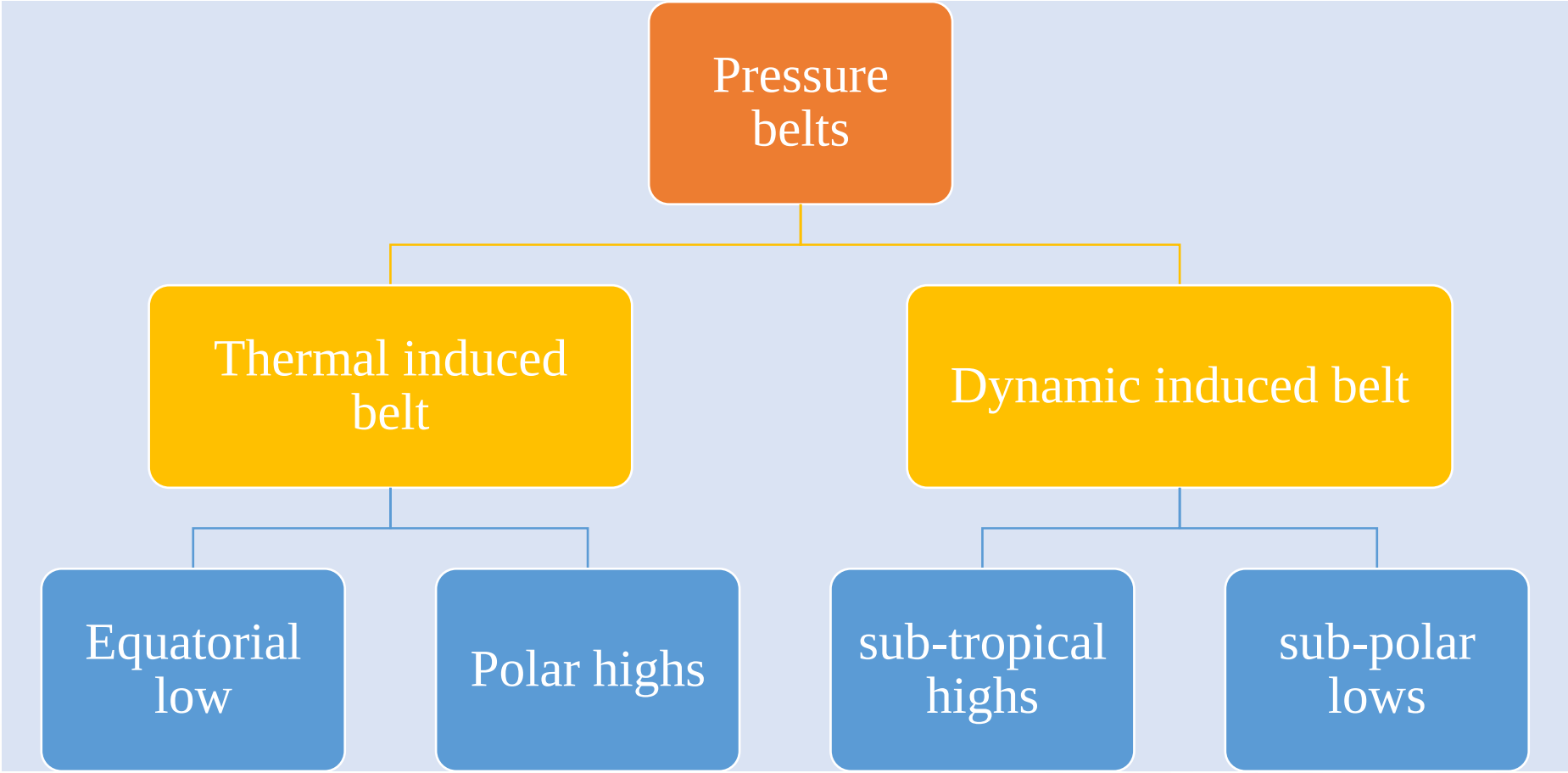
- Due to rotation of the earth , **strong Coriolis force develops. It causes deflection of wind.**
- **In northern hemisphere winds moves toward its right and in southern it moves leftward.**



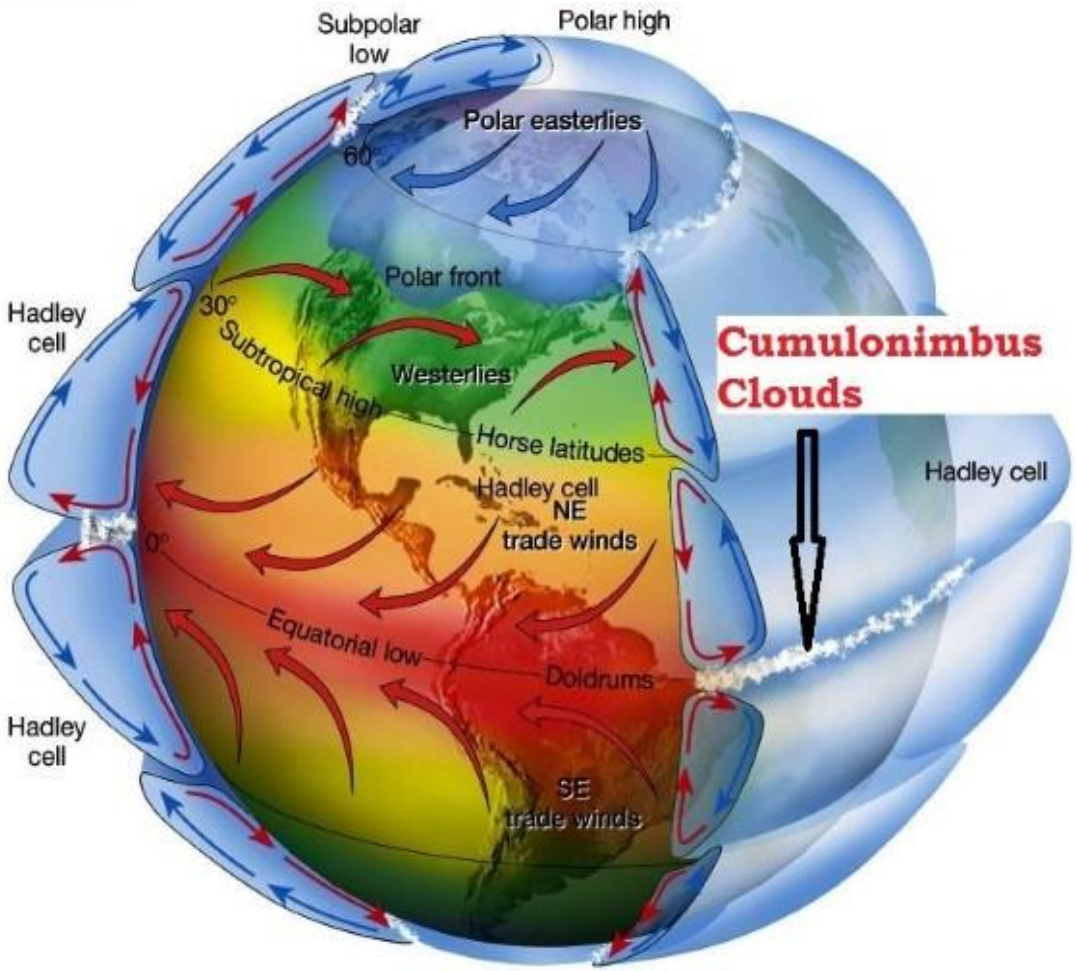
PRESSURE BELT OF EARTH

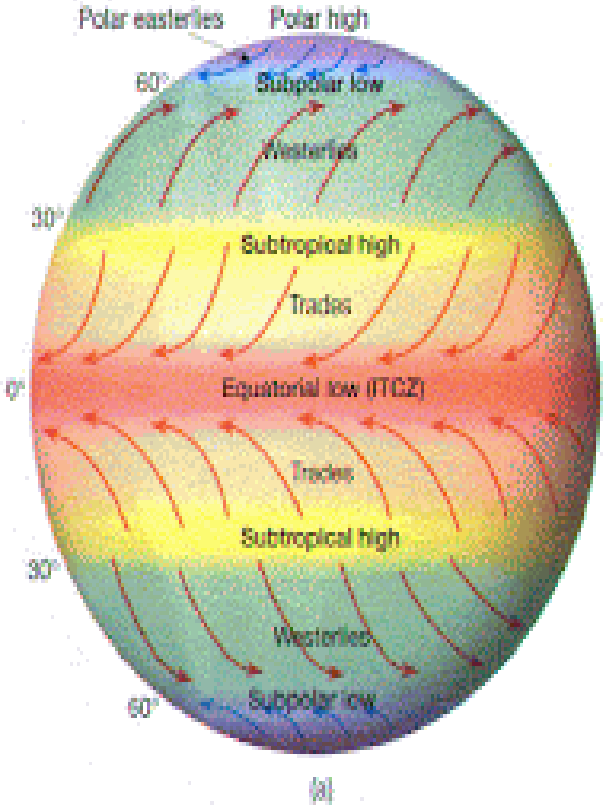


- There are 7 identifiable horizontal ‘pressure belts’ found on the earth’s surface.
- All such can be put into two groups-

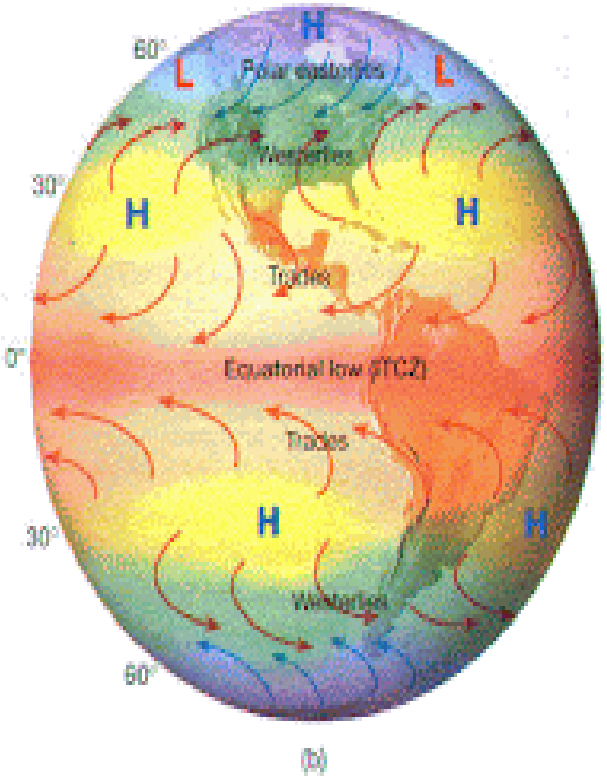


Equatorial low pressure belt or Doldrums





(a)



(b)

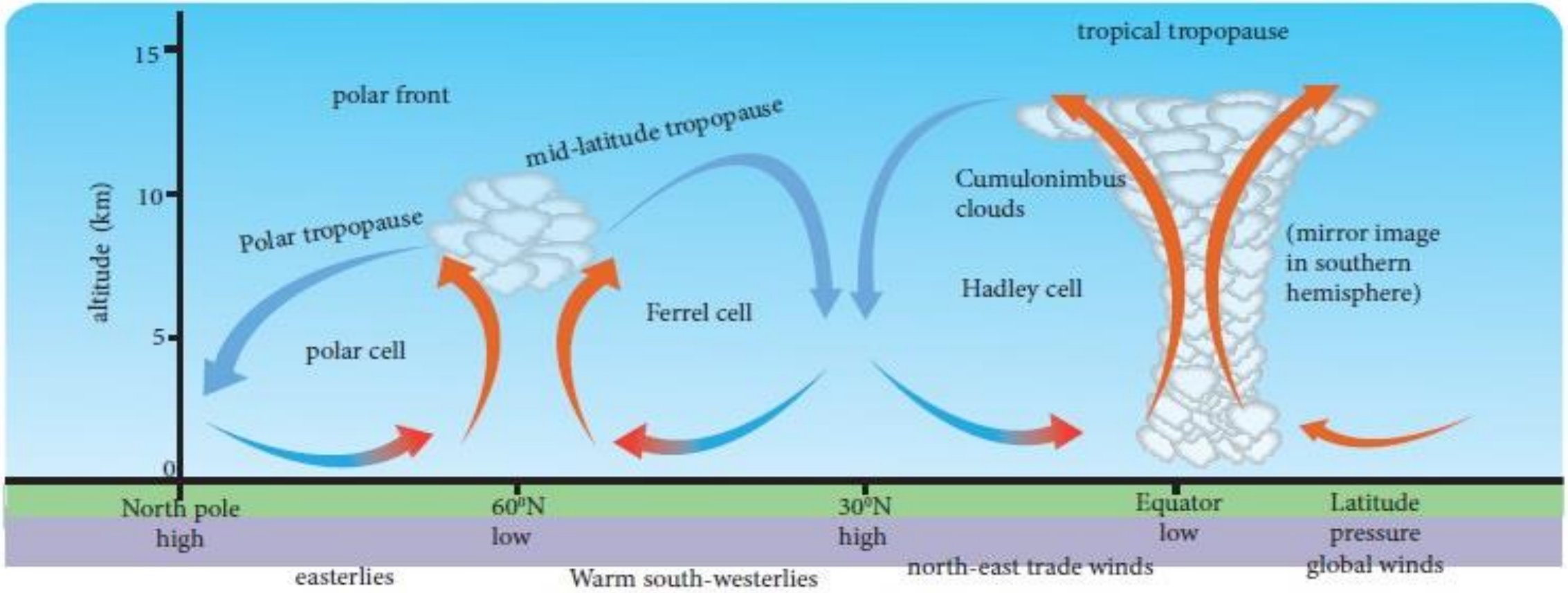
- It Lies between **10° N and 10° S latitudes.**
- Is also called the **Doldrums**, because of the **extremely calm air movements.**
- The position of the belt varies with the apparent movement of the Sun.

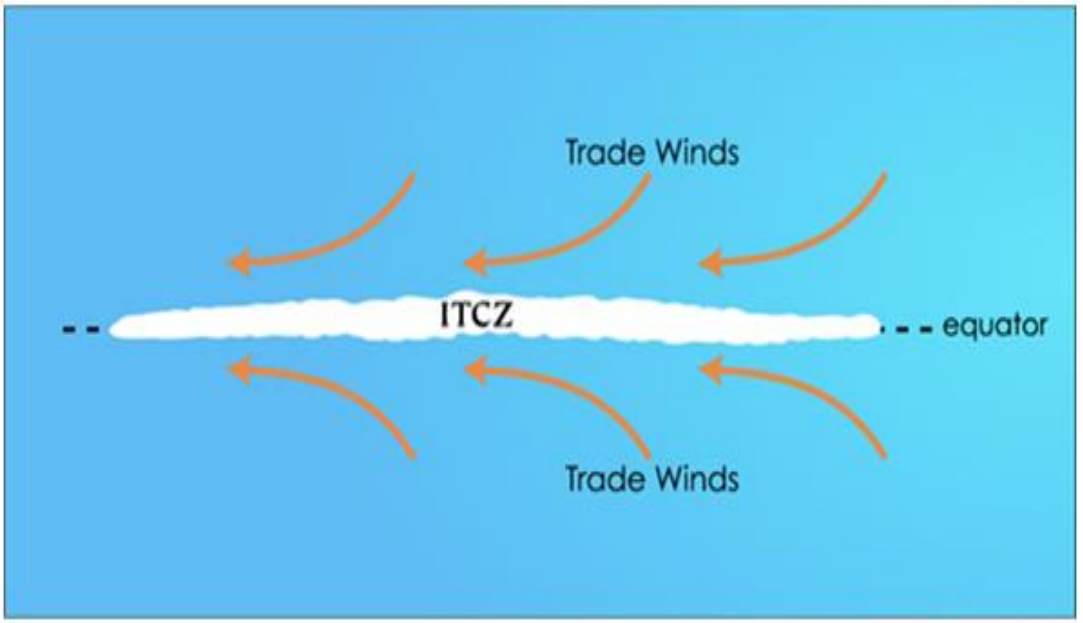
Formation

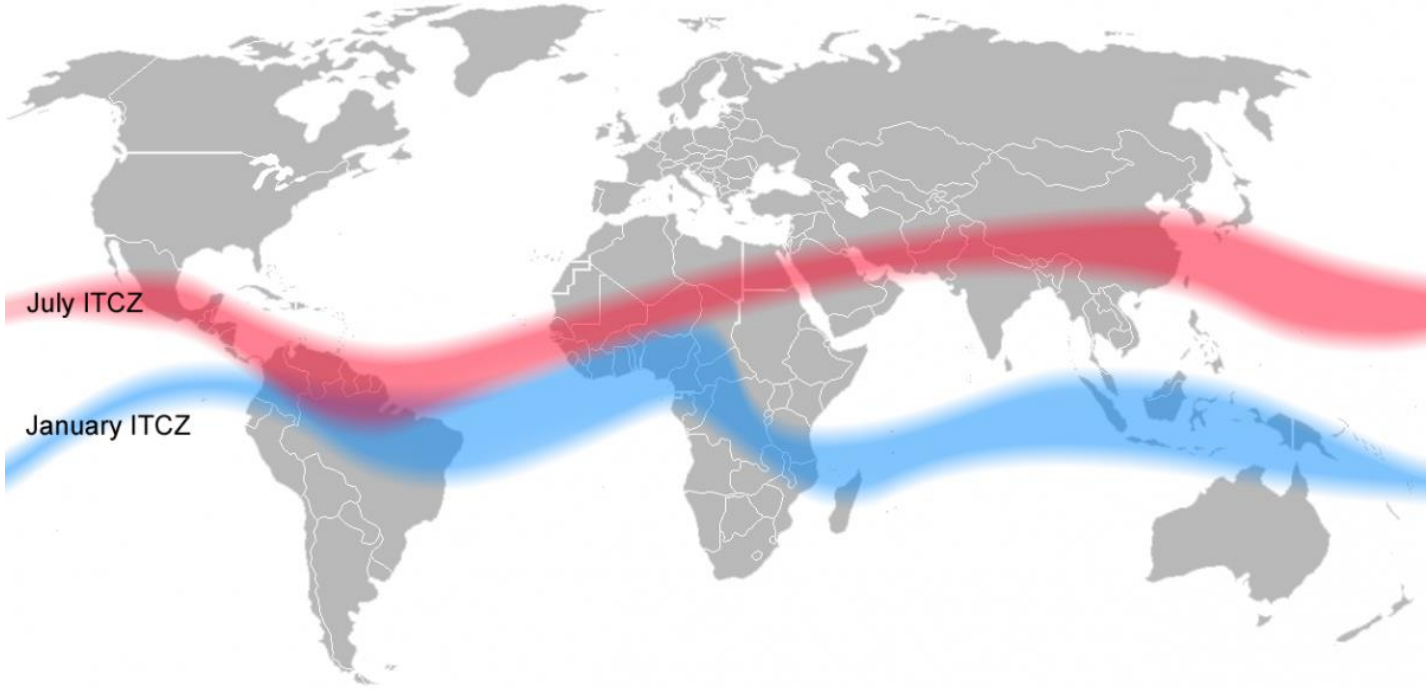
- As this region lies along the equator, **it receives highest amount of insolation**.
- Due to intense heating, air gets warmed up and rises over the equatorial region (convection)

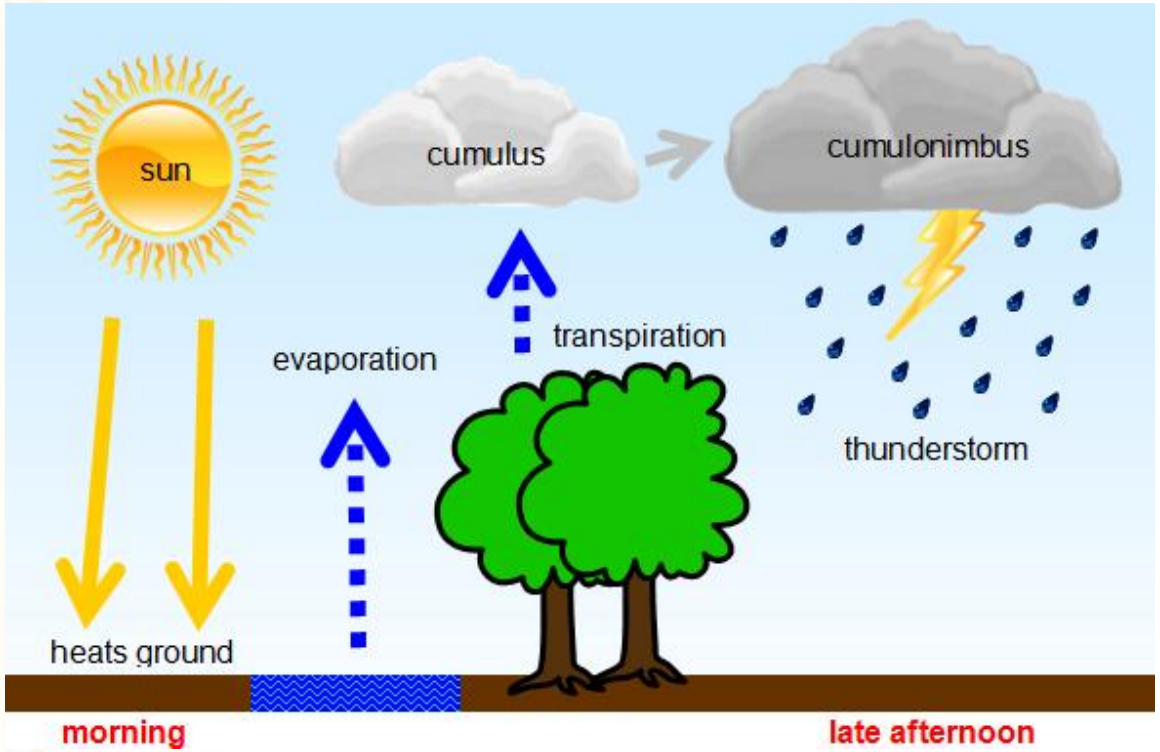
Characteristics

- Characterized by **extremely low pressure** with **calm conditions**.
- It is the **zone of convergence of trade winds hence called ITCZ (Inter-Tropical Convergence Zone)**
- Vertical winds (convection) carry moisture and give birth to **cumulonimbus clouds. That yield downpour and thunderstorms (convectional rainfall).**
- **In spite of high temperatures, cyclones are not formed at the equator because of 'zero' Coriolis force.**

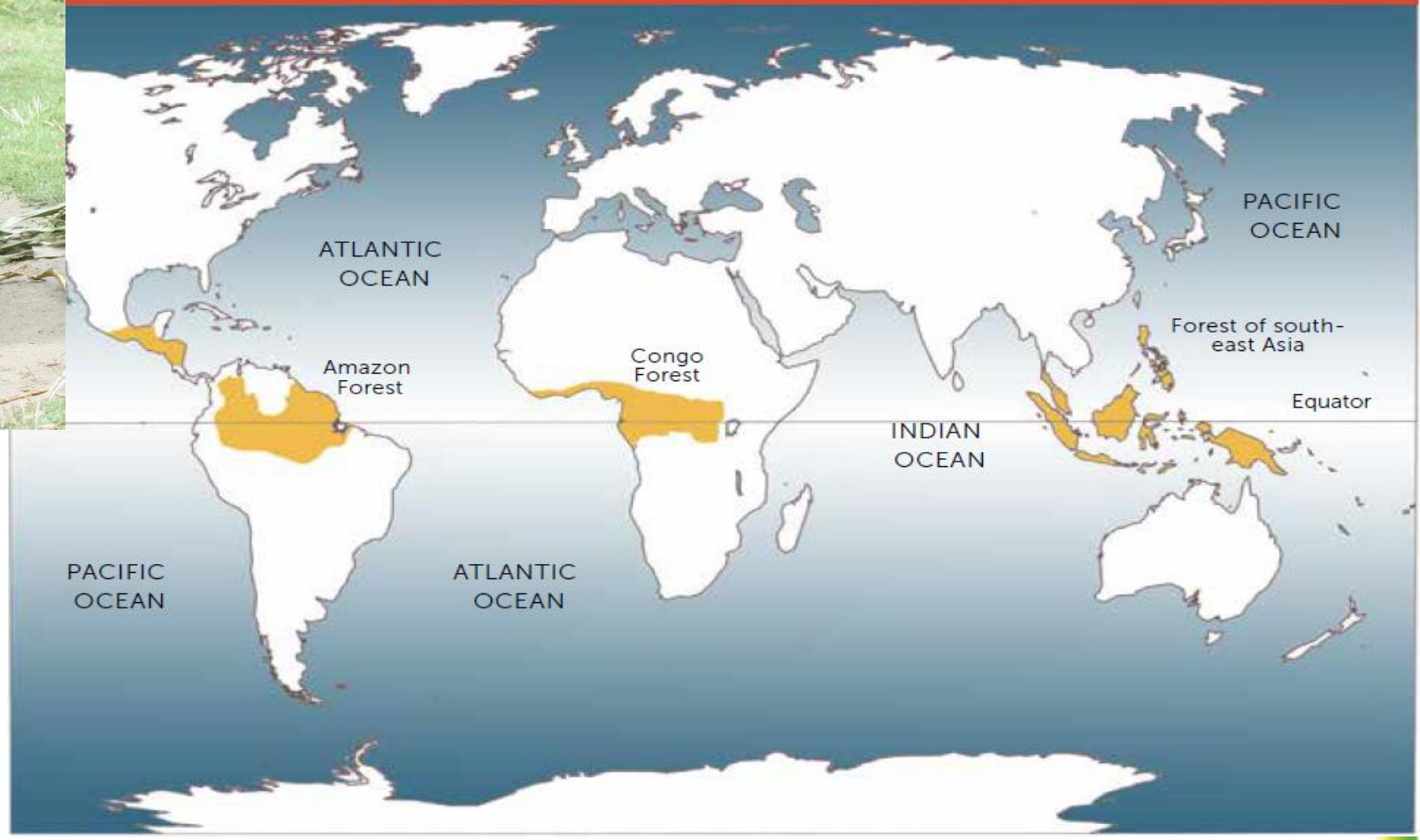

tropical tropopause
15
polar front
mid-latitude tropopause
10
altitude (km)
Polar tropopause
Cumulonimbus clouds
(mirror image in southern hemisphere)
Hadley cell
Ferrel cell
polar cell
5
0
North pole high
60°N low
30°N high
Equator low
Latitude pressure global winds
easterlies
Warm south-westerlies
north-east trade winds

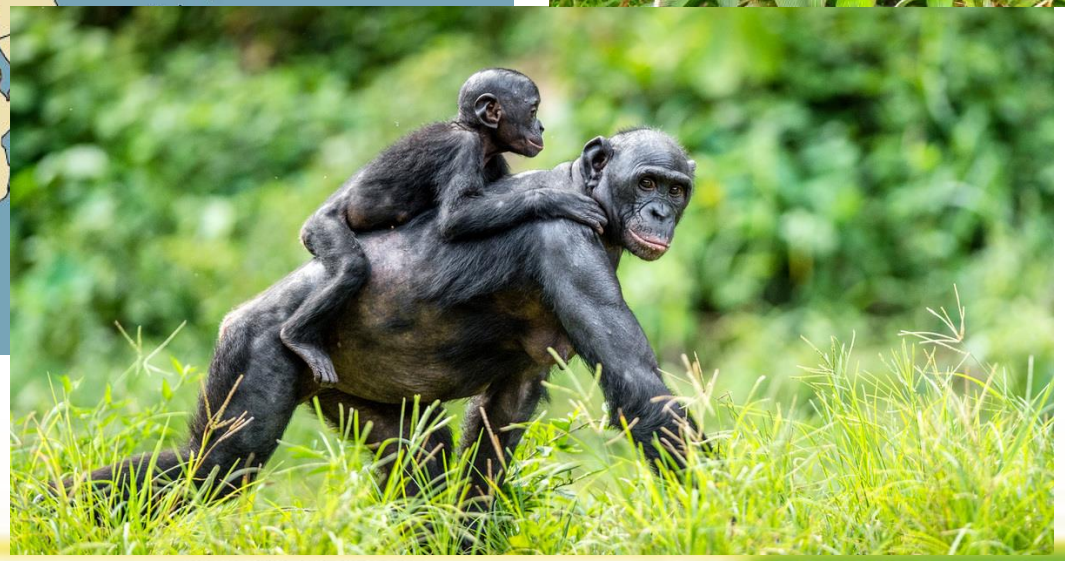

Trade Winds
ITCZ
equator
Trade Winds


July ITCZ
January ITCZ

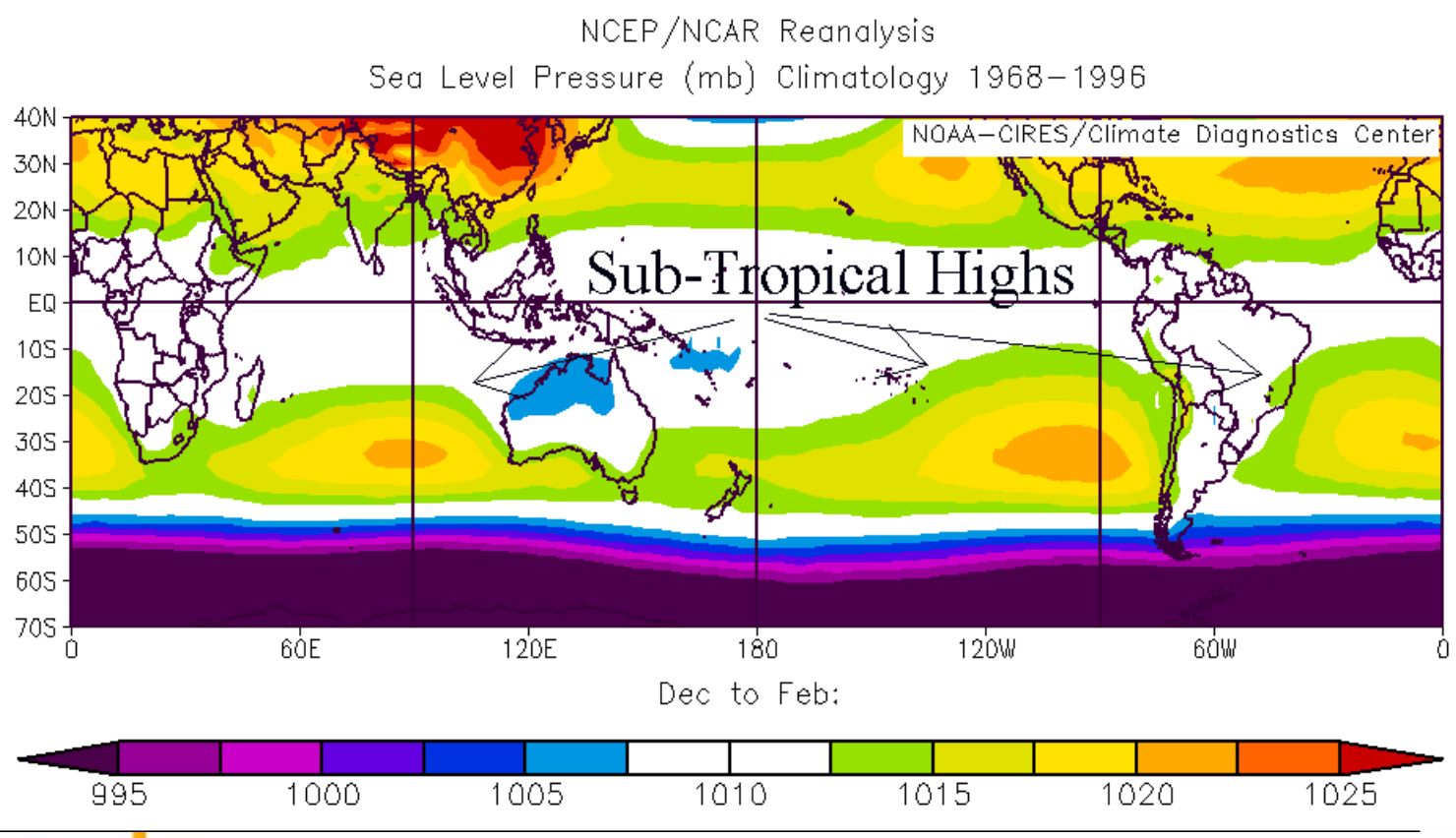

sun
cumulus
cumulonimbus
transpiration
evaporation
thunderstorm
heats ground
morning
late afternoon

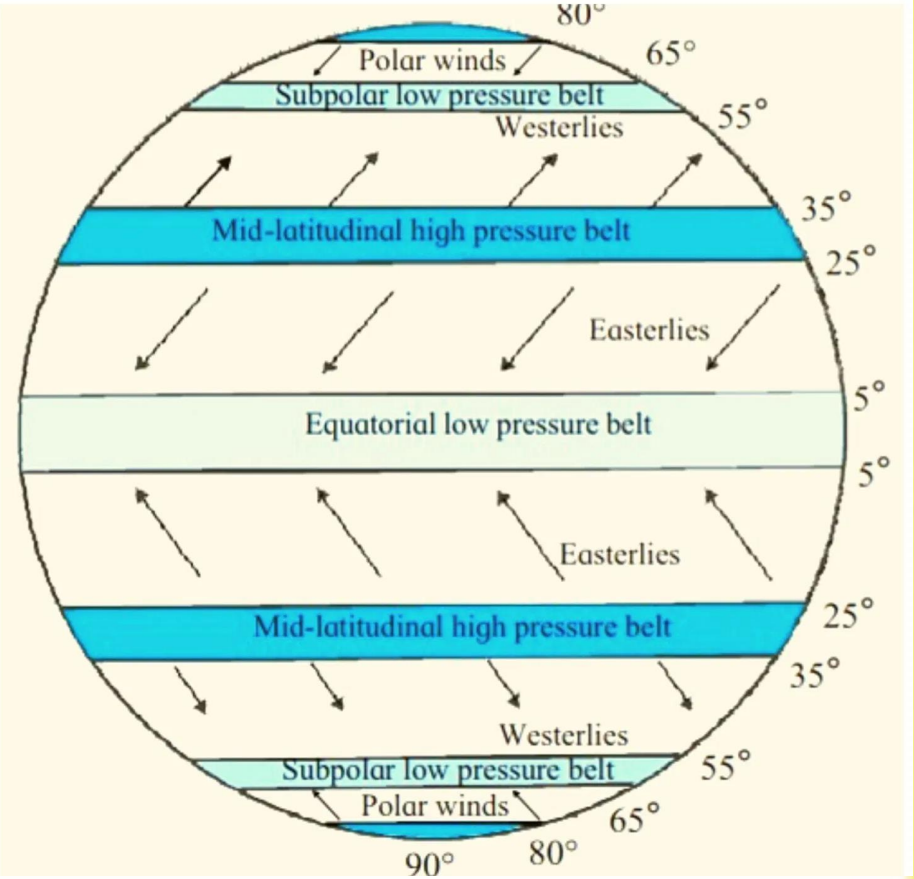
Tropical rainforests





Sub-Tropical High Pressure Belt (Horse Latitudes)





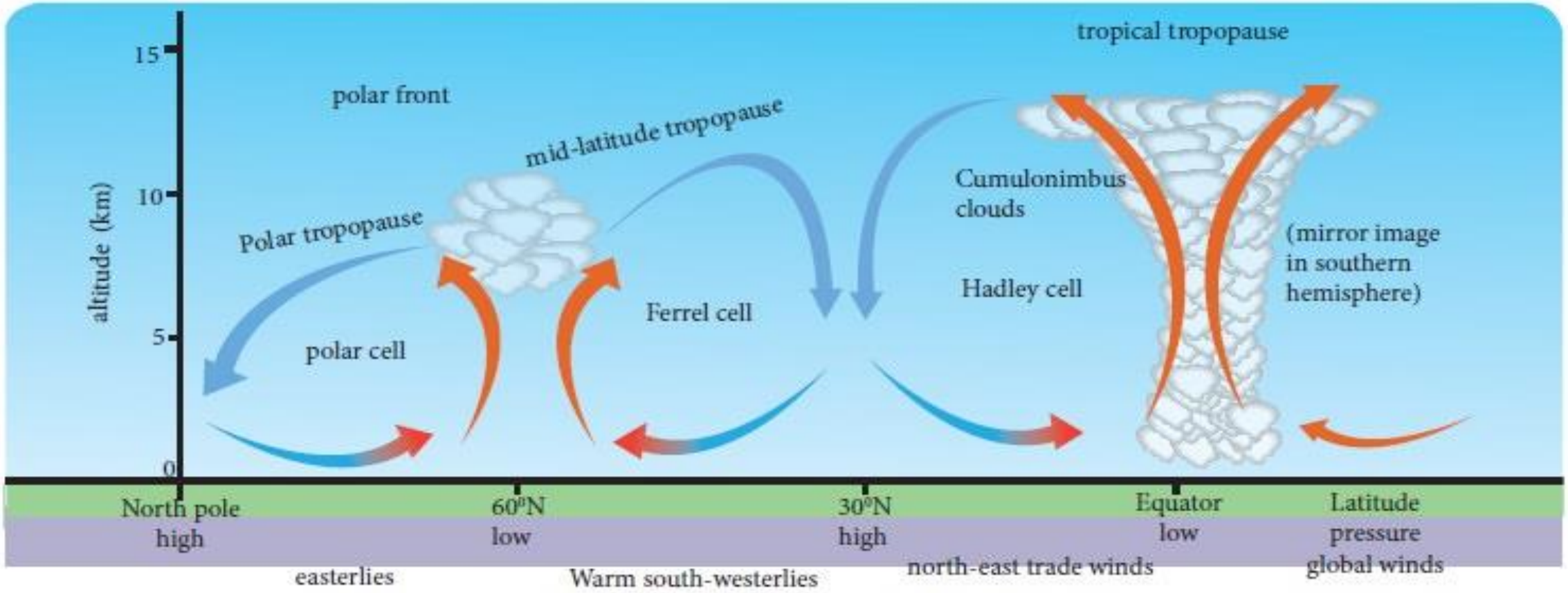
- The sub-tropical highs extend from near the tropics to about **25-35° N and S**.

Formation

- Air above ITCZ start moving away from equatorial low pressure belt due to rotation and deflection caused by earth rotation.
- Gradually, in the upper troposphere air becomes dry and cold. It indeed subsides at 30°N and S.
- So the high pressure along this belt is due to subsidence of air coming from the equatorial region which descends after becoming heavy.
- The high pressure is also due to the **blocking effect of air at upper levels because of the Coriolis force.**

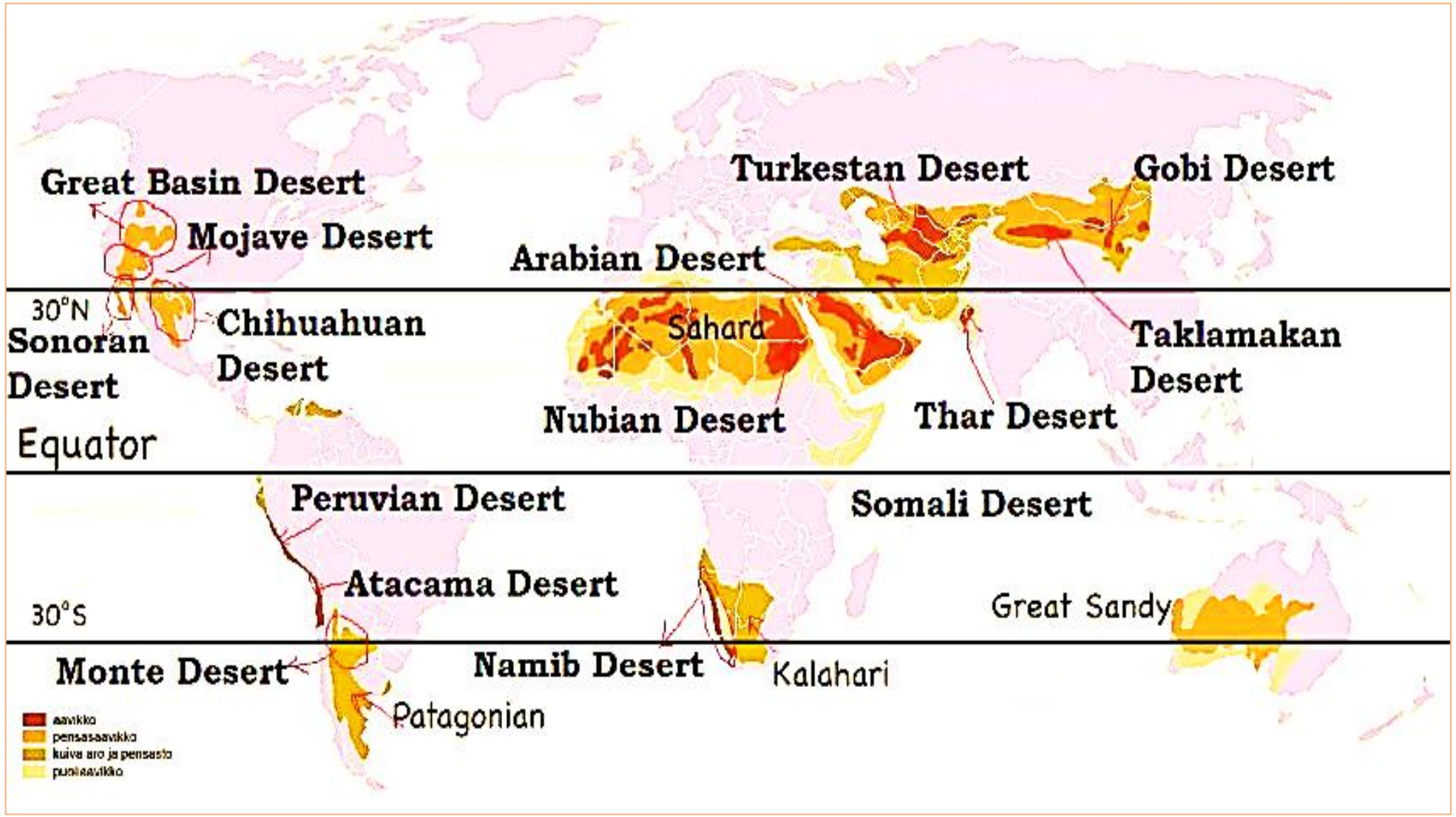
Horse Latitudes

- The corresponding latitudes of **subtropical high pressure belt (25-35)** are called horse latitudes.
- In early days, sailors used to throw horses into the sea.


tropical tropopause
15
polar front
mid-latitude tropopause
10
altitude (km)
Polar tropopause
Cumulonimbus clouds
(mirror image in southern hemisphere)
Hadley cell
Ferrel cell
polar cell
5
0
North pole high
60°N low
30°N high
Equator low
Latitude pressure global winds
easterlies
Warm south-westerlies
north-east trade winds

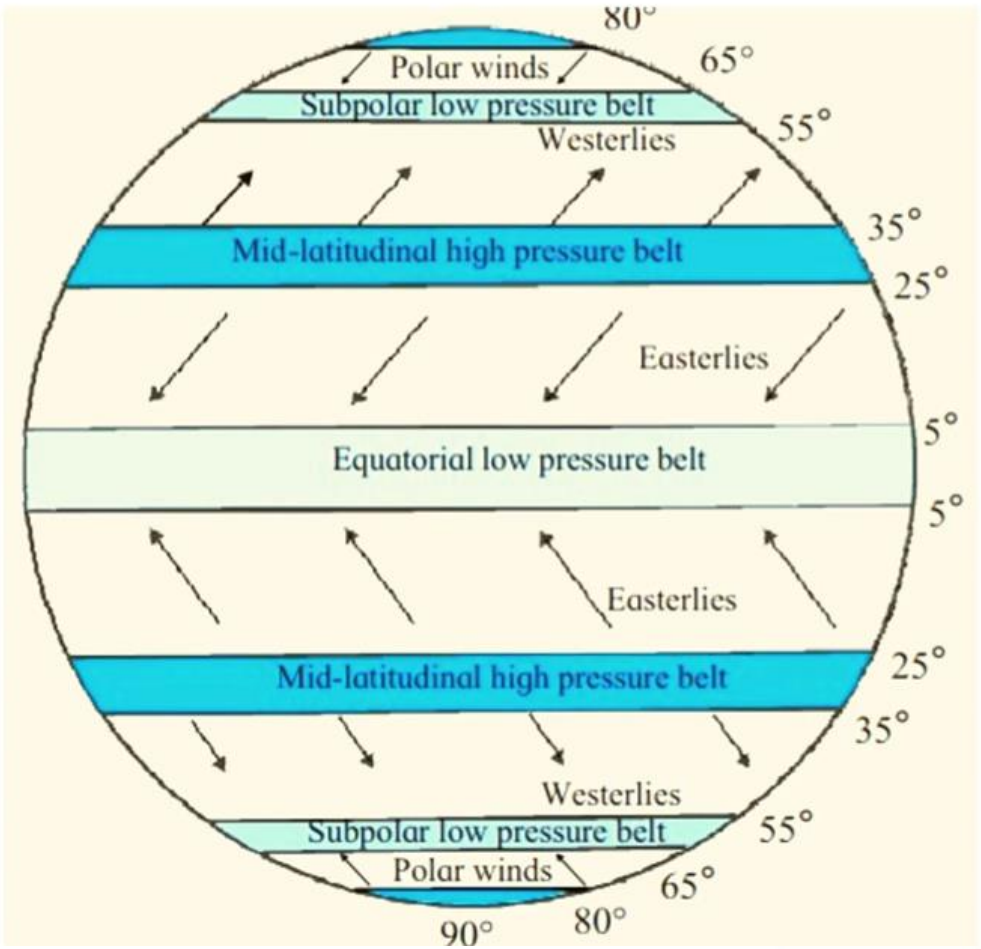
Characteristics

- Due to warm and dry subsiding air, **most of the warm deserts are present along this belt, in both hemispheres.**
- A calm condition (anticyclonic) with feeble winds is created in this high pressure belt.
- This belt is frequently invaded by tropical and extra-tropical disturbances.


Great Basin Desert
Mojave Desert
Turkestan Desert
Gobi Desert
Arabian Desert
30°N
Sonoran Desert
Chihuahuan Desert
Sahara
Taklamakan Desert
Nubian Desert
Thar Desert
Equator
Peruvian Desert
Somali Desert
Atacama Desert
30°S
Great Sandy
Monte Desert
Namib Desert
Kalahari
Patagonian
aavikko
pensasaavikko
kuiva aro ja pensasto
puoliaavikko

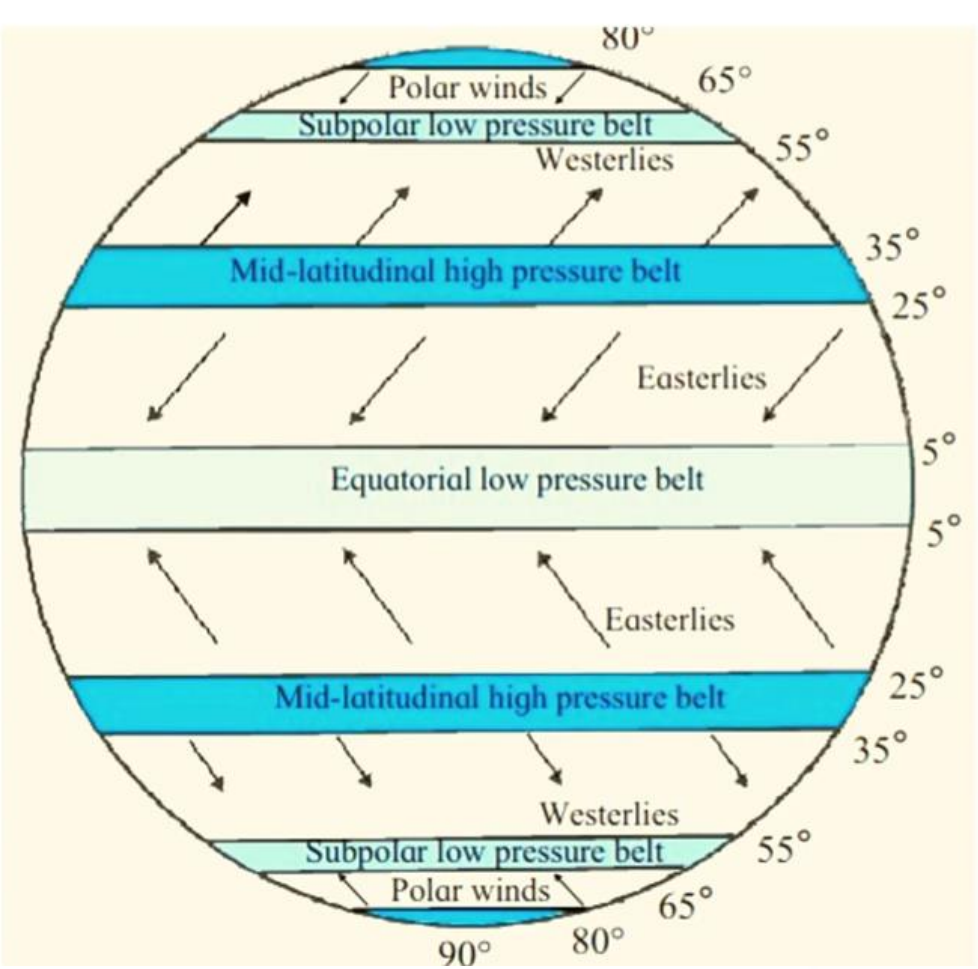
Sub-Polar Low Pressure Belt

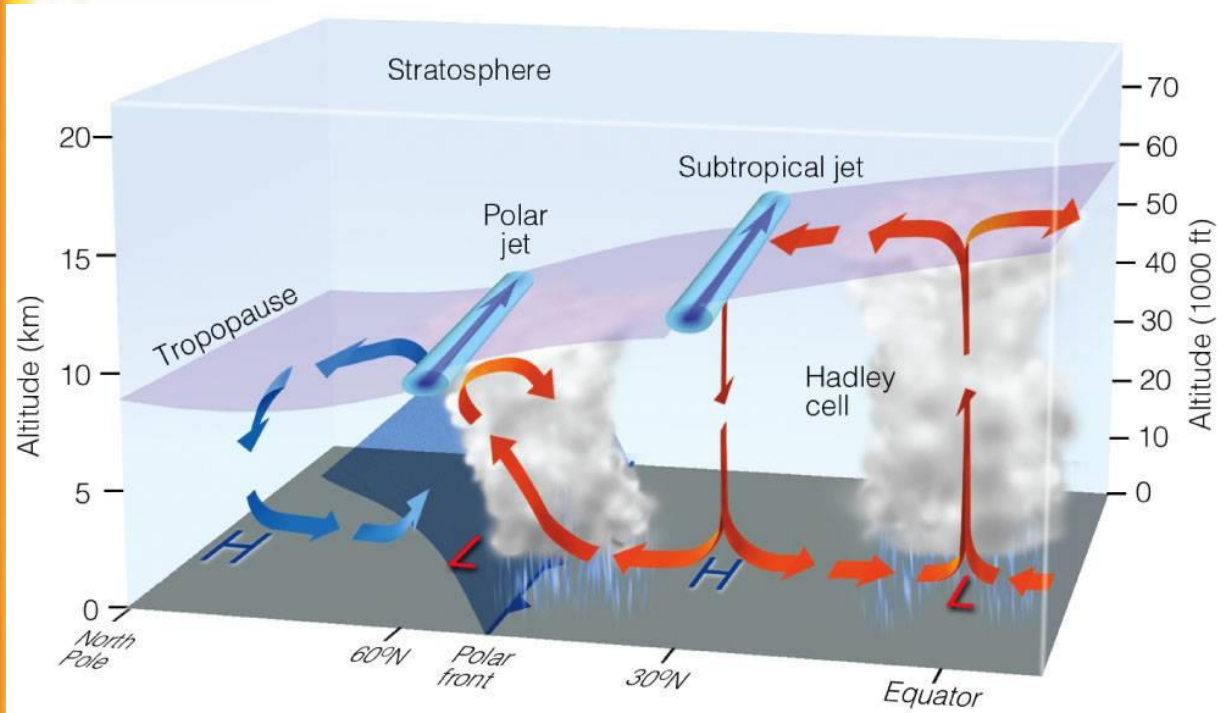
- It lies between **55°-65 N and S latitudes** and the **Arctic and the Antarctic circles (66.5° N and S latitudes).**
- Owning to low temperatures in these latitudes the sub polar low pressure belts are not very well pronounced year long.
- On long-term mean climatic maps, the sub polar low-pressure belts of the northern hemisphere are grouped into two centers of atmospheric activity: the **Iceland low** and the **Aleutian depression (Aleutian low).**
- Such belts in the southern hemisphere surround the periphery of Antarctica and are not as well differentiated.



Formation

- These are **dynamically produced** due to
  - **Coriolis Force** produced by **rotation of the earth on its axis, and**.
  - **Ascent of air as a result of convergence of westerlies and polar easterlies**
- Sub polar low-pressure belts are mainly encountered above **oceans.**





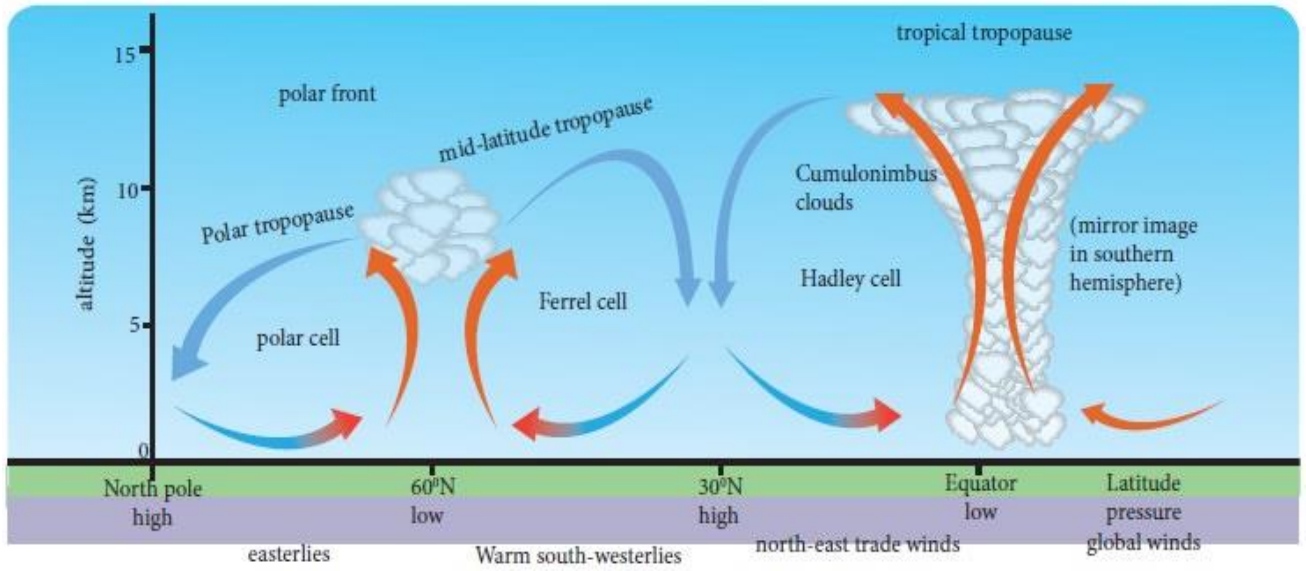
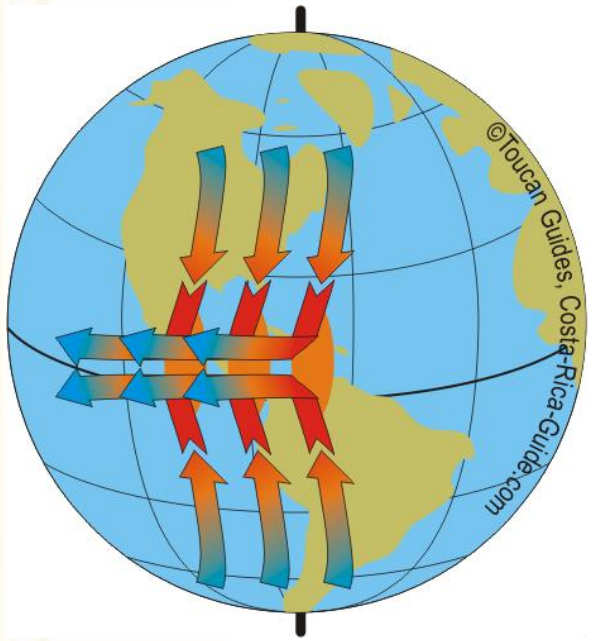


Figure 6.15 Meridional circulation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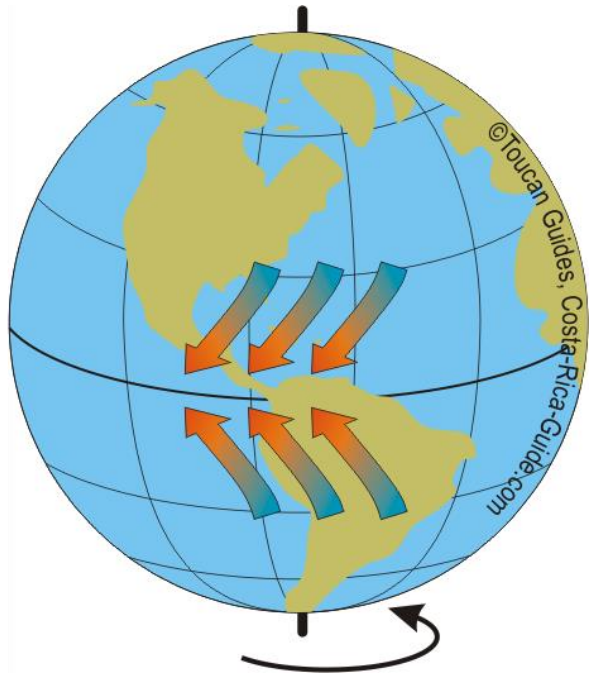
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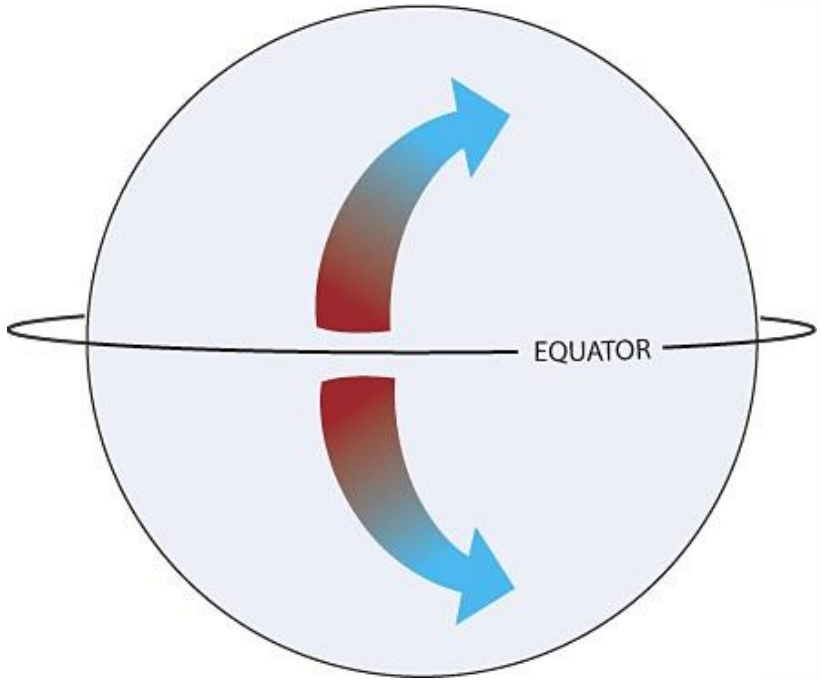
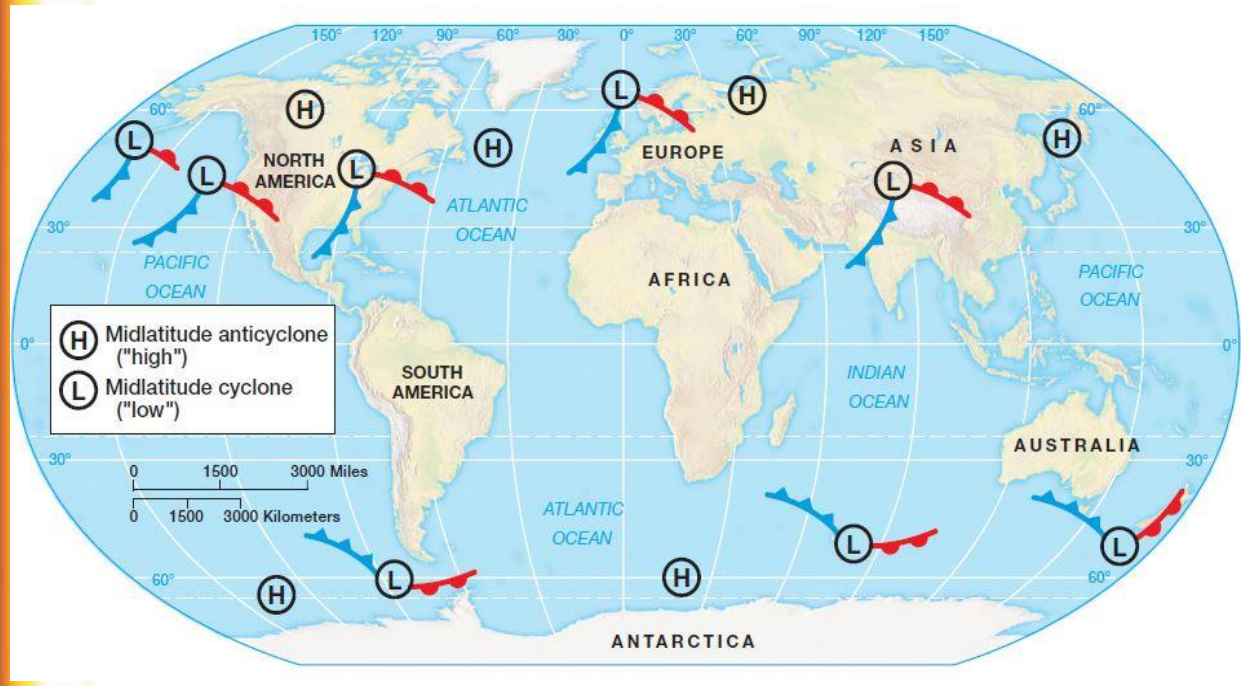

EQUATOR

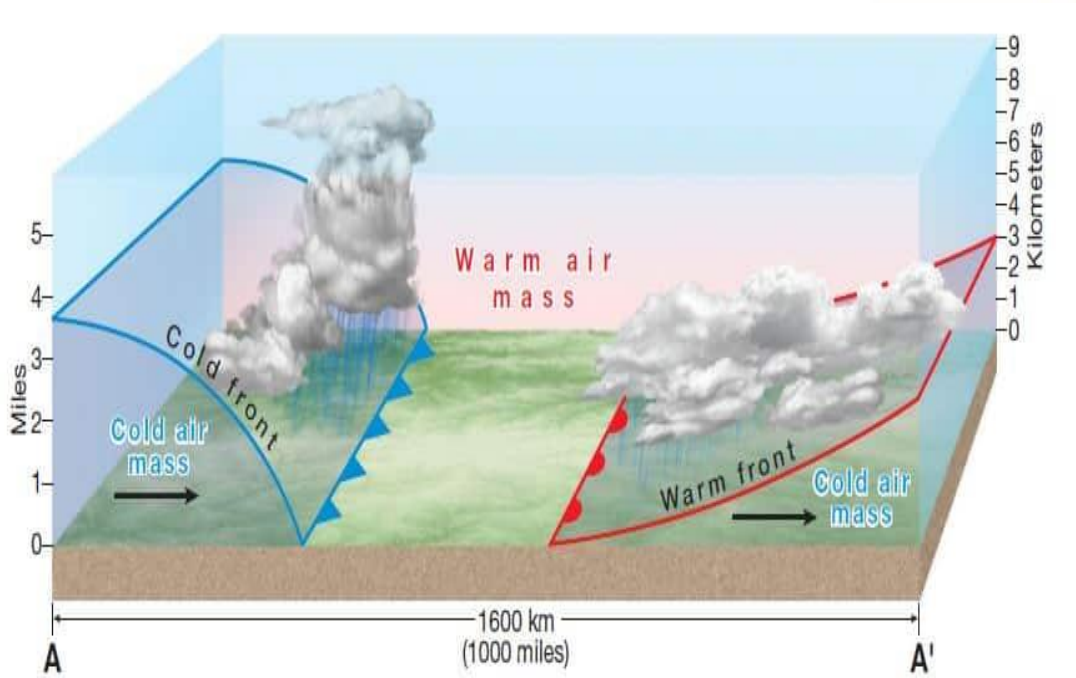
Seasonal behavior

- During winter, because of a high contrast between land and sea**, this belt is broken into two distinct low centers** – one in the **vicinity of the Aleutian Islands** and the other **between Iceland and Greenland.**
- During summer, a lesser contrast results in a **more developed and regular belt**.

Climate

- The area of contrast between cold and warm air masses produces **polar jet streams** which encircles the earth at 60 degrees latitudes and is focused in these low pressure areas.
- **Due to a great contrast between the temperatures of the winds from subtropical and polar source regions, extra tropical cyclonic storms or lows' (temperate cyclones or frontal cyclones) are produced in this region.**


NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
ANTARCTICA
ATLANTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
Midlatitude anticyclone ("high")
Midlatitude cyclone ("low")
0 1500 3000 Miles
0 1500 3000 Kilometers


Warm air mass
Cold front
Cold air mass
Warm front
Cold air mass
Miles
Kilometers
1600 km
(1000 miles)
A
A'

Polar High Pressure Belt

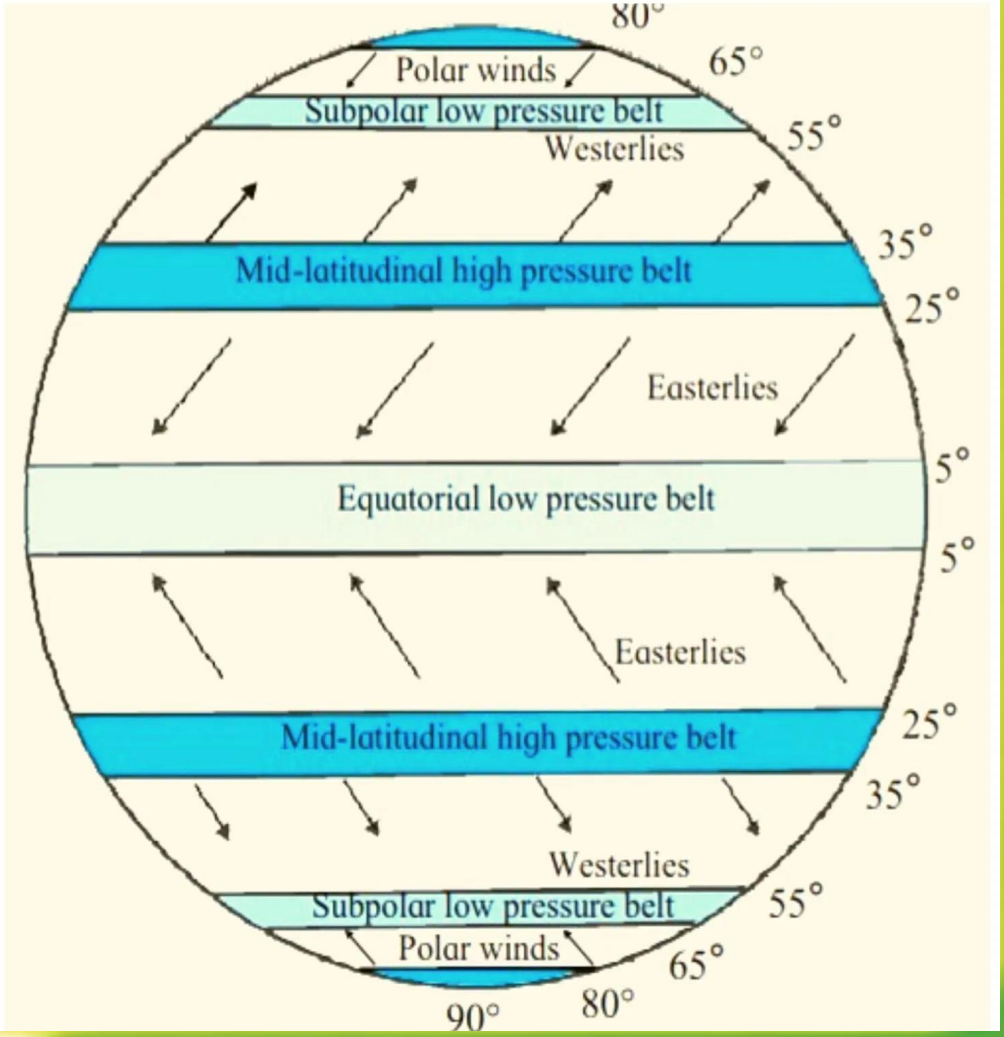
- The polar highs are small in area and extend around the poles.
- They lie around poles between 80 – 90° N and S latitudes.

Formation

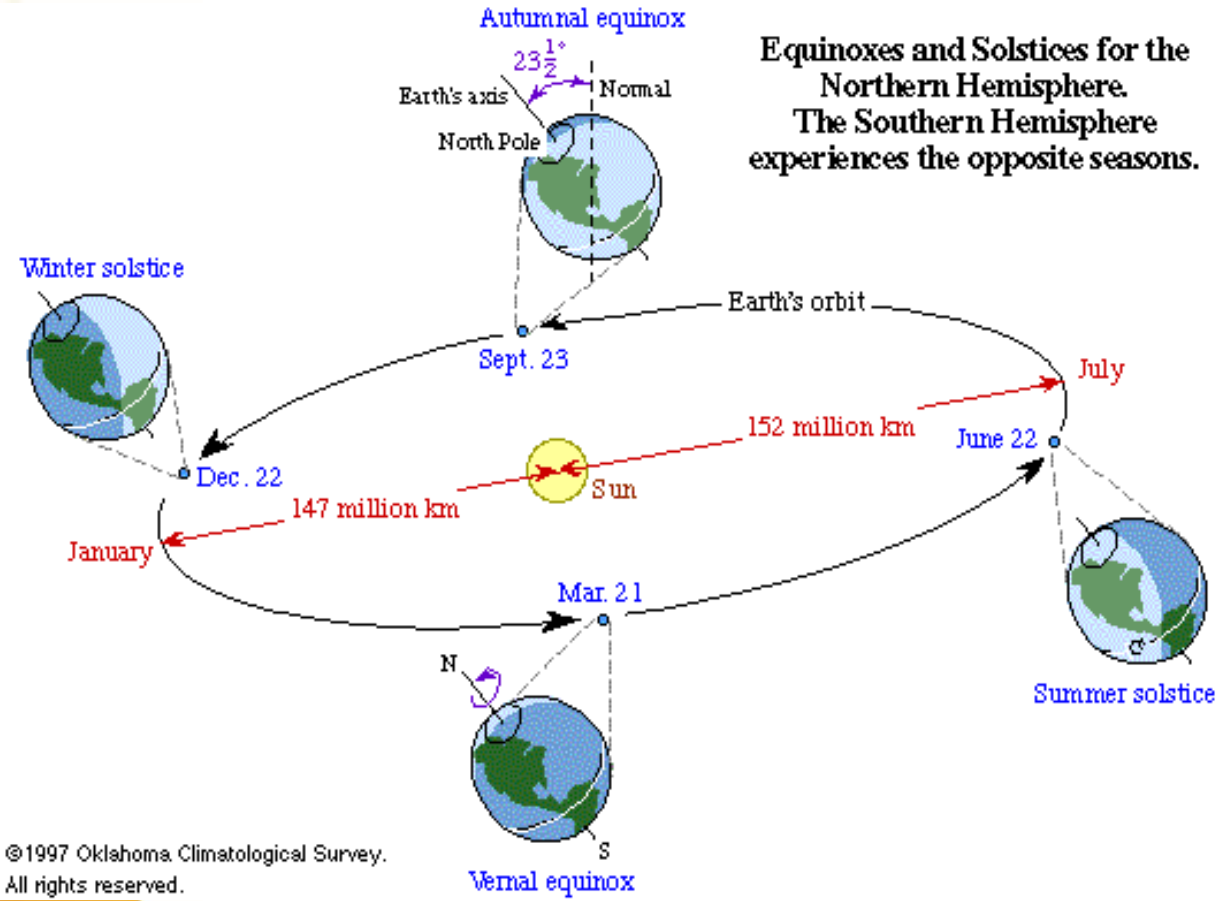
- The air from sub-polar low pressure belts after saturation becomes dry. This dry air becomes cold while moving towards poles through upper troposphere.
- The cold air (heavy) on reaching poles subsides creating a high pressure belt at the surface of earth.

Climate

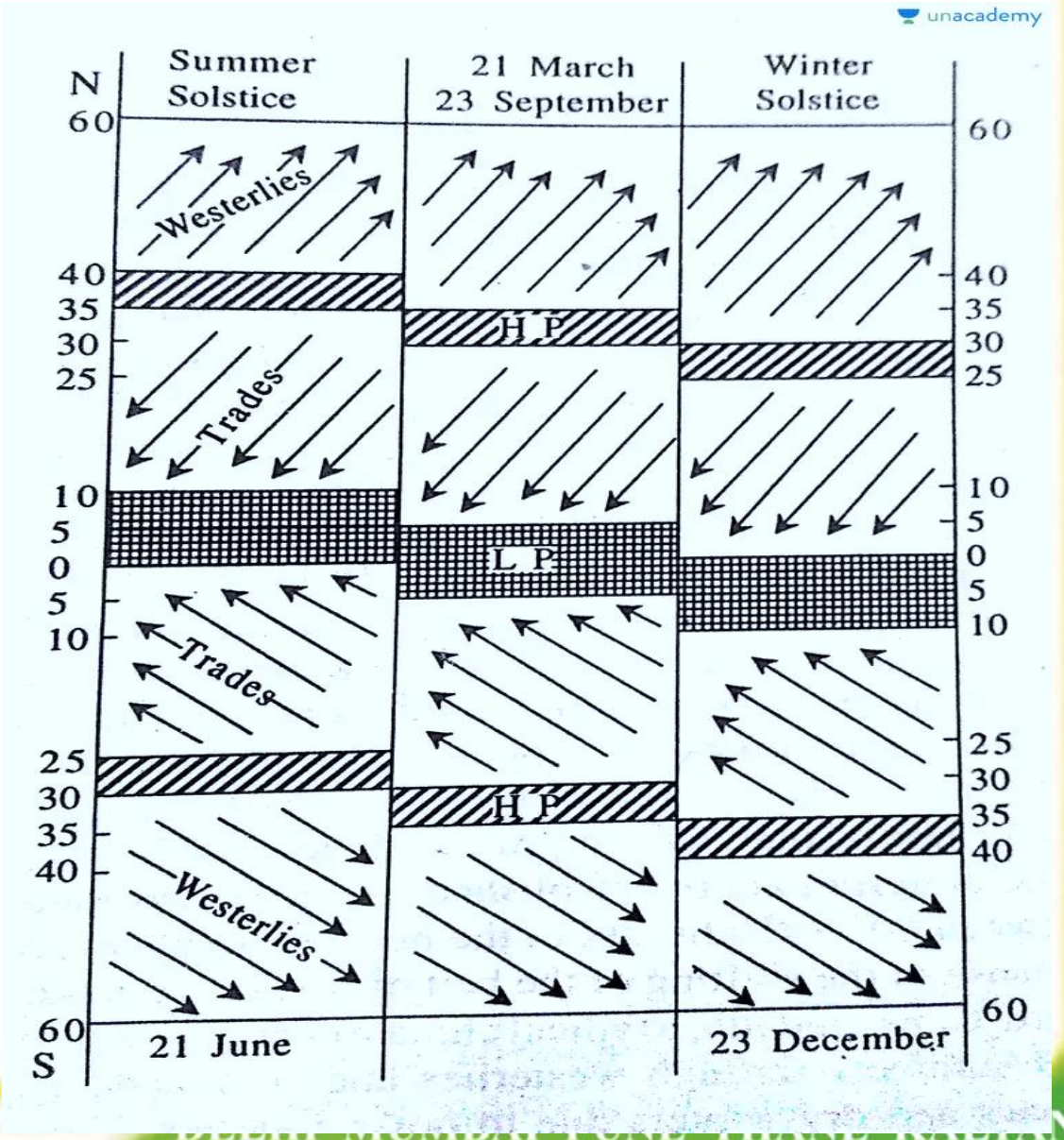
- The lowest temperatures are found over the poles.



SHIFTING OF PRESSURE BELT



Equinoxes and Solstices for the Northern Hemisphere. The Southern Hemisphere experiences the opposite seasons.



Summer (JUNE)

- In the northern hemisphere, during summer, with the apparent northward shift of the sun, the thermal equator (belt of highest temperature) is located north of the geographical equator.
- The pressure belts shift slightly north of their annual average locations.

Winter (December)

- During winter, these conditions are completely reversed and the pressure belts shift south of their annual mean locations.
- Opposite conditions prevail in the southern hemisphere. The amount of shift is, however, less in the southern hemisphere due to predominance of water.