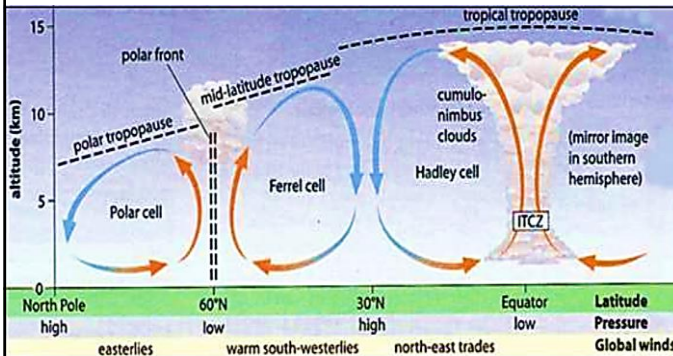
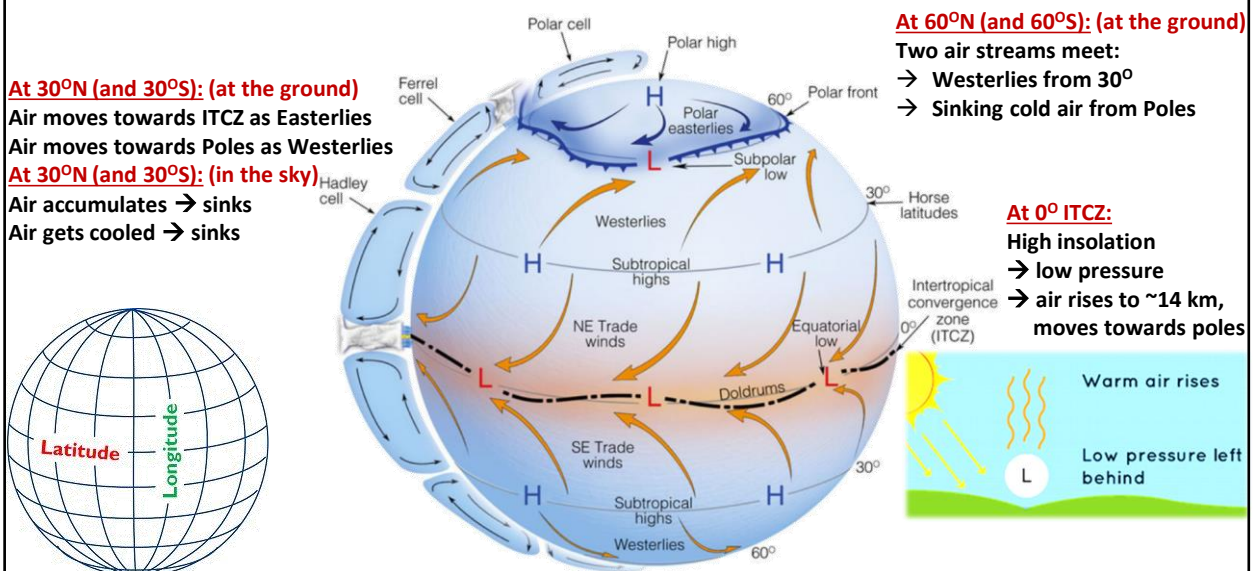
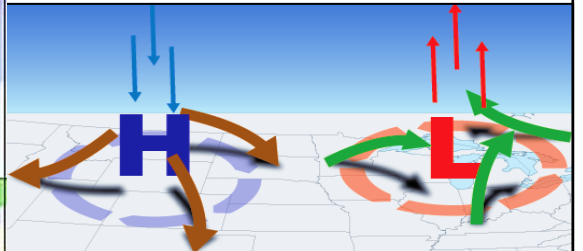


ATMOSPHERIC CIRCULATION

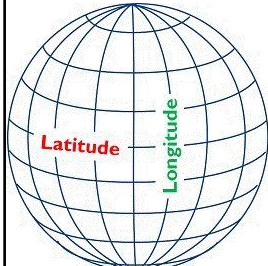


Air moves from high pressure area to low pressure area

- LP area: Air will rise, surrounding air will converge
- HP area: Air will sink, diverge to surrounding area



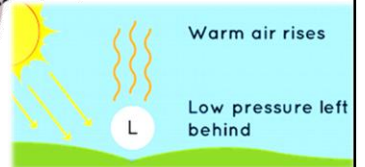
At 30°N (and 30°S): (at the ground)
 Air moves towards ITCZ as Easterlies
 Air moves towards Poles as Westerlies
At 30°N (and 30°S): (in the sky)
 Air accumulates → sinks
 Air gets cooled → sinks



At 60°N (and 60°S): (at the ground)

- Two air streams meet:
 → Westerlies from 30°
 → Sinking cold air from Poles

At 0° ITCZ:
 High insolation
 → low pressure
 → air rises to ~14 km,
 moves towards poles

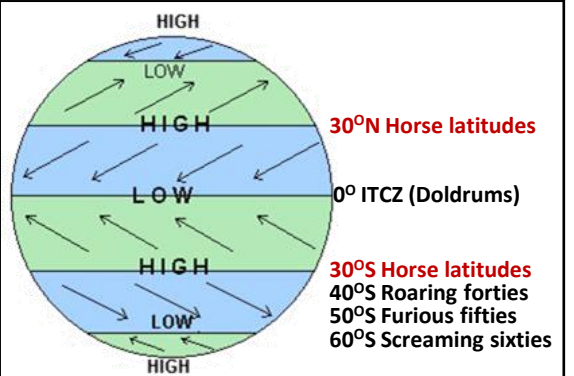


Heat is transferred from lower to higher latitudes by:

- ✓ Planetary Winds
- ✓ Ocean Currents

Pressure belts: (just think of position of ITCZ)

- ☐ Not permanent
 - they oscillate with apparent movement of Sun
- ☐ In Northern hemisphere:
 - they move northwards during summer
 - they move southwards during winter



Prelims 2011

Westerlies in Southern Hemisphere are stronger and persistent than in Northern Hemisphere. Why?

1. Southern hemisphere has less landmass as compared to northern hemisphere.
2. Coriolis force is higher in southern hemisphere as compared to northern hemisphere.

Which of the above statements are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

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Prelims 2007

Consider the following statements:

1. Either of the two belts over the oceans at about 30° to 35° N and S Latitudes is known as **Horse latitude**.
2. Horse latitudes are low pressure belts.

Which of the above statements are correct?

- (a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Prelims 2000

Consider the following statements about '**Roaring Forties**':

1. They blow uninterrupted in the northern and Southern Hemispheres
2. They blow with great strength and constancy
3. Their direction is generally from north-west to east in the Southern Hemisphere
4. Overcast skies, rain and raw weather are generally associated with them

Which of these statements are correct?

- (a) 1, 2, 3 (b) 2, 3, 4 (c) 1, 3, 4 (d) 1, 2, 4

Prelims 2002

Assertion (A): **60° - 65°** latitudes in both the hemispheres have a **low pressure** belt instead of high pressure.

Reason (R): The **low pressure areas are permanent** over oceans rather than on land.

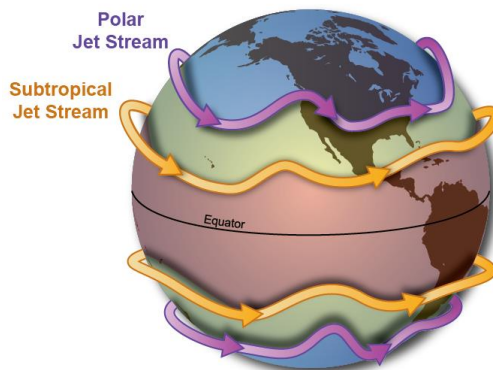
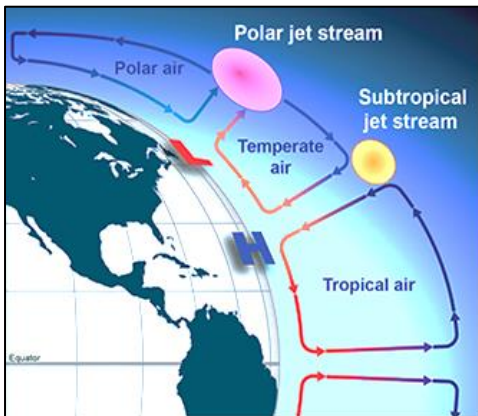
- (a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Aircrafts fly in lower stratosphere as it has almost no clouds / water vapour / vertical wind



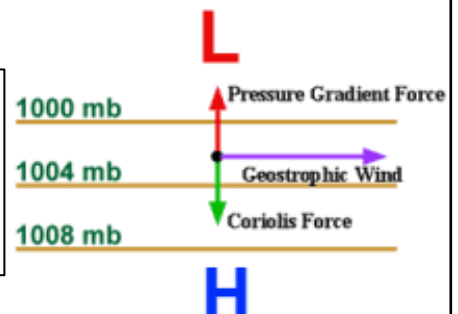
Jet stream

- Type of **geostrophic** wind
- They move **perpendicular** to pressure gradient force
- They move **eastwards** at altitude 8-15 km
- They can speed up **aircrafts** moving towards east
- They follow the **boundary** between hot and cold air.
- Since these boundaries are most pronounced in winter, jet streams are **strongest during winter**.



Geostrophic wind

- When Coriolis force is balanced by pressure gradient force,
- wind blows parallel to isobars. This is called as Geostrophic wind.
- Since Coriolis force is zero at the equator there are no geostrophic winds at the equator.



Continentality a measure of the difference between continental and marine climates characterized by the increased range of temperatures that occurs over land compared with water.

Prelims 2007

Consider the following statements:

- Annual range of temperature is greater in the Pacific Ocean than that in the Atlantic Ocean.
- Annual range of temperature is greater in the Northern Hemisphere than that in the Southern Hemisphere.

Which of the above statements are correct?

- (a) 1 only **(b) 2 only**
 (c) Both 1 and 2 (d) Neither 1 nor 2

Prelims 2013

The annual range of temperature in the interior of the continents is high as compared to coastal areas. What are the reasons?

- Thermal difference between land and water
- Variation in altitude between continents and oceans
- Presence of strong winds in the interior
- Heavy rains in the interior as compared to coasts

Select the correct answer

- (a) 1 only** (b) 1 and 2 only
 (c) 2 and 3 only (d) 1, 2, 3 and 4

- Land heats up and cools down **quickly**.
- Sea heats up and cools down **slowly**.
- Hence, **variation in** temperature over **sea is less** compared to land.
- NH: more land less sea, hence more variation in temperature
- SH: more sea less land, isotherms mostly parallel to latitudes

- Isopleth:** line of equal values
- Isobar:** line of equal pressure
- Isotherm:** line of equal temperature
- Isohyet:** line of equal rain
- Isochrone:** line of equal time to reach

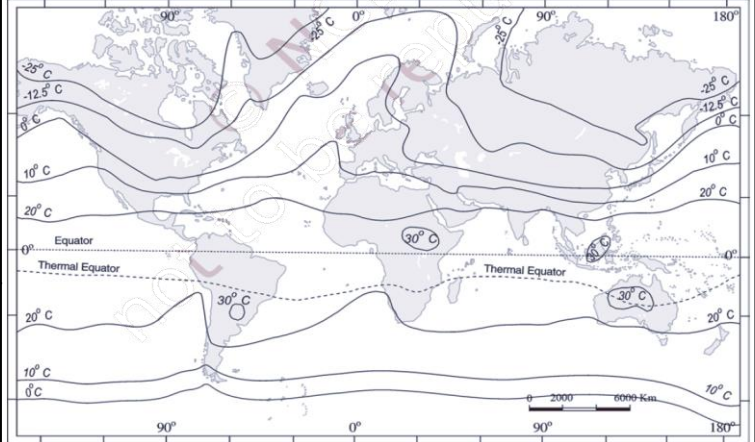
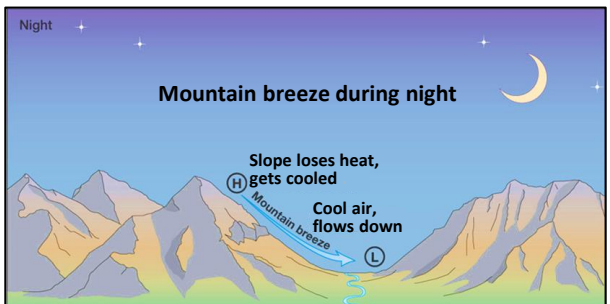
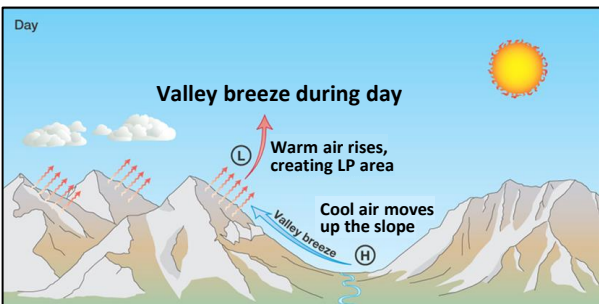
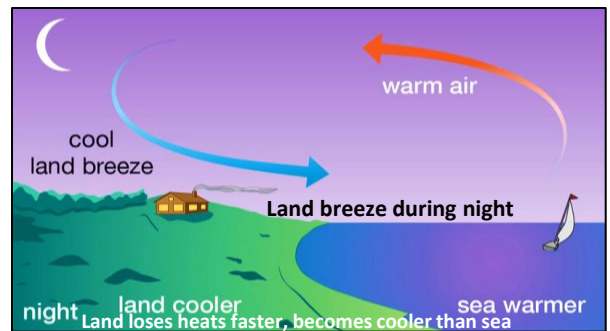
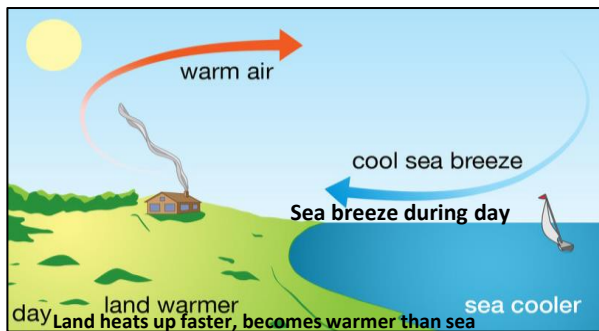


Figure 9.4 (a) : The distribution of surface air temperature in the month of January



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CYCLONES

Name	Region
Cyclone	Indian Ocean
Hurricane	Atlantic Ocean
Typhoon	Japan, China
Willy Willies	Australia

Temperate cyclone	Tropical cyclone	Trick to remember
Move west to east → (Westerlies)	Move east to west ← (Easterlies)	Cyclones come from Bay of Bengal to Odisha
Affects larger area	Affect less area	Mostly only Odisha is in news
Lower wind speed	Higher wind speed	Very high winds in news
Can form on sea as well as land	Forms on sea, dissipates on land	Most news comes only till it reaches coast
Formed due to fronts	Frontal system absent	Never saw this in news
Usually lasts 14 days	Usually lasts 7 days	News only for 3-4 days

Conditions favorable for the formation and intensification of tropical cyclones:

1. **Large sea surface with temperature higher than 27° C**
 - For low pressure area to form
2. **Small variations in the vertical wind speed**
 - Air rises; moisture in air condenses; releases latent heat; this energy intensifies cyclone
3. **Presence of the Coriolis force enough to create a cyclonic vortex**
 - At the equator, the Coriolis force is zero.
 - Low pressure gets filled instead of getting intensified.
4. **A pre-existing weak low-pressure area or low-level-cyclonic circulation**
 - Many Bay of Bengal cyclones are remains of typhoons
5. **Upper divergence above the sea level system**

Why more cyclones recently in Arabian sea?

Main reason is global warming, but exactly how, is under research, multiple theories, not for prelims

Why more cyclones in Bay of Bengal than Arabian sea?

1. Higher sea surface temperature
2. Many Bay of Bengal cyclones are remains of typhoons

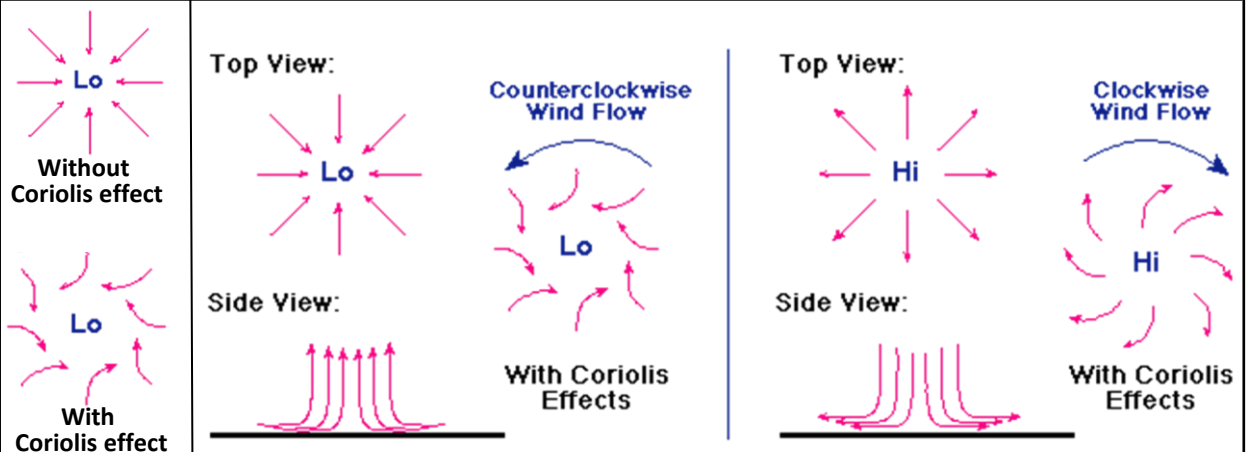
Medicanes? Mediterranean Hurricanes; colder; smaller

Naming of cyclones in Indian Ocean:

- ✓ Chosen from list of 169 names (13 countries submit 13 names each)
 - ✓ Mechanism by WMO and UN-ESCAP
 - ✓ **IMD** as RSMC names cyclones in Indian Ocean
- RSMC: Regional Specialised Meteorological Centres

Table 10.2 : Pattern of Wind Direction in Cyclones and Anticyclones

Pressure System	Pressure Condition at the Centre	Pattern of Wind Direction	
		Northern Hemisphere	Southern Hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise



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Prelims 2020:

Consider the following statements:

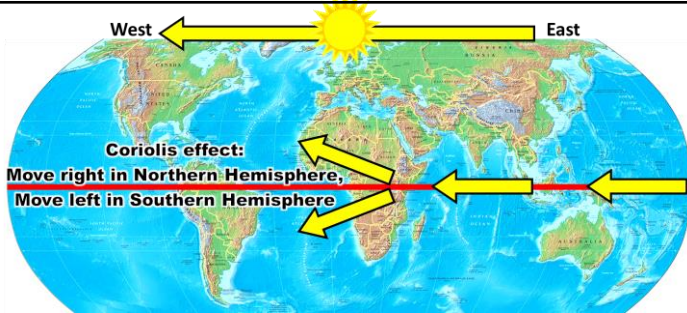
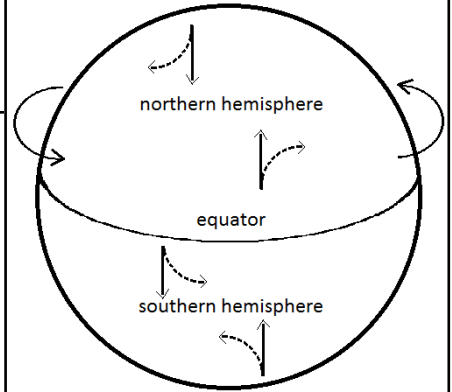
1. Jet streams occur in Northern Hemisphere only
2. Only some cyclones develop an eye
3. The temperature inside the eye of a cyclone is nearly 10°C lesser than that of the surroundings

Which of the above statements is/are correct:

- (a) 1 only (b) 2, 3 only (c) 2 only (d) 1, 3 only

Coriolis Force deflects wind:

- ✓ Clockwise (right) in NH
- ✓ Anti-clockwise (left) in SH



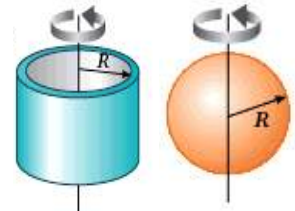
Prelims 2010:

What causes wind to deflect towards left in the Southern Hemisphere?

- (a) Temperature
- (b) Magnetic field
- (c) Rotation of earth
- (d) Pressure

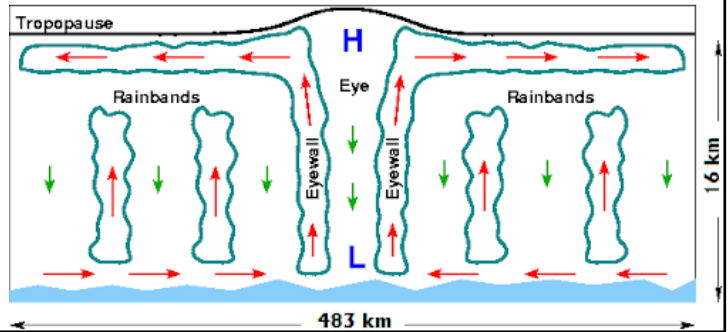
Coriolis Force

The rotation of the earth about its axis affects the direction of the wind. This force is called the Coriolis force after the French physicist who described it in 1844. It deflects the wind to the right direction in the northern hemisphere and to the left in the southern hemisphere. The deflection is more when the wind velocity is high. The Coriolis force is directly proportional to the angle of latitude. It is maximum at the poles and is absent at the equator.



Prelims 2002:

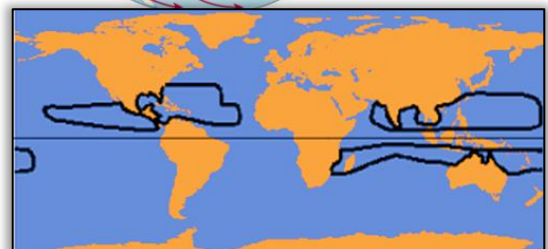
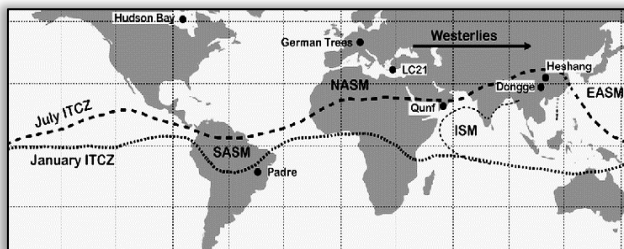
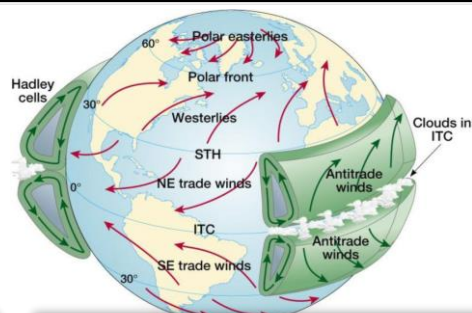
- (A): Surface winds spiral inwards upon the centre of cyclone
 (R): Air descends in the centre of cyclone
- (a) Both A and R are true and R is the correct explanation of A
 - (b) Both A and R are true but R is NOT a correct explanation of A
 - (c) A is true but R is false
 - (d) A is false but R is true



Prelims 2015:

In the South Atlantic and South Eastern Pacific regions in tropical latitudes, cyclone does not originate. What is the reason?

- (a) Sea Surface temperatures are low
- (b) ITCZ seldom occurs
- (c) Coriolis force is too weak
- (d) Absence of land in those regions

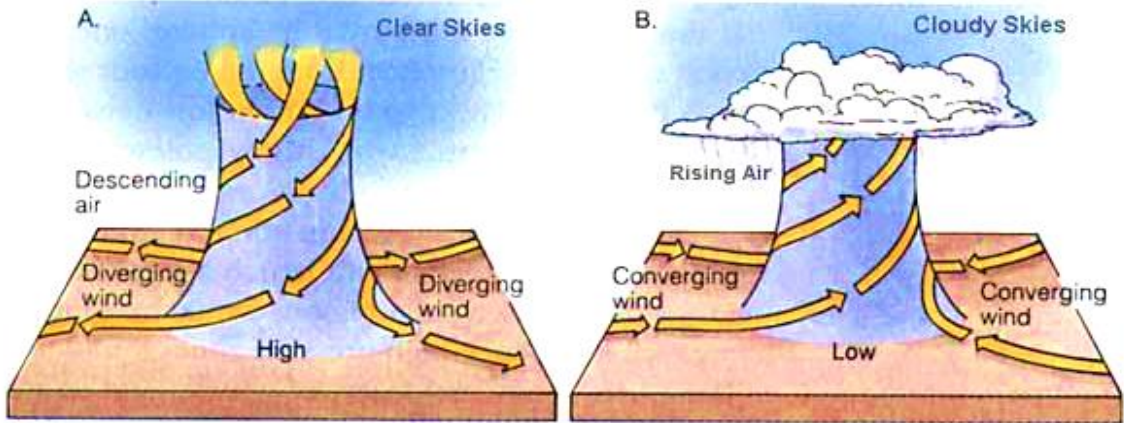
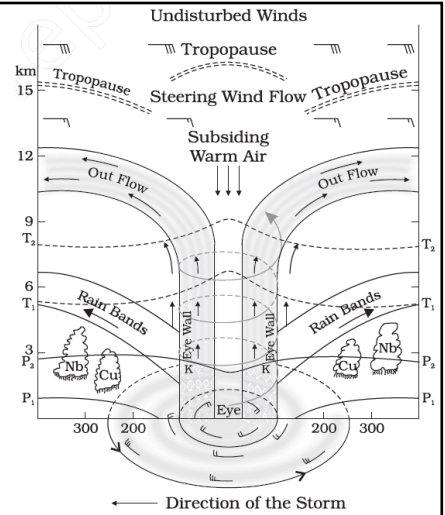


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Tropical cyclones [NCERT]

- ❑ **Energy** comes from **condensation** process in towering cumulonimbus clouds, surrounding the centre.
- ❑ Moisture from sea strengthens the storm.
- ❑ On reaching land, moisture supply is cut off, storm dissipates.
- ❑ **Landfall**: place where cyclone crosses coast
- ❑ Cyclones which cross 20° N latitude generally, **recurve** and are more destructive.
- ❑ **Eye**: Region of calm with subsiding air.
- ❑ **Eyewall**: air spirals at speed up to 250km/h, rises to tropopause, torrential rain occurs here.
- ❑ From the eye wall rain bands may radiate and trains of cumulus and cumulonimbus clouds may drift into the outer region.



HP systems:

- ❑ Normally have clear skies and dry weather.
- ❑ Large diurnal temperature changes due to greater sunshine during the day and radiation at night.

LP systems:

- ❑ Normally have clouds and precipitation.
- ❑ Low diurnal temperature changes.
- ❑ Sudden fall in Barometer reading indicates storm

FRONTS

Front: boundary between two air masses

Frontogenesis: process of formation of front

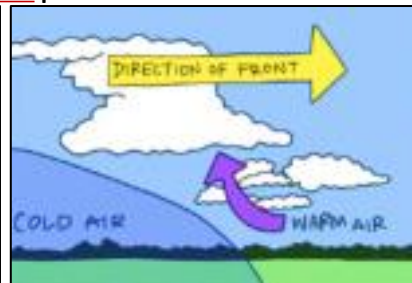
Warm front:

Warm air moves towards cold air



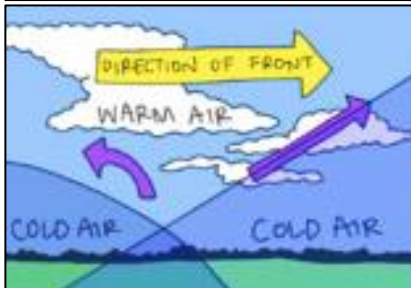
Cold front:

Cold air moves towards warm air



Occluded front:

warm air fully lifted above land



Stationary front:

front remains stationary

