

CYCLONES

TROPICAL CYCLONE

- ☐ These are the atmospheric disturbances that are developed over the tropical oceans and seas.
- ☐ The formation of the cyclone is a combined phenomenon of atmosphere and ocean surface temperature.
- ☐ The release of heat (latent heat of condensation) from the moist winds, and the Coriolis effect on the convergent air are the main drivers of tropical cyclones.
- ☐ Cyclones are given many names in the different regions of the world as follows:
- ☐

Part of the World	Tropical Cyclone
Eastern Australian Part	Willy Willy
Japan	Taifu
Philippines	Baiguois
South China Sea (North West Pacific)	Typhoons
Caribbean Sea, North East Pacific, West Indies	Hurricane
North and South Indian Ocean	Tropical Cycle
USA, West Africa	Tornadoes

Classification Based on Speed

☐

Type of Disturbance	Wind Speed (in Km/hr)	Wind Speed (in Knots)
Low Pressure	<31	<17
Depression	31-49	17-27
Deep Depression	49-61	27-33
Cyclonic storm	62-88	47-63
Severe Cyclonic Storm	89-118	47-63
Cyclone	120-221	48-119
Super Cyclone	>221	>120

Prerequisites for the formation of Tropical cyclones

- ☐ (a) Tropical Cyclones can only form when the sea surface water temperature (60 m depth) is 26 degrees or more.

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- (b) The low-pressure centre attracts winds from the surrounding.
- (c) Significant pressure gradient shall intensify the wind velocity.
- (d) These high-velocity winds are subjected to a higher degree of Coriolis effect.

Note:

- In the latitude 0-5 degrees North-South, there is a minimum Coriolis effect; thus, tropical cyclones cannot form at the equator.
 - The low pressure required for the tropical cyclone is filled rather than getting intensified in the equatorial region.
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- (e) The latent heat of condensation is considered the driving energy source for tropical cyclones.
 - This is provided by the warm moist winds that move up the eye wall, condense, and release energy.
 - As the cyclone enters the land, it is cut off from the source of moist winds resulting in landfall.
 - Cyclones are generally formed along the eastern coast of the continents (The western part of the Ocean), and not the western coast.
 - This is because the cold currents do not facilitate the required sea surface temperature.
 - As the intertropical convergence Zone starts moving from the tropics to the equator, it facilitates the formation of tropical cyclones as it can intensify the low pressure (October- November east coast of India).
 - During May-June, tropical cyclones of lower intensity are also formed.
 - These cyclones have an average diameter compared to temperate cyclones.
 - Tropical cyclones' diameter extends to 300 km on average.
 - The low-pressure centre has very few clouds and is calm. This is the eye of the cyclone. It is surrounded by an eye wall.
 - The low-pressure centre attracts moist winds of higher velocity toward it.
 - In this process, the winds push water along the centre. Thus the centre exhibits a slight increase in water level. This on reaching the coast results in inundation or flooding of the coastal region. This is known as a storm surge.
 - Such coastal flooding shall result in a loss of life and property, and a negative impact on the fertility of land, and water resources.
 - Tropical cyclones are under the influence of trade winds and the Coriolis effect concerning their direction and movement.

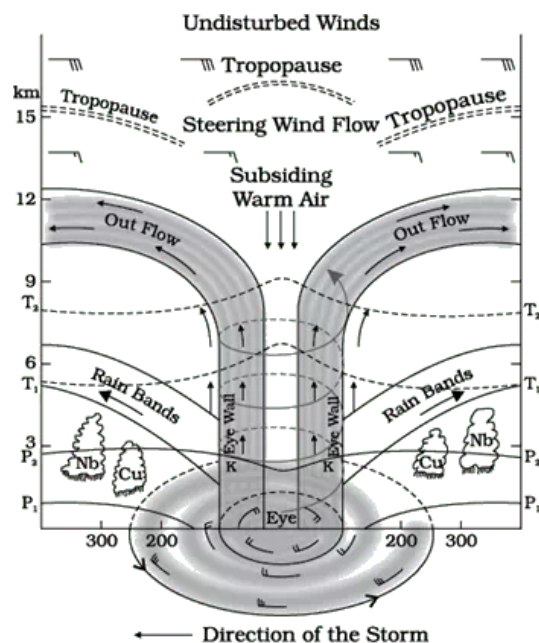


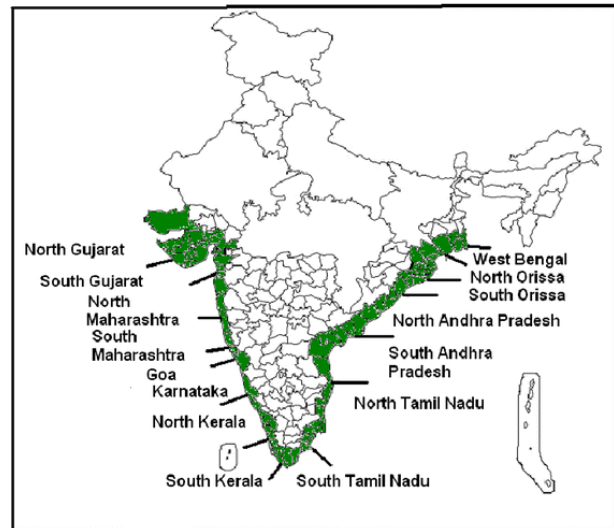
Fig: Vertical section of the tropical cyclone

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- Thus, tropical cyclone curves as they move from east to west in the Northern Hemisphere.

Vulnerability Zone in India

- In India, four eastern coastal states and one western coastal state are significantly prone to tropical cyclones.
- These states are Tamil Nadu, Odisha, Andhra Pradesh, West Bengal, and Gujarat.
- Coastal Andhra and Odisha experience a higher degree of impact from tropical cyclones.
- Thus, it results in severe disaster in thickly populated areas across the Mahanadi Delta to Krishna Godavari Delta.



Anthropogenic Impacts on Cyclones

- The phenomenon of global warming increases the sea surface temperature which in turn results in an increased frequency of tropical cyclones.
- Further, an increase in the global average temperature can nullify the impact of cold currents on tropical sea surface temperatures.
- This would result in the formation of tropical cyclones on western coast of continents in tropical region.

Impact of Tropical Cyclone

- (a) Cyclone brings loss to lives and livestock.
- It has been characterized by the destructive results on infrastructure, due to its high-velocity winds.
- (b) Heavy rainfall and storm surges result in coastal flooding and inundation of low-lying areas.
- (c) Soil erosion of the beaches, embankments, and others.
- (d) The first impact of the cyclones is taken by mangroves and corals, which shall have a consequential effect on ecology, economy, and livelihood.
- Such natural disasters impact the Indian GDP by close to 2%, and specifically it affects 12 % of the central government income.
- (e) Storm surges and inundations are responsible for the salinization of the land, reducing soil fertility, contaminating water resources with saline water, and more.

The naming of the Tropical Cyclone

- World Meteorological Organization/United Nations Economic and Social Commission for Asia and Pacific Panel on tropical cyclones held its session in Muscat.
- In the session, they decided to start naming the cyclones of the Bay of Bengal and the Arabian Sea.
- The panel members' names are listed alphabetically countrywide.

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- ❑ The name would be used sequentially column-wise.
- ❑ Each country shall suggest 13 names as of now.
- ❑ In total, it amounts to 169 cyclone names.
- ❑ The Initial member countries in 2000 were Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka, and Thailand.
- ❑ The grouping expanded by including 5 more countries, Iran, Qatar, Saudi Arabia, Yemen, and UAE.

New List of Names for Tropical Cyclone over North Indian Ocean													The Weather Channel
Place	List 1	List 2	List 3	List 4	List 5	List 6	List 7	List 8	List 9	List 10	List 11	List 12	List 13
Bangladesh	Nisarga	Biparjoy	Arnab	Upakul	Barshon	Rajani	Nishith	Urmi	Meghala	Samiron	Pratikul	Sarobor	Mahanisha
India	Gati	Tej	Murasu	Aag	Vyom	Jhar	Probaho	Neer	Prabhanjan	Ghurni	Ambud	Jaladhi	Vega
Iran	Nivar	Hamoon	Akvan	Sepand	Booran	Anahita	Azar	Pooyan	Arsham	Hengame	Savas	Tahamtan	Toofan
Maldives	Burevi	Midhili	Kaani	Odi	Kenau	Endheri	Riyau	Guruva	Kurangi	Kuredhi	Horangu	Thundi	Faana
Myanmar	Tauktae	Michaung	Ngamann	Kyarhit	Sapakyee	Wetwun	Mwaihout	Kywe	Pinku	Yinkaung	Linyone	Kyeekan	Bautphat
Oman	Yaas	Remal	Sail	Naseem	Muzn	Sadeem	Dima	Manjour	Rukam	Watad	Al-jarz	Rabab	Raad
Pakistan	Gulab	Asna	Sahab	Afshan	Manahil	Shujana	Parwaz	Zannata	Sarsar	Badban	Sarrab	Gulnar	Waseq
Qatar	Shaheen	Dana	Lulu	Mouj	Suhail	Sadaf	Reem	Rayhan	Anbar	Oud	Bahar	Seef	Fanar
Saudi Arabia	Jawad	Fengal	Ghazeer	Asif	Sidrah	Hareed	Faid	Kaseer	Nakheel	Haboob	Bareq	Alreem	Wabil
Sri Lanka	Asani	Shakhti	Gigum	Gagana	Verambha	Garjana	Neeba	Ninnada	Viduli	Ogha	Salitha	Rivi	Rudu
Thailand	Sitrang	Montha	Thlanyot	Bulan	Phutala	Aiyara	Saming	Kraison	Matcha	Mahingsa	Phraewa	Asuri	Thara
United Arab Emirates	Mandous	Senyar	Afoor	Nahhaam	Quffal	Daaman	Deem	Gargoor	Khubb	Degl	Athmad	Boom	Saffar
Yemen	Mocha	Ditwah	Diksam	Sira	Bakhur	Ghwyzi	Hawf	Bahaf	Brom	Shuqra	Fartak	Darsah	Samhah

Importance of naming the Cyclone

- ❑ (a) With the name it is easy to identify the individual cyclones.
- ❑ (b) It helps the public to be fully aware of its development.
- ❑ (c) It helps in the rapid dissemination of the warning to increase community preparedness.
- ❑ (d) It doesn't confuse the public or other stakeholders when there is more than one tropical cyclone in the same area.
- ❑ (e) Local and international media can become focused on a particular tropical cyclone.

Colour Coding of the Cyclone

- ❑ It was given by IMD for the first time during the cyclone Yaas.
- ❑ IMD provides four colour-coded warnings and advisories in India.
- ❑ Several departments use these warnings to signify the intensity of the situation and the warning associated with it.
- ❑ These warnings have the following objectives:
 - ❑ (a) Preparedness for handling the cyclones concerning the disaster management team.
 - ❑ (b) Alert the common people of hazardous conditions that have the potential to damage their property and incur loss of life.
- ❑ For colour codes are:
- ❑

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Colour Code	Warning	Description
Green	All is well	No adverse weather conditions and no advisories were issued.
Yellow	Be Aware	It indicates the bad weather spanning for several days. It also suggests that the weather could change for the worse disrupting the day to day activities. It is also a signal to the disaster management teams to be prepared.
Orange or amber	Be prepared	It is issued as a warning for bad weather with the potential to disrupt the lifeline infrastructure, i.e. closure of rail and road, and interruption to the power supply. It is to alert the DM team and keep the necessities ready.
Red	Take Action	It is the highest level of warning in the worst weather conditions indicating a significant risk to life.

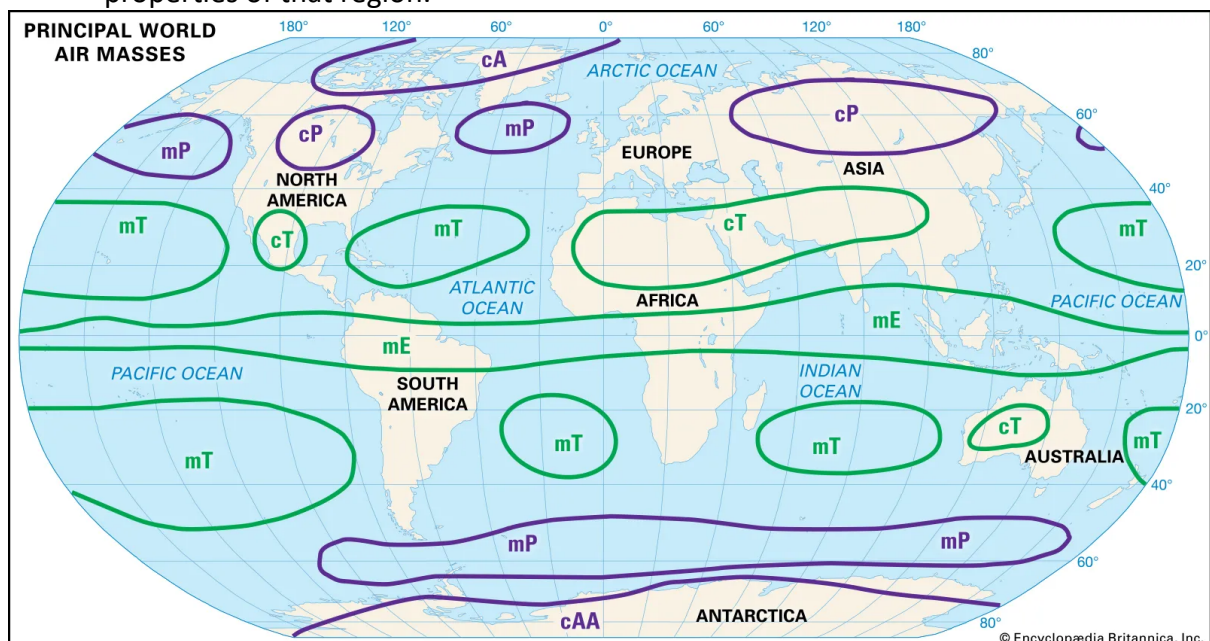
Reasons behind the non-occurrence of Tropical Cyclones during South-West Monsoons

- ❑ South-West monsoonal winds are strong surface winds that are pushed upwards.
- ❑ In Addition, there is the presence of strong upper air circulation (Tropical Easterly Jet Streams) this reduces the chances of the formation of clouds.
- ❑ There is also a wind shear movement. On top of that, there is significant turbulence which prevents the formation of tropical cyclones.

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AIR MASSES

- ☐ When a huge pile of air exhibits uniform properties both horizontally and up to a limited vertical extent i.e. temperature, humidity, and pressure.
- ☐ **Prerequisites for the genesis of airmasses-**
- ☐ 1) They should form over a homogeneous area of land or sea
- ☐ 2) Atmospheric pressure conditions should be stable as it is important to facilitate adoption of the uniform properties such as temperature, humidity, and pressure of the region.
- ☐ 3) Atmospheric low pressure has persistent instability, then the formation of airmass is not possible in such areas due to frequent changes in the factors of the atmosphere.
- ☐ Thus, **atmospheric stability is needed.**
- ☐ 4) Airmasses should be exposed to the region for at least 3 to 5 days to acquire the properties of that region.



Important air masses-

- ☐ 1) Cold continental areas of Canada
- ☐ 2) Cold Continental areas of Russia
- ☐ 3) Cold maritime region of the Atlantic
- ☐ 4) Cold maritime region of the Pacific
- ☐ 5) Tropical and Sub-Tropical interior of Sahara and Sub-Sahar desert
- ☐ 6) Maritime regions of the Pacific, Atlantic, and Indian Ocean
- ☐ Since very few regions in the world develop airmasses such regions of development are known as source regions.
- ☐ The above-mentioned are important source regions.

CLASSIFICATION OF AIR MASS

- ☐ **Based on Temperature-**
- ☐ Airmasses are considered cold and warm based on their impact on the destination area.
- ☐ Cold air masses are those whose temperatures are lesser than the area they visit.
- ☐ Warm air masses are those with temperatures greater than the area it visits.

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- For instance, the air mass that brings ease to the extreme winter of the British Isle is considered a warm air mass.
- **Based on origin-**
- Continental air mass- these originate over the land surface and adopt their properties
- Maritime air mass- these originate over the water bodies and adopt their properties.
- **Significance of air masses-**
- It can modify the weather conditions at the destination
- For instance the British type of climate experiences comparatively warmer winters than the rest of Europe under the influence of warm air mass.
- Air masses are moved from source to destination under the influence of permanent winds.
- Air masses helped in the formation of **Fronts and Temperate Cyclones.**

FRONTS

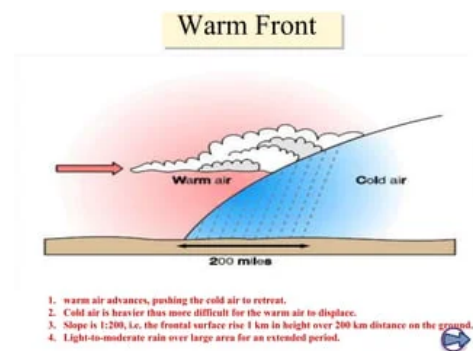
- The sloping boundary between the two contrasting air masses is called a Front
- **Prerequisites for the formation of fronts-**
- 1)Convergence of airmasses
- 2)There should be different air masses in properties(contrasting air masses in terms of temperature, pressure and humidity)
- **NOTE-** The formation of the front is known as **Frontogenesis.**
- This also signifies the formation of the temperate cyclone (**Cyclogenesis**)
- **Frontolysis** is the breakdown or the death of the front signifying the end of a temperate cyclone.

TYPES OF FRONTS

- Warm front
- Cold front
- Occluded front
- Stationary front

WARM FRONT

- The warm front is developed when a warm air mass actively flows into the territory of the cold air mass.
- Since the warm air is lighter, at the zone of convergence it is gently lifted up forming a gradual slope of the warm front
- Since the rise of warm air is gentle, it condenses to form **Nimbostratus clouds.**
- Nimbostratus clouds are characterized by gentle to moderate precipitation over a large area for a longer duration.

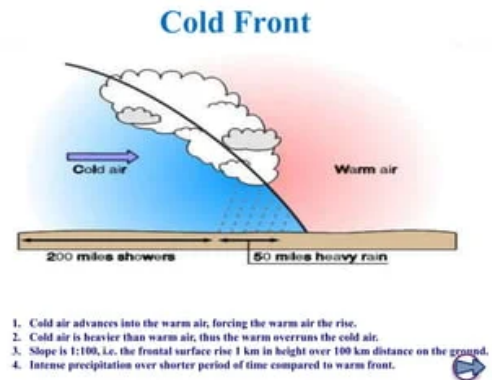


COLD FRONT

- These are formed when the active cold air flows into the territory of warm air mass.

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- Since the cold airmass is denser, at the zone of convergence this cold airmass throws the warm air mass vertically upward.
- This led to the formation of the **Cumulonimbus clouds, Nimbostratus, Altostratus, Cirrostratus, and Cirrus clouds.**
- Cumulonimbus clouds result in heavy precipitation along with lightning and thunder over a small area for a limited duration.
- The steep slope formed between the warm and cold air mass is called the **Cold Front**

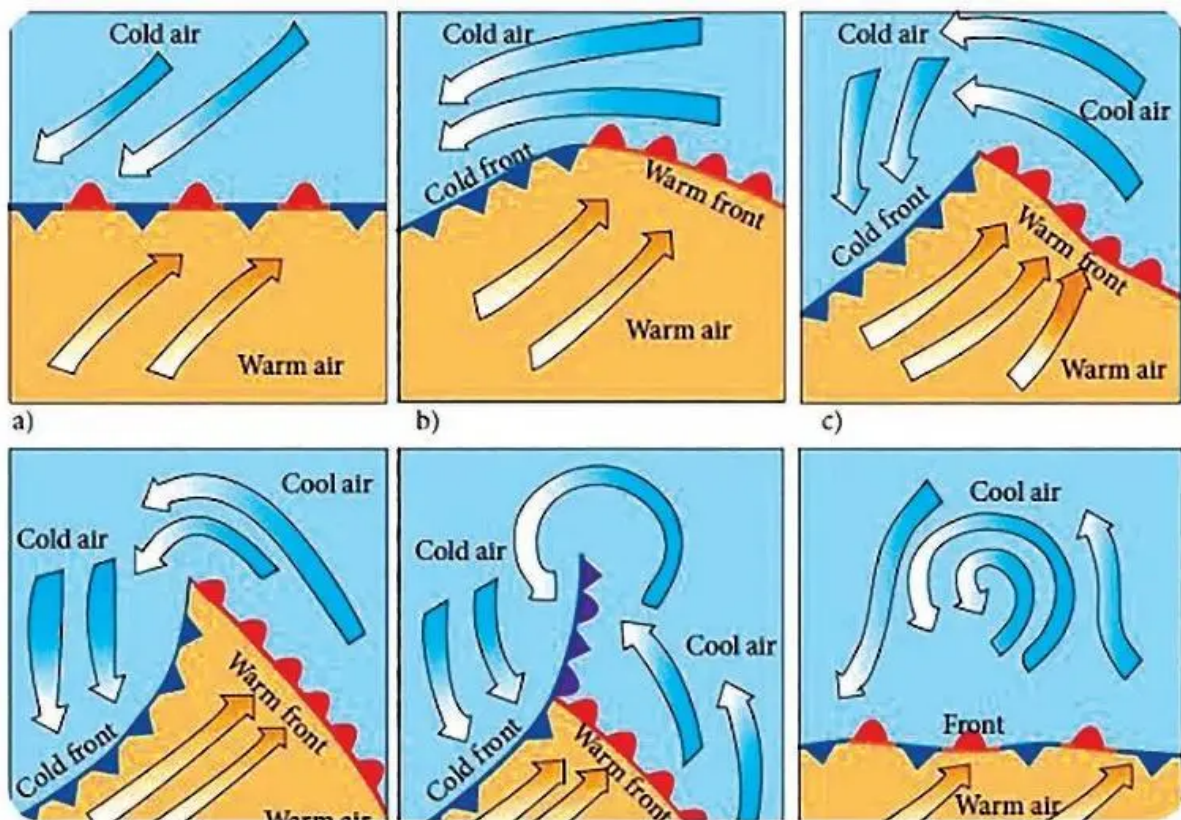


OCCCLUDED FRONT

- In this situation, the warm air mass is completely displaced from the ground.
- **NOTE-** Warm air is trapped between two colder airmasses and forced upwards by the cold air mass.
- The cold front completely takes over the warm air mass.

STATIONARY FRONT

- This is formed when two air masses are completely flowing parallel to each other instead of converging.
- These are characterized by cloudy weather with some amount of precipitation.

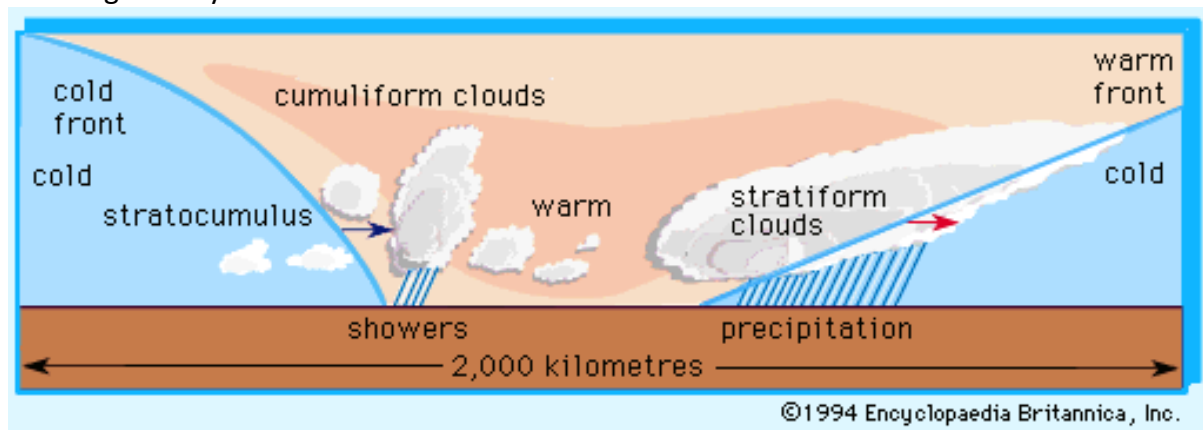


STRUCTURE OF TEMPERATE CYCLONES

- Temperate cyclones are under the influence of **Polar Jet Streams and Westerlies** which make them move from west to east.

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- These can originate either over the sea or land as a result of two contrasting air masses converging.
- They originate all across the year when the prerequisites are fulfilled.
- But they become **stronger and more frequent during the winter**.
- **NOTE**- the impact of global warming shall nullify the contrasting temperature and pressure factors. This can affect the year-long formation of temperate cyclones.
- The winds generally flow with lower velocity due to a lesser pressure gradient.
- Temperate cyclones are spread over **1000 to 3000 km in diameter** exhibiting different weather conditions across different regions of the cyclone. (as mentioned in the diagram)
- **Rainfall in temperate cyclones is only defined along the fronts.**
- Unlike tropical cyclones, **the isobars are not closed**. Therefore they are generally referred to as **V**



Weather conditions-

- As the temperate cyclones arrive there is the presence of cirrus clouds in the sky.
- As the cold sector approaches, one can witness a decrease in temperature clear weather, and atmospheric stability.
- As the warm front arises, temperature shall increase and it is accompanied by gentle showers (Nimbostartus)
- Further increase in temperature shall be witnessed for a brief period along with clear sky.
- With the advent of the cold front, there shall be heavy precipitation, lightning, and thunder that is facilitated by cumulonimbus clouds.
- Finally, the arrival of the cold sector again reduces the temperature and establishes a cloudless clear sky.

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- These are high-pressure centres with decreasing pressure outwards
- They shall facilitate the movement of winds outwards from the centre.
- The movement of winds is subject to the Coriolis effect (**thus clockwise direction in the northern hemisphere and anti-clockwise in the southern hemisphere**)

Characteristics-

- 1) These are high-pressure centres in the zone of descending air
- 2) It facilitates a clear sky and no precipitation.
- 3) Such atmospheric stability is the reason behind dry weather conditions.

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- 4) Sub-tropical high-pressure belts and polar high-pressure belts are the regions of anti-cyclone.