Climatology

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Geography

a) Structure / Composition of atmosphere
b) Insolation

1) Elements of Weather & Climate

→ Temperature ← Anomaly
Inversion

→ Pressure & Circulation → Advection

Surface
- Planetary
- Regional → Monsoon
- Local

Upper
- Jet streams

→ Moisture (Instability / Stability, Hydrological cycle, Precipitation)

2) Weather Mechanism *

→ Air masses & Fronto genesis → Temperate → Thunderstorm, Tornadoes, Water spouts
→ Cyclonic circulations → Tropical

3) Climate classification

Koppen, Trewartha, Thornthwaite

Atmosphere

Air realm – It is gravity that is keeping 10,000 km of atmosphe intact

Composition

Major

N_2

O_2

99%

* Inactive (bcz no role in weather mechanism)

Homogenous everywhere

Trace → Aerosols

CO_2, CH_4 – GHG

O_3

Water vapour (WV)

Active / gaseous

Active

- Stable: CO_2 (CH_4), O_3
- Variable: WV, Aerosol

Variable bcz Sahara's atmosphere will have aerosols and Atlantic ocean's atmosphere will have WV.

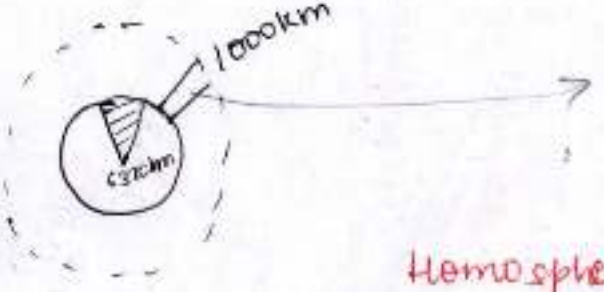
Structure

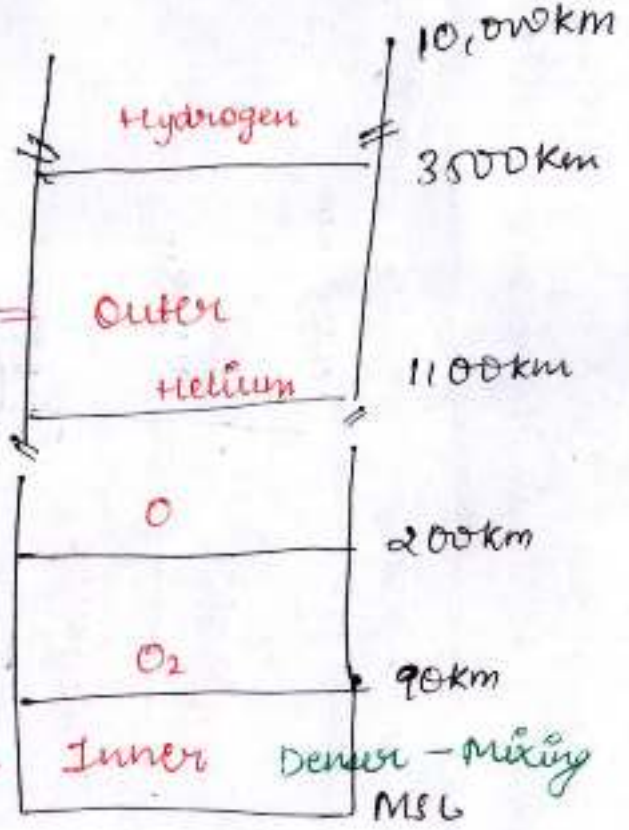
Inner

- >85% of atmosphere – diff composition
- height of 90km

Heterosphere = No Mixing

Homosphere = Denser – Mixing





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Inner atm accounts for >85% of atmosphere & extends upto 90km, so major concentration of composition here toh ye toh heterogenous hona chahiye but inner is more denser hence mixing up of constituents ∴ homogenous.

Troposphere

- The inner most layer troposphere is the densest layer.
- Thus is comprised of almost all water vapour, aerosols & CO_2.
- All the weather phenomena takes place in this layer.
- Climatalogically troposphere is the atmosphere (including tropopause i.e the limit of troposphere).

Insolation

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- It is incoming solar radiation i.e small amount of total solar radiation received by Earth's system.

small amt received due to large distance.

- The amount is attributed to the involved distance between the 2 celestial body i.e approx 149 million km.

- The Insolation amt received by Earth's system remains near constant (with negligible influence of Perihelion (147m km) and Aphelion position (152m km))

- It is distribution of insolation that however varies regulating the developed climatic conditions.

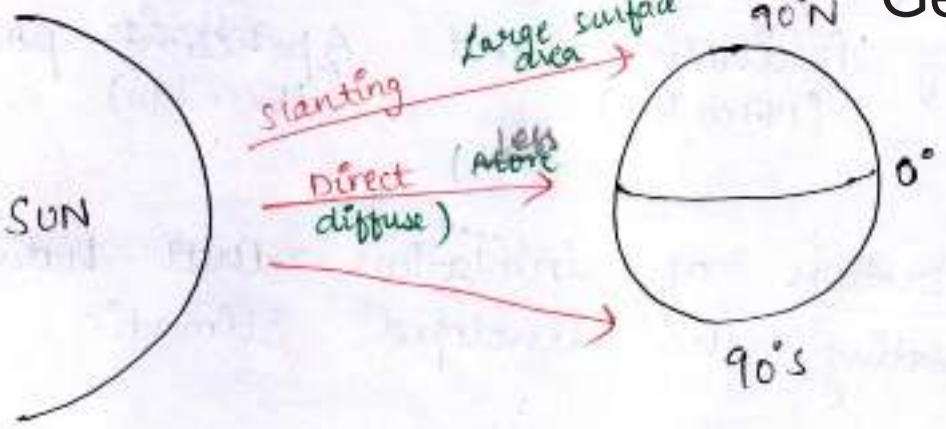
- Determiners of distribution includes –

(a) Angle of Sun rays
(b) Season cycle
(c) Atmospheric influence.

} Primary determiner

a) Angle of sun rays

- It is distintion b/w direct and slanting sun rays.
- The direct sun rays combines less distance of travel and less diffusion thus relates to a higher amount of insolation.
- In comparison, slanting sun rays travels more and diffuses more thus relates to ~~toto~~ lesser amt of insolation



Season cycle experienced bcs of revolution & axial inclination influencing insolation

b) Season cycle

- Axial inclination of planet Earth and its Revolution around sun tends to create season

cycle.

- The high sun season i.e summers as combines more direct sun rays and lengthier duration of day forms insolation surplus season.

* As there is reversal of seasons between the hemispheres insolation distribution is influenced by seasonal cycle.

Primary determiners - Planetary influenced
secondary - only regional / local influenced

Cloudy days are colder as clouds reflects back solar radiations.
cloudy nights are warmer than cloudless nights.

c) Atmospheric influence - related to trace & variable constituent

- It is a secondary determiner of insolation pattern (involving influence at regional or local level).

- Involving the role of active variable constituent it includes -
  - Scattering by aerosols
  - Absorption by water vapour
  - Reflection by cloud cover

- All resulting in decreased amount of received

insolation.

Temp ↔ amt of heat present in atmosphere
Source of temp - outgoing longwave terrestial radiation.
max temp measured at 2PM bcz of terrestial radiations
warmer the body - shorter wavelength
Atmosphere near transparent to incoming solar radiation some is absorbed
& opaque to outgoing terrestrial radiation hence
heats up bcz of terrestial radiation

Atmospheric Temperature

* Air temperature have a positive relation with insolation.

- It is amount of heat present in atmosphere.
- It is fundamental most element of weather and climate.

* i.e influenced by insolation and influences air pressure.

- Principal source of atmospheric temperature is outgoing longwave terrestrial radiation.
- The secondary source of air temperature is incoming short wave ~~or~~ insolation.
- Pattern of air temp. thus is influenced by -

↳ can't be substituted by angle of sun rays bcz temp ↑ is bcz of terrestrial radiation

Horizontal Pattern of air temp:

a) Sign of latitude
b) Land - water distribution

] Planetary or Primary determiner

c) Prevailing winds & oceanic currents
d) Cloud cover

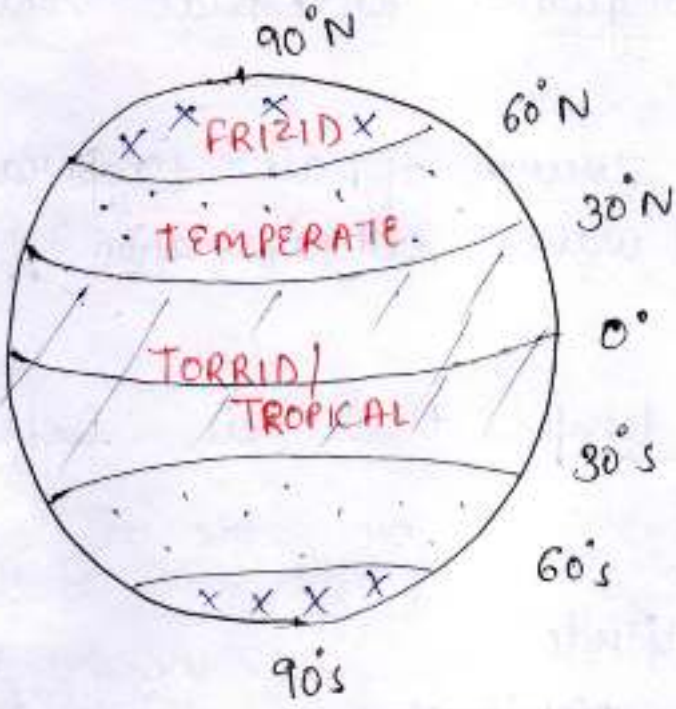
] Secondary determiner

e) Altitude or height.

↓ Vertical

(a) Sign of latitude

- Primary determiner of horizontal pattern of air temp.
- As with ↑ in sign of latitude, amt of received insolation ↓s, atmospheric temperature tends to decrease with ↑ in latitude.
- It is therefore that thermal zones are distinguished that includes
  - Torid zone : Lowest latitudinal, warmest
  - Temperate zones : Mid latitudinal, moderate temp.
  - Frizid zones : High latitudinal, coldest



Thermal zones

water is - translucent
mobile
Higher specific heat
} hence maintains its temp.

(b) Land - Water Distribution

- This primary determiner regulates longitudinal temperature pattern as land and water in a given sign of latitude do not develop same temperature.
- water always tends to maintain prevailing temperature as -
  - It is translucent
  - It is mobile
  - It has higher specific heat - amt of heat required to change the heat of 1 gram by 1°C
- In comparison, neighbouring land shows extreme, generating temperature anomaly.

Temperature anomaly

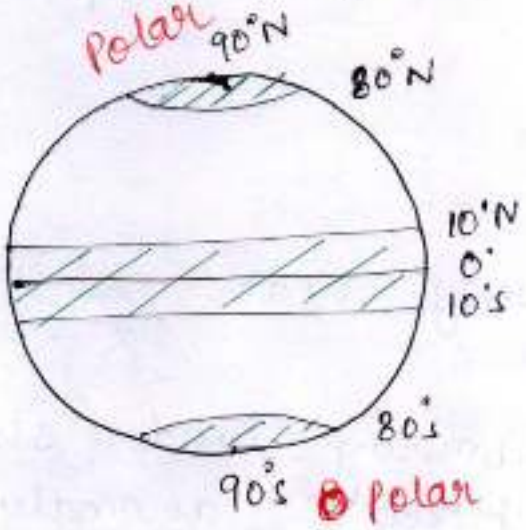
variations / deviations from "NORMAL"

Theoritically
doesn't consider season cycle

	+ve (Prevailing temp. more than "normal")	-ve (Prevailing temp. less than "normal")
lower latitude (0-45° N/S)	Land (India)	Water (Arabian Sea)
upper latitude (45-90° N/S)	Water (Sea of Okhostk)	land (Russia)

* As maximum of locations experiences season cycle temperature anamaly practically reflects -

- Land during summers will develop +ve temp. anomaly.
- Land during winters will develop -ve temp. anomaly.



Equatorial Belt

Polar & equatorial belt don't experience season cycle

Climatalogically, if 'relief' is written it by default means 1st order relief

The temperature anomaly pattern at the global scale is depicted with pattern of isotherm.

- Isotherms are imaginary lines joining the places that have same temperature.
- It's factor in homogenous relief remains parallel

to the latitudes-

* At along shoreline, isotherms always bends depicting temperature anomaly.

* the nature of bends is determined by relief, transition and prevailing season.

for eg. Summer isotherm traced from-

- Land to water bends towards equator
- water to land bends towards Pole.

© Prevailing winds and Oceanic currents

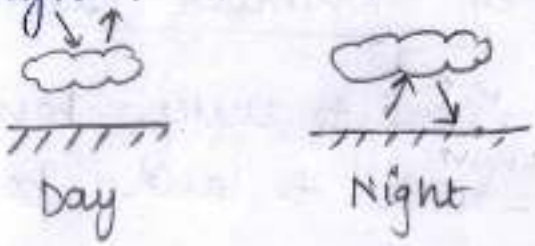
- These factors induces manipulating role on prevailing temperature "as regulated by sign of latitude and relief".

- Western European Plain projecting higher temperature than the same latitudinal Manchurian Plain as it remains in perennial influence of warm oceanic current called North Atlantic drift and onshore westerlies

Europe has a favourable or equitable climate hence the floods, heatwaves it is experiences now is due to climate change.

(d) Cloud Cover

- The cloud cover regulates temperature patterns as it is capable of influencing both incoming and outgoing radiations.
- It is therefore that cloudy days are colder than cloudless days and cloudy nights are warmer than cloudless nights.



(e) Altitude / Height

→ vertical pattern of air temp.

- throughout troposphere temp. normally decreases with increase in height.
- This is due to increase in distance from the principal source (i.e Earth's surface).

* The rate of decrease of temperature is 6.5°C / km called Normal lapse rate (NLR)

In winters long cold winter nights, cold surface air ko ~~warm~~ cold kr degi but air upr vali air ko coldwave bc2 Air Poor conductor of heat, but in cloudless & windless

↓ bc2 ↑ cold he rhegi

↓ wind se cold more ho jaayegi

Temperature Inversion

- Applied at regional or local levels, temperature inversion depicts to be the condition when within troposphere temperature increases with increase in height.

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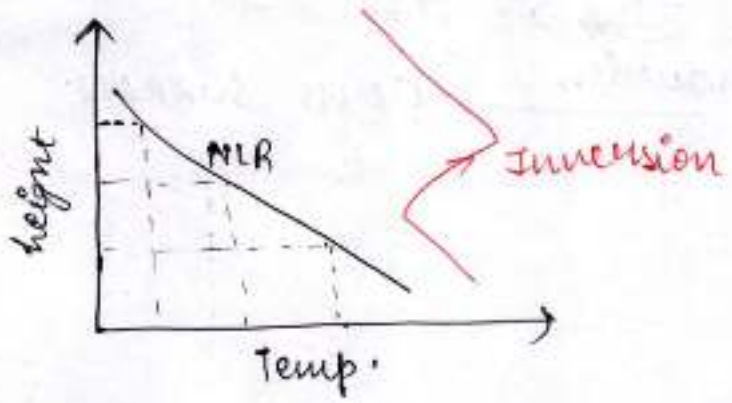


- Developed temp. inversion relates to range of weather mechanism.

common set of conditions that tends to evolve temp. inversion includes -

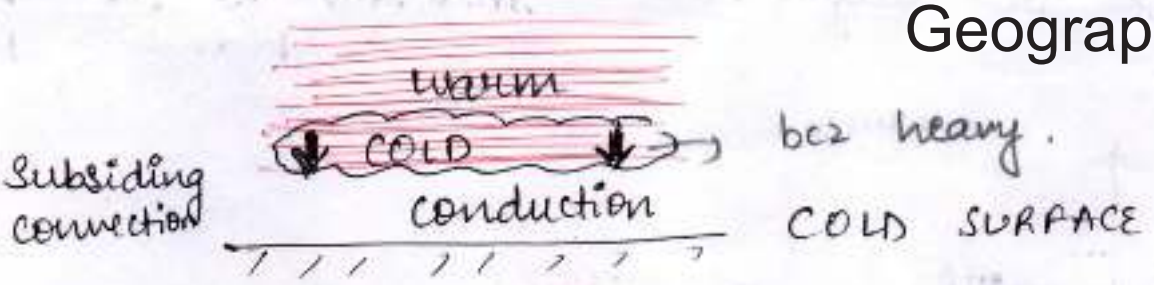
a) Contact cooling
b) Air convergence
c) Adiatic cooling
d) Air drainage

a) Contact Cooling

Typical to long cold winter nights that are cloudless and windless.

Process of conduction makes cold surface cool

down the air column in contact with it generating subsiding convection, as air is poor conductor of heat there will be warmer air over the evolved cold air column generating inversion

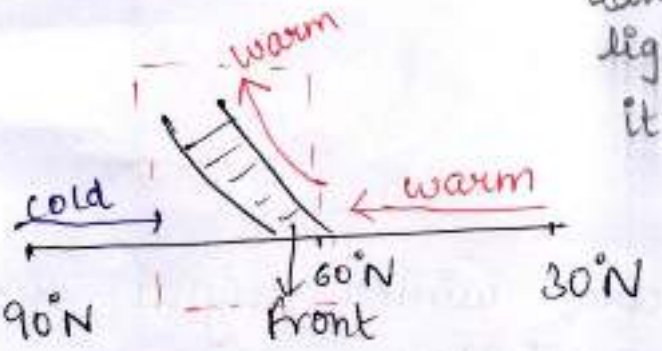


b) Air Convergence

- At near 60th parallel regular convergence of warm and cold wind facilitates frontal rise.
- This tends to generate mid latitudinal temp. inversion.

* That denotes the pre condition for temperate cyclonic circulation.

Warm air moves bcz of advection, it is not that lighter to rise on its own it is when its passage is blocked it rises.



Rising air column will expand its volume hence will cool - Adiabatic

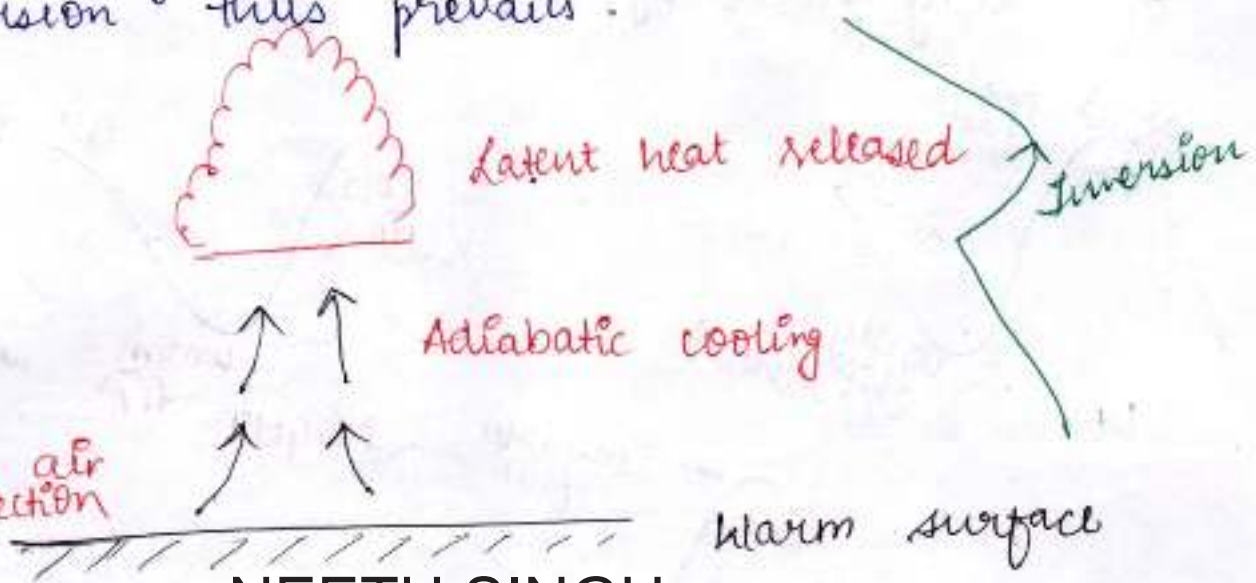
then condensation & releases its heat i.e latent heat of condensation

c) Adiabatic cooling → Air rising till cool ho jaaye ki condensation ho then isse latent heat (so temp ↑s here)

- The adiabatic changes is denoted to be the change in air temperature without any addition or subtraction of heat.
  ↓ cooling bcz of ~~subtra~~ expansion.
- The adiabatic cooling thus depicts rising air column subjected to volume increase that leads to the proces of condensation.

with this process release of latent heat tends to generate inversion.

* At every level of cloud formation temp. inversion thus prevails.



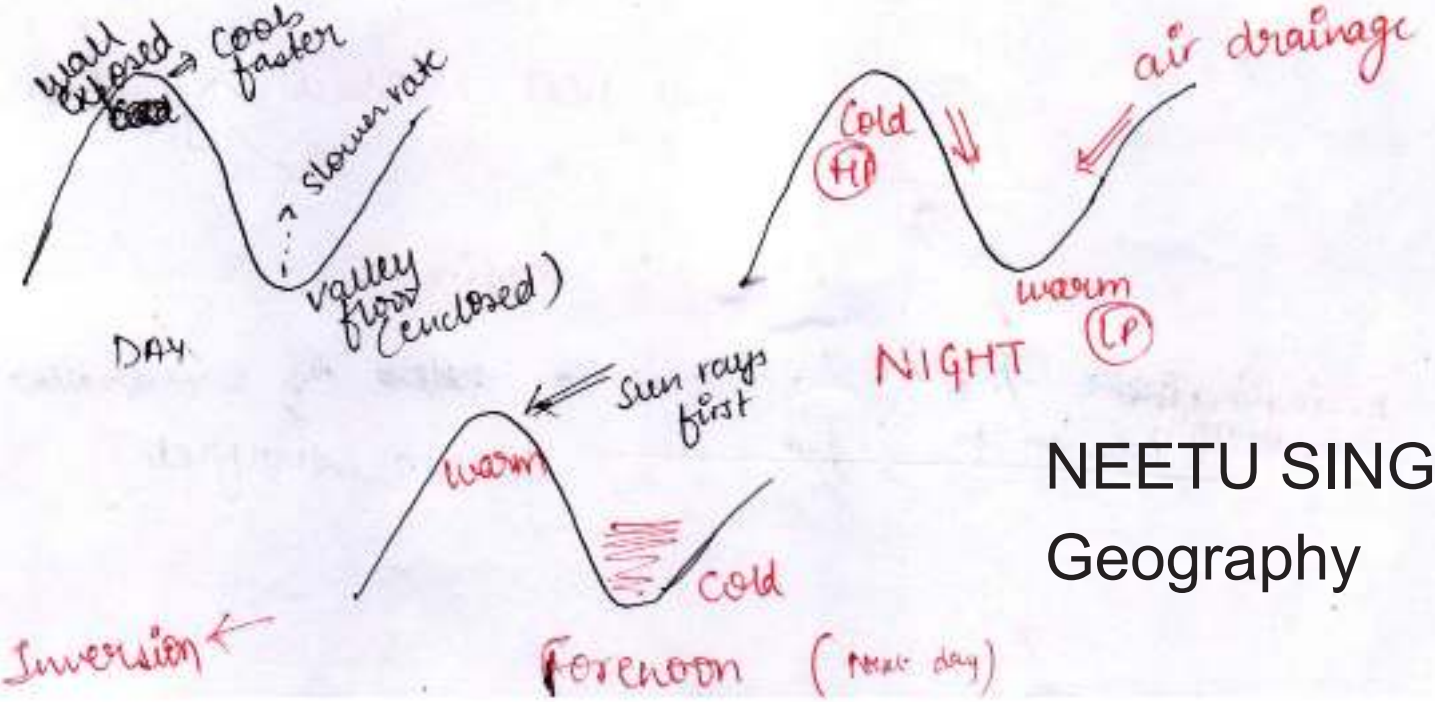
d) Air drainage

- The condition for temp. inversion in mountainous areas involves air drainage.
- It is due to differential rate of cooling of exposed mountain wall and enclosed valley floor that air drainage is experienced during night.

* This tends to settle down the air column at the valley floor subjected to gradual cooling throughout the night.

- In the following day during forenoon hours when exposed mt wall gets heated up due to incoming solar radiation temp. inversion develops.

* The inversion decays with the warming up of valley floor by afternoon.



If ques mentions element of weather & climate don't write (e) point as weather mech. only till troposphere, if open ended ques of temp. inversion then write (e)

— ice clouds

Mesosphere has Noctilucent clouds bcz temp ↓s in ↑ in height that will facilitate condensation

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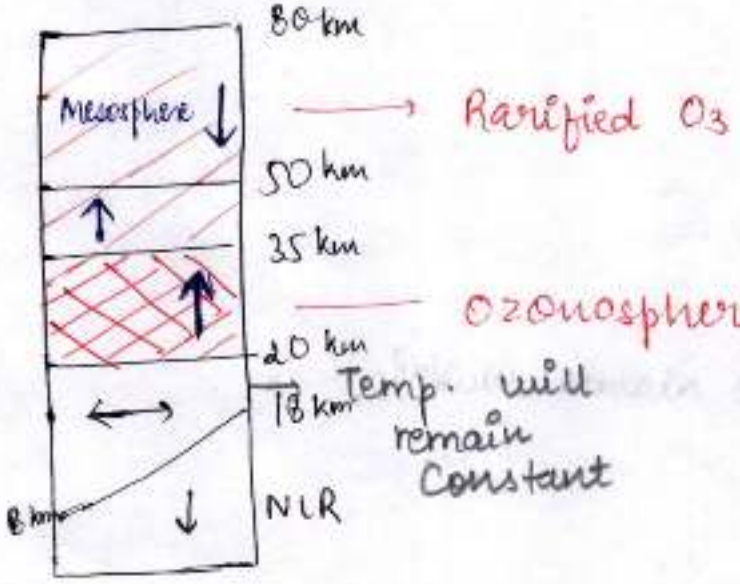
(e) Temperature in other layers of atmosphere

i) Inner



The stratospheric inversion is defined to be increase of temp. with increase in height due to the concentrated presence of ozone (the ozonosphere) thus strongest absorption.

(QE) Alternate ↑ & ↓ in temp in layers of atmosphere & reason is diff-

ii) Outer

→ Thermosphere

→ bcz of ions (electrically charged particles)

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Air Pressure & Circulation

HP is developed when air column subside (due to cold air)
Elongated LP at equatorial belt - Trough , HP - Wedges
Sudden LP - cyclone HP - Anti-cyclon

temp & Pressure has inverse relation, Pressure don't have standard pattern when height is so, Pressure ko only horizontally study.

- fundamental element of weather & climate, air pressure is defined to be the weight that air column exerts on ground.

- The Pressure systems thus are regulated by convective mout of air i.e not warm but rising + mechanical

  - Rising air convection (thermally or mechanical induced) creates low pressure system.

  - Subsiding air convection (thermally or mechanically induced) develops high pressure system.

- The Pressure systems are also classified on the basis of their size

Pressure system

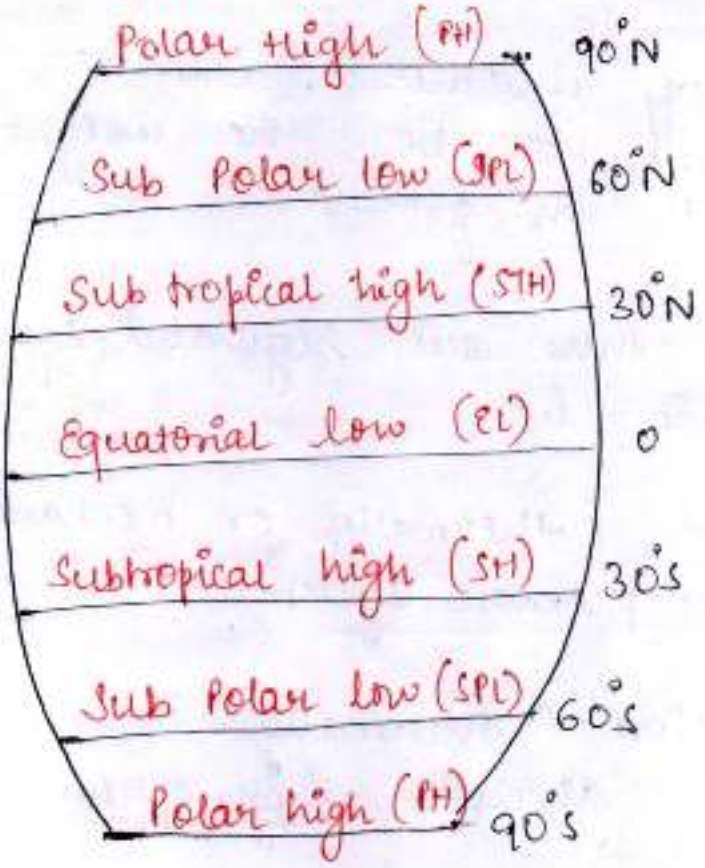
Size based

- Low
  - Troughs — Elongated Low
  - Cyclones — Small sized low
- High
  - Wedges — Elongated high
  - Anti cyclones — Small sized high

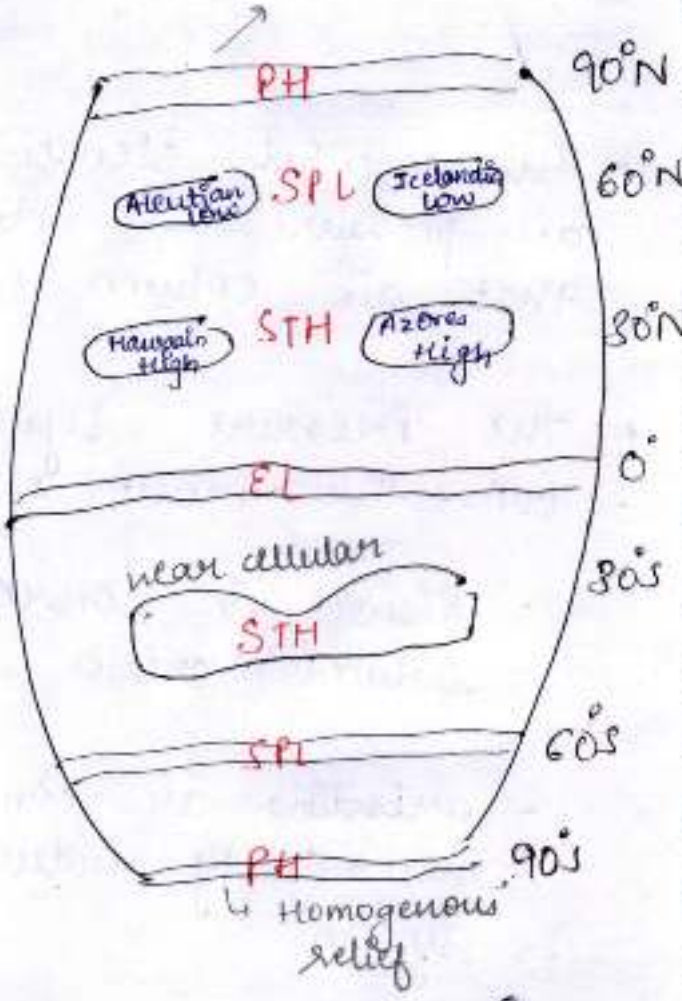
* The air pressure at MSL is 1013.25 milli bars

Horizontal Pattern of Air Pressure

Look at world map



Latitudinal air pressure pattern



Longitudinal air pressure pattern

Land water diff don't occur in equatorial belt (climatalogically) Land will be as wet as water

In equator air merge hone se petle rise ho jaati hai bcz air is warm bcz of direct insolation

- Latitudinally on the spinning Earth combined influence of thermally and mechanically generated pressure combines to generate 7 pressure profiles.

With Equatorial low and Polar highs being thermally induced.

Whereas Sub-tropical highs and Sub Polar lows are mechanically generated.

- In the reference of land water distribution, longitudinal air pressure pattern depicts -
  - Polar highs and Sub polar low of S^n hemisphere are continous belt due to homogenity of relief
  - Equatorial low is also continous belt as land water climatological difference is not applicable in equatorial region.
  - Sub-tropical high of S^n hemisphere forms near cellular due to dominating equitable influence of water in the otherwise unequal distribution of land and water.

- 30°N Ocean m humesha STH maintain Rhega in summers but not on Land (USA - LP)

- STH cellular he rhega be it winters or summers bcz winters m USA m bhi STH or oceans m

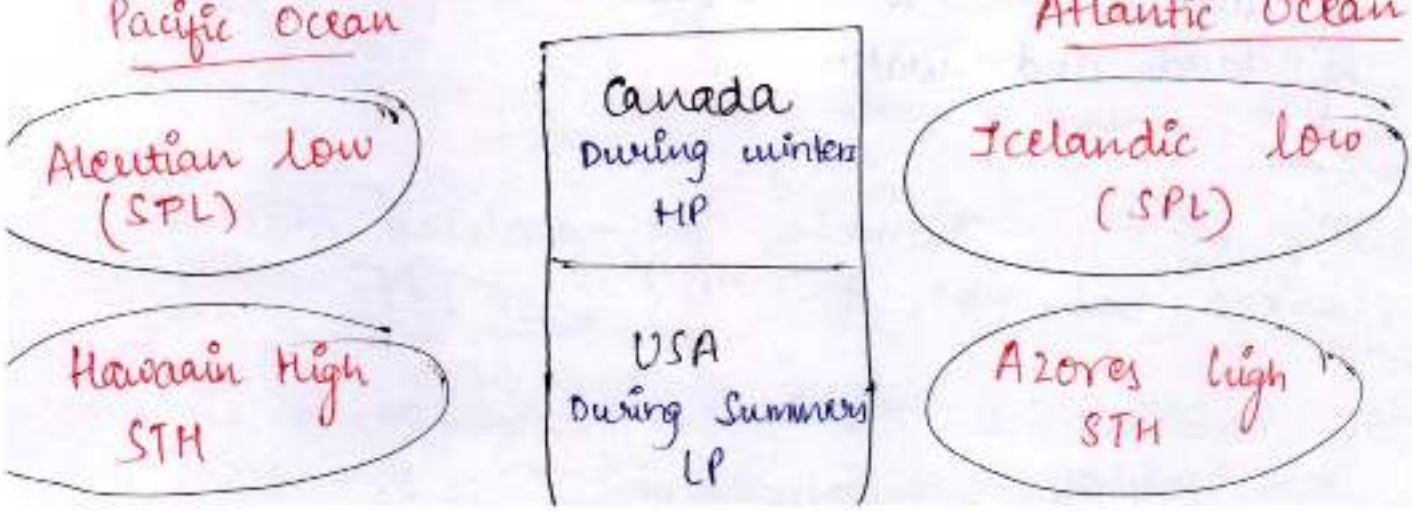
bhi but land -ve anomaly

- The Sub-tropical high of N^n hemisphere has cellular profile with perennial presence in open Atlantic as Azores high and open Pacific as Hawaain High

The adjoining land masses tends to maintain HP during winters but completely terminates its during summers due to generated +ve temp anomaly

- The Sub-Polar low of N^n hemisphere has cellular profile with perennial presence in open Atlantic as Icelandic low and open Pacific as Aleutian low.

The adjoining land masses tends to maintain LP during summers but completely terminates it during winters due to generated -ve temp anomaly.



* During summers STH evolves stronger cellular characteristics.

* During winters SPL evolves stronger cellular characteristics.

STH & SPL maintain rhete hai bcz water temp. ko maintain krta hai

Every rising air column will develop (LP) on ground and near tropopause it will accumulate, developing (HP)

and once this pressure diff is created, Advection generates.

Adiabatic cooling jha tk hoti hai or air jha se subside hoti hai vha tropopause distinguish krta hai.

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Atmospheric circulation

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- The consistent nature of most of atmosphere relates to the fact that -

a) Every rising air convection tends to create pressure difference wherein LP is created on ground and HP vertically over at tropopause level.

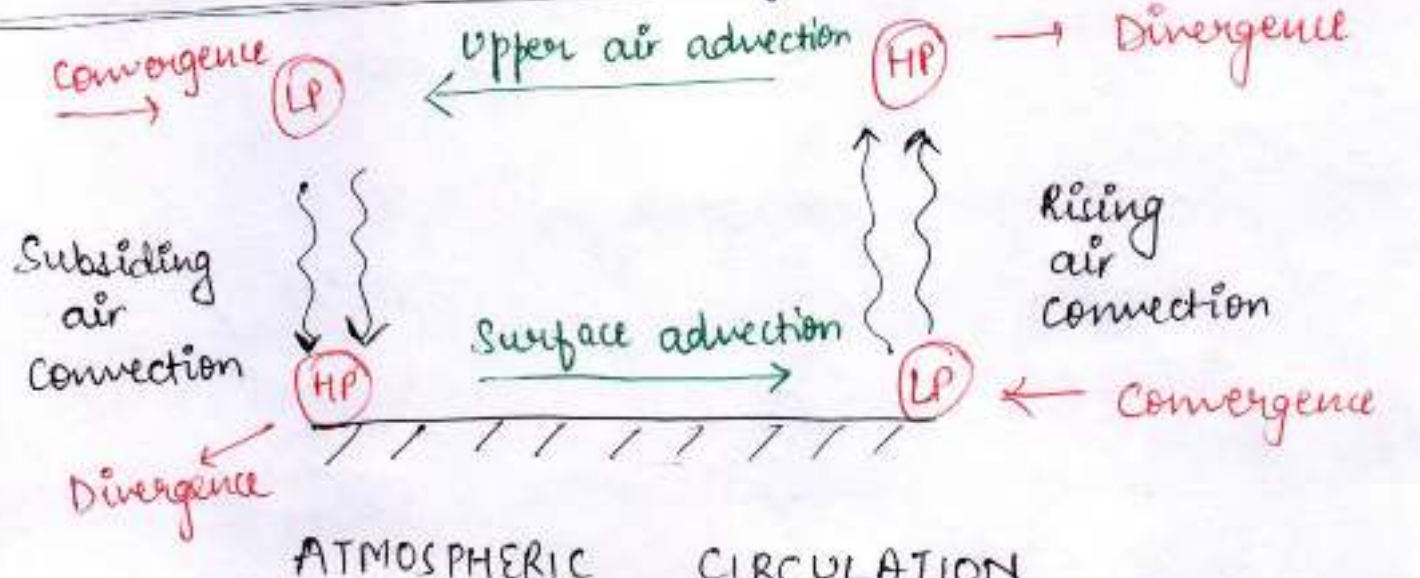
b) Similarly every subsiding air convection tends to create HP on ground and LP vertically over at tropopause level

bcz it creates vacuum ↑ upper

c) The generated pressure difference causes genesis of advective air movement i.e horizontal movement of air called Wind.

It is therefore that wind always moves from HP to LP i.e

→ LP areas been convergence zone.
→ HP areas been divergence zone

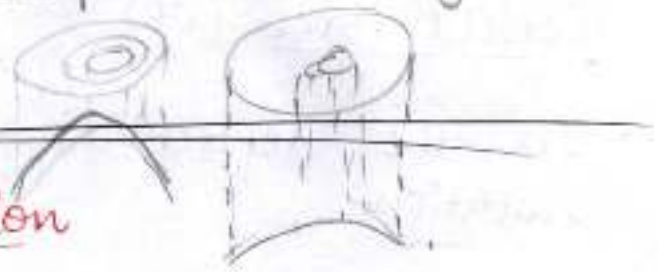


ATMOSPHERIC CIRCULATION

* Air convection (vertical movement of air) creates pressure difference

* Air advection (Horizontal mont of air) is caused by created pressure difference.

If pressure gradient force steeper then high wind velocity



Forces regulating advection

- Advective mont of air is regulated by 3 principle determiners -
  - The Pressure gradient force
  - The Coriolis force
  - The frictional force

Pressure gradient force (PGF)

→ aka barometric slope

- It depicts rate of change of pressure.
- On the weather map it is depicted by placing of isobars (closed spaced isobars depicts steeper pressure gradient vice versa)

- The PGF is genesis of force of wind.
- PGF determines wind direction i.e wind is always named after the direction from where it blows

- PGF determines wind velocity (steeper baromet

gradient higher will be the wind velocity)

Equatorial bulge will spin faster
higher will be wind velocity → higher deflection
higher will be sign of latitude → higher deflection

Coriolis force (Cf)

- Its the deflective force generated by Earth's rotation.

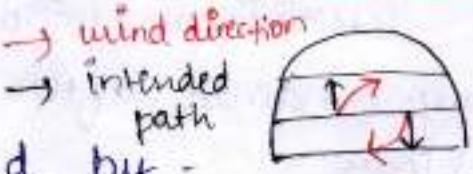
* At different latitudes spinning velocity of Earth tends to differ generating Coriolis effect.

- At equator spinning velocity is highest which decreases with increase in sign of latitude.

- for every advective mont having latitudinal dimension, coriolis effect thus is applicable.

- Recognized as Ferrel's law, wind will get deflected to its right in N^n hemisphere and its left in S^n hemisphere

- Cf thus tends to influence wind direction only



- It is however influenced by -
  - Wind velocity (higher velocity more deflection)
  - Sign of latitude (higher latitude more deflection

as coriolis force is 0% at equator and 100% at Poles).

Frictional drag of surface winds and not upper winds.

Frictional Force / Drag

- It is the drag force that is experienced by surface winds.
- It tends to influence wind velocity.
- Accordingly it involves the capacity to manipulate coriolis deflection thus wind direction.
- Analysis of frictional drag effect is credited to scholar Ekman who concluded Ekman's Spiral effect.
- This effect is the outcome of a lab experiment that justifies that with increase in the height of advective movt., decrease in the frictional drag tends to.
  - → Increase the wind velocity → ↑ coriolis force strong so change in wind direction.
  - → Thus changes the wind direction.
- The spiral effect thus incorporate -
  - → Veering effect

    when clockwise change in the wind direction

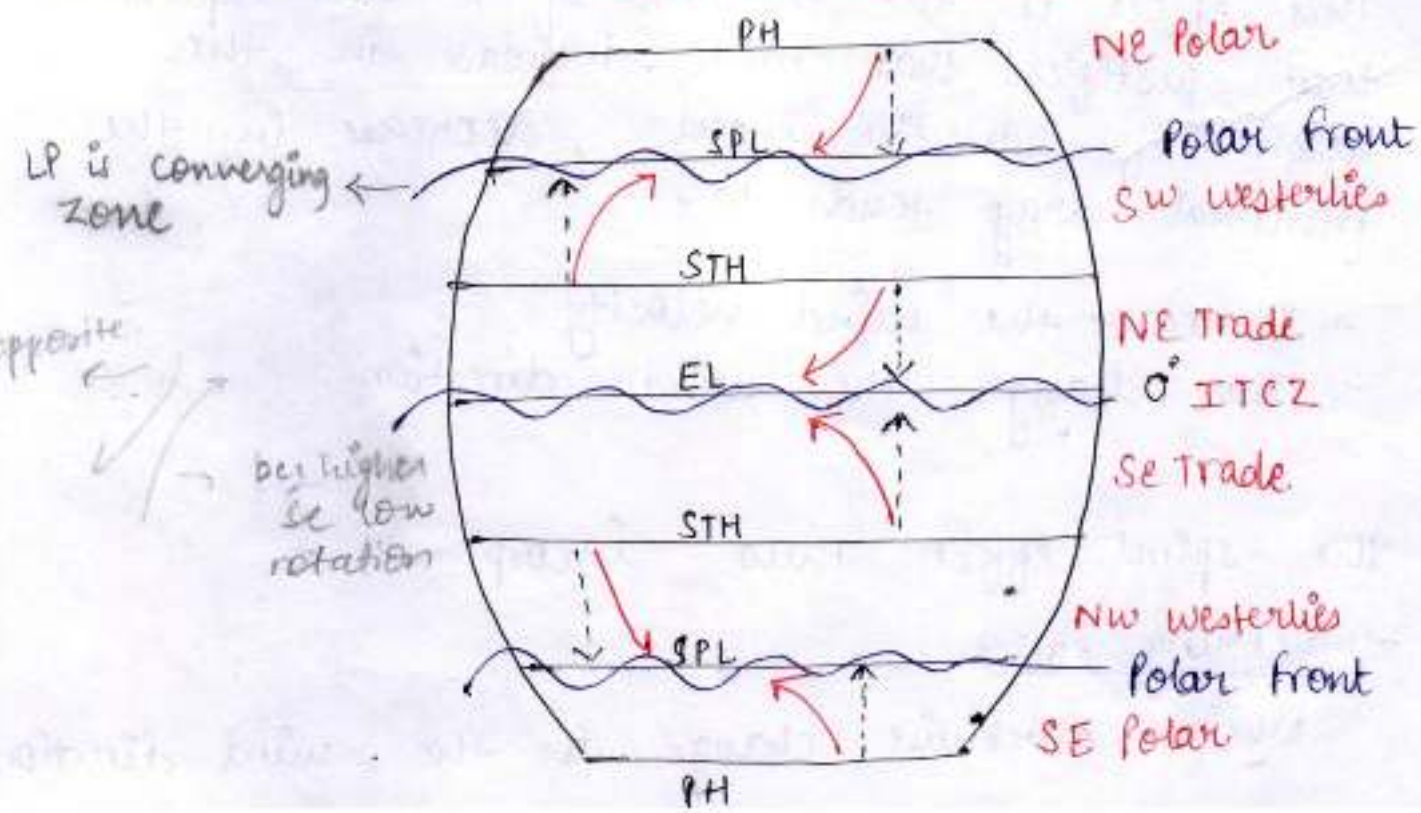
is observed.

→ Backing effect
when counter clockwise change in wind direction is observed.

Types of Advection

- Synoptic / global scale (macro scale)
  - a) Planetary winds
  - b) Geostrophic winds (Jet streams)
- Regional scale
  - Monsoonal winds
- local scale
  - Local winds

Planetary winds



- The prevailing winds that represents synoptic scale with perennial existence.
- It is ~~that~~ categorised into 3 principle categories -

a) Trade Winds

- Lowest latitude planetary winds
- It moves from Sub tropical highs to Equatorial low.
- are North Eastern trade in N^n hemisphere ~~and~~ and South Eastern trade in S^n hemisphere.
- It develops Inter tropical convergence zone (ITCZ) along thermal equator.

* In the geographical equatorial belt Doldrum (quiet zone) marks its presence that gets strongly evolved during equinoxes.

b) Westerlies

- Are mid latitudinal planetary winds.
- Moves from STH to SPL
- These are South west Westerlies in N^n hemisph and North ~~West~~ West Westerlies in S^n hemisphere.
- These winds play significant role in the genesis of polar fronts

c) Polar winds

- are the highest latitudinal planetary winds.
- moves from SPHs to SPLs.
- These are N. Eastern in Nn hemisphere & S. Eastern in Sn hemisphere.

* Plays significant role in the development of Polar front.

30° 60° pr mechanical bcz temp diff. aye na aye there is diff due to subsiding or dense CO rising bcz of less area so Contraction & subside

↓
bde area ki traf so expansion hence rise

Mechanism of formation of sub tropical highs and sub polar lows

- Ideally, thermally induced rise at equator subjected to adiabatic cooling generates taller height of tropopause along with HP at that elevation.

- From this tropopause high the upper air spreads out & moves towards Poles.
It thus crosses latitudes which are getting shorter.

It has to thus occupy lesser space thus contracts to subside creating sub-tropical high at near 30^{m} parallel.

- The Polar High generated in cold Polar latitude tends to generate surface advection towards equator.

As these surface winds crosses latitudes they tend to expand.

This is because latitudes are getting longer.

these surface advection thus results in Sub polar low at near 60^{m} parallel.

* It is these mechanically generated pressures that creates tricellular circulation in both the hemisphere.

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Atmospheric Moisture

- Fundamental element of weather & climate
- It is trace, active & variable.

* It is therefore that humidity is more relevant term as it is defined to be amount of water vapour present in specific air column.

- The source of humidity is Earth's surface and thus involves proces of Evapo-transpiration

The term is applied to denote both
- Potential evapotranspiration (PE)
- Actial evapotranspiration (AE)

PE is measure of ~~availability~~ ability of atmosphere to remove water through the Earth's surface assuming that there is no control in the water supplies.

The regulators of evapotranspiration principally includes prevailing temp. that is determined by
- Sign of latitude (lower latitude PE high)
- Prevailing season (Summers PE high)
- Time of the day (Afternoon PE high)

AE apart from considering 3 determiners of prevailing temp. identifies prevailing control in water supplies thus actual evapotranspiration is less than potential evapotranspiration in most of the cases except humid areas.

As sign of latitude ↑, specific humidity decreases but in same sign of latitude Sahara desert will have more aerlols & ocean will have more humidity

Evapotranspiration

- is a continous proces however its rate varies
- the rate is determined by prevailing temp. and humidity levels.

- humidity is measured as -

a) Absolute humidity - ⇒ Ability of air to hold water vapour depends entirely on its temperat. (warm air can hold more moisture than cold)

- i.e mass/weight of water vapour per unit volume of air.
- expressed as gm/m^3.
- is highly fluctuating measure thus is least utilised in climatology.

b) Specific humidity - Since it is measured in weight it is not affected by change in pressure or temp.

- it is measure of mass of water vapour per unit mass of air.
- Expressed as gm/kg.

- it is sufficiently stable measure utilized in climatology to compare humidity levels of different air column.

* Specific humidity decreases with increase in sign of latitude.

c) Relative humidity

- it is the ratio of amount of water vapour present in the air column & its carrying capacity at that given temp.

- is always expressed as percentage.

- It is this measure that helps in distinguishing
  → unsaturated air
  → dew point temp.
  → saturated air &
  → Super saturated air

* Thus have the significant role in analysing the potential weather mechanism.

$$\text{Relative} = \frac{\text{Amt. Present}}{\text{Carrying capacity}} \times 100$$

Unsaturated air

The air column yet to reach its dew point temp. (have relative humidity less than 100%.)

Dew point temp.

It is the temp. at which the air column becomes saturated i.e attains 100% relative humidity (either by cooling down or by addition of water vapour).

Saturated air

i.e the air column reached its dew point temp. ie 100% relative humidity.

Super saturated air → effect of temp on saturated air

It the air column that has cooled below its dew pt temp

* is the pre requisite for condensation.

	Temp.	Carrying Capacity	Carrying	RH	
A	30°C	30 units	15 units	50%	- unsaturated
I A (subjected to cooling)	15°C	15 units	15 units	100%	- saturated
II A (added with WV)	30°C	30 units	30 units	100%	- saturated

Supersaturated by only cooling exception Arctic Smoke

Types of Precipitation

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- It is based on the mechanism that leads to formation of cloud and thus precipitation.
- 4 different types are distinguished.
- Convectional Prec^n & Cyclonic Prec^n are thermally induced mechanism

  These therefore don't relate to snowfall and their variants.

* Convectional precipitation is typical to low latitude along with mid latitude during summers.

  Cyclonic precipitation incompasion is typical to tropical marginal waterbodies

- Frontal prec^n & orographic prec^n are mechanically induced
- These therefore don't relate to hailstorms (baring the exception of squall line).

  Frontal prec^n is typical in mid & high latitudes.

  Orographic prec^n relates to the mountaneous areas (developing wetter windward & drier leeward sides)

Hydrological Cycle

- Movt of water in the different spheres of environment in rhythmic cyclic form is hydrological cycle.

- Technically, hydrological cycle include processes of evaporation, condensation & precipitation.

* Climatalogically, hydrological cycles are distinguished in 3 types -

a) Atmospheric hydrological cycle -

Is the cycle that involves prominence of virga i.e evaporated precipitation prior to reaching the surface

b) Diurnal hydrological cycle -

this involves daily sequence of evaporation & precipitation as is typical to equatorial climate with forenoon evaporation and afternoon prec°.

c) Delayed | Elongated hydrological cycle -

This is defined when precipitation -
- enriches snowfield or,
- Replenishes ground water

as in both the case evaporation gets significantly

delayed, delaying the cycle.

Normal lapse rate - for troposphere

Envtal lapse rate - rate @ which specific air column cools

Adiabatic lapse rate - is lapse rate of temp that rising column will experience

Dry AIR

Wet AIR

Moisture V/s humidity

overall water vapour in troposphere

water vapour in specific air column

Atmospheric- | Stability and Instability |

I • NLR ≠ ELR

(6.5°C/Km) (variable) Envtal lapse rate is rate @ which specific air column cools.

• ALR (Adiabatic Lapse rate)

Rate at which rising air column cools.

Dry ALR (DALR)

Steeper

10°C/Km

(Cools faster)
Unsaturated

Wet ALR (WALR)

(Also called retarted ALR)

↓

Bcz latent heat will 5°C/Km retard the rate of cooling

Gentler

Saturated (cools slow)

(b) Air will rise jb tk vo light hogi surrounding se & rising parse when it becomes denser bcz of faster cooling rising air cools

Atmospheric stability is when adiabatic LR is greater than ELR - turbundy

(a) Subsiding → stable isliye bcz air only subsiding no weather mechanism.

II. Atmospheric stability –

a) Subsiding air column

Polar is perennial stability zone.

b) Rising Pauses

ALR > ELR

III. Atmospheric Instability → (surrounding rising cooling faster than)

→ Range of wetter weather mechanism

→ ELR > ALR

Instability

Absolute instability

- when ELR is steeper than steepest ALR
  ELR > DALR
- cyclonic and convectional precipitation.
- → surrounding itna dense hoga ki air bht jldi zyada rise hoga hence bad weather

→ kyuki kisi condition ki vja se air rise hui.

Conditional instability

- When ELR is in b/w DALR & WALR.
- creating stable and instable condition with variable combination

DALR > ELR (say) > WALR

10°C/km 7°C/km 5°C/km

Stability Instability

- Frontal & orographic prec^n.
  ↓
  bcz they are not so warm to rise on its own so no hail.

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Earth's surface se 2 things attained -
→ temp.] differ in diff. air column
→ moisture

Air mass - Troposphere ka divide i.e homogenous
↳ attains more homogenity in winters bcz jb stable hoga (air subsides so remain in contact with its source area)

Air Masses, Types & weather effectivity

- Air mass are defined to be 3 dimensional homogenous masses of air (divided of troposphere) that projects homogenity in terms of temp. and humidity.

- The part of the Earth's surface from where the air masses attains their physical properties is called its source area.

- Barring the exception of extensive mountain cordilleras every location of earth's surface acts as source area for air masses (temp. change with ↑ in height)

- As stability is required for defined dept of homogenity, stronger air masses are developed during winters.

* Air masses developed at their source area are

called Barotropic, as they advect in the influence of prevailing winds they induced range of weather conditions along with modifying themselves to become Baroclinic air masses.

Types of air masses

- The air masses are principally classified on the basis of
  - latitude
    as tropical and Polar air masses
  - Relief
    as continental & maritime air masses

* Combining these major criteria 4 principle air masses are distinguished which are applied for global weather effectivities.

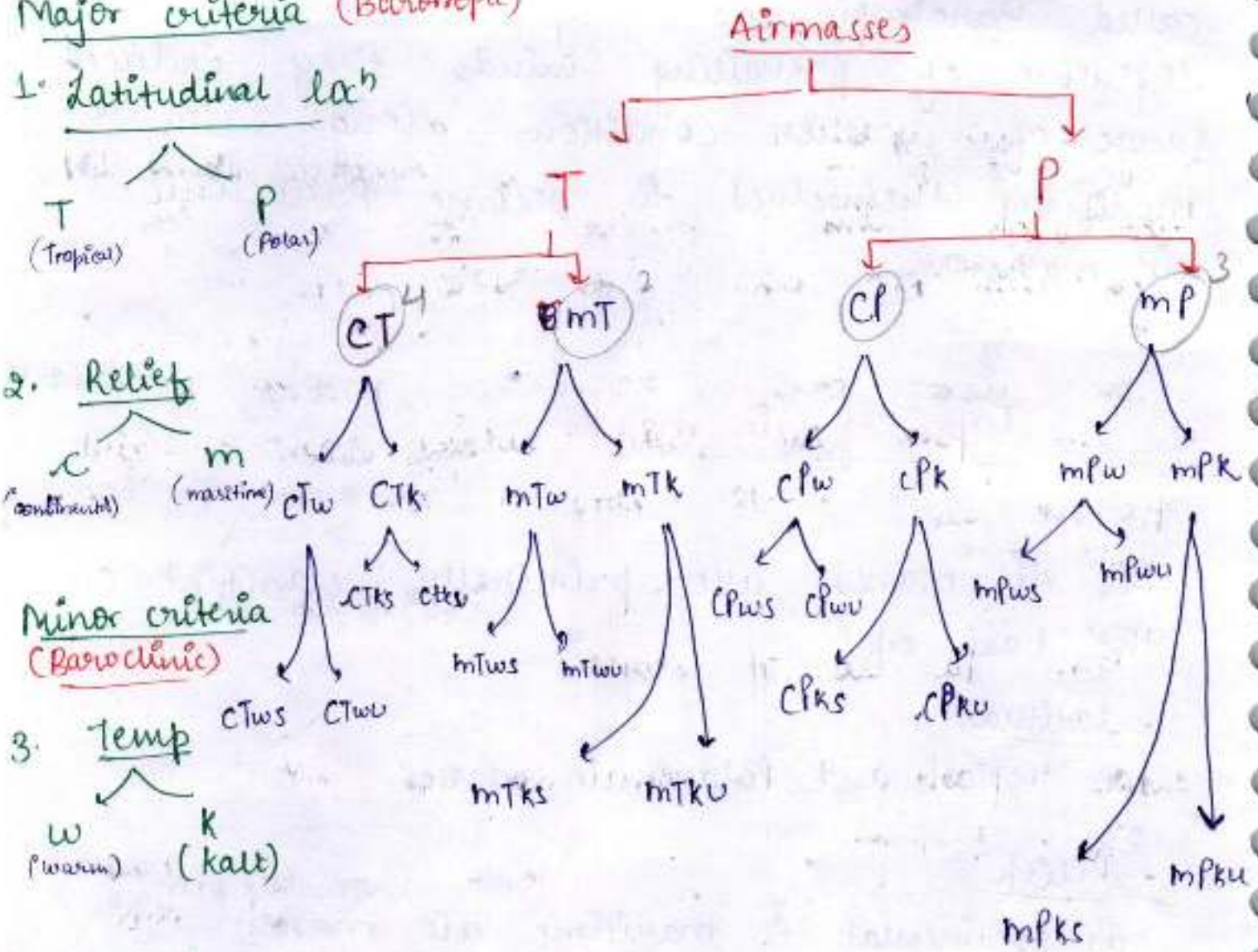
- The minor criteria to classify air masses includes -
  - temperature & stability

* Combining them ideally 16 different types of air masses can be distinguished.

Major criteria (Barotropic)

1. Latitudinal lab

T (Tropical) P (Polar)



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Weather effectivity of air masses

- The barotropic air masses are considered to analyse the weather effectivity.
- These includes -
  - Continental (dry) Polar (cold) (cP)
  - Maritime Tropical (warm) (mT)

- Maritime Polar (mP)
- Continental Tropical (cT)

In effect of Blizzard in Canada cP air mas when extend exponentially, USA hence grim winters in USA so now in westerlies belt so advect towards NE in effect of SW westerlies & come in contact with warm Atlantic ocean & 2 diff air masses will make front in sub tropical east margin known as arctic front hence prec^n in New found land etc

Same in effect of Purgas in Russia
Front in Sea of Japan

Russia's weak. bcz extended is weak bcz of orographic barrier
& front here is bcz of temp anomoly (land water diff).

1) cP

- cold dry air mass
- involves 2 prominent source areas - N^n Canada & N^n Siberia
- During winters both these airmasses in the effect of polar outbreak (extends) (southward extension) in lower latitude creating cold & dry weather conditions.

with blizzards been stronger than Purgas Canadian air mas creates stronger winter

condition in USA.

- This exponential extension makes both continental Polar air masses influenced by westerlies.

They thus advect towards North East to create arctic front along east margins of mid latitude.

This creates frontal precipitation in coastal N. America and coastal Asia (including neighbouring islands).

* Canadian air mass tends to develop stronger arctic front as it involves the influence of west boundary warm current (whereas Siberian air mass involves benefit of temp. anomaly only).

(*) It is with Canadian air mass that occassionally development of turbullent weather relating to squall line adds to the weather influence.

(strong control) Strong HP on USA & strong LP in ocean.

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2) mT (STH)

mT (weather effectivity)

- Permanent
  - Open Oceanic
    - Azores High
    - Hawaiian H
  - maritime equatorial (mE)
- Temporary (Seasonal) (marginal water)
  - Summer effective
  - Winter effective

- Its warm moist air mass that induces wetter weather conditions.
- It is identified with distinctive categories both based on location as well as induced weather effectivity.
- The Permanent mT airmasses induces year round weather effectivity.

It includes (a) maritime equatorial airmas - effective in equatorial belt.
- Influences land water alike
- Experiences convective rise throughout the year causing perennial precipitation
- involving rainfall maximas during equinoxes

(b) Open Oceanic maritime tropical airmas -

- relates to open tropical Atlantic (Azores high, open tropical pacific - Hawaiian High)
- Involves perennial advection in effect of trade winds & westerlies generating ITCZ & polar front with respective wetter weather condition

The temporary mT airmases belongs to warmer marginal water bodies.

Though these airmasses exist throughout the year their weather effectivity is seasonal in nature

It includes.

(a) Summer effective mT airmas -

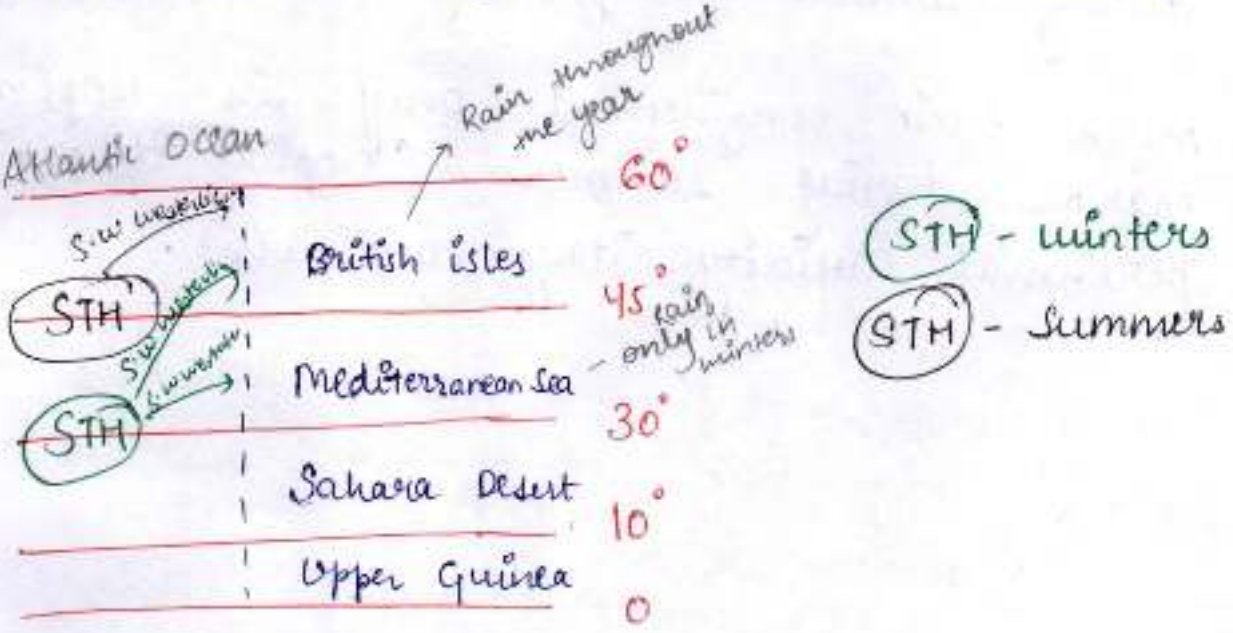
- is applied to largest no. of marginal waterbodies
- as Arabian Sea, Bay of Bengal (in Indian ocean), S. China Sea. Gulf of California (Pacific Ocean) & Gulf of Mexico (Atlantic Ocean).
- These air masses tends to advect onshore only during summers when the landmass develops effective LP.
- These thus causes summer concentrated rain (corresponding to monsoonal mechanism).

(b) winter effective

- is maritime mediterrean airmass

- that tends to advect onshore only during winters in the effect of prevailing westerlies.

- The Mediterreanean coastal areas thus experiences long hot summer drought & winter concentrated rain.



This can't happen with Canada, USA bcz of orographic barrier.

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3) mP airmass

- cold moist airmas
- creates wetter weather condition
- largely involving frontal mechanism
- This includes perennial effective, polar front that influences weather condition of both mid & high latitudes.
- Arctic front i.e winter effective influencing weather condition of mid latitudinal of east margin.

4) cT air mass

- warm & dry air mass
- creates dry weather conditions
- Prevails over tropical land in near totality during winters creating dry winter conditions.
- marks their confinement only in tropical west margins during summers (tropical deserts) generating perennial aridity (dry conditions).

out of 3 convergence zones (# makes front - Polar fronts), 60°N more strong front bcz Nth hemisphere is land.

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Temperate Cyclonic Circulation

when very strong front is developed, air advect in each others zone/domain.

- The extra tropical cyclone i.e also called wave cyclone, regulates prec^n mechanism in extensive area of mid & high latitudes.

- This weather system is characterised with
  - Frontal mechanism
  - Capable of influencing of both maritime & continental locations
  - Lengthier life span (15-20 days)
  - Extensive system
  - Prevails throughout the year however is stronger during winters (as airmases are stronger Barotrophic)

- This cyclonic circulation involves well defined life stages based on Polar front theory of Jacob Bjerkens. It includes - when maintain the zone of discontinuity of air column

i) Stage of frontogenesis or dept of stable front for 2 to 3 d

ii) Division of stable front and beginning of cyclonic Circulation

means jldi merge ~~advection~~ nhi hota hai maintain krte

iii) Quick shift of cold front
iv) Closing down of warm sector
v) Stage of occlusion
vi) Stage of frontolysis or frontal decay

warm front - Jb cold area m warm front advect kre
cold airmass intruding in mid latitude forming cold front

(i) Frontogenesis

- At near 60th parallel convergence of cold dense air mass (advecting due to polar winds) and warm moist air mass (advected due to westerlies) tends to develop stable front.

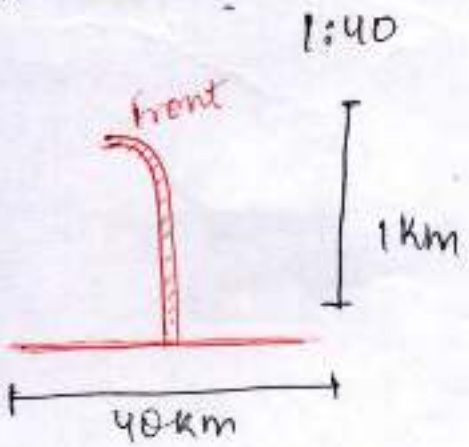
It is distinguished from the ordinary fronts because of the contrast between the converged airmasses.

The stability of this front facilitates advection of air masses in each others domain resulting in (ii) Division of the stable front

Stable front is divided into 2.

Cold Front

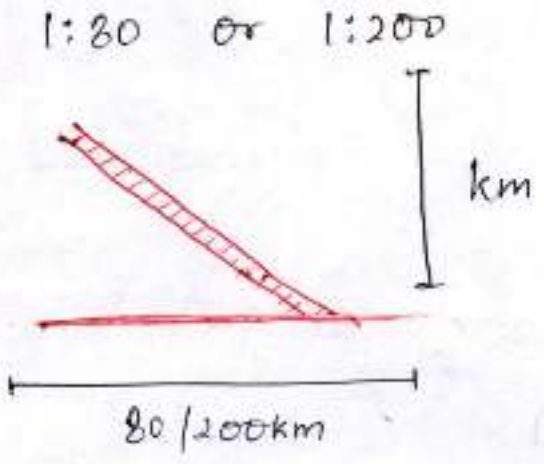
- That part of stable front which develop due to advection of cold air in warmer latitude.
- It involves pushing effect experienced by warm airmas as cold continues to maintain it ground contact.
- This front thus is involving comparitive steeper gradient that denotes 1:40 i.e 1 km of vertical extension over 40 kms of horizontal extension



Cold front

Warm Front

- It is that part of stable front which develops due to advection of warm air in colder latitude.
- It involves gradual ramp or march of warm air over cold airmas.
- This front thus develops gentler gradient that denotes 1:80 or 1:200 i.e a km of vertical extension over 80 or 200 kms of horizontal extension.



Warm front

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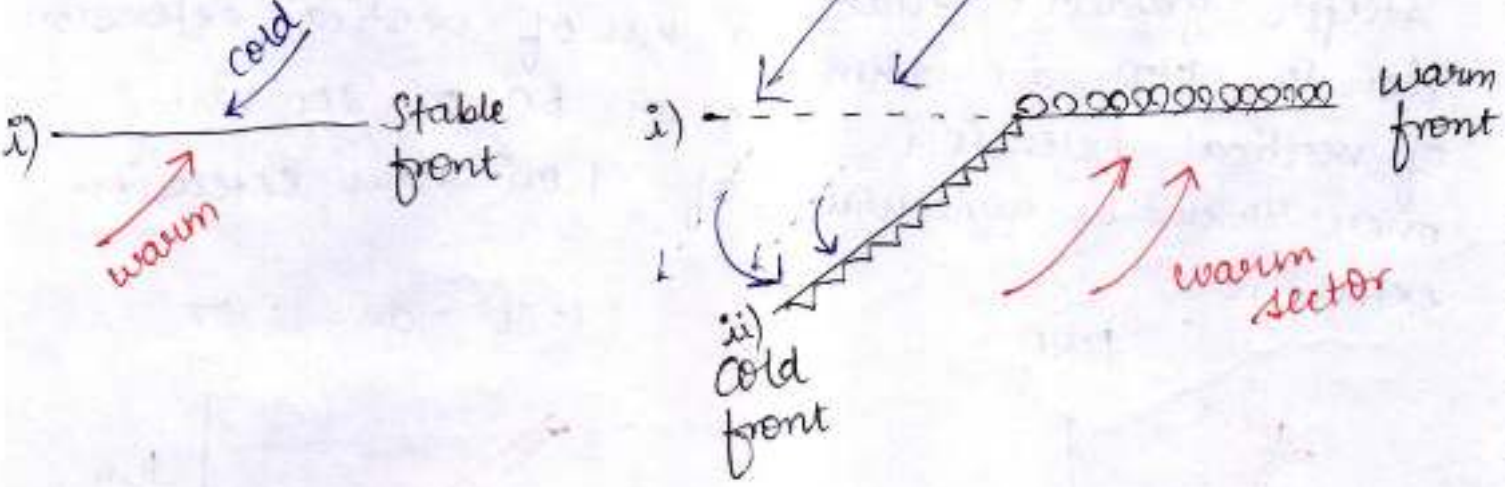
cold sector (cold latitude) m ground m change ni hoga, cold air ground ke contact m ke rhegi. & in warm sector cold air intrude kregi or cold, ground contact rhegi.

- with sufficient advection of cold airmass in warmer latitude effectivity of Buy's Ballot law marks the beginning of cyclonic circulation

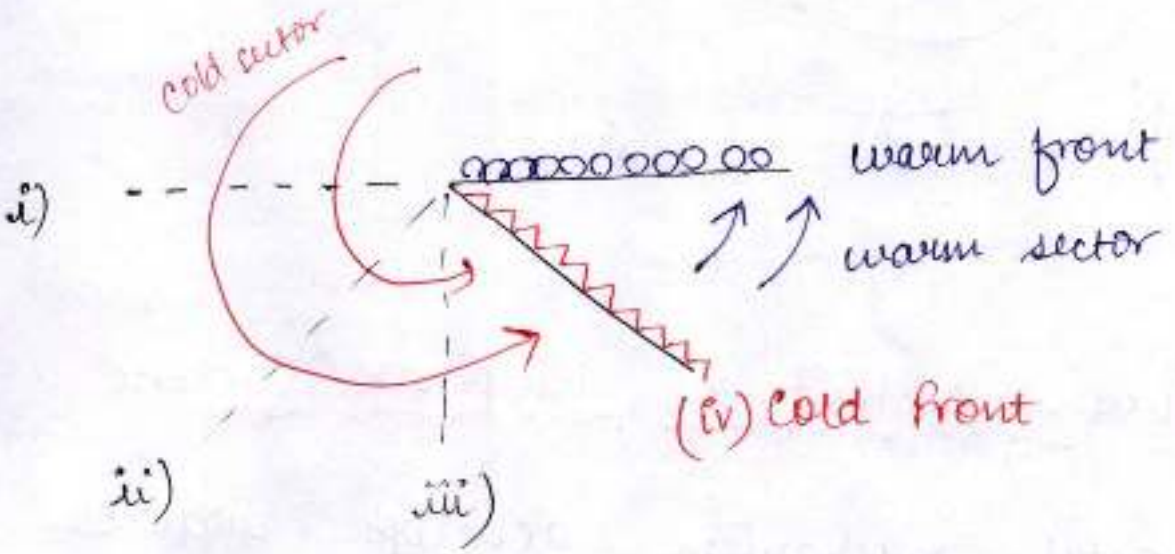
> Buy's Ballot law states that if we stand with our back towards advective winds low pressure will be on our left



iii)

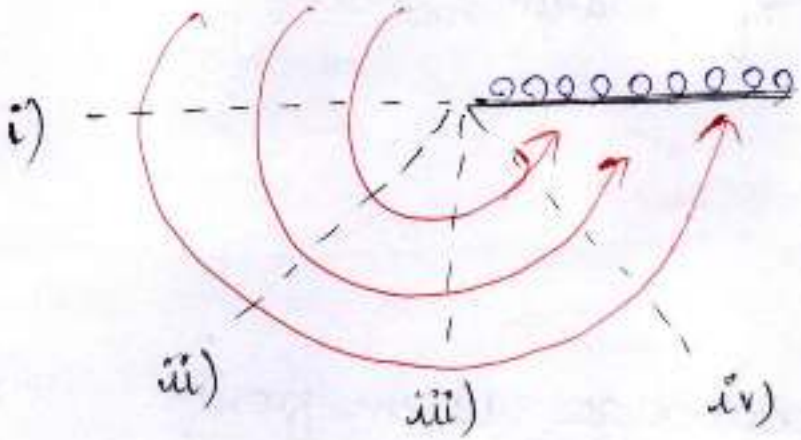
With the beginning of cyclonic circulation cold air mass develops swift tendency to

develop elaborate ground contact. This leads to iii) Quick shift of cold front & iv) closing down of warm sector.



v) The stage of occlusion is denoted with closed warm sector, it is therefore that it marks conclusion of induced weather conditions and beginning of frontal decay.

vi) The frontal decay or frontolysis is therefore the stage that marks complete termination of the system with presence of cold air in ground contact throughout the area.



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Weather effectivity of Temperate Cyclone

- This frontal mechanism develops weather conditions in absolute accordance to evolved types of fronts.
- It is therefore that stable front weather, warm front weather, cold front weather & occlude front weather are distinguished.

The stable front weather

- is principally characterised with transitional weather
- that includes short lived temp. increase towards higher latitude margin.
- Prolonged temp. decrease towards mid latitude

margin.

- Formation of dew in mid latitudinal region
* Including possibility of light rain or drizzle

The warm front weather

- Technically, warm front weather is completely devoid of intensity.

Gradual ramp of warm over cold tends to develop multi altitudinal clouds.

Causing periodic precipitation.

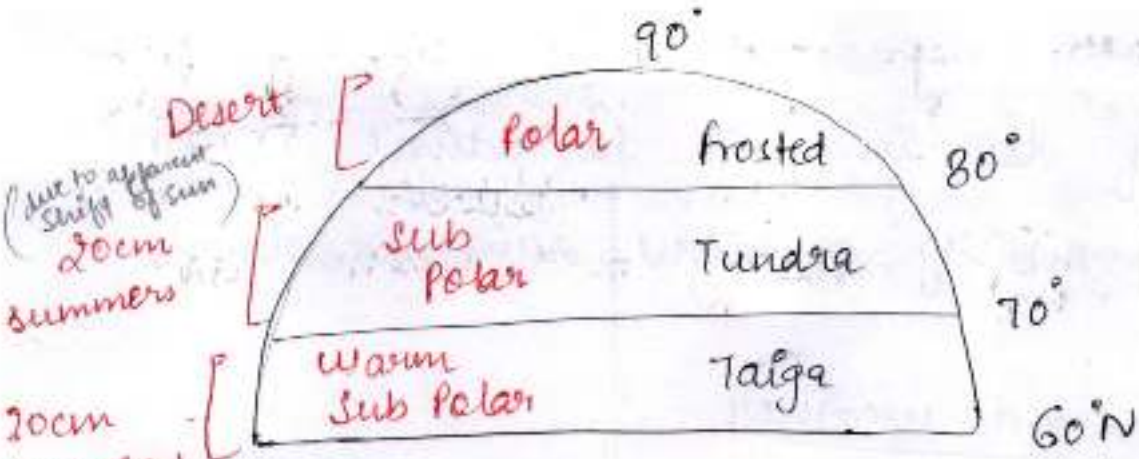
Pertaining to larger area and longer time

Cold airmas is too cold to hold moisture & too dense to rise

- Geographically, warm front weather projects importance as it restricts Polar desert only to frosted area.

with Taiga climate receiving frontal prec^{n} throughout the year.

Tundra climate receiving frontal prec^{n} only during summers.



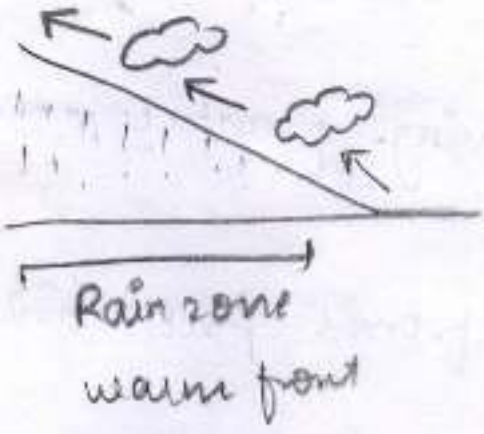
Warm front weather zone

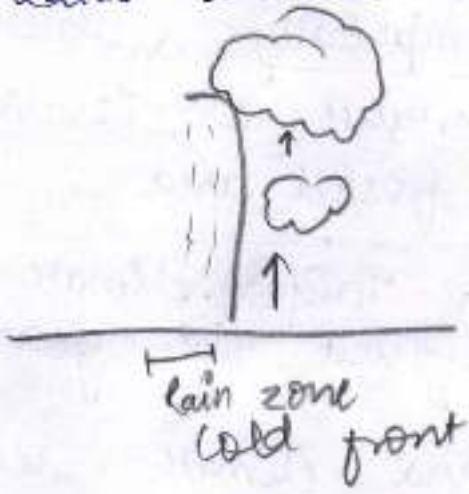
Cold front weather

- Technically, this front involves pushing up of warm air.

It is therefore that single dominant condensation developing cumulus & cumulonimbus clouds is experienced

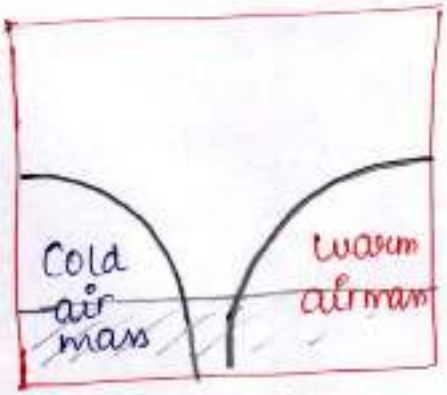
Strong precipitation confined to smaller area and shorter duration creates intense weather





Steppe receive dependable prec^n bcz of cold front, amt is less but throughout the year. cold front doesn't have exclusive nature/ prominence geographically like warm has.

- Geographically, cold front weather justifies semi-arid climatic conditions prevailing in steppe inspite of same magnitude of continentality as mid latitudinal deserts (Gobi) (as they experience dependable frontal prec^n throughout the year).



Stable front

Cold Front

Warm Front

Occluded front

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* Precipitation decreasing with increasing continentality (though

3) Tropical Desert

- Tropical west margins of land
- Permanent effective zone of continental tropical airmass.
- Erratic summer advection of maritime tropical airmass causes torrential rain.
- Amt - 30 to 50 cms
- Forms - rain & drizzle
- Types of prec° - Convectional

4) Mid latitude Deserts & Steppe

- Continental interiors of mid latitude
- Influence zone of continental airmasses
- Prec° amt of 0 to 75 cms, increasing with increase in sign of latitude.
- Form - Rain, drizzle, snow, sleet
- Type - Convectional, orographic & frontal

5) Westerlies

- Mid latitude west margins
- influence zone of maritime tropical airmass
- Precn amt 50 to 130 cms, increasing with increase in sign of latitude.
- Precn changes from seasonal (mediterranean) to perennial (western Europe) with increase in sign of latitude.
- Form - Rain, drizzle, snow, sleet
- Type - Connectional, orographic, frontal

6) Moist mid latitude

- East margins of mid latitude
- Influence of maritime tropical & maritime polar airmasses.
- Amt of precn b/w 100 to 150 cms

* Decreasing with increase in sign of latitude
* Becoming more seasonal (winter specific - Manchuria) with increase in sign of latitude

- Form - Rain, drizzle, snow, glaze - mf effectivity
- Type - Connectional, frontal & orographic

7) Arctic / Polar Desert

- In frigid zone
- Involves arctic or Polar airmasses
- Involves frontal rise effective only in N^n hemisphere including - warm front creates tundra & taiga.
  a) Perennial frontal rise thus well distributed prec^n in Taiga (Amt upto 30 cms)

  b) Summer specific frontal rise with 20cm of prec^n in Tundra.

- Form - Glaze & snow
- Type - frontal.

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What are the basis of Koppen's Classification

1) Temp. - Prominent most as 4 type are based on temp that are

A, B, C, D, E < EF / ET

2) Precn

(a) B < BW < h / k
BS

(b) A
Af Am Aw

C
Cs Cw Cf

D
Dw Df

3) Altitude

4) Vegetation

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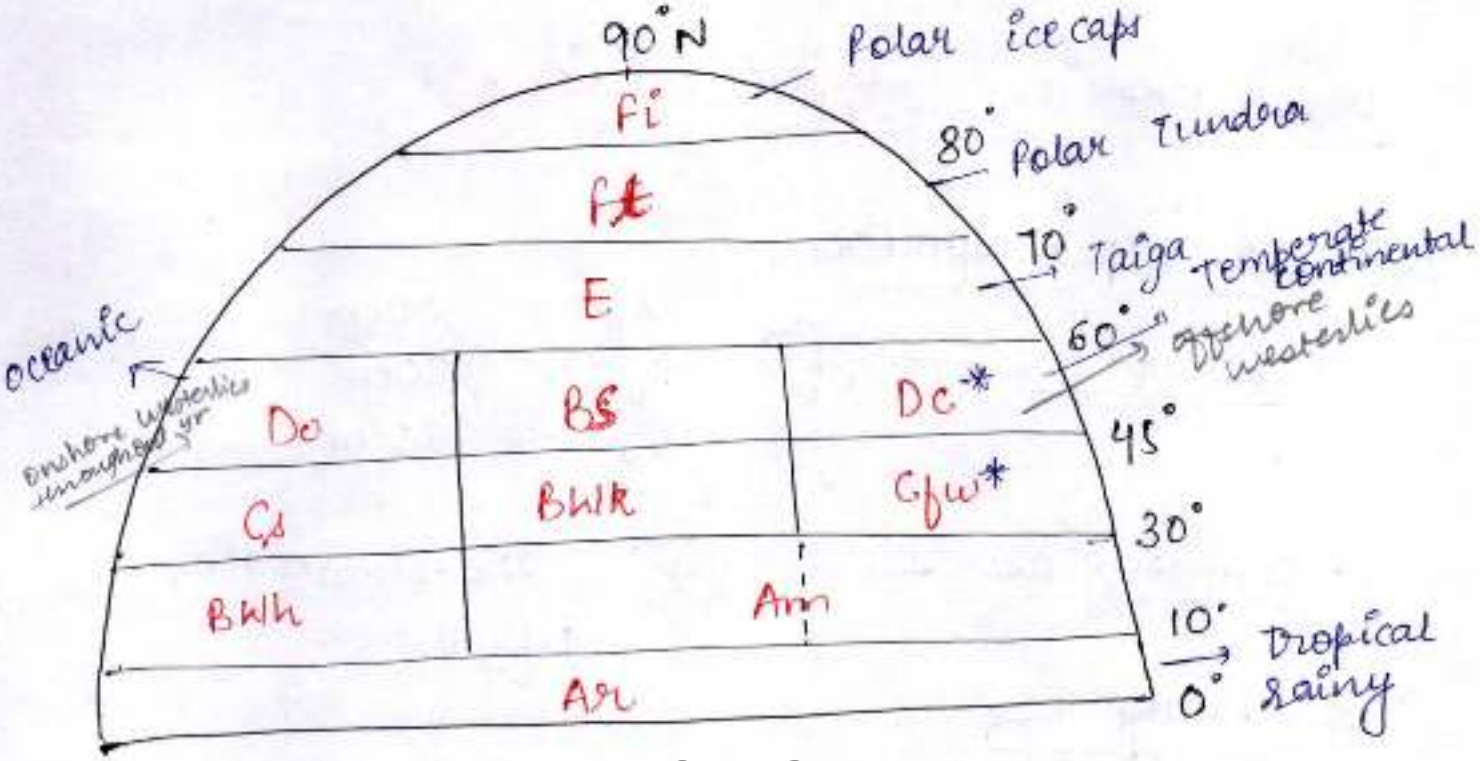
Trewartha's classification

- Glen Trewartha
- American climatalogist (Empirical scheme)



- Geographically utilised emperical classification scheme that involves near similar alphabetical symbols as that of Koppen's scheme.

- The positive aspect includes -
  - Better alphabetical symbol for China type of climate (Cfw).
  - More correct alphabetical symbol for Manchurian climate (Dc)

etc.....