FACTORS INFLUENCING THE CLIMATE OF E.AFRICA

The climate of E.Africa varies from one region to another ranging from Equatorial to Tropical, Semi arid and MoS5ntane climate although the region is located across the equator.

The variations in E.Africa's climate are as a result of the following factors:

a. Altitude
   It refers to the height of the land above sea level. High altitude areas especially highlands like Mt Rwenzori, Mt Elgon, Mt Kenya and Mt Kilimanjaro experience cool temperatures because temperatures decrease with increase in altitude and heavy rainfall ranging between 1000-1500mm resulting into montane climate. Cool temperatures in high altitude areas are due to the effect of the environmental lapse rate i.e For every 1000metres of ascent, temperatures fall by 6.5^{o}c. Equally, high altitude areas experience low pressure because pressure reduces with an increase in altitude. It is also due to a small column of air pressing down on the earth's surface. High altitude areas experience low humidity due to the cool temperatures
   On the other hand, low altitude areas such as the rift valley region, the foothills of mountains and coastal areas experience hot temperatures due to intense heating by both solar and terrestrial radiation as well as the excessive impurities in the air such as dust particles, water molecules and carbondioxide which absorb heat that is radiated in the low altitudes. This explains why Mombasa is hotter than Nairobi. Low altitude areas experience high pressure because pressure increases with a decrease in altitude. This is also because of a big column of air pressing over the earth's surface. Low altitude areas such as the Nyika plateau in Kenya are dry, receiving rainfall of less than 700mm. Low altitude areas experience high humidity due to the high rates of evapotranspiration as a result of hot temperatures
b. Latitude
   It is the angular distance of an area as measured from the equator. E.Africa lies astride the equator. Its location explains the generally hot temperatures experienced throughout the year. Areas near the equator experience hot temperatures, heavy rainfall with a bi modal (double rainfall pattern), low atmospheric pressure and high

humidity due to the effect of the overhead sun twice a year leading to equatorial climate e.g around the lake Victoria basin.

On the other hand, areas far from the equator such as Northern Uganda and Southern Tanzania experience cool temperatures as well as wet and dry conditions (mono modal/single rainfall pattern) because the sun's rays are scattered (spread) over a wide area and reach the earth's surface at acute angles causing less heating.

Temperate and polar areas experience temperate climate due to their far distance from the equator

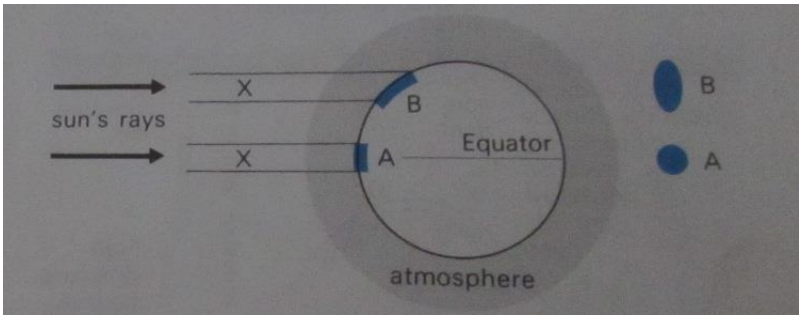


Fig. 14.2 More insolation reaches the earth's surface when the angle of the sun's rays is 90° than when it is less than 90°. The sun's rays pass through a greater thickness of atmosphere to reach B than to reach A. You can see that the surface area of B is oval-shaped and is larger than the surface at A.

c. Relief

It refers to the physical appearance of the landscape in an area. Highland areas such as Mt Rwenzori, Mt Kenya and Mt Kilimanjaro experience heavy rainfall and cool temperatures on the wind ward sides while dry conditions are experienced on the lee ward sides. This is because mountains act as barriers towards the movement of moist winds thereby forcing them to rise upwards to the condensation level leading to rainfall on the wind ward side while the descending dry winds resulting into dry conditions on the lee ward side. For instance Masai land in Tanzania lies on the lee ward side of Usambara and Pare mountains.

Lowland areas on the other hand experience low and un reliable rainfall due to the absence of relief barriers to trap the moving moist winds in areas such as Turkanaland in Northern Kenya, Karamoja in North eastern Uganda and the Albert flats

d. Continentality (Distance from the sea)

Areas near the sea (water bodies) such as the coastal areas of E.Africa and lake Victoria basin experience heavy rainfall due to the effect of land and sea breezes. The sea breeze occurs during day time where cold moist air moves from the sea towards the adjacent land while the land breeze occurs at night involving cold moist winds from the land blow towards the sea. This modifies the temperatures over the land and the sea respectively thereby causing the formation of convectional rainfall as warm air rises towards the condensation level.

Water bodies also recharge the atmosphere with moisture through evaporation resulting into heavy rainfall in the adjacent areas e.g the lake Victoria basin.

Areas far away from water bodies like North eastern Uganda and Central Tanzania are hot and dry due to the absence of water bodies

e. Prevailing winds

They are defined as local winds which blow from sub tropical areas of high pressure into areas of low pressure in the tropics.

The winds are either moist or dry, cool or warm thus influencing the rainfall and temperature conditions of the areas where they flow to. The climate of E.Africa is mainly influenced by three (3) trade winds i.e The North east trade winds, South east trade winds and the westerlies.

The North east trade winds originate from the Arabian desert. They are therefore dry. As they blow towards E.Africa, they pick moisture from the Red sea which is later lost on the wind ward slopes of the Ethiopian highlands. The winds later continue into E.Africa as cool dry winds causing low rainfall and low humidity in areas like North eastern Uganda, North western Kenya as well as Northern Kenya in general hence semi arid climate.

The South east trade winds originate from the Indian ocean hence they are moist. They flow towards the E.African coast thereby causing heavy rainfall and high humidity. They later continue on their eastward journey towards the interior of E.Africa as dry winds causing dry conditions in Central Tanzania. They are later recharged with moisture after crossing lake Victoria consequently causing heavy rainfall on the northern and north eastern shores of lake Victoria but leaving Ankole Masaka corridor dry.

The westerlies originate from the Atlantic ocean with a lot of moisture from the sea. They blow over the Congo basin leading to heavy rainfall on the western slopes of Mt Rwenzori. They however continue towards the lee ward slopes with areas like

Kasese and the rift valley region of western Uganda as dry winds leading to semi arid climate

f. Ocean currents

They are defined as large scale movements of surface water in an ocean/sea within a defined direction.

Ocean currents are either warm or cold hence they influence the temperature and rainfall conditions of the coastal areas. The warm ocean currents such as the Mozambique current cause hot temperatures and heavy rainfall around the coastal areas of E.Africa e.g The equatorial climate between Mombasa and Dar es Salaam is due to the effect of the warm Mozambique current.

Cold ocean currents such as the Benguela current lead to low temperatures, low humidity and low rainfall in coastal areas such as Namibia

g. Coastal configuration

The alignment of the E.African coast in the North east to South west direction forces the prevailing winds and ocean currents to flow or move parallel to the coast. This leads to low humidity and low rainfall in areas like North eastern Kenya hence semi arid climate because the moisture carried by the prevailing winds and ocean currents is not deposited at the adjacent areas

h. Perturbation

This refers to the formation of a low pressure belt over the Indian ocean due to hot temperatures. Winds are therefore drawn from the interior of E.Africa towards the Indian ocean causing heavy rainfall over the ocean while leaving the coastal areas dry. The semi arid climate in North eastern Kenya is as a result of the perturbation effect

i. Rotation of the earth (Corriolis force effect)

According to Ferrel's law, any loose object or body such as a wind in the northern hemisphere flowing over the earth's surface is deflected to the right of its path after crossing the equator. The South east trade winds are therefore deflected to the right causing heavy rainfall (equatorial climate) on the northern shores of Lake Victoria and dry conditions (semi arid climate) in the Ankole Masaka corridor.

Winds blowing across Kenya from the south are deflected to the Indian Ocean causing rainfall over the sea and dry conditions in North eastern Kenya

j. Vegetation cover

Forested areas such as Mabira, Budongo and Bugoma experience heavy rainfall, high humidity and moderate temperatures. Areas with limited vegetation cover on

the other hand experience low rainfall totals, low humidity and hot temperatures in areas like Turkana land and Ankole Masaka corridor

k. Human activities
A variety of man's activities like deforestation, swamp reclamation, bush burning, overstocking and over grazing result into reduced rainfall amounts and hot temperatures. That is why semi arid climate is experienced in North eastern Uganda, North western Kenya and in some parts of Central Tanzania.
On the other hand, man's activities such as afforestation and re afforestation have restored vegetation cover resulting into increased rainfall amounts in areas such as Mt Elgon slopes, Kigezi highlands and Kenya highlands
Qn. To what extent has altitude influenced the climate of E.Africa?

TEMPERATURE

It refers to the measure of the degree of hotness or coldness of the atmosphere over a given place **OR** It is the amount of sensible heat or cold with in the atmosphere of a given area.

The major source of heat affecting the atmosphere and the earth's surface is solar radiation which is defined as the heat emitted and transferred to the earth's surface by the sun. However, heat is also transferred from the earth's surface into the atmosphere which is known as Terrestrial radiation.

The temperature of a place is measured using a sixth thermometer which records the maximum and minimum temperature of the day. When the highest and lowest temperature is obtained, the following expressions can be made:

- **Daily Temperature**
  It refers to the actual amount of heat or cold that is recorded at a weather station in a day

- **Mean Daily Temperature**
  It refers to the average of heat or cold that is recorded in a specific area in a day. ,It is obtained by;
  Mean Daily Temperature = $\frac{\text{Maximum Temperature + Minimum Temperature}}{2}$

- **Daily (Diurnal) Temperature Range**
  It refers to the difference between the highest and lowest temperature of the day

Daily Temperature Range = Highest Temperature – Lowest Temperature

- **Mean Monthly Temperature**
  It is the average temperature of an area obtained when the sum of the mean daily temperature for a month is divided by the number of days in the month
  Mean Monthly Temperature = $\frac{\text{Sum of the Mean Daily Temperature}}{\text{Number of days in a month}}$

- **Mean Annual Temperature**
  It is the final figure obtained when the sum of the mean monthly temperatures in a year is divided by 12 months
  Mean Annual Temperature = $\frac{\text{Sum of Mean Monthly Temperature}}{12}$

- **Annual Temperature Range**
  It is the difference between the highest and lowest mean monthly temperature in a year
  OR It is the difference between the hottest month and the coolest month of the year

Qn. Differentiate between diurnal temperature range and annual temperature range

FACTORS WHICH INFLUENCE THE TEMPERATURE OF AN AREA:

Different areas in E.Africa experience varying temperatures. Some areas experience extremely hot temperatures of over 30^{o}c. They include North eastern Uganda, Northern Kenya, the rift valley areas and the coastal areas.

Other areas experience very low / cool temperatures especially the mountainous or highland areas such as the Kenya highlands, Kigezi highlands, Mt Kilimanjaro, Mt Rwenzori, Mt Meru and Mt Elgon among others.

Several factors influence temperature or contribute to the variations in the temperature in E.Africa and they include:

a. Altitude
   It refers to the height of the land above sea level. Temperatures tend to drop as altitude increases by approximately 6.5^{o}c for every 1000 metres of ascent / rise. Due to this lapse rate effect, highland areas like Mt Rwenzori, Kenya and Kilimanjaro

experience low temperatures while low altitude areas like the rift valley region experience hot temperatures

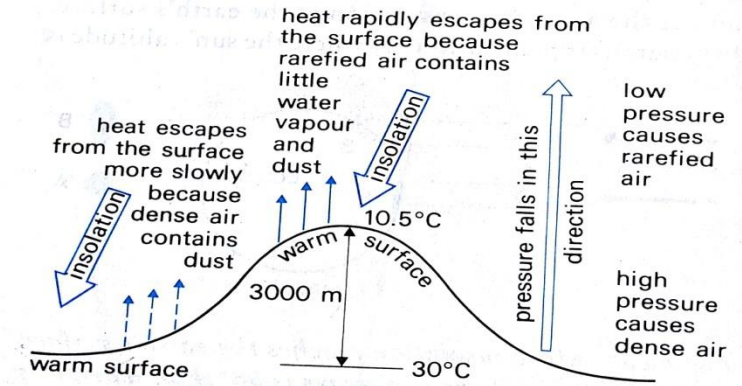


Fig. 14.3 A diagram to show the effect of altitude on temperature. What would the temperature be at the top of Mount Cameroon (4070 m) if the temperature at sea level were 30°C?

b. Latitude
It refers to the angular distance of an area from the equator. Temperatures tend to reduce as one moves away from the tropics towards the Polar regions. Given that E.Africa lies astride the equator, temperatures are uniformly hot with no big variations

c. Prevailing winds
They have a modifying effect on the temperature of the places where they blow depending on their origin. The North east trade winds which blow from the Arabian desert bring hot temperatures in North eastern Uganda (Karamoja) and Turkanaland while the Southeast trade winds and the Westerlies cause moderate temperatures around the Central plateau of E.Africa because they originate from the Indian ocean and the Atlantic ocean respectively

d. Continentality
It refers to the distance of a place from the sea. It is responsible for the variations in the temperatures between places near the coast and those in the interior. The South east trade winds transfer warm conditions to the coastal areas of E.Africa and this explains why Mombasa is relatively warmer than the interior of Kenya and E.Africa in general. Water bodies also have a modifying effect on temperature through the land and sea breezes

e. Vegetation cover

Thick vegetation cover has a modifying effect on the temperature of the surrounding areas through evapotranspiration. Forested areas have high humidity and relatively low temperatures for instance Mabira and Budongo forest. On the other hand, areas with limited vegetation cover tend to experience hot temperatures e.g North eastern Uganda and Turkana land in North western Kenya

f. Ocean currents

They are defined as streams of surface sea water moving on a large scale towards a defined direction. They are sub divided into two (2) categories i.e warm and cold ocean currents. They have a modifying effect on the temperature of the adjacent areas. Warm ocean currents such as the Warm Mozambique currents raise the temperatures of the winds blowing around hence causing warm and/or hot temperatures to the adjacent lands such as Mombasa and Dar es Salaam

g. Cloud cover

It also determines the temperature of a place. Thick clouds control the amount of solar insolation reaching the earth's surface and at the same time trap the escaping radiation from the earth's surface. For this reason, areas with thick cloud cover like the Lake Victoria basin experience a small diurnal range of temperature than areas like Turkana land with limited cloud cover

h. Apparent movement of the overhead sun

The position of the sun influences seasonal variations in temperature. Temperatures are higher in regions where the sun is overhead. When the sun is overhead in the northern hemisphere between June and July, hot temperatures are experienced in the northern hemisphere and low temperatures in the southern hemisphere. When the sun is overhead in the southern hemisphere in December and January, temperatures are high in the southern hemisphere and low in the northern hemisphere

i. Humidity

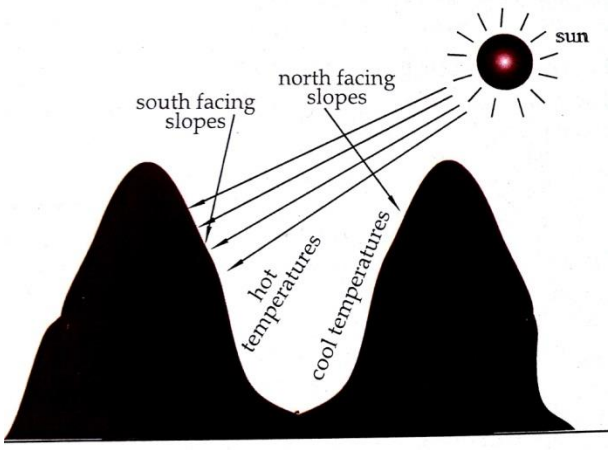
The amount of water vapour in the atmosphere determines the atmospheric temperature of a place. High amounts of humidity absorb heat and prevent heat loss from the earth's surface. This explains why areas with high humidity e.g equatorial regions experience hot temperatures during the day and at night than areas with low humidity which experience cool temperatures during the night due to excessive heat loss

j. Nature of the earth's surface (Albedo)

Surfaces covered by water or ice are bright so they reflect much of the heat (solar radiation) back into the atmosphere leading to low (cool) temperatures over the water surface during the day while solid dark coloured land surfaces absorb heat faster during the day leading to warm / hot temperatures

k. Aspect

It refers to the direction of a hill slope in relation to the position of the sun. It influences temperature in the temperate / polar regions where the south facing slopes in the northern hemisphere experience warm temperatures than the north facing slopes. In the southern hemisphere on the other hand, the north facing slopes are warmer than the south facing slopes. In the tropics however, the influence of aspect is not experienced due to the effect of the overhead sun



l. Human activities

The various activities of man such as deforestation, bush burning, overgrazing, mining and industrialization result into hot temperatures due to the destruction of natural vegetation, depletion of the ozone layer and the subsequent increase in carbonic emissions (gases) into the atmosphere which absorb solar radiation thereby causing hot temperatures. On the other hand, afforestation reduces carbon concentrations in the atmosphere since plants absorb carbondioxide leading to moderate temperatures.

Qn. Account for the variations in the temperature experienced in the different areas of E.Africa

ATMOSPERIC TEMPERATURE DISTRIBUTION

Temperature is distributed in the atmosphere in such a way that an increase in altitude leads to a fall in temperature i.e temperatures are warmer near the earth's surface (lower atmosphere) and lower in the upper atmosphere. As air rises, its temperature changes. This is referred to as adiabatic temperature change. The rate of decrease in temperature with increase in altitude is known as adiabatic lapse rate. The average rate of fall in temperature is 1^{o}c per 150metres of ascent or 6.5^{o}c per 1000metres of ascent. Temperatures fall with increase in altitude because of the following:

I. The air above the earth's surface expands over a wide space which leads to cooling hence low temperatures while air molecules near the earth's surface are compressed leading to high pressure and warm temperatures
II. The air above the earth's surface contains less impurities to absorb heat hence it is cooler than the air near the earth's surface with impurities such as dust particles which absorb heat
III. The amount of carbondioxide in the air is greater near the earth's surface than in the atmosphere and this causes temperature differences with variations in altitude
IV. The air above the earth's surface is far from the effect of terrestrial radiation hence it is cooler than the air near the earth's surface.

LAPSE RATE

It refers to the natural fall in temperatures with an increase in altitude **OR** a rise in temperatures with a decrease in altitude. As warm air rises, it expands and cools leading to a fall in temperatures. The increase in temperature or heat is caused by the compression of the air as altitude falls.

Types of Lapse Rate:

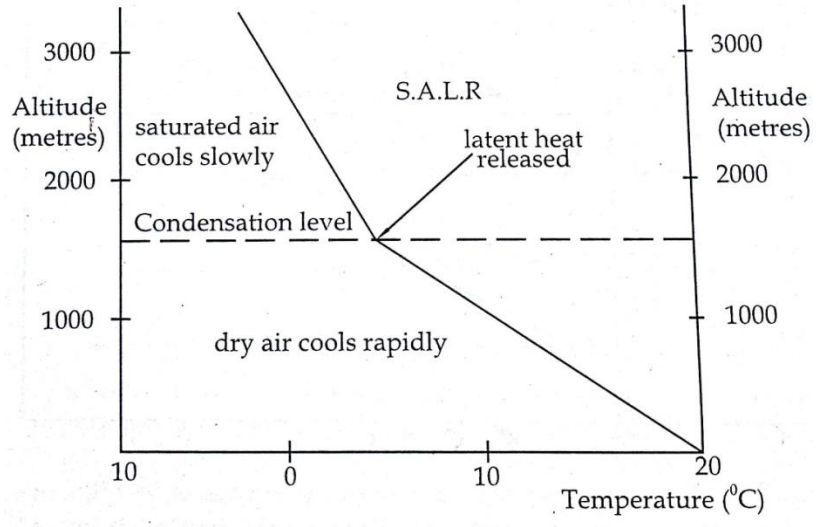
Lapse rate is described in three (3) ways:

a) **Environmental lapse rate**
   It is the rate at which temperatures change with an increase or a decrease in altitude. It is the vertical distribution of the temperature of a given geographical location at a particular period
b) **Dry adiabatic lapse rate**

It is the rate at which dry air cools as it rises without affecting the temperature of the surrounding atmosphere. Dry air cools at a faster rate of $1^{o}c$ per 100 metres of ascent

c) Saturated (Wet) adiabatic lapse rate

It refers to the rate at which air saturated with water vapour cools as it rises to greater heights (higher levels) of the atmosphere. Saturated (humid) air cools at a rate which is slightly lower than that of dry air i.e between $0.3^{o}c$ – $0.9^{o}c$ per 100metres of ascent.



Qn. Distinguish between **stability** and **instability** in the atmosphere

Stability in the atmosphere refers to a state of equilibrium reached in the atmosphere when a mass of dry air which is rising in form of a wind has a lapse rate that is greater than that of the surrounding air i.e the environmental lapse rate of an air mass is less than the dry adiabatic lapse rate.

The rising air mass loses its temperature ultimately becoming cooler and denser than the surrounding air mass. It then sinks back to the ground level unless when some external force is at work.

While;

Instability is a state of unstable equilibrium of the atmosphere where the environmental lapse rate of an air mass is greater than the dry adiabatic lapse rate. A surface pocket of un saturated air when heated, will rise and cool at the dry adiabatic lapse rate and because it is warmer than the surrounding air mass, it will continue to rise. Due to the fact that the

surrounding air is denser than the rising air mass, it will force it up to greater heights where it cools from.

High instability leads to the formation of cumulo-nimbus clouds, stratus and cirrus clouds. The strato-cumulus and cumulo-nimbus clouds are associated with intense rainfall and thunderstorms.

The cirrus and stratus clouds give rise to clear skies / sunny weather conditions

The alto-cumulus and alto-stratus clouds give rise to light drizzles and unstable windy conditions

High humidity is formed with in the atmosphere

TEMPERATURE INVERSION

It is an atmospheric condition in which temperatures increase with an increase in altitude. In other words, the air at a higher altitude is warmer than the one in the valleys.

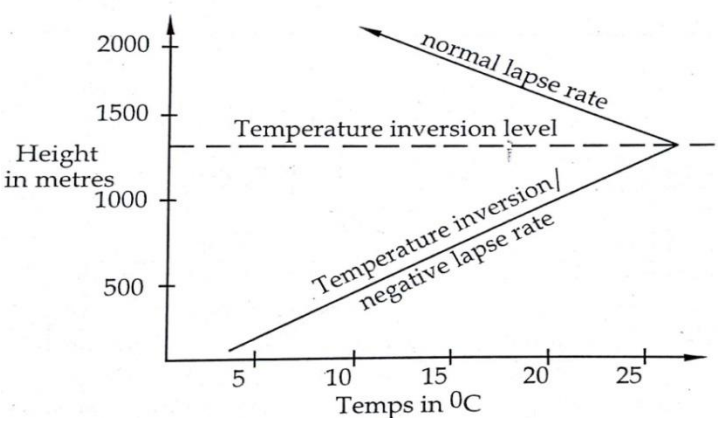
It is the opposite of the environmental or normal lapse rate where temperatures decrease with an increase in altitude.

Within the troposphere, an increase in temperature with altitude is up to a certain level referred to as the Temperature inversion level. Beyond this level, the normal lapse rate applies.

It is a temporary atmospheric condition which usually lasts for only a few hours especially in the morning time.

It normally occurs in highland areas due to temperature differences between the hill slopes and the valleys e.g In the Kigezi highlands, Kenya highlands as well as areas of limited cloud cover marked by air stability or calm weather. It also occurs in the semi arid areas.

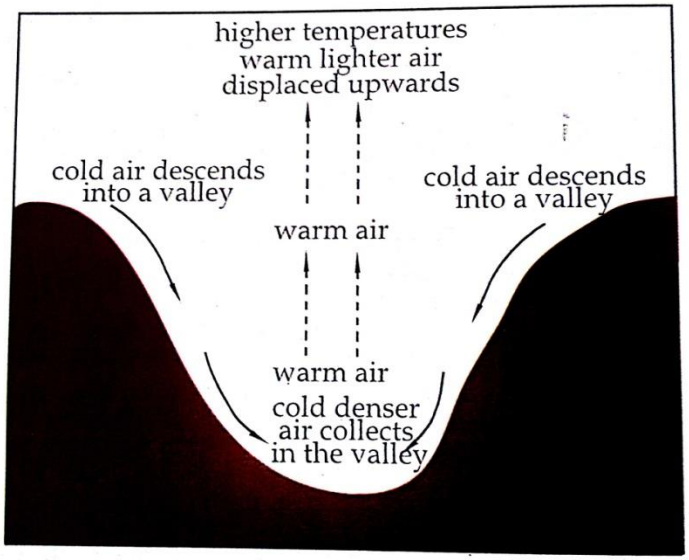
It happens when surface air is cooled by the descending cold dense air while the warm light air is displaced upwards as illustrated below:



Causes of Temperature Inversion

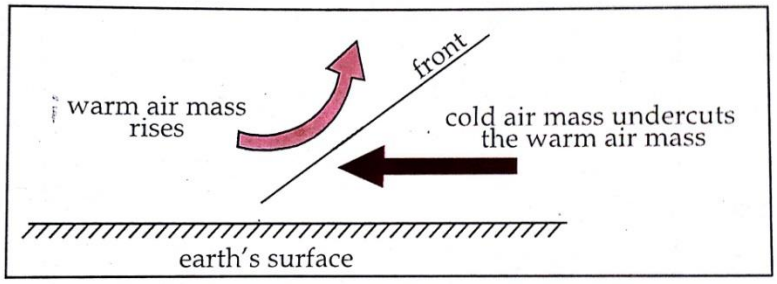
1. Rapid radiation of the earth's surface during the night
   When there's limited or no cloud cover, the earth's surface cools faster at night due to the rapid loss of heat. At night, the earth is cooled as a result of the following:
   - The sky must be clear with no clouds to allow rapid loss of heat
   - The air must be static to ensure effective cooling
   - Longer nights to enable adequate time for cooling to take place

   This causes cooling of the air near the earth's surface hence causing low temperatures near the ground surface as compared to the air which is far above the ground surface.
2. Subsidence or sinking of cold dense air from the highlands to the valleys at night i.e the effect of the Katabatic winds
   Due to the rapid cooling of the upper slopes of highlands at night, air cools and becomes dense causing high pressure while the air in the valleys remains warm leading to low pressure. The cold dense air from the upper slopes therefore sinks downwards into the valleys displacing the warm air upwards hence causing temperature inversion e.g In the Kigezi highlands.
   N.B: **Katabatic winds** are defined as winds which blow from the hill slopes downwards into the valleys at night



3. Frontal convergence of warm and cold air masses
   When two air masses with different temperature characteristics meet, the cold air mass which is dense sinks downwards and undercuts the warm light air mass. The cold air mass ultimately lies below the warm air mass leading to temperature inversion called frontal / cyclonic temperature inversion. This occurs in the tropics where air fronts are common i.e the Inter tropical frontal zones in E.Africa. It is also referred to as Frontal or cyclonic temperature inversion

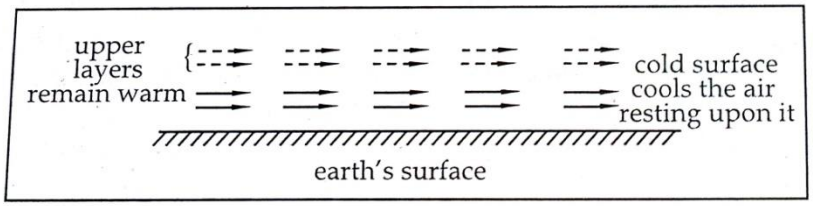
   Illustration: Frontal temperature inversion



4. Advection
   This is the horizontal movement and cooling of warm air blowing over a cold surface. This occurs when a mass of warm air horizontally blows over a cold surface. The cold surface cools down the lower layers of the air above it while the air far above remains warm. Temperatures will therefore become cold near

the earth's surface and warm far above the ground surface. This is referred to as Advective temperature inversion. It eventually leads to the formation of advection fog

Illustration: formation of fog due to advection.



5. Movement of warm air into a cold region
   Temperature inversion will occur when a warm air mass suddenly moves into a cold region where it is forced to rise upwards due to its lightness. As the warm air over rides the cold air, warm temperatures are transferred further to the cold region. This often occurs when warm trade winds blow into cold regions usually at a high altitude.

Effects of Temperature Inversion:

- It limits or retards the vertical movement of air currents leading to the creation of a stale atmospheric condition associated with limited rainfall
- It leads to premature surface condensation hence the formation of fog i.e tiny light water droplets which form over the earth's surface
- It leads to the formation of cold frosty conditions especially in the hilly areas due to the subsidence of cold dense air
- It promotes atmospheric pollution at higher levels especially in the industrial areas since the industrial carbons are easily spread by the warm air above the earth's surface
- The fog formed due to temperature inversion reduces visibility which affects the aviation and the transport industry in general thereby causing accidents
- The cold frosty conditions caused by temperature inversion discourage the growth of some crops such as tomatoes
- The cold frosty conditions which occur in the valleys due to temperature inversion favour the growth of some crops like pyrethrum, tea and sorghum as well as temperate crops like grapes and apples

- It leads to cold related diseases like asthma and pneumonia due to the cold conditions associated with it
- The fog experienced in the morning hours in areas such as Kigezi highlands due to temperature inversion reduces the morning working hours

Qn. Examine the causes and effects of temperature inversion in E.Africa.

TERRESTRIAL RADIATION

It is also known as **Thermal radiation**. It is defined as the energy transmitted or transferred from the earth's surface to the atmosphere. Radioactive decay of isotopes at the earth's surface contributes to the occurrence of terrestrial radiation

Terrestrial radiation is transferred in form of long waves(electro-magnetic radiation) and it occurs all the time both during day and night time in form of infra red energy i.e both light and heat energy

The amount of terrestrial radiation varies with the nature of the surface area and its size e.g water surfaces emit less radiation than land surfaces. Equally, mountain tops emit less radiation than the lowlands

The air, water vapour and clouds take up a great deal of this energy emitted by the earth thus resulting into the rising of temperature in the atmosphere which is measured and recorded at a weather station

Terrestrial radiation therefore results into **a rise in the temperature** of the atmosphere

SOLAR RADIATION

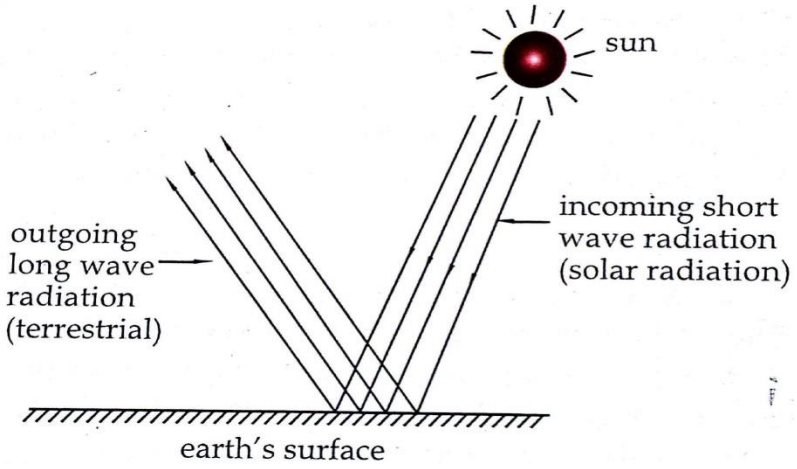
It refers to the energy transmitted from the sun to the earth through the atmosphere.

It passes in the atmosphere in form of a beam of short wave rays (solar short wave radiation)

Solar radiation is received in a place during the day in form of light and it is converted into heat at the earth's surface

The amount of solar radiation received in a place also varies from time to time. The air, clouds and the ozone in the atmosphere absorb some of this energy while dust particles and clouds reflect and scatter the energy into the space

The earth therefore absorbs only a fraction of the energy emitted by the sun. The nature of the earth's surface (Albedo) is used to express the ability of a surface to reflect insolation



Conditions Influencing the In-coming Solar Radiation In an area:

- Latitude
  The angular distance of a place from the equator partly determines the distance from the sun to the earth's surface. This further determines the angle of incidence at which the sun's rays fall upon the earth's surface
  Hence, there's always maximum insolation in the low latitudes because the sun's rays strike the earth's surface at right angles and have a short distance to travel through the atmosphere. There's intensive heating since there's a smaller surface area per ray. The sun's rays are however less intensive towards the mid latitudes and polar regions (high latitudes) because of the long distance they travel through the atmosphere and the oblique angle at which they strike the earth's surface
- Rotation of the earth
  The rotation of the earth on its axis causes changes in solar radiation received in a place. Within the tropics when the sun is overhead, high amounts of solar radiation are received. Absence of the overhead sun at the poles, arctic and sub-arctic regions reduces the insolation rates
- Revolution of the earth

This causes seasonal variation in the amount of insolation received in the different places of the earth. More solar radiation is experienced during the summer season compared to the winter season

- Cloud cover
  Clouds in the atmosphere absorb, reflect and refract insolation. This reduces the amount of solar radiation reaching the earth's surface hence implying that areas with thick cloud cover experience less solar radiation as compared to areas with clear skies
- Aspect
  Areas in the direct path of the sun's rays especially in the mid and high latitudes receive more solar radiation as compared to those areas sheltered from the sun's rays. For instance, in the mid latitudes of the Northern hemisphere, the south facing slopes receive more solar radiation than the north facing slopes. This is because the south facing slopes are in the direct path of the sun's rays. The reverse is also true
- Humidity The amount of water vapour in the atmosphere may absorb or reflect solar radiation. It prevents some percentage of the solar radiation from reaching the earth's surface. Areas with a low humid content such as arid and semi arid regions on the other hand experience more insolation on their surfaces because direct heat from the sun is received
- Impurities in the atmosphere
  Impurities such as smoke and dust particles tend to absorb part of the solar radiation reaching the earth's surface. This means that areas with a lot of atmospheric impurities receive less solar radiation as compared to areas with clear atmospheric conditions
- The sun's hot spots
  The surface of the sun has certain sections which are hotter and emit more radiation. Therefore, sections on the earth's surface that receive heat directly from these hot spots experience greater solar radiation. The reverse is also true.
- Green house effect
  The increase in the amount of green house gases like carbondioxide, methane, nitrous oxide, and carbon monoxide in the atmosphere affects the ozone layer hence triggering off the occurrence of global warming which ultimately increases the amount of solar radiation.
  On the other hand, areas with limited atmospheric green house gases have an intact ozone layer hence they experience less solar radiation reaching the earth's surface

Qn a) Distinguish between terrestrial radiation and solar radiation

b) Describe the conditions that influence the in-coming solar radiation in an area

HUMIDITY

It is the amount of water vapour held in a given volume of air at a given time. Atmospheric water vapour is as a result of evaporation and transpiration.

Humidity varies from place to place usually ranging between 48% to 80%. Water vapour is significant in the atmosphere because:

- It influences the formation of rainfall through condensation
- It regulates the temperature of the atmosphere through absorbing radiation i.e solar and terrestrial radiation
- It stores energy in the atmosphere

The humidity of a place can be described as follows:

- **Absolute humidity**
  It is the actual amount of water vapour held by a given volume of air at a given temperature and time. Absolute humidity varies according to temperature and pressure. When air temperature reduces, water vapour condenses consequently lowering the humidity and when temperature rises, air is capable of holding more water vapour leading to high humidity

- **Relative humidity**
  It is the actual amount of water vapour held by a given volume of air at a given temperature expressed as a percentage ratio of water vapour it is capable of holding **OR** It is the ratio of the actual amount of water vapour present in a given volume of air at a particular temperature to the amount of water vapour which the air can hold.

$$\text{Relative humidity} = \frac{\text{Actual amount of water vapour in a given volume of air}}{\text{Saturated water vapour content}} \times 100$$

OR

$$\text{Relative humidity} = \frac{\text{Absolute humidity}}{\text{Saturated water vapour content}} \times 100$$

Example:

If saturated air at $40^{o}c$ contains $40g/m^3$ of water vapour per $1m^3$, at a time of measurement the volume of air contains $20g/m^3$. Calculate the relative humidity.

$$\text{Relative humidity} = \frac{\text{Absolute humidity}}{\text{Saturated water vapour content}} \times 100$$

$$= \frac{20}{40} \times 100$$

Relative humidity = 50%

Factors which influence the Humidity of a place:

- Temperature
  Temperature controls or determines the rate of evaporation and transpiration. Hot temperatures lead to high rates of evaporation hence increasing the amount of water vapour in the atmosphere while cool temperatures reduce evaporation rates resulting into minimum condensation hence lowering the humidity of a place
- Altitude
  Since temperatures decrease with increase in altitude, high altitude areas like mountain tops experience low humidity as water vapour condenses while areas of low altitude like the coastal areas of E.Africa and the rift valley region experience hot temperatures which encourage high evaporation rates leading to high humidity
- Water bodies such as lakes and the Indian ocean act as sources of water vapour through evaporation. Areas near water bodies therefore experience high amounts of water vapour and hence high humidity e.g around the lake Victoria basin and the coastal areas compared to areas far away from water bodies e.g North eastern Uganda (Karamoja region) and North western Kenya (Turkana land)
- Vegetation cover
  Areas with thick vegetation cover such as forests experience high rates of evapotranspiration leading to high humidity than areas with scattered vegetation

such as scrub, thickets and steppe savannah which experience minimum evapotranspiration and therefore low humidity

- Inter Tropical Convergence Zone (I.T.C.Z)
  The apparent movement of the sun leads to variations in humidity between the northern and southern hemisphere. When the sun is overhead in the north, hot temperatures are experienced leading to high humidity in the north and low humidity over the south while the south experiences high humidity than the north when the sun is overhead in the south. The equatorial region however experiences uniformly hot temperatures throughout the year thereby leading to high humidity
- Continentality or Distance from the sea
  Areas near the coast experience high humidity because of the effect of the land and sea breezes while the areas far away from the coast experience low humidity due to the absence of land and sea breezes. Coastal areas also experience low humidity due to the effect of warm ocean currents which transfer warm temperatures towards the land masses leading to high evaporation

- Influence of ocean currents
  Warm ocean currents raise the temperature of the winds blowing over them hence resulting into high humidity while cold ocean currents have a cooling effect on the winds blowing over them leading to low humidity. The high humidity experienced along the E.African coast is therefore as a result of the influence of the warm Mozambique currents
- Prevailing winds
  Moist winds such as the South east trade winds cause high humidity in the areas over which they blow e.g the E.African coastal areas and the Lake Victoria basin. However, dry winds with less moisture cause low humidity in the areas over which they blow e.g the North east trade winds are responsible for the low humidity in Karamoja in North eastern Uganda and in the Turkana land in North western Kenya
- Relief
  Highland areas tend to have high humidity on the wind ward side because of the ascending moist winds e.g on the wind ward side of Mt Rwenzori, there's high humidity than on the lee ward side

- Human activities such afforestation, re afforestation and agro forestry encourage high rates of evapotranspiration resulting into high amounts of water vapour in the atmosphere hence high humidity while activities like bush burning, overgrazing, deforestation and swamp reclamation lead to reduced evapotranspiration and hence low humidity

Qn a) Distinguish between absolute humidity and relative humidity
b) Account for the variations in the humidity experienced in E.Africa

AIR PRESSURE

It is the weight (force) of the air exerted per unit area on the earth's surface. It is mathematically expressed as:

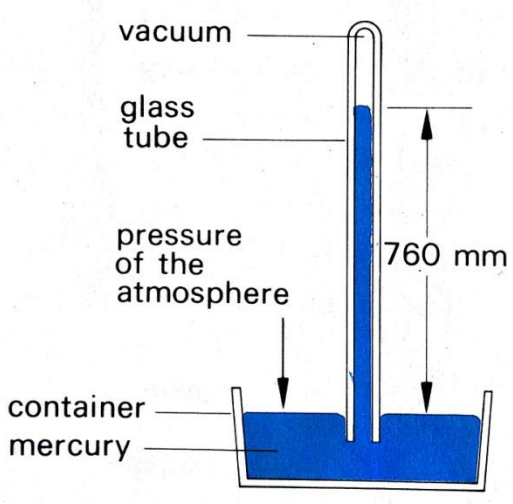
$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

The weight of air is the vertical column exerted from the upper limit of the atmosphere to the earth's surface which is approximately $1.034 kg/cm^3$ over the sea level.

It is measured and recorded in units known as **Millibars**. However, the average pressure or weight of the air on the earth's surface is measured in **Millibars per unit area**.

Atmospheric pressure is measured using a mercury barometer or an aneroid barometer.

A **mercury barometer** consists of a glass tube which is inverted over a bowl of mercury. The glass tube is marked in mm as illustrated below:



Air has weight and therefore exerts pressure on the earth's surface. A rise in atmospheric pressure caused by air pressure over the surface forces the mercury to rise in a glass tube.
When atmospheric pressure falls, mercury is forced to flow out of the glass tube and the mercury column in the glass tube falls
Atmospheric pressure is measured by looking at the column of mercury supported in the glass tube
It is expressed in Millibars e.g 750mm of mercury corresponds to 1000millibars (mbs)
N.B: When air pressure changes, the weight of the mercury column changes accordingly i.e when air pressure increases, the mercury column in the glass tube rises and vice versa. The recorded mean pressure values are used in tables, maps and charts.

An **aneroid barometer** comprises of a small metal container with most of the air driven out to form a vaccum.
Since there's practically no pressure at all inside the box, any increase in pressure on the outside of the box will cause the lid to move inwards hence registering high pressure by the indicator on the revolving dial.
When there's a decrease in pressure, the lid springs outwards registering or recording (indicating) low pressure by the indicator on the revolving dial.

Pressure varies from one place to another and from time to time.

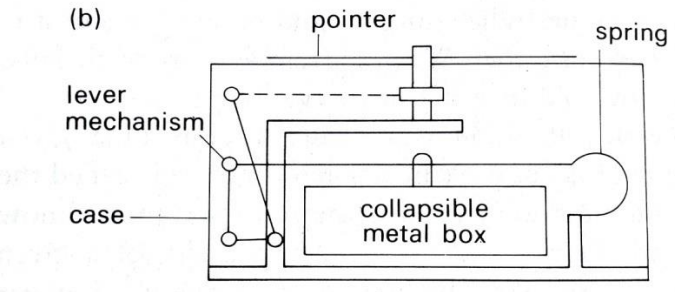


Fig. 13.11 (b) section through aneroid barometer

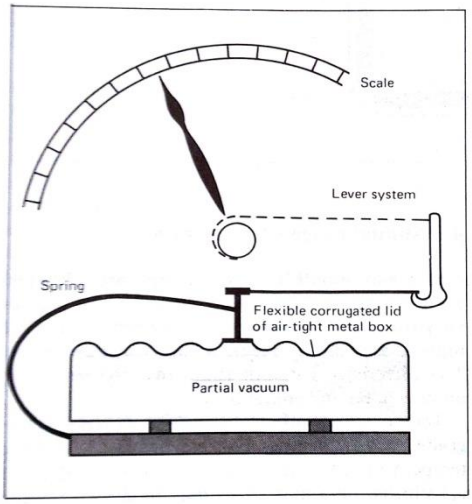


Fig. 11.3 *Aneroid barometer which measures air pressure*

Factors influencing atmospheric pressure:

- Temperature

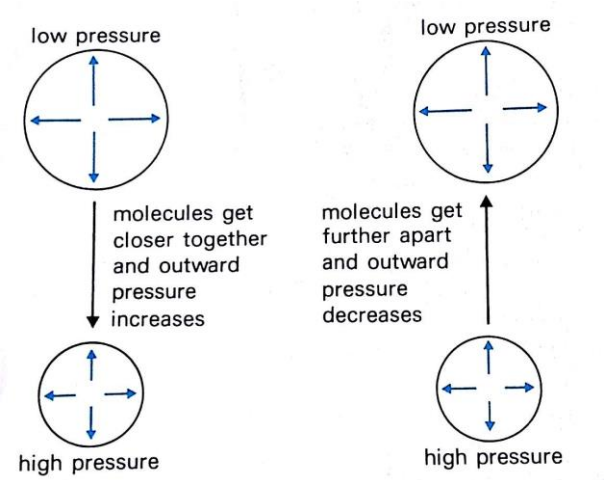
  There's an inverse relationship between the temperature and atmospheric pressure of a place.

  Hot temperatures lead to low pressure while cold temperatures lead to high atmospheric pressure. When air is heated, the air molecules expand and spread over a wide area resulting into low pressure while low or cold temperatures result into contraction and condensation of air molecules thereby exerting high pressure on the earth's surface. For that matter, Polar regions are high pressure zones while equatorial areas are low pressure belts.

- Altitude

  Atmospheric pressure decreases with an increase in altitude. This is because air at a high altitude spreads over a wide area which reduces its weight thereby causing low pressure. So, high altitude areas like highlands / mountain tops have low pressure due to the gravitational force towards the low altitudes.

  Low altitude areas such as foot hills and sea level on the other hand experience high pressure because the air near the ground supports the weight of air above it hence, the underlying or bottom air molecules constantly push downwards onto the earth's surface. This is also due to the high concentration of air impurities like dust particles and carbondioxide at the low altitudes.



- Rotation of the earth

  As the earth rotates, air at the poles (North and South poles) is blown away towards the equator. It crosses parallels which are getting longer. The cold dense air at the poles crosses from the high latitudes towards the equator spreading over a wide area leading to low pressure. This accounts for the low pressure at the equator.

  Air rising at the equator spreads out as it moves towards the poles. It crosses parallels which are getting shorter and contracts to occupy a small space. Its pressure therefore rises. This accounts for the high pressure at the horse latitudes.
- Latitudinal location

  Air pressure tends to increase away from the equator towards the Polar Regions. The equatorial region experiences low air pressure because of the intense or high insolation (heat) from the overhead sun while Polar Regions which experience a low intensity of insolation experience high pressure
- Nature of the earth's surface

  Land and water surfaces experience varying air pressure because of differences in the rate of heating and heat loss. This however affects atmospheric pressure at a local scale. During the day, land surfaces absorb heat faster than water surfaces leading to low pressure over the land and high pressure over the sea. Conversely at night, low pressure develops over the sea and high pressure over the land because the land surface cools faster than the water surface
- Amount of water vapour in the atmosphere

Moist air is cold and dense hence it exerts high pressure on the earth's surface while dry air with little or no moisture is warm and light (less dense) hence exerting low pressure on the earth's surface

- Apparent movement of the sun (Influence of the I.T.C.Z)
  Low pressure belts shift with the apparent movement of the overhead sun. When the sun is overhead the northern hemisphere (Tropic of Cancer) in June – July, high temperatures are experienced in the north leading to low pressure and high pressure over the southern hemisphere. In December – January when the sun is overhead in the southern hemisphere (Tropic of Capricorn), temperatures rise and low pressure develops over the south while the north develops high pressure.

Qn a) Describe how atmospheric pressure is measured and recorded at a weather station

b) Explain the factors that influence the atmospheric pressure of a place

PRECIPITATION

It refers to all forms of moisture which fall on the earth's surface from the atmosphere. Precipitation occurs as a result of the condensation of water vapour in the atmosphere to form rainfall, hail, fog and dew.

Precipitation forms under the following conditions:

- ✓ Adiabatic cooling of air which occurs when moist air rises and cools until when the temperatures reach the dew point at the condensation level. The water vapour condenses to form clouds or precipitation
- ✓ Air contact with a cold surface
  When warm moist air moves over a cold surface, the water vapour is cooled and it condenses into precipitation. This commonly occurs over the sea leading to the formation of fog
- ✓ Mixing of air in the atmosphere
  When two (2) air masses or wind systems meet in the atmosphere, the warm air is cooled down and it condenses leading to the formation of water droplets
- ✓ Terrestrial radiation at night

Rapid loss of heat by the land surface causes rapid cooling which also in turn causes the condensation of water vapour near the earth's surface. This is responsible for the formation of dew especially in the semi arid areas

- ✓ The degree of relative humidity
  When air is fully saturated i.e with a relative humidity of 100%, any increase in water vapour results into condensation to take place hence forming water droplets
- ✓ Existance of condensation nuclei
  The amount of tiny particles in the atmosphere such as dust and smoke facilitate the occurrence of condensation. Water molecules often form or cling onto these tiny particles suspended in the atmosphere acting as condensation nuclei

N.B: Condensation in the atmosphere results into the formation of clouds. Clouds are defined as thick water droplets suspended in the atmosphere as a result of the condensation of water vapour when temperatures drop to the dew point.
Clouds in the atmosphere affect the weather conditions of a given place in the following ways:

- Clouds lead to low surface temperatures by absorbing radiation from the sun during the day. This reduces the amount of insolation received on the earth's surface
- Clouds regulate warm temperatures during the night by acting as a blanket that prevents heat loss from the earth's surface. Areas with thick cloud cover e.g the equatorial region experience a low diurnal range of temperature due to the reduced amount of heat loss at night
- Dense cloud cover results into dark un clear conditions during day time. Thin cloud cover results into clear sunny day conditions
- Thick cloud cover is associated with heavy rainfall while thin clouds lead to little or no rainfall at all
- Low altitude clouds like mist and fog reduce visibility that hinders human activities such as transport thereby causing accidents.

RAINFALL

It is defined as coalesced water droplets that fall under the influence of gravity. It occurs as a result of condensation of water vapour in the atmosphere. The water droplets become heavy

to be held up in the atmosphere and hence, they later on fall down to the ground under the influence of gravity.

Types of Rainfall:

- **Convectional Rainfall**
  It is a type of rainfall which occurs as a result of evaporation induced by heat. Evaporation releases water vapour into the atmosphere which condenses to form clouds and later rainfall. It is common in the equatorial areas which experience intense heating almost throughout the year while in the mid latitudes, it is received during summer. The heat from the sun causes evaporation from the land and water surfaces as well as evapotranspiration from vegetation. The water vapour rises until when it reaches the condensation level where it cools and condenses into water droplets or clouds which result into rainfall.
  Characteristics of Convectional rainfall:
  - It is experienced in areas with intense heating
  - It is associated with prolonged rains covering a wide area
  - It is mainly received in the afternoons
  - Lightning and thunderstorms are so common
  - It involves heavy showers
  - It occurs during summer in the mid latitudes

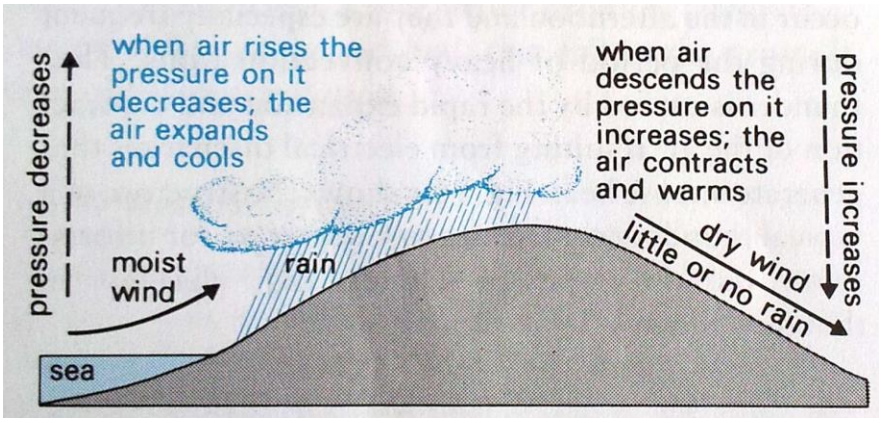
- **Orographic Rainfall**
  It is also known as relief rainfall.

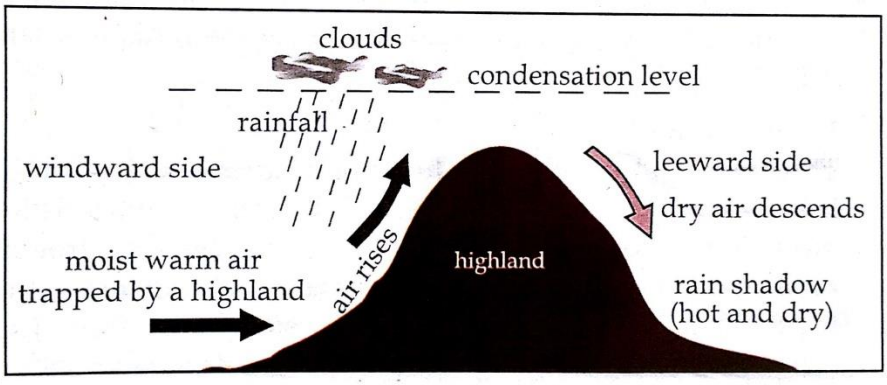
This is a type of rainfall experienced in the highland areas. It occurs when moist air is forced to rise upwards by a relief barrier such as a mountain (highland) or hill. The onshore moist air rises until when it reaches the condensation level to form clouds which consequently release rainfall on the wind ward side. Air rises up the mountain cooling at an adiabatic lapse at the condensation point at an average rate of 1^{o}c per 100metres to form cumulo nimbus clouds. As the clouds become dense, water droplets are released as rainfall on the wind ward slopes. Air descends on the lee ward side when it is cool and dry hence resulting into little or no rainfall. This region is called the rain shadow.

This type of rainfall is common in the mountainous areas / highlands of Kilimanjaro, Rwenzori, Elgon, Muhavura and Mt Kenya

Characteristics of Relief rainfall:

- It is often heavy on the wind ward side of the highlands
- It occurs as a result of the ascent of moisture laden air over a highland
- It involves prolonged periods of rain or precipitation
- It occurs in proximity to highlands Occasional thunderstorms and hail are common





- **Frontal (Cyclonic) Rainfall**

  It is a type of rainfall which occurs when two air masses of different characteristics meet at a front. The warm air mass is forced to rise over the cold dense air mass which descends at front. Warm moist air rises and cools at an adiabatic lapse rate until when the condensation level is reached. Condensation occurs to form clouds which eventually release water droplets called frontal rainfall.

Characteristics of Frontal Rainfall

- It is experienced along fronts such as the Inter tropical convergence zone (I.T.C.Z) where trade winds meet

- It involves heavy showers covering small local areas
- It lasts for only a few hours It involves violent thunderstorms

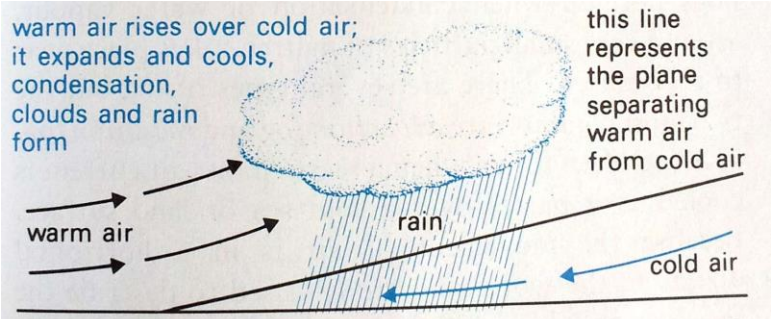
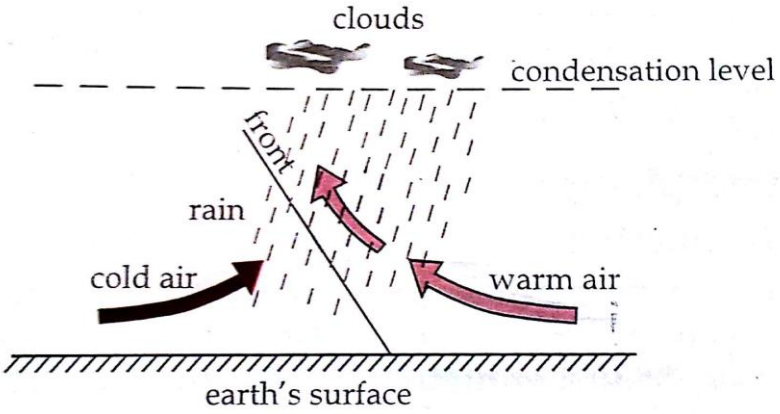


Fig. 16.4 Warm air is forced to rise when it is undercut by colder air; clouds and sometimes rain, occur



FACTORS INFLUENCING RAINFALL DISTRIBUTION IN E.AFRICA:

Rainfall distribution refers to the pattern in which rainfall is spread over a given area in a specific period of time.

Rainfall in E.Africa varies mainly in terms of amount and seasonality. Heavy rainfall of over 1000mm per annum is experienced in areas around the Lake Victoria basin, coastal areas and the highland areas of Mt Kenya, Elgon and around the Kigezi highlands among others.

Moderate rainfall ranging between 760-1000mm per annum is experienced in South western Tanzania, Central and Northern Uganda]as well as Southern Kenya

Low rainfall of less than 760mm per annum is received in areas like Karamoja region, Ankole Masaka corridor, Turkana land, Masai land and the Albert flats

The variations in the amount of rainfall received in E.Africa are influenced by the following factors:

- Apparent movement of the sun (I.T.C.Z)
  In June – July when the sun is overhead in the north, intense heating occurs creating a low pressure belt and the convergence of moist winds which result into heavy rainfall in the north. The same condition is experienced in the south in December – January. The north and south therefore experience a single rainfall maximum due to the movement of the sun. Because the sun is overhead at the equator twice in a year, a double rainfall maxima is experienced in the equatorial areas such around the Lake Victoria basin
- Prevailing winds
  They have a rainfall effect on the areas over which they blow because they transfer weather characteristics to the areas where they move. The South east trade winds emerge from the Indian ocean when they are moist so they are responsible for the heavy rainfall experienced along the E.African coast as well as the northern shores of lake Victoria while the North east trade winds from the Arabian desert are responsible for the low and un reliable rainfall in North eastern Uganda and North western Kenya
- Vegetation cover
  Areas with thick vegetation cover like tropical rain forests experience heavy rainfall due to the high rates of evapotranspiration e.g around Mabira, Budongo and the coastal areas with mangrove forests. On the other hand, semi arid areas with scattered vegetation cover experience low and un reliable rainfall e.g Karamoja region and Turkana land
- Influence of water bodies such lakes and the Indian ocean recharge the atmosphere with water vapour through evaporation as well as through land and sea breezes. Therefore, areas near water bodies experience heavy convectional rainfall e.g the lake Victoria basin and the coastal areas while areas far away from water bodies experience low and un reliable rainfall e.g In North eastern Uganda
- Relief
  Highland areas in E.Africa experience heavy rainfall on the wind ward slopes since they act as barriers towards the movement of the moist winds hence forcing them to rise upwards towards the condensation level thereby forming orographic rainfall. On

the other hand, lowland areas like the Albert flats experience low rainfall due to the absence of relief barriers to trap them

- Altitude

  High altitude areas like mountainous regions experience heavy rainfall due to cool temperatures which induce condensation of moisture bearing winds while areas of low altitude experience low to moderate rainfall due to the limited cooling effect for instance Mt Elgon areas receive heavy rainfall than the rift valley region
- Latitudinal location

  Areas located at or near the equator experience heavy rainfall which is evenly distributed throughout the year with a double rainfall maxima in March and September because the sun is overhead at the equator twice in a year while areas far away from the equator experience moderate to low rainfall with a single rainfall maximum because the sun is overhead at the tropic of cancer in the north and tropic of Capricorn in the south once in a year
- Ocean currents

  Warm ocean currents like the warm Mozambique currents increase the temperature of the ocean water and cause an increase in the rate of evaporation. The water vapour is therefore picked up by the onshore winds resulting into heavy rainfall in the coastal areas of E.Africa between Mombasa and Dar es Salaam
- Corriolis force effect

  According to Ferrel's law, the South east trade winds are deflected to the right of their path as they cross the equator due to the rotation of the earth. This is responsible for the heavy rainfall received around the northern and north eastern shores of lake Victoria while low and un reliable rainfall experienced in the Ankole Masaka corridor
- Perturbation

  It refers to the development of low pressure belts over the Indian ocean due to intense insolation. This forces winds from the interior of E.Africa to blow offshore (seaward) resulting into heavy rainfall over the Indian ocean and dry conditions in North eastern Kenya
- Coastal configuration

  The North east and South west alignment of the coast forces winds to blow parallel to the coast instead of blowing onshore. This is responsible for the low rainfall received in North eastern Kenya
- Human activities such as deforestation, overgrazing, sinking of bore holes and swamp reclamation among others reduce the rate of evaporation and evapotranspiration

resulting into low rainfall e.g in the Karamoja region and Turkana land. On the other hand, afforestation and re-afforestation result into increase in the rate of evaporation and evapotranspiration hence increasing the amount of rainfall in the areas where the trees are planted

Qn a) Distinguish between convectional rainfall and orographic rainfall
b) Account for the variations in rainfall distribution in E.Africa

FOG

It refers to tiny and light water droplets which form close to the earth's surface. It is a meteorological condition where condensation occurs at a low altitude or near the ground surface resulting into poor visibility over a given area to about 1 kilometre (0.62 miles).

Fog develops by condensation of water vapour in the atmosphere near a cold surface. For condensation to occur, condensation nuclei such as smoke and dust particles must be suspended in the atmosphere near the earth's surface.

Types of Fog:

There are different types of fog which occur depending on the conditions of formation

- ✓ **Radiation fog**

  It is a type of fog which is formed due to rapid terrestrial radiation and cooling of the earth's surface. It mainly occurs at night. The air near the earth's surface therefore cools and condenses to form a layer of fog called radiation fog

- ✓ **Advection fog**

  It is a type of fog formed when warm moist air passes over a cold surface. This causes rapid cooling and condensation of the lower layers of air to form fog

- ✓ **Frontal Fog**

  It is a type of fog formed when a warm air mass meets with a cold air mass. The cold air mass cools down the warm air mass above it resulting into condensation near the earth's surface. This is so common around the coastal areas and the Inter tropical convergence zone

- ✓ **Hill fog**

  It refers to a low sheet of cloud that covers the lower slopes of hills. It is common in the hilly and mountainous areas which experience cool / low temperatures at high

altitude. The rising air is cooled down along the hill slopes leading to pre mature condensation that results into the formation of hill fog

- ✓ **Steam fog**

  Is a type of fog formed when a cold air mass passes over a warm water surface. The water vapour from the water surface condenses easily upon mixing with the overlying cold air. Steam fog forms rapidly and disappears quickly.

HAIL

It refers to frozen rain droplets which usually range between 5 – 50 mm in diameter. The frozen rain droplets usually have a concentric layer of ice as well as being white and opaque in character.

Hail is a form of precipitation which falls on the earth's surface in form of small ice pellets or hail stones.

It is associated with extreme instability in the atmosphere resulting from uplift of air by convective currents

Hail forms due to the condensation of moisture in the lower atmosphere followed by strong rising air currents. The water droplets are therefore pushed up to the freezing point to form ice pellets which are thick and dense enough to overcome the uprising air currents. Consequently, ice falls on the earth's surface in form of hail stones.

It usually occurs in unstable cumulo nimbus clouds where vertical uplift or rise of air is strong enough to carry condensed droplets above to great heights of the freezing level where they are turned into ice crystals at a very high altitude.

The initial droplets freeze above the freezing point hence condensation nuclei is ice. After being carried upwards to greater heights by the uprising air currents, an additional layer of ice is formed on the original ice nucleus by collision and coalescence with super cooled water vapour / droplets around.

The pellets fall and rise many times until when the weight of the enlarged ice crystals is sufficiently great to overcome any uprising current. Finally, the crystals fall as hailstone due to gravity

Qn. Describe the processes leading to the formation of the following:

a) Fog
b) Hail
c) Orographic rainfall

WIND

It is defined as moving air or air in motion. Air usually moves in a definite direction and is therefore referred to as a wind system.
Winds often blow from regions of high pressure to regions of low pressure determined by temperature differences.
Winds are either local or global. Global winds are generally referred to as Air masses and they have great influence on the climate of extensive areas while local winds have micro climatic influence.
Winds may also be referred to as breezes when they are light.

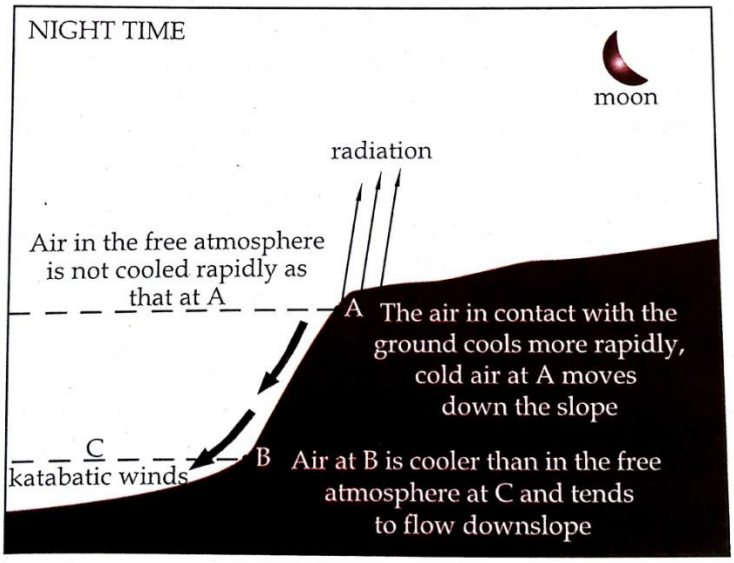
LOCAL WINDS

They are winds which blow over localized areas i.e they are less extensive wind systems. They result from differences in pressure in particular areas leading to air masses from areas of high pressure to blow towards areas of low pressure.

TYPES OF LOCAL WINDS:

A. KATABATIC WINDS

They are local winds which move down slope under the influence of gravity at night. They occur in highland areas at night when cold dense air moves down slope.
Katabatic winds form due to rapid cooling of the highland slopes at night due to their exposure leading to high pressure over the slopes. The slopes lose a lot of heat through radiation hence they cool down much faster than the valleys ultimately becoming areas of high pressure. The air on the slopes becomes denser than the air in the valleys. The cold dense air from the highland slopes therefore blows down slope (descends) to the valleys i.e from a high pressure zone to a low pressure zone forming a Katabatic wind as illustrated below;



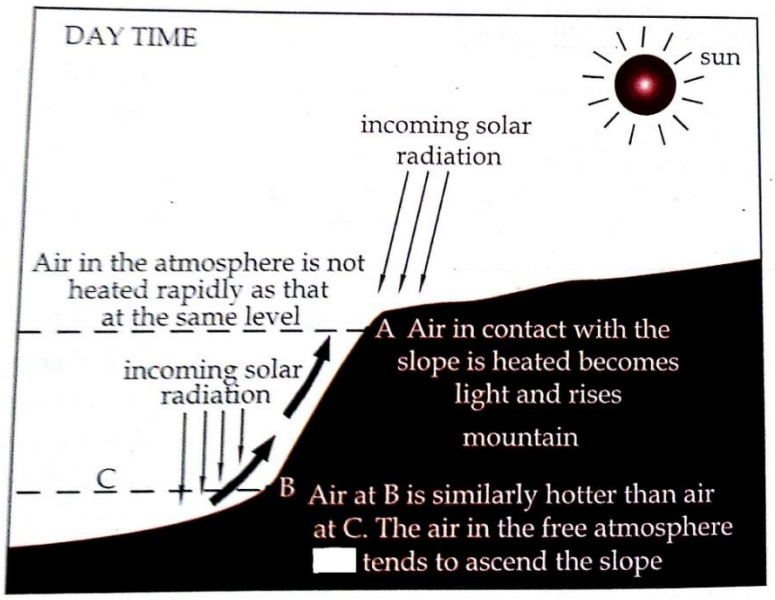
Katabatic winds normally result into the following weather conditions:

- There's formation of mist and fog in the valleys especially in the morning hours because of the meeting of descending cold air and the warm air in the valley
- Cold conditions are created in the valleys during the night usually extending to the morning hours
- Temperature inversion is experienced in the valleys as the cold descending air displaces the warm air upwards thus the air in the valley is colder than the air above it
- Frost conditions are experienced in the valleys due to rapid cooling caused by the descending cold air

B. ANABATIC WINDS

They are local winds which flow from the valleys upwards the highland slopes during the day. They occur as a result of the differences in the rate of heating between the valley and the upper slopes in highland areas.

During the day, the highland slopes are heated more than the valleys hence, the air over the hill slopes is heated, it expands, becomes light and rises upwards thereby creating a low pressure zone hence convectional rising of air on the upper slopes. The cold dense air in the valleys under high pressure rises up the slopes to replace the vacuum created by the warm rising air finally resulting into Anabatic winds as illustrated below:



Anabatic winds result into the following weather conditions:

- Formation of mist and fog on the upper slopes of the mountains as the ascending cold air moves over a warm surface
- Orographic rainfall is experienced in the mountainous areas as warm air rises from the upper slopes
- Low clouds are formed in highland areas due to the cooling effect of the ascending cold air at and beyond its condensation level or dew point
- Cold temperatures are transferred from the valleys to the upper slopes of the highlands

Qn a) Distinguish between Anabatic winds and Katabatic winds

b) Describe the weather conditions associated with:

I. Anabatic winds
II. Katabatic winds

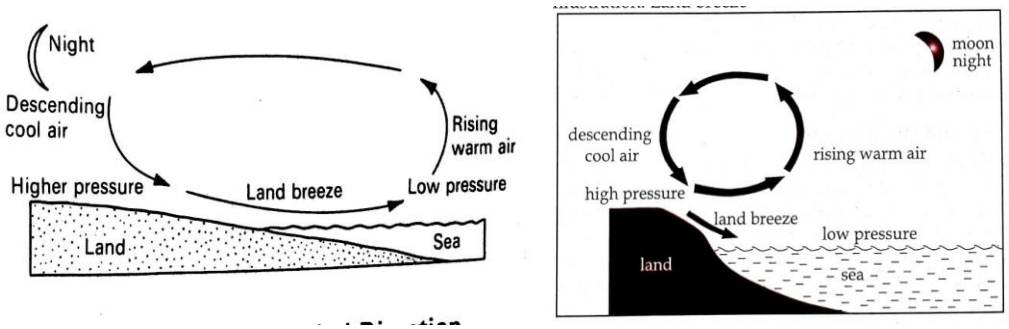
C. LAND BREEZE

In general, land and sea breezes are local winds which occur in areas where land lies in close proximity to a water body such as around the L.Victoria shores and the coastal areas of E.Africa.

Factors for the occurrence of Land and Sea breezes:

- Differences in specific heat capacities of the land and sea
- Mobility of water compared to the solid land
- Heat transmission through the transparent water as opposed to the opaque land
- Differences in the reflecting capacity of the land and water

A land breeze is the movement of cold dense air from the land towards the sea. It occurs at night. It is as a result of differences in the air pressure between the land and water surface. Rapid terrestrial radiation over the land leads to rapid cooling hence creating a high pressure belt while low pressure is created over the warm sea surface. Wind therefore blows from the land towards the sea as a Land breeze.



Causes of a Land breeze:

- Loss of radiation at the coastal lands at night. Land therefore cools faster than the sea / water hence temperatures are cooler over the land than the sea which retains much of its heat
- Water loses heat more slowly such that the air above it remains relatively warm
- Low pressure is created over the warm sea and high pressure over the cold land. Cool air from the land under high pressure blows towards the sea to replace the rising air hence forming a land breeze

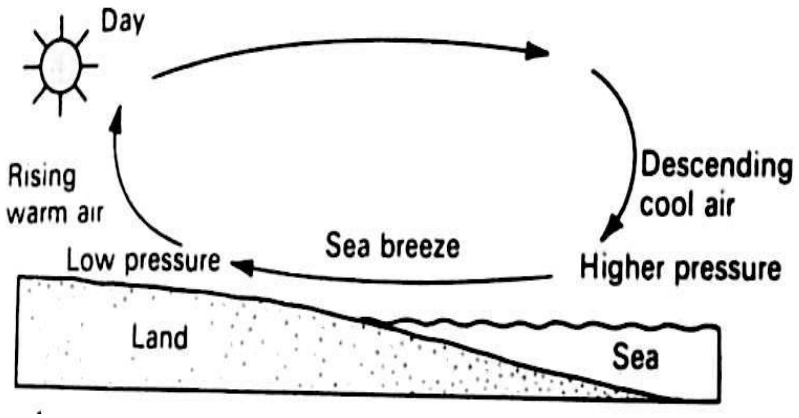
Effects of a Land breeze:

- It results into lowering of temperature over the sea as cold air from the land blows towards the sea

- Formation of fog / misty conditions occurs over the sea as cold air from the land cools down the warm air over the sea leading to premature condensation as well as poor visibility
- Temperature inversion occurs over the sea as cold air from the land displaces warm air upwards over the sea
- Dense clouds and heavy offshore rainfall are experienced over the sea as warm air is displaced upwards to the condensation level
- It results into dry conditions on the land because little or no rainfall is received
- It results into violent thunderstorms
- It also causes high humidity over the sea / lake

D. SEA BREEZE

It is the movement of cool moist air from the sea towards the land. It occurs during the day. Rapid heating of the land surface during the day creates a low pressure belt over the land while high pressure develops over the sea which is less heated. So land warms faster than the sea hence temperatures are high over the land and cold over the sea. Convective currents of warm air rise over the land and create low pressure at the sea surface. This forces cool moist wind (air) to blow from the sea towards the land to replace the rising air hence forming a sea breeze as illustrated below;



Effects of a Sea breeze:

- It lowers temperature on the land especially in the afternoons as cool air from the sea replaces the rising warm air

- It is associated with onshore convectional rainfall which is normally received in the early morning and afternoon hours
- It causes violent thunderstorms
- It results into high humidity over the land
- Thick cloud cover is formed over the land
- It leads to the formation of fog / misty conditions on the land which results into poor visibility

Qn. Examine the causes and effects of land and sea breezes in East Africa

F. FOEHN WIND

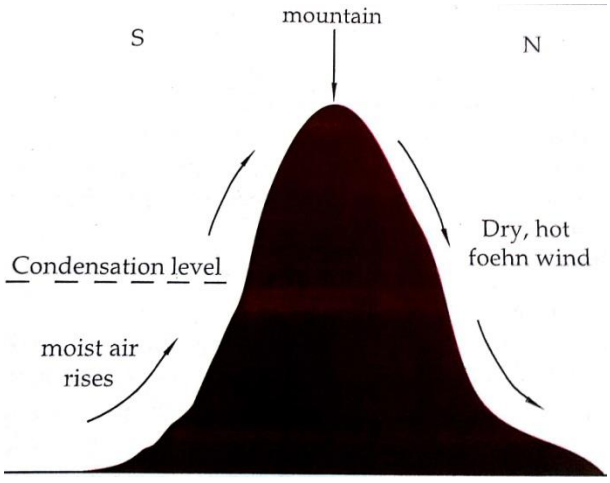
It is a dry wind experienced on the lee ward side of mountains when descending air becomes compressed with increased pressure.

It is experienced in the valleys of the northern Alps particularly in Switzerland during spring

Air is forced to move upwards the southern slopes of the Alps, where it later expands and cools. Condensation takes place when the air is saturated. Rain and even snow falls on the higher slopes.

On the lee ward slopes, the air descends and gains heat due to an increase in temperature. The air is compressed and warmed. Most of its moisture is lost and wind reaches the valley bottom as a dry hot wind known as a Foehn wind

The wind incidentally causes a sudden rise in temperature. Being hot and dry, sometimes it triggers off wild fires in the Alpine valley as well as causing low relative humidity



G. CHINOOK WIND

The term “Chinook wind” is derived from the Indian word “Chinook” which means “Snow eater.”

It is called so because it is hot and it causes melting of snow. Chinook winds are experienced on the eastern slopes of the Rocky mountains in the United States of America and Canada during the winter season.

Chinook winds are similar to Foehn winds in terms of development and effects. They only differ in areas of occurrence (operation)

Chinook winds are so hot that they can raise the temperature of an area by 19^{o}c within 25minutes.