

## **Climate of Africa**

**Climate** is the **state of the average weather** conditions of a **given place** recorded over a **long period of time** usually **about 35 years** and above.

Climate of a place is determined when the elements of weather like rainfall and temperature are measured and recorded for a long period of time - 35 years.

Africa's climate is varied owing to various factors that control the climate.

In Africa, climate experienced is mainly hot and wet although there are some place experience different types of climate like semi desert climate, hot desert climate as well as temperate climate in highland areas.

### **The Types of climate and their characteristics**

Africa has the following general types of climate:

- Equatorial climate
- Savanna climate/tropical continental/Sudan type of climate
- Tropical Semi-arid climate
- Desert climate
- Montane/ mountain climate
- Mediterranean
- East margin

**Activity:** Draw the sketch map of Africa to show the different climatic zones

### **Equatorial climate**

#### **Location:**

It is mainly found between 5° North and South of Equator, but extend to 10° north and south of 0°.

It is well developed in central Africa, West Africa in the southern Ghana, southern parts of Nigeria, Cameroon, Gabon, Republic of Congo, Democratic Republic of Congo, Guinea, southern Ivory Coast, east coast of coastal Malagasy Republic and east African highlands.

It is characterized by the following:

- It has uniformly warm to hot temperatures of about 26°C, small (low) annual range of about 2°C to 3°C, and small diurnal range of 1°C to 8°C. The temperature ranges between 22°C - 29°C.
- Heavy and well distributed rainfall throughout the year with a double maxima/two peaks of rainfall: march-may (long rains) and October- November (short rains) and April is the wettest month
- The rainfall is normally conventional type of rainfall from towering cumulonimbus clouds, accompanied by thunderstorms and lightening; and rainfall occurs in the afternoons and evenings.
- Humidity is very high throughout the year and relative humidity is constantly high over 80%.
- Heavy clouds cover throughout the year.
- The sun rising is between 6:00am and 6:30am and setting is between 6:00pm-6:30pm (almost equal).
- The mid-day sun is always near vertical and overhead twice a year at the equinoxes.
- Morning weather is often quite sunny and clear, but heat builds up during the day until by about 2.00pm. Cumulus clouds develop growing into towering Cumulo nimbus which gives heavy rain.
- There is little or no dry season.

**Summary:** *Hot and wet throughout the year.*

**Economic activities carried out in this type of climate:**

Growing of annual and perennial crops/traditional and non-traditional crops on both small and large farming, Livestock farming, harvesting the forest resources/lumbering, Mining and quarrying, Art and craft, Fishing, Tourism and wild life conservation

**Activity:** *Study the climate figures below answer the questions that follow:*

**Libreville- Gabon coast**

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 30  | 31  | 31  | 31    | 30  | 29   | 28   | 28  | 29   | 29  | 29  | 30  |
| Rain [mm] | 250 | 250 | 325 | 300   | 213 | 25   | 25   | 25  | 100  | 275 | 380 | 200 |

**Freetown: Sierra Leone coast**

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 30  | 31  | 31  | 30    | 29  | 28   | 27   | 27  | 28   | 29  | 30  | 30  |
| Rain [mm] | 25  | 25  | 50  | 100   | 275 | 500  | 900  | 925 | 700  | 300 | 125 | 25  |

**Activity:**

- Draw suitable graph to represent the information in the table for Libreville.
- Describe the characteristics of climate of Libreville.

**Hint 1: How to draw graph climate graphs:**

- The vertical axis should be labeled ‘rainfall in mm’, temperature in °c and the horizontal axis ‘months of the year’
- Use the space on the graph profitably by drawing an appropriate graph. Remember that all the information [title, scale, labeling of the horizontal and vertical lines] should fit on the graph paper.
- On top of the axis for rainfall add another for temperatures. Label its Degrees centigrade.
- Use appropriate scale to draw the climatic graph. A suitable scale is 1cm for 5 degrees centigrade. State that 1cm represents 5 degrees centigrade of temperature. If you make a big scale the temperature graph will be exaggerated and misleading. The line graph tends to suggest high range of temperature which may not be the case.
- Use a line graph for temperature graph. Plot neat points/dots in the right locations and join them together from the left axis to the right axis.
- Plot vertical bars with uniform width to show variations of rainfall amounts for each of the month.
- Preferably use between 1 to 2 cm for about 100 mm of rain for equatorial and tropical climates.
- It is advisable to use 2 cm for 100 mm of rain for dry climates for example desert/semi-arid climates to bring out the low rainfall months of the year. State that 1cm represent ... mm of rainfall.
- Shade uniformly the bars to add on visual impression.
- All writings **MUST** be horizontal on the graph paper
- Finish your graph with the correct heading or tittle for example: **A bar and line graph showing rainfall and temperatures of Cairo**

**Hint 2: How to describe the climate from a graph:**

To describe the main characteristics of a climate, we have to use the correct words. The list below gives the terms/adjectives which should be used;

**Temperature:**

**Mean monthly temperature**

- Above 30<sup>0</sup>c----- very hot temperatures
- Between 20<sup>0</sup>c-29<sup>0</sup>c----hot temperatures
- Between 10<sup>0</sup>c-19<sup>0</sup>c----warm temperatures
- Between 0<sup>0</sup>c-10<sup>0</sup>c-----cool/mild temperatures
- Below 0<sup>0</sup>c----- very cold temperatures

### **Annual range of temperature**

- Large  $>20^{\circ}$
- $5^{\circ}$  < moderate  $< 20^{\circ}$
- Small  $< 5^{\circ}$

**Avoid** the use of terms like *good or bad temperature* which are not measurable when describing temperatures.

### **Rainfall**

#### **Annual rainfall**

- Above 1500mm per annum – very wet
- Between 1000mm - 1500mm per annum – wet
- Between 500mm - 1000mm per annum – moderate
- Between 250mm - 500mm per annum – dry
- Less than 250mm per annum – very dry

#### **Monthly rainfall**

- Above 125mm – very wet
- 80-125mm – wet
- Less than 80mm – dry

#### **Other terms:**

Heavy, Moderate, Reliable, well distributed, poorly distributed, Unreliable, unevenly distributed

**AVOID** using terms like good rainfall, high rainfall, low rainfall, poor /bad rainfall **which are not measurable.**

### **Savanna climate/tropical continental climate/Sudan type of climate**

#### **Location:**

It occurs between  $5^{\circ}$  and  $15^{\circ}$  north and south of the equator.

It is a transitional type of climate found between the equatorial forests and the trade wind hot deserts. It is confined within the tropics and is best developed in the Sudan where the dry and wet seasons are most distinct, hence its name the Sudan climate.

The belt includes West African Sudan, and then curves southwards into East Africa and southern Africa north of the Tropic of Capricorn.

Tropical continental climate is characterized by:

- An alternate hot, rainy season and cool, dry season.
- Summers are hot with temperatures over  $30^{\circ}\text{C}$ .
- Winters are cooler with temperatures hovering between  $21^{\circ}\text{C}$  and  $26^{\circ}\text{C}$ .
- The annual temperature range is moderate which is about  $11^{\circ}\text{C}$
- The highest temperatures occur just before the rainy season begins in April in the northern hemisphere and October in the southern hemisphere.
- Rainfall varies between 1700mm (heavy rainfall) towards the equator to less than 500 mm (unreliable rainfall) towards the semi desert margins.
- The wet season associated with the apparent movement of the sun.
- Heavy rains, mainly convection rain, occur in the summer.  
The rains are caused by the doldrums which move over the regions in this season
- Very little rain falls in the cooler season because these regions lie under the offshore trade winds. Some regions the offshore winds are strong, hot and dusty, for example the Harmattan of north and West Africa.
- Both the length of the rainy season and annual total rainfall decrease appreciably from the equatorial region pole wards towards the desert fringes.
- Humidity is high during the wet season and low during the dry season.

Summary: hot throughout the year with rain occurring in the summer only and with dry, dusty winds blowing in the winter

Harare: altitude 1500 M Zimbabwe

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 24  | 23  | 22  | 21    | 20  | 18   | 17   | 18  | 20   | 23  | 24  | 24  |
| Rain [mm] | 200 | 175 | 100 | 25    | 20  | -    | -    | -   | -    | 50  | 100 | 175 |

Kayes: Mali

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 25  | 27  | 32  | 35    | 36  | 33   | 28   | 27  | 27   | 26  | 26  | 25  |
| Rain [mm] | -   | -   | -   | -     | 25  | 100  | 200  | 200 | 150  | 50  | 10  | 5   |

Kano: Nigeria, Altitude: 469m

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 22  | 24  | 27  | 32    | 31  | 27   | 26   | 25  | 26   | 26  | 25  | 23  |
| Rain [mm] | -   | -   | -   | 25    | 75  | 125  | 200  | 325 | 150  | 25  | -   | -   |

**Activity:** Draw the climatic graph to represent the climate of Kano

**Economic activities carried of the Savanna climatic zone:**

- The savanna climate supports wild life conservation because the trees and grass are good habitats for wild life. Hence, they are areas of National Parks
- Savanna climate is favourable for livestock farming – pastoralism
- This type of climate is suitable for arable farming especially growing of annual crops such as cotton, ground nuts in west Africa and millet
- The climate attracts human activities such as tourism and safari rallies
- Lumbering also takes place in the woodlands that are supported by the climate.
- Forestry activities

**Problems experienced in the area:**

- The climate and vegetation conditions attract pests like tsetse flies
- There is a lot of soil erosion due to flash floods in summer.
- The unreliable rainfall limits the development of agriculture
- At times the swamps and generally flat lands get flooded in the region

**Semi-arid climate:**

This climate covers a broad belt of land across the northern Africa and a smaller zone in southern Africa.

It occurs between savanna climate zones and the true deserts.

- There is an intense dry hot season from November to March.  
The rainy season is from April to August with a marked minimum in June and marked peaks in May and July.  
December and January are the driest months.
- Rainfall is less than 550mm and unreliable throughout the year.
- The passage of inter – tropical convergence zone northwards and the onset of the south east monsoon in April – May, accounts for the one peak of rainfall.
- Temperatures are very hot throughout the year and the average temperature range from 28°C-35°C.
- There is very high diurnal range of temperature between 17°C-22°C.
- There is very Low humidity of about 20% or less.
- There is limited cloud cover that is they are generally clear skies partly due to the limited atmospheric moisture required for cloud formation.

Economic activities: because of the harsh conditions of hot weather and semi-arid conditions little agriculture is carried out. Others are Tourism, hunting, Conservation of wildlife and Pastoralism

## **Tropical Desert climate:**

### **Location:**

They occur on the western side of Africa extending into the interiors, where the trade winds originate from over the land, blowing to the oceans.

The aridity of the hot deserts is mainly due to the effects of the off-shore trade winds; hence they are also called the *Trade Wind Deserts*.

The tropical deserts are

- Sahara Desert which extends from Senegal to Egypt and it is the largest single stretch of the desert, Namibia and Kalahari Deserts.

They are characterized by:

- The rainfall is generally less than 250 mm per year, scarce and unreliable.
- Rain normally occurs as violent thunderstorms of convectional type and may evaporate as soon as it stops raining.
- It falls suddenly and pours continuously for a few hours over small areas.
- The temperatures are extremely hot over 35°C throughout the year.
- Days are unbearably hot and the nights are cold which brings about high daily temperature ranges
- Humidity is low

Study the table below showing the climatic characteristics of the different stations and answer the questions that follow:

Windhoek: Namibia

| <b>Month</b>     | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>April</b> | <b>May</b> | <b>June</b> | <b>July</b> | <b>Aug</b> | <b>Sept</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|------------------|------------|------------|------------|--------------|------------|-------------|-------------|------------|-------------|------------|------------|------------|
| <b>Temp [°C]</b> | 27         | 27         | 26         | 25           | 22         | 20          | 20          | 23         | 26          | 27         | 29         | 30         |
| <b>Rain [mm]</b> | 125        | 75         | 50         | 10           | 7          | 5           | 3           | 3          | --          | 7          | 3          | 35         |

Timbuktu: Mali

| <b>Month</b>     | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>April</b> | <b>May</b> | <b>June</b> | <b>July</b> | <b>Aug</b> | <b>Sept</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|------------------|------------|------------|------------|--------------|------------|-------------|-------------|------------|-------------|------------|------------|------------|
| <b>Temp [°C]</b> | 12         | 15         | 20         | 25           | 30         | 35          | 37          | 36         | 33          | 26         | 26         | 16         |
| <b>Rain [mm]</b> | -          | -          | 3          | 10           | 10         | 35          | 85          | 50         | 13          | 12         | -          | -          |

Massawa, Ethiopia: altitude: 20 meters

| <b>Month</b>     | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>April</b> | <b>May</b> | <b>June</b> | <b>July</b> | <b>Aug</b> | <b>Sept</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|------------------|------------|------------|------------|--------------|------------|-------------|-------------|------------|-------------|------------|------------|------------|
| <b>Temp [°C]</b> | 26         | 26         | 27         | 29           | 31         | 33          | 35          | 34         | 33          | 32         | 30         | 27         |
| <b>Rain [mm]</b> | 38         | 15         | 15         | 20           | -          | -           | -           | -          | -           | 8          | 18         | 36         |

Question: Draw suitable graph to represent the above information for Mali

Economic activities: tourism, nomadic pastoralism [Tuaregs of the Sahara Desert], sand quarrying, research and experiments in solar power development, hunting, irrigation farming in Egypt, Chad and Senegal; mining of minerals for example diamonds and copper in Kalahari and oil in Algeria.

Mediterranean Climate [Warm Temperate Western Margin climate]

### **Location:**

This is located in limited areas of Africa. It is entirely confined to the western portion of the African continent, between 30° and 45° north and south of the equator in north-western and south-western Africa.

Characteristics of the Mediterranean climate:

- Hot dry summers of 20°C – 24°C or sunny summers.
- Cool/mild /wet winters of 10°C – 13°C and moist.
- It is characterized by summer drought.
- Temperature range is 24°C during the summer to 10°C during the winter.
- Onshore westerlies bring in winter rainfall.
- The annual range of temperature is quite large of 14°C.

- Moderate Annual rainfall totals varies from 500 mm at coastal areas to over 750mm in the Atlas Mountains.
- Cold winters with snow and night frost, and hot desert-like summers occur in the of Shots

Algiers: North West Africa:

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 12  | 13  | 15  | 16    | 19  | 22   | 25   | 26  | 24   | 20  | 17  | 15  |
| Rain [mm] | 150 | 87  | 87  | 60    | 30  | 12   | --   | --  | 25   | 75  | 110 | 140 |

Cape Town: South west tip of South Africa:

| Month     | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|-----------|-----|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|
| Temp [°C] | 21  | 20  | 20  | 17    | 15  | 13   | 12   | 13  | 15   | 16  | 18  | 20  |
| Rain [mm] | 12  | 12  | 15  | 50    | 90  | 110  | 87   | 87  | 50   | 35  | 20  | 15  |

Question: Draw the climatic graph for Cape Town

**The Montane Climate:** This type of climate is experienced in the high land areas like the Ethiopian highlands, East African Highlands and the Rwanda highlands and the Drakensberg Mountains of South Africa.

There is a ring of climatic types depending on the altitude:

- Savanna climate at the foot of the mountain
- Rainfall belt between 2000m-3000mm
- The temperate climate above 3000m
- Semi-arid and arid climate over 4000m above seas level

**Activity: Draw a diagram to show the climatic zones around the mountain in the tropics and Describe the economic activities for each of the zone**

The high altitude lowers the daily temperatures to an average of less than 16°.

When winds blow over the highlands, they are forced to rise and cool leading to deposition of moisture within the air and to heavy relief rainfall on the wind ward side of the highlands.

**The High Veld:**

**Location:** The plateau region extending from the Pretoria district and Swaziland south eastwards through Orange Free State, western Natal and Lesotho, to the plateau edge in Cape Province.

Climatic characteristics:

- A temperate continental climate with temperatures ranging from 10° centigrade (winter) to 19° (summer).
- Annual rainfalls decrease from 780 mm in the east to about 400 mm in the west. Rain is brought by westerly air streams from the Indian Ocean.
- Winter months tend to be dry.

**Warm East Margin or humid Sub-tropical:**

**Location:** This covers by the coastal areas of Eastern Cape Province, Natal and Mozambique, westwards to the interior plateau.

**Climatic characteristics:**

- Annual rainfall is between 900mm and 1150 mm, most of which falls in the summer (November to Mach).
- Rain is conventional and orographic

**The main factors that influence the climate of Africa are:**

**Altitude:**

The climatic differences in Africa are partly attributed the Altitude.

The temperature drops or becomes cooler by 1°C for every 150 metres of ascent.

This is known as temperature Lapse rate.

Altitude has a remarkable effect on temperature distribution in Africa.

It influences climate as follows:

- The highland areas of Ethiopian massifs, Atlas have lower temperatures because the temperatures tend to decrease with altitude at the rate of 1°C after every 150 metres. This partly explains why mountain Rwenzori experience snow on its top despite its location near the equator.
- High altitude areas of Africa receive heavy orographic/relief rainfall because the warm dry ascending air cool, condense, and form cumulus and cumulonimbus clouds as it ascends a mountain leading to heavy rainfall on the windward sides.
- It also affects pressure in that atmospheric pressure decreases with an increase in altitude that is why high-altitude experience low atmospheric pressure and higher pressure on the foothills of the mountains.
- There is also low humidity in the highland areas because of the low temperatures experienced in mountainous areas.
- Low lying areas have high temperatures rising above 24°C for example in the rift valley areas, while the mountain peaks have cool temperatures.

### **The influence of relief**

Relief is the general appearance of the land of the land surface.

Africa has a varied relief ranging from plains to high mountains all these have influence on the climate of Africa as follows:

- Flat areas experience dry weather conditions because there are hardly any hills or mountains which could hold back winds. As a result, the winds gather speed over such areas and drive away clouds to other areas.
- Highland areas like Ethiopian highlands, Cameroon highland and Atlas receive heavy rainfall due to the fact that the incoming winds are forced to rise when they blow towards the highlands and in the process cool, and the moisture condenses into orographic rainfall on the windward side.

The leeward side is however in the rain shadow and they have arid/dry conditions as illustrated below; **illustration of the relief rainfall**

### **Latitude:**

The latitudinal position of Africa explains the tropical nature of climate generally characterised by hot temperatures since the sun is normally overhead the tropics that is the sun migrates within the tropics. This is because the concentration of the sun rays is greater within the tropical region.

Places near the equator experience maximum heat from the sun and therefore, experiencing warm to hot temperatures all the year except in hilly areas.

The warm to hot temperatures lead to high moisture content in the atmosphere which results into high precipitation with two peaks of rainfall or bimodal rainfall.

Areas far away from the equator have one rainy season followed by a long dry season.

### **Wind systems:**

Africa is placed in the global context of winds.

The most influencing ones on her climates are the:

North east, south east and south west prevailing/trade winds.

Generally, the low-pressure trough that develops over Africa in the tropics attracts winds from centres of high pressure usually over the cooler water bodies. The winds are drawn in into the trough and converge over the tropical lands and causes convectional rainfall over many places in Africa.

**Activity:** Draw the sketch map of Africa showing the trade winds that affect climate.

At the front of the winds heavy rainfall develops and falls as convectional rain. The winds blowing from ocean surfaces pick moisture from the water and deposit it over the surface of the continents.

This explains why much of West African coast is wet.

However, some of these trade winds are dry especially when they passed over the continents or highlands which rob them of the winds.

Examples are the Harmattan trade winds in West Africa and the northeast trades over Ethiopian highlands.

**Activity:** Draw the diagram in Africa by Minns showing the wind patterns over Africa

### **Ocean currents:**

There are two types of ocean currents namely the warm ocean currents and the cold ocean currents. Both affect the climate of Africa and *for effects refer to ocean current notes.*

### **Vegetation cover:**

Areas that are covered with extensive, dense and thick forests like in the Democratic Republic of Congo receive heavy rainfall throughout the year because of high rates of evapo-transpiration from the thick leaves of plants.

Areas without vegetation or with scatty vegetation cover are dry.

### **Water bodies - lakes:**

Some places close to large masses of water bodies experience local climate. For example, through lake and breeze processes the temperatures and rainfall of adjacent lands bring about special climate conditions.

A lake breeze is a blow of wind from the water surface to the land to replace a rising warmer air. Such winds blow during the day when the temperatures over the land become higher than those over the water surface. The lake breezes impregnate the air with moisture for usually heavy afternoon rains.

During the night when temperatures fall, the land cools faster than the water and so the pressure over land is high compared to that over the water. A wind from the land blows to the water as a land breeze leading to heavy stormy rain over the water surface and adjacent lands.

**Activity:** Draw diagrams of lake and land breezes

### **Apparent movement of the overhead sun**

The position of the overhead sun influences the moment and subsequent position of the inter Tropical convergence zone (**ITCZ is the low-pressure zone of unstable air masses which keep on shifting depending on the position of the overhead sun**).

The ITCZ have a great influence on the prevailing winds - North east and south east Trade winds because they are forced to blow into low pressure belt from regions of high pressure. The inter-tropical convergence is responsible for the seasonal pattern of rainfall distribution in many areas of Africa. It influences climate in the following ways;

- At the time when the sun is overhead around the equator in March and September each year, this belt receives intense heat up air and air masses mainly North east and South east trade winds come to replace the rising air.  
The convergence of winds along the Equator in March and September causes heavy rainfall which is well distributed throughout the year with two peaks (Bimodal).
- As the sun moves northwards to the Tropic of cancer the rainfall belt also swifts because the air masses are now converging further north of the Equator. The sun is at the tropic of Cancer around June and the northern part of the equator in Africa experiences a rainy season from April up to August.
- The other months of the year experience little or no rainfall.  
The highest temperatures occur just before the onset of rainy season in the Northern hemisphere.
- As the sun continues its journey Southwards beyond the Equator, the rain belt also shifts because the convergence of the air masses is somewhere south of the Equator. The sun is apparently overhead at tropic of Capricorn in December. Therefore, areas south of the Equator like **Harare** in Zimbabwe experience a rainy season from around October to March.

**Human/man's activities:**

Environmental unfriendly human activities like deforestation, bush burning, wetland reclamation, sinking of boreholes, overstocking of cattle, urbanization, industrialization lead to desertification.

However, environmental conservation practices like afforestation, re-afforestation, and conservation of forested areas increase the amount of rainfall and also lower the temperatures.