HAWIKO ACADEMY SECONDARY SCHOOL

GEOGRAPHY STUDENT'S LECTURE NOTE FOR GRADE 10TH IN 2016 E.C

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DODOLA,OROMIA,ETHIOPIA

UNIT ONE
1. LANDFORMS OF AFRICA

1.1 OVERVIEW OF THE WORLD'S MAJOR LANDFORMS

- **Landforms** are physical features on the Earth's surface that form **terrain** of an area.
- Landforms are divided into **two** main categories. These are **Major and Minor** Landforms. **Mountains**, **plateaus**, and **plains** are the **three major** types of landforms.
- **Minor landforms** include **hills, gorges, valleys, and basins.**
- Landforms are formed by **internal and external** processes.
- **Tectonic plate movement and volcanic activities** (**internal processes**) under the Earth can create landforms by **pushing up mountains and hills.**
- Erosion by **water and wind** (**external processes**) can erode land and create minor landforms like **gullies, river valleys and gorges**.
- Both processes happen over a **long period of time**, sometimes millions of years.

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- **For example**, it took a very long period to cut the **deep Abbay Gorge** between the towns of **Goha Tsiyon** in **North Shewa**, **Oromia** and **Dejen** in **East Gojam**, Amhara National Regional State.
- The **Abbay Gorge** thus cuts down about **1000m** deep between the two towns mentioned above.
- The major landforms, mentioned above, are widely distributed on the earth's surface.
- The surface of the Earth is covered by **land and water**. The **landforms** make up **continents** and the **water** forms **oceans**.
- **Continents** are any one of the **largest landmasses** in the world.
- The Earth is divided into **seven** continents, from **largest to smallest** they are; **Asia**, **Africa**, **North America**, **South America**, **Antarctica**, **Europe,** and **Oceania** (**Australia).**

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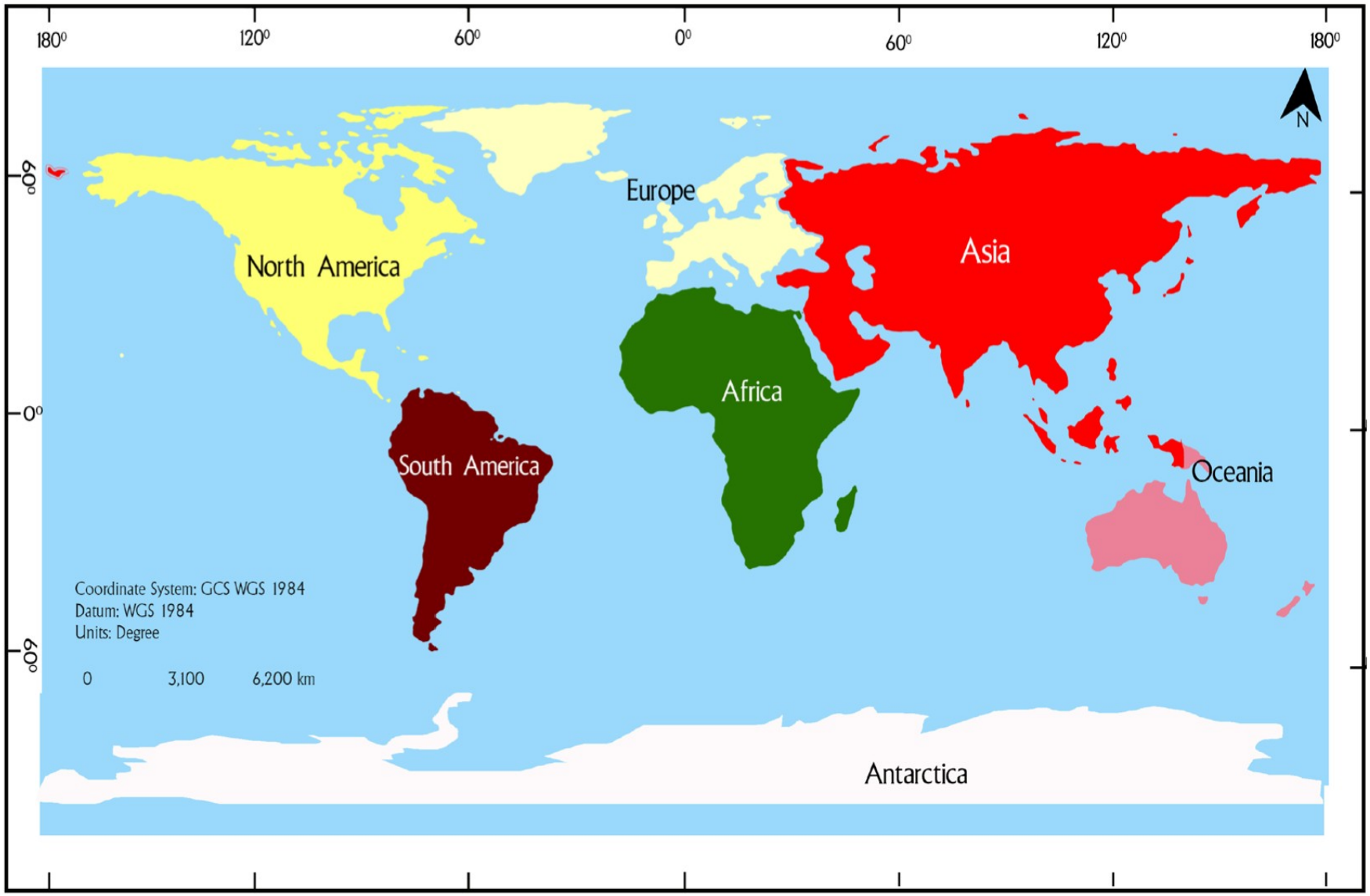

Figure 1.2: Map of the World

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- **Oceans** are large areas of **salt water** between **the continents**.
- Although all the oceans are **connected**, making them one big ocean,
- Oceans are divided into **five** smaller oceans that are separated by **their location** and the **way the water in them moves**. These are includes:
  - **The Arctic Ocean,**
  - **The Atlantic Ocean,**
  - **The Indian Ocean,**
  - **The Pacific Ocean and**
  - **The Southern Ocean.**

- The oceans together **cover huge** areas of the Earth. They cover **71%** of the Earth.
- The **Pacific Ocean** is both the **largest and the deepest ocean**, which covers **one third** of the Earth's surface.

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- Oceans are important **factors** for **creating or forming coastal land features.**
- Some of the **coastal landforms** along the edge of coast are the followings.

1.Island: is a piece of land completely surrounded by water such as ocean,sea,lake or river.

- Islands can be **big or small** in any part of the world.
- The **largest island** in the world is **Greenland**. **Australia** is **bigger** than **Greenland** but it is so big that it is called a **continent** instead of an **island**.

2.Archipelago:is a **group** of **islands** in an **ocean, sea or lake**.

3.Strait:is a **narrow stretch** of **a sea** which connects **two larger areas of water.**

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- The **two** more coastal land features that involve **a little land** and **a lot of water** are **peninsulas, and isthmus**.

4. A Peninsula: is a **piece of land** that has water on **three sides** but it is connected on the **fourth side** to the **mainland**.

- The two well-known **peninsulas** are **Italy and Florida**.

5.Isthmus:is a **narrow strip of land (**with water on both sides) connecting **two larger** areas of land.

- A well-known example is the **Isthmus of Panama** that connects **North America to South America.**

- Thus, the major landforms of the world **create unique areas** where people around the world want to **know, explore, and visit**.
- These landforms generally divide **continents and countries** into different **physiographic divisions**.

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- **Mountains**, **plateaus**, and **plains** are the **three** common major landform types we finds in the world.

I. Mountain

- ✓ **Mountains** are the **largest elevated** and most **recognizable landforms** on the Earth's surface.
- ✓ They have **steep sides**, and **high peaks,** that stand out from the surrounding land.
- ✓ Around mountains, we may find **smaller, less steep landforms** called **hills**.
- ✓ Mountains are usually formed when rock layers are **pushed together** from **opposite sides**.
- ✓ Thus, the pressure exerted from the movement forces the land in the middle to rise.
- ✓ The **low areas** between **mountains** are called **valleys**.
- ✓ Mountains may also be formed by **volcanic activity** when lava and other materials build up on the surface, but mountains are not the only landforms that can be made by volcanoes.

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- The **highest** landform on Earth is **Mt. Everest**. It is a peak in the **Himalaya's Mountain range.**
- It is located between **Nepal and Tibet**. It measures **8,849 meters** above sea level.
- It is part of the **Himalaya Mountain range** that runs across several countries in **South and Southeast Asia** such as **India, Pakistan, Nepal, Bhutan, China, and Afghanistan.**
- The mountain range extends **320 to 400kms** in **width** and **1500 kms** in length.
- The **Himalayas** were formed about **40 to 50 million years** ago when the **Indian tectonic plates** collided with the ***Eurasian plate***.
- Indian tectonic plate and the **Eurasian** plates are **continental crust** and have the same density.
- Landforms can also exist **under oceans** in the form of **mountain ranges and basins**.
- The, **deepest landform** on Earth, is **Mariana Trench which located** in the **South Pacific Ocean**.

- Another major type of landform is **plain**.
- **Plains** are **large areas** of **flat lowland** with **no hills or mountains** in them.
- The **Great Plains** in the **Mid United States** is a good example of a **large** plain.
- **Plains** are very important areas for **crop cultivation and animal husbandry (ranch).**

III. Plateaus

- **Plateaus** are **large areas** of **raised land** that are **flat on top**.
- Plateaus may be formed by **volcanic activity** beneath the earth's surface.
- Sometimes the pressure of the magma beneath is not strong enough to break through the crust and create a volcano, hence, instead, the land is **pushed upwards,** plateaus may stand all by themselves in otherwise flat land or may sometimes be close to other plateaus.

1.2 LOCATION AND RELATED FEATURES OF AFRICA

- Africa lies between **37°21'N** and **34°52'S latitudes** and between **17°33'W and 51°28'E longitudes**.
- The **four** extreme points of the continent, which mark the extreme points of Africa are the following.
  - **Extreme North - Cape Bon (Tunisia) -37°21'N**
  - **Extreme South - Cape Agulhas (Republic of South Africa)- 34°52'S**
  - **Extreme East - Cape Guardafui (Somalia) - 51°28'E**
  - **Extreme West - Cape Verde (Senegal) - 17°33'W.**
- Africa divided into half by the **Equator**.
- In terms of its **relative location**, Africa is a continent that is surrounded by these **major bodies** of water:
  - **The Mediterranean Sea at the South,**
  - **The Indian Ocean at Northwest,**
  - **The Red Sea and the Gulf of Aden at West and**
  - **The Atlantic Ocean at the East and**
  - **The Southern Ocean** in the **North**.

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- With respect to the **major landmasses**, Africa is found to:
- **The South of Europe,**
- **The Southeast of Asia,**
- **The East of the Americas,**
- **The Northwest of Australia and**
- **The North of Antarctica.**
- **Africa** gets closest to **Europe** across the **Strait of Gibraltar,** which is about **22kms** wide between **Morocco and Spain.**
- With relation to **Asia**, the continent comes closest across the **Strait of Bab-el Mandab**, which is about **40kms** wide.
- A narrow stretch of land called the **Isthmus of Suez**, which is **cut into two** by an artificial canal called the **Suez Canal,** connects **Africa with Asia**.
- Africa's **relative location** gives the continent a higher level of **geographical accessibility** to almost all of the continents of the world.
- Africa is the **second largest and second most populous** continent on earth after **Asia** in both cases.
- Africa's **areal size** is **30.37 million Km2**, hence, it covers **6%** of the Earth's **total surface area** and **20%** of the world's **total land area**.
- Africa's total population was estimated to be **1.3 billion** people in **2020**.
- Therefore, Africa accounts for about **17%** of the world's population.

1.3 MAJOR LANDFORMS OF AFRICA

- In Africa there are several recognizable major landforms.

The Importance of Studying Landforms

- Understanding landforms is **very important** because as part of a **landscape**
- Landforms greatly **affect** human **perception and interactions** with the environment.
- Landforms **provide** a **physical context** for describing the **landscape, topography, and ecological units** within the environment.
- Studying landforms helps people to **determine** the **economic potentials** of an area.
- Landforms necessary in order to understand the **temporal and spatial scales of** ecosystems.
- Landforms are **ecologically important** elements because **ecosystems** (which consists of all the **organisms and the physical** environment with which they interact) develop within **landform regions**, and **material and energy flows** occur within the **landform system.**
- It also helps people to understand the **weather patterns** of the **landforms.**
- Landforms also **affect, modify, and influence** climate. The effect can be recognized in both **large areas** as **macroclimate** and **small areas** as **microclimate**.

Effects Of Landforms On Ecosystem Patterns and Processes

- **The main effects of landforms on ecosystem patterns and processes include:**

1. Landform **attributes** (**elevation, steepness of slope, and aspect**(direction in which land surface faces) produce many different patterns which determine the **ecological potential** of an area.
2. Landform regions affect the **flow** of **organisms, energy and material**.
3. Landform regions affect the **spatial pattern** of **non-geomorphic** disturbance by **fire and wind**.
4. Landforms may resist changes that geomorphic processes create; hence they protect **biotic features and processes**.

- In Africa there are **four major landform regions**. These are:
  - **African Alpine System,**
  - **African massif,**
  - **East African Highlands and rift system and**
  - **Southern Africa Platform.**
- Each of these regions contains **8 (eight) major physical regions**:
  - ***Atlas Mountains***
  - ***The Sahara***
  - ***The Sahel***
  - ***The Savanna***
  - ***The Tropical rainforest***
  - ***The Rift Valley and African Great Lakes***
  - ***The Ethiopian Highlands; and***
  - ***A Mountains and desert systems of Southern Africa.***
- The landforms regions also vary in terms of the **area they cover**. Hence, the **African Alpine System** covers a **small area** compared to the

Table 1.1: Major Regions Of Landform In Africa

Major Landform Regions	Physical Regions
African Alpine System	Atlas Mountains
African Massif	The Sahara
	The Sahel
	The Savanna
	The Tropical Rainforest
East African Highlands and Rift System	The Rift Valley and African Great Lakes
	The Ethiopian and Eritrean Highlands
Southern Africa Platform	Mountains and Desert Systems Of Southern Africa

1.3.1 African Alpine System

I. Atlas Mountains: contains a range of mountains in **North Africa** that extends from **Morocco to Tunisia**.

- It forms a series of mountain chains including, the **Anti-Atlas,High Atlas, Middle Atlas, Rif Mountains, Tell Atlas, and Sahara Atlas**.
- The Atlas Mountains covers the largest proportion in the **Maghrib** (meaning '**west'** in **Arabic**) region including **Morocco, Algeria, and Tunisia**.
- The mountain range extends for more than **2,000** kilometers, from the Moroccan port of **Agadir** in the **southwest**, to the **Tunisian** capital of Tunis in the **northeast.**
- The topography of the mountain forms a high divide between the **Mediterranean Sea** in the **north** and the **Sahara Desert** in the **south**.

1.3.2 African Massif

I. The Sahara Desert

- The Sahara is a desert on the African continent.
- With an area of **9,200,000** square kilometers, it is the **largest hot desert** in the world.
- It covers the entire region of **North Africa**, from the **Atlantic coast** in the **west** to the **Red Sea** in the **east**.
- The Sahara encompasses whole or large parts of **ten** countries in **North Africa**. These countries are **Algeria, Chad, Egypt, Libya, Mali, Mauritania, Morocco, Niger, Sudan, and Tunisia**.

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- The **landscape** of the Sahara desert is covered with different types of landforms. These are include:
- **Erg:** a region in a desert where a **large mass** of **sand dunes/sand sea** is **very abundant.**
- **Reg:** a flat plains covered with a **stony and pebbles in** desert. A **rock desert** landscape.
- **Hamada's: hard rocky plateaus** in the Sahara desert which most of the sand has been removed by **wind erosion.**
- **Wadis:** a **valley** that is **usually dry** except during the period of **rain fall. A dry water course in a desert re**
- **Oa** **n a** **ater an**

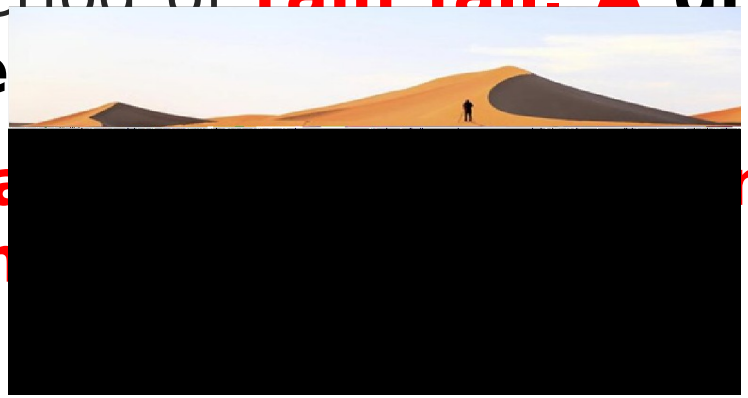



Figure 1. 8: Erg - in the Sahara Desert *Figure 1.9: Reg - in the Sahara Desert*

II. The Sahel

- The **Sahel** is a vast **semi-arid transitional zone** in Africa between the **Sahara** to the **north** and the **Savannas** to the **south.**
- Sahel is an **Arabic** word **(sahil)** meaning **"shore"/ border/ margin**.
- It refers to the **5,000** kilometers stretch of savanna that is the **shore or edge** of the Sahara Desert.
- The Sahel spreads **west** to **east** from **Mauritania and Senegal** to **Somalia.**
- Countries in the **Sahel region** include: **Mauritania, Senegal, Mali, Niger,Nigeria,Burkina Faso, Chad, Sudan and Eritrea**.
- The Sahel lands are **grasslands and savannahs**, with **shrub** areas to the **north**, alternating areas of **trees**, mainly **acacias** in the **south**.

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- The **semi-arid grassland** of the **Sahel** has **natural pasture** (land covered with **grass** and other **low plants** suitable for grazing animals),with **low-growing grass** & **tall herbaceous perennials.**
- Hence, there is plenty of **forage** for the livestock (**camel, pack ox, and grazing cattle and sheep).**
- The landscape of the **Sahel** is similar to the **savanna type**.
- However, it tends to merge into **desert** because of human activities and climate change.
- Thus, due to its **semi-arid** condition and being a transition zone, it is very susceptible to **desertification** and the **climate change**.

III. The Savanna

- The Savanna is a **transitional region** between Tropical **rainforest and the Sahel grassland.**
- The African savanna region is a **tropical grassland** with few **trees and shrubs.**
- **A shrub** is a **woody plant** smaller than **a tree** and has a very **short stem** with branches near the ground.
- It is a **major landforms** of Africa in which many of the **national parks found**.
- The trees in the Savanna region are **drought resistant trees**.
- The **tree and shrub** species in the savanna usually **shed their leaves** during the dry season.
- The **shedding of the leaves** is an adaptation process of the trees to the all year-round hot temperature of the Savanna. This adaptation reduces **water loss** from the plants.

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- Based on vegetation types, the Savanna region has **two** important parts – **woodland and thorn tree tall grass Savana**.
- **In Savana woodland,** the trees are widely spaced because there is not enough **soil moisture** during the **dry season** to support a full tree cover.
- The open spacing lets a dense lower layer where grasses develop.
- The woodland has an **open**, park-like appearance.
- In the tropical savanna woodland of Africa, the trees are of **medium height**.
- Tree **crowns** are flattened or **umbrella-shaped**, and the **trunks** have **thick, rough bark.**
- Some species of trees are **xerophytic forms-**adapted to the **dry environment** with **small leaves and thorns**.
- Others are **broad-leaved deciduous** species that shed their leaves in the **dry season.**
- **Fires** occur frequently in the savanna woodland during the dry season, but the tree species are mostly **fire resistant**.

IV. The Tropical Rainforest

- Tropical rainforests occur both to the **north and south** of the Equator.
- The rainforests near the **equator** are known as **equatorial rainforests**.
- These forests are **very diverse** and contain **large number** of **plant and animal species**.
- **Flora** is **highly diverse** in the equatorial rainforests where a square kilometer may contain as many as **100** different tree species as compared to **3 or 4** in the temperate zone.
- **Broadleaf evergreen** trees dominate the vegetation cover.
- **Six African** countries-**Cameroon,CentralAfricanRepublic, Republic of the Congo, Democratic Republic of the Congo, Gabon, and Equatorial Guinea** makeup the **Congo Basin** of the **Tropical Rainforest.**
- Other areas where the rainforest is found include; **Ghana, Ivory Coast and Madagascar.**

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- The various trees of the tropical rain forests are **closely spaced together** and form a **thick** continuous **canopy** some **25 to 35 meters tall.**
- Sometimes the canopy is interrupted by the presence of very tall trees (up to 40 meters) that have wide buttressed bases for support.
- Most plants are **evergreen** with large, dark green, leathery leaves.
- **Epiphytic and herbaceous** plants as well as vines (lianas) **and ferns** are very characteristic of the tropical rainforest.

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- The rainforest climate is wet all the year or it has a **short dry season**.
- Annual rainfall, which exceeds **2000 to 2250** millimeters, is evenly distributed throughout the year.
- Temperature and humidity are relatively **high** throughout the year.
- Decomposition is rapid in the tropical rainforests because of high temperature and high moisture.
- Meanwhile, due to the frequent and heavy rainfall in the area, tropical soils are subject to **extreme chemical weathering and leaching**.
- These environmental conditions also make tropical soils **acidic and nutrient poor**.

1.3.3 East African Highlands and Rift System

I. The Rift Valley and African Great Lakes.

- The Rift Valley of East Africa was formed by normal **faulting**.
- It was formed as the land stretched by forces moving in opposite direction creating **rupture and splitting** apart the land in between.
- This creates an area called **graben**. This is an **elongated block** of the earth's crust lying between **two faults** and displaced **downward** relative to the blocks on either side in a **rift valley.**

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- The Rift Valley System is a **unique feature** of Africa's physiography.
- It begins from the **Red Sea** and extends through the **Ethiopian l**andmass to the **Lake Victorian** region where it subdivides into an **east and west** segment and continues southward through Lake **Malawi** to **Mozambique.**
- Its **total length** is estimated to be **5,600km**.
- The average width of the Rift Valley System ranges between **32 km and 80 km.**
- The Rift Valley lakes are series of lakes in the East African Rift valley that runs through eastern Africa from Ethiopia in the **north** to Malawi in the **south**, and includes the African Great Lakes in the south.
- Many of the lakes are **freshwater lake** with great biodiversity in them, while others are **alkaline or salty lakes**.

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- The Ethiopian Rift Valley lakes are the **northernmost** of the African Rift Valley lakes.
- In central Ethiopia, the Main Ethiopian Rift, also known as the **Great Rift Valley**, **splits** the Ethiopian highlands into **northwestern and southeastern halves**, and
- The Ethiopian Rift Valley **lakes** occupy the floor of the rift valley between the **two highlands**.
- **Lake Victoria** lies at an elevation of **1,134meters** above sea level, with an area of **68,800** square kilometers is the **largest** lake in Africa.

II. The Ethiopian and Eritrean Highlands

- Ethiopia has some of the most **spectacular** scenery in Africa.
- Much of the country is set on a **high plateau**, with a massive central highland complex of mountains divided by the deep Great Rift Valley and a series of lowlands along the periphery (edges) of the higher elevations.
- The **wide diversity** of terrain produces **regional variations** in **climate, natural vegetation, soil composition, and settlement patterns**.

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- Ethiopia's northwestern highlands extend into Eritrea, reaching elevations of more than 2,000 meters above sea level.
- Eritrea shares the **northeast** section of the Ethiopian high plateau, which in appearance looks more like a set of rugged uneven mountains.
- The plateau, also known as the Northwestern Highlands, rise on the western scarp of the Great Rift Valley and projects northward from Addis Ababa in Ethiopia to the Red Sea coastline in Eritrea.
- It descends to the Red Sea coast in a series of hills.

1.3.4 Southern Africa Platform

I. Mountains and Desert Systems of Southern Africa

- The region of the African continent south of the **Congo and Tanzania** is named **Southern Africa**.
- This landform region has a very **diverse landscape**.
- It includes **escarpment, mountains, grassland and desert landscapes**.
- The **Tropic of Capricorn** runs straight through the middle of the region, indicating that the southern portion is outside the tropics or there is a **temperate** part in the region.
- The **Ukhahlamba(Drakensberg)** escarpment is the most **recognizable** landscape in the region.
- The average altitude of the escarpment is almost **3,000m** above sea level.

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- **Two** important deserts form large part of **southern Africa**.
- The first one is the **Kalahari Desert**, which lies mainly in **Botswana**.
- It is an extensive desert region with an arid mixture of grasslands and sand.
- When there is adequate rainfall, the grasslands provide excellent grazing for wildlife.
- The Kalahari is home to **game reserves and national parks**.
- The second is **Namib Desert**, found along the west coast of **Namibia.**

➢ It is a desert land affected by the **cold ocean current** of **Benguela** that borders the area.

➢ Hence, the Namib desert was formed partly because of the **cold ocean current nearby.**

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- The **Highveld** is the portion of the South African inland plateau.
- The Highveld is home to some the South Africa's most important commercial farming areas.
- The continuation of the Great Escarpment to the south separates the Highveld from **KwaZulu-Natal.**
- The southeastern portion of the Great Escarpment or the **UKhahlamba (Drakensberg)** forms the boundary between **KwaZulu-Natal and Lesotho**.

UNIT TWO
2. CLIMATE OF AFRICA

2.1 OVERVIEW OF WORLD CLIMATIC REGIONS AND TYPES

- **Weather:** the condition of the atmosphere in one place for a **short period of time.**
- **Climate:** is an average of weather conditions in a place over a **long period** of time– 30 years or more.
- It represents the sum of all interacting atmospheric processes over a given period of time.
- **Climatic zones:** the divisions of the earths climates into general climate zone according to average **temperature and rainfall.**
- The Climate zones are areas with distinct climates, which occur in the **east-west direction** around the Earth, and they can be classified using different climatic parameters.
- **Climatic region:** refers to a continuous geographic area in which similar climate characteristics are observed.
- Average **temperature** is the most important factor in determining climate regions of the world, although other weather aspects like **precipitation** play roles.
- **Global climate** is a description of the climate of the Earth as a whole, with all the regional differences averaged.

2.1.1 Climate Classifications

- **Climate Classifications: the** system of **grouping climates** of the world in order **to enhance** the **scientific understanding** of climates.
- Geographers and scientists use different criteria to classify climate into different types and regions. The criterion could be **temperature, natural vegetation precipitation, humidity, or location.**
- Climate classifications help people know **what types of conditions** a region usually **experiences** throughout the year.
- knowing a regions climate useful when choosing building materials for protection and **durability,** or when considering what crops are likely (or unlikely) to thrive in a region.
- For tourists, knowing a location's climate classification can help them **select and pack** appropriate clothing.
- There are various classification schemes used by climate scientists for categorizing world's climate into different regions. However the **two** most important **systems** of world climate **classification** are.
- **The ancient Greeks classification system and**
- **The Koppen's classification system.**

1. The Ancient Greeks Climate Classification System

- The **Ancient Greeks,** perhaps, made the **first** attempt to classify the world climate.
- The basis for the Greek classification is **temperature and sunshine** within **latitudinal boundaries.**
- This system divides the world into **three** climatic zones which include;

  1. The Low-Latitude Tropical (Torrid) Zone

  2. A Middle-Latitude (Temperate) Zone

  3. The High-Latitude Polar (Frigid) Zone

- NB: The ancient Greeks' system is some what **simplistic method** of climatic classification because it does not consider **precipitation**, and therefore it does not differentiate between **wet and dry region.**

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- Since the beginning of the **20thC**, however, many climate-classification schemes have been devised.
- Long-term records of **temperature and precipitation** reveal climate patterns across continents, delineating them into climate regions.
- Class names for classification systems based on **weather patterns** often include **geographical names** such as **polar, tropical, continental, and marine**.
- These terms are modified by terms describing **temperature and moisture**, or the intensity of weather during **summer or winter**.
- The descriptors that are used in this method of classification include **moist or dry, warm or cold, and temperate or severe.**
- Today, climate scientists split the earth into approximately **five major types**: **tropical, dry, temperate, continental, and polar** considering a variety of factors including **altitude, air pressure, wind patterns, latitude and geographical characteristics such as mountains and oceans.**

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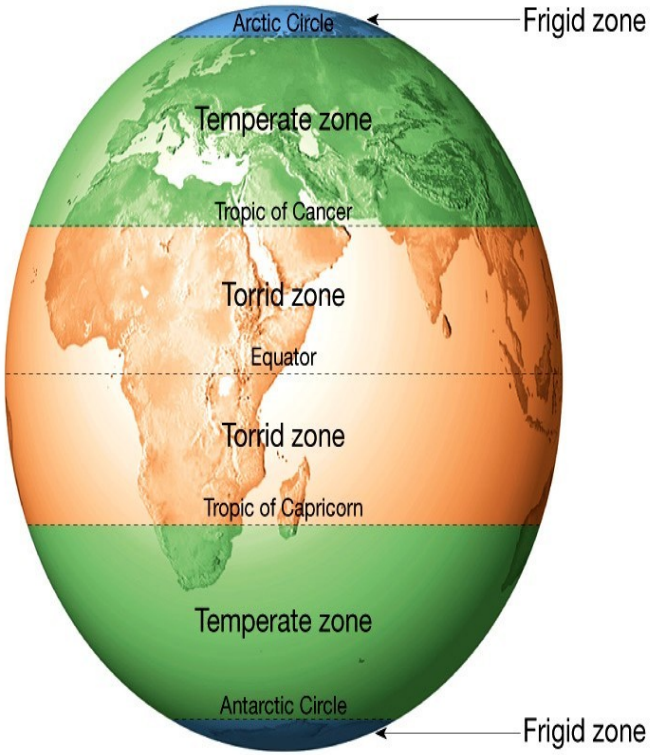

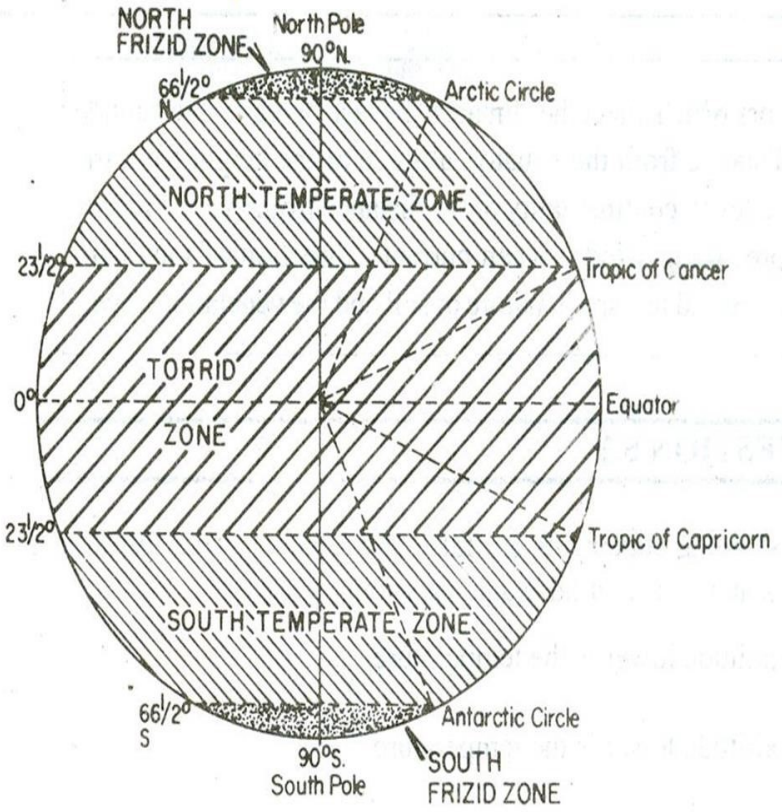

Figure 2.1: World Climate Zones According to Ancient Greeks

2. The Köppen Climate Classification System

- The most **popular and widely** used classification schemes is made by the **German Climatologist and Botanist Wladimir Köppen (1846-1940).**
- He divided the world's climates into categories based upon **temperature and precipitation** their combined **interaction** with **vegetation zones.**
- **Koppen (1936)** divided the world climate into the following **6 principal** groups, each type is designated with a **capital letter**:
  - **A (humid tropical),**
  - **B (dry),**
  - **C (humid middle-latitude, mild winters),**
  - **D (humid middle-latitude, severe winters),**
  - **E (polar), and**
  - **H (highland).**

➢ **Four groups (A, C, D, E)** are defined by **temperature**. The **fifth (group B),** has **precipitation** as its primary criterion.

2.1.2 World Climate Zones and Regions

- Climate zones are areas with distinct climates, which occur in the east-west direction around the Earth, and they can be classified using different climatic parameters.
- Generally, climate zones are **belt-shaped** and **circular around** the poles.
- In some areas, climate zones can be interrupted by **mountains or oceans.**
- The world's climate pattern reflects a regular and dependable operation of the **major climate controls**.
- The differences in the **suns heating power** cause different climate zones on earth.

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- There are **four** major global climate zones:

  1. Tropical Zone

- It Lies between the **Tropic of Cancer (0°– 23 $^{1}/_{2}$ N)** and **tropic of Capricorn (0°– 23 $^{1}/_{2}$ S**).
- The solar radiation reaches the ground on different parts of the Earth at different angles.
- On the **equator**, the sunlight reaches the ground **nearly vertically** at noontime during almost the entire year , whilst at the **poles** the angle of the Sun is lower or even under the horizon during the **polar night**.
- Tropical Zone is characterized by;
- High **angle of the Sun** almost throughout the year,
- **High temperature**,
- High humidity and
- Has equal **day and night length**.

2. Subtropics Zone

- It Lies between the **23.5°– 40°.**
- The Subtropics Zone is characterized by; receiving high radiation in summer, whilst the cloud cover is relatively thin.
- These regions receive **less moisture** (see trade winds), which increases the effect of radiation.
- Therefore, most of **the deserts** in the world are situated in this zone.
- In **winter,** the radiation in these regions decreases significantly, and it can temporarily be **very cool** and **moist.**

3 . Temperate Zone

- It Lies from **40°– 60°.**
- Temperate Zone is **characterized** by;
  - **Low** angle of **the Sun**,
  - **Low temperature**,
  - **Seasonal variation** of lengths of **day and night,**
  - More **regular distribution** of the **precipitation** over the **year.**
  - Less frequent **extremes of climate** and
  - A **longer** vegetation period – therefore, it is named as **“temperate”**.

4. Cold Zone

- It Lies from **60°– 90° .**
- The **Cold Zone** is **characterized** by;
  - Receiving **less heat** through **solar radiation**,
  - **Low angle** of the Sun,
  - **Significant variation** in **length of days**, and
  - **Low level** of **vegetation growth**.
  - The conditions in these regions make life very **challenging**.
- The characteristics of the **climate zones** change with **great altitude** differences within a **small area**, like in **mountain areas**, since temperatures **decrease** rapidly with **altitude**.

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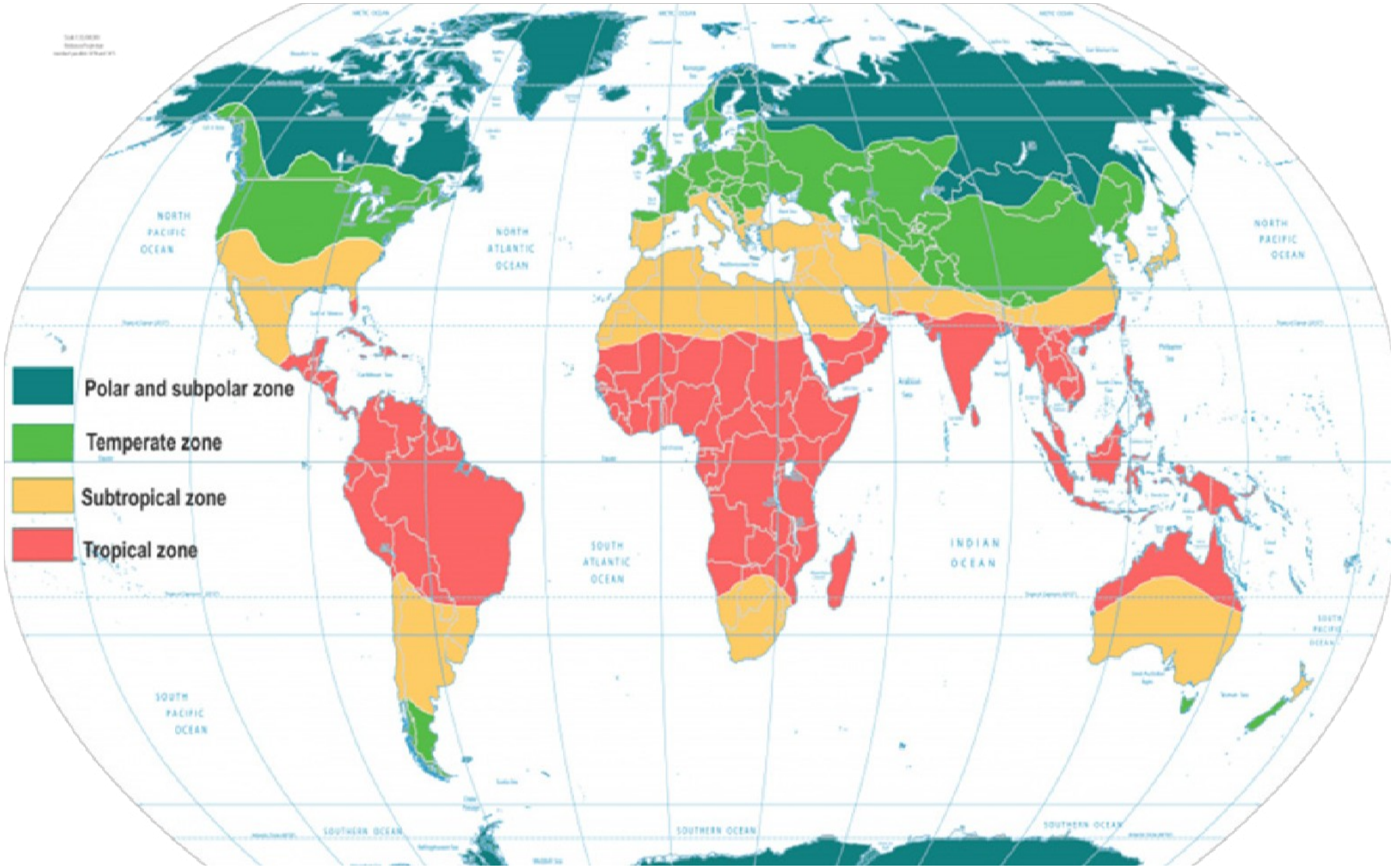

Figure 2.3: World Climate Zones

2.2 CLIMATE TYPES AND ZONES OF AFRICA

- **A climatic region** is a geographical area with more or less similar climatic characteristics mainly of **temperature and rainfall**.
- The climate of Africa is characterized by **great diversity**.
- The continent has different types of climate over its vast area.
- Africa's position across **equatorial and subtropical latitudes** in both the **northern and southern hemispheres**, different climate types can be found within it.
- Africa is the most **tropical** of all the continents.
- The climate of Africa is regulated by the apparent movement of the Sun between the two tropics (Tropic of Cancer and Tropic of Capricorn) and the associated **movement of winds**.

2.1 Types and Characteristics of Climate Zones in Africa

- The movement of **air masses** and **their effects** provide the basis for a division of the continent into **eight climatic regions**. These are:
  - **The Equatorial Climate;**
  - **The Tropical Wet-And-Dry Region;**
  - **The Semi-arid Climatic Region;**
  - **The Hot Desert Climatic Region;**
  - **The Mediterranean Climate;**
  - **The Warm Temperate East Coast climate;**
  - **The Warm Temperate Continental climate and**
  - **The Mountain Climatic Region.**
- The details of the types and characteristics of each climate zones are presented below.

1. The Equatorial Climate Region

- The equatorial climate is experienced in the lowland area between latitudes **5°N** and **5°S** of the equator.
- This climatic region is dominant in **Central and Western Africa.**
- This covers mainly parts of **Central Africa** which includes the **Democratic Republic of Congo, Gabon and Cameroon**.
- It is also experienced in the **Southern part** of **Western Africa** which includes the **Nigeria, Ghana, Benin and Sera Leone.**

➢ The Equatorial Climate is **characterized** by;

- It is the **wettest Climatic** region in Africa
- **Very high temperatures** throughout the year averaging about **26°C**, the **hottest months** in the year are **March and September** when the sun is overhead at the **equator.**
- The **diurnal temperature range** is **very low**, about **3°C**.
- There is often **heavy cloud cover** and the **humidity** is **high** throughout the year.
- This region mainly receives **convectional** type of rainfall.

2. The Tropical Wet-and-Dry Climate Region

- This climatic region is found between **5° and 15° north and south** latitudes.
- The tropical wet-and-dry region is often called the **savanna climatic** region;
- It is the **transitional** zone between the **equatorial** and the **desert** climatic regions of Africa.
- This climatic region is found in many parts of **Western and Southern Africa** and in most of **Madagascar.**
- The Tropical **Wet-and-Dry Region** is characterized by;
  - It covering **very large** half of the total surface area of the continent.
  - It has **seasonal character** of its rainfall and temperature.
  - It has double passage of the ITCZ, hence has

3. Semi-arid Climatic Region

- This region **fringes** the desert areas and include the greater part of the land south of the **Zambezi River.**
- They differ from **true desert** regions in being just within reach of the **ITCZ** in the course of its **seasonal movement** and therefore **receiving** more rainfall.
- Temperatures are about the same as those in the **desert regions.**

4. The Hot Desert Climatic Region

- Hot deserts are places where there is **little or no rainfall**.
- They are the **hottest and driest** parts of the continent.
- The hot desert region consists of the **Sahara and Kalahari** deserts, which are always under the influence of dry continental tropical air masses, .
- In addition to aridity, the desert climate is characterized by **high mean monthly temperatures;**
- The diurnal (daily) temperature range is, however, **greater than** the annual range of the **mean monthly**.
- The daytime temperatures are **extremely high** usually range between **30ºC-40ºC,**
- Some places in the Sahara Desert experience above **40°C**, the highest ever recorded temperature in the region, and also in the world, was **58°C** in **Azizia, Libya**.
- At **night**, temperatures are **very low**, dropping to below **10º C**.
- The **skies are clear** and because of this, the heat received from the sun during the day is quickly lost back into the atmosphere at **night**.

5. Mediterranean Climate Region

- This climate is also called **Warm Temperate Western Margin Climate**
- This type of climate prevails on the **western margins** of the **continent** between **30º-45º North and South** Latitudes.
- It is experienced in **very small areas** of the continent.
- In Africa such climate region is found in the **northern and southern tips of the Maghreb (Atlas)** region in the **north** and the **Cape Province of South Africa** in the **South**.
- The Mediterranean climate is best developed on the shores of the Mediterranean Sea.
- Temperatures in the Mediterranean climate region range from **10º C** in **winter** to about **21º C** in **summer**.
- These areas have **sunny, hot and dry Summer** and **cool** to **mild wet Winters**.
- The average amount of **rainfall** each year is about **500-750mm.**

6. The Warm Temperate East Coast Climate Region

- The climate is experienced between latitudes **30º - 40º North and South** of the Equator.
- It is experienced along the **Eastern coast of South Africa**, especially in **Natal and Cape Provinces**, as well as in **Mozambique**.
- These areas are under the **strong influence** of the **warm Mozambique ocean current** and the warm **southeast trade winds.**
- **Summer temperatures** are generally **high** with an average of about **26ºC.**
- **Winter temperatures** are **low**, averaging about **10ºC**.
- **Annual rainfall** is between **1000-1500mm** per year but it decreases as one moves **westwards** into the interior.

7. Warm Temperate Continental Climate Region

- This climate is mainly experienced in the interior of **South Africa**, between the **Drakensberg Mountains** and the **Kalahari Desert**.
- The **rainfall amount** is generally **low** because the area is inland and the winds blowing from the sea reach here when they are already dry.
- Most of the rain falls during the **winter season** and averages about **700mm** per year.
- The **Eastern areas** are wetter than those in the West which are close to the **Kalahari Desert**.
- The annual temperature ranges from about **26ºC** in summer to about **10ºC** in **winter**.

8. The **Highland (**Mountain) Climatic Region

- This climate region includes the **high mountain areas** of **Kenya, Ethiopia,** the lakes region of **East Africa**, the higher parts of **South Africa** (the **Drakensberg mountain** region) and the **Atlas mountains** region of **Northern Africa.**
- The Mountain Climatic Region is characterized by;
  - **Temperate type** of climate;
  - **Cool temperature** and **small annual ranges** of temperature.
  - Some areas are covered by **permanent snow**, as on **Kilimanjaro and Kenya** mountains.
  - The area receives **more rainfall** than the surrounding areas.
  - It mostly receives **Orographic (relief) rainfall**, formed as the warm moist winds are forced to rise up the highlands.
  - **Windward part** of the mountains **receives high rainfall**,
  - **Leeward Parts** receive **no rainfall** or referred to as '**rain shadow' slopes**.
  - Climate modified by **altitude.i,e** Temperature **decreases** with an **increase** in altitude.
  - At the very top of **high mountains**, temperatures are **below freezing point**.

2.2.2 Factors Controlling Climate of Africa

- There are several factors that influence the climate of the African continent. These includes: **latitude, Pressure Systems, Winds, and the Intertropical Convergence Zone (ITCZ),major ocean currents, land and water (maritime versus continental) influence, and altitude**.
- These factors determine the amount of temperature and precipitation. Below is the description of each one of the factors.

1. Latitude and its influence on Solar Radiation received

- Africa straddles the Equator from 37º N to 34º S, hence it lies within the tropics.
- Variations in the receipt of solar energy and temperature differences are largely a function of latitude.
- Temperature is high throughout the continent because of the continent's location relative to Equator.
- As latitude increases, the sun shines more obliquely and provides less energy.
- The equator, however, faces the sun's rays directly, so the climate is warm year-round.

II. Pressure Systems, Winds, and the Intertropical Convergence Zone (ITCZ)

- Located on about Latitude 30º North and South of the Equator are Sub-tropical HighPressure Belts that dictate surface wind patterns and influence rainfall and temperature regimes on the continent.
- The Subtropical High-Pressure Systems on both sides of the Equator generate two wind systems that converge on the equator in a zone termed as Inter-Tropical Converge Zone (ITCZ).
- From the north, Subtropical High-Pressure Belt zone blows the Northeast Trade Winds (locally called Harmattan).
- The Harmattan is dry and cool and blows over Sub-Saharan Africa from about November to April.
- From the south Sub-tropical High Pressure belt zone blows the Southwest Trade Winds (locally called Monsoon).

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- The Monsoon winds are moist and bring rainfall to the coasts of West Africa.
- The African continent does not extend much beyond 35º of latitude from the equator.
- The implication is that the range of climatic conditions is limited and that the general direction of wind movement is towards the equator (or in more accurate terms towards the inter-tropical convergence zone - ITCZ).
- The ITCZ shifts with the seasonal movement of the sun across the tropics:
- In June: the northern summer season, the ITCZ is located at about 13 degrees of latitude in North Africa at the southern boundary of the Sahara.
- In December, the Northern winter season, the ITCZ moves southward along the West African Coast and to the northern and eastern margins of the Congo basin and continues to Madagascar.
- Movements in the ITCZ are closely related to the distribution of rainfall and climatic zones.
- The climatic zones assume symmetry around the equator, although the high altitudes in some parts of the continent and the adjacent disturb the symmetry

II. Major Ocean Currents

- Winds that tend to blow persistently over the ocean tend to drag a thin surface layer of the water in their direction of flow.
- This layer of ocean water called Ocean Current dictates the temperature and moisture characteristics of the wind and the coastal regions over which the wind blows.
- When ocean currents blow from low latitudes (near to the equator) towards higher latitudes (towards the pole) the currents carry Warm ocean water into relatively cool regions. Such an ocean current is called Warm Ocean Current.

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- Warm Ocean Currents supply moisture to winds blowing over them to develop rainfall on the adjacent coasts.
- In Africa, Warm Ocean Currents include Warm Guinea Currents - in West Africa, Warm Mozambique Currents – in Southeast Africa.
- The cool surface of Cool Ocean Currents causes moisture in winds blowing over them to condense and form fogs, etc.
- The winds are deprived of their moisture so they tend to absorb rather than deposit moisture at the adjacent coasts.
- Cool currents, therefore, cause dry conditions and in Africa the Cool Canary Currents- the western coast of the Sahara Desert, the Cool Benguela Currents – the Western coast of Kalahari Desert.
- The cool ocean currents tend to create rich fishing grounds. Rich fishing grounds exist along the Morocco and Spanish Saharan Coasts that are washed by the Cool Canary Currents. The Namibian coast that is washed by the Cool Benguela current also has rich fishing grounds

V. Distribution of Land and Water

- Large water bodies such as the Ocean and huge lakes modify climates in adjacent lands.
- In the continental interior, where there are no large bodies of water, temperatures get very warm in summer or during the day.
- The land is solid, so it heats up more rapidly during the day.
- The compact nature of the land means that only a thin surface gets heated.
- As a result, heat absorbed into the thin layer of surface rocks is released very rapidly.
- The land surface is, therefore, very cool at night and in winter.
- The interior location does not also allow rainfall to reach such places thereby creating warm, humid, hot and dry climates.
- These extremities in climate affect all states located in the interior of continents. Such climates are called Continental Climates as against Maritime Climates experienced on lands located along coasts.

- In places such as Timbuktu in Mali the diurnal and annual ranges in temperature are very high because of continentality. Places near to the sea coast have low range of temperature & high humidity.
- The interiors of the continent have high temperature & experience wide range of temperature.
- Climates whose temperatures are influenced greatly by the sea are called Maritime /Oceanic Climate/.
- Climates whose temperatures are influenced greatly by remoteness from the sea are called Continental Climate

V. Altitude

- Since energy from the sun is transformed into heat on the surface of the earth, air temperature decreases with altitude at an average rate of 6.4ºC per 1000 meters.
- This change in temperature with altitude is called the Lapse Rate.
- Because of this decrease in temperature with height, mountainous regions such as the Ethiopian highlands have very cool temperatures.
- Very high peaks such as Mountain Kilimanjaro located along the equator even have permanent snow cover
- While these factors help to account for the broad climatic patterns of African continent, there are nevertheless numerous local variations to be found from place to place within the same climatic zone.

2.3 BENEFITS OF CLIMATE FOR LIFE OF PEOPLE OF AFRICA

- Africa is a continent with a diversity of climate landscapes.
- It has a climate that ranges from intense heat to bitter cold in its different parts.
- This diversity in turn influences the living style of people including settlement patterns, livelihood options, resource endowments, health ,and wellbeing.
- The relationship between climate, physical resources ,and socio-economic condition of people in Africa is briefly presented in the following section.

2.3.1 Climate and Agriculture in Africa

- It is indisputable that agriculture is the backbone of Africa's economy and accounts for the majority of livelihoods across the continent.
- Agriculture is an extremely important sector on the African continent, on average accounting for 70% of the labor force and over 25% of the Gross Domestic Product (GDP).
- Agriculture has always been deeply dependent on the weather, with farmers needing a steady mixture of sun, warmth, and rains to reliably produce the crops they need.
- The bulk of agricultural systems in Sub-Saharan Africa are highly climate-dependent: the region is marked by a strong dependence on rain-fed agriculture and natural resources.
- Africa is one of the continents that are most highly affected by climate change for two reasons: its geographical characteristics of having a major land lying across the warming tropics, and the limited human, social, and economic capacity that African countries have to adapt to the impacts of climate change.
- A change in a climate, therefore, exacerbates the complexity of issues (such as few technological inputs, the majority of Africa's farmers working on a small-scale or subsistence level and have few financial resources, limited access to infrastructure, and, etc.) in the continent.

2.3.2 Climate and Health in Africa

- Climate change has widespread effects on human health by impacting both environmental and social determinants.
- Humans have understood the importance of climate to human health since ancient times.
- In some cases, the connections appear to be obvious.
- For instance, a flood can cause drownings, a drought can lead to crop failure and hunger, and temperature extremes pose a risk of exposure.
- In other cases, the connections are obscured by complex or unobserved processes, such that the influence of climate on a disease epidemic or a conflict can be difficult to diagnose.
- In reality, however, all climate impacts on health are mediated by some combination of natural and human dynamics that cause individuals or populations to be vulnerable to the effects of a variable or changing climate.
- Africa is commonly described as a "**climate-vulnerable**" continent in which rainfall variability, hydrological extremes, and anthropogenic climate change have the potential to inflict significant harm on a large population.

2.3.3 Climate and Water Resources in Africa

- Water is the most important of all natural resources.
- Without water ,life would not be able to thrive on the Earth.
- It has been argued that the level of streams, flow of streams/rivers, the volume of underground water and the like all depend on types of climates and water availability.
- Therefore, persistent climate change may lead to shrinkage in the surface-water supply as well as the quantity and regularity of streams and rivers, and water supplies in Africa.

2.4 CLIMATE CHANGE AND ITS CHALLENGES TO AFRICA'S DEVELOPMENT VISION

- In many cases climate variability and climate change are interchangeably used.
- However, there is a clear demarcation between the two. Variability may be due to natural internal processes within the climate system or to variations in anthropogenic (caused by human) external forcing.
- In other words, climate variations occur with or without our actions.
- It is critical to assess precisely which human actions affect climate and those that do not.
- Climate change, on the other hand, is a change in the state of the climate system, identified by changes in the average conditions and the variability of its properties, that persists for an extended period, typically decades or longer, due to natural and/or anthropogenic processes and drivers.

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- Climate change in Africa is an increasingly serious threat for Africans as Africa is among the most vulnerable continents to climate change.
- Anthropogenic climate change is already a reality in Africa, as it is elsewhere in the world.
- According to the Intergovernmental Panel on Climate Change (IPCC), the vulnerability of Africa to climate change is driven by a range of factors that include weak adaptive capacity, high dependence on ecosystem goods for livelihoods, and less developed agricultural production systems.
- The risks of climate change on agricultural production, food security, water resources and ecosystem services will likely have increasingly severe consequences on lives and sustainable development prospects in Africa.

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- Most studies on the potential impact of climate change have predicted that Africa is likely to experience higher temperatures, rising sea levels, changing rainfall patterns and increased climate variability, all of which could affect much of its population.
- The actual and potential impacts of climate change in Africa are large and wide-ranging, affecting many aspects of people's everyday lives.
- Many climate models predict negative impacts of climate change on agricultural production and food security in large parts of Sub-Saharan Africa (SSA).
- Higher temperatures, the drying up of soils, increased pest and disease, shifts in suitable areas for growing crops and livestock, desertification, floods, deforestation, and erosion are all signs that climate change is already happening.
- Therefore, this indicates that climate change is one of the greatest environmental, social and economic threats facing Africa.
- The impact of climate change is more serious on the world's poorest countries, most of which are found in Africa.
- Poor people already live on the frontlines of pollution, disaster, and degradation of resources and land.

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- For them, adaptation is a matter of sheer survival. Unfortunately, despite growing concern, no exact and reliable figures are available to quantify the economic costs of the negative impacts of climate change in Africa for either individuals or society as a whole.
- As far as development is concerned, climate change will have a strong impact on Africa's ability to achieve the Millennium Development Goals (MDGs) and the Africa 2063 goal and on its development policies in general, with increased pressure on agriculture, water supply and demand, health, and political stability.
- In general, African has been seriously affected due to the following reasons.
- First, the African society is very closely coupled with the climate system, hundreds of millions of people depend on rainfall to grow their foods.
- Second, the African climate system is controlled by an extremely complex mix of large-scale weather systems.
- Third, the degree of expected climate change is large.
- The two most extensive land-based end of- century projected decreases in rainfall anywhere on the planet occur over Africa, particularly in North and South Africa.
- Finally, the capacity for adaptation to climate change is low

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