# UNIT TWO

## CLIMATE OF ETHIOPIA

### Introduction

Climate plays a crucial role in determining the distribution of plants and animals, which in turn influences agricultural activities, and the materials available for shelter and clothing. Understanding climate is vital for recognizing the environmental conditions that shape various aspects of life.

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1. **Meaning of Weather and Climate**
2. **Elements of Weather and Climate**
3. **Controls of Weather and Climate in Ethiopia**
4. **Climatic Regions and Seasonal Variations in Ethiopia**
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### 2.1 Meaning of Weather and Climate

**Key Terms:** Climate, Weather

**Learning Objectives:**

- Recognize the meaning and concepts of weather and climate.
- Define weather and climate.
- Describe the difference between weather and climate.

**Explanation:**

- **Weather** refers to the short-term atmospheric conditions in a specific place, including temperature, rainfall, pressure, wind, moisture, cloud cover, and humidity. Weather can change from hour to hour or day to day.
- **Climate**, on the other hand, refers to the long-term patterns of weather in a particular area. It includes the average conditions as well as trends, fluctuations, and variations that occur over time.

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### 2.2 Elements of Weather and Climate

**Key Terms:** Air pressure, Precipitation, Cloud cover, Temperature, Humidity, Wind

**Learning Objectives:**

- Identify and define the elements of weather and climate.
- Differentiate the elements of weather and climate from their controls.

**Explanation:**

Weather and climate are composed of several key elements:

- **Precipitation:** Any form of water, liquid or frozen, that falls from the atmosphere, such as rain, sleet, hail, and snow.
- **Temperature:** The degree of hotness or coldness measured on a specific scale.
- **Humidity:** The concentration of water vapor in the air.
- **Air Pressure:** The force exerted by the weight of air in the atmosphere.
- **Wind:** The movement of air caused by differences in air pressure, usually due to the uneven heating of the Earth's surface.
- **Sunshine:** The amount of direct sunlight a given area receives.
- **Cloud:** A visible mass of water droplets or ice crystals suspended in the atmosphere.

These elements vary across different locations and times due to various controlling factors.

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## 2.3 Controls of Weather and Climate in Ethiopia

**Key Terms:** Altitude, Mountain barriers, Distance from the sea, Ocean currents, Latitude

**Explanation:**

Ethiopia's diverse climate is influenced by several physical factors known as climate controls. These include:

- **Latitude:** Refers to the angular position of a place relative to the equator. In Ethiopia, being located within the tropical zone results in high temperatures, significant daily temperature variations, and small annual temperature ranges.
- **Altitude:** Elevation significantly influences temperature. Higher altitudes generally experience cooler temperatures. For example, cities at different altitudes, such as Addis Ababa, Bako, and Awash, have different temperatures despite being on the same latitude.
- **Mountain Barriers:** Mountains can affect the distribution of rainfall. The windward side receives more rain, while the leeward side (rain shadow) gets less.
- **Revolution of the Earth and Inclination of the Earth's Axis:** The tilt of the Earth's axis and its revolution around the sun cause seasonal variations, affecting the climate throughout the year.
- **Distance from the Sea:** Areas closer to large bodies of water tend to have moderated climates due to the slower heating and cooling of water compared to land.
- **Ocean Currents:** Warm and cold ocean currents can influence the climate of coastal regions by raising or lowering temperatures. However, this factor is less significant in Ethiopia.

**Note:** In Ethiopia, altitude and latitude are the dominant climate controls.

## 4.2. Seasonal Variation in Ethiopia

Ethiopia experiences significant seasonal variations in both temperature and rainfall, primarily influenced by its geographical location, altitude, and the movement of global atmospheric systems like the Inter-Tropical Convergence Zone (ITCZ). These variations have a profound impact on agriculture, water resources, and overall living conditions in the country.

### *4.2.1. Seasonal Variation of Temperature*

Temperature variations in Ethiopia are closely linked to altitude and the Earth's axial tilt, resulting in distinct seasonal patterns:

- **High Temperatures:**
  - The hottest period typically occurs between **March and June**, coinciding with the end of the dry season and the onset of the main rainy season (Kiremt). During this time, temperatures can soar, particularly in the lowland areas such as the Afar and Somali regions.
  - **Peak Temperatures:** The western, northeastern, and southeastern lowlands often experience the highest temperatures, with some areas exceeding 30°C.
- **Low Temperatures:**
  - The coldest period is generally observed from **November to February**, during the Bega season (dry season). This period is characterized by clear skies and cooler temperatures, especially in the highlands.
  - **Cold Spots:** The high-altitude areas, including the Semein Mountains and the Arsi-Bale range, experience significantly lower temperatures, sometimes dropping below freezing at night.
- **Diurnal Temperature Range:**
  - During the Bega season, there is a notable difference between daytime and nighttime temperatures, especially in the highlands. Clear skies during the day result in warm temperatures, while rapid cooling occurs at night due to the loss of heat, leading to chilly nights.

### *4.2.2. Seasonal Variation of Rainfall*

Rainfall in Ethiopia varies significantly across different regions and seasons, influenced by the movement of the ITCZ and other atmospheric systems:

- **Spatial Variation of Rainfall:**
  - Ethiopia's rainfall patterns are highly diverse, ranging from regions with year-round rainfall to areas that receive only seasonal precipitation. The spatial distribution of rainfall is influenced by factors such as altitude, proximity to the equator, and the presence of mountain ranges.
- **Temporal Variation of Rainfall:**
  - Ethiopia has two primary rainy seasons:
    - **Kiremt (Main Rainy Season):** Occurs from **June to August**, primarily affecting the western and central highlands. This season is crucial for agriculture as it provides the bulk of the annual rainfall needed for crop production.
    - **Belg (Short Rainy Season):** Occurs from **March to May**, mainly impacting the southern and southeastern regions. This season is important for the planting of certain crops, especially in areas that rely on two growing seasons.
- **Dry Season (Bega):**
  - The Bega season, from **October to February**, is generally dry across much of the country, with minimal rainfall. This season is marked by cooler temperatures, especially in the highlands, and is often a period of water scarcity.

### *4.2.3. Rainfall Regions of Ethiopia*

Ethiopia can be divided into distinct rainfall regions based on the timing and amount of rainfall received:

1. **Year-Round Rainfall Region:**
    - **Location:** Southwestern plateau, including Wollega, Kafa, and Gamo Gofa.
    - **Rainfall Characteristics:** This region receives consistent rainfall throughout the year, with annual totals ranging from 1,400 mm to 2,200 mm. The reliable rainfall supports dense forests and agriculture.
2. **Summer Rainfall Region:**
    - **Location:** Northwest Highlands and Western Lowlands, represented by areas like Debre Markos and Bahir Dar.
    - **Rainfall Characteristics:** The majority of the rainfall occurs during the Kiremt season, driven by the Equatorial Westerlies and Easterlies. Annual rainfall ranges from 1,000 mm to 1,800 mm.
3. **Autumn-and-Spring Rainfall Region:**
    - **Location:** Southeastern Highlands and adjacent lowlands, including regions like Gode and Jigjiga.
    - **Rainfall Characteristics:** Rainfall is received during both the Belg and Meher seasons, with totals ranging from 500 mm to 1,000 mm. The region often experiences erratic rainfall, making agriculture challenging.
4. **Winter Rainfall Region:**
    - **Location:** Eastern escarpment of the western highlands and the Afar region.
    - **Rainfall Characteristics:** Limited rainfall occurs during the Bega season, mainly due to the influence of the Northeast Trade winds. Annual totals are generally low, often less than 500 mm.

This seasonal and regional variability in temperature and rainfall significantly influences the livelihoods of Ethiopia's population, particularly in terms of agriculture, water availability, and disease patterns. Understanding these patterns is essential for effective planning and management of resources in the country.

## 4.5 Measurements of Weather and Climate

Understanding and measuring various elements of weather and climate is crucial for predicting weather patterns and understanding climate behavior. Here are the key instruments and methods used for measuring and recording different climatic elements:

### *A. Measuring and Recording Air Temperature*

- **Temperature** is a fundamental element of climate and weather. The instrument used to measure temperature is a **thermometer**.
    - A thermometer consists of a narrow glass tube filled with mercury or alcohol.
    - **How It Works:** Mercury expands when heated and contracts when cooled. The scale on the thermometer indicates the temperature, usually in Celsius (°C) or Fahrenheit (°F).
    - **Scales:**
        - **Celsius (°C):** Freezing point is 0°C, and the boiling point is 100°C.
        - **Fahrenheit (°F):** Freezing point is 32°F, and the boiling point is 212°F.
    - **Calculations:**
        - **Mean Daily Temperature:** Calculated by adding the maximum and minimum temperatures of the day and dividing by 2.
        - **Daily (Diurnal) Range of Temperature:** The difference between the daily maximum and daily minimum temperature.
        - **Mean Monthly Temperature:** Determined by averaging the daily temperatures of a month.

        - **Mean Annual Temperature:** Calculated by averaging the mean monthly temperatures over a year.
        - **Annual Range of Temperature:** The difference between the temperatures of the hottest and coldest months of the year.

***B. Measuring and Recording Rainfall***

- **Rainfall** is measured using a **rain gauge**.
    - **How It Works:** A rain gauge is anchored in the ground with the top about 30 cm above the surface to prevent splashing. Rainfall is measured by reading the depth of water collected in the container, usually at 9:00 a.m. daily.
    - **Calculations:**
        - **Mean Monthly Rainfall:** Calculated by summing daily rainfall amounts for the month and dividing by the number of days in the month.
        - **Total Annual Rainfall:** Calculated by adding the monthly rainfall totals for the year.
        - **Mean Annual Rainfall:** Determined by averaging the annual rainfall amounts over a period of 30-35 years.

***C. Measuring and Recording Air Pressure***

- **Air Pressure** is the force exerted by the weight of air on the Earth's surface. It is measured using a **barometer**.
    - **How It Works:** A barometer measures the height of a mercury column in millimeters (mm) or the pressure in millibars (mb).
    - **Standard Air Pressure:** At sea level, the standard pressure is 1013.25 millibars or 760 mm of mercury.

***D. Measuring and Recording Wind Speed***

- **Wind Speed** is measured using an **anemometer**.
    - **How It Works:** An anemometer is held above the head, allowing the cups to rotate freely. The speed at which the cups rotate indicates the wind speed.

***E. Measuring and Recording Wind Direction***

- **Wind Direction** is the direction from which the wind is blowing. It is typically measured using a **wind vane**.
    - **How It Works:** A wind vane points in the direction from which the wind is coming. For example, a westerly wind blows from the west towards the east.

These measurements provide valuable data for understanding weather patterns and predicting future climate behavior. By regularly recording and analyzing this data, meteorologists can make informed forecasts and contribute to the study of climate science.