CHAPTER 6 WORLD CLIMATES

Objectives

After studying this chapter, students will be able to:

- describe the various types of world climates;
- describe the various climatic classifications;
- define climate change and describe the causes and effects of climate change;
- describe current efforts at mitigating the effects of climate change.

6.1 Major Climatic Types of the World

There are several climates in the world and they may be grouped into four major categories with each of the four major groups having its own sub-group. The groupings are shown below:

(a) The Hot Climates (found between latitudes 30^0N and 30^0S)

(i) Equatorial climate
(ii) Tropical continental
(iii) Tropical monsoon
(iv) Hot deserts

(b) The Warm Temperate Climates (found between latitude 36^0N and 45^0S)

(i) Warm temperate western margin or Mediterranean
(ii) Warm temperate eastern margin

(c) The Cool Temperate Climate (found between latitude 45^0N and 50^0N)

(i) Cool temperate western margin
(ii) Cool temperate continental
(iii) Cool temperate eastern margin

(d) The Cold Climates (found between latitudes 50^0N and beyond)

(i) Cold temperate or boreal
(ii) Tundra
(iii) Polar climate

The Hot Climates

1. The Equatorial Climate

(a) Location: This climate is located between Lat 5^0N and Lat 5^0S of the Equator.

(b) Areas

(i) Amazon Basin of South Africa
(ii) The Zaire Basin of Central Africa
(iii) The Coasts of West Africa
(iv) Parts of Columbia (South America), Malaysia, Burma, Java and New Guinea (Asia)

(c) Characteristics of Hot Climate

(i) The temperatures are constantly high throughout the year with a mean monthly temperature of about 27^0C.
(ii) The daily range of temperature is between 6^0C and 8^0C while the annual range of temperature is about 3^0C.
(iii) The relative humidity is high and is over 80% which makes people to feel 'sticky'.

(iv) Rainfall is generally high and well distributed throughout the year and is between 2000mm and 2200mm.

(v) There is the presence of large amount of clouds in the sky.

(vi) In this type of climate rainfall is experienced virtually all year round as there is hardly any month which do not experience rain.

(vii) Dry season is virtually non-existent due to the prevalence of rain.

(viii) The rainfall is convectional and characterized by torrential or heavy downpours with thunder and lightning that often occur in late afternoons.

(ix) The climate generally experiences two periods of maximum rainfall which occurs just after the equinoxes (March and September).

(x) This climatic belt is under the influence of moisture laden off-shore winds. This is one of the reasons why rainfall is constant throughout the year.

(xi) This climate is marked by intermittent (occasional) rain showers. This is as a result of the meeting of air masses at the Doldrums (the low pressure belt found along the Equator).

(xii) Along rugged topography, relief rainfall is most common.

2. Tropical Continental Climate

(a) Location: This climate is found between latitudes 5^0 and 15^0 north and south of the Equator.

(b) Areas

(i) West and Central Africa where it is known as Sudan climate

(ii) Brazil (South America)
(iii) Guyana and Venezuela
(iv) Queensland (Australia)

(c) Characteristics of Tropical Continental Climate

(i) It is marked by dry and wet seasons
(ii) The temperatures are hot all the year round with a mean annual temperature of 32^0C while the annual range is around 11^0C. It decreases as one moves from the equator.
(iii) Days are usually hot but nights are cold due to the prevalence of cloudless skies.
(iv) Rainfall is usually concentrated in the wet season which usually runs from October to March in the southern hemisphere and April to October in the northern hemisphere.
(v) The annual rainfall is about 879mm and it is convectional.
(vi) The length of the rainy season and the annual rainfall decreases with distance from the Equator.
(vii) The wet season is hot with a mean temperature of 21^0C.
(viii) Humidity is high especially in summer when the rainy season is at its peak.
(ix) The climate is controlled by the North East Trade winds.
(x) Sunshine is available all year round due to its closeness to the Equator.

3. Tropical Monsoon Climate

(a) Location: It is found between latitudes $23\frac{1}{2}^0$N and $23\frac{1}{2}^0$S of the equator.

(b) Areas

(i) India, Pakistan, Bangladesh, Sri Lanka, Burma, Thailand, Vietnam, Southern Chine (Asia)

(ii) North-East Australia

(c) Characteristics of Tropical Monsoon Climate

(i) Temperatures are high during the hot, dry season that comes up between March and May with a mean temperature of about 32^0C.

(ii) The dry season is cool between November and February with the mean temperatures at about 25^0C.

(iii) During the wet season, the temperatures are hot between June and October, while the mean temperature is about 30^0C.

(iv) The annual range of temperature is about 9^0C.

(v) There is marked variation in the annual rainfall and this is due to the effect of aspects and relief.

(vi) The majority of rainfall that falls in this climatic belt is experienced during the rainy season which occurs between June and October.

(vii) During the wet season, winds blow from on-shore to the inland and is reversed during dry season when winds blow from the land to the sea which results into little or no rain.

(viii) The monsoon winds may be described as the occurrence of the land and sea breezes.

(ix) Humidity rises to its peak during June to October when the wet season is in operation.

(x) This climatic belt experiences a phenomenon known as the 'burst of land' which means that little rain is experienced in

May and heavy rain occurs in the following month of June. The increase in rainfall is sporadic.

4. Hot deserts

(a) Location: It occurs mostly on the western sides of large land masses under the influence of permanent trade winds. The only place outside this belt is North Africa which runs from the west coast through the continent down into South-West Asia. This location is so because the trade winds influence the eastern part of North Africa are blowing from the landmass of Southwest Asia and they are therefore dry in nature and dust-laden since they blow over deserts. Specifically, they blow over areas within latitudes 15^0 and 30^0 north and south of Equator.

(b) Areas: It occurs within the following areas:

(i) Sahara Desert (North Africa)
(ii) Great Australian Desert (Australia)
(iii) Iranian Desert (Middle East/Persian Gulf)
(iv) Arabian Desert (Middle East)
(v) Thai Desert (Asia)
(vi) Mexican Desert (Mexico)
(vii) Atacama/Peruvian Desert (South America)
(viii) Ethiopian Desert (East Africa)

(c) Characteristics of Hot Desert

(i) Temperatures are usually high throughout the year with a mean annual temperature of 31^0C. This can be directly attributed to a clear, cloudless sky, intense insolation and a

high rate of evaporation that is a common feature in this climate.

(ii) The daily range of temperature is very high due to the increasing distance from the coast and is usually between 16^0C and 23^0C. This can also be as a result of the rapid loss of heat by radiation after sunset.

(iii) Hot desert have much lower temperatures along the coast than the interiors due to the influence of the ocean currents especially the cooling effect of the cold currents.

(iv) Occasional rainfall is often experienced and are in the form of violent thunderstorms associated with convectional rainfall.

(v) The interior parts of the hot deserts experience severe aridity (dry conditions) as a result of the long distance from the coast.

(vi) Rainfall are low and unreliable usually not exceeding 260mm in a year.

(vii) The relative humidity is extremely low usually below 60% in coastal areas to less than 30% in the interior.

(viii) The prevailing trade winds in this climate blow from cooler to warmer regions.

(ix) The hot deserts occur mostly in the tropical high pressure belts where air is subsiding. Such air absorbs moisture rather than yielding due to the influence of the cold currents blowing along the coast. Most of the winds blowing over deserts originate from cooler regions and when crossing the desert the winds get hotter and this prevents condensation. This is in contrast to on-shore winds which sometimes affect the west costs of desert belts. Such winds get cooled and

condensation takes place resulting in fog or light showers. The winds become dry and on reaching warm land surface gets drier still.

(x) Daily range of temperatures are also high.

5. Warm Temperate Western Margin or Mediterranean Type

(a) Location: It occurs in the interior of continents, excluding Asia, between latitudes 20^0N and 35^0N and 20^0S and 35^0S.

(b) Areas: It can be found in the following places

(i) Coastlands of the Mediterranean Sea

(ii) Central California (USA)

(iii) Central Chile (South America)

(iv) Cape Province of South Africa

(v) South and Southwest Australia (Murray Darling Lowlands)

(c) Characteristics of Warm Temperate Western Margin or Mediterranean Type

(i) The mean annual temperature is about 19^0C.

(ii) Temperature varies significantly from 23^0C in the summer which is usually hot and dry to below 10^0C in the winter which is warm and wet.

(iii) The annual range of temperature is about 9^0C.

(iv) The annual rainfall of this climatic belt ranges between 550mm and 770mm with most of it concentrated in winter.

(v) Rainfall distribution varies from place to place depending on factors such as relief, continentality and the passage of cyclones.

(vi) Rain occurs in torrential, heavy or copious showers only on few days mixed with sunny periods between them.

(vii) Fogs often occur off the coast in winter when most of the rain is experienced especially in places along the coast of California and Chile.

(viii) Relative humidity is usually higher during winter when most of the rain occurs while it is low in summer.

(ix) Off-shore winds usually blow in summer while on-shore westerly winds dominate in winter.

(x) In addition to trade and westerly winds, other winds such as hot and cold local winds operate (hot siroccos) winds which blow in the summer across the Mediterranean Sea from the Sahara Desert while the cold Mistral winds blow in winter down the Rhine valley towards the Mediterranean coast and the local wind – Bora blows in winter across the former Yugoslavia towards the Adriatic Sea.

6. The Warm Temperate Eastern Margin (China Type)

(a) Location: This climate is located on the eastern side of continents between latitudes 23^0N and 35^0N, and 23^0S and 35^0S of the Equator.

(b) Areas: This climate can be found in:

(i) Central China

(ii) Southern Japan

(iii) South-east Australia

(iv) South-eastern Africa

(v) Southern Brazil

(vi) South-eastern USA

(c) Characteristics of Warm Temperate Eastern Margin

(i) The mean annual temperature is about 18^0C.

(ii) The summers are generally hot with a mean temperatures of about 28^0C.

(iii) Winters are usually mild and clement (fair) with a mean temperature of about 14^0C.

(iv) The annual range of temperature is about 27^0C.

(v) Annual rainfall ranges between 645mm and 1650mm.

(vi) The climate is associated with a fairly uniform distribution of rainfall throughout the year save for places such as central China where there exists a distinct dry season.

(vii) Rainfall are both of convectional and orographic (relief) types.

(viii) Both on-shore and off-shore winds blow over this climatic belt.

(ix) Some of the local winds common in this climatic belt are usually in operation during summer and they include the typhoons in southern China and hurricanes in south-eastern USA.

(x) Most of the local winds are developed by depression (places of high pressure belts) such as Pampero (Argentina) and southerly burster (Australia) and they are strong winds.

7. The Cool Temperate Western Margin (the British Type)

(a) Location: This climate occurs on the western sides of continents between latitudes 45^0N and 60^0N and 45^0 and 60^0 south of the equator.

(b) Areas: The climate is best developed in the following places:

(i) Northwest Europe
(ii) British Columbia (Canada)
(iii) Southern Chile (South America)
(iv) Tasmania (Australia/Oceania)
(v) South Island of New Zealand (Oceania)

(c) Characteristics of Cool Temperate Western Margin (the British Type)

(i) The climate has a mean annual temperature ranging from 5^0C to 17^0C.

(ii) The mean temperature varies as it is about 17^0C in summer, while during winter, it is about 7^0C.

(iii) The annual range of temperature is between 7^0 and 13^0C.

(iv) Rain is well distributed throughout the year with the maximum peak being experienced during the winter.

(v) The total amount rainfall varies between 550mm and 2600mm.

(vi) The rainfall types experienced in this climatic belt are the cyclonic (frontal) and orographic (relief) rainfall.

(vii) The climate is characterized by dense cloud cover, sunshine and frequent weather changes on a daily basis.

(viii) The relative humidity is high throughout the year but it is higher during winter when there is high rainfall.

(ix) The prevailing on-shore winds operates throughout the year and are mainly the south-westerly winds in the northern hemisphere and north-westerly winds in the southern hemispheres.

(x) Their climate belt has equable, warm summers and mild winters.

8. Cool Temperate Eastern Margin Climate (Laurentian Type)

(a) Location: This climate occurs on the eastern sides of North America and Asia between latitudes 35^0N and 50^0N and on the eastern side of South-America, south of latitude 45^0S.

(b) Area: It is best developed in the following places:

(i) Maritime Provinces of Eastern Canada

(ii) The states of New England of U.S.A

(iii) Northern China

(iv) Manchuria

(v) Korea

(vi) Northern Japan

(c) Characteristics of Cool Temperate Eastern Margin Climate (Laurentian Type)

(i) The mean annual temperature is about 9^0C.

(ii) The temperature during summer range from 17^0C to 26^0C while the winter temperature range between -7^0C to -10^0C.

(iii) Winters are cold such that surface water bodies and the sub-soil is frozen for a greater part of the year.

(iv) The annual range of temperature is high usually from 22^0C to 32^0C.

(v) Rainfall is well distributed over the year and falls every month even though it is more experienced during the summer.

(vi) Annual rainfall ranges from 625mm to 1060mm.

(vii) The rainfalls are of both convectional and cyclonic types.

(viii) Relative humidity is generally high throughout the year but is much higher in summer months where there is heavy concentration of rainfall.

(ix) The prevailing winds blowing over this climatic belt are varied while cold winds blow seawards from the interior at winter, and thereby causes low temperatures, also on-shore summer winds bring rain to all parts of the climatic belt.

(x) The climatic belt has similar characteristics with northeast Asia which is of a typical monsoon wind pattern, that is, of seasonal wind reversal.

9. The Cool Temperate Interior or Continental Climate

(a) Location: This climate occurs in the interior of the continent in the mid-latitudes. Specifically it occurs within the interior of North America and Eurasia between latitudes 35^0N and 60^0N.

(b) Areas: It is best developed in places such as:

(i) The Provinces of Manitoba, Alberta and Saskatchewan Canada

(ii) The North-central and Mid-west of USA

(iii) Central and Eastern Europe

(iv) Western USSR (now Russia)

(c) Characteristics of Cool Temperature Interior or Continental Climate

(i) It is a climate of extremes as a result of the distance of the places from the sea.

(ii) It has a mean annual temperature of about 6^0C.

(iii) The summer temperature is 19^0C while winter temperatures often fall below -11^0C.

(iv) The winters are very cold, long and severe with most rivers usually frozen including the ground surface as they are covered by snow for over six months. Summers on the other hand are warm.

(v) The annual range of temperature is high as a result of continentality, that is long distance from the sea.

(vi) Rainfall is light and occurs during spring and early summer.

(vii) The rainfall is of the convectional type and ranges from 420mm to 640mm depending on the location.

(viii) The relative humidity is high especially during summer when there is heavy rainfall.

(ix) The prevalent winds in this climatic belt are the cold polar air and warm maritime air.

(x) Rainfall decreases towards the extreme west in North America and also decreases towards the eastern extreme.

10. The Cold Temperate Continental (Siberian or Sub-Arctic or Boreal Climate)

(a) **Location:** This climate occurs between latitudes of 50^0 and 65^0 north of the Equator. It is conspicuously absent in the southern hemisphere because of the narrow nature of southern continents especially within the high latitudes.

(b) **Areas:** The climate can be found in the following places:

(i) Canada and Northern Newfound land
(ii) Norway
(iii) Sweden
(iv) Finland
(v) Northern Russia and Siberia

(c) **Characteristics of Cold Temperature Continent**

(i) It has a long cold winter period and a brief cool summer.
(ii) The belt has a mean annual temperature of about 7^0C.
(iii) The warmest month is July, with a mean temperature of about 22^0C while the coldest month in January is with about -13^0C.
(iv) The annual range of temperature is about 32^0C.
(v) The summers have longer days while the winters have shorter days.
(vi) The annual rainfall range between 390mm and 660mm.
(vii) The rainfall is well distributed throughout the year.
(viii) In winter, the precipitation is in the form of snow while mean temperature are well below the freezing point virtually all the time.
(ix) The rainfall is mainly of the convectional type.
(x) The climate is influenced by prevailing winds such as westerlies, temperate monsoons and cyclones.

11. The Tundra Climate

(a) Location: This climatic belt lies between Lat 65^0N and the fringe of the great polar ice desert.

(b) Areas: The climate can be found in places such as:

(i) Northern Canada and Alaska (North America)

(ii) The coastal strip of Greenland

(iii) The Arctic Seaboard of Eurasia (Europe)

(c) Characteristics of Tundra Climate

(i) The climate has a mean temperature of about -6^0C.

(ii) The winter is long and the temperature ranges between -30^0C to -42^0C.

(iii) The summer has a mean temperature of about 12^0C.

(iv) The summer is short but often very warm.

(v) The annual range of temperature is high due to continentality and usually range between 25^0C and 28^0C.

(vi) Winter nights are long without daylight while summer days are long without any night.

(vii) Rainfall is generally light and falls in summer month while precipitation is in form of snow in winter.

(viii) The ground is permanently frozen and the soils are thin and of few centimeters below the surface.

(ix) Relative humidity is always low because of low temperatures.

(x) The westerlies are strongest in the summer months while the climatic belt is under the influence of the high pressure belt of the arctic region which brings in the dry northerly winds.

12. The Polar Climate

(a) Location: It lies north of latitude $22\frac{1}{2}^0$N which is the Arctic Circle.

(b) Areas

This climate is found in the interior of Iceland, interior of Greenland and Antarctica.

(c) Characteristics of Polar Climate

(i) Temperatures in this climatic belt are permanently below 0^0C.

(ii) Temperatures in the summer months are generally low, often below -22^0C.

(iii) Temperatures in winter are also very low usually below -62^0C.

(iv) The annual range of temperature is usually high.

(v) Precipitation is mainly in the form of snow.

(vi) This climatic belt is characterized by a terrible snow-storm called a **BLIZZARD**. The strong cold winds of a blizzard often carry masses of powdery snow or ice crystals which reduces visibility considerably.

6.2 Climatic Classification

There are several climates in the world as seen from the last section. In order for us to understand them better it is better to classify them into specific groups. Over the years, several types of classifications has been derived. However, there are two basic classifications namely:

(a) Greek system

(b) Koppen's system

The Greek System

The Greeks were involved in the classification of climates. The scheme they developed divided the whole world into three climatic zones on the basis of temperatures. The various climatic zones include:

(i) Torrid or Hot: These are areas that are within the tropics that experiences intense heat.

(ii) Frigid or Very Cold: These fall into areas of excessive cold both in the Arctic and Antarctic regions.

(iii) Temperate or Mild: These areas lie between the torrid and frigid zones which are neither too hot or too cold.

The Greek classification scheme, simple as it is, has been found to be inadequate for the following reasons:

(i) It is rather too simple.

(ii) It ignores some vital climatic factors such as latitude, altitude, prevailing winds, vegetative cover and ocean currents all of which are known to have great impact on climates worldwide.

It was on the basis of the shortcomings of the Greek system that the Koppen's classification scheme was devised.

The Koppen's Scheme

This scheme was devised by a German botanist, Dr Vladimir Koppen in the 19th Century who attempted to explain the variations of the Earth's climate by examining the connection between vegetation and climate. The basis of Koppen's classification is vegetation.

Koppen's classification was developed in 1918 and it consists of five major climatic groups. Each group was coded alphabetically namely:

A Tropical rainy climates, with no month cooler than 180C.

B Dry climates in which potential evaporation exceed annual precipitation.

C Warm temperate, rainy or humid megathermal climates with the coldest month below 18^0C but above -3^0C.

D Cool temperate or microthermal climates with the coldest month below -3^0C and warmest month below -3^0C and warmest month above 10^0C.

E Polar or ice climates with the warmest month below 10^0C

Koppen went further to add secondary letters to the above letters in order to differentiate between sub-divisions within the five major groups. The secondary letters and what they stood for are:

f - adequate rain all months

F - ice cap with perpetual frost

s - summer dry months

S - Steppe with 360 – 760mm rain in low latitudes

T - Tundra

w - Winter dry season

W - Desert with less than 250mm rain per year

A third letter was added later to include information about temperature thus:

a - hot summer with warmest month greater than 22^0C

b - warm summer with less than 22^0C

c - cool, short summer, with only four months greater than 10^0C

d - very cold winter with less than 38^0C

h - dry, hot with mean annual temperature greater than 18^0C

k - dry cold with less than 18^0C

The above letters are grouped together and ascribed to appropriate climatic belts e.g.

BW - Hot desert-climate and vegetation
BS - Steppe climate and vegetation
BWK - Cool desert climate
Dfe - Cold, snowy forest climate with cool, short summer

Merits of Koppen's Scheme

1. It is simple to comprehend.
2. It is quantitative in that it used numbers to define the boundaries of climatic groups.
3. It makes it easy to ascribe a given place to a particular climatic sub-group on the basis of temperature and precipitation.

Demerits of Koppen's Scheme

1. It contains some inconsistencies in that it uses mean temperature for A, C, D and E climatic zones, whereas zone B is based on precipitation-evaporation ratio.
2. It is not comprehensive enough as it did not take into account the climates of mountainous regions and regions affected by fog.
3. The boundaries of Koppen's climatic types are rather too empirical.
4. It is rather too simple for it to be used and is rather confusing.

In spite of the limitations, the Koppen's climatic classification system has been used in the study of several climates especially West African climates.

6.3 Concept of Climate Change

In recent times, there has been world-wide concern as to the extent to which climates in the world have been experiencing considerate and significant changes and its effects on the Earth, living things and man especially. This concern has led several countries of the world to focus their attention and resources on how to mitigate and reduce the effects of these changes on their citizens and environments.

Climate change may be defined as a significant and far-reaching difference between two mean climatic states or climatic normal with its attendant impact on the world's ecosystem. Put simply, climate change is the difference in the state of climate of a particular place within two or more time periods spanning over 35years. In climate change, emphasis is on significant departures from a normal climate on monthly, seasonal or annual basis. In Nigeria, in analyzing climate change, the attention will be on changes recorded in the state of the Nigeria climates which are quite different from what it was about 35 years ago.

Causes

Attempts have been made at identifying the specific causes of climate changes in the last thirty-five years. Several reasons have been adduced for this phenomenon, some of which are:

1. Changes in the distribution of land and water surfaces as a result of the influence of some human activities such as agriculture, construction, urbanization, industrialization, land reclamation, etc.
2. Increased green-house effect as a result of the emission of toxic gases such as chloro-fluoro carbon into the atmosphere which are capable of having negative impacts on the atmosphere.

3. Depletion of the ozone layer as a result of the emission of effluents and pollutants which led to the increase in temperatures all over the world. This phenomenon is called ***global warming***.
4. Indiscriminate destruction of forest resources leaving the ground surface bare of vegetation and affecting the functioning of the ecosystem with its attendant problems.
5. Increase in the rate of atmospheric pollution due to industrialization, flaring of gases, emission of carbon monoxide from automobiles all of which have had negative and serious impact on the environment and has changed the pattern of the climate all over the world.
6. Destruction of the ecosystem by mining activities, sinking of boreholes, road construction, etc. all of which combine to affect the operations of the climate.

Effects

The effects of climate change are many, some of which are:

1. There has been a consistent increase in temperature distribution which is felt in virtually every part of the world. This phenomenon is referred to as **global warming**.
2. Increase in the patterns and distribution of rainfall such that some places in the Earth's surface have experienced large scale flooding due to increase in the amount of rainfalls. In 2012, Nigeria experienced massive flooding due to increased rainfall.
3. Melting of ice caps as a result of global warming and differential heating. This has led to flood incidents, massive erosion, loss of lives and properties etc.
4. Increased incidents of desertification following high temperatures, high evaporation and transpiration that has led to the destruction of

vegetation and increased threats of desert encroachment can be directly traced to incidents of climate change.

5. The incidents of climate change has brought about the emergence of diseases and ailments such as cancer, eye cataracts, diarrhea, water-borne disease, etc. all of which are capable of killing people within a short time and over a large area.
6. The occurrence of climate change has led to the submergence of coastal cities following the incidents of flooding experienced in several countries in recent years due to increase rainfall. In Nigeria, due to increased flooding several towns and cities became submerged for some time such that there were reported cases of loss of lives and properties.
7. Climate change has also led to the extinction of some plants and animals particularly during the occurrence of environmental hazards such as flooding and the practice of some human activities such as lumbering, mining, road construction, urbanization, etc. which involve large scale destruction of plant and animal species.

Remedies

Several solutions have been put forward and executed as a step toward limiting the effects of climate change and they include:

1. Establishment of government agencies to manage and prevent the effects of climate change on people.
2. Establishment of forest reserves and other forms of reforestation schemes aimed at replacing trees that has been destroyed through the effect of climate change.
3. Mounting of enlightenment programmes aimed at educating people about the negative effects of climate change.

4. Practice of population reduction through the adoption of birth control and family planning methods. Through this, less people are affected by the ravages of climate change.
5. Carbon emission through automobiles and industrialization should be discouraged and reduced to a bearest minimum by ensuring that durable vehicles using biofuels that will not pollute the environment are used. Also industries must be sanctioned whenever they engage in acts that will amount to atmospheric pollution.
6. Modern cars that consume gas and biofuels should be imported to the country so that air pollution will be reduced and the negative effects of climate change are avoided.
7. Legislation should be made to curb certain human practices that encourage the negative effects of climate.

Summary

- There are several climate types in the world depending on criteria such as location, their attributes and scope.
- The various types of climates in the world can be classified into categories based on criteria such as vegetation, weather elements, etc.
- Two climatic classification schemes adopted are the Greek and Koppen's climatic classification schemes.
- Major climatic types in the world can be grouped into four categories: hot climate, warm temperate climates, the cool, temperate climates and The cold climates.
- The Greek system of climatic classification recognizes three climatic belts: torrid (hot), temperate (mild) and frigid (very cold) on the basis of temperature.
- Koppen's classification of climate is based on vegetation and involved the use of an alphabetical code namely A, B, C, D and E

which is used to refer to each of the five major climatic groups. secondary letters are used to refer to the subdivisions within each group. Both the Greek system and Koppen's system of climatic classification have their strengths and weaknesses.

Objectives Questions

1. The four seasons in temperate latitudes are caused by
   A. rotation of the Earth.
   B. revolution of the Earth.
   C. the movement of the sun in space.
   D. the varying position of the sun.
2. Convectional rainfall is caused by
   A. mountains. B. cold air. C. ocean currents. D. heating.
3. Orographic rainfall is caused by
   A. heating. B. mountains. C. cold air. D. ocean currents.
4. Cirrus, cumulus, stratus and nimbus are types of
   A. frost. B. fog C. cloud. D. dew.
5. A line of equal temperature is called an
   A. isotherm. B. isohyets. C. isobar. D. isoneph.
6. Deserts are classified by having
   A. 254mm or less of rain. B. high temperatures.
   C. 100mm or less of rain. D. 50mms or less of rain.
7. Which of the following conditions numbered I-IV would exist in both tundra and cool temperate types of climate?
   I. Precipitation throughout the year
   II. A cold season of 9 months below freezing
   III. Forests with needle leaves
   IV. Evergreen forest
   A. I and II only B. II only C. I and III only D. I and IV only

8. Which of the following is the odd one out in a consideration of the factors controlling natural vegetation?

   A. Temperature B. Rainfall C. Atmosphere D. Soil

9. Which climatic belt is associated with the eucalyptus, olive and orange?

   A. Mediterranean type B. Laurentian type C. Steppe type D. Chine type

10. Swamp forest is found in the coastal areas of many parts of

    A. Chile B. Eastern Australia C. China D. West Africa

Essay Questions

1a. Briefly describe the Koppen's classification of climate.

b. Give three limitations of this classification system.

2a. Give two differences between equatorial climate and tropical continental climate.

b. State two similarities between Mediterranean climate and hot deserts.

3a. Describe the characteristics of the tropical continental climate.

b. Outline the main features of the vegetation type associated with the climate.

4a. Enumerate the important features of the Koppen's system.

b. Mention three advantages of this system.

5a. Briefly describe the Greek's classification of climate.

b. Why is the system not popularly accepted?