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GEOGRAPHY: 15

## CLIMATE AND DIFFERENT WORLD CLIMATES

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## 1] Introduction

Climate holds an important place in our own life. Our life and various economic activities (agriculture, industries, commerce, etc.) are affected by climate. Climate has also an important place in physical geography. Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Any independent study of each of these elements does not present any comprehensive view of climate. On the basis of these elements, there could be thousands of types of climates in the world.

## 2] Climate & Weather

The *difference* between weather and climate is that weather consists of the short-term (minutes to months) changes in the atmosphere while climate is the average of weather over time and space. In most places, weather can change from minute-to-minute, hour-to-hour, day-to-day, and season-to-season. Climate, however, is the average of weather over time and space.

### 2.1 Comparison between Weather and Climate

	Climate	Weather
<b>Definition</b>	Describes the average conditions expected at a specific place over a long period of time. A region's climate is generated by the climate system, which has <b>five components</b> : atmosphere, hydrosphere, cryosphere, land surface and biosphere.	Describes the atmospheric conditions at a specific place at a <b>specific point in time</b> . Weather generally refers to day-to-day temperature and precipitation activity
<b>Components</b>	Climate may include precipitation, temperature, humidity, sunshine, and wind velocity, phenomena such as fog, frost, and hail storms over a long period of time.	Weather includes sunshine, rain, cloud cover, winds, hail, snow, sleet, freezing rain, flooding, blizzards, ice storms, thunderstorms, steady rains from a cold front or warm front, excessive heat, heat waves and more
<b>Forecast</b>	By aggregates of weather statistics over periods of 30 years	By collecting meteorological data, like air temperature, pressure, humidity, solar radiation, wind speeds and direction etc.
<b>Determining factors</b>	Aggregating weather statistics over periods of 30 <sup>1</sup> years.	Real-time measurements of atmospheric pressure, temperature, wind speed and direction, humidity, precipitation, cloud cover and other variables.

<sup>1</sup> NCERT mentions 50 years but according to WMO it is 30 years.

Time period	Measured over a long period	Measured for short term
Study	Climatology	Meteorology

## 2.2 Importance of Climate and Weather

The influence of climate and weather can be seen in day to day activities of human beings. Forces of nature have regulated to a very great extent the sort of food we eat, what we wear, how we live and work. Conditions of temperature, precipitation and humidity may promote or discourage the growth of fungus and diseases which may be injurious to both men and crops. Today, our activities are becoming more and more dependent upon meteorological services. Meteorological stations are set up all over the globe to provide weather updates and predict future conditions. A fair knowledge of the weather is not only useful but often essential.

## 2.3 Elements of climate

There are various environmental elements which have *significant influence* on the climate of a region. Among them, *temperature, pressure, precipitation and winds* are the most important because of their far reaching global influence. These elements are affected in different manner by the following climatic factors: *latitude, altitude, continentality, ocean currents, insolation, prevailing winds, slope and aspect, natural vegetation and soil.*

## 2.4 Factors affecting climate

**Latitude:** Due to the earth's inclination, the mid-day sun is almost overhead within the tropics but the sun's rays reach the earth at an angle outside the tropics. Thus, temperature diminishes from equatorial regions to the poles.

**Altitude:** Earth's atmosphere is mainly heated through conduction from the surface, so places near the surface are warmer than those higher up. Thus temperature decreases with increasing height above sea level. This rate of decrease in temperature with altitude (*lapse rate*) is never constant, varying from place to place and from season to season. However, for all practical purposes, it may be reckoned that a fall of  $6.5^{\circ}\text{C}$  occurs with an ascent of 1000 meters or  $1^{\circ}\text{C per 165 meters.}$

**Continentality (Distance from sea):** Land surfaces have higher specific heat capacity of heat as compared to water bodies i.e. it takes less energy to raise the temperature of a given volume of land by  $1^{\circ}\text{C}$  as compared to same volume of water body. This accounts for temperature extremes in the continental interiors as compared to maritime areas.

**Oceans Currents:** Marine areas are influenced by the *warm or cold ocean currents*. Ocean currents like the Gulf Stream or the North Atlantic Drift warm the coastal districts of Western Europe keeping their ports ice-free. Ports located in the same latitude but washed by cold currents, such as the cold Labrador Current off north-east Canada, are frozen for several months. Cold currents also lower the summer temperature, particularly when they are carried landwards by on-shore winds.

**Local winds:** If winds are warm i.e. they have been blown from a hot area, they will raise temperatures. If winds have been blown from cold areas, they will lower temperatures. Local winds like Fohn, Chinook, Sirocco and Mistral also produce marked changes in temperature.

**Relief and Topography:** Climate can be affected by mountains. Mountains receive more rainfall than low lying areas because as air is forced over the higher ground it cools, causing moist air to

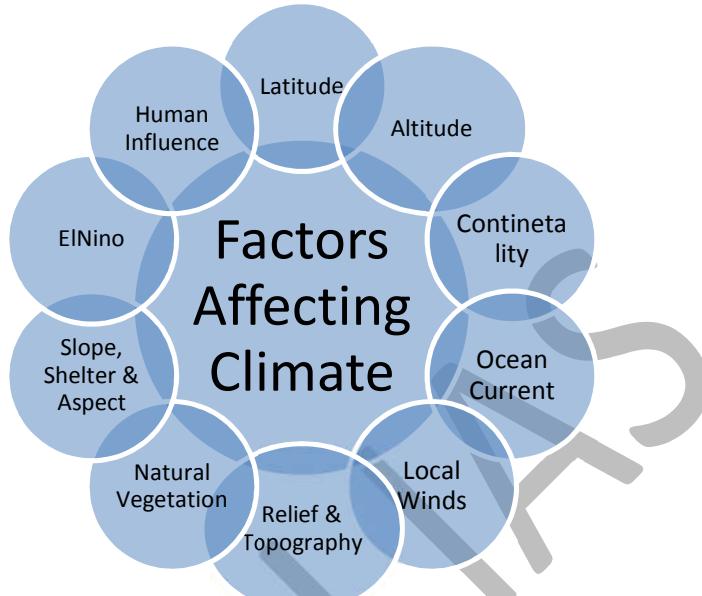
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condense and fall out as rainfall. The higher the place is above sea level the colder it will be. This happens because as altitude increases, air becomes thinner and is less able to absorb and retain heat.



**Fig 1: Factors Affecting Climate**

**Natural Vegetation and Soil:** Natural vegetation affects the temperature of the region significantly. Often areas with dense forest cover like areas in thick foliage of Amazon jungles receive less insolation and are, often, cooler than the areas in open space. Light soils reflect more heat than darker soils which are better absorbers. Such soil differences may give rise to slight variations in the temperature of the region. As a whole, dry soils like sands are very sensitive to temperature changes, whereas wet soils, like clay, retain much moisture and warm up or cool down more slowly.

**Slope, Shelter and Aspect:** A steep slope experiences much rapid change in temperature as compared to a gentle slope. Mountain ranges that have an east-west alignment like the Alps show a higher temperature on the *south-facing 'sunny slope'* than the north facing 'sheltered slope'. The greater insolation of the southern slope is better suited for vine cultivation and has a more flourishing vegetative cover. Consequently, there are more settlements and it is better utilised than the 'shady slope'.

**El Niño Effect:** El Niño, which affects wind and rainfall patterns, has been blamed for droughts and floods in countries around the Pacific Rim. El Niño refers to the irregular warming of surface water in the Pacific. The warmer water pumps energy and moisture into the atmosphere, altering global wind and rainfall patterns. The phenomenon has caused tornadoes in Florida, smog in Indonesia, and forest fires in Brazil. *El Niño* is Spanish for 'the Boy Child' because it comes about the time of the celebration of the birth of the Christ Child. The cold counterpart to El Niño is known as La Niña, Spanish for 'the girl child', and it also brings with it weather extremes.

**Human Influence:** The factors above affect the climate naturally. However, we cannot forget the influence of humans on our climate. Early on in human history our effect on the climate would have been quite small. However, as populations increased and trees were cut down in

large numbers, so our influence on the climate increased. The number of trees being cut down has also increased, reducing the amount of carbon dioxide that is taken up by forests

## 2.5 Classification of climate

If we were to compare the climates of different places on the basis of climatic elements, we would come across many such places which would have similarity between one and more of these elements. On the basis of these very regional similarities and differences of climatic elements, attempts have been made to classify climate for easy understanding, description and analysis.

Three broad approaches have been adopted for classifying climate. They are empirical, genetic and applied. Empirical classification is based on observed data, particularly on temperature and precipitation. Genetic classification attempts to organise climates according to their causes. Applied classification is for specific purpose.

**Heat Zones Classification:** The Greek philosophers were the first to present classification of climates. The temperature of the earth was the main bases of their classifications. They had divided the earth into Torrid, Temperate and Frigid zones.

(1) *Tropical or Torrid Zone:* This zone lies between the Tropic of Cancer and the Tropic of Capricorn. In this zone the sunrays are almost vertical throughout the year. The temperature always remains high. There is no winter season in this zone.

(2) *Temperate Zone:* There are two zones lying between the Tropic of Cancer - the Arctic Circle and the Tropic of Capricorn - the Antarctic Circle.

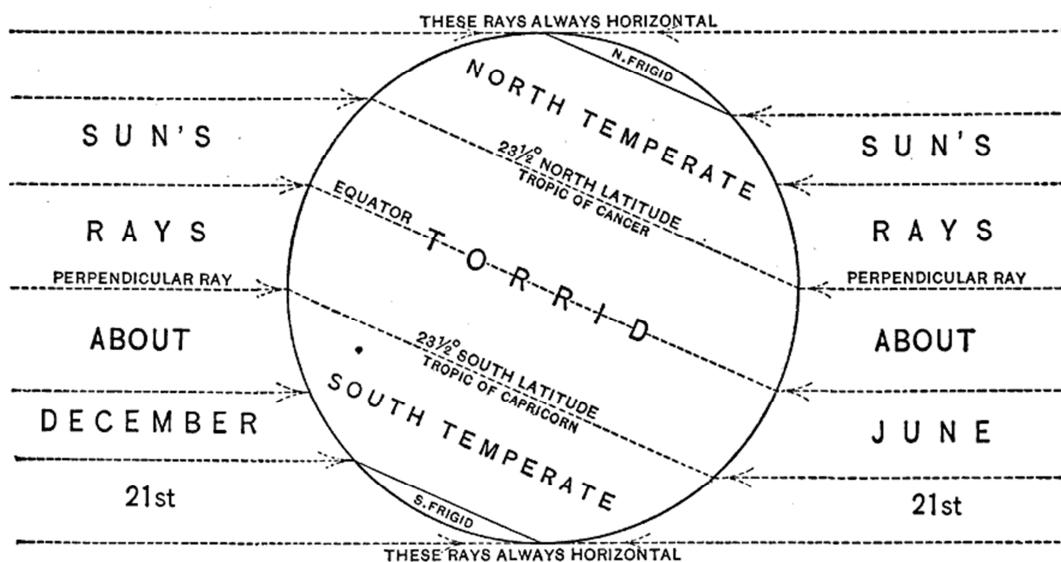


Fig 2: Heat Zones Classifications

(3) *Frigid Zone:* This zone lies between Arctic Circle and North Pole and the Antarctic Circle and the South Pole. The sunrays in these two zones in the Northern and Southern Hemisphere fall in slanting form throughout the year. Therefore these zones experience very low temperature and high degree of coldness. Therefore, these latitudinal zones are known as Frigid Zone.

### Koeppen Classification:

The most widely used classification of climate is the climate classification scheme developed by German climatologist and plant geographer V. Koeppen, in 1918. The annual as well as monthly averages of temperature and precipitation formed the basis of Koeppen classification of climate. He also based his classification on the distribution of weather conditions. This classification is both empirical and genetic type. Koeppen in his classification laid great emphasis that all the characteristics of climate can well be expressed through the distribution of natural vegetation that's why he tried to associate his climate types with vegetation zones of the world. He made use of annual averages of temperature and precipitation in fixing the climate regions of the world. He presented five main climate types. Each of these climate types was represented by capital English alphabets of A, B, C, D and E. He used the letter 'H' for highland type of climates. While keeping temperature and precipitation variations in view these five climate types were further subdivided as shown in the following table:

Sr. No.	Chief Climatic Groups	Climatic Types
A	Tropical Climate (Average temperature of the coldest month is 18° C or higher)	1. Tropical rain forest type climate 2. Savannah type climate 3. Monsoon type climate
B	Dry Climate (Potential evaporation exceeds precipitation)	4. Desert climate 5. Steppe (Semi-desert) climate
C	Temperate Climate (The average temperature of the coldest month is higher than minus 3°C but below 18°C)	6. Mediterranean climate 7. China type climate 8. West European type climate
D	Continental Climate (The average temperature of the coldest month is minus 3° C or below)	9. Taiga climate 10. Eastern coastal cold climate 11. Continental climate
E	Polar Climate (Average temperature for all months is below 10° C)	12. Tundra climate 13. Snow-capped region type climate
H	Highland Climate (Cold due to elevation)	

### Thornthwaite Classification:

Thornthwaite was an American climatologist. He presented his first climate classification in 1931. In 1931, his classification looked similar to Koeppen. Like Koeppen, Thornthwaite also thought that vegetation is the indicator of climate type. Two basic features of this classification are (i) Precipitation Effectiveness, (ii) Temperature Efficiency. On the basis of these two indicators, Thornthwaite divided the world into five humidity regions. Each region had its own special type of vegetation as shown in the table below:

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Sr. No.	Humidity Region	Special type of Vegetation
A	Very Humid	Rain Forest
B	Humid	Forest
C	Semi Humid	Grassland
D	Semi Dry	Steppe
E	Dry	Desert

On the basis of distribution of seasonal rainfall the above types of humidity regions were further divided into following subdivisions:

Y = Heavy rainfall in all seasons

s = Scarcity of rainfall in summer season

w = Scarcity of rainfall in winter season

d = Scarcity of rainfall in all seasons

After linking precipitation effectiveness and seasonal distribution of rainfall to temperature anomalies, the climates could be of 120 different types.

### 3] Global Climate Classification

The global climatic conditions can be studied under the following twelve classifications.

Climatic Zone	Latitude (Approximate)	Climatic Type	Rainfall Regime (with approx. total)	Natural Vegetation
Equatorial Zone	0°-10°N and S	1. Hot, wet equatorial	Rainfall all year round : 80 inches	Equatorial rain forests
Hot Zone	10°-30°N and S	2. a) Tropical Monsoon b) Tropical Marine	Heavy summer rain: 80 inches Much summer rain: 70 inches	Monsoon forests
		3. Sudan Type	Rain mainly in summer: 30 inches	Savanna (tropical grassland)
		4. Desert: a) Saharan type b) Mid-latitude type	Little rain: 5 inches	Desert vegetation and scrub
Warm Temperate Zone	30°-40°N & S	5. Western Margin (Mediterranean type)	Winter rain: 35 inches	Mediterranean forests and shrub
		6. Central Continental (Steppe type)	Light summer rain: 20 inches	Steppe or temperate grassland
		7. Eastern Margin: a) China type b) Gulf type c) Natal type	Heavier summer rain : 20 inches	Warm, wet forests and bamboo

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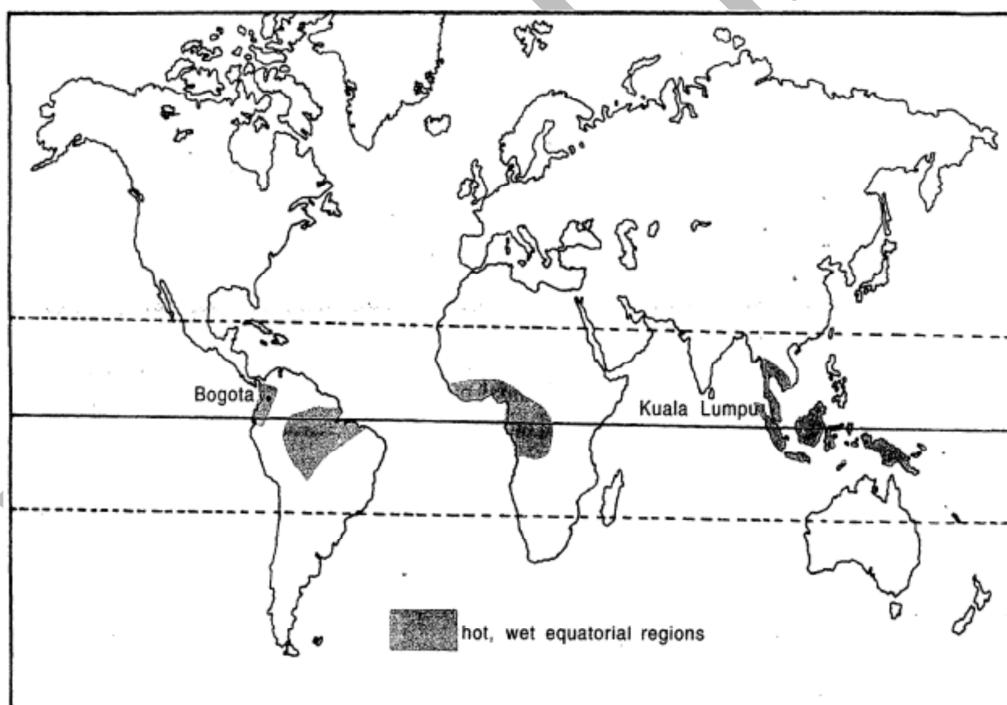
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Cool Temperate Zone	$45^{\circ}$ - $65^{\circ}$ N & S	8. Western Margin (British type)	More rain in autumn & winter: 30 inches	Deciduous forests
		9. Central Continental (Siberian type)	Light summer rain: 25 inches	Evergreen coniferous forests
		10. Eastern Margin (Laurentian type)	Moderate summer rain : 40 inches	Mixed forests (coniferous and deciduous)
Cold Zone	$65^{\circ}$ - $90^{\circ}$ N & S	11. Arctic or Polar	Very light summer rain : 10 inches	Tundra, mosses, lichens
Alpine Zone		12. Mountain climate	Heavy rainfall (variable)	Alpine pastures, conifers, fern, snow

### 3.1 The Hot, Wet Equatorial Climate

#### Distribution

The equatorial, hot, wet climate is found between  $5^{\circ}$  and  $10^{\circ}$  north and south of the equator. Its greatest extent is found in the lowlands of the Amazon, the Congo, Malaysia and the East Indies. Further away from the equator, the influence of the on-shore Trade Winds, gives rise to a modified type of equatorial climate with *monsoonal influences*.



#### Climatic Conditions

**Temperature:** The most outstanding feature of the equatorial climate is its great uniformity of temperature throughout the year. The mean monthly temperatures are always around  $27^{\circ}\text{C}$  with very little variation. There is no winter. Cloudiness and heavy precipitation moderates the daily temperature, so that even at the equator itself, the climate is not unbearable. The diurnal range of temperature is small, and so is the annual range.

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**Precipitation:** Precipitation is heavy, between 60 inches and 100 inches, and well distributed throughout the year. There is no month without rain and a distinct dry season like those of the Savannah or the Tropical Monsoon Climates, is absent. Due to the great heat in the equatorial belt, mornings are bright, and sunny. There is much evaporation and convectional air currents are set up, followed by heavy downpours.

**Natural Vegetation:** It supports a luxuriant type of vegetation – the tropical rain forest. Amazon tropical rain forest is known as Selvas. It comprises a multitude of evergreen trees that yield tropical hardwood, e.g. mahogany, ebony, greenheart, cabinet wood. Lianas, epiphytic and parasitic plants are also found. Trees of single species are very scarce in such vegetation.

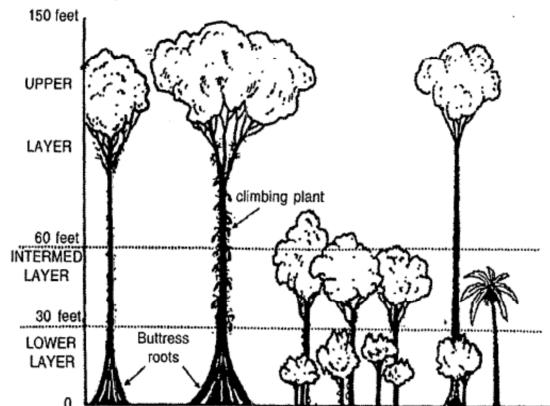
**Life and Development in the Equatorial Regions:** The equatorial regions are generally sparsely populated. In the forests most primitive people live as *hunters and collectors* and the more advanced ones practise shifting cultivation. In the Amazon basin, the Indian tribes collect wild rubber, in the Congo Basin the Pygmies gather nuts and in the jungles of Malaysia the Orang Asli make all sorts of cane products and sell them to people in villages and towns. In the clearings for shifting cultivation, crops like manioc (tapioca), yams, maize, bananas and groundnuts are grown.

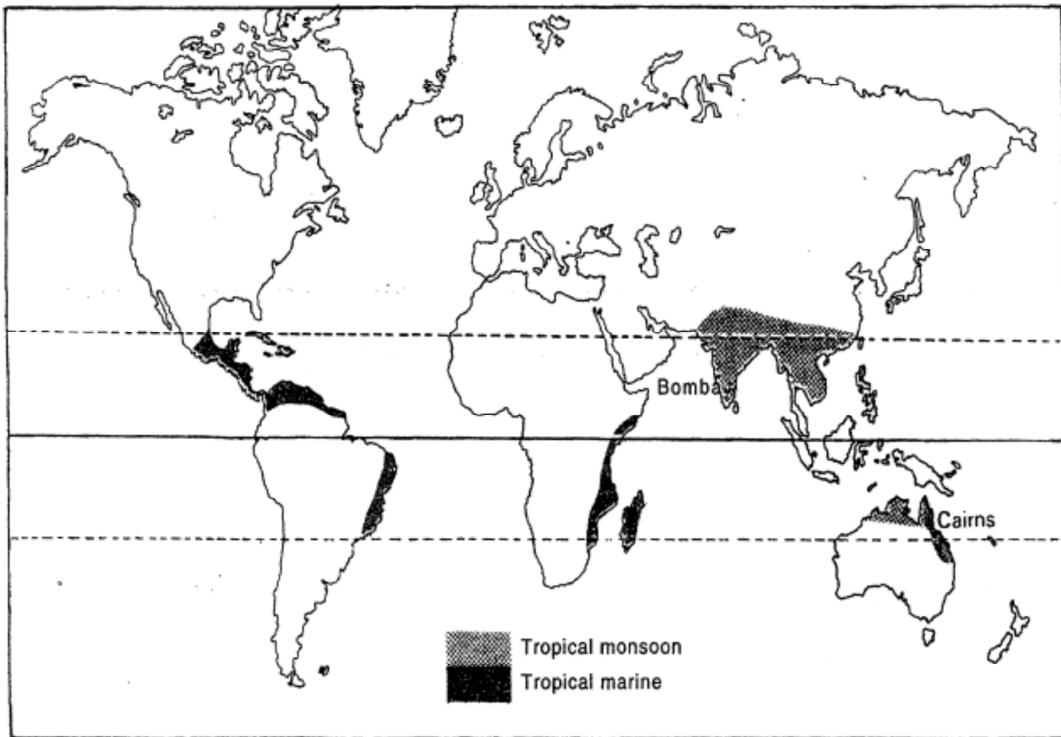
### 3.2 The Tropical Monsoon and Tropical Marine Climates

**Distribution:** It is found in the zones between  $5^{\circ}$  and  $30^{\circ}$  latitudes on either side of the equator. These areas are the **tropical monsoon** lands with on-shore wet monsoons in the summer and off-shore dry monsoons in the winter. They are best developed in the Indian sub-continent, Burma, Thailand, Laos, Cambodia, parts of Vietnam and south China and northern Australia.

Outside this zone, the climate is modified by the influence of the on-shore Trade Winds all the year round, and has a more evenly distributed rainfall. Such a climate, better termed the **Tropical Marine** Climate, is experienced in Central America, West Indies, north-eastern Australia, the Philippines, parts of East Africa, Madagascar, the Guinea Coast and eastern Brazil.

Fig. 123 Sketch to show the three distinct layers of an equatorial forest





#### Climatic Conditions:

The basic cause of monsoon climates is the difference in the rate of heating and cooling of land and sea. Average temperature of warm dry summer months ranges between 27°C and 32°C. In the summer, when the sun is overhead at the Tropic of Cancer, the great land masses of the northern hemisphere are heated. The seas, which warm up much slower, remain comparatively cool. At the same time, the southern hemisphere experiences winter, and a region of high pressure is set up in the continental interior of Australia. Winds blow outwards as the South-East Monsoon, to Java, and after crossing the equator are drawn towards the continental low pressure area reaching the Indian sub-continent as the South-West Monsoon. In the winter, conditions are reversed. The sun is overhead at the Tropic of Capricorn, central Asia is extremely cold, resulting in rapid cooling of the land. A region of high pressure is created with out-blowing winds—the North-East Monsoon.

*The Seasons of Tropical Monsoon Climate:* In regions like the Indian sub-continent which have a true Tropical Monsoon Climate, three distinct seasons are distinguishable - The cool, dry season (October to February), the hot dry season (March to mid-June) and the rainy season (mid-June to September).

*The Tropical Marine Climate:* This type of climate is experienced along the eastern coasts of tropical lands, receiving steady rainfall from the Trade Winds all the time. The rainfall is both *orographic*, where the moist trades meet upland masses as in eastern Brazil, and *convictional* due to intense heating during the day and in summer. Its tendency is towards a summer maximum as in monsoon lands, but without any distinct dry period.

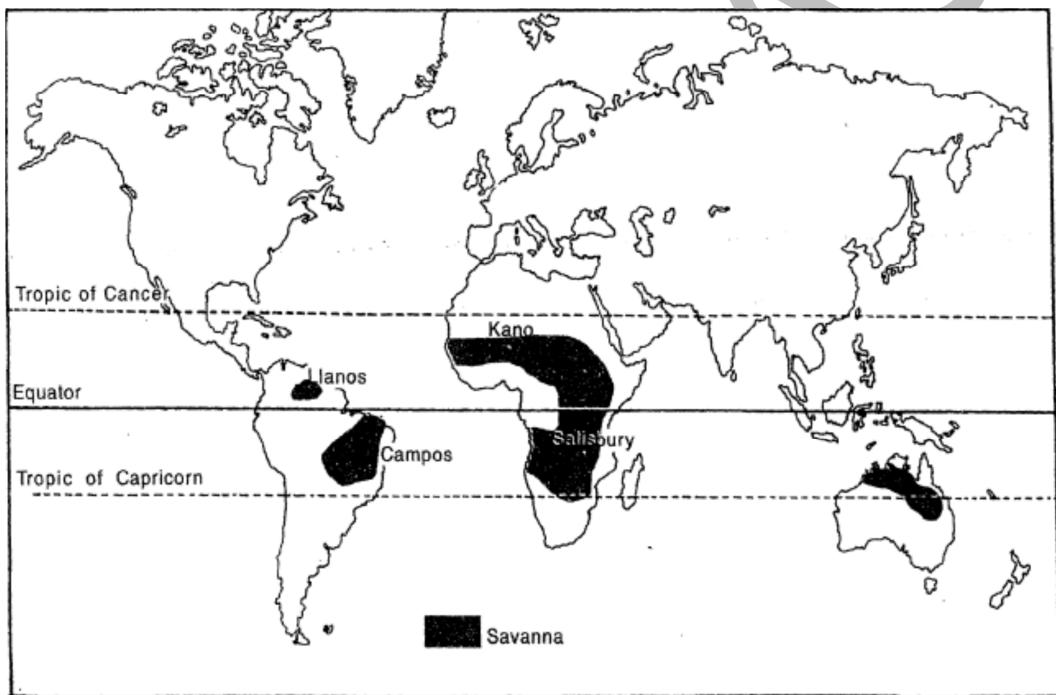
**Natural Vegetation:** The natural vegetation of tropical monsoon lands depends on the amount of the summer rainfall. Trees are normally deciduous because of the marked dry period, during which they shed their leaves to withstand the drought. Where the rainfall is heavy, e.g. in

southern Burma, peninsular India, northern Australia and coastal regions with a tropical marine climate, the resultant vegetation is forest. The forests are more open and less luxuriant than the equatorial jungle and there are far fewer species. Most of the forests yield valuable timber, and are prized for their durable hardwood. Amongst these teak is the best known.

**Economy:** The main economic activity of the people is agriculture. Major agricrops are rice, cane sugar, jute etc.

### 3.3 The Savannah or Sudan Climate

**Distribution:** The Savannah or Sudan Climate is a transitional type of climate found between the equatorial forest and the trade wind hot deserts. It is confined within the tropics and is best developed in the Sudan where the dry and wet seasons are most distinct, hence its name the Sudan Climate. The belt includes West African Sudan, and then curves southwards into East Africa and southern Africa north of the Tropic of Capricorn. In South America, there are two distinct regions of *savannah* north and south of the equator, namely the *llanos* of the Orinoco basin and the *Campos* of the Brazilian Highlands.



#### Climatic Conditions:

The Savannah climate is characterized by distinct wet and dry seasons. Mean high temperature throughout the year is between 24°C and 27°C. The annual range of temperature is between 3°C and 8°C, but the range increases as one moves further away from the equator. The extreme diurnal range of temperature is a characteristic of Sudan type of climate. The average annual rainfall ranges between 100 cm and 150 cm. The prevailing winds of the region are the Trade Winds which bring rain to the coastal districts.

**Natural Vegetation:** The savannah landscape is typified by tall grass and short trees. The terms '*parkland*' or '*bush-veld*' perhaps describe the landscape better. Trees grow best towards the equatorial humid latitudes or along river banks but decrease in height and density away from the equator. The trees are deciduous, shedding their leaves in the cool, dry season to prevent

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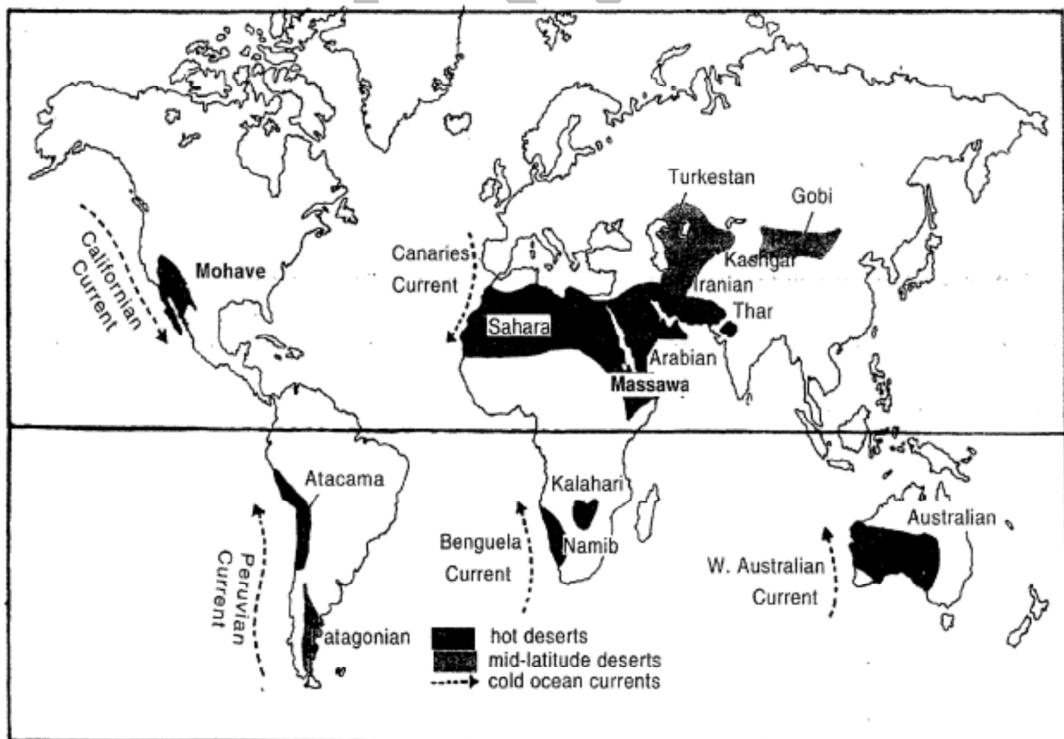
excessive loss of water through transpiration, e.g. acacias. Others have broad trunks, with water-storing devices to survive through the prolonged drought such as baobabs and bottle trees. Trees are mostly hard, gnarled and thorny and may exude gum like *gum arabic*.

**Animal Life of the Savannah:** The savannah, particularly in Africa, is the home of wild animals. It is known as the 'big game country' and thousands of animals are trapped or killed each year by people from all over the world. Some of the animals are tracked down for their skins, horns, tusks, bones or hair, others are captured alive and sent out of Africa as zoo animals, laboratory specimens or pets.

**Economy:** Many tribes live within the Savannah lands. Some tribes live as pastoralists like the Masai and others as settled cultivators like the Hausa of northern Nigeria. However, agriculture is not much developed.

### 3.4 The Hot Desert and Mid-latitude Desert Climates:

**Distribution:** Deserts are regions of scanty rainfall which may be hot like the hot deserts of the Saharan type or temperate as are the mid-latitude deserts like the Gobi. The major hot deserts of the world are located on the western coasts of continents between latitudes 15° and 30°N and S. They include the Sahara Desert, the largest single stretch of desert, which is 3,200 miles from east to west and at least 1,000 miles wide. The next biggest desert is the Great Australian Desert which covers almost half of the continent. The other hot deserts are the Arabian Desert, Iranian Desert, Thar Desert, Kalahari and Namib Deserts. In North America, the desert extends from Mexico to USA and is called by different names at different places, e.g. the Mohave Sonoran, Californian and Mexican Deserts. In South America, the Atacama or Peruvian Desert is the driest of all deserts with less than 0.5 inches of rainfall annually. The Patagonian Desert is more due to its rain-shadow position on the leeward side of the lofty Andes than to continentality.



**Climatic Conditions:**

**Rainfall:** The aridity of deserts is the most outstanding feature of the desert climate. Few deserts whether hot or mid-latitude have an annual precipitation of more than 10 inches while in others less than 0.02 inches. The hot deserts lie astride the Horse Latitudes or the Sub-Tropical High Pressure Belts where the air is descending, a condition least favourable for precipitation of any kind to take place. The rain bearing trade winds blow off shore and the Westerlies, that are on-shore, blow outside the desert limits. Whatever winds reaches the deserts blow from the cooler to the warmer regions, and their relative humidity is lowered, making condensation almost impossible.

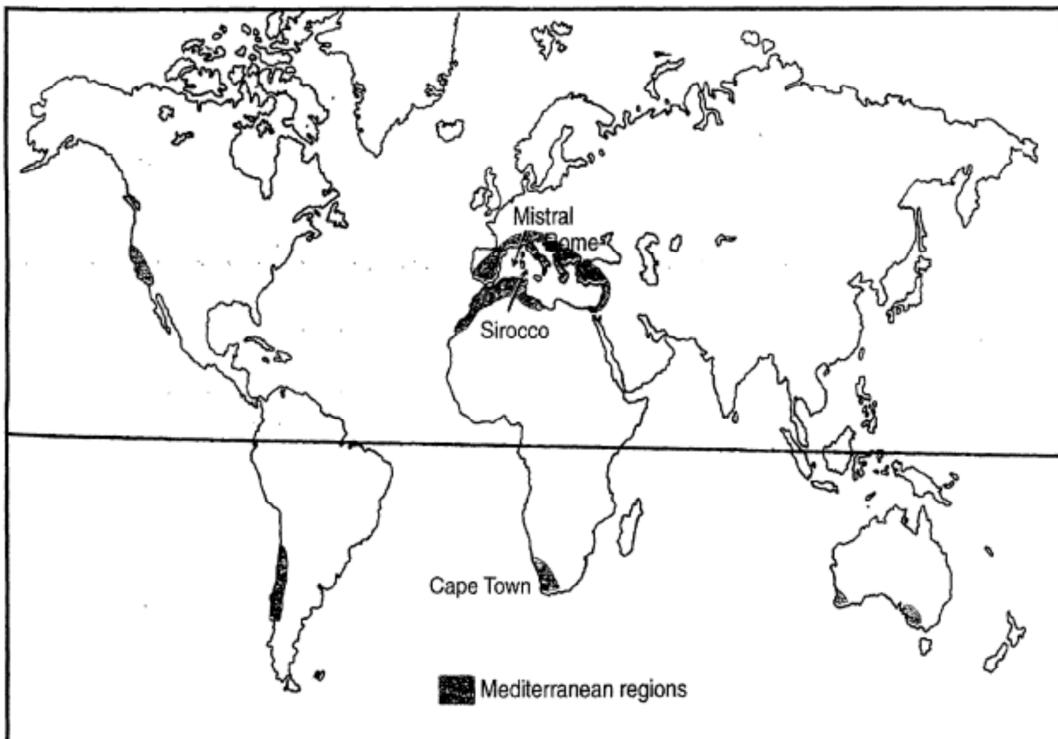
**Temperature:** The deserts are some of the hottest spots on earth and have high temperatures throughout the year. There is no cold season in the hot deserts and the average summer temperature is around 30°C. The highest shade temperature recorded is 58°C at Al Azizia, 25 miles south of Tripoli, Libya, in the Sahara. The diurnal range of temperature in the deserts is very great.

**Natural Vegetation:** All deserts have some form of vegetation such as grass, scrub, herbs, weeds, roots or bulbs. Though they may not appear green and fresh all the time, they lie dormant in the soil awaiting rain which comes at irregular intervals or once in many years. The environment, so lacking in moisture and so excessive in heat, is most unfavourable for plant growth and significant vegetation cannot be expected. The predominant vegetation of both hot and mid-latitude deserts is xerophytes or drought-resistant scrub. This includes the bulbous cacti, thorny bushes, long-rooted wiry grasses and scattered dwarf acacia. Trees are rare except where there is abundant ground water to support clusters of date palms.

**Life in the Deserts:** Despite its inhospitality, the desert has always been peopled by different groups of inhabitants. They struggle against an environment deficient in water, food and other means of livelihood. The desert inhabitants may be grouped under the following categories - The primitive hunters and collectors (The Bushmen and The Bindibu), the nomadic herdsmen (The Tuaregs of the Sahara, the Gobi Mongols and The Bedouin of Arabia), the caravan traders, the settled cultivators and the mining settlers.

### 3.5 The Warm Temperate Western Margin (Mediterranean) Climate

**Distribution:** The Warm Temperate Western Margin Climate is found in relatively few areas in the world. They are entirely confined to the western portion of continental masses, between 30° and 45° north and south of the equator. The basic cause of this type of climate is the shifting of the wind belts. Though the area around the Mediterranean Sea has the greatest extent of this type of 'winter rain climate', and gives rise to the more popular name Mediterranean Climate. Other Mediterranean regions include California (around San Francisco), the south-western tip of Africa (around Cape Town), southern Australia (in southern Victoria and around Adelaide, bordering the St. Vincent and Spencer Gulfs), and south-west Australia (Swanland).



**Climatic Conditions:** The Mediterranean type of climate is characterized by very distinctive climatic features - a warm summer with off-shore trades, a concentration of rainfall in winter with onshore westerlies, bright, sunny weather with hot dry summers and wet, mild winters and the prominence of local winds around the Mediterranean Sea (Sirocco, Mistral). Since all regions with a Mediterranean climate are near large bodies of water, temperatures are generally moderate with a comparatively small range of temperature res between the winter low and summer high. Areas with this climate receive almost all of their yearly rainfall during the winter season, and may go the summer without having any significant precipitation.

**Natural vegetation:** Trees with small broad leaves are widely spaced and never very tall. Though there are many branches they are short and carry few leaves. The absence of shade is a distinct feature of Mediterranean lands. Growth is slow in the cooler and wetter season, even though more rain comes in winter. The warm, bright summers and cool, moist winters enable a wide range of crops to be cultivated. The Mediterranean lands are also known as the world's orchard lands. A wide range of citrus fruits such as oranges, lemons, limes, citrons and grapefruit are grown. Wine production is another speciality of the Mediterranean countries, because the best wine is essentially made from grapes. Some 85 per cent of grapes produced, go into wine. The long, sunny summer allows the grapes to ripen and then they are hand-picked.

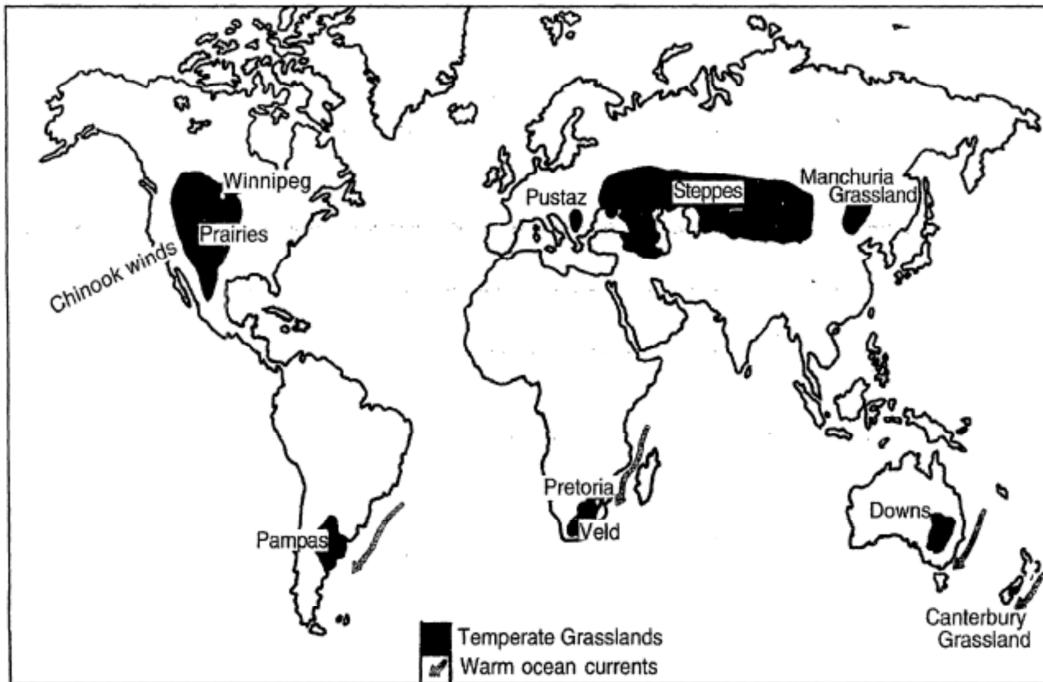
**Economy:** The area is important for fruit cultivation, cereal growing, wine-making and agricultural industries as well as engineering and mining.

### 3.6 The Temperate Continental (Steppe) Climate

#### Distribution

Bordering the deserts, away from the Mediterranean regions and in the interiors continents are the temperate grasslands. Though they lie in the Westerly wind belt, they are so remote from maritime influence that the grasslands are practically treeless. These grasslands are so distinctive in their natural vegetation that, although those which occur in the southern hemisphere have a much more moderate climate, they are often dealt with together. In the northern hemisphere, the grasslands are far more extensive and are entirely continental. In Eurasia, they are called the **Steppes** and stretch eastwards from the shores of the Black Sea across the Great Russian plain to the foothills of the Altai Mountains, a distance of well over 2,000 miles. There are isolated sections in the *Pustaz* of Hungary and the plains of Manchuria. In North America, the grasslands are also quite extensive and are called **Prairies**. They lie between the foothills of the Rockies and the Great Lakes astride the American Canadian border.

In the case of the **Pampas** of Argentina and Uruguay, the grasslands extend right to the sea and enjoy much maritime influence. In South Africa, the grasslands are sandwiched between the Drakensberg and the Kalahari Desert; and are further subdivided into the more tropical **Bush-veld** in the north, and the more temperate High Veld in the south.



#### Climatic Conditions

**Temperature:** Their location in the heart of continents means that they have little maritime influence. Their climate is thus continental with extremes of temperature. **Summers are very warm**, over 19°C. **Winters are very cold** in the continental steppes of Eurasia because of the enormous distances from the nearest sea. The winter months are well below freezing. In contrast, the steppe type of climate in the southern hemisphere is never severe. The winters are mild. Temperatures below freezing point even in midwinter (July in the southern hemisphere) are exceptional.

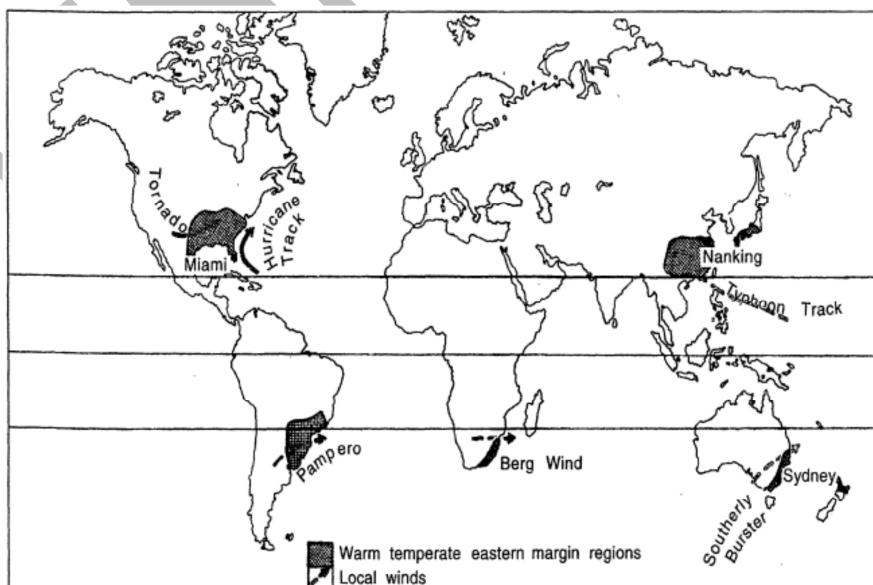
**Precipitation:** In its continental position, the annual precipitation of the Steppe Climate is light. The average rainfall may be taken as about 20 inches, but this again varies according to location from 10 inches to 30 inches. The maritime influence in the steppe type of climate of the southern hemisphere is even better brought out by the rainfall regime. Its annual precipitation is always more than the average 20 inches because of the warm ocean currents that wash the shores of the steppe-lands.

**Natural Vegetation:** The reference to steppe grassland is taken to mean the temperate grasslands of the mid-latitudes, the Steppes, Prairies, Pampas, Veld and Downs. The steppes are grass covered, differing only in the *density and quality* of the grass. Their greatest difference from the tropical savannah is that they are practically treeless and the grasses are much shorter. Where the rainfall is moderate, above 20 inches, the grasses are tall, fresh and nutritious and are better described as long prairie grass. The *appearance* of the temperate grasslands varies with seasons. Trees are very scarce in the steppes, because of the scanty rainfall, long droughts and severe winters.

**Economy:** The grasslands have been ploughed up for extensive, mechanized wheat cultivation and are now the 'granaries of the world'. Besides wheat, maize is increasingly cultivated in the warmer and wetter areas. The tufted grasses have been replaced by the more nutritious Lucerne or alfalfa grass.

### 3.7 The Warm Temperate Eastern Margin (China Type) Climate

**Distribution:** This type of climate is found on the eastern margins of continents in warm temperate latitudes, just outside the tropics. It has comparatively more rainfall than the Mediterranean climate in the same latitudes, coming mainly in the summer. It is, in fact, the climate of most parts of China – a modified form of monsoonal climate. It is thus also called the *Temperate Monsoon or China Type* of climate. In south-eastern U.S.A., bordering the Gulf of Mexico, continental heating in summer induces an inflow of air from the cooler Atlantic Ocean. It is sometimes referred to as the Gulf type of climate. In the southern hemisphere, this kind of climate is experienced along the warm temperate eastern coastlands of all the three continents: in New South Wales with its eucalyptus forests; in Natal where cane sugar thrives; and in the maize belt of the Parana-Paraguay-Uruguay basin.



**Rajinder Nagar:** 1/8-B, 2<sup>nd</sup> Floor, Apsara Arcade, Near Gate 6, Karol Bagh Metro, Delhi

**Mukherjee Nagar:** 103, 1<sup>st</sup> Floor, B/1-2, Ansal Building, Behind UCO Bank, Delhi-9

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### Climatic Condition:

The Warm Temperate Eastern Margin Climate is typified by a warm moist summer and a cool, dry winter. The mean monthly temperature varies between 5°C and 25°C and is strongly modified by maritime influence. The relative humidity is a little high in mid-summer. Rainfall is more than moderate, anything from 25 inches to 60 inches. Another important feature is the fairly uniform distribution of rainfall throughout the year. There is rain every month, except in the interior of central China, where there is a distinct dry season. Rain comes either from convectional sources or as orographic rain in summer, or from depressions in prolonged showers in winter. Local storms, e.g. typhoons, and hurricanes, also occur.

It can be sub-divided into three main types – a) The China type: central and north China (including southern Japan (temperate monsoonal). b) The Gulf type: south-eastern United States, (slight-monsoonal). c) The Natal type: the entire warm temperate eastern margin (non-monsoonal areas) of the southern hemisphere including Natal, eastern Australia and southern Brazil-Paraguay-Uruguay and northern Argentina.

**Natural Vegetation:** The eastern margins of warm temperate latitudes have a much heavier rainfall than either the western margins or the continental interiors and thus have luxuriant vegetation. The lowlands carry both evergreen broad-leaved forests and deciduous trees quite similar to those of the tropical monsoon forests. On the highlands, are various species of conifers such as pines and cypresses that are important softwood.

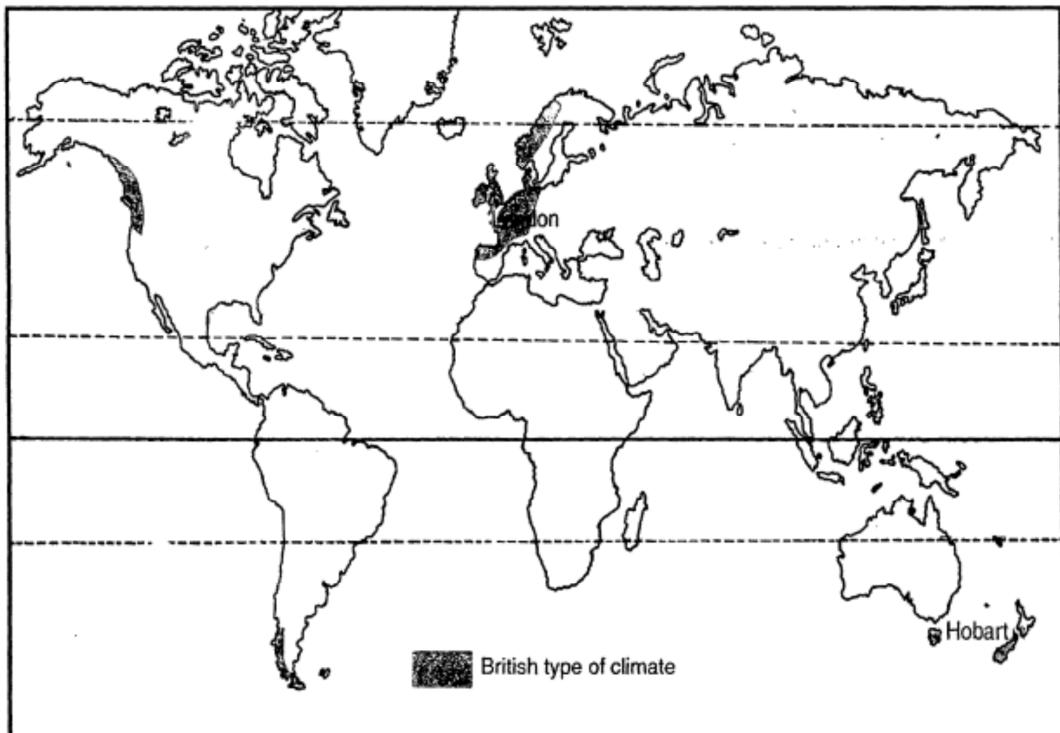
**Economy:** The warm temperate eastern margins are the most productive parts of the middle latitudes. Besides the widespread cultivation of Maize and cotton in the Corn and Cotton Belts of U.S.A. fruit and tobacco are also grown. Rice, tea and mulberries are extensively grown in monsoon China.

Elsewhere are found other products of economic importance, e.g. cane sugar in Natal, coffee and maize in South America and dairying in New South Wales and Victoria.

### 3.8 The Cool Temperate Western Margin (British Type) Climate

#### Distribution Climate

The cool temperate western margins are under the permanent influence of the Westerlies all round the year. They are also regions of much cyclonic activity, typical of Britain, and are thus said to experience the British type of climate. From Britain, the climatic belt stretches far inland into the lowlands North-West Europe, including such regions as northern and western France, Belgium, the Netherlands, Denmark, western Norway and also north-western Iberia. In the southern hemisphere, the climate is experienced in southern Chile, Tasmania and most parts of New Zealand, particularly in South Island.



### Climatic Conditions

**Temperature:** The mean annual temperatures are usually between 5°C and 15°C. The annual range of temperature is small. Summers are, in fact, never very warm. Monthly temperatures of over 18°C even in mid-summer are rare.

**Precipitation:** The British type of climate has adequate rainfall throughout the year with a tendency towards a slight winter or autumn maximum from cyclonic sources. Since the rain-bearing winds come from the west, the western margins have the heaviest rainfall. The amount decreases eastwards with increasing distance from the sea.

**Natural Vegetation:** The natural vegetation of this climatic type is deciduous forest. The trees shed their leaves in the cold season. This is an adaptation for protecting themselves against the winter snow and frost. Shedding begins in autumn, the 'fall' season, during which the leaves fall and are scattered by the winds. Some of the more common species include oak, elm, ash, birch, beech, poplar, and hornbeam. Unlike the equatorial forests, the deciduous trees occur in pure stands and have greater lumbering value from the commercial point of view. The deciduous hardwoods are excellent for both fuel and industrial purposes.

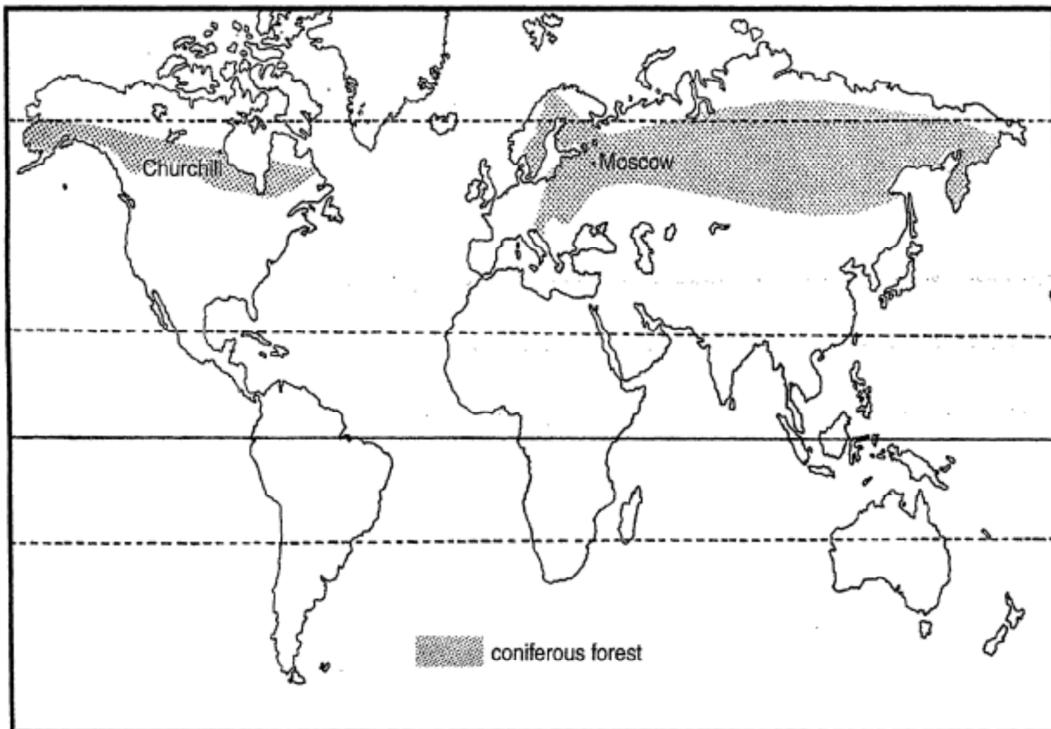
**Economy:** The region differs from many others in its unprecedented industrial advancement. The countries are

concerned in the production of machinery, chemicals, textiles and other manufactured articles rather than agriculture, fishing or lumbering, though these activities are well represented in some of the countries. Fishing is particularly important in Britain, Norway and British Columbia. A very large part of the deciduous woodlands have been cleared for fuel, timber or agriculture.

### 3.9 The Cool Temperate Continental (Siberian) Climate

#### Distribution

The Cool Temperate Continental (Siberian) Climate is experienced only in the northern hemisphere where the continents within the high latitudes have a broad east-west spread. On its pole ward side, it merges into the Arctic tundra of Canada and Eurasia at around the Arctic Circle. The Siberian Climate is conspicuously absent in the southern hemisphere because of the narrowness of the southern continents in the high latitudes. The strong oceanic influence reduces the severity of the winter and coniferous forests are found only on the mountainous uplands of southern Chile, New Zealand, Tasmania and south-east Australia.



#### Climatic Conditions:

**Temperature:** The climate of the Siberian type is characterized by a bitterly cold winter of long duration, and a cool brief summer. Spring and autumn are merely brief transitional periods. The extremes of temperature are so great in Siberia that it is often referred to as the 'cold pole of the earth'. Some of the lowest temperatures in the world are recorded in Verkhoyansk.

**Precipitation:** The interiors of the Eurasian continent are so remote from maritime influence that annual precipitation cannot be high. Generally speaking, a total of 15 to 25 inches is typical of the annual precipitation of this sub-Arctic type of climate. It is quite well distributed throughout the year, with a summer maximum from convectional rain.

#### Natural Vegetation

No other trees are as well adapted as the conifers to withstand such an inhospitable environment as the Siberian type of climate. The coniferous forest belts of Eurasia and North America are the richest sources of softwood for use in building construction, furniture, matches, paper and pulp, rayon and other branches of the chemical industry. The world's

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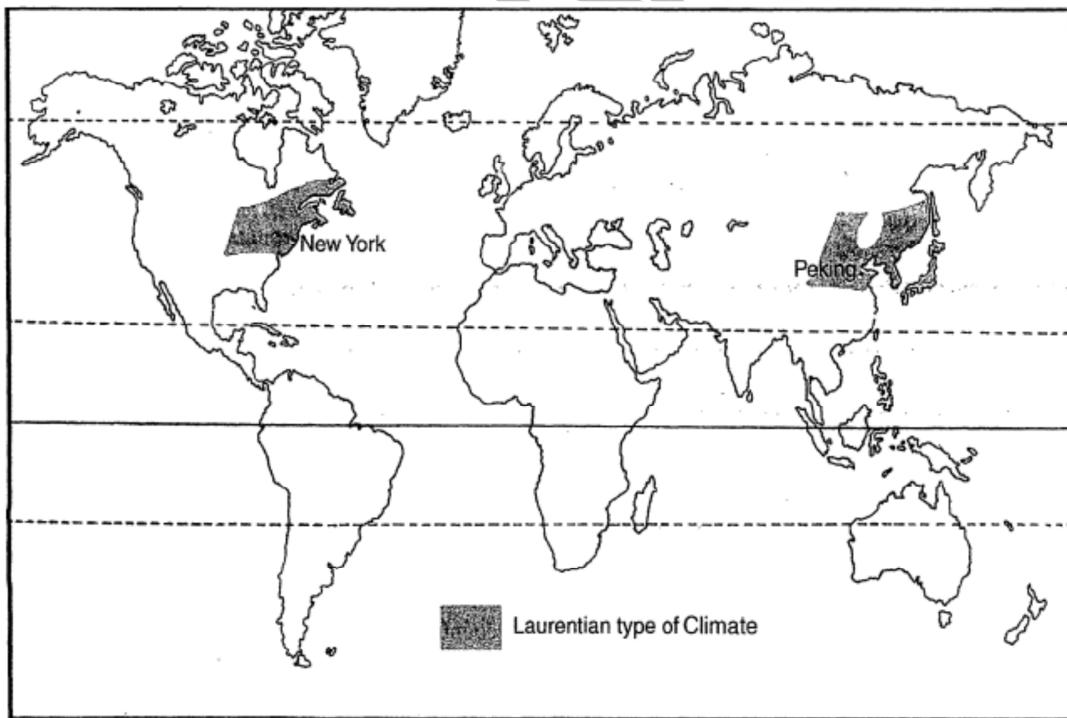
greatest softwood producers are U.S.S.R, U.S.A., Canada and the Fenoscandian countries (Finland, Norway and Sweden). In the field of newsprint, Canada has outstripped all other producers, accounting for almost half of the world's total annual production. There are four major species in the coniferous forests – a) Pine, e.g. white pine, red pine, Scots pine, Jack pine, b) Fir, e.g., Douglas fir and balsam fir, c) Spruce and d) Larch.

**Economy:** The coniferous forest regions of the northern hemisphere are comparatively little developed. Only in the more accessible areas are the forests cleared for lumbering. There is little agriculture, as few crops can survive in the sub-Arctic climate of these northerly lands. Many of the Samoyeds and Yakuts of Siberia, and some Canadians are engaged in hunting, trapping and fishing.

### 3.10 The Cool Temperate Eastern Margin (Laurentian) Climate

#### Distribution

The Cool Temperate Eastern Margin (Laurentian) Climate is an intermediate type of climate between the British and the Siberian type of climate. It has features of both the maritime and the continental climates. The Laurentian type of climate is found only in two regions. One is north-eastern North America, including eastern Canada, north-east U.S.A., (i.e. Maritime Provinces and the New England states), and Newfoundland. This may be referred to as the North American region. The other region is the eastern coastlands of Asia, including eastern Siberia, North China, Manchuria, Korea and northern Japan. It may be referred to as the Asiatic region. In the southern hemisphere, this climatic type is absent because only a small section of the southern continents extends south of the latitude of 40° S.



#### Climatic Conditions:

The Laurentian type of climate has cold, dry winters and warm, wet summers. Winter temperatures may be well below freezing-point and snow falls to quite a depth. Summers are as

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warm as the tropics ( $21^{\circ} - 27^{\circ}\text{C}$ ) and if it were not for the cooling effects of the off-shore cold currents from the Arctic, the summer might be even hotter. Though rain falls throughout the year, there is a distinct **summer maximum** from the easterly winds from the oceans. Of the annual precipitation of 30 to 60 inches, two-thirds come in the summer. Winter is dry and cold, because the winds are dry Westerlies that blow out from the continental interiors.

#### Natural Vegetation

The predominant vegetation of the Laurentian type of climate is cool temperate forest. The heavy rainfall, the warm summers and the damp air from fogs, all favour the growth of trees. Generally speaking, the forest tends to be coniferous north of the  $50^{\circ}\text{ N}$ . parallel of latitude. The increase in the length and severity of the winter excludes forests that are not adaptable to cold conditions. Oak, beech, maple and birch are the principal trees.

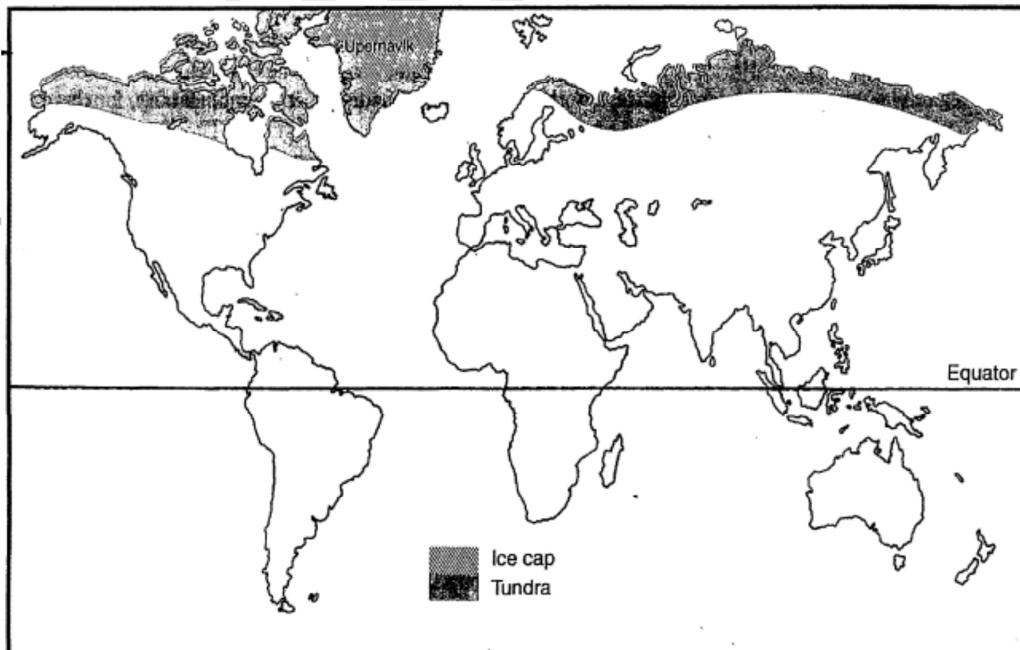
#### Economy

Lumbering and its associated timber, paper and pulp industries are the most important economic undertaking. Agriculture is less important in view of the severity of the winter and its long duration. Fortunately the maritime influence and the heavy rainfall enable some hardy crops to be raised for local needs. The fertile Annapolis valley in Nova Scotia is the world's most renowned region for apples. Fishing is, however, the most outstanding economic activity of the Laurentian climatic regions.

### 3.11 The Arctic or Polar Climate

#### Distribution

The polar type of climate and vegetation is found mainly north of the Arctic Circle in the northern hemisphere. The ice-cap is confined to Greenland and to the highlands of these high-latitude regions, where the ground is permanently snow-covered. The lowlands, with a few months ice-free, have tundra vegetation. They include the coastal strip of Greenland, the barren grounds of northern Canada and Alaska and the Arctic seaboard of Eurasia.



### Climatic Conditions

**Temperature:** The polar climate is characterized by a very low mean annual temperature and its warmest month in June seldom rises to more than 10°C. In mid-winter (January) temperatures are as low as –35°C and much colder in the interior. Winters are long and very severe; summers are cool and brief.

**Precipitation:** Precipitation is mainly in the form of snow, falling in winter and being drifted about during blizzards. Snowfall varies with locality; it may fall either as ice crystals or large, amalgamated snowflakes. Convectional rainfall is generally absent because of the low rate of evaporation and the lack of moisture in the cold polar air. There is normally a summer maximum, and the precipitation is then in the form of rain or sleet.

### Natural vegetation

In such an adverse environment as the tundra, few plants survive. The greatest inhibiting factor is the region's deficiency in heat. With a growing season of less than three months and the warmest month not exceeding 10° C (the tree-survival line), there are no trees in the tundra. Such an environment can support only the lowest form of vegetation, mosses, lichens and sedges. Drainage in the tundra is usually poor as the sub-soil is permanently frozen. Ponds and marshes and waterlogged areas are found in hollows.

### Economy:

Human activities of the tundra are largely confined to the coast. Where plateaux and mountains increase the altitude, it is uninhabitable, for these are permanently snow-covered. The few people who live in the tundra live a semi-nomadic life and have to adapt themselves to the harsh environment. The Arctic region, once regarded as completely useless, is now of some economic importance. Apart from the efforts of the various governments in assisting the advancement of the Arctic inhabitants the Eskimos, Lapps, Samoyeds etc., new settlements have sprung up because of the discovery of minerals.

## 4] Mains Questions

1. Major hot deserts in northern hemisphere are located between 20-30 degree north and on the western side of the continents. Why? (UPSC 2013/10 Marks)
2. "As regards the increasing rates of melting of Arctic ice, the interests of the Arctic Council nations may not coincide with those of the wider world. "Explain. (UPSC 2011/12 Marks)
3. Why is India undertaking expeditions to Antarctica? Describe the influence of Antarctica and Antarctic ocean on the climate of India and on the nutrient and energy supply to Indian Ocean.

## 5] Prelims Questions

1. "Climate is extreme, rainfall is scanty and the people used to be nomadic herders." The above statement best describes which of the following regions? (2013)
 

(a) African Savannah	(b) Central Asian Steppe
(c) North American Prairie	(d) Siberian Tundra
2. Which one of the following is the (2012) Characteristic climate of the Tropical Savannah Region?
 

(a) Rainfall throughout the year	(b) Rainfall in winter only
(c) An extremely short dry season	(d) A definite dry and wet season
3. What could be the main reason/reasons of the formation of African and Eurasian desert belt? (2011)
  1. It is located in the sub-tropical high pressure cells.
  2. It is under the influence of warm ocean currents.
 Which of the statements given above is/are correct in this context?
 

(a) 1 only	(b) 2 only
(c) Both 1 and 2	(d) Neither 1 nor 2
4. A geographic region has the following distinct characteristics:
  1. Warm and dry climate
  2. Mild and wet winter
  3. Evergreen oak trees
 The above features are the distinct characteristics of which one of the following regions? (2010)
 

(a) Mediterranean	(b) Eastern China
(c) Central Asia	(d) Atlantic coast of North America
5. Consider the following statements: (2002)
  1. In equatorial regions, the year is divided into four main seasons.
  2. In Mediterranean region, summer receives more rain.
  3. In China type climate, rainfall occurs throughout the year.
  4. Tropical highlands exhibit vertical zonation of different climates.
 Which of these statements are correct/
 

(a) 1, 2, 3 and 4	(b) 1, 2 and 3
(c) 1, 2 and 4	(d) 3 and 4

6. The temperature and rainfall of a meteorological station are given below:  
**Temperature (OC) Rainfall (cm) (2001)**

	Temperature (°C)	Rainfall (cm)
J	9.4	12.2
F	10.6	9.1
M	11.7	7.9
A	12.2	2.5
M	13.3	1.8
J	13.9	0.3
J	13.9	-
A	14.4	-
S	15.6	0.8
O	15.0	2.5
N	13.3	6.1
D	10.6	11.7

Average Temperature: 12.80C

Average Rainfall: 54.9 cm per annum

Identify the region having the above climatic pattern from amongst the following:



7. Consider the following statements:

1. The annual range of temperature is greater in the Pacific Ocean than that in the Atlantic Ocean.
  2. The annual range of temperature is greater in the Northern Hemisphere than that in the Southern Hemisphere.

Which of the statements given above is/are correct? (2007)