

## PRECIPITATION

- Precipitation refers to the release of moisture that occurs after the condensation of water vapour.
- Rainfall: Precipitation in the form of liquid water.
- Snowfall: When the temperature is below freezing point, precipitation takes the form of fine snowflakes.
- Sleet: Consists of frozen raindrops or refrozen melted snow-water; Occurs when there's a layer of air with a temperature above freezing point overlying a subfreezing layer near the ground.
- Hailstones: Formed when rainwater droplets solidify into small, rounded pieces of ice while passing through colder layers; Typically have multiple concentric layers of ice.
- Freezing Rain: Drizzles or light rains occurring below 0° C temperature and being frozen before reaching the ground.
- Virage: Raindrops evaporate before reaching Earth in dry air.

### Types of Rainfall

On the basis of origin

#### 1 Convective Rainfall:

- Warm air rises due to convection currents, expands, cools down, and subsequently undergoes condensation, resulting in the formation of cumulus clouds & precipitation
- Prevalent during the summer or in the warmer hours of the day.
- Particularly common in equatorial regions and the inner regions of continents, especially in the northern hemisphere.
- Heavy rainfall accompanied by thunder and lightning occurs, but it tends to be of shorter duration

#### 2 Orographic Rainfall (Relief Rainfall) or Inversion of rainfall :

- Occurs when a moisture-saturated air mass encounters a mountain and is compelled to rise. With ascendance, adiabatic expansion and cooling takes place resulting in condensation and precipitation. ☒
- More rainfall towards windward slopes, while on the leeward side (rainshadow area), adiabatic heating (temperatures increase) takes place,

allowing for greater moisture absorption and resulting in dry conditions without rain. ☒

- Area situated on the leeward side is known as the rain-shadow area.

#### 3 Cyclonic Rainfall:

- Widespread precipitation associated with weather fronts and cyclones; includes tropical and extra-tropical cyclonic rain.

#### World Distribution of Rainfall

- Rainfall diminishes steadily from the equator towards the poles.
- Equatorial regions receive consistent year-round rainfall.
- Coastal areas receive more rainfall than inland regions.
- Between latitudes 35° and 40° N and S, eastern coasts get heavier rainfall due to easterly winds, decreasing westward.
- Between 45° and 65° N and S, westerly winds bring rainfall first to western continental margins, decreasing eastward.

#### Rainfall Regions

- Heavy Rainfall (greater than 200 cm annually): equatorial region; coastal monsoon region; Windward side of coastal mountains.
- Moderate Rainfall (between 100 to 200 cm annually): Adjacent regions of very heavy rainfall areas; Coastal regions in the warm temperate region.
- Inadequate Rainfall (between 50 to 100 cm annually): Eastern part of the continents in temperate regions; Interior of continents in tropical regions.
- Low Rainfall (less than 50 cm annually): Rain shadow regions; Western part of continents in tropical regions

## WORLD CLIMATE

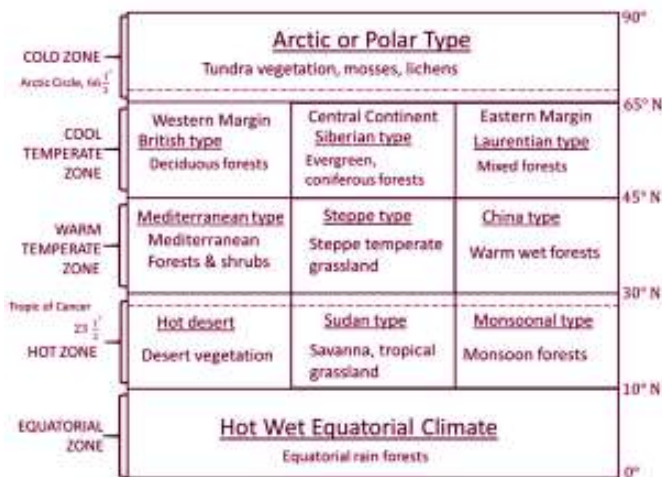


Fig.: Climatic Regions of the World

### Hot wet equatorial climate

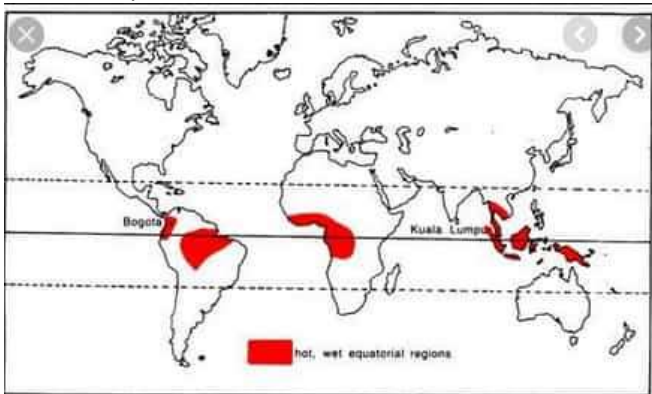


Fig. 121 The hot, wet equatorial regions

#### Distribution:

- Between 5-10 degrees north and south of the equator

#### Climate (Temperature & Precipitation):

- Uniformity of temperature throughout the year.

### TAIGA AND TUNDRA CLIMATE

#### Tundra Region Climate



- ❖ Tundra is a type of biome where the tree growth is hindered by frigid temperatures and short growing seasons.
- ❖ Extreme type of climate
- ❖ Tundra climates ordinarily fit the Köppen climate classification etc.
- ❖ Tundra vegetation is composed of dwarf shrubs, sedges, grasses, mosses, and lichens
- ❖ Notable plants in the arctic tundra include blueberry, crowberry, Labrador tea

- Both diurnal and annual range of temperature is small.
- Heavy rainfall (60-100 inches) well distributed throughout the year with double rainfall peaks
- The highest rainfall occurs at the time of equinoxes and least rainfall at the time of summer and winter solstice
- Throughout the year, precipitation is abundant and evenly distributed
- Seasons do not exist.
- The annual average is always greater than 150 cm

#### Vegetation & Wildlife:

- Tropical rainforest type vegetation
- 'Selvas' - Dense rainforest with the dense canopy
- Evergreen trees e.g. ebony, mahogany, greenheart, cabinet woods and dyewoods.

#### Major Tribes:

- Indian tribes of Amazon basin
- Pygmies of Congo basin
- Orang Asli of Malaysia

#### Equatorial Climate Soil

- The majority of the soil is nutrient-deficient.
- A thin layer of fertile soil forms on the surface as the dead leaves decay.
- Because of its high iron content, it is reddish in colour.
- Excessive rains quickly flush nutrients out of the soil.
- Oxisols : Equator soil . Some oxisols have been previously classified as laterite soils.

- ❖ Vegetation also include: . Dwarf willows, cotton grass, birches and sedges, rushes
- ❖ Notable animals include reindeer (caribou), musk ox, arctic hare, arctic fox, snowy owl, ptarmigan, northern red-backed voles, lemmings, and even polar bears near the ocean
- ❖ Alpine tundra occurs in mountains worldwide.
- ❖ The tundra soil is rich in nitrogen and phosphorus
- ❖ The soil also contains large amounts of biomass and decomposed biomass that has been stored as methane and carbon dioxide in the permafrost, making the tundra soil a carbon sink.
- ❖ As global warming heats the ecosystem and causes soil thawing, the permafrost carbon cycle accelerates and releases much of these soil-contained greenhouse gases into the atmosphere, creating a feedback cycle that increases climate change.

- ❖ Gelisols soils of permafrost region . (international classification )

- The few people of this region live a semi-nomadic life and have to adapt themselves to a severe environment
- Apart from the efforts of the different governments of the world in assisting the advancement of the Arctic inhabitants the Eskimos, Lapps, Samoyeds etc., new settlements have sprung up due to the finding of minerals LIKE iron ore from Labrador region of Canada; Gold, petrol and coal from Alaska, copper of Canada

**Economy:**

- **Human activities** of the tundra are **mostly restricted to the coast**. Where plateaus and mountains (permanently snow-covered) increase the altitude, it is uninhabitable

· In the Eurasian tundra live the other nomadic tribes viz.

Lapps	Northern Finland & Scandinavia
Samoyeds	Siberia (From the Ural mountains & Yenisey basin)
Yakuts	Siberia (Baikal Mountains & Lena River Basin)
Koryuks & Chuckchi	North East Asia

**Taiga vegetation**



- The warm temperate western margin climate or the Mediterranean climate is found between 30° and 45° North and South of the Equator
- Mediterranean climate occurs in southern and southwestern Australia, central Chile, coastal California, the Western Cape of South Africa and around the Mediterranean Basin.
- Basic cause of this type of climate is the shifting of the wind belts

See Map



- ❖ Taiga referred to in North America as a boreal forest or snow forest, is a biome characterized by coniferous forests consisting mostly of pines, spruces, and larches.
- ❖ The taiga or boreal forest has been called the world's largest land biome
- ❖ The largest areas are located in Russia and Canada.
- ❖ The taiga is found throughout the high northern latitudes, between the tundra and the temperate forest, from about 50°N to 70°N, but with considerable regional variation.
- ❖ Taiga has a subarctic climate
- ❖ This climate is classified as Dfc, Dwc, Dsc, Dfd and Dwd in the Köppen climate classification scheme
- ❖ Boreal or snow forest include moss and lichens fungi also . Moss They grow well in acidic soils such as the one that is found within the forest because of the fallen coniferous needles that lower the pH of the soil.

They are usually known by different names in different regions such as –

Maquis	Mediterranean
Chaparral	California
Matorral	Chile
Fynbos	South Africa
Mallee and kwongan	Australia

- Four Mediterranean Type of Climate distinctive features :**
1. A dry , warm summer with off shore trades winds
  2. A concentration of rainfall in winter with on shore Westerlies .
  3. Bright, Sunny weather with hot dry summer and wet , mild winters
  4. The Prominence of local winds around the mediterranean sea

**Mediterranean Climate**

Areas -Location and Extent :

### Key Lines :

- ❖ The concept of Mediterranean climate is characterized by mild wet winters and warm to hot, dry summers and occur on the west side of continents between about 30° to 31° and 40° latitude.
- ❖ The largest area with a mediterranean climate is the Mediterranean Basin, which has given the climate its name, although stretches of the Mediterranean coast (in Egypt, Libya and part of Tunisia) are too dry to be thus classified.
- ❖ More than half of the total mediterranean-climate regions on earth occur on the Mediterranean Sea.

### According to Koppen Climate :

- mediterranean climate code : Cs ( dry hot summer)
- this climate called Western Margin climate
- The warm temperate western margin climate or the Mediterranean climate is found between 30° and 45° North and South of the Equator
- This climate is witnessed in relatively fewer parts of the world and is almost entirely confined to the western margins of the continental landmasses.
- The basic cause of this climate is the seasonal shift of the wind belts.
- The Mediterranean climate is characterized by very distinctive climatic features with dry, warm summers and wet, cold winters and local winds.

Major cities : of mediterranean climate

Most historic cities of the Mediterranean Basin lie within Mediterranean

climatic including Algiers, Athens, Barcelona, Beirut, İzmir, Jerusalem, Marseille, Monaco, Naples, Rome, Tunisia, Valletta, and Valletta.

Current major cities with Mediterranean climates

outside of the Mediterranean Basin

include Adelaide, Cape

Town, Casablanca, Dushanbe, Lisbon, Los

Angeles, Perth, Porto, San

Francisco, Santiago, Tashkent and Victoria.

### The Mediterranean biome

- is also called as sclerophyll ecosystem or biome because of the development of special feature and characteristic in the dominant trees and shrubs to adapt to the typical environmental conditions of the Mediterranean climates (dry summer and wet winter).

Types of Mediterranean vegetation:

#### 1 Evergreen forests:

- They are found only in climatically suitable regions with rainfall over 25 inches and are open woodlands with evergreen oaks.

- The cork oaks are used for making wine-bottle corks.
- In Australia, the eucalyptus forests replace the evergreen oak.
- The giant sequoia or redwood is typical of the Californian trees.

#### 2. Evergreen Coniferous forests

- They include various kinds of pines, firs, cedars and cypresses.
- They appear mostly in the cooler highlands and where droughts are not so severe.

#### 3 Bushes and Shrubs

- This is the most prominent type of Mediterranean vegetation.
- The low bushes grow in scattered clumps and are often thorny.

#### 4 Grass

- Since most of the rain comes during the cool season when the growth is slow, the conditions of this region do not suit grass.
- They are generally wiry and bunched and are not suitable for animal farming.
- Thus cattle rearing is not an important occupation in the Mediterranean.

Que : Which local winds influence Mediterranean climatic region in Europe

1. **Sirocco**

2. **Mistral**

3. **Bora:**

**Explain :**

#### Local winds

- The Mediterranean climatic region in Europe experiences many local winds due to the topography of the region with the Alps in the North, the Sahara desert in the South, the continental interiors in the East, and the open Atlantic in the west. These create great differences in temperature, pressure, and precipitation. The two most important local winds are:

#### Sirocco

- This is a hot, dry and dusty wind.
- It originates in the Sahara desert and might occur at any time of the year but is mostly witnessed during spring.
- Normally it lasts only for a few days.
- It blows from the desert interiors of Sahara into the Mediterranean Sea and is usually associated with the depressions from the Atlantic ocean.
- After crossing the Sea, it is slightly cooled by the absorption of water vapour but is hot enough that it withers vegetation and crops of the region.
- Hence it is also called "Blood Rain" because it is carrying the red dust of the Sahara desert.

#### Mistral

- Mistral is a cold wind from the north.
- It rushes down the Rhone valley and its velocity is intensified by the funnelling effect in the valley between the Alps and the Central Massif [Plateau in France].
- In some extreme cases, the velocity of the wind is so high that trains can be derailed and trees are uprooted.
- In winter, if the Mistral is frequent the temperatures could go below the freezing point.

#### Other local winds

- Bora: Cold north-easterly wind along the Adriatic coast.
- Tramontana and Gregale: cold winds in the Mediterranean Sea.

**Que : Examine the salient features of Mediterranean climate. What makes the Mediterranean the Orchard Land of the World? (250 words)**

#### Economic Development

The region is important for

- Fruit cultivation, fruit canning and food processing
- Cereal growing, and flour mining
- Wine-making and
- Agricultural industries :
- Engineering and mining. The region is a net exporter of citrus fruits and the net importer of dairy products.

#### Orchard farming

- These regions are known as the world's orchard lands.
- A wide range of citrus fruits grows in the region. Examples: Sunkist oranges of California, Jaffa oranges of Israel. Seville oranges of Spain
- The fruit trees have long roots to draw water from depths during the long summer months.
- The olive tree is probably the most typical of all Mediterranean cultivated vegetation.
- Besides these, many nut trees like chestnuts, walnuts, hazelnuts and almonds are grown.: important for chocolate industry.
- Other important fruits are peaches, apricots, pears, cherries, plums and figs.

#### Crop cultivation

- Cereals are the most important crops and wheat is the leading crop followed by barley.

- Though the climatic conditions are not favourable for the extensive cultivation of wheat, the farmers have utilised the seasonal climatic rhythm to their best advantage.

#### • Sheep rearing

- The mountain pastures with cooler climate support a few sheep, goats and cattle.
- Transhumance is widely practised in the region.

#### Wine production

- Viticulture is speciality and tradition of Mediterranean region.
- The long, sunny summer allows the grapes to ripen.
- Regions bordering the Mediterranean Sea account for three-quarters of the world's production of wine.
- In Spain, Italy, France, Portugal wine is national drink

Wines name: Region and local name

- South Spain : Sherry
- Portugal: port wine
- Italy : Chianti, asti, marsala
- France : Champagne ( paris basin ), Burgundy in Rhone Saone valley

Grapes : Most of the inferior grapes are preserved as dried grapes and exported

Ex: name of grapes :

- Currants : from Levantine grapes
- raisins: from California
- Sultanas from Asia Minor/ Anatolia plateau, Turkey

#### DESERT AND GRASSLAND VEGETATION

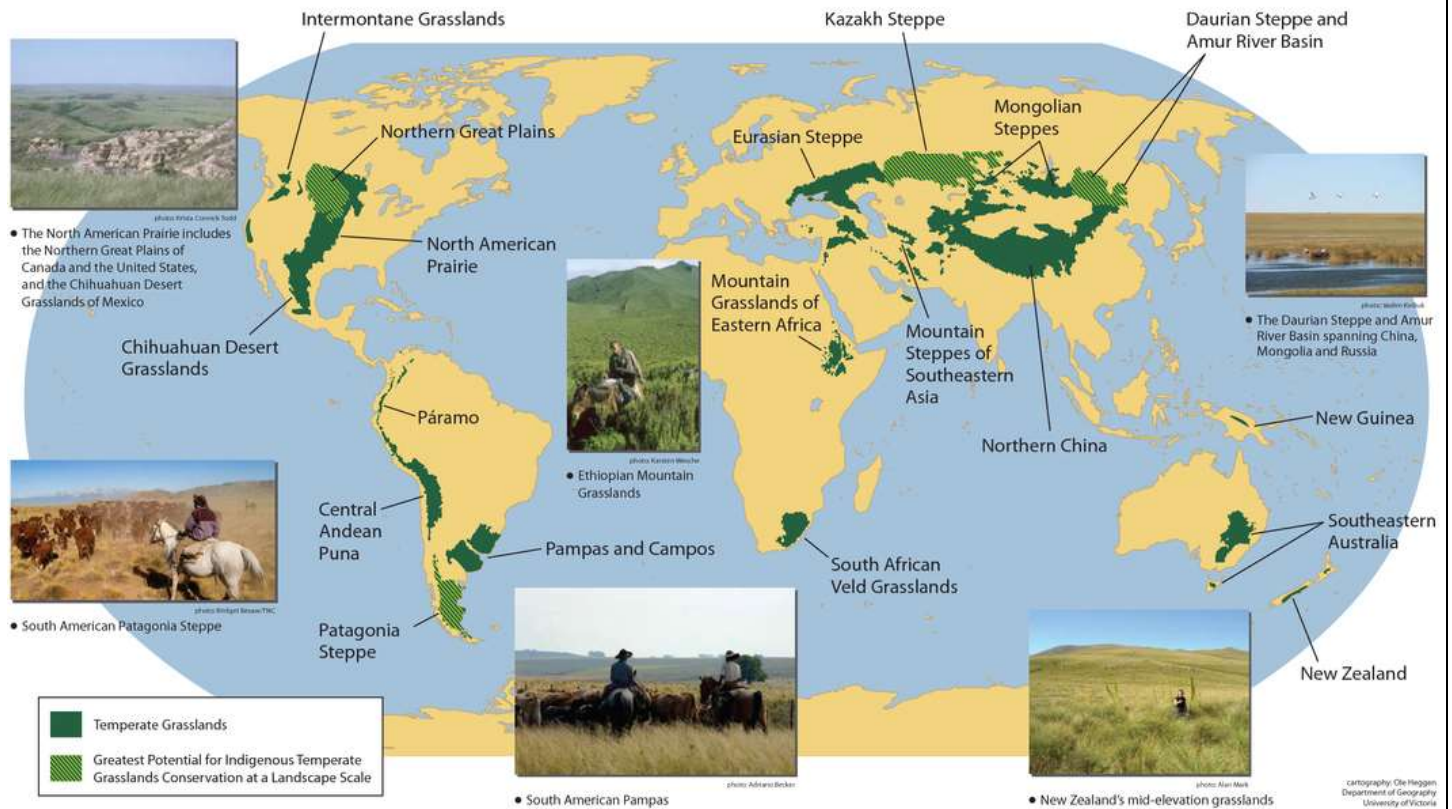
##### GRASSLAND VEGETATION

A **Grassland** : is a type of Habitat or Biome which is dominated by Grasses and other Herbaceous (non-woody) Flowering Plants and a variety of scattered Trees and Bushes. Grasslands occur in areas where there is not enough regular rainfall to support the growth of a Forest, but not so little as to form a Desert.

**Tropical Grasslands** - Tropical Grasslands are located near the equator, between the Tropic of Cancer and the Tropic of Capricorn. Most of the Tropical Grasslands are found in the interior part of continents between the Tropical Rain Forests and Tropical Deserts. Tropical Grasslands are also known as 'Savannahs'. Tropical Grasslands have a tropical continental climate

wherein wet and dry seasons come alternately.

# The World's Temperate Grasslands Conservation Priorities



## Areas of Tropical Grasslands

- Llanos of the Orinoco basin of Venezuela and Colombia.
- Cerrado of Brazil.
- Pine Savannahs of Belize and Honduras.



- Pampas in South America.
- Veld in Africa.
- Canterbury Plains in New Zealand.
- Murray-Darling Basin in Australia.
- Prairies in North America.
- Steppes in Central Asia.

## Grassland Regions

- Northern Prairie of North America.
- Patagonian Steppe in South America.
- Daurian Steppe in Asia

List of the Grassland of the World and their Location:

Grassland	Regions
Dawns	Australia
Pampas	South America (Argentina & Uruguay)
Prairies	North America
Savannah	Africa and Australia
Selvas	South America
Steppes	Europe and Northern Asia
Taiga	Europe and Asia
Velds	South Africa
Llanos	Venezuela (South America)
Pustaz	Hungary
Canterbury	New Zealand

**Temperate Grasslands** - Temperate Grasslands are located in the mid-latitudes, north of the Tropic of Cancer and south of the Tropic of Capricorn. They generally lie between Deserts and Temperate Forests. Temperate Grasslands have a temperate continental climate, which is cooler than Savannahs.

## 6 Areas of Temperate Grasslands

## DESERT VEGETATION

There are four types of desert found in the world: **sub-tropical desert; Coastal deserts; Cold desert; Polar Desert.**

Sahara is the world's largest tropical desert (desert).

#### DESERT CLIMATE

- Deserts are regions of scanty rainfall that may be Hot like the hot deserts of the Saharan type or Temperate as are the mid-latitude deserts like the Gobi

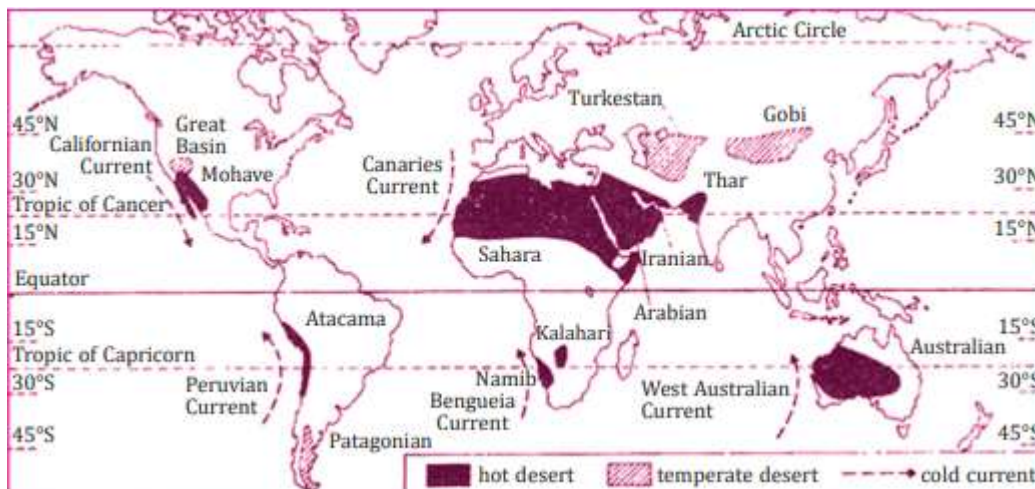
#### Hot Desert Climate

- Major hot deserts of the world are located on the western coasts of the continent between 15° and 30° N and S
- Aridity of the hot deserts is mainly due to the effects of off-shore Trade Winds; also called Trade Wind Deserts

- Sahara Desert, Great Australian Desert, Arabian, Iranian, Thar, Kalahari, Namib, Mohave, Sonoran, Atacama desert

#### Mid-Latitude Desert Climates

Among the mid-latitude deserts (usually between 30° and 50° N and S of the equator), many are found on plateau



#### Climate Conditions in Hot Deserts (Trade Wind Deserts)

- Average summer temperature is around 30°C.
- Rainfall: scarce (less than 25 cm) and most unreliable.
- Aridity is high due to subtropical high-pressure belt (descending air), offshore trade winds, desiccating effect of cold current.
- Temperature: high throughout the year, coastal deserts due to maritime influence have much lower temperatures; desert interiors however experience much higher summer temperatures and winter months are rather cold.
- Diurnal temperature range is very great, frost may occur at night in winters.

- Patagonian Desert is drier due to its rain-shadow position on the leeward side of the lofty Andes than to continentality.

#### Vegetation

- Xerophytic/drought-resistant scrubs, grasses and plants;
- Most desert shrubs have long roots to gather moisture
- Few or no leaves; foliage is waxy, leathery, hairy, or needle-shaped to prevent moisture loss.

#### Economy

- Gold mining in Great Australian Desert (e.g., Kalgoorlie, Coolgardie); Diamonds and copper in Kalahari; Sodium nitrate extraction in Atacama.
- North American deserts (silver in Mexico, uranium in Utah, copper in Nevada)
- Oil exploration in Sahara and Arabian Deserts (Saudi Arabia, Iran, Iraq, Kuwait, Algeria, Libya, Lebanon, Nigeria)

#### Climate Conditions in the Mid-Latitude Deserts

- They are cutoff from the rain-bearing winds; Rainfall less than 25 cm.
- Occasionally depressions may penetrate the Asiatic continental mass or unexpected convectional storms may bring rain in summer and falls in winter.
- Rainless because of either continentality (Gobi Desert) or rain-shadow effect (Patagonian Desert).

- Tribes: Bedouin (Arabs), Bushman (Kalahari), Bindibu (Australia), Tuaregs (Sahara), Gobi Mongols (Gobi)

#### WARM TEMPERATE WESTERN MARGIN (MEDITERRANEAN) CLIMATE

Confined to the western portion of continental masses, between 30 and 45 degrees north and south of the equator. Basic cause of this type of climate is the shifting of the wind belts. Found in areas around Mediterranean sea, central Chile, California, south-western tip of Africa, Southern Australia and south west Australia

##### Climate

- Temperature: Monthly average in summer is around 25° C and in winter below 10°C.
- Dry, warm summer with offshore trade winds, a concentration of rainfall in winter with on shore westerlies; annual precipitation ranges between 35-90 cm

##### Local winds around the Mediterranean Sea:

- Sirocco- hot, dry, dusty wind which originates in the Sahara Desert (Most frequent in spring). ☒ Other names of Sirocco: Chili (Tunisia), Ghibli (Libya), Leveche (Spain), Khamsin (Egypt), Gharbi (Adriatic and Aegean sea). ☒
- Mistral: cold wind from the north, rushing down the Rhone valley, intensified by the funnelling effect in the valley between the Alps and the Central Massif (Plateau in France). ☒
- Bora: cold north easterly wind in Adriatic sea.
- ☒ Tramontana and Gregale: cold winds of Mediterranean sea;

##### Vegetation

Shrubs- Maquis (South France), Macchia (Italy), Chaparral (California), Mallee (Australia) Eucalyptus forests in Australia, and Giant Sequoias or Redwoods in California; Species found include Pines, Firs, Cedars. Bushes and Shrubs are the most predominant type.

##### Economic Activity

- World's orchard lands: famous for citrus fruits Sunkist oranges (California), Seville oranges (Spain), Jaffa oranges (Israel) etc;

- Wine production: Viticulture is by tradition a Mediterranean occupation, sherry (Wine from southern Spain), Port wine (Portugal), Chianti, asti and marsala (Italy), Champagne, Bordeaux and Burgundy (France).
- Nut-bearing trees like chestnuts, walnuts, hazelnuts, and almonds;
- Cattle Rearing: Mountain pastures, with their cooler climate, support sheep, goats and sometimes cattle. Transhumance is widely practised (moving up and down the hills in search of pastures according to seasons)

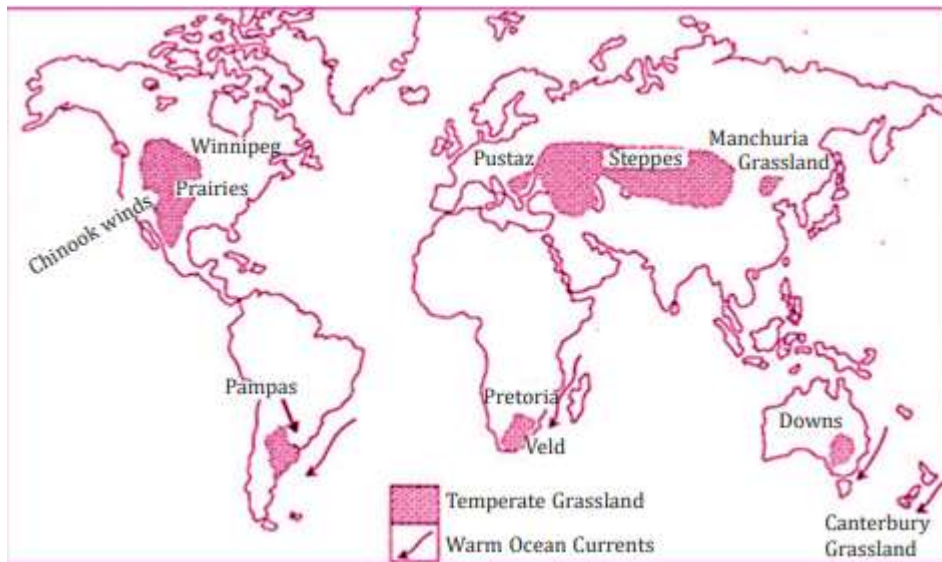
#### TEMPERATE CONTINENTAL (STEPPE) CLIMATE

- Lies in the westerly wind belt but they are so remote from maritime influence that the grasslands are practically treeless (between 40° and 55° N and S of the equator).
- They are known as Steppe (Eurasia), Pustaz (Hungary), Prairies (North America), Pampas (Argentina and Uruguay), Bush-Veld (North South Africa), High-Veld (Southern South Africa), Downs (Australia), Canterbury (New Zealand).

##### Climate

- Temperature: Seasonal variations with warm to hot summers (often exceeding 30°C) and cold winters.
- Extremes of temperature in northern hemisphere, steppe type of climate in the southern hemisphere is never severe (maritime influence) and winters are mild
- Precipitation: Low annual rainfall (25-75 cm); the dry season is particularly pronounced in temperate grasslands adjoining desert
- Summer rainfall (Maximum) from convectional sources when continental interiors are heated
- Winter rainfall (lesser) by occasional depressions of the Westerlies.
- Maritime influence in the southern hemisphere, greater rainfall because of warm ocean currents.
- In Prairies a local hot wind called the Chinook (also called 'snow eater') comes melting the snow covered pastures





### Vegetation

- Grasslands are practically treeless, grass is nutritious thus promoting livestock rearing in the region
- Grasses are not only shorter but also wiry and sparse. In arid areas like Asia's continental interiors, wiry grasses favour ranching over arable farming.
- Moving polewards, increased precipitation results in wooded steppes, where conifers gradually appear

### Economic Activity

- Extensive mechanized wheat cultivation, nomadic herding, pastoral farming etc; Due to extensive, mechanised wheat cultivation they are known as the 'granaries of the world'.

### WARM TEMPERATE EASTERN MARGIN (CHINA TYPE)

- It is a modified form of monsoonal climate, found on the eastern margins of continents in warm temperate latitudes. In summer, the regions are under the influence of moist, maritime airflow from the subtropical anticyclonic cells
- Climate: Warm moist summer and cool, dry winter; strong maritime influence; small annual temperature range
- In summer, the regions are under the influence of moist, maritime airflow from the subtropical anticyclonic cells
- Rainfall throughout the year (60 to 150 cm); Rainfall from Convictional sources or as orographic rain in summer, or from depressions in winter.
- Local storms: Typhoons (tropical cyclones), and Hurricanes, also occur

### Subdivided Into Three Main Types

- China Type (Central and North China, South Japan): temperate monsoonal; great annual temperature

range; rain in summer and winter; occurrence of typhoons in late summer;

- Gulf Type (South Eastern USA): slight monsoonal; no distinct dry period; occurrence of hurricanes and tornadoes
- Natal type: Natal, Eastern Australia, Southern Brazil, Paraguay, Uruguay and Northern Argentina and all warm eastern temperate margins of southern hemisphere; Dominance of maritime influence

### Vegetation

- Lush vegetation with evergreen broad-leaved forests and deciduous hardwood trees in lowlands due to well distributed rainfall all year round.
- Conifer species like pines and cypresses in highlands; z No dry or cold seasons, allowing uninterrupted perennial plant growth.

### Economic Activity

- Warm temperate eastern margins are the most productive parts of the middle latitudes.
- World's greatest rice-growing areas, warm wet and lowland favour rice cultivation. Sugarcane, cotton, tobacco, maize, dairy products etc.
- Timber: Economic value in China and southern Japan (oak, camphor); Eucalyptus forests in Eastern Australia; Lowland deciduous forests in Gulf states of the U.S.A.

Local Winds Southerly Burster (Cold Wind in Australia) impacts New South Wales and Victoria ; Pampero (Cold Dry Wind in Argentina & Uruguay; Berg (Hot & Dry Wind in South Africa) bring

### Cool Temperate Western Margin (British Type)

Found in Britain, North West Europe, British Columbia(USA), Southern Chile, Tasmania and most parts of New Zealand (between 40° and 65° latitude in the Northern Hemisphere)

## Climate

- They are under the permanent influence of westerlies throughout the year;
- Regions of frontal cyclonic activity, typical of Britain, and are thus said to experience the British type of climate.
- High maritime influence on temperature and precipitation
- Temperature: Mild winters and cool summers (Mean annual temperature - 5 to 15°C)
- Rainfall: Throughout the year, with a tendency towards a slight winter or autumn maximum from cyclonic sources.
- Seasons are very distinct. Winter - short duration and mild (due to warming effect of North Atlantic Drift ); Spring are driest; summer and autumn

## Vegetation

Deciduous trees occur in pure stands. Higher up the mountains deciduous trees (Shed leaves in winters to protect against snow and frost) are generally replaced by conifers. Valuable temperate hardwood: oak, elm, birch, beech, poplar, Willows, Alder, Aspen, etc.

## Economic Activity

- Market gardening, mixed farming, sheep rearing etc. Fishing is important in Britain, Norway, and British Columbia.
- British-type climate suitable for crops and dairy farming. Mixed farming in north-western Europe with wheat, barley, and advanced dairy practices.

## COOL TEMPERATE EASTERN MARGIN (LAURENTIAN):

Intermediate type of climate between the British and the Siberian type that is found in only two regions: north eastern North America (eastern Canada, north east USA and Newfoundland) and eastern coastlands of Asia, including eastern Siberia, North China, Manchuria, Korea and northern Japan.

In the southern hemisphere, this type of climate is absent.

## Climate

- Temperature: Features of both continental and maritime climate; cold, dry winters and warm, moist summers.
- Arctic off-shore cold currents are instrumental in cooling the summer, otherwise, it would have been even hotter
- Rainfall: 75 - 150 cm of rainfall distributed throughout the year with a maximum during summer,

- Northern Hemisphere: Rainfall distribution is uniform due to Atlantic influence and the Great Lakes, high temperatures in summer and snowfall in winters;
- Asiatic regions: Rainfall is far less uniform, the rainfall regime is similar to that of the tropical monsoon type in India. Japan receives adequate rainfall from both the south east monsoon in summer and North West Monsoon in winter

## Vegetation

- Coniferous (north of 50 Degree N latitude) and deciduous (south of 50 Degree N latitude); Oak, beech, maple, and birch are principal trees.

## Economic Activity

- Lumbering important activity, agriculture is less important due to severity and length of winter.
- Fishing, particularly in the Grand Banks of Newfoundland.

## THE COOL TEMPERATE CONTINENTAL CLIMATE (SIBERIAN)

Experienced only in the Northern hemisphere: North America (from Alaska across Canada into Labrador), Europe and Asia (between 50° and 70° N and S of the equator).

## Climate

- Temperature Brief, warm summers (20-25°C) and long, extremely cold winters (-30 to -40°C); Occasional violent cold polar winds, like Canadian blizzards and Eurasian buran.
- Rainfall: Relatively dry year-round, low annual precipitation mainly in the form of snow ;
- Vegetation Mosses, lichens and sledges In more sheltered spots, stunted birches, dwarf willows, hardy grasses and reindeer moss are found.
- Tundra, taiga (boreal forest), and grasslands adapted to harsh conditions ;
- Conifers with adaptations like conical shape, thick needle-shaped leaves, and podzolized soils

## Economic Life

- Lumbering is the primary economic activity, utilizing vast coniferous forests; Softwood logs transported downstream on rivers.
- Paper and pulp industry (Canada and the U.S.A.)
- Agriculture is challenging with limited crops due to extreme cold and short growing season

## Arctic or Polar or Tundra Climate

- Found north of the Arctic Circle in the northern hemisphere and in the southern hemisphere in the

continent of Antarctica; Extremely cold with long winters, devoid of tall trees or forests.

- Climate
- Temperature: Winters harsh, often below -37°C; summers brief with temperatures rarely exceeding 10°C.
- Precipitation: Generally low, with limited moisture in the form of snow and occasional freezing rain; Summer maximum precipitation in the form of rain or sleet

**Vegetation**

- Tundra vegetation limited to hardy, low-growing plants, mosses, and lichens
- Permafrost restricts the growth of deep-rooted plants
- Coastal lowlands support hardy grasses and reindeer moss;
- Brief summer bloom with the melting of snow, known as "Arctic Prairies
- Inhabitants like Eskimos, Lapps, and Samoyeds lead a semi-nomadic lifestyle, residing in compact igloos during winter

**WORLD CLIMATE**

**THREE BROAD APPROACHES** have been adopted for classifying world climate

- **Genetic classification** attempts to organise climates according to their causes.- This approach considers
- Major Types:

Capital Letter	Climate Types	Average Temperature
A	Tropical Climate	above 18°C throughout the year.
B	Dry Climate	S- Semi Arid and W - arid
C	Warm Temperate	Between 18°C and -3°C
D	Cool Temperate	Between 10°C and below -3°C
E	Ice Climates	Below 10°C

**Table 11.1 : Climatic Groups According to Koeppen**

Group	Characteristics
A - Tropical	Average temperature of the coldest month is 18 C or higher
B - Dry Climates	Potential evaporation exceeds precipitation
C - Warm Temperate	The average temperature of the coldest month of the (Mid-latitude) climates years is higher than minus 3 C but below 18 C
D - Cold Snow Forest Climates	The average temperature of the coldest month is minus 3 C or below
E - Cold Climates	Average temperature for all months is below 10 C
H - High Land	Cold due to elevation

- Subdivision = designated by small letters, based on seasonality of precipitation and temperature characteristics

seasons of dryness	degree of severity of temperature
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factors such as geographical location, altitude, ocean currents, atmospheric circulation, and prevailing winds that contribute to the formation of specific climatic conditions For example, genetic classifications may explore how mountain ranges create rain shadows or how ocean currents influence coastal climates.

- **Applied classification** is for specific purpose like agriculture, urban planning, or environmental management.
- **Empirical classification** is based on observed data, particularly on temperature and precipitation

**NAME OF THREE CLIMATE CLASSIFICATION :**

- Trewartha being more temperature-vegetation oriented
- Thornthwaite centers around moisture availability.
- V. Koeppen. - identified a close relationship between the distribution of vegetation and climate

**Koeppen Climate**

- He introduced the use of capital and small letters to designate climatic groups and types
- The capital letters : A, C, D and E delineate humid climates and B dry climates
- The B- Dry Climates are subdivided using the capital letters S for steppe or semi-arid and W for deserts.

f - no dry season	a
m- monsoon climate	b
w- winter dry season	c
s- summer dry season	d

Small Letters : Sub types

- f -sufficient precipitation
- m- rainforest despite dry season
- w- dry season in winter
- h- dry and hot
- c- cool summer
- g - gangetic plain

Main Climates	Precipitation	Temperature
A: equatorial	W:desert	h: hot arid
B: arid	S: steppe	k: cold arid
C: warm temperate	f: fully humid	a: hot summer
D: continental	s: summer dry	b: warm summer
E: polar	w: winter dry	c: cool summer
	m: monsoonal	d: extremely continental
		F: polar
		T: polar

Table 11.2 : Climatic Types According to Koeppen

Group	Type	Letter Code	Characteristics
A-Tropical Humid Climate	Tropical wet	Af	No dry season
	Tropical monsoon	Am	Monsoonal, short dry season
	Tropical wet and dry	Aw	Winter dry season
B-Dry Climate	Subtropical steppe	BSh	Low-latitude semi arid or dry
	Subtropical desert	BWh	Low-latitude arid or dry
	Mid-latitude steppe	BSk	Mid-latitude semi arid or dry
	Mid-latitude desert	BWk	Mid-latitude arid or dry
C-Warm temperate (Mid-latitude) Climates	Humid subtropical	Cfa	No dry season, warm summer
	Mediterranean	Cs	Dry hot summer
	Marine west coast	Cfb	No dry season, warm and cool summer
D-Cold Snow-forest Climates	Humid continental	Df	No dry season, severe winter
	Subarctic	Dw	Winter dry and very severe
E-Cold Climates	Tundra	ET	No true summer
	Polar ice cap	EF	Perennial ice
H-Highland	Highland	H	Highland with snow cover

x

Group A : Tropical Humid Climates:

Features :

- Tropical humid climates exist between Tropic of Cancer and Tropic of Capricorn. The sun being overhead throughout the year and the presence of Inter Tropical Convergence Zone (ITCZ) make the climate hot and humid.
- Annual range of temperature is very low and annual rainfall is high.
- The tropical group is divided into three types, namely (i) Af- Tropical wet climate; (ii) Am - Tropical monsoon climate; (iii) Aw- Tropical wet and dry climate

Tropical Wet Climate (Af)

- Found : Near the Equator
- Areas : Amazon Basin in South America, western equatorial Africa and islands of East Indies-Philippine Archipelago, Indonesian Archipelago, Borneo, and New Guinea.
- Significant amount of rainfall occurs in every month of the year as thunder showers in the afternoon.
- The temperature is uniformly high and the annual range of temperature is negligible.

- The maximum temperature on any day is around 30°C while the minimum temperature is around 20°C.
- Tropical evergreen forests with dense canopy cover and large biodiversity are found in this climate

#### Tropical Monsoon Climate (Am)

- found over the Indian sub-continent, North Eastern part of South America and Northern Australia. Heavy rainfall occurs mostly in summer.
- Winter is dry.

#### Tropical Wet and Dry Climate (Aw)

- occurs north and south of Af type climate regions.
- It borders with dry climate on the western part of the continent and Cf or Cw on the eastern part
- found to the north and south of the Amazon forest in Brazil and adjoining parts of Bolivia and Paraguay in South America, Sudan and south of Central Africa
- The annual rainfall in this climate is considerably less than that in Af and Am climate types and is variable also
- The wet season is shorter and the dry season is longer with the drought being more severe.
- Temperature is high throughout the year and diurnal ranges of temperature are the greatest in the dry season.
- Deciduous forest and tree-shredded grasslands occur in this climate.

#### Dry Climates : B

##### Features :

- very low rainfall that is not adequate for the growth of plants.
- These climates cover a very large area of the planet extending over large latitudes from 15° - 60° north and south of the equator
- At low latitudes, from 15° - 30°, they occur in the area of subtropical high where subsidence and inversion of temperature do not produce rainfall
- On the western margin of the continents, adjoining the cold current, particularly over the west coast of South America, they extend more equatorwards and occur on the coast land.
- In middle latitudes, from 35° - 60° north and south of equator, they are confined to the interior of continents where maritime-humid winds do not reach and to areas often surrounded by mountains. Dry climates are divided into
- steppe or semi-arid climate (BS) and
- desert climate (BW).

#### Further divided into:

- subtropical steppe (BSh) and subtropical desert (BWh) at latitudes from 15° - 35° and
- mid-latitude steppe (BSk) and mid-latitude desert (BWk) at latitudes between 35° - 60°.

#### Subtropical steppe (BSh) and subtropical desert (BWh)

##### Features:

- They have common precipitation and temperature characteristics
- Located in the transition zone between humid and dry climates
- The rainfall in both the climates is highly variable.
- subtropical steppe receives slightly more rainfall than the desert
- Rain occurs in short intense thundershowers in deserts and is ineffective in building soil moisture.
- Fog is common in coastal deserts bordering cold currents.
- The annual and diurnal ranges of temperature are also high
- Maximum temperature in the summer is very high. The highest shade temperature of 58° C was recorded at Al Aziziyah, Libya on 13 September 1922.

#### Warm Temperate (Mid-Latitude) Climates-C

- Extend from 30° - 50° of latitude mainly on the eastern and western margins of continents.
- Warm summers with mild winters.
- They are grouped into four types:
  - (i) Humid subtropical, i.e. dry in winter and hot in summer (Cwa);
  - (ii) Mediterranean (Cs);
  - (iii) Humid subtropical, i.e. no dry season and mild winter (Cfa);
  - (iv) Marine west coast climate (Cfb).

#### Humid Subtropical Climate (Cwa)

- Humid subtropical climate occurs poleward of Tropic of Cancer and Capricorn, mainly in North Indian plains and South China interior plains. The climate is similar to Aw climate except that the temperature in winter is warm.

#### Mediterranean Climate (Cs)

- occurs around Mediterranean sea, along the west coast of continents in subtropical latitudes between 30° - 40° latitudes
- e.g. — Central California, Central Chile, along the coast in south eastern and south western Australia.

- These areas come under the influence of sub tropical high in summer and westerly wind in winter.
- Hence, the climate is characterised by hot, dry summer and mild, rainy winter.
- Monthly average temperature in summer is around 25° C and in winter below 10°C.
- The annual precipitation ranges between 35 - 90 cm

#### Humid Subtropical (Cfa) Climate

- lies on the eastern parts of the continent in subtropical latitudes
- In this region the air masses are generally unstable and cause rainfall throughout the year
- They occur in eastern United States of America, southern and eastern China, southern Japan, northeastern Argentina, coastal south Africa and eastern coast of Australia
- The daily range of temperature is small
- The annual averages of precipitation vary from 75-150 cm.
- Thunderstorms in summer and frontal precipitation in winter are common.
- Mean monthly temperature in summer is around 27°C, and in winter it varies from 5°-12° C..

#### Marine West Coast Climate (Cfb)

- is located poleward from the Mediterranean climate on the west coast of the continents.
- The main areas are: Northwestern Europe, west coast of North America, north of California, southern Chile, southeastern Australia and New Zealand.
- Due to marine influence, the temperature is moderate and in winter, it is warmer than for its latitude.
- The mean temperature in summer months ranges from 15°-20°C and in winter 4°-10°C.

- The annual and daily ranges of temperature are small.
- Precipitation occurs throughout the year.
- Precipitation varies greatly from 50-250cm

#### Cold Snow Forest Climates (D)

- occur in the large continental area in the northern hemisphere between 40°-70° north latitudes
- in Europe, Asia and North America
- divided into two types: (i) Df- cold climate with humid winter; (ii) Dw- cold climate with dry winter.
- The severity of winter is more pronounced in higher latitudes.

#### Cold Climate with Humid Winters (Df)

- Cold climate with humid winter occurs poleward of marine west coast climate and mid latitude steppe
- The winters are cold and snowy. The frost free season is short.
- The annual ranges of temperature are large.
- Poleward, the winters are more severe

#### Cold Climate with Dry Winters (Dw)

- occurs mainly over Northeastern Asia
- The development of pronounced winter anti cyclone and its weakening in summer sets in monsoon like reversal of wind in this region
- Poleward summer temperatures are lower and winter temperatures are extremely low with many locations experiencing below freezing point temperatures for up to seven months in a year.
- Precipitation occurs in summer.
- The annual precipitation is low from 12-15 cm

#### Polar Climates (E)

- Polar climates exist poleward beyond 70° latitude.
- Polar climates consist of two types: (i) Tundra (ET); (ii) Ice Cap (EF)

Tundra Climate (ET)	Ice Cap Climate (EF)
Vegetation= low growing mosses, lichens and flowering plants	occurs over interior Greenland and Antarctica.
This is the region of permafrost where the sub soil is permanently frozen	Even in summer, the temperature is below freezing point.
The short growing season and water logging support only low growing plants.	This area receives very little precipitation. The snow and ice get accumulated and the mounting pressure causes the deformation of the ice sheets and they break.
During summer, the tundra regions have very long duration of day light	They move as icebergs that float in the Arctic and Antarctic waters.

#### Highland Climates (H)

- Highland climates are governed by topography. In high mountains, large changes in mean temperature occur over short distances.
- Precipitation types and intensity also vary spatially across high lands

- There is vertical zonation of layering of climatic types with elevation in the mountain environment

As per Koeppen's scheme, India comprises EIGHT distinct climatic regions.

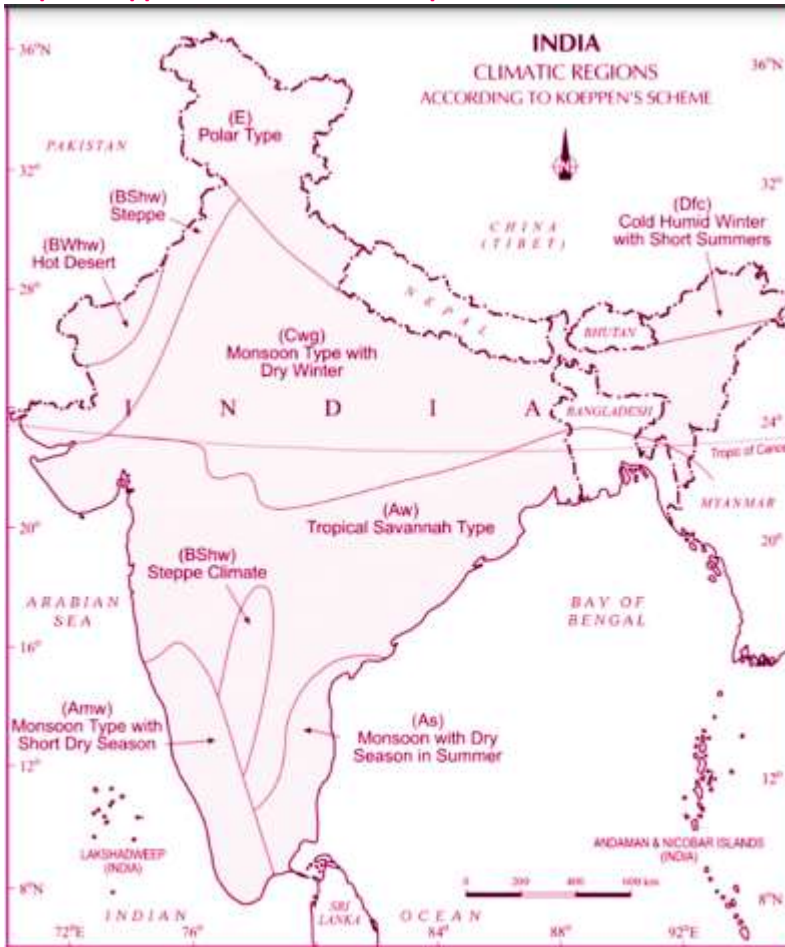


Fig: India: Climatic Region According to Koeppen's Scheme

Table: Climatic Regions of India According to Koeppen's Scheme

**Table 4.1 : Climatic Regions of India According to Koeppen's Scheme**

Type of Climate	Areas
Amw Monsoon with short dry season	West coast of India south of Goa
As - Monsoon with dry summer	Coromandel coast of Tamil Nadu
Aw - Tropical savannah	Most of the Peninsular plateaus, south of the Tropic of Cancer
BShw - Semi-arid steppe climate	North-western Gujarat, some parts of western Rajasthan and Punjab
BWhw - Hot desert	Extreme western Rajasthan
Cwg - Monsoon with dry winter	Ganga plain, eastern Rajasthan, northern Madhya Pradesh, most of North-east India
Dfc - Cold humid winter with short summer	Arunachal Pradesh
E - Polar type	Jammu and Kashmir, Himachal Pradesh and Uttarakhand

Questions :

1. Which one of the following is suitable for Koeppen's "A" type of climate?
  - (a) High rainfall in all the months
  - (b) Mean monthly temperature of the coldest month more than freezing point
  - (c) Mean monthly temperature of all the months more than 18°C
  - (d) Average temperature for all the months below 10° C.

Answer:

- (a) High rainfall in all the months

2 Koeppen's system of classification of climates can be termed as

- (a) Applied
- (b) Systematic
- (c) Genetic
- (d) Empirical.

Answer:

- (d) Empirical

3 Most of the Indian Peninsula will be grouped according to Koeppen's system under:

- (a) "Af"

(b) "BSh"

(c) "Cfb"

(d) "Am"

Answer:

(d) "Am"

4 Which one of the following groups of four climates represents humid conditions?

(a) A—B—C—E

(b) A—C—D—E

(c) B—C—D—E

(d) A—C—D—F

Answer:

(b) A—C—D—E

5 What kind of climate is expressed by the letter code- BSh?

(a) Tropical Dry

(b) Tropical Monsoon

(c) Subtropical Dry Steppe

(d) Mid Latitude Climate

Answer:

(c) Subtropical Dry Steppe

6. What kind of climate is expressed by the letter code- ET?

(a) Humid subtropical

(b) Mediterranean

(c) Marine west coast

(d) Tundra

Answer:

(d) Tundra

7. Which of the following area come under tropical wet climate?

(a) Amazon Basin in South America

(b) Western equatorial Africa

(c) Islands of East Indies.

(d) All of the above

Answer:

(d) All of the above

5 What type of climatic conditions would prevail if the sun spots increase?

Answer:

Sunspots are dark and cooler patches on the sun which increase and decrease in a cyclical manner. According to some meteorologists, when the number of sunspots increase, cooler and wetter weather and greater storminess occur. A decrease in sunspot numbers is associated with warm and drier conditions.

Que : On what basis did Koeppen classified the climates of different regions of the world?

1. Latitude

2. Altitude

3. Vegetation

Select the correct code from the options given below:

a) 1 and 3

b) 1 and 2

c) 3 only

d) 1,2 and 3

### Que 2

Which region of Rajasthan experience Aw type of climate as per Koeppen's climatic classification?

1. Southern most region

2. North Eastern region

3. Western region

4. Northern most region

### Q 3 : Match the List

Koeppen's Climate Region	Located In
As	Coromondal Coast
Bwhw	North West Gujarat
Dfc	Arunachal Pradesh
Amw	West Coast of India,
SOut of Goa	

Q 4 According to Koeppen Climate the term " Aw" denoted as

a) Konkan Coast

b) Peninsular Plateau

c) Western Himalaya

d) Narmada Valley

Q5 According to Koeppen Climate Classification, the climate of North Bihar or Great Northern Plains of India may be explained as

a) Cwg

b) Aw

c) Amw

d) As