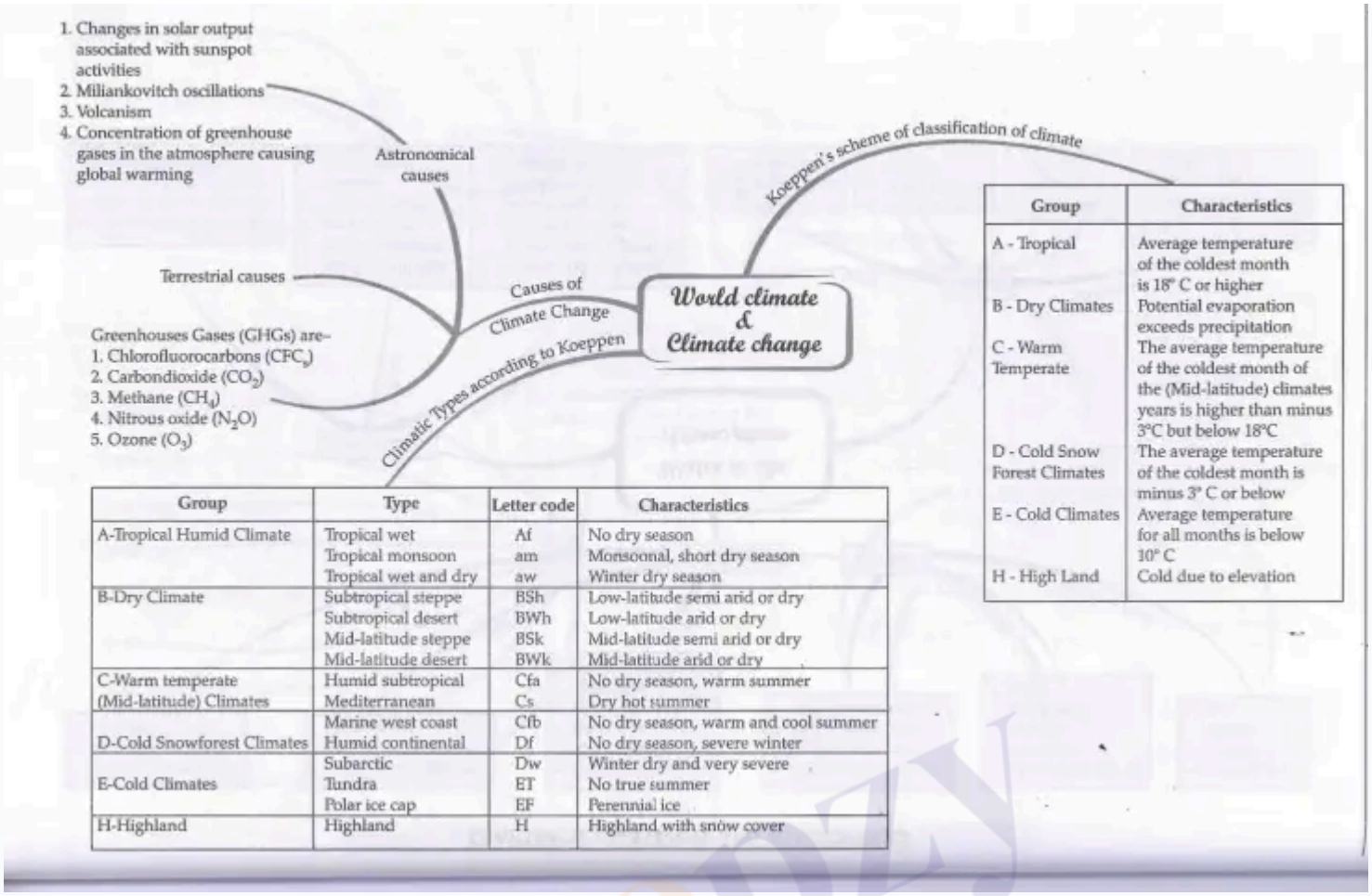
World Climate and Climate Change

Climate refers to the average weather conditions of a place over a long period. The Earth's climate varies widely due to natural and human factors. Climate change involves significant changes in global or regional climate patterns, especially from the mid to late 20th century onwards.



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

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 Snowforest 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

This diagram illustrates the causes of climate change, including astronomical and terrestrial factors, and presents the classification of various climate types based on Köppen's system.

Köppen's Scheme of Classification of Climate

Köppen's classification is an empirical system that relates climate to vegetation distribution using temperature and precipitation data. It divides climates into five major groups, designated by capital letters A, B, C, D, and E, with an additional group H for highland climates. Each group is further subdivided using small letters indicating seasonality of precipitation and temperature severity.

Exam Question

Q: What is the basis of Köppen's climate classification?

A: Köppen's classification is based on observed temperature and precipitation patterns and their relationship with vegetation distribution.

Tropical Humid Climates (Group A)

Located between the Tropic of Cancer and Tropic of Capricorn, these climates are hot and humid due to the sun's overhead position and the Inter Tropical Convergence Zone (ITCZ). They include:

- **Af - Tropical Wet Climate:** Found near the equator, e.g., Amazon Basin, western equatorial Africa. Temperatures range from 20°C to 30°C with high rainfall year-round.
- **Am - Tropical Monsoon Climate:** Found in the Indian subcontinent, northeastern South America, and northern Australia, characterized by seasonal monsoon rains.
- **Aw - Tropical Wet and Dry Climate:** Located north and south of Af regions, with distinct wet and dry seasons and deciduous forests.

Exam Question

Q: Name the three types of tropical humid climates in Köppen's classification.

A: Tropical wet (Af), tropical monsoon (Am), and tropical wet and dry (Aw) climates.

Dry Climates (Group B)

Characterized by low rainfall insufficient for most vegetation, these climates occur between 15° and 60° latitudes. They are subdivided into:

- **BS - Steppe or Semi-arid Climate:** Receives slightly more rainfall than deserts, supports sparse grasslands.
- **BW - Desert Climate:** Very low rainfall, extreme temperatures, and sparse vegetation.

Subtypes include subtropical steppe (BSh) and subtropical desert (BWh), with high summer temperatures and large temperature ranges.

Exam Question

Q: What distinguishes steppe climates from desert climates?

A: Steppe climates receive more rainfall than deserts, enough to support grasslands, while deserts have very low rainfall and sparse vegetation.

Warm Temperate Climates (Group C)

Found between 30° and 50° latitudes on continental margins, these climates have moderate temperatures and precipitation. Types include:

- **Cwa - Humid Subtropical Climate:** Warm winters, summer rainfall, found in North Indian plains and South China.
- **Cs - Mediterranean Climate:** Dry summers, wet winters, found around the Mediterranean Sea and similar latitudes.
- **Cfa - Humid Subtropical Climate:** Rainfall throughout the year, thunderstorms in summer, found in eastern USA, southern China.
- **Cfb - Marine West Coast Climate:** Mild temperatures, precipitation year-round, found in Northwestern Europe and parts of North America.

Exam Question

Q: Describe the Mediterranean climate characteristics.

A: Mediterranean climate has dry summers, wet winters, moderate temperatures, and annual precipitation between 35-90 cm.

Cold Snow Forest Climates (Group D)

Located between 40° and 70° north latitudes in Europe, Asia, and North America, these climates have severe winters and short summers. Types include:

- **Df - Cold Climate with Humid Winters:** Short frost-free season, large temperature ranges.
- **Dw - Cold Climate with Dry Winters:** Found in Northeastern Asia, low precipitation, monsoon-like wind reversals.

Exam Question

Q: What are the main features of cold snow forest climates?

A: They have severe winters, short summers, large temperature ranges, and varying precipitation patterns.

Polar Climates (Group E)

Found beyond 70° latitude, polar climates include:

- **ET - Tundra Climate:** Vegetation includes mosses and lichens; permafrost present; long daylight in summer.
- **EF - Ice Cap Climate:** Found in Greenland and Antarctica; temperatures below freezing year-round; very low precipitation.

Exam Question

Q: What distinguishes tundra climate from ice cap climate?

A: Tundra climate supports some vegetation and has permafrost, while ice cap climate is permanently frozen with no vegetation.

Highland Climates (Group H)

These climates are influenced by altitude and topography. Temperature and precipitation vary greatly over short distances, with vertical zonation of climate types on mountains.

Exam Question

Q: How does altitude affect highland climates?

A: Altitude causes temperature to decrease and precipitation patterns to change, creating distinct climate zones vertically.

Climate Change, Climate in the Past, Causes of Climate Change, Global Warming

Earth's climate has changed naturally over millions of years, with evidence from geological records, glacial deposits, tree rings, and historical data showing alternating warm and cold periods.

Examples include the wet and cool climate in Rajasthan around 8,000 B.C., the Harappan Civilization period with higher rainfall, and the Pleistocene Epoch with glacial and inter-glacial cycles.

Recent decades have seen increased climate variability, including extreme weather events and temperature rises.

Causes of Climate Change

Causes are grouped into astronomical and terrestrial factors:

- **Astronomical Causes:** Changes in solar output linked to sunspot cycles, Earth's orbital variations (Milankovitch cycles), and axial tilt affect insolation.
- **Terrestrial Causes:** Volcanic eruptions release aerosols that reduce solar radiation reaching Earth.
- **Anthropogenic Causes:** Increased greenhouse gas emissions from fossil fuel combustion, deforestation, and industrial activities enhance the greenhouse effect, leading to global warming.

Exam Question

Q: What are the main natural and human causes of climate change?

A: Natural causes include solar activity, Earth's orbital changes, and volcanic eruptions. Human causes mainly involve increased greenhouse gas emissions.

Greenhouse Effect and Global Warming

Greenhouse gases (GHGs) like carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and ozone trap heat in the atmosphere, warming the Earth. The greenhouse effect is essential for life but enhanced GHG concentrations cause global warming.

Global warming leads to rising temperatures, melting glaciers, sea-level rise, and climate disruptions.

International efforts like the Kyoto Protocol aim to reduce GHG emissions to mitigate climate change.

Exam Question

Q: What is the greenhouse effect and how does it relate to global warming?

A: The greenhouse effect is the trapping of heat by greenhouse gases in the atmosphere. Increased GHGs intensify this effect, causing global warming.

Solved Examples

1. **Example:** Identify the climate type of a region with high temperatures year-round, heavy rainfall, and dense tropical forests.

   Solution: This describes a Tropical Wet Climate (Af) under Köppen's classification.

2. **Example:** Explain why deserts are found around 30° latitude.

   Solution: These areas lie under subtropical high-pressure belts where descending air inhibits rainfall, creating dry desert climates.

Practice Set

Easy

1. What does Köppen's climate classification primarily use to classify climates?
2. Name two greenhouse gases responsible for global warming.

Moderate

1. Describe the characteristics of the Mediterranean climate.
2. What are Milankovitch cycles and how do they affect climate?

Challenging

1. Explain the impact of volcanic eruptions on climate change.
2. Discuss the significance of the Kyoto Protocol in addressing climate change.

Answer Key

1. Köppen's classification uses temperature and precipitation data.
2. Carbon dioxide (CO_2) and methane (CH_4).
3. Dry summers, wet winters, moderate temperatures, and annual precipitation between 35-90 cm.
4. Milankovitch cycles are variations in Earth's orbit and tilt that affect solar radiation and climate patterns.
5. Volcanic eruptions release aerosols that reduce solar radiation, causing temporary cooling.
6. The Kyoto Protocol is an international agreement to reduce greenhouse gas emissions to combat global warming.

Quick Reference

- **Köppen Classification:** A (Tropical), B (Dry), C (Warm Temperate), D (Cold Snow Forest), E (Polar), H (Highland)
- **Greenhouse Gases:** CO_2, CH_4, N_2O, CFCs, O_3
- **Major Climate Change Causes:** Solar activity, volcanic eruptions, greenhouse gas emissions
- **Global Warming Effects:** Temperature rise, glacier melting, sea-level rise

Glossary

Köppen's Scheme
: Climate classification system based on temperature and precipitation related to vegetation.

Greenhouse Effect
: Warming of Earth's atmosphere due to trapped heat by greenhouse gases.

Global Warming
: Increase in Earth's average surface temperature due to enhanced greenhouse effect.

Milankovitch Cycles

Periodic changes in Earth's orbit and tilt affecting climate.

Ozone Hole

Depletion of ozone layer in the stratosphere allowing harmful UV rays to reach Earth.

Kyoto Protocol

International treaty to reduce greenhouse gas emissions.

Time Period / Year	Event / Change	Importance
8,000 B.C.	Wet and cool climate in Rajasthan desert	Indicates past climate variability affecting human settlements
3,000-1,700 B.C.	Harappan Civilization flourished during higher rainfall period	Shows climate influence on ancient civilizations
18,000 years ago	Last major glacial period in Pleistocene Epoch	Marks significant climate cooling phase
1550-1850	Little Ice Age in Europe	Period of cooler temperatures affecting agriculture and society
1997	Kyoto Protocol signed	Global effort to reduce greenhouse gas emissions