UNIT –V
CLIMATE CLASSIFICATION

Koppen's Classification :

- Of the several schemes of climatic classification, the one devised by Wladimir Koppen, a German botanist and climatologist, still remains the most widely known descriptive system.

- It is a quantitative as well as empirical classification of climate. Koppen proposed his first classification in 1900, using the world vegetation map of de Candole, a French plant physiologist.

- This classification scheme uses certain critical values of temperature of the warmest and the coldest months and precipitation of the wettest and the driest months. It uses naerical values for Classification of Climate.

- The plant classification proposed by A. de Candole in 1874 was accepted by Koppen. The following are the five principal biological groups that are largely controiled by temperature and moisture

(A) Megatherms. This group includes plants which require uniformly high temperature andabundant supply of moisture. The season is winterless, the average temperature of the coldest month being above 18 deg * C There is at least one month of heavy precipitation. Certain areas of this belt are characterized by two rainy seasons. The characteristic vegetation is the tropical rain forest.

(B) Xerophytes. Plants that prefer aridity and need high temperatures, even though for a short season, are classed as Xerophytes. This class of vegetation is found in the semi-arıd steppes and hot deserts. These plants are also found in the warmer parts of the middle latitude zone. The type of vegetation varies with the soil types.

(C) Mesotherms. This group of vegetation consists of plants that are adapted to moderate heat and a moderate amount of moisture. Certain types of plants are not adapted to low winter temperatures, while others shun dryness of the warm season. These plants are found in regions lying between latitudes 22 deg and 45 deg N and S. The average values of temperatures are usually

(D) Microtherms. Plants that need lower mean values of annual temperature. summers cool and short, and winters colder are called microtherms. The monthly mean temperature for the warmest month is at least 10 deg * C and less than 22 deg * C The mean temperature for the coldest month is below 6 deg * C Occasional snow in winter and adequate precipitation during the warmer months suit the climatic requirements of these plants. Evergreen deciduous forests and steppes are the natural vegetation regime.

(E) Hekistotherms. This group of vegetation comprisesof plants of the snow-bound Arctic region, beyond the polar limits of tree growth. Mosses, lichens, etc. are the natural vegetation. Not satisfied with his first scheme of climatic classification, Koppen revised and modified it several times during his own life time.

The Koppen system recognizes five principal categories of climate; each category is designated by a capital letter as follows :

A. Humid tropical climates. Winterless climates; it is hot all seasons; all months have a mean temperature above 18 deg * C

B. Dry climates. In these climates evaporation exceeds precipitation; there is a constantwater deficiency.

C. Humid mesothermal climates or warm temperate rainy climates. These climates have mild winters, the average temperature of the coldest month is below 18 deg * C but above 3 deg * C the average temperature of the warmest month over 10 deg * C In this group of climate both the seasons, winter and summer, are found.

D. Humid microthermal climates or cold snow-forest climates. These climates have severewinters; the average temperature of the coldest month is below - 3 deg * C and that of thewarmest month exceeds 10 deg * C E. Polar climates. These are summerless climates; the warmest monthly mean is below10 deg * C

Advantages of Koppen's classification :

- Koppen used the temperature and precipitation statistics in his classification of the climate. These two weather elements are easy to measure. Because of this quality, these elements are most widely and most frequently used.

- Since Koppen's classification is based on statistical parameters, each climatic region can be precisely defined.Besides, the temperature and precipitation are the two most effective weather elements that exhibit the effects of climatic controls more clearly than any other weather elements.

- These elements affect other aspects of our physical environment more directly than any other element. Obviously, the system of classification devised by Koppen is directly related to those aspects of environment which are clearly visible to us.

- His climatic classification system is based on the relationship between the types of plants at a particular place and the climatic characteristics of the place. Thus, his scheme is not a mere abstraction.

Limitations of Koppen's classification :

- The fact that the author himself revised and modified his system several times, he always felt it to be imperfect. Koppen based his classification on the mean monthly values of temperature andprecipitation.

- By these statistics the most potent factor of precipitation can only be estimated, rather than measured accurately.
- This makes comparison from one locality to another rather difficult.
- Further, Koppen did not take into account such weather elements as winds, precipitation intensity, amount of cloudiness, and daily temperature extremes only for the sake of making his classification generalized and simple.Another major drawback is that it is empirical and, therefore, is based on facts and observations.
- The causative factors of climate have been totally ignored.
- Thus, the air masses, which form the very basis of modern climatology, could not find any place in Koppen's classification

CHANGE CLIMATE :

climate change refers to the long-term warming or cooling of the Earth's surface, atmosphere, and oceans. It encompasses changes in temperature, precipitation, wind patterns, and other indicators of the Earth's climate system.

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as:"A change in the climate of the Earth, including a change in temperature, precipitation, or other parameters, that is attributed directly or indirectly to human activity, which alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods.“

Climatologists use various metrics to measure climate change, including:

1. Global temperature anomalies
2. Sea-level rise
3. Shifts in precipitation patterns
4. Changes in ocean chemistry (e.g., ocean acidification)
5. Increases in extreme weather events (e.g., heatwaves, droughts, floods)Climate change can be caused by natural factors (e.g., volcanic eruptions, solar variability) or human activities (e.g., burning fossil fuels, deforestation, land-use changes), which release greenhouse gases like carbon dioxide, methane, and nitrous oxide, leading to global warming.

WEATHER FORECASTING :

Weather forecasting is the process of predicting the state of the atmosphere at a specific place and time, including temperature, humidity, cloudiness, wind, precipitation, and other meteorological conditions.Methods:

1. Observations: Collecting data from weather stations, radar, satellites, and weather balloons.

2. Numerical Weather Prediction (NWP): Using computer models to analyze data and forecast future weather patterns.

3. Nowcasting: Predicting weather over a short period (0-2 hours) using current weather conditions.

4. Forecasting Models: Such as Global Forecast System (GFS), European Centre for Medium-Range Weather Forecasts (ECMWF) model, and Weather Research and Forecasting (WRF) model.

5. Ensemble Forecasting: Combining multiple models to generate a single, more accurate forecast.

Trends:

1. Increased use of High-Performance Computing (HPC): Allowing for more complex models and higher resolution.

2. Artificial Intelligence (AI) and Machine Learning (ML): Improving forecast accuracy and automating forecasting processes.

3. Internet of Things (IoT): Expanding weather observation networks using sensors and devices.

4. Satellite Technology: Next-generation satellites providing higher resolution and more frequent data.

5. Crowdsourcing: Leveraging citizen weather reports and social media to enhance forecasting.

6. Model Output Statistics (MOS): Using statistical techniques to improve forecast accuracy.

7. Ensemble Post processing: Combining multiple models and techniques to generate a single, most accurate forecast.

Emerging Trends:

1. Quantum Computing: Potential to revolutionize weather forecasting with unprecedented processing power.

2. Big Data Analytics: Extracting insights from large datasets to improve forecasting.

3. Urban Weather Forecasting: Focusing on high-resolution forecasting for urban areas.

The Greenhouse Effect:

Definition: The Greenhouse Effect is a natural process where certain gases in the Earth's atmosphere, such as carbon dioxide (CO_2), methane (CH_4), and water vapor (H_2O), trap heat from the sun, keeping the planet warm enough to support life.

1. Solar Radiation: The sun emits solar radiation, which enters the Earth's atmosphere.
2. Absorption: The Earth's surface absorbs some of this radiation, warming the planet.
3. Infrared Radiation: The warmed surface emits infrared radiation, which is directed towards space.
4. Greenhouse Gases: Greenhouse gases in the atmosphere absorb some of this infrared radiation, trapping heat and preventing it from escaping into space.
5. Heat Retention: This trapped heat is then distributed around the globe by atmospheric circulation, keeping the planet warm.

Greenhouse Gases:

1. Carbon Dioxide (CO_2): Released through fossil fuel combustion, deforestation, and land-use changes.

2. Methane (CH_4): Released through agriculture, natural gas production and transport, and landfills.

3. Water Vapor (H_2O): The most abundant greenhouse gas, influenced by temperature and humidity.

4. Nitrous Oxide (N_2O): Released through agriculture, industrial processes, and fossil fuel combustion.

5. Ozone (O_3): Created in the stratosphere through UV radiation and chemical reactions.

Enhanced Greenhouse Effect:

Human activities, such as burning fossil fuels, deforestation, and land-use changes, have increased greenhouse gas concentrations, leading to an enhancement of the natural Greenhouse Effect.

1. Global Warming: An increase in the Earth's average surface temperature.

2. Climate Change: Changes in precipitation patterns, sea-level rise, and extreme weather events.

Consequences:

1. Sea-Level Rise: Melting glaciers and ice sheets, leading to coastal flooding and erosion.
2. Extreme Weather: Increased frequency and intensity of heatwaves, droughts, and heavy precipitation events.
3. Ecosystem Disruption: Changes in temperature and precipitation patterns, affecting biodiversity and ecosystem function.

Mitigation Strategies:

1.Reduce Greenhouse Gas Emissions:
Transition to renewable energy sources, increase energy efficiency, and protect natural carbon sinks.
2. Carbon Capture and Storage:
Technologies that capture CO_2 emissions and store them underground.
3. Sustainable Land Use: Practices that promote carbon sequestration, such as reforestation and agroforestry.

Ozone Depletion:

Definition:

Ozone depletion refers to the thinning of the ozone layer in the stratosphere, caused by the release of ozone-depleting substances (ODS) such as chlorofluorocarbons (CFCs), halons, and other gases.

Causes:

1. Chlorofluorocarbons (CFCs): Used as refrigerants, propellants, and solvents.

2. Halons: Used as fire extinguishing agents.

3. Methyl Bromide: Used as a pesticide and fumigant.

4. Nitrous Oxide (N2O): Released through agricultural activities and industrial processes.

Effects:

1. Ozone Layer Thinning: Reduction of ozone concentration in the stratosphere.

2. Increased UV Radiation: More UV-B radiation reaches the Earth's surface, causing Skin cancer and cataracts, Damage to crops and marine ecosystems and Disruption of the food chain

The Ozone Hole:

1. Formation: Over Antarctica during the Southern Hemisphere spring (August-October)

2. Causes: CFCs and other ODS accumulate in the stratosphere, leading to ozone depletion.

3. Consequences: - Increased UV radiation - Impacts on Antarctic ecosystems .

International Response:

1. Montreal Protocol (1987): Global agreement to phase out ODS production and consumption.

2. Vienna Convention (1985): Framework for international cooperation on ozone protection.

Mitigation Strategies:

1. Transition to ODS-free technologies
2. Improved ODS management and disposal
3. Enhanced monitoring and enforcement

HUMAN COMFORT ZONE :

The Human Comfort Zone refers to the range of environmental conditions that allow individuals to feel comfortable and relaxed. These conditions include:

1. **Temperature:** 22-25°C (72-77°F) - ideal range for most adults
2. **Humidity:** 40-60% - relative humidity, avoiding dryness and dampness
3. **Lighting:** Soft, natural light or gentle artificial lighting
4. **Noise:** Quiet environment, avoiding loud or distracting sounds
5. **Air Quality**: Fresh, clean air with minimal pollutants
6. **Clothing:** Comfortable, loose-fitting clothing suitable for the temperature
7. **Seating and Posture:** Supportive seating and comfortable posture
8. **Visual Comfort:** Pleasant visual surroundings, avoiding glare or clutter

Being within the comfort zone can:

1. Improve focus and productivity
2. Enhance mood and overall sense of well-being
3. Reduce stress and fatigue
4. Support physical health and immune function

Factors influencing individual comfort zones include:

1. Age
2. Health and disability
3. Cultural background
4. Personal preferences
5. Acclimatization to local climate and environment

GLOSSARY FOR CLIMATOLOGY :

https://serc.carleton.edu/eslabs/weather/glossary.html

file:///C:/Users/User/Downloads/CCKP_Glossary.pdf

https://19january2017snapshot.epa.gov/climatechange/glossary-climate-change-terms_.html