

## Weather and Climate

### 1. Weather

- The short-term atmospheric conditions experienced at a particular place are called Weather.
- It includes:
  - a) Temperature
  - b) Atmospheric pressure
  - c) Wind
  - d) Humidity
  - e) Precipitation, etc.
- Weather can change within hours or days

### 2. Climate

- The long-term average pattern of weather conditions experienced over a large area is called Climate.
- Climate is determined using atmospheric data collected over a long period, generally around 35–40 years.

| Weather                             | Climate                      |
|-------------------------------------|------------------------------|
| Short-term                          | Long-term                    |
| Changes rapidly                     | Relatively stable            |
| Conditions on a particular day/time | Long-term average conditions |

### 3. Atmospheric Temperature

- **Solar Energy**
  - The Sun is the main source of energy for the Earth.
  - Energy is produced in the Sun through Nuclear Fusion.
  - Insolation :- The portion of solar radiation received by the Earth is called Insolation.
  - Terrestrial Radiation :- The Earth's surface absorbs solar energy and radiates it back in the form of long-wave radiation. This is called Terrestrial Radiation.



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- Greenhouse Effect :- The warming of the atmosphere due to the absorption of terrestrial radiation by greenhouse gases such as CO<sub>2</sub> is called the Greenhouse Effect.
- Processes of Heating :- Heat is transferred from the Earth's surface to the atmosphere through four major processes:
  1. Conduction
  2. Convection
  3. Advection
  4. Radiation
- Heat Budget of the Earth :- The balance between the incoming solar radiation and outgoing terrestrial radiation is called the Heat Budget.
- 35 units of incoming solar energy → reflected back
- 14 units → absorbed by atmospheric gases
- PSC Point: Heat Budget = Balance between incoming and outgoing energy.
- Temperature – Important Facts
  - Instrument -Thermometer → Measures atmospheric temperature.
  - Maximum-Minimum Thermometer → Records the highest and lowest temperature of a day.
  - Diurnal Range of Temperature→ Maximum Temperature – Minimum Temperature  
Example:Maximum = 36°C ; Minimum = 28°C → Diurnal Range = 36 – 28 = 8°C
  - Mean Daily Temperature(Maximum Temperature + Minimum Temperature) ÷ 2 Example:(36 + 28) ÷ 2 = 32°C
- Isotherm - An Isotherm is an imaginary line joining places having the same temperature on a map.
- Factors Affecting the Distribution of Temperature
  - Latitude
  - Altitude
  - Relief/topography
  - Differential heating of land and water
  - Distance from the sea
  - Ocean currents
- Temperature decreases with increase in altitude.
- Temperature decreases by approximately 6.4°C for every 1 km increase in altitude. This is called the Normal Lapse Rate.
- Thermal Zones :- Based on temperature, the Earth is broadly divided into:
  - a) Torrid/Hot Zone
  - b) Temperate Zone
  - c) Frigid/Polar Zone
- Thermal Equator :- The imaginary line joining places having the highest mean annual temperature at each longitude is called the Thermal Equator.



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## 4. Atmospheric Pressure

- The weight exerted by atmospheric air on the Earth's surface is called Atmospheric Pressure.
- Factors Affecting Atmospheric Pressure
  - Temperature
  - Altitude
  - Amount of water vapour/humidity
- Instrument - Barometer → Measures atmospheric pressure.
- Types:
  - i) Mercury Barometer
  - ii) Aneroid Barometer
- Standard Atmospheric Pressure
- At sea level: 76 cm of Hg = 1013.2 millibar
- Atmospheric pressure decreases with increasing altitude.
- Approximately, pressure decreases by 1 millibar for every 10 metres increase in altitude.
- Isobar :- An Isobar is an imaginary line joining places having the same atmospheric pressure.
- Global Pressure Belts
  1. There are 7 major pressure belts on Earth.
  1. Equatorial Low Pressure Belt
    - Located around the Equator
    - High temperature
    - Air becomes warm and rises
    - Also known as the Doldrums
  2. Sub-Tropical High Pressure Belts
    - Around 30° N and 30° S
    - Air descends.
  3. Sub-Polar Low Pressure Belts
    - Around 60° N and 60° S
    - Air rises.
  4. Polar High Pressure Belts
    - Around the North and South Poles
    - Cold air descends.
- 7 Pressure Belts = 1 Equatorial Low + 2 Sub-Tropical High + 2 Sub-Polar Low + 2 Polar High = 7

## 5. Wind

- The horizontal movement of air from a high-pressure area towards a low-pressure area is called Wind.



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- Wind is named according to the direction from which it blows.
- Instruments
  - Anemometer → Measures wind speed.
  - Wind Vane → Shows wind direction.
- Coriolis Force :- The apparent force caused by the rotation of the Earth, which deflects the direction of winds, is called the Coriolis Force.
- Northern Hemisphere → Winds are deflected towards the right.
- Southern Hemisphere ← Winds are deflected towards the left.
- North → Right
- South → Left
- Classification of Winds

### A. Permanent/Planetary Winds

- Winds that blow throughout the year in a relatively fixed direction.
- Trade Winds
- Westerlies
- Polar Easterlies

### B. Periodic Winds

- Winds that change their direction periodically.
- Examples: Sea Breeze, Land Breeze, Valley Breeze, Mountain Breeze, Monsoon Winds

### C. Local Winds

| Wind       | Region/Feature                          |
|------------|-----------------------------------------|
| Loo        | Hot wind of Northern India              |
| Chinook    | Warm, dry wind near the Rocky Mountains |
| Föhn/Foehn | Warm, dry wind in the Alps              |
| Harmattan  | Dry wind from the Sahara region         |

### D. Variable/Unstable Winds

- Winds that exist for a short period and may change their direction and intensity.



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- Examples: Cyclone. Anticyclone
- Sea Breeze and Land Breeze
  - Daytime → Sea Breeze
  - Sea → Land
  - Why? Land heats up faster.
  - Low pressure develops over land.
  - Sea has relatively higher pressure.
  - → Wind blows from sea to land.
- Night → Land Breeze
- Land → Sea
- Why? Land cools faster.
- High pressure develops over land.
- Sea has relatively lower pressure.
- → Wind blows from land to sea.
- Day = Sea → Land
- Night = Land → Sea

### Monsoon Winds

#### A) South-West Monsoon

- Occurs mainly during summer.
- Low pressure develops over the Indian subcontinent.
- Moist winds blow from the Indian Ocean towards India.
- Brings widespread rainfall.

#### B) North-East Monsoon

- Occurs mainly during winter.
- High pressure develops over land.
- Winds blow from land towards the sea.
- Monsoon winds are named according to the direction from which they originate/blow.

### Cyclone and Anticyclone

- Cyclone :- A weather system in which winds move towards and rotate around a low-pressure centre.
- Anticyclone :- A weather system in which winds move outward from a high-pressure centre.
- Tropical Cyclone :- Develops over tropical oceans., Comparatively smaller in size., Can be highly destructive.



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- Temperate/Extratropical Cyclone :- Develops where warm and cold air masses meet., Usually larger in size., Generally less destructive than tropical cyclones.

## 6. Atmospheric Humidity

- The amount of water vapour present in the atmosphere is called Atmospheric Humidity.
- Absolute Humidity:- The actual amount of water vapour present in a given volume of air.
- Relative Humidity :- The ratio between the actual amount of water vapour present in the air and the amount of water vapour required to saturate the air at a particular temperature.
- Expressed as a percentage.
- Instrument- Hygrometer → Measures humidity.
- At saturation, Relative Humidity = 100%.
- Condensation :- The process by which water vapour cools and changes into water droplets is called Condensation.
- Important Forms of Condensation
  1. Dew - Water droplets formed on cool surfaces during the night.
  2. Frost- When the temperature falls below 0°C, water vapour forms ice crystals instead of dew.
  3. Fog- Tiny water droplets suspended close to the Earth's surface, reducing visibility.
- Clouds
  - Clouds are formed when water vapour condenses around dust particles and other condensation nuclei in the atmosphere.
  - Major Types

| Cloud                      | Feature                                |
|----------------------------|----------------------------------------|
| Cirrus                     | High-level, feather-like               |
| Stratus                    | Layer-like clouds                      |
| Cumulus                    | Cotton/wool-like, vertically developed |
| Nimbus(Rain-bearing cloud) | Dark rain-bearing clouds               |

- Precipitation: When water droplets or ice particles in clouds become sufficiently large and fall to the Earth's surface due to gravity, the process is called Precipitation.
- Major Forms
  - a) Rain
  - b) Snowfall



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c)Hail :- Ice pellets formed when water droplets repeatedly freeze and grow inside clouds and eventually fall to the ground.

- Types of Rainfall

## 1. Orographic Rainfall

- Moist air encounters a mountain → rises → cools → condensation → rainfall.
- Rain Shadow Region:- The area on the leeward side of a mountain that receives comparatively little rainfall.
- Parts of eastern Kerala and Tamil Nadu experience the influence of the rain-shadow effect of the Western Ghats.

## 2. Convectional Rainfall

- Land becomes strongly heated → air becomes warm and rises → air cools → condensation → rainfall.
- Common in equatorial regions.
- Often associated with afternoon/evening showers.

## 3. Cyclonic Rainfall

- Warm air and cold air meet → warm air rises over cold air → cooling and condensation → rainfall.
- Also called Frontal Rainfall.
- Cloudburst:- A very intense rainfall occurring within a very short period over a small area is called a Cloudburst. More than 10 cm of rainfall in one hour is considered a cloudburst.

## 7. Climate Change

- Long-term changes in the Earth's climate system, particularly changes associated with increasing temperatures and disruption of the natural climate balance, are referred to as Climate Change.
- Major Causes
  - Increase in greenhouse gases
  - Deforestation
  - Industrialisation
  - Excessive use of fossil fuels
  - Unsustainable human activities



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## 8. IMPORTANT FACTS

- Energy-producing process in the Sun → Nuclear Fusion
- Instrument for measuring temperature? → Thermometer
- Instrument recording maximum and minimum temperature → Maximum-Minimum Thermometer
- Instrument for atmospheric pressure → Barometer
- Average sea-level pressure → 1013.2 millibar / 76 cm Hg
- Instrument for wind speed → Anemometer
- Instrument showing wind direction → Wind Vane
- Instrument for humidity → Hygrometer
- Line joining places of equal temperature → Isotherm
- Line joining places of equal pressure → Isobar
- What happens to temperature with increasing altitude → It decreases
- Temperature decrease per 1 km altitude → About 6.4°C
- Equatorial low-pressure belt is also called → Doldrums
- Wind blows from → High pressure to low pressure
- Coriolis deflection in Northern Hemisphere → Right
- Coriolis deflection in Southern Hemisphere → Left
- Daytime local wind from sea to land → Sea Breeze
- Night-time local wind from land to sea → Land Breeze
- Loo → Hot, dry wind of Northern India
- Chinook → Warm, dry wind of the Rocky Mountain region
- Föhn → Warm, dry wind of the Alps
- Maximum relative humidity? → 100%
- Condensation below 0°C produces? → Frost
- Feather-like clouds? → Cirrus
- Cotton-like clouds? → Cumulus
- Rain-bearing clouds? → Nimbus
- Afternoon/evening convectional rainfall? → Convectional Rainfall
- Rain caused by mountains forcing moist air upward? → Orographic Rainfall
- Frontal rainfall is also called? → Cyclonic Rainfall
- Cloudburst rainfall rate? → More than 10 cm/hour
- Terrestrial radiation? → Long-wave radiation
- Solar radiation? → Mainly short-wave radiation
- Heat Budget? → Balance between incoming and outgoing radiation.



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