

Atmospheric Circulation and Weather Systems

Introduction

The Earth's atmosphere is constantly in motion due to differences in **temperature, air pressure and the Earth's rotation**. This movement of air is called **atmospheric circulation**. It helps distribute heat and moisture around the world, influencing **weather and climate**. Weather systems such as cyclones, anticyclones and fronts are formed because of these atmospheric movements.

Atmospheric Circulation

Meaning

Atmospheric circulation is the large-scale movement of air that distributes heat from the equator towards the poles.

It helps to:

- Maintain the Earth's heat balance
 - Regulate weather and climate
 - Distribute moisture across different regions
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Pressure Belts

Major Pressure Belts

The Earth has **seven major pressure belts**:

- Equatorial Low Pressure Belt
- Two Subtropical High Pressure Belts
- Two Subpolar Low Pressure Belts
- Two Polar High Pressure Belts

These pressure belts influence global wind patterns.

Planetary Winds

Types of Winds

The permanent winds that blow throughout the year are called **planetary winds**.

They are:

- Trade Winds
- Westerlies

- Polar Easterlies

These winds help in the movement of heat and moisture across the globe.

Jet Streams

High-Speed Winds

Jet streams are narrow bands of very fast winds that blow in the upper atmosphere.

Characteristics:

- Blow from west to east
 - Found near the tropopause
 - Influence weather systems
 - Affect the movement of cyclones and aircraft
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Air Masses

Meaning

An **air mass** is a large body of air having similar temperature and moisture characteristics.

Air masses are classified based on:

- Temperature
- Moisture content
- Region of origin

Examples:

- Continental Air Mass
 - Maritime Air Mass
 - Polar Air Mass
 - Tropical Air Mass
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Fronts

Meaning

A **front** is the boundary where two different air masses meet.

Types of Fronts

- Cold Front
- Warm Front
- Stationary Front

- Occluded Front

Fronts often bring changes in weather such as rainfall, thunderstorms and strong winds.

Cyclones

Meaning

A **cyclone** is a low-pressure weather system where air moves towards the centre and rises upward.

Characteristics

- Centre has low pressure
- Air converges and rises
- Cloud formation and rainfall occur
- Strong winds are produced

Types of Cyclones

- Tropical Cyclones
- Temperate Cyclones

Tropical cyclones develop over warm oceans and are associated with heavy rainfall and high-speed winds.

Anticyclones

Meaning

An **anticyclone** is a high-pressure weather system where air moves away from the centre and sinks downward.

Characteristics

- High pressure at the centre
 - Descending air
 - Clear skies
 - Dry and stable weather
 - Light winds
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Tropical Cyclones

Formation

Tropical cyclones develop over warm tropical oceans where the sea surface temperature is generally above **27°C**.

Conditions required:

- Warm ocean water
- Low atmospheric pressure
- High humidity
- Coriolis force
- Weak vertical wind shear

Effects

- Heavy rainfall
 - Floods
 - Strong winds
 - Storm surges
 - Damage to life and property
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Temperate Cyclones

Formation

Temperate cyclones develop in the **mid-latitudes** due to the meeting of warm and cold air masses.

They are associated with:

- Fronts
 - Cloud formation
 - Rainfall
 - Changing weather conditions
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Weather Forecasting

Importance

Weather forecasting predicts future weather conditions using observations and satellite data.

It helps in:

- Agriculture
- Aviation
- Disaster management
- Transport
- Daily planning

Modern forecasting uses:

- Satellites
- Weather radar
- Computers

- Meteorological instruments
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Importance of Atmospheric Circulation

Benefits

Atmospheric circulation:

- Distributes heat around the Earth
 - Maintains global climate balance
 - Brings rainfall
 - Supports agriculture
 - Influences ocean currents
 - Shapes weather patterns
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Key Points

- Atmospheric circulation is the large-scale movement of air.
 - Unequal heating of the Earth causes pressure differences.
 - The Earth has seven major pressure belts.
 - Planetary winds include Trade Winds, Westerlies and Polar Easterlies.
 - Jet streams are fast-moving upper-air winds.
 - Air masses are large bodies of air with similar characteristics.
 - Fronts are formed where different air masses meet.
 - Cyclones are low-pressure systems with rising air.
 - Anticyclones are high-pressure systems with sinking air.
 - Tropical cyclones form over warm oceans.
 - Temperate cyclones form in the mid-latitudes.
 - Weather forecasting helps predict future weather conditions.
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Chapter Summary

Atmospheric circulation is the continuous movement of air that distributes heat and moisture across the Earth. It is controlled by pressure belts, planetary winds and jet streams. Air masses and fronts lead to the formation of weather systems such as cyclones and anticyclones. Tropical cyclones develop over warm oceans, while temperate cyclones form where warm and cold air masses meet. Weather forecasting uses modern technology to predict weather and reduce the impact of natural disasters. Atmospheric circulation plays a vital role in maintaining the Earth's climate and supporting life.