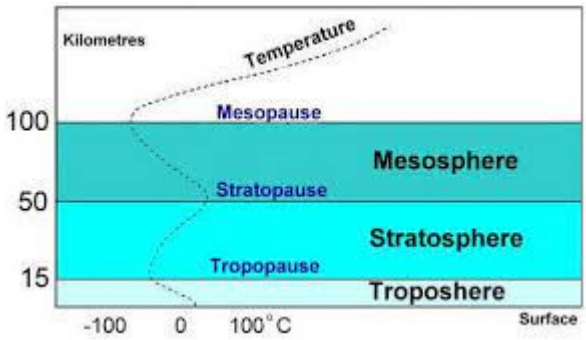
Atmospheric circulation

Atmospheric circulation is the **movement of air masses in the Earth's atmosphere**. It plays a **crucial role in the transfer of heat and moisture** from one place to another, which ultimately **determines the Earth's weather patterns and climate**. The Earth's atmosphere is a complex system that is constantly in motion, driven by various forces, like the **Sun's energy**, the **Earth's rotation**, and the **planet's topography**.

Wind on Earth

Layers of Atmospheric Circulation

The Earth's atmosphere is divided into several layers, each with its own unique characteristics and functions. The **lowest layer, the troposphere, extends from the Earth's surface to an altitude of about 7 to 20 kilometers,** depending on the location and the season.

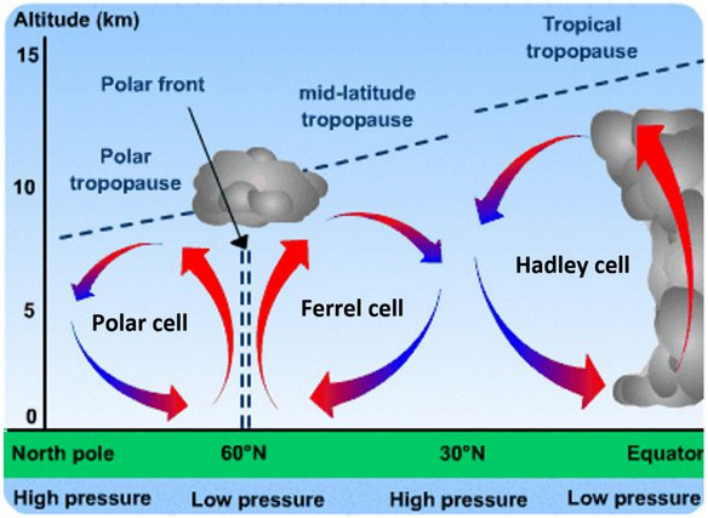


The troposphere is where most of the **Earth's weather occurs**, like **precipitation, cloud formation, and temperature changes**. The **next layer, the stratosphere, extends from the top of the troposphere to an altitude of about 50 kilometers.** The **stratosphere contains the ozone layer, which protects the Earth from harmful ultraviolet radiation from the Sun.**

Atmospheric circulation is driven by differences in temperature and pressure between different parts of the atmosphere. **When a difference in temperature or pressure exists between two regions, air masses will flow from high to low pressure**, driven by the tendency of the atmosphere to reach a state of balance. This flow of air masses is known as atmospheric circulation, and it plays a critical role in the transfer of heat, moisture, and momentum from one place to another.

Types of Atmospheric Circulation

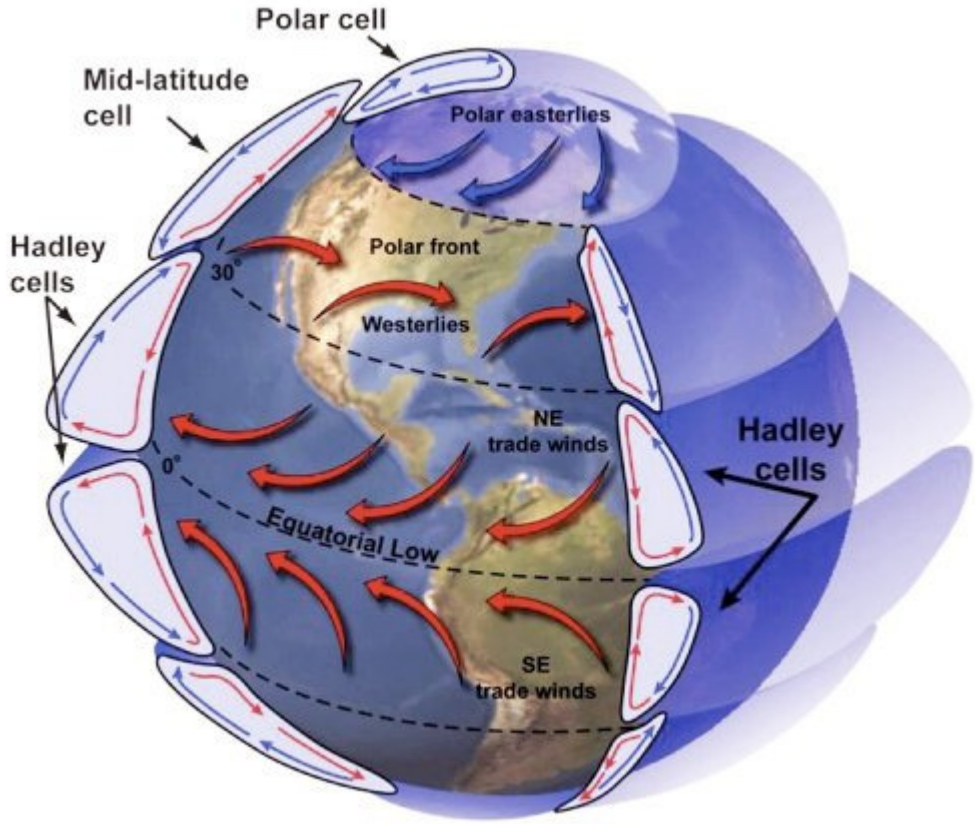
There are several types of atmospheric circulation patterns that exist on the Earth, each with its own unique characteristics and functions.



Hadley Cell Circulation

The Hadley Cell circulation is a type of atmospheric circulation that **occurs in the tropics**. It is characterized by **rising air near the equator and sinking air near the tropics.**

The rising air near the equator is driven by the Sun's energy, which heats the Earth's surface and causes the air to rise. As the air rises, it cools, condenses, and releases moisture, leading to the formation of clouds and precipitation. The **cooled air then sinks near the tropics**, creating areas of high pressure known as the **subtropical high.**



Hadley Cell

Ferrel Cell Circulation

The Ferrel Cell circulation is a type of atmospheric circulation that **occurs in the mid-latitudes.** It is characterized by **rising air near the sub polar region and sinking air near the subtropics.** The rising air near the poles is **driven by the Earth's rotation (dynamically induced),** which causes the air to flow from high to low pressure. The cooled air then sinks near the subtropics, creating areas of high pressure known as the subtropical high.

Feature	Hadley Cell	Ferrel Cell
Location	Found near the equator (0° latitude)	Found between 30° and 60° latitude
Direction	Moves air from the equator towards poles	Moves air from the poles towards the equator
Air Movement	Descending air near 30° latitude	Ascending air near 60° latitude
Surface Winds	Trade winds at surface level	Prevailing westerlies at surface level
Coriolis Effect	Minimal effect due to proximity to equator	Strong effect due to latitude
Role in Weather	Influences tropical climate and weather patterns	Contributes to mid-latitude weather systems
Pressure Zones	Associated with subtropical high pressure zones	Associated with mid-latitude low pressure zones
Precipitation	Causes low precipitation and dry conditions in subtropical regions	Contributes to mid-latitude precipitation and storm systems
Climate Effects	Responsible for tropical rainforests and deserts	Contributes to temperate climates and storm tracks
Size	Larger and more pronounced	Smaller and less defined

Polar Cell Circulation

The Polar Cell circulation is a type of atmospheric circulation that occurs in the polar regions. It is characterized by rising air near the sub polar region and **sinking air near the polar region** creating areas of high pressure known as the polar high.