Section 3: Atmospheric Circulation

Preview

• Key Ideas
• The Coriolis Effect
• Global Winds
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Key Ideas

• Explain the Coriolis effect.

• Describe the global patterns of air circulation, and name three global wind belts.

• Identify two factors that form local wind patterns.
The Coriolis Effect

- The circulation of the atmosphere and of the ocean is affected by the rotation of Earth on its axis.
- Points near the equator travel farther and faster than points closer to poles do. When air moves toward the poles, it travels east faster than the land beneath it does. As a result, the air follows a curved path.
- **Coriolis effect** the curving of the path of a moving object from an otherwise straight path due to Earth’s rotation
- In general, the Coriolis effect is detectable only on objects that move very fast or that travel over long distances.
The Coriolis Effect, *continued*

The diagram below shows the movement of air due to the Coriolis effect.
Global Winds

- Each hemisphere contains three looping patterns of flow called *convection cells*.
- Each convection cell correlates to an area of Earth’s surface, called a *wind belt*, that is characterized by winds that flow in one direction.
- These winds are called *prevailing winds*.
Global Winds, continued

Trade Winds

• **trade wind** prevailing winds that blow from east to west from 30° latitude to the equator in both hemispheres.

• Like all winds, trade winds are named according to the direction from which they flow.

• In the Northern Hemisphere, the trade winds flow the northeast and are called the *northeast trade winds*.

• In the Southern Hemisphere, they are the *southeast trade winds*.
Global Winds, *continued*

**Westerlies**

- Between 30° and 60° latitude, air moving toward the poles is deflected by the Coriolis effect.
- *westerlies* prevailing winds that blow from west to east between 30° and 60° latitude in both hemispheres
- In the Northern Hemisphere, the westerlies are the southwest winds. In the Southern Hemisphere, they are the northwest winds.
Reading Check

Name two ways in which the trade winds of the Northern Hemisphere differ from the westerlies of the Northern Hemisphere.

They flow in opposite directions from each other, and they occur at different latitudes.
Global Winds, *continued*

**Polar Easterlies**

- Over the polar regions, descending cold air creates areas of high pressure.

- Surface winds created by the polar high pressure are deflected by the Coriolis effect and become the polar easterlies.

- **polar easterlies** prevailing winds that blow from east to west between 60 and 90 latitude in both hemispheres.

- Where the polar easterlies meet warm air from the westerlies, a stormy region known as a *front* forms.
Global Winds, continued

The Doldrums and Horse Latitudes

• The trade wind systems of the Northern Hemisphere and Southern Hemisphere meet at the equator in a narrow zone called the *doldrums*.

• As the air approaches 30° latitude, it descends and a high-pressure zone forms. These subtropical high-pressure zones are called *horse latitudes*.

• Surface winds are weak and variable in both of these zones.
Global Winds, *continued*

**Wind and Pressure Shifts**

- As the sun’s rays shift northward and southward during the changing seasons of the year, the positions of the pressure belts and wind belts shift.

- Although the area that receives direct sunlight can shift by up to $47^\circ$, the average shift for the pressure belts and wind belts is only about $10^\circ$ of latitude.

- However, even this small change causes some areas of Earth’s surface to be in different wind belts during different times of the year.
Global Winds, \emph{continued}

Jet Streams

- \textbf{jet streams} a narrow band of strong winds that blow in the upper troposphere.
- These winds exist in the Northern and Southern Hemisphere.
- Polar jet streams can reach speeds of over 400 km/h and can affect airline routes and the paths of storms.
- Subtropical jet streams do not change much in speed or position.
Global Winds, continued

The diagram below shows the different wind belts on Earth.
Local Winds

- Movement of air are also influenced by local conditions, and local temperature variations commonly cause local winds.
- Local winds are not part of the global wind belts.
- Winds that blow at speeds of less than 50 km/h are called breezes.
Local Winds, *continued*

Land and Sea Breezes

- Equal areas of land and water may receive the same amount of energy from the sun. However, land surfaces heat up faster than water surfaces do.
- The cool wind moving from water to land is called a *sea breeze*.
- Overnight, the land cools more rapidly than water does, and the sea breeze is replaced by a *land breeze*. 
Local Winds, continued

Mountain and Valley Breezes

• A valley breeze forms when warm air from the valleys moves upslope.

• At night, the mountains cool more quickly than the valleys do, and cool air descends from the mountain peaks to create a mountain breeze.

• Areas near mountains may experience a warm afternoon that turns to a cold evening soon after sunset.
Maps in Action

Absorbed Solar Radiation

[Maps showing absorbed solar radiation in January and July with color gradients indicating different levels of radiation.]