

Section 11.1.

Natural Causes of Climate Change.

Textbook pages 464 to 481.

Before You Read.

What is the difference between climate and weather?

What is climate?

Climate describes the average conditions of the atmosphere in a large region over thirty years or more. Climate includes such characteristics as clouds and precipitation, average temperature, humidity, atmospheric pressure, solar radiation, and wind. Climate can refer to conditions in a region as small as an island or to conditions across an entire planet. Because of its varied geography, British Columbia has a range of climates. A **biogeoclimatic zone** is a region with a certain type of plant life, soil, geography, and climate. British Columbia has fourteen biogeoclimatic zones.

How do scientists determine past and current climatic change?

Geologic evidence shows that, throughout its history, Earth has undergone many climatic changes, including ice ages and periods of warming. **Paleoclimatologists** study fossils and sediments or gather information about glaciers to help them understand climatic change. They examine **ice cores** to determine what types and amounts of gases existed in the atmosphere when the ice was formed. Ice core data have been used to estimate the concentration of carbon dioxide gas that was in the atmosphere over the past six hundred and fifty thousand years, allowing scientists to estimate past climatic conditions. Scientists draw conclusions about current climatic changes by observing current climate and by comparing their observations with evidence of past climates.

Next page.

Which factors affect climate?

The processes that contribute to climate change are complex and include factors that affect Earth's radiation budget and heat transfer around the globe. Several factors affect climate:

1. The composition of Earth's atmosphere: **Greenhouse gases** in the atmosphere absorb and emit radiation as thermal energy, increasing Earth's temperature. The more greenhouse gases, the higher the temperature of our atmosphere.
2. Earth's tilt, axis of rotation, and orbit around the Sun: Earth experiences seasons due to the combination of its tilt and orbit. Seasonal changes are most extreme when Earth's tilt is greatest (the angle of Earth's tilt varies between twenty two

- point one degrees and twenty four point five degrees in cycles of about forty one thousand years). Changes in Earth's axis of rotation also affect the angle of incidence of the Sun's rays. Variation in the shape of Earth's orbit changes its distance from the Sun and the amount of solar radiation that reaches Earth's surface. In addition, Earth's rotation also has a wobble, which will affect the angle of incidence of the Sun's radiation over a period of thousands of years.
3. The water cycle: The **water cycle** describes the circulation of water on, above, and below Earth's surface. High temperatures increase the evaporation of water (the most abundant greenhouse gas) and the capacity of air to hold water vapour. As surface temperatures rise, so does the amount of water vapour in the atmosphere. As the atmosphere holds more water vapour, it traps more thermal energy, resulting in a further increase in temperature. As temperatures continue to rise, glaciers and ice shelves melt, causing sea levels to rise around the world.
 4. Ocean currents: The sinking and rising of deep ocean waters produces convection currents that act as a global conveyer belt that transports water—and thermal energy—around Earth. Surface currents, caused in part by the Coriolis effect, exchange heat with the atmosphere, so these currents also influence both weather and climate.

Next page.

- Periodically, surface waters off the coast of Ecuador and Peru get unusually warm, a phenomenon known as an **El Niño** event. Unusually weak westerly trade winds allow warm water in the western Pacific to move eastward. This prevents cold water from upwelling, and triggers changes in weather across much of North America. In contrast, in a **La Niña** event, stronger than normal westerly winds allow cooler-than-normal waters to come to the surface in the eastern Pacific Ocean. This brings cooler temperatures to northwestern North America. Both El Niño and La Niña affect climate in North America. The variation in the winds, including El Niño and La Niña events, is known as El Niño-Southern Oscillation.
5. The carbon cycle: The carbon cycle maintains the balance of carbon dioxide in the atmosphere. Carbon dioxide is an important greenhouse gas. **Carbon sinks**, such as the deep ocean, shelled organisms, and forests, remove carbon dioxide from the atmosphere. Carbon in ocean waters is converted to carbonates, an important ingredient in the shells of many marine organisms. **Carbon sources**, such as weathering and decaying vegetation, add carbon dioxide to the atmosphere.
 6. **Catastrophic events**: Large-scale disasters, such as volcanic eruptions and meteor impacts, add dust, debris, and gases high into the atmosphere. They reflect and absorb solar radiation, causing the atmosphere below to cool.

This text is copyrighted and has been developed for the educational use of students using McGraw-Hill BC Science 10.