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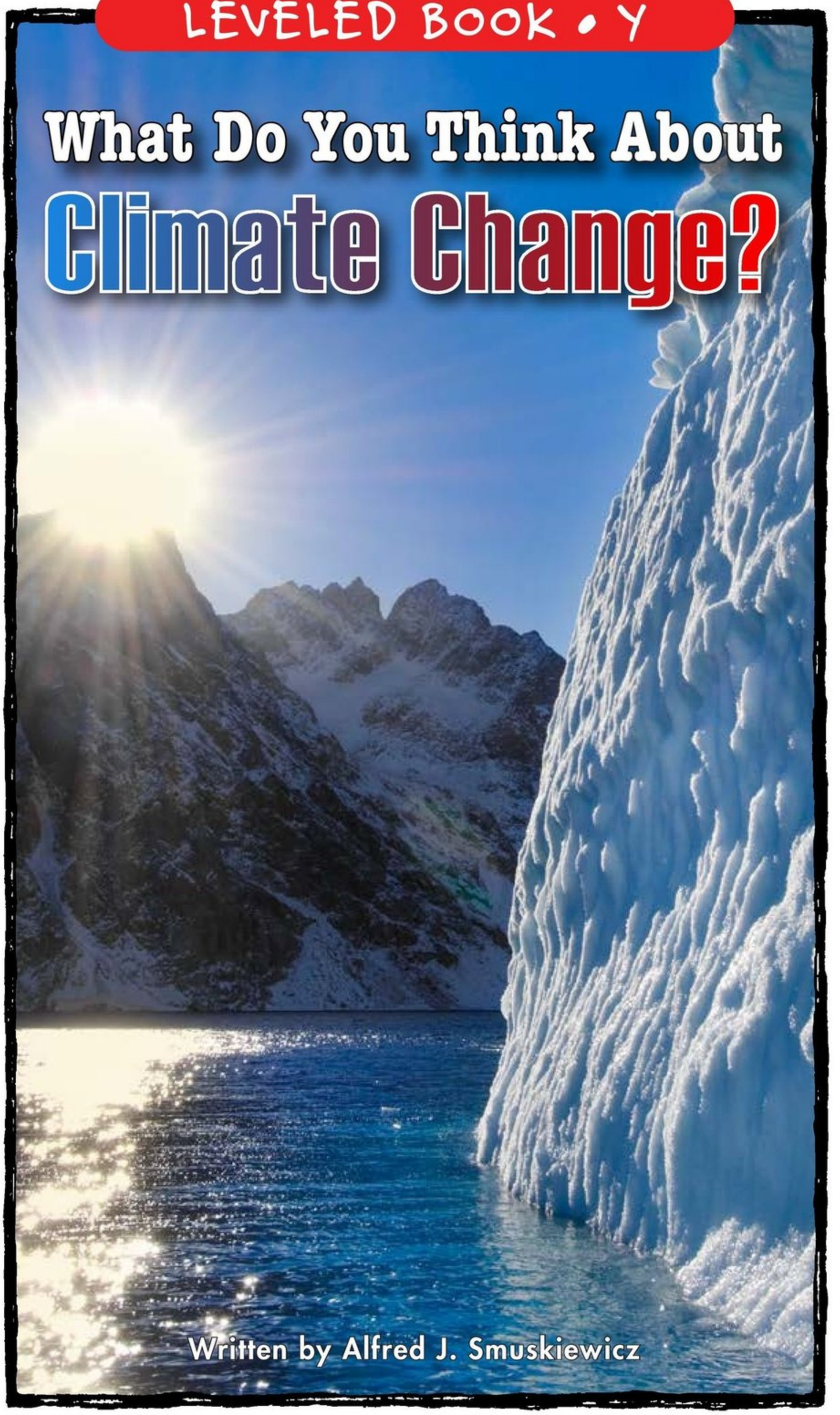
What Do You Think About Climate Change?



Written by Alfred J. Smuskiewicz

www.readinga-z.com

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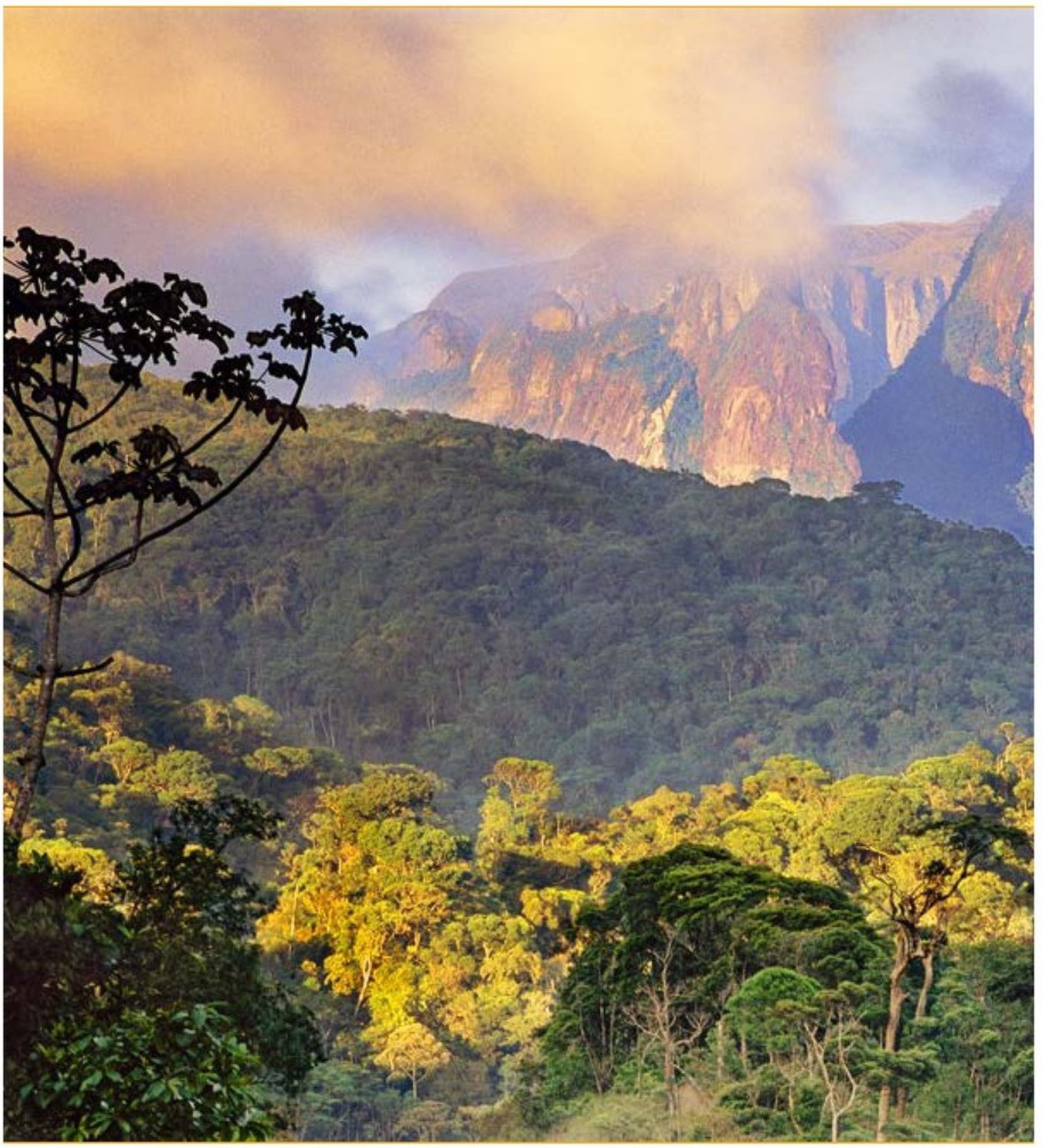

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Introduction: What Is Climate Change?

What is the weather like today? Is it warm or cold? Sunny or rainy? It's easy to see what the weather is like on any given day, but what about the **climate**? Over long periods, there are certain patterns to the weather. These long-term patterns are called *climate*, and sometimes these patterns change.

For example, it was colder in Europe from 1400 to 1800 than it was from 1100 to 1300. That was because the pattern of weather—the climate—changed between these two periods.

Many scientists believe that the climate is changing again, back to a warmer pattern. They call this change **global warming**. Although some people are concerned that global warming could harm plant and animal communities and human societies, other people believe that there is little to worry about.

This book tells what scientists have discovered about climate change. Read it carefully and then ask yourself, "What do I think about climate change?"

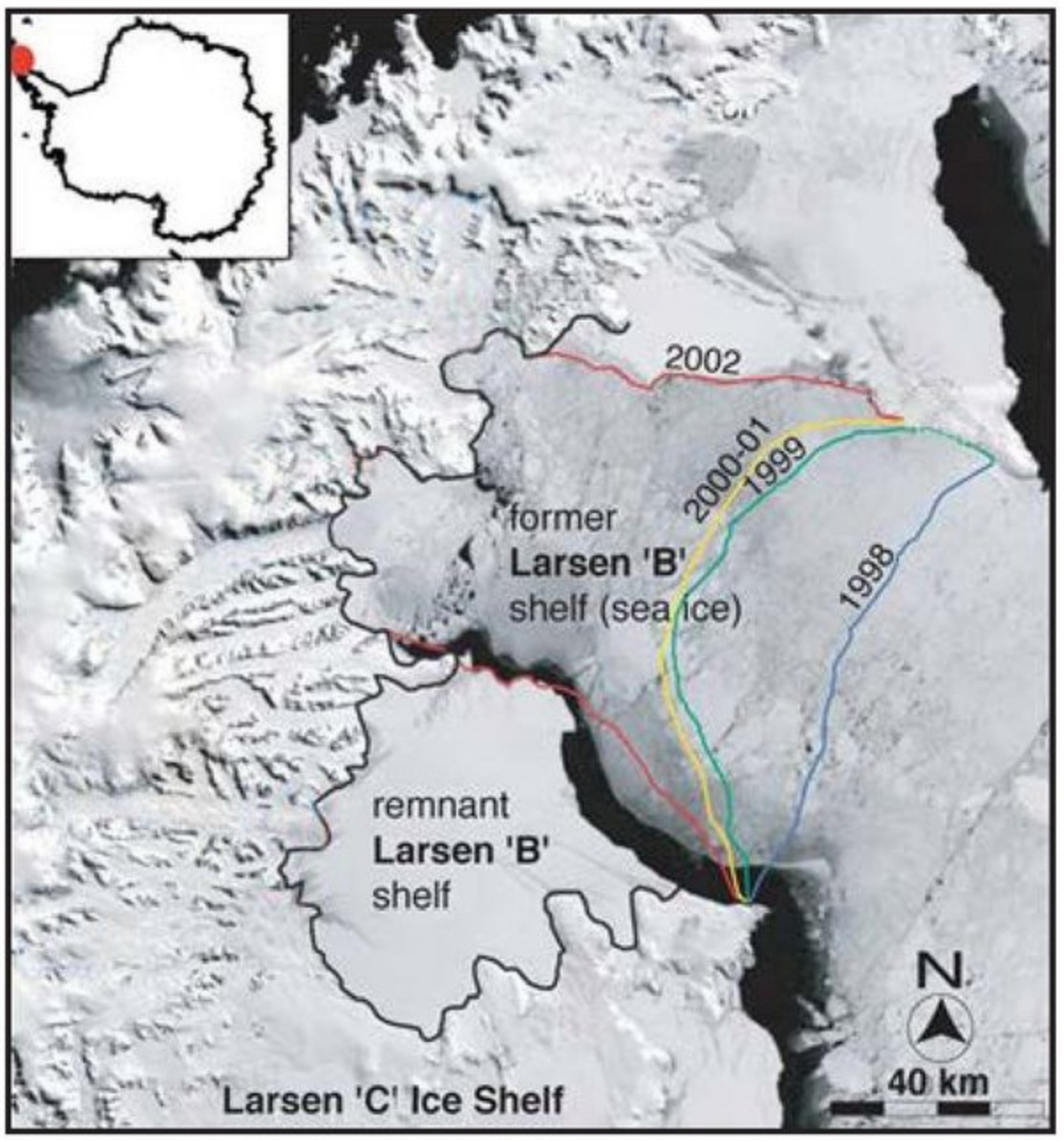
Evidence for Climate Change

When scientists have an idea, such as the idea that global warming is happening, they need to present evidence to support that idea. What evidence have scientists discovered about global warming?

Meteorologists (scientists who study the weather) have kept careful records of Earth's surface temperatures since the mid-1800s. Surface temperatures include the temperature of the air near the ground, such as what you see on an outdoor thermometer. Surface temperatures also include temperatures of the ocean surface. These records show that the average surface temperature around the world has increased by roughly 1.0°F to 1.8°F (0.6°C to 1.0°C) since the late 1800s.

Scientists have also compared records of this recent temperature increase with other evidence of what Earth's climate was like thousands of years ago. This comparison led a group of U.S. scientists to report in 2006 that Earth's surface is probably warmer now than at any time in the past 12,000 years.

Old photographs provide additional evidence that Earth's surface is warming. For example, photos of certain mountain **glaciers** taken in the early to mid-1900s show that the glaciers were larger years ago than they are today. Scientists have found that some of these mountain glaciers are melting and shrinking at faster and faster rates. Researchers have observed such glaciers in Alaska, South America, Europe, and Asia. Many scientists believe that this shrinking is being caused by an increase in global surface temperatures.



Melting glaciers helped cause the shattering of the 400-year-old Larsen B ice shelf in Antarctica.

polar bear

calving iceberg

Evidence indicates that ice around the North and South Poles is also melting. Much of this evidence comes from photographs of the polar regions taken by cameras aboard satellites.

Satellite photos have shown that the amount of sea ice in the Arctic Ocean around the North Pole has decreased since the 1970s. Measurements revealed that, *between 2004 and 2005*, an area of sea ice the size of Texas disappeared from the Arctic.

Because of the melting Arctic ocean ice, the survival of polar bears may be at risk. Polar bears use ice floes (floating ice) in winter as platforms to hunt seals. Scientists reported in 2005 that there are not as many ice floes in the Arctic sea as there used to be. As a result, many polar bears are not getting enough to eat, and some may be drowning.

Near the South Pole, satellite photos show that both sea ice and ice sheets (ice covering land) in western Antarctica are melting. In 2002, photos showed an **ice shelf** larger in area than Rhode Island breaking into small pieces and drifting away from Antarctica. An ice shelf is part of an ice sheet that extends into the sea.

When ice on land, such as on Antarctica and Greenland, melts, the meltwater flows into the ocean. Over time, this extra water could cause sea levels to rise. Researchers with the United Nations have reported that the average sea level around the world has risen by at least 4 inches (10 cm) since the early 1900s.

Searching for More Evidence

More evidence for global warming exists than is described in this chapter. Other evidence pointed to by scientists includes:

- changes in migration habits of certain birds
- an unhealthy condition of coral reefs called "bleaching"
- possible increases in extreme weather, such as hurricanes

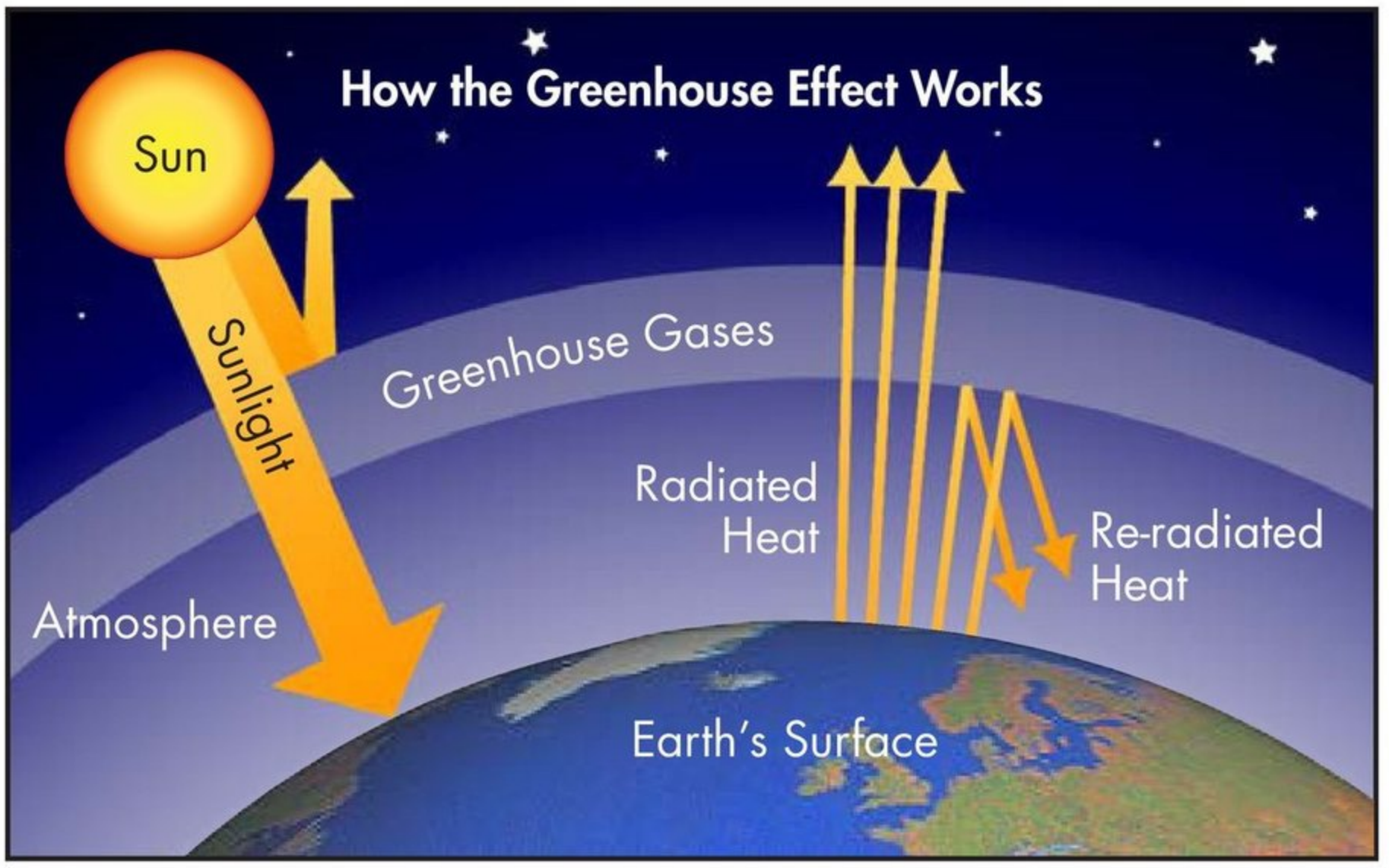
You can find out more about this evidence by using the Internet. However, you need to be careful about which websites you use. Many websites about global warming contain incorrect information. Websites run by government agencies, universities, or scientific organizations are usually the best. When you read about any evidence, remember to ask yourself, "Does this make sense to me?"

What Is Causing Climate Change?

There are many ideas as to what may be causing global warming and climate change. These ideas can be divided into two main categories: human activities and natural causes.

The main human activity blamed for global warming is the burning of **fossil fuels** (coal, oil, natural gas) in automobiles, factories, and electric power plants. When these substances are burned for fuel or energy, carbon dioxide gas and other gases are released into the **atmosphere** (air). These gases build up in the atmosphere over time. The gases let much of the energy of sunlight pass through the air to warm Earth's surface. Earth's surface then radiates (sends out) heat energy back into the air.

Much of the radiated heat energy drifts off into space. However, some of the heat energy is trapped near Earth's surface by carbon dioxide and certain other gases in the atmosphere. The trapped heat energy is then re-radiated back to the surface, warming the surface more. Because this process acts like a greenhouse (a building in which special glass walls trap heat to warm plants inside), it is called the **greenhouse effect**. Carbon dioxide, methane, and other gases that trap heat are called **greenhouse gases**.

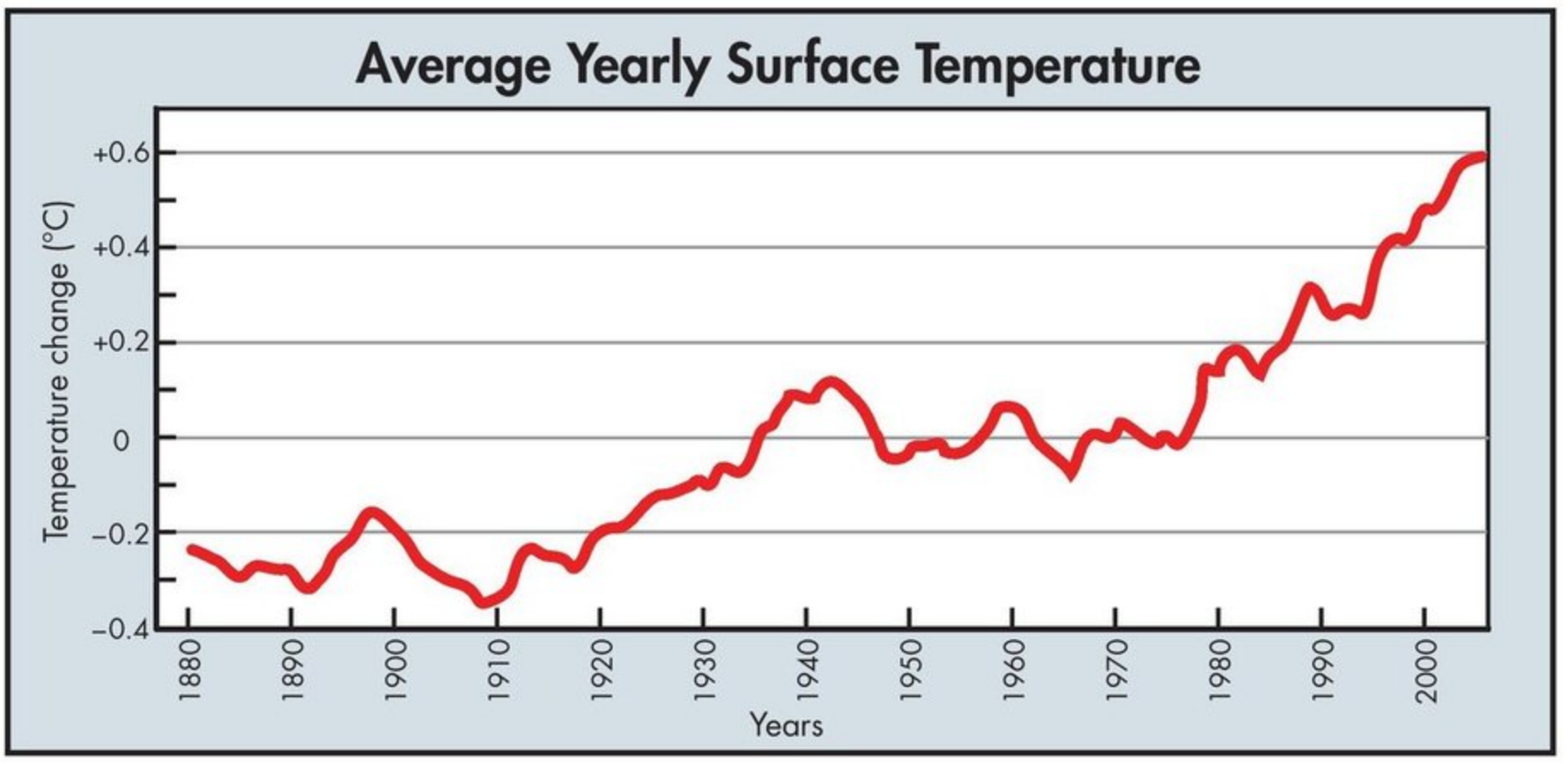


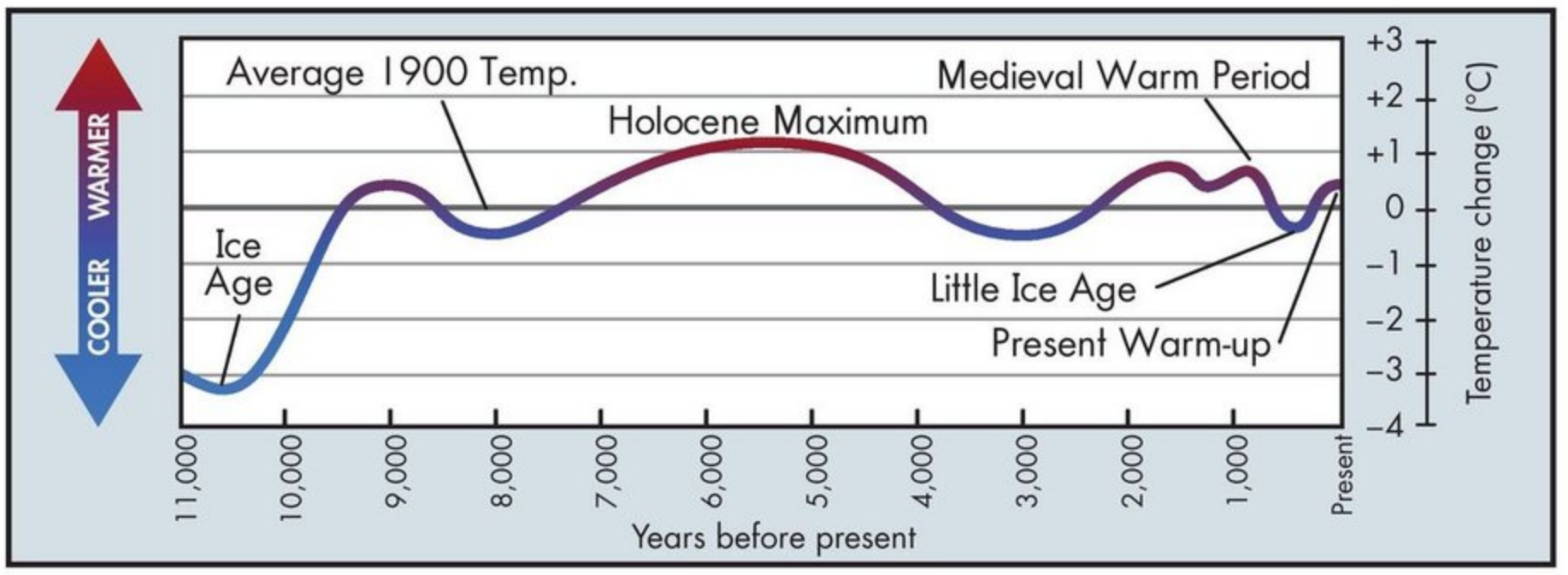
Greenhouse Gas	Sources
Carbon dioxide	Fossil fuels, burning and cutting down forests, volcanoes
Methane	Burning forests, microbes in wetlands and inside cattle intestines
Nitrous oxide	Fossil fuels, burning forests, chemical reactions in soil and ocean
Halocarbons	Old spray cans, certain cleaning fluids, other products
Aerosol particles	Fossil fuels, burning forests, volcanoes
Ozone	Automobiles, power plants
Water vapor	Evaporation, plants

The greenhouse effect is a natural part of how Earth functions. If Earth did not have a natural greenhouse effect, it would be as cold as Mars—too cold for liquid water or life. However, many scientists believe that the carbon dioxide released into the air by the burning of fossil fuels is increasing the warming of the greenhouse effect.

What is the evidence that carbon dioxide from fossil fuels is related to global warming? Humans began burning fossil fuels in large amounts when **industrialization** (the use of power-driven machinery) became widespread in the mid-1800s. Since then, measurements suggest that the amount of carbon dioxide in the atmosphere has increased by about 25 percent. According to meteorologists, Earth's surface temperature has increased during this same time.

Another human activity that has increased the carbon dioxide in the air is the burning and cutting down of forests, or deforestation. Trees and other plants remove carbon dioxide from the air to carry out **photosynthesis**, the chemical process by which plants make their own food. When there are fewer plants to carry out photosynthesis, more carbon dioxide builds up in the atmosphere.





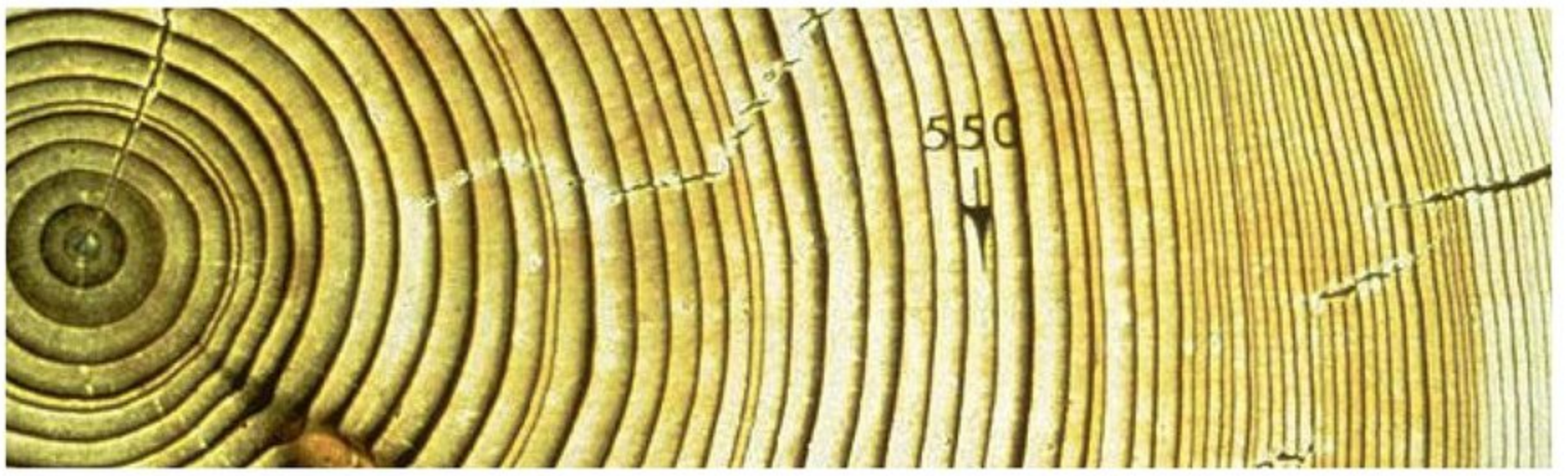
Some scientists point out that global warming does not have to be caused by human activities. Global warming and global cooling happened over and over before people started burning fossil fuels.

During the past few hundreds of thousands of years, there have been several **ice ages**, when much of Earth's surface was covered by ice. In between these ice ages have been warm periods. The last ice age ended about 11,500 years ago. According to geologists, we are now in a warm period between two ice ages.

What else do weather records and other scientific evidence show? In Europe, the climate cooled between the "Medieval Warm Period" (about 1100 to 1300) and the "Little Ice Age" (about 1400 to 1800). The climate has been warming since the end of the Little Ice Age.

These earlier climate changes had natural causes. Perhaps the current global warming has some natural causes, too.

If meteorologists have been keeping careful records of Earth's temperatures since only the mid-1800s, how can we know what earlier temperatures and climates were like?



One way to know is by studying growth rings in cross-sections of very old trees. Trees grow more when climate is wet and warm than when climate is dry and cold. Tree rings are thicker when there is greater growth. By analyzing such rings, scientists can discover trends in temperature going back hundreds of years.

To discover even older temperature trends, scientists use various other methods. One such method is to examine ice cores. Ice cores are long, cylinder-shaped samples of ice that are drilled out of the ground in Antarctica and other frozen places. An ice core contains chemical evidence

A library of ice cores

Scientists examine an ice core that shows volcanic activity under a glacier.

of what the atmosphere was like during different times—going back many thousands of years. The deeper the ice, the farther back in time it was formed. Certain chemicals, such as large amounts of carbon dioxide, tell researchers that Earth's climate was relatively warm at the time the ice formed.

Such methods allow scientists to learn about Earth's past natural changes in climate. Although scientists do not fully understand the natural causes of climate change, they suspect that a number of factors are involved. For example, the amount of heat energy produced by the Sun varies from time to time. Also varying over time are the shape of Earth's **orbit** around the Sun and the angle of the tilt that Earth makes on its **axis** (the imaginary line about which Earth spins).

Possible Results of Climate Change

Whether global warming is caused by human activities, natural factors, or a combination of both, it may result in certain changes to the planet. How do scientists predict these changes? What might these changes be? What would such changes mean to you?

One of the main ways that scientists try to predict the future of climate change is by using **computer models**. These are computer programs based on mathematical equations about sunlight, heat, rainfall, wind, ocean currents, and other climate factors. Scientists change these equations in different ways to mimic the ways that these factors might change in the real world. The computer program then figures out the most likely effects that these factors would have on Earth's climate.

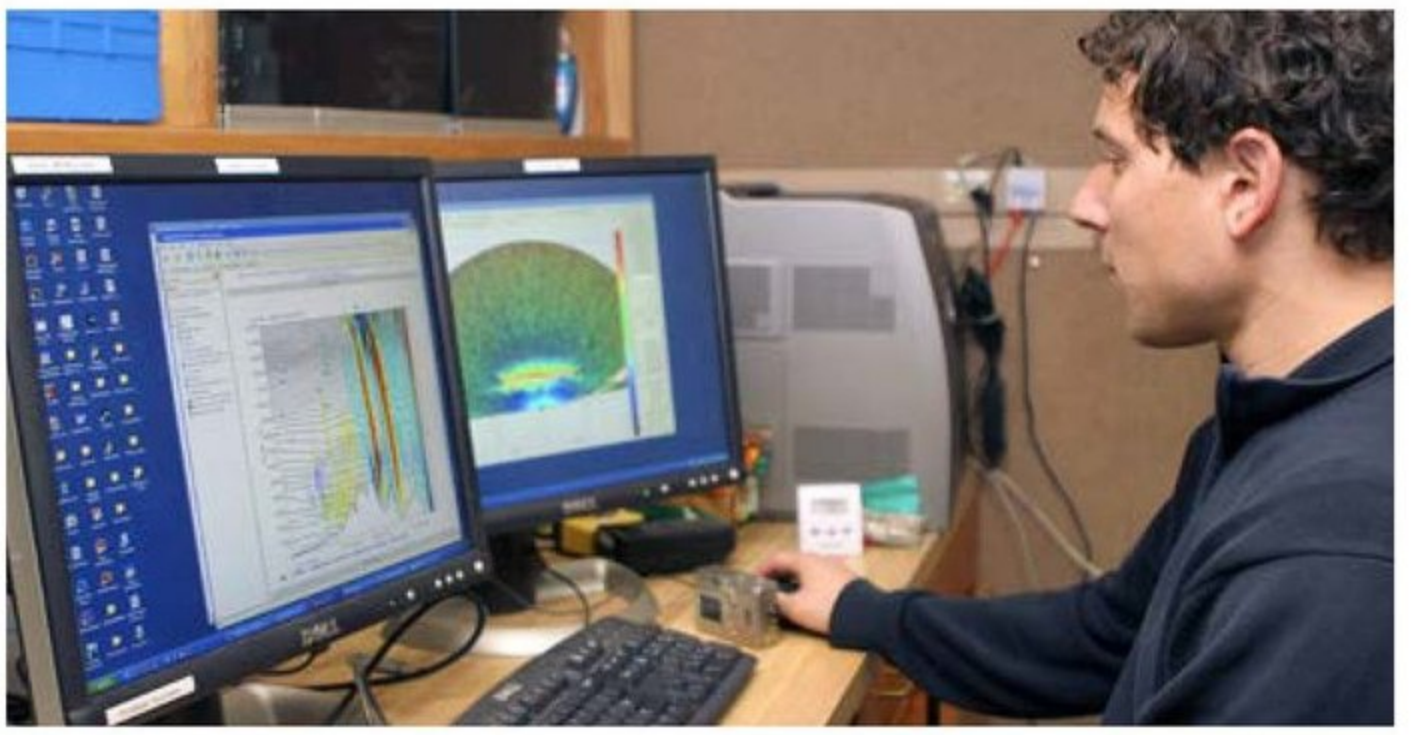
Computer models are most useful for helping researchers learn several possible results of climate change. However, predictions made with computer models are not certain. Maybe these predictions will really happen; maybe they will not happen. The following possibilities are based on computer models predicting very serious effects of global warming. Other computer models predict far less serious effects.

According to some computer models—if current rates of warming continue—Earth's average surface temperature may increase by as much as 10°F (5.5°C) by 2100. Such a great rise in temperature could cause enormous changes in the natural habitats of many plant and animal species. Wetlands might change into grasslands, and grasslands might change into deserts. Plants and animals that could not adjust to these changes would die out.

Large increases in Earth's surface temperature could cause vast amounts of ice on Antarctica and Greenland to melt into the sea. This could, in turn, result in rises in sea level of several feet. If all the ice on Greenland were to melt, for example, sea levels might increase by more than 20 feet (6 m), according to some computer models.

An Inconvenient Truth

In 2007, former U.S. Vice President Al Gore was awarded the Nobel Peace Prize for his work in warning the public about the possible dangers of global warming. Gore also wrote a book and appeared in a movie about global warming, both of which were titled *An Inconvenient Truth*. The book and movie featured several possible disasters that might be in store for Earth because of global warming. These disasters included the extinction of many species of animals, deadly floods in many countries, and much more powerful hurricanes. It is important to keep in mind that these disasters are not *definitely* going to happen. They are only the worst among many different possibilities.



Computers help map the pollutants in the air above major urban areas.

If sea levels were to rise high enough and fast enough, many cities along coasts and on small islands would be flooded by ocean water and destroyed. These cities might include New York City, Boston, and other large U.S. cities with millions of people.

Earth's surface temperature affects the weather in many complex ways. Computer models predict that weather in different parts of the world would be affected by continued warming in different ways. In some areas, it could become drier and more difficult to grow crops. This would lead to water and food shortages. In other areas, the growing season could lengthen because of warmer, wetter weather. Crops in these areas would become easier to grow.

Changing weather caused by global warming might also mean more hurricanes, tornadoes, snowstorms, or droughts—depending on where a person lives.

Brazil's city of Rio de Janeiro faced a dengue fever epidemic in March 2008. Mosquitoes help spread the disease.

Warmer weather could mean more disease. Many kinds of viruses, bacteria, and other germs spread more easily when the weather is warm than when it is cool. Among such diseases are malaria, dengue (a disease that causes fever and pain), and lung infections.

How Global Warming Might Affect You

- You might have to conserve electricity, such as by watching less television and using the computer less often.
- You might have to deal with more tornadoes, hurricanes, heat waves, and other dangerous weather.
- You might experience water or food shortages.
- You might be at increased risk of getting certain diseases.
- You might find that wild animals you enjoy seeing, such as certain birds and butterflies, become less common.

What Is Being Done About Climate Change?

Because of the serious effects that climate change might have on human society and wildlife habitats, governments around the world are working on this problem. They have come up with plans to limit the possible effects of global warming.

Governments of most countries support a plan to limit global warming called the Kyoto Protocol. This plan is named after the city in Japan where the first version of it was written in 1997. According to the plan, industrialized countries will reduce the amount of carbon dioxide and other greenhouse gases released by power plants, automobiles, and other sources. Industrialized countries are those nations in which there is widespread use of machinery and fossil fuels. The greenhouse gas reductions have to be great enough to reach certain levels by certain dates, depending on the country.

An Indonesian student plants a tree as part of a climate conference campaign.

As of 2010, the government of the United States had not approved the Kyoto Protocol. Some officials in the U.S. government were concerned that the Kyoto Protocol might harm the U.S. economy.

Both the federal government and state governments in the United States are working to reduce emissions (releases) of greenhouse gases in other ways. For example, some laws require power plants and factories to reduce their carbon dioxide emissions, such as by using "scrubbers." Scrubbers are filtering systems that trap carbon dioxide or other **pollutants** before they are released into the air. Certain newer systems can then store the carbon dioxide underground. Other laws require that automobiles emit less carbon dioxide.

Some U.S. factories have reduced the amount of greenhouse gases they emit, but others have not.

The U.S. government also gives grants (awards of money) to scientists to help them study "renewable" ways of producing energy. Most **renewable energy** sources do not use fossil fuels or emit greenhouse gases. They are called renewable, because—unlike fossil fuels—their supplies will not eventually run out.

Maple Ridge Wind Farm in New York produces enough energy to power about 160,000 homes.

Renewable energy sources include **hydropower** and **geothermal**, wind, and solar power. Hydropower uses moving water, such as a river, to produce energy. Geothermal power uses hot water or steam from inside the ground. Wind power uses moving air. Solar power uses sunlight.

Nuclear power is another way to produce energy that does not emit greenhouse gases. However, nuclear power produces dangerous wastes.

Besides cutting emissions of greenhouse gases, we can also remove some greenhouse gases from the atmosphere. The best way to do this is by planting more trees.

Conclusion: What Do You Think?

Now that you know what scientists have discovered about climate change and global warming, it's time for you to think for yourself. What do you think about climate change? How would you answer the following questions? What evidence can you give to support your answers?

- Is Earth becoming warmer?
- If so, why is Earth becoming warmer?
- Could there be more than one reason why the planet is warming?
- What might be some results of global warming for plants, animals, and humans? Which results do you think are most likely and least likely?
- What, if anything, should be done about climate change?
- Will you change your behavior in any way to help reduce climate change? If so, in what ways?
- How will you find out more about climate change?

Ways You Can Fight Global Warming

Less use of fossil fuels equals less release of greenhouse gases. You can reduce your use of fossil fuels by:

- Using less electricity
- Recycling aluminum cans, paper, and plastics
- Walking or riding your bicycle to places that you have to go
- Using solar-powered electronic products, such as calculators and watches
- Planting trees and gardens.

Glossary

atmosphere *(n.)* a layer of gases surrounding a planet, star, or moon (p. 9)

axis *(n.)* an imaginary line around which an object, such as Earth, rotates (p. 14)

climate *(n.)* the weather conditions in an area over a long period of time (p. 4)

computer models *(n.)* representations of real objects or ideas by computer programs using mathematical equations (p. 15)

fossil fuels *(n.)* energy sources taken from the Earth, such as coal, oil, and natural gas (p. 9)

geothermal *(adj.)* relating to heat produced inside Earth (p. 21)

glaciers *(n.)* large bodies of accumulated ice and compacted snow that are found year-round and slowly move downhill (p. 6)

global warming *(n.)* an increase in the average temperature of Earth's atmosphere and oceans, especially an increase great enough to change the climate (p. 4)

greenhouse effect *(n.)* the process by which heat is trapped inside Earth's atmosphere by gases (p. 9)

greenhouse gases *(n.)* gases in Earth's atmosphere that trap heat and contribute to global warming (p. 9)

hydropower *(n.)* electricity produced by moving water (p. 21)

ice ages *(n.)* periods in Earth's history when ice sheets covered large areas of land (p. 12)

ice shelf *(n.)* a chunk of ice sheet extending into the sea and floating on the water (p. 8)

industrialization *(n.)* the change in a group and its lifestyle that comes with widespread use of machines, automation, and technology to create goods (p. 11)

meteorologists *(n.)* scientists who study Earth's atmosphere, climate, and weather (p. 5)

orbit *(n.)* the path that one celestial body, such as a planet or moon, follows around a larger celestial body, such as the Sun (p. 14)

photosynthesis *(n.)* the process by which chlorophyll in plant cells transforms sunlight, water, air, and nutrients into food (p. 11)

pollutants *(n.)* dirt or debris in the air, in water, or on the ground that causes something to become unclean (p. 20)

renewable energy *(n.)* a source of energy that is not depleted by use (p. 21)

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