

SCHOLASTIC

BRAIN BANK

What's the difference between weather and climate? What kind of climate do you live in? Find out about the different climate zones of the world, and how people, plants, and animals survive in extreme conditions.

In this book, you'll discover how Earth's climates are changing. You'll also learn how people's actions today might affect the weather and climate of the future.

SCHOLASTIC

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Weather or Climate?

by Frances Chan

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What Is Weather?

When we talk about the weather in a particular place, we are talking about what is happening in the **atmosphere** above that place. The weather is constantly changing, because the air in the atmosphere is constantly moving. Factors such as the temperature, the **humidity**, and the amount of cloud and **precipitation** make up the weather.

Scientists who study the atmosphere are called meteorologists. Today, meteorologists get information from computers to help make their weather forecasts. The information comes from weather stations around the world, which are connected to a global satellite network. Not all forecasts are accurate, however, as weather conditions can change suddenly!

There are about 10,000 land-based weather stations around the world. Many are in remote places. They use sensors to monitor the atmosphere. Then they send the information back to meteorologists. There are also thousands of weather **buoys** floating in the sea. They provide data on approaching storms and hurricanes.



This mobile weather radar is used to track extreme weather. The truck can be driven to almost any place to monitor a nearby tornado or hurricane. The radar scans the air and records the speed of anything moving toward or away from it, such as wind, dust, or rain.

That's Extreme!

Tornadoes are the most powerful winds of all. They can travel at speeds of more than 300 miles per hour, instantly uprooting trees and destroying buildings. In the past, it was not possible to track a tornado after dark, because it could not be seen. However, using a weather radar truck, scientists are able to follow a tornado at night, while keeping at a safe distance.

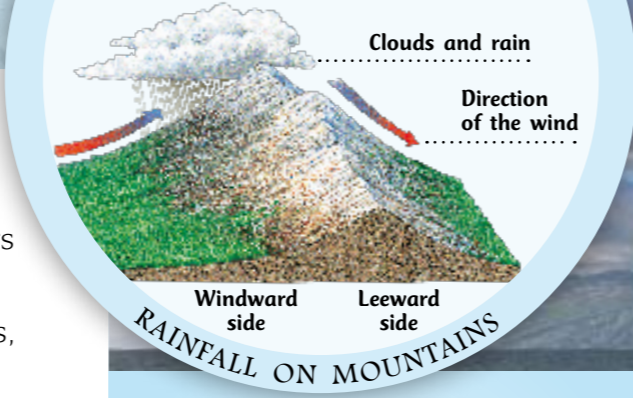


What Is Climate?

The climate is the pattern of weather that occurs in a particular place over a long period of time. Different climates create different environments, such as tropical, desert, and polar regions.

Scientists who study the climate are called climatologists. They calculate the average rainfall and temperature in an area over many years. Certain factors affect an area's climate. One factor is how far the area is from the **equator**. The nearer it is to the equator, the warmer and wetter the climate is. Another factor is altitude, or how high the area is above sea level. The higher an area's altitude, the cooler its climate is.

There are often different regional climates within a country, such as a northern or southern climate. Sometimes there are local climates, which may cover only a few miles.



Mountains can influence climate. When warm air blows up a mountain's slopes, it cools. This causes the moisture in the air to form clouds and then fall as rain. The windy side of a mountain is called the windward side. It is often wet. The other side of the mountain is often drier. It is called the leeward side.

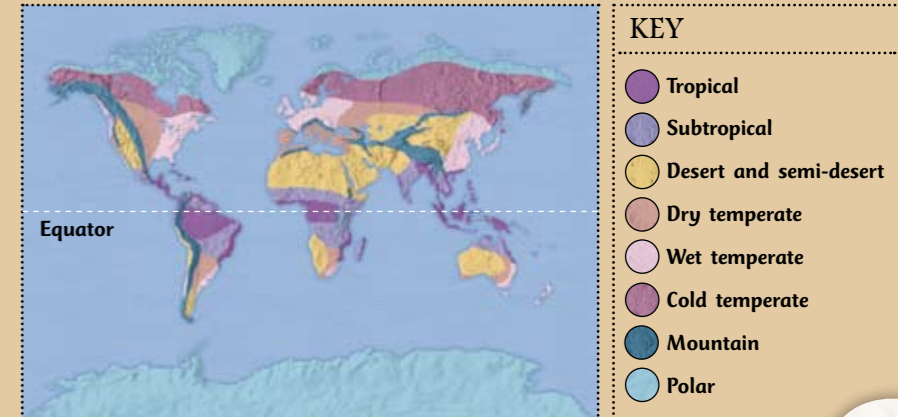


The climate in the city of San Francisco is much cooler and foggier than the climate in other parts of California. The summer fog is formed when hot air from the California mainland strikes the cooler air from the Pacific Ocean and turns to cloud.

Five Main Zones

There are five main climate zones on Earth: tropical, **temperate**, desert, mountain, and polar. Some zones can be divided into more specific zones, such as **subtropical** and dry, wet, or cold temperate.

The World's Climate Zones



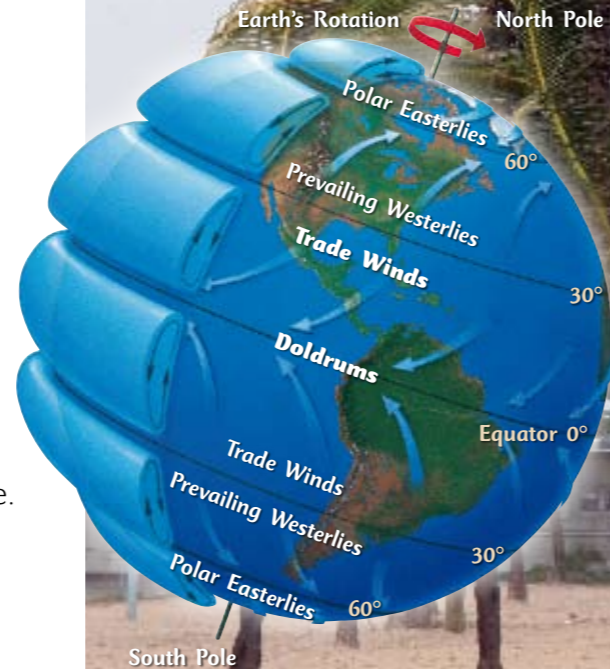
Sun and Wind

As Earth spins, the area around the equator is always closest to the sun. Here, the sun's rays strike Earth almost straight on. Places near the equator are hot all year round. Near the North and South poles, however, the sun's rays have to travel farther to reach Earth. Also, they strike Earth at an angle, so are more spread out. These factors make the polar regions much colder than the equator.

This uneven heating of Earth creates winds. Hot air is lighter than cold air, so it rises upward. At ground level, cold air moves in to replace the hot air. This moving air is called circulation. It creates prevailing winds, which are winds that blow steadily from one direction most of the time. Earth has six main belts of prevailing winds.



The Prevailing Winds



As well as prevailing winds, local winds may affect an area. In some deserts, patches of hot ground can turn warm breezes into fast-spinning columns of wind called dust devils. These whirling winds usually whip dust and sand a few feet off the ground. However, strong dust devils raise dust about 1,000 feet into the air.



In late winter and early spring, a warm, dry wind, called the chinook (*shih NOOK*), blows down the eastern slopes of the Rocky Mountains. The wind gets warmer as it descends. Sometimes it can raise the local temperature by up to 40° F in less than an hour.

That's Extreme!

Antarctica is the windiest continent on Earth. It is subjected to coastal winds from the north, south, east, and west. It also experiences interior winds from the wide, flat Polar Plateau. At Commonwealth Bay, gales sweep down from icy peaks toward the sea at speeds of up to 200 miles per hour.



The Hot Tropics

The tropics lie near the equator. They are hot all year round. Temperatures often reach higher than 85°F and rarely fall below 65°F. Many tropical places are also very wet and have high humidity. In the places nearest the equator, the rain falls reasonably evenly through the year. Slightly farther from the equator, tropical places tend to have a wet season and a dry season. The wet season is often hotter than the dry season.

In the **continental** tropics, the rain often falls in the afternoon. As the sun heats the land each morning, hot air starts rising upward, where the temperatures are cooler. As the warm air cools, water **condenses** into dark clouds filled with moisture. This moisture falls as heavy rain in the afternoon. The high rainfall helps trees to grow well, creating dense tropical rain forests.



In tropical places, some people build their houses on stilts. These tall houses provide protection from floods and allow air to circulate underneath the house to keep it cool. The house itself creates a shady place beneath it.

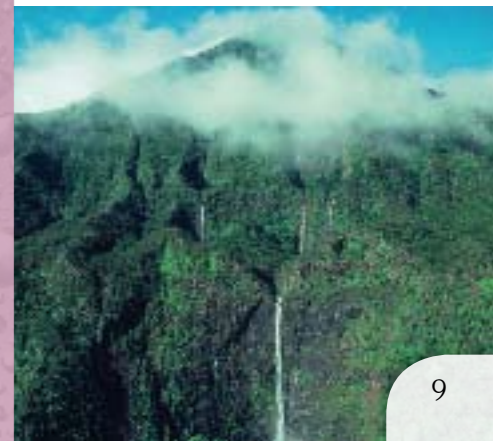


Some tropical places, such as India and Sri Lanka, have monsoon weather. From about July to September every year, the monsoon winds bring heavy rain and floods. The remainder of the year is mainly dry.

That's Extreme!

One of the rainiest places in the world is Mount Waialeale on Kauai Island, Hawaii. On average, it rains there 355 days of the year.

Trade winds are a major factor in making Mount Waialeale a very wet place. The mountain is tall and cone-shaped, which exposes it to winds from all directions. The winds sweep 5,200 feet up to the top of the mountain. At the summit, the air cools and condenses into thick clouds, which bring rain.



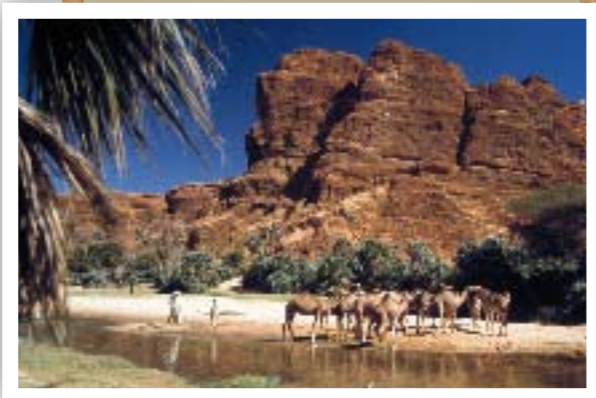
The Dry Deserts

Deserts, or arid zones, are dry places that receive less than ten inches of rain a year. With no clouds around to shade the sun or hold in the heat, temperatures often soar to 104°F or more during the day and then fall quickly to almost freezing at night. Not all deserts are hot, however. The Gobi Desert in Mongolia has icy snow and sandstorms, because of the cold winds that blow across it.

To survive the fierce heat in most deserts, many desert animals hide underground during the day and come out to hunt only at night. Camels are very well suited to desert life. They can go without water for about two weeks, and without food for up to a month. Camels can withstand heat up to 105°F before they start sweating, losing precious moisture.



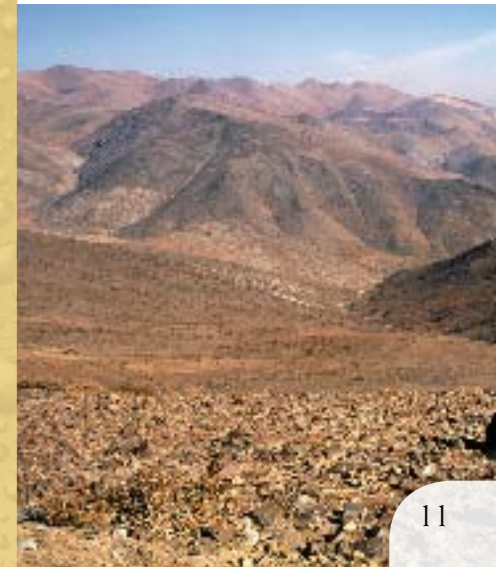
Some water in deserts comes from underground rather than from rainfall. A place where underground water comes to the surface is called an oasis. An oasis can provide drinking water for people and animals, as well as provide water for crops, such as date palms.



In some places, such as Nepal, where there is plenty of cloud but little rain, people use fog collectors to collect water. A large sheet of mesh is stretched between poles, and a trench is dug below it. Water in the fog condenses on the mesh and then drips into the trench.

That's Extreme!

The driest place in the world is the Atacama Desert in northern Chile. On average, it receives less than $\frac{1}{250}$ inch of rain a year. Some parts of the desert have not seen rain for 400 years! It is so lifeless that NASA uses it to test machines that may be used to search for signs of life on Mars.



The Temperate Zones

Many people live in climates with warm summers and cool winters. These places are called temperate zones. They lie between the poles and the equator. There are two bands of temperate zones – one in the northern hemisphere and one in the southern hemisphere.

Sufficient rainfall and sunshine help make many temperate places good for growing plants. Much of the land is used for raising crops or animals. In the spring, many plants in temperate zones produce new leaves. This is also the time when animals are born. Plentiful sunshine in summer ensures that plants grow to their fullest. As temperatures drop in the fall, many trees begin to change color, and some animals **migrate** to warmer regions. In the winter, the trees are bare and many areas are covered with snow.



The northern-hemisphere temperate zone covers large landmasses in the European, Asian, and North American continents. Much of this zone has a continental climate with hot summers, when crops grow well, followed by very cold winters.

Southern Chile, Argentina, South Africa, New Zealand, and parts of Australia are in the southern-hemisphere temperate zone. This zone has an oceanic climate with mild summers and wet, windy winters. These temperate zones are well suited to sheep farming.



That's Extreme!

The temperate zones cover an extremely large area of Earth (see map on page 12). As a result, there is great variation in the climates of temperate places. Winters in Tampa, Florida, for example, are much warmer and drier than winters in Minneapolis, Minnesota.



Florida



Minnesota

The Frozen Poles

The polar zones are the parts of Earth farthest from the sun. They are cold all year round. Antarctica, at the South Pole, is a large continent, covered with snow and ice. In the winter, it gets bigger as the sea surrounding it freezes over. There are many snowstorms with gale-force winds, and the temperatures are always below zero. There are no native peoples from Antarctica.

The Arctic Circle, which includes the North Pole, is mostly frozen ocean. At its edges are the tips of many northern countries. The land is mainly treeless tundra that lies below ice caps much of the year. In the brief summer, temperatures can reach 50°F. Thick grasses and low shrubs grow, as well as lichens and mosses. The Arctic Circle is home to various indigenous peoples, such as the Inuit in Alaska and the Sami in Sweden.



Scientists are the only people living in Antarctica. Many countries have scientific research stations there. The U.S. research station, which includes this dome-shaped building, is the southernmost continually inhabited place on Earth.



The people of Qaanaaq (*KAH nahk*), Greenland, live in the northernmost naturally inhabited village in the world. It is by the coast, but the sea is usually frozen from October to July. No sunlight reaches the village for four months each winter. However, the moon often provides enough light to see by.

That's Extreme!

The coldest town in the northern hemisphere is Verkhoyansk (*Verk hu YANSK*) in Siberia. When the temperature there is below -63°F , the vapor in people's breath turns to ice crystals, and boiling water thrown into the air freezes before it hits the ground.

The coldest place in the southern hemisphere, and the world, is Vostok Base, the Russian research station in Antarctica. Its average annual temperature is -72°F !



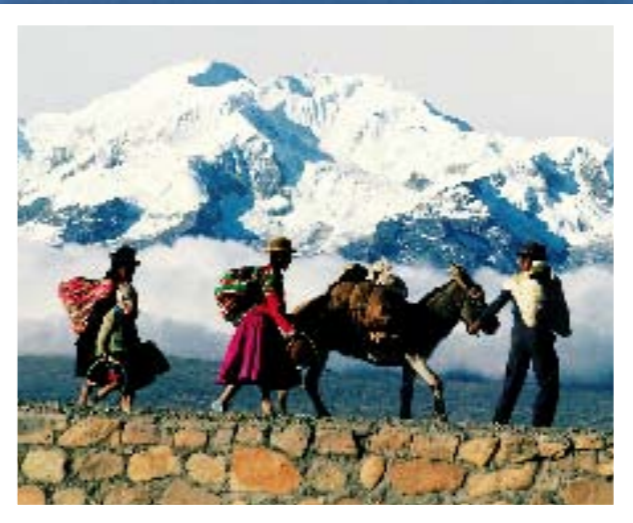
Seas and Mountains

The climates of **maritime** places and places near large lakes are often milder than the climates of places farther inland. This is because, in the summer, large bodies of water take longer to warm up than land, and in the fall, they take longer to cool down. Breezes blowing off seas and lakes affect the land nearby. As a result, these places tend to have cooler summers and warmer winters than continental places.

Mountains produce their own kinds of climates. Air gets cooler with altitude. As wind rises up mountains, the moisture in it condenses and falls as rain. The rain allows plants to grow well, and many mountains are covered in forest. However, above a certain height, it is too cold for trees to survive. Very high peaks are often covered in snow – even near the equator!



The city of Melbourne, in Australia, is by the sea. It has a maritime climate – it experiences cooler summers than inland Australia, and more rain. Lake Mountain, a two-hour drive from Melbourne, has a mountain climate. In winter, it is a popular ski resort.



The Andes make up the longest mountain range in the world. They stretch 4,500 miles along the west coast of South America. Many peoples, such as the Aymara of Bolivia (above), have lived and farmed on the lower slopes of the Andes for thousands of years. Aconcagua, the highest peak in the Americas, is in the Argentinian part of the Andes. It is 22,835 feet high. In the Andes, there are also many active volcanoes and large glaciers.

That's Extreme!

The highest mountain in the world, Mount Everest, is part of the Himalayan mountain chain in Nepal. The mountain is more than 29,000 feet above sea level. At this height, the air is thinner, which means that there is less oxygen in each breath that a climber takes. Most climbers use oxygen tanks for breathing.



What Is El Niño?

El Niño (*El NEE nyoh*) is an event that affects the climate of many places around the Pacific. It occurs every two to seven years and lasts about 18 months.

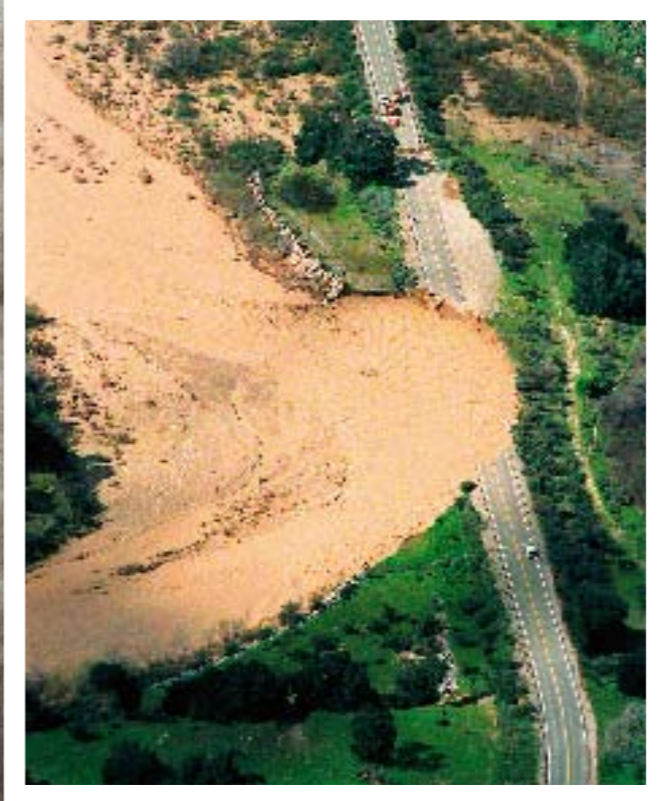
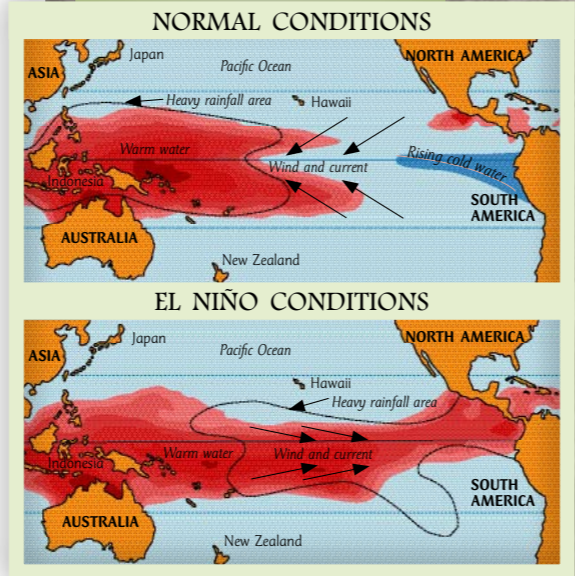
Normally, the Pacific winds blow from the cooler, high-pressure air above South America to the warmer, low-pressure air above Australia and the islands in the western Pacific. This causes the water currents to flow from east to west. These conditions bring much-needed rain to the western Pacific. On the eastern side, near South America, cold water rises to the surface, bringing up nutrients that feed many fish.

When El Niño occurs, strong westerly winds reverse the currents. The western Pacific Ocean suffers drier climates, which can cause droughts and wildfires. In the eastern Pacific, the cold water does not rise, and so there are fewer fish. There is also more rain in the east, which sometimes leads to flooding.



In 1998, El Niño led to the flooding of the Cuyama River in California. Many roads and farms were damaged.

These maps show how the currents in the Pacific are changed during El Niño.



That's Extreme!

Much of northeast Australia is affected by El Niño. During El Niño, it experiences severe droughts. The following year, there is often a strong reverse in the weather. This effect is called La Niña, and it often brings flooding to Australia.

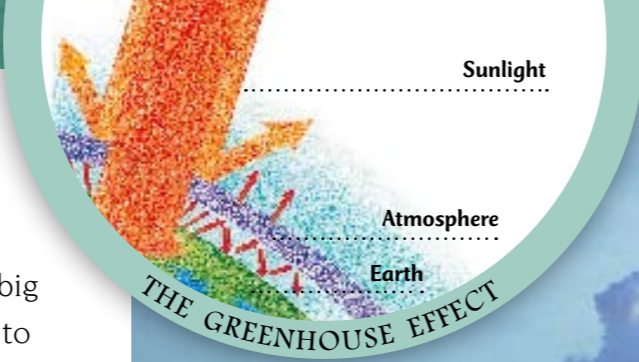


Global Warming

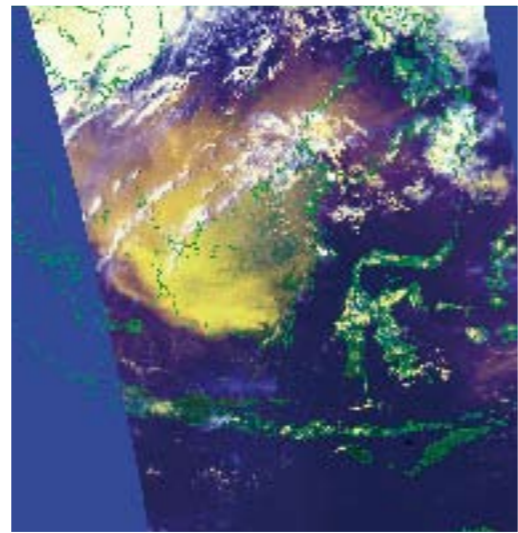
Earth's temperature has increased by 1s°F in the last 100 years. This may not seem to be a big change, but if average temperatures continue to rise, life on Earth could be affected dramatically.

Our atmosphere works like a greenhouse. It traps some of the sun's heat that is reflected off Earth's surface, and reflects much of it back toward Earth. Without the gases in the atmosphere, this heat would escape into outer space, and Earth would be too cold to support life. This natural process is called the greenhouse effect.

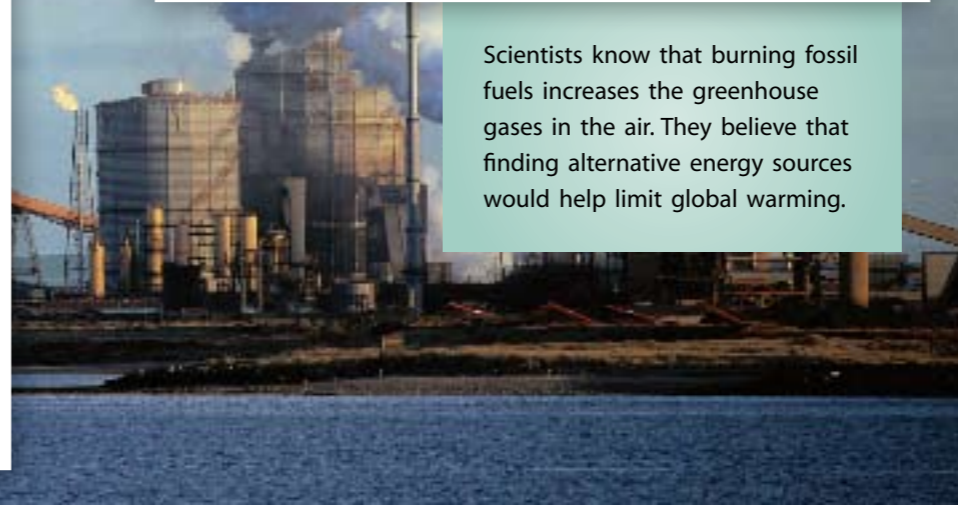
However, since the mid-1800s, industries on Earth have released more greenhouse gases into the atmosphere. Scientists believe this may be increasing the greenhouse effect, and so increasing the average temperatures on Earth.



This satellite picture of forests burning in Indonesia shows smoke pollution escaping into the atmosphere.



Scientists know that burning fossil fuels increases the greenhouse gases in the air. They believe that finding alternative energy sources would help limit global warming.

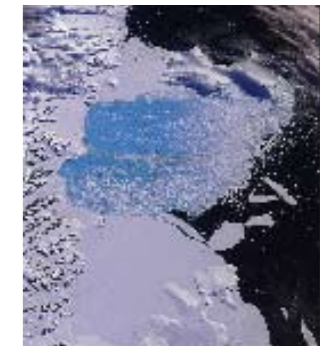


That's Extreme!

Some scientists predict that the enhanced greenhouse effect could:

- melt polar ice caps, causing sea levels to rise
- change rainfall patterns, causing droughts, floods, and storms
- cause some plants and animals to become extinct
- increase Earth's temperature by 8°F by the year 2100.

Some of these effects may already be happening! In 2002, an area of ice the size of Rhode Island, which had been stable for 10,000 years, melted into the sea off Antarctica.

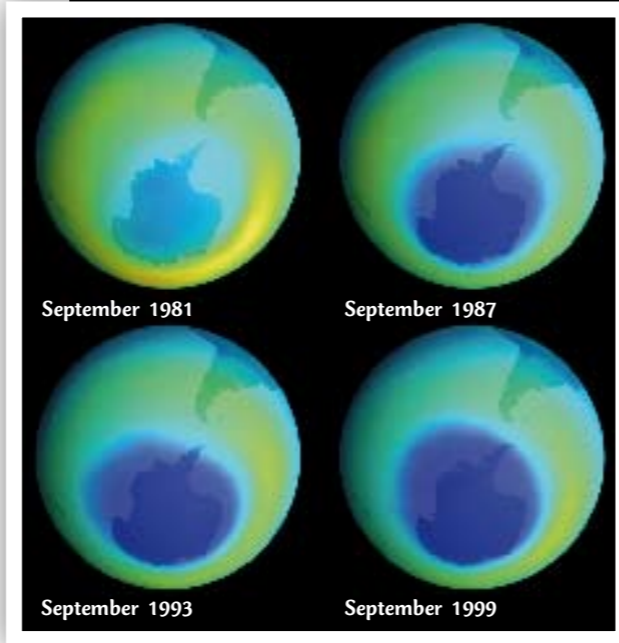


Satellite image of Antarctic ice melting

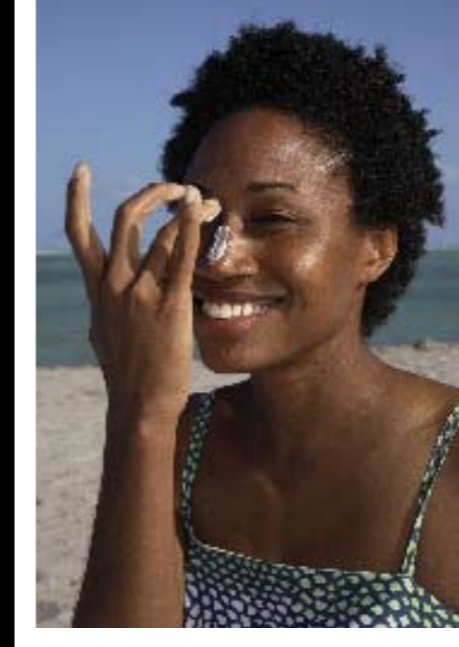
The Hole in the Sky

Ozone gas is a vital part of the atmosphere. It helps retain heat and shields Earth from the sun's harmful ultraviolet (UV) rays. Scientists have discovered that human-made chemicals called chlorofluorocarbons (CFCs) are destroying the ozone and creating a hole in the atmosphere. This ozone hole has been growing above Antarctica, Australia, and New Zealand during the last 30 years. In the Southern Ocean, the increased UV rays could harm the plankton that feed many other animals, such as whales.

CFCs are used in some air-conditioning units, refrigerators, and spray cans. In 1987, many countries signed the Montreal Protocol, an international treaty aimed at greatly reducing the production of CFCs worldwide by 2015.



Images from space clearly show how the ozone hole has increased in size. Monitoring of the ozone hole is continuing.



With more dangerous UV rays reaching Earth through the ozone hole, people are more exposed to sunburn, which can lead to skin cancer. Applying sunblock and avoiding the midday sun can help protect us from UV rays.

In July 2004, the Aura satellite was launched into space. It carries ozone-monitoring equipment. The data it collects are sent back to scientists on Earth.



Help Save Earth

Many countries are now making efforts to reduce greenhouse gases. Here are some things you can do to help the planet:

- Don't use products containing CFCs.
- Use cars less, and bike and walk more. Cars emit carbon dioxide and other harmful gases in their exhaust.
- Plant trees. They absorb carbon dioxide, and so reduce the amount of greenhouse gases.
- Conserve water.
- Use energy-efficient appliances in your home.
- Reduce household waste.
- Recycle aluminum cans, plastic, glass, and paper.



Glossary

- atmosphere** the layer of gases around Earth
- buoy** a floating object anchored in one place
- condense** to change from a gas to a liquid
- continental** having to do with a large land mass,
or continent
- doldrums** a band around the equator where there
is very little wind
- equator** an imaginary line around the middle of Earth,
halfway between the North and South poles
- humidity** the amount of water vapor in the air
- maritime** having to do with the sea
- migrate** to travel to different places at different times
of the year
- precipitation** rain, sleet, or snow
- subtropical** slightly cooler than the tropics
- temperate** having warm summers and cool winters
- trade winds** easterly prevailing winds in the tropics

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