

# ScienceNews for Students

HEALTH WEATHER & CLIMATE SCIENCE & SOCIETY CLIMATE CHANGE CHRONICLES

## Warning: Climate change can harm your health

Low-income people and vulnerable groups will be hit the hardest

BY KATHIANN KOWALSKI MAY 2, 2019 — 6:45 AM EST



In March, Cyclone Idai struck Mozambique, causing widespread flooding. It also sparked an outbreak of cholera. Climate Centre/Flickr (CC BY-NC 2.0)

***This is the ninth in a 10-part series (<https://www.sciencenewsforstudents.org/topic/climate-change-chronicles>) about the ongoing global impacts of climate change. These stories will look at the current effects of a changing planet, what the emerging science suggests is***

***behind those changes and what we all can do to adapt to them.***

The city of Beira was overwhelmed when Cyclone Idai slammed into Mozambique on March 14 and 15. Floods swept across 3,000 square kilometers (1,200 square miles) of the nation. The area affected was about three-quarters the size of the state of Delaware. Homes were inundated. Roads and bridges washed away. More than 1,000 people died in this country, Malawi and Zimbabwe. The full death toll may never be known.

The waters laid waste to crops in areas around Beira. This set the stage for hunger. Floods shut down much of the city's water and sanitation systems. The threat of waterborne disease loomed.

As of April 10, Mozambique's health officials said more than 4,000 people had been infected with cholera. Bacteria in contaminated water cause this disease. Its symptoms include severe diarrhea, violent vomiting and dehydration. People who don't get prompt treatment can die. Clearly, the country faced a major health crisis.

Scientists can't yet say exactly what role climate change may have played in Cyclone Idai. But they do know that extreme storms will become more common with climate change. They know, too, that low-income countries in Africa and elsewhere will be hit harder than more well-to-do nations. And they know that there will be a wide range of health impacts — including more waterborne disease.

Climate change is acting in many ways that can harm health. Between 2030 and 2050, a quarter million more people will die each year than would if climate change were not a factor, the World Health Organization now predicts. And this estimate may be low. It doesn't include all the many ways that climate change can affect health.

We don't have to wait until 2030 to see impacts, either, says Kristie Ebi. She's a public health expert at the University of Washington in Seattle. "Climate change is already affecting our health," she notes.

Extreme heat is one problem. More intense hurricanes, rainstorms and wildfires are others. Such events cause direct harm. They also can disrupt basic health services and promote the spread of disease. But climate change will alter the planet in less obvious ways that can harm health. Air and water pollution will worsen in many places. Infectious diseases will become more common at some sites, or spread to new ones.

The more scientists and engineers learn about climate change and its impacts, the better people will be ready to deal with them. "If we understand that we are part of the cause, it gives some hope that we can be a part of the solution," says Sarah Kew. She's a climate scientist with Vrije University Amsterdam in the Netherlands.

## Climate change poses mental health risks to children and teens

(<https://www.sciencenewsforstudents.org/article/climate-change-poses-mental-health-risks-children-and-teens>)

## Muddy waters

Cyclone Idai was just the latest in a series of devastating storms, many of which have been intensified by climate change. Last September in the United States, for instance, Hurricane Florence flooded huge areas of North Carolina. The waters swept sewage, fertilizers, animal waste, coal ash and animal carcasses into waterways. Floodwaters also messed with water-treatment plants and sewage systems. Water systems shut down in about two dozen communities. Another 20 or so warned their residents to boil their water before use.

Climate change threatens water supplies in other ways, too. Storms can bring contamination. Sea level rise can overwhelm sewer pipes and treatment plants, sweeping more contamination into waterways. Droughts can take away once abundant water supplies.

Blooms of harmful algae happen when some single-celled species grow out of control. Some of them make poisons that cause breathing problems. Others algal toxins can harm the liver, damage the nervous system or affect the brain (and memories).

A bad bloom in Lake Erie forced the city of Toledo, Ohio, to shut down its water system for two days in 2014. Climate change will likely bring more bad blooms. One way they can do this: Climate-intensified storms can wash more fertilizer into waterways. Those nutrients can feed toxic algal species in lakes and along coastlines. Warmer waters also are expanding the areas where algal blooms are likely to emerge.

Christopher Gobler is a coastal ecologist at Stony Brook University in New York. He and other scientists found that since 1982, the *niche* for harmful algal blooms had grown in the northern Atlantic and Pacific oceans. The timing of when blooms might erupt could shift as well. The group reported its findings in 2017 in the *Proceedings of the National Academy of Sciences*.

“Water is the primary medium through which we will feel the effects of climate change,” reports UN-Water, a United Nations agency. Water supplies, water cleanliness and water-delivery systems are all at risk. Yet the health impacts of climate change don’t stop there.

## Turning up the heat

In folklore, Lucifer is a name for the devil. But in 2017, Lucifer took on an extra meaning. It was the name given to a heat wave that made many people think about fires in hell. In parts of southern Europe that August, temperatures



Heavy rains in the spring of 2018 brought an early algal bloom to western Lake Erie in July. Extreme weather events such as heavy storms will be more frequent with climate change. Such storms and warmer summers could lengthen the season for harmful blooms. Zachary Haslick/Aerial Associates Photography, Inc./NOAA Great Lakes Environmental Research Laboratory

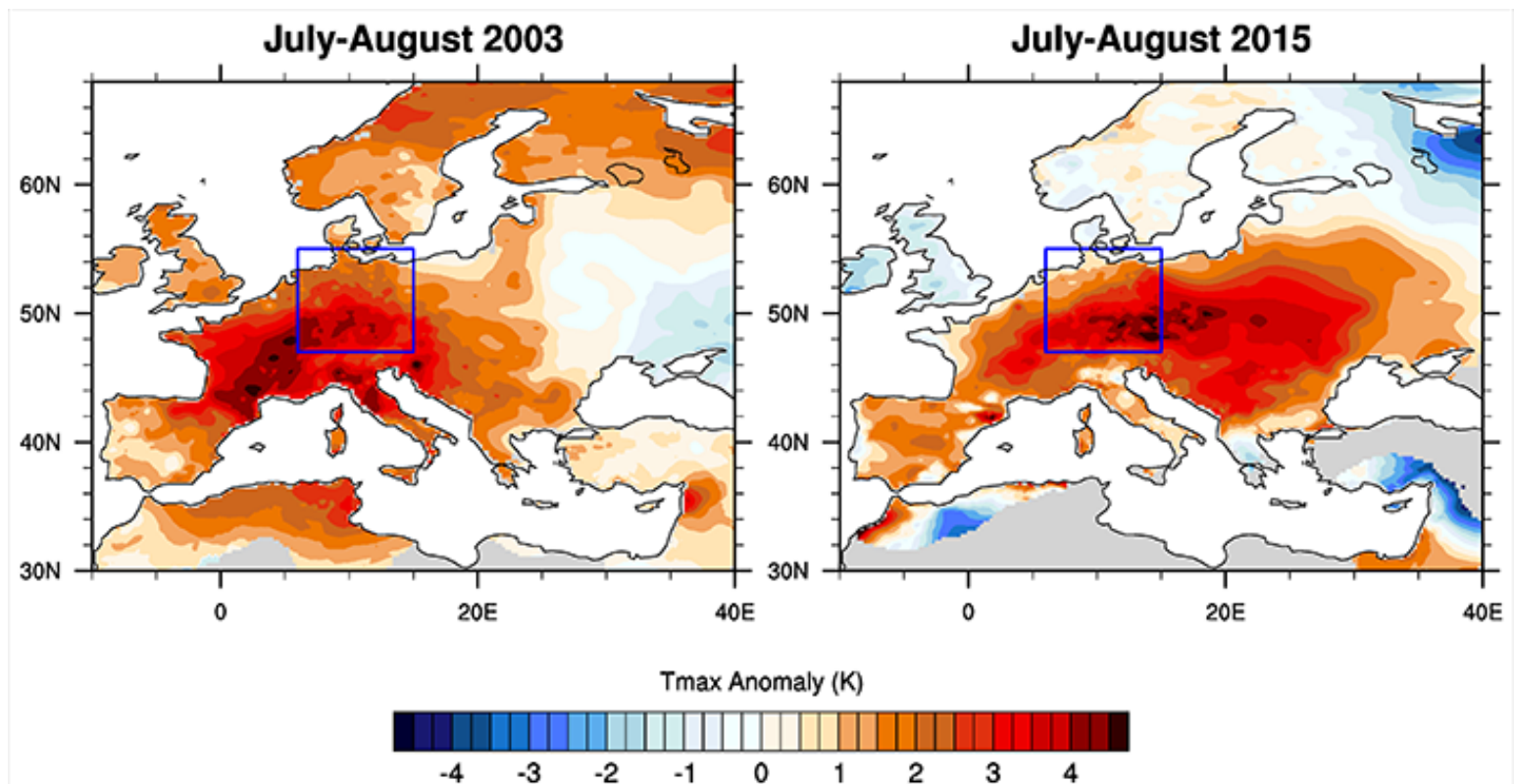
## Explainer: How heat kills

(<https://www.sciencenewsforstudents.org/article/explaine>)

topped 40° Celsius (104° Fahrenheit). Even at night, those hot spots didn't dip below 30 °C (86 °F). So public health officials issued warnings. Find cooler shelter, they said. Limit physical activity. Drink extra fluids. Their concern: Heat can kill.

how-heat-kills)

Lucifer-like heat waves were once rare. Now, southern Europe can expect them about once every 10 years. "We estimate that human-caused climate change has increased the odds of such an event more than threefold since 1950," says Kew. She led the study behind that forecast.

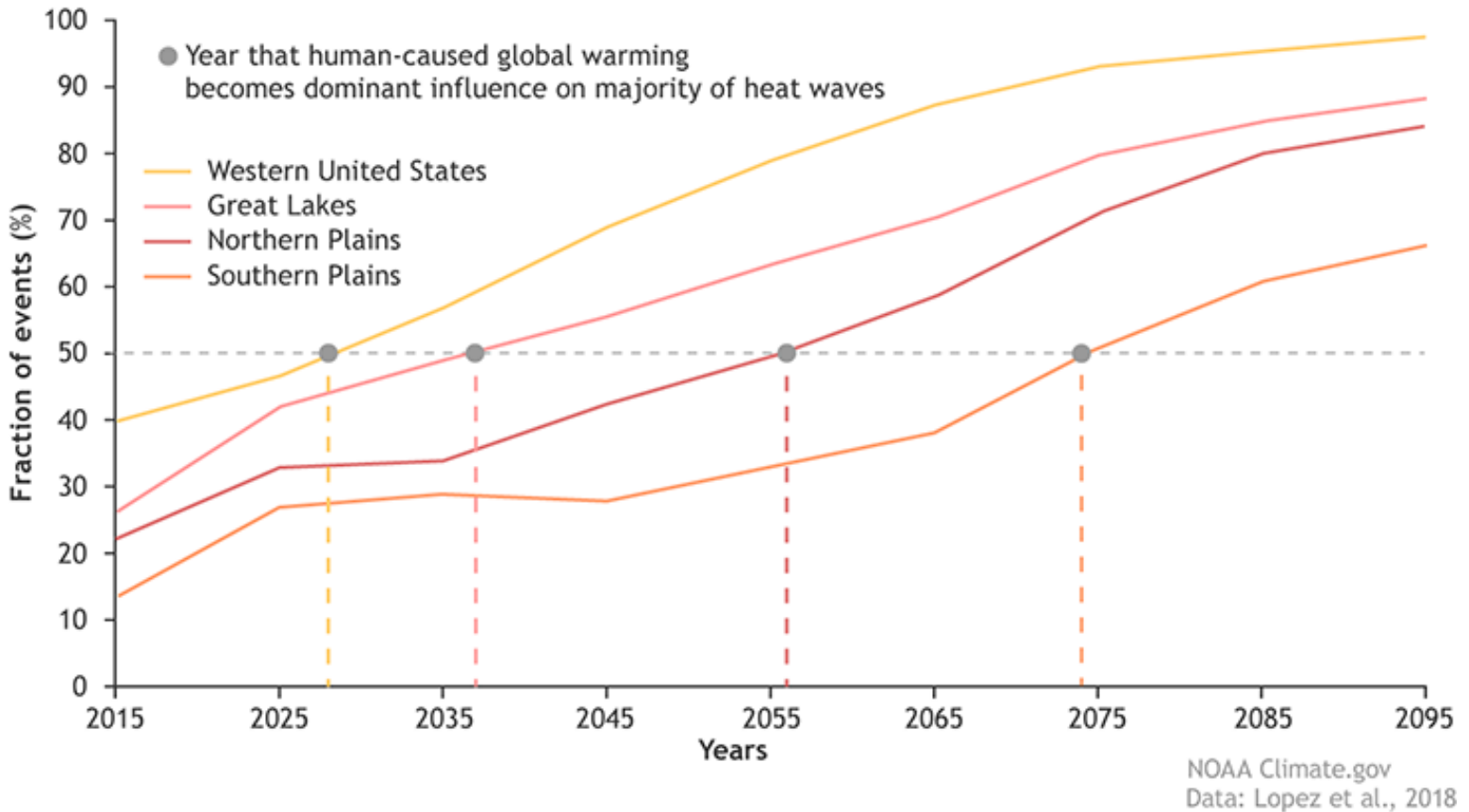


These maps show variations from normal summer temperatures in Europe in 2003 and 2015. Redder areas were hotter than normal. On average, areas in the blue boxes were 2.8° C (5° F) warmer than usual.

S. Muthers *et al/Atmosphere* 2017

There's a similar forecast for the United States. Hosmay Lopez is a climate scientist in Florida with the National Oceanic and Atmospheric Administration and the University of Miami. "Without human influence, half of the extreme heat waves projected to occur in the future wouldn't happen" in most of the United States, he says. And by human influence, he's referring to the burning of fossil fuels and other activities that have been playing a role in warming Earth's climate.

## Contribution of global warming to 21st-century U.S. heat waves



Climate change will soon be the main factor that drives most heat waves in much of the United States. Or so reports scientists at NOAA and universities in Florida.

Graph: NOAA/Climate.gov, Data: Lopez et al./*Nature Climate Change* 2018

An increased risk of death from heat waves exists worldwide, says Yuming Guo. As a biostatistician, he's a numbers man. He's also an epidemiologist — a disease detective — at Monash University in Melbourne, Australia. He and other scientists calculated the added risks for heat-wave deaths in 20 countries and regions. They compared the risks that have been forecast to occur between 2031 and 2080 to those seen between 1971 and 2020.

## Workers won't work as well in a very warm world

(<https://www.sciencenewsforstudents.org/article/workers-wont-work-well-very-warm-world>)

In general, poorer countries in warm regions will be hit hardest, they found. If people do nothing about climate change, for example, Colombia in South America could have roughly 20 times more deaths from heat waves. Moldova in Eastern Europe would have about 50 percent more deaths. The team shared its results in *PLOS Medicine* on July 31, 2018.

"Climate change affects all of us," Madeleine Thomson says, "except some of us have a lot more resources [money and experts] to be able

to tackle it.” She’s an insect biologist and environmental health scientist at Columbia University in New York City.

## Not breathing easy

Climate change isn’t just warming the air. It’s also making that air harder to breathe for many people. Some of the reasons include rising levels of pollen, pollution and other air quality problems.



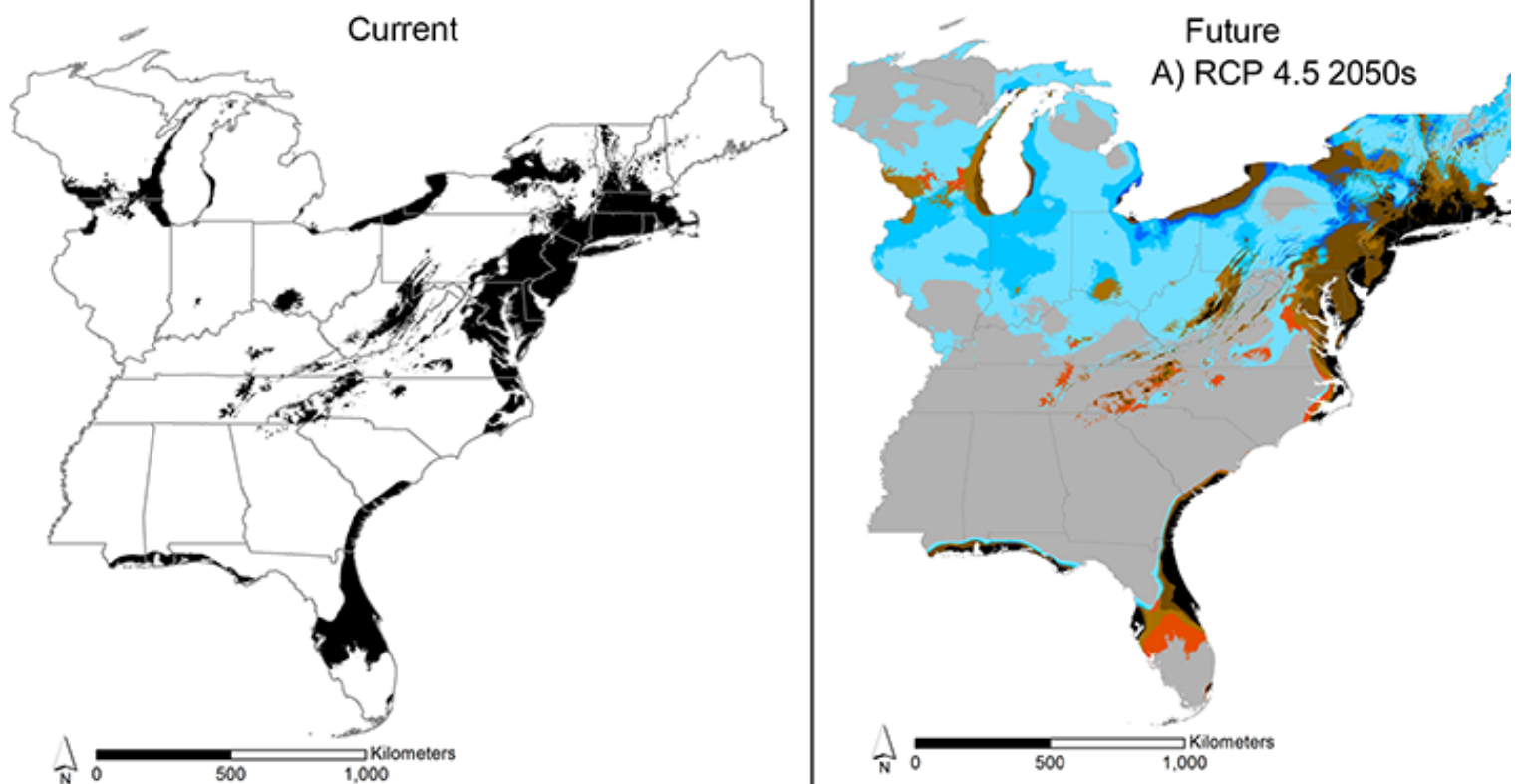
Allergy season will shift in different areas of North America as climate change shifts the range for common ragweed (shown here).

Yevhenii Orlovi/Stock/Getty Images Plus

Plant pollen can cause hay fever. Its misery includes sneezes, runny noses, sore throats, headaches and itchy eyes. Pollen also can trigger asthma attacks, making it hard to take a breath. Climate change may lengthen the growing season for the pesky sources of pollen in many areas. Higher levels of carbon dioxide may also promote more plant growth.

“I personally suffer from spring-time allergies and fear a longer and potentially worse pollen season,” says Michael Case. He’s a climate scientist at the University of Washington in Seattle. Case and ecologist Kristina Stinson looked at how sneeze zones for ragweed pollen could shift in the eastern United States. She works in Massachusetts at the University of Amherst. The duo shared their work in *PLOS ONE* on October 31, 2018.

Climate change will bring warming and a shift in rainfall patterns. That will push ragweed farther north into new places, such as the northeastern United States. The plant also could spread northwest into Wisconsin, Minnesota and Canada. Meanwhile, parts of Florida and the Appalachian mountains may become less ragweed-friendly. “These changes will have real effects on people’s health,” Case says, “making it worse in some areas and potentially better in other areas.”



The map on the left shows current places in the eastern United States where ragweed pollen can pose allergy problems. Blue areas on the map on the right show where the plant's distribution will likely expand by the 2050s due to a moderate increase in greenhouse-gas emissions. Brown areas show where there may be less ragweed by then.

M. Case and K. Stinson/*PLOS ONE* 2018

Trees, too, can trigger allergies and asthma. Patrick Kinney is an epidemiologist at Boston University in Massachusetts. He was part of a team that looked at how changes in when oak trees release their pollen will affect asthma sufferers in the eastern United States. Oak pollen led to 21,000 emergency room trips there for asthma in 2010. Severe climate change could up that by another 5 to 10 percent by 2050 to 2090, the team reported in the May 2017 issue of *GeoHealth*.

A bigger concern, though, may be pollution. Last year Kinney looked into research on the interactions of climate change, pollution and health. Burning of fossil fuels and other activities release chemicals called *nitrous oxides* and *volatile organic compounds*, or VOCs. Sunlight triggers chemical reactions in both types of chemicals. That brews up ground-level ozone. And ozone is a trigger for asthma attacks and other breathing problems.

"VOC emissions go up as the temperature goes up," Kinney notes. "And that promotes ozone formation because there's more of that stuff" in the air. Also, people will need more air conditioning during hot spells. But burning fossil fuels to make electricity will end up releasing even more ozone-forming chemicals.

The burning of fossil fuels also fills the air with teeny, tiny pollutant particles. More of these *particulates* can form as sunlight breaks down other air pollutants. Particulate pollution can cause lung disease. But that's not all. "There's all sorts of gunk in the particles that gets absorbed into

the bloodstream,” Kinney notes. Studies show those tiny bits can cause [heart and circulation](https://www.sciencenewsforstudents.org/article/tiny-air-pollutants-inflate-airways-and-harm-heart) (<https://www.sciencenewsforstudents.org/article/tiny-air-pollutants-inflate-airways-and-harm-heart>) problems. They also may mess with hormone levels and some [brain functions](https://www.sciencenewsforstudents.org/article/nano-air-pollutants-strike-blow-brain) (<https://www.sciencenewsforstudents.org/article/nano-air-pollutants-strike-blow-brain>). Kinney shared his findings in the March 2018 *Current Environmental Health Reports*.

Wildfires [spew particulates](https://www.sciencenewsforstudents.org/article/wildfires-worsen-extreme-air-pollution-us-northwest) (<https://www.sciencenewsforstudents.org/article/wildfires-worsen-extreme-air-pollution-us-northwest>), too, along with other pollutants. Bad air quality affected vast areas of the western United States, where wildfires raged last year. And there are more to come. From 2046 to 2051, 440 western U.S. counties will have at least one high-pollution smoke day. The total 5-year increase across all those counties: almost 5,000 more high-smoke days than had plagued them during the 5-year span of 2004 to 2009. That’s because bigger fires will affect multiple counties. So concludes a 2016 study in *Environmental Research Letters*.

Even droughts can make breathing harder. Dry spells make the ground dusty. Winds can kick that dust into the air. Breathing it in can irritate lungs. Dry soil also kick-starts the growth of a harmful fungus. It causes a disease commonly known as valley fever. A team of scientists found a link between the number of valley fever cases in California and Arizona and soil-moisture levels the fall and winter before. Their report was in *GeoHealth* in 2017.



When wildfires swept through large swaths of California in 2018, the smoky air triggered health warnings for vast areas. The International Space Station captured this shot of the wildfire pollution near Lake Tahoe on August 5.

NASA Johnson/Flickr ([CC BY-NC-ND 2.0](https://creativecommons.org/licenses/by-nc-nd/2.0/)) (<https://creativecommons.org/licenses/by-nc-nd/2.0/>)

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Up to 400,000 children were at risk for starvation when Somalia suffered a severe drought in 2011. Climate change increases the risk for more severe droughts in many places around the world.

Kate Holt/UNICEF/DFID - UK Department for International Development/Flickr ([CC BY-NC-ND 2.0](https://creativecommons.org/licenses/by-nc-nd/2.0/))  
(<https://creativecommons.org/licenses/by-nc-nd/2.0/>)

## Dealing with disease

Scientists describe an organism that can spread disease as a vector. Insects, ticks and various other animals can be culprits. Climate change will affect where such vectors thrive, notes Anna-Sofie Stensgaard. She's a disease ecologist at the Natural History Museum of Denmark in Copenhagen.

For instance, she and her colleagues looked at how climate change might affect three types of parasitic worms. These worms cause schistosomiasis (Shis-toh-so-MY-uh-sis). The disease affects more than 200 million people worldwide. Infected children grow weak and poorly nourished. They also may develop learning problems.

The team examined climate data and experimental evidence on how temperature affects the snails that host these parasites. And, she notes, "It is not just a matter of warmer equals more disease."

For instance, warming might bring some areas of Africa fewer cases of schistosomiasis. But that warming might also spread these infections to places that hadn't seen the disease before. Those new sites will mainly be at the edge of current high-risk regions. Recent cases that popped up in southern Europe could be the first sign of this spread, Stensgaard suggests.

Her team's study appeared in the February 2019 issue of *Acta Tropica*.

Many insects carry disease. That's why "any change to climate is expected to have a big influence on the importance and distribution of insect-borne diseases," says Jennifer Lord. She's a biologist at the Liverpool School of Tropical Medicine in England. One of her recent studies looked at how that will likely play out for tsetse flies. These insects carry the parasites that cause sleeping sickness in people and nagana in cattle. Both diseases can be deadly.

## Explainer: What is a computer model?

(<https://www.sciencenewsforstudents.org/article/explainer-what-computer-model>)

Lord and other scientists built a *computer model* based on the fly's biology. They also analyzed 27 years of climate data and tsetse-fly counts from Mana Pools National Park in Zimbabwe. This park is in a valley, so it's warmer than higher-altitude areas nearby. The model predicted temperatures to climb over the next several decades. It also projected the park's fly population would drop. The team expects that trend will continue.

But what could happen outside the park, at higher elevations, is worrisome. "Rising temperatures may have made some higher, cooler areas of Zimbabwe more suitable for tsetse," Lord says. Many of those places don't have the flies now. But they do have many more people and cattle than the valley does. So, she notes, "Any arrival of tsetse there may increase disease."

A warmer climate also may drive disease-carrying mosquitos into new regions, including higher elevations that used to be too cool for them. Some of those migrating mosquitos are likely to spread malaria to those higher-altitude sites. That's the conclusion of one 2014 study in *Science*.

Malaria parasites attack the liver and blood cells. People with mild cases suffer with fevers, headaches and chills. In worse cases, the blood can't carry enough oxygen. Sometimes malaria also attacks the lungs and brain. Roughly 435,000 people died from the disease in 2017, notes the World Health Organization.

Mosquitoes can also carry dengue (DEN-gay) into new areas. This virus causes fevers and severe joint pain. Most new areas are likely to be next to or near to places where the mosquitoes live now. This shift would present risks to people on all continents except Antarctica, note Ebi at the University of Washington and a colleague. They published their 2016 study in *Environmental Research*.

Similar shifts may occur for other diseases as well. But there's no one-size-fits-all forecast. That's because different species will not all respond the same way to changes in their environment. In general, though, low-income countries will be hit the hardest. And within those places, women, children and the elderly are expected to fare worst.

Even in richer countries, children and older people are more apt to get certain diseases. Among

the reasons why: Poor people often lack the means to eat well, to get good healthcare and to avoid living in high-risk regions.

## Taking action

The more the average global temperature climbs, the worse climate's health impacts will be. "Each additional unit of warming will increase the risks for adverse health outcomes," says Ebi. Fortunately, she adds, "There's a lot we can do now to reduce the number of people who are suffering and dying from climate change."

Governments and health agencies can help people plan and adapt. Timon McPhearson is an ecologist at the New School in New York City. His work on *resilience* looks at how cities can adapt to climate change. "Every city is getting hotter — and getting hotter faster than the global average," McPhearson says. Yet while cities are hot spots, some areas are hotter than others.

To explain that variation, he says, "all we need to do is look at [what sits on] the land and the building height." One of his studies showed this with data for New York City. "What you get," he says, "is if it's paved, it's hot."

Such information can help planners bring help to those places that will need it most. For example, older and low-income people have less money for air conditioning. So cities might focus efforts on

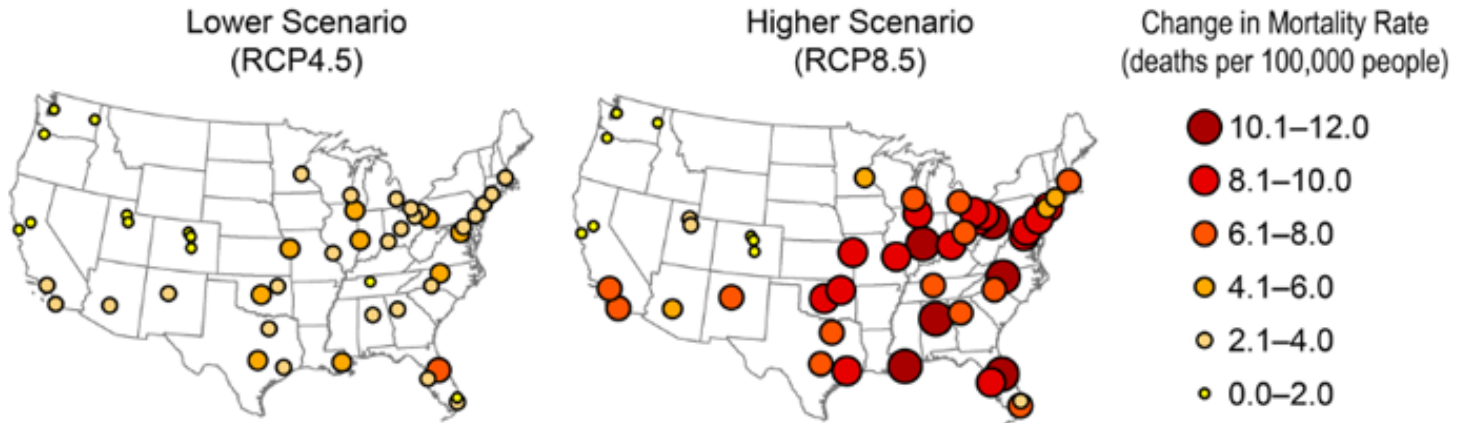
hot spots with higher concentrations of people in those groups, McPhearson suggests. Cities might also make those places a priority for planting more trees, which can bring cooling shade. And they can set up neighborhood programs to make sure people are safe or cool places to find refuge in when heat waves strike.



A tsetse fly's bite can infect a person with the parasite that causes African sleeping sickness.

Recent research shows that where the fly can comfortably live will likely shift to new areas in a warming world.

Geoffrey M. Attardo/Yale School of Public Health



These maps show projected changes in annual deaths due to very hot and cold days for 49 U.S. cities, based on two possible levels of greenhouse-gas emissions between 2080 and 2099. Those numbers are compared to rates in 1989 to 2000. (The lower scenario assumes that governments will make some cuts in emissions. The higher scenario does not.) A 2018 report from the U.S. Global Climate Change Program projects an additional 3,900 deaths per year under the lower scenario and roughly 9,300 more deaths per year under the higher emissions level.

U.S. Global Change Research Program

One way to slow climate change is to cut emissions of the pollutants responsible. And people can do that by using energy very efficiently or switching their sources of energy from fossil fuels to renewable fuels (such as wind). Too often, people focus only on the costs for those actions, Ebi says. In fact, she notes, “almost all the *mitigation* policies benefit our health — and they benefit our health now.”

Indeed, pollution already imposes huge costs to society. “We can save hundreds of millions of dollars in hospitals and people not dying early by mitigating [climate change] now,” Ebi says.

And while climate change is a global issue, cuts in emissions also provide local health benefits, Kinney notes. People there get cleaner air and cleaner water very quickly. “It’s a win-win if we take action,” he says. “It always turns out the health benefits far outweigh the costs.”

## Power Words

([more about Power Words \(https://www.sciencenewsforstudents.org/power-words-aid-stem-literacy\)](https://www.sciencenewsforstudents.org/power-words-aid-stem-literacy))

## Classroom questions

(<https://www.sciencenewsforstudents.org/questions/quest>

[warning-climate-change-can-harm-your-health](https://www.sciencenewsforstudents.org/questions/quest/warning-climate-change-can-harm-your-health))

**algae** Single-celled organisms, once considered plants (they aren't). As aquatic organisms, they grow in water. Like green plants, they depend on sunlight to make their food.

**Antarctica** A continent mostly covered in ice, which sits in the southernmost part of the world.

**asthma** A disease affecting the body's airways, which are the tubes through which animals breathe. Asthma obstructs these airways through swelling, the production of too much mucus or a tightening of the tubes. As a result, the body can expand to breathe in air, but loses the ability to exhale appropriately. The most common cause of asthma is an allergy. Asthma is a leading cause of hospitalization and the top chronic disease responsible for kids missing school.

**average** (in science) A term for the arithmetic mean, which is the sum of a group of numbers that is then divided by the size of the group.

**bacteria** (singular: bacterium) Single-celled organisms. These dwell nearly everywhere on Earth, from the bottom of the sea to inside other living organisms (such as plants and animals). Bacteria are one of the three domains of life on Earth.

**biology** The study of living things. The scientists who study them are known as biologists.

**biostatistics** A field of mathematics that applies statistics to understand events or testing that involves biology or medicine. In statistics, experts collect and analyze numerical data in large quantities, then work to interpret their meaning. Much of this work involves reducing errors that might be attributable to random variation. People who work in this field are known as **biostatisticians**.

**bloom** (in microbiology) The rapid and largely uncontrolled growth of a species, such as algae in waterways enriched with nutrients.

**carbon dioxide** (or CO<sub>2</sub>) A colorless, odorless gas produced by all animals when the oxygen they inhale reacts with the carbon-rich foods that they've eaten. Carbon dioxide also is released when organic matter burns (including fossil fuels like oil or gas). Carbon dioxide acts as a greenhouse gas, trapping heat in Earth's atmosphere. Plants convert carbon dioxide into oxygen during photosynthesis, the process they use to make their own food.

**cell** The smallest structural and functional unit of an organism. Typically too small to see with the unaided eye, it consists of a watery fluid surrounded by a membrane or wall. Depending on their size, animals are made of anywhere from thousands to trillions of cells. Most organisms, such as yeasts, molds, bacteria and some algae, are composed of only one cell.

**chemical** A substance formed from two or more atoms that unite (bond) in a fixed proportion and structure. For example, water is a chemical made when two hydrogen atoms bond to one oxygen atom. Its chemical formula is H<sub>2</sub>O. Chemical also can be an adjective to describe properties of materials that are the result of various reactions between different compounds.

**chemical reaction** A process that involves the rearrangement of the molecules or structure of a substance, as opposed to a change in physical form (as from a solid to a gas).

**cholera** A bacterial disease that infects the small intestine, causing severe diarrhea, vomiting and dehydration. It is spread by germs from feces that contaminate water or food.

**climate** The weather conditions that typically exist in one area, in general, or over a long period.

**climate change** Long-term, significant change in the climate of Earth. It can happen naturally or in

response to human activities, including the burning of fossil fuels and clearing of forests.

**colleague** Someone who works with another; a co-worker or team member.

**compound** (often used as a synonym for chemical) A compound is a substance formed when two or more chemical elements unite (bond) in fixed proportions. For example, water is a compound made of two hydrogen atoms bonded to one oxygen atom. Its chemical symbol is H<sub>2</sub>O.

**computer model** A program that runs on a computer that creates a model, or simulation, of a real-world feature, phenomenon or event.

**concentration** (in chemistry) A measurement of how much of one substance has been dissolved into another.

**continent** (in geology) The huge land masses that sit upon tectonic plates. In modern times, there are six established geologic continents: North America, South America, Eurasia, Africa, Australia and Antarctica. In 2017, scientists also made the case for yet another: Zealandia.

**cyclone** A strong, rotating vortex, usually made of wind. Notable examples include a tornado or hurricane.

**dengue** A potentially lethal infectious disease transmitted by mosquitoes. No vaccine yet exists to prevent infection with the virus responsible for the disease, which causes high fevers, severe headache, joint pain, pain behind the eyes, rash, bone pain and sometimes mild bleeding. A more severe form of the disease, known as dengue hemorrhagic fever can cause uncontrolled bleeding if not treated right away.

**disrupt** (n. disruption) To break apart something; interrupt the normal operation of something; or to throw the normal organization (or order) of something into disorder.

**drought** An extended period of abnormally low rainfall; a shortage of water resulting from this.

**ecology** A branch of biology that deals with the relations of organisms to one another and to their physical surroundings. A scientist who works in this field is called an ecologist.

**elevation** The height or altitude at which something exists.

**emergency room** Also known as the ER. It's that part of the hospital where doctors initially attend to the immediate medical needs of accident victims and others who need critical care.

**engineer** A person who uses science to solve problems. As a verb, to engineer means to design a device, material or process that will solve some problem or unmet need.

**entomology** The scientific study of insects. One who does this is an entomologist.

**environment** The sum of all of the things that exist around some organism or the process and the condition those things create. Environment may refer to the weather and ecosystem in which some animal lives, or, perhaps, the temperature and humidity (or even the placement of things in the vicinity of an item of interest).

**environmental health** A research field that focuses on measuring the effects of pollutants and other factors in the environment on the health of people, wildlife or ecosystems.

**epidemiologist** Like health detectives, these researchers figure out what causes a particular illness and how to limit its spread.

**factor** Something that plays a role in a particular condition or event; a contributor.

**fertilizer** Nitrogen, phosphorus and other plant nutrients added to soil, water or foliage to boost crop growth or to replenish nutrients that were lost earlier as they were used by plant roots or leaves.

**fossil fuels** Any fuels — such as coal, petroleum (crude oil) or natural gas — that have developed within the Earth over millions of years from the decayed remains of bacteria, plants or animals.

**fungus** (plural: fungi) One of a group of single- or multiple-celled organisms that reproduce via spores and feed on living or decaying organic matter. Examples include mold, yeasts and mushrooms.

**greenhouse gas** A gas that contributes to the greenhouse effect by absorbing heat. Carbon dioxide is one example of a greenhouse gas.

**hormone** (in zoology and medicine) A chemical produced in a gland and then carried in the bloodstream to another part of the body. Hormones control many important body activities, such as growth. Hormones act by triggering or regulating chemical reactions in the body.

**host** (in biology and medicine) The organism (or environment) in which some other thing resides. Humans may be a temporary host for food-poisoning germs or other infective agents.

**hurricane** A tropical cyclone that occurs in the Atlantic Ocean and has winds of 119 kilometers (74 miles) per hour or greater. When such a storm occurs in the Pacific Ocean, people refer to it as a typhoon.

**infection** A disease that can spread from one organism to another. It's usually caused by some type of germ.

**infectious** An adjective that describes a type of germ that can be transmitted to people, animals or other living things.

**insect** A type of arthropod that as an adult will have six segmented legs and three body parts: a head, thorax and abdomen. There are hundreds of thousands of insects, which include bees, beetles, flies and moths.

**link** A connection between two people or things.

**liver** An organ of the body of animals with backbones that performs a number of important functions. It can store fat and sugar as energy, break down harmful substances for excretion by the body, and secrete bile, a greenish fluid released into the gut, where it helps digest fats and neutralize acids.

**malaria** A disease caused by a parasite that invades the red blood cells. The parasite is transmitted by mosquitoes, largely in tropical and subtropical regions.

**mental health** A term for someone's emotional, psychological and social well-being. It refers to how people behave on their own and how they interact with others. It includes how people make choices, handle stress and manage fear or anxiety. Poor mental health can be triggered by disease or merely reflect a short-term response to life's challenges. It can occur in people of any age, from babies to the elderly.

**mitigation** (v. **mitigate**) Actions or features that made (or could make) something less extreme, painful or disruptive.

**National Oceanic and Atmospheric Administration** (or NOAA) A science agency of the U.S. Department of Commerce. Initially established in 1807 under another name (The Survey of the Coast), this agency focuses on understanding and preserving ocean resources, including fisheries, protecting marine mammals (from seals to whales), studying the seafloor and probing the upper atmosphere.

**nervous system** The network of nerve cells and fibers that transmits signals between parts of the body.

**niche** A small or narrow pocket that sets something apart, or perhaps offers a region of protection. (In ecology) The term for the role that an organism plays in its community.

**organic** (in chemistry) An adjective that indicates something is carbon-containing; a term that relates to the chemicals that make up living organisms.

**organism** Any living thing, from elephants and plants to bacteria and other types of single-celled life.

**oxide** A compound made by combining one or more elements with oxygen. Rust is an oxide; so is water.

**oxygen** A gas that makes up about 21 percent of Earth's atmosphere. All animals and many microorganisms need oxygen to fuel their growth (and metabolism).

**ozone** A colorless gas that forms high in the atmosphere and at ground level. When it forms at Earth's surface, ozone is a pollutant that irritates eyes and lungs. It is also a major ingredient of smog.

**parasite** (adj. **parasitic**) An organism that gets benefits from another species, called a host, but doesn't provide that host any benefits. Classic examples of parasites include ticks, fleas and tapeworms.

**particle** A minute amount of something.

**particulate** A tiny bit of something. A term used by pollution scientists to refer to extremely tiny solid particles and liquid droplets in air that can be inhaled into the lungs. The smaller the particulate, the more easily it can be inhaled deeply into the lungs. Ultra-fine particulates may be small enough to pass through cell walls and into the blood, where they can then move throughout the body.

**physical** (adj.) A term for things that exist in the real world, as opposed to in memories or the imagination. It can also refer to properties of materials that are due to their size and non-chemical interactions (such as when one block slams with force into another).

**policy** A plan, stated guidelines or agreed-upon rules of action to apply in certain specific circumstances. For instance, a school could have a policy on when to permit snow days or how many excused absences it would allow a student in a given year.

**pollen** Powdery grains released by the male parts of flowers that can fertilize the female tissue in other flowers. Pollinating insects, such as bees, often pick up pollen that will later be eaten.

**population** (in biology) A group of individuals from the same species that lives in the same area.

**primary** An adjective meaning major, first or most important.

**range** The full extent or distribution of something. For instance, a plant or animal's range is the area



over which it naturally exists. (in math or for measurements) The extent to which variation in values is possible. Also, the distance within which something can be reached or perceived.

**renewable energy** Energy from a source that is not depleted by use, such as hydropower (water), wind power or solar power.

**resilience** The ability to recover quickly from a setback.

**risk** The chance or mathematical likelihood that some bad thing might happen. For instance, exposure to radiation poses a risk of cancer. Or the hazard — or peril — itself. (For instance: *Among cancer risks that the people faced were radiation and drinking water tainted with arsenic.*)

**sanitation** The protection of human health by preventing human contact with our own bodily wastes, through hand washing, use of things like use of toilets or latrines, separation of disposal of wastes from drinking-water sources and water, and cleaning water to rid of disease causing agents disinfecting foods and materials that may be ingested or otherwise enter the body.

**sea** An ocean (or region that is part of an ocean). Unlike lakes and streams, seawater — or ocean water — is salty.

**sea level** The overall level of the ocean over the entire globe when all tides and other short-term changes are averaged out.

**sewage** Wastes — primarily urine and feces — that are mixed with water and flushed away from homes through a system of pipes for disposal in the environment (sometimes after being treated in a big water-treatment plant).

**sewer** A system of water pipes, usually running underground, to move sewage (primarily urine and feces) and storm water for collection — and often treatment — elsewhere.

**smoke** Plumes of microscopic particles that float in the air. They can be comprised of anything very small. But the best known types are pollutants created by the incomplete burning of oil, wood and other carbon-based materials.

**society** An integrated group of people or animals that generally cooperate and support one another for the greater good of them all.

**species** A group of similar organisms capable of producing offspring that can survive and reproduce.

**symptom** A physical or mental indicator generally regarded to be characteristic of a disease. Sometimes a single symptom — especially a general one, such as fever or pain — can be a sign of any of many different types of injury or disease.

**tick** A small eight-legged blood-sucking arthropod, related to spiders and mites. Although they look like bugs, these are not insects. They attach themselves to the skin of their host and feed on their blood. But in the process, they may spread any germs that could have been present in the blood of an earlier host.

**toxin** A poison produced by living organisms, such as germs, bees, spiders, poison ivy and snakes.

**vector** (in medicine) An organism that can spread disease, such as by transmitting a germ from one host to another. (in biology) A material used to introduce the genes of some outside organism, often for genetic engineering, immunology or other purposes.

**virus** Tiny infectious particles consisting of RNA or DNA surrounded by protein. Viruses can reproduce only by injecting their genetic material into the cells of living creatures. Although scientists frequently refer to viruses as live or dead, in fact no virus is truly alive. It doesn't eat like animals do, or make its own food the way plants do. It must hijack the cellular machinery of a living cell in order to survive.

**volatile organic compounds (VOCs)** Certain solid and liquid chemicals that evaporate (become gases), often at room temperature or lower. Many of these chemicals can be harmful if inhaled or allowed to move through the skin. Concentrations of these chemicals tend to be higher indoors than out. Sources of VOCs include numerous household products, such as paints, varnishes, waxes, oil-dissolving solvents, cleansers, disinfecting, cosmetics, degreasers and glues. Many fuels also release VOCs.

**World Health Organization** An agency of the United Nations, established in 1948, to promote health and to control communicable diseases. It is based in Geneva, Switzerland. The United Nations relies on the WHO for providing international leadership on global health matters. This organization also helps shape the research agenda for health issues and sets standards for pollutants and other things that could pose a risk to health. WHO also regularly reviews data to set policies for maintaining health and a healthy environment.

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7.6

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