

Climate Change

Climate change is the current trend of rising temperatures and shifting weather patterns in Earth's atmosphere. The trend does not fit any natural cycle; instead, it is largely the result of human activities. The primary human activity that leads to climate change is the burning of fossil fuels.



Fossil fuels include coal, oil, and gasoline. When these fuels are burned, they release water vapor, carbon dioxide, and methane, which trap heat in Earth's atmosphere. The gases act like the glass in a greenhouse. They are called greenhouse gases.

These gases enhance the natural "greenhouse effect." This effect was recognized about 200 years ago. It keeps Earth's surface about 36 Fahrenheit degrees (20 Celsius degrees) warmer than it would otherwise be.

For thousands of years, the greenhouse effect hardly changed. This was because the levels of greenhouse gases remained stable. However, one of these gases, carbon dioxide, started a dramatic increase in the 1800s. The increase was due to the burning of large amounts of fossil fuels during the Industrial Revolution. Since then, the burning of fossil fuels has increased. More greenhouse gases have entered the atmosphere. Temperatures have continued to rise.

There is some debate as to how much of climate change is caused by humans. Some people who doubt that human activities cause climate change say that it could be due to changes in the Sun's output. But in 2007 a study revealed that the Sun's output has been decreasing since 1985. In contrast, global temperatures have been rising quickly.

Gathering Evidence

Changes in Earth's temperature are nothing new. Over the past 1,000 years, temperature changes have fit within a range defined by two extreme periods. The high

mark was a warm period that took place between 1200 and 1400. A "little ice age," which occurred between 1600 and 1900, was the low point. But the warming over the past 100 years does not fit neatly into that range.

Past temperature and climate trends can be attributed to reasons that have nothing to do with human activities. Natural reasons are not enough to explain climate change. Natural climate cycles tend to unfold slowly; the changes seen with climate change are relatively sudden.

The world has warmed by 5 to 9 Fahrenheit degrees (2.8 to 5 Celsius degrees) over the past 18,000 to 20,000 years. By 2100 it is estimated that the world temperature will rise by 2 to almost 12 Fahrenheit degrees (1.1 to 6.7 Celsius degrees).

In recent years, temperatures and carbon dioxide levels have increased greatly. If the current trend continues, human activities may push carbon dioxide to twice its preindustrial level within the next 100 years. This rate of change seems extraordinarily quick when one considers that the preindustrial level had been relatively stable over the last million years or more. Human-induced changes are happening so much faster than natural changes. As a result, much of nature itself, including humans, may have difficulty adapting.

Negative Effects

Climate change is expected to have a few positive effects, but not many. For example, longer growing seasons will occur in some places. This will lead to higher yields of some crops.

But the negatives will far outweigh the positives. As ocean water expands as it is heated, the sea level will rise. One projection predicts that the sea level could rise more than 50 inches (127 centimeters) by the year 2100. This will threaten communities in coastal regions.

Extreme weather events will be more common. An unusually strong heat wave in Europe during the summer of 2003 led to over 20,000 deaths. The summer of 2012 was the third hottest on record in the United States. Much of the nation's midsection suffered under a severe drought. In 50 years, such summers may be the norm.

In a warmer world, more water will evaporate. It will enter the atmosphere and condense into clouds. This is important because cloud formation releases a lot of heat. This heat is the largest source of energy driving the atmosphere's circulation. Adding to this heat intensifies the atmosphere's circulation, producing greater extremes in the climate. Some areas will receive more intense rainfall. Other areas will receive less, even though they are already too dry. Floods and droughts will become worse and strike more often.

The changes could affect everything from wildlife to farming to public health. Some estimates say that 20 to 30 percent of the world's species could die out. Rising ocean temperatures will harm coral reefs. Warming will also harm other delicate ecosystems. Increases in wildfires and insect pests will put forests at risk.

Other effects are less certain. Temperature increases in polar regions may speed up the melting of ice caps. Large changes are already being observed. In 2003, for example, the massive Ward Hunt Ice Shelf in the Arctic broke apart. Many scientists believe that this and other such events are the result of rapid warming at Earth's poles. Extensive melting over a long period would dramatically increase the sea level. Also, ocean currents could be disrupted. For example, if the current known as the Gulf Stream slowed down, it would carry less heat to northwestern Europe. The weather there could grow colder, even while the world as a whole grew warmer.

One problem related to climate change is ozone depletion. Ozone forms a thin, protective layer around Earth, shielding the world from the Sun's most harmful rays. But the use of halocarbons (chemicals used as coolants and for other purposes) has created holes in the ozone layer. These holes allow through harmful ultraviolet rays that can cause skin cancer and eye problems. Recent international efforts may help to limit or eliminate the use of halocarbons. This could allow the ozone layer to repair itself.

Predicting Change

Scientists use many methods to learn about Earth's climate. Weather stations, balloons, aircraft, ships, and satellites all provide valuable information. Historical records are also important. Ice cores, tree rings, sediments from the ocean floor, and other specimens all contain a climate record of the past. By examining them, scientists learn about the climate that existed when these specimens were created.

Powerful computers are used to simulate the natural processes that affect climate. These processes are very complicated. They include the actions and interactions of the atmosphere, the oceans, and many other factors. By taking all these things into account, computers can create a model of the climate and predict how the climate will change.

Limiting Damage

The best way to slow down climate change is by cutting carbon dioxide. This can be done in three ways. First, humans must use energy more efficiently. Reducing the burning of fossil fuels reduces the production of carbon dioxide.

Second, humans must use sources of energy besides fossil fuels. Alternatives include waterpower, wind power, and solar power. Biomass, which is fuel created from plants such as corn, is another option. Plants used to create biomass take in carbon dioxide when they grow. When that carbon dioxide is released as the fuel is burned, it does not increase the carbon dioxide content of the atmosphere.

Last, humans must find ways to store carbon dioxide that would otherwise enter the atmosphere. Storing carbon dioxide underground is one method that has been explored. Planting forests is another. Trees absorb carbon dioxide as they grow.

Global Solutions

Climate change is a problem that will require global solutions. Individuals can do their part by reducing their use of fossil fuels. But large changes will also be required of governments, businesses, and other organizations around the world.

The United Nations (U.N.) body called the Intergovernmental Panel on Climate Change (IPCC) has described the global scale of the problem. The IPCC has released several reports clearly stating that climate change threatens the human community.

In 1997 the United Nations Framework Convention on Climate Change (UNFCCC) negotiated the Kyoto Protocol. This international treaty aims to reduce carbon-dioxide emissions. In 2005, when the treaty came into effect, it had the support of over 150 nations. Together these nations account for about 60 percent of greenhouse-gas emissions. (The United States, which contributes about 25 percent, has refused to ratify

the treaty.) The nations failed to reach their overall goal by 2012, the date set out in the agreement. Several countries refused to take part in the next phase of the treaty, which aimed to reduce greenhouse-gas emissions by 2020.

In 2009 the United Nations Climate Change Conference was held in Copenhagen, Denmark. It brought together leaders from around the world, including China and the United States, two of the world's largest greenhouse-gas emitters. The result was the Copenhagen Accord, a nonbinding agreement that aims to limit the increase in global temperatures to less than 3.6 Fahrenheit degrees (2 Celsius degrees). It calls for a reduction in greenhouse-gas emissions and for financial assistance from developed nations to developing nations to help in such efforts. The accord is nonbinding, which has caused some experts to question how effective it will be.

Another effort led by the U.N. began in 2014. During that year, nations began submitting plans on how they would combat climate change. In 2015 representatives from countries around the world came together in Paris to work out a coordinated plan. The result was the Paris Agreement. It set a goal of keeping global temperatures from rising by 2 degrees Celsius (3.6 degrees Fahrenheit), or preferably 1.5 degrees Celsius (2.7 degrees Fahrenheit). In all, 195 nations signed on. Each pledged to take certain actions, such as increasing usage of solar power or limiting deforestation. The United States, for example, pledged to cut its greenhouse gas emissions by 26 percent. These efforts, however, will not be enough to achieve the goals of the Paris Agreement. The countries will therefore be encouraged to revisit their goals every five years. The pact calls for wealthy countries to provide funding to developing countries for clean energy and to deal with results of climate change. It also includes measures to make sure that countries are transparent in tracking their progress.

In 2017, U.S. president Donald Trump announced that the United States would pull out of the accord. Trump cited costs, jobs, and the fairness of the agreement as reasons for the departure. He promised that the United States would continue efforts to protect the environment. The president also expressed a willingness to return to the agreement under different terms. Many other nations reacted to the announcement by reasserting their commitment to the Paris Agreement's terms.

Sir John Houghton

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