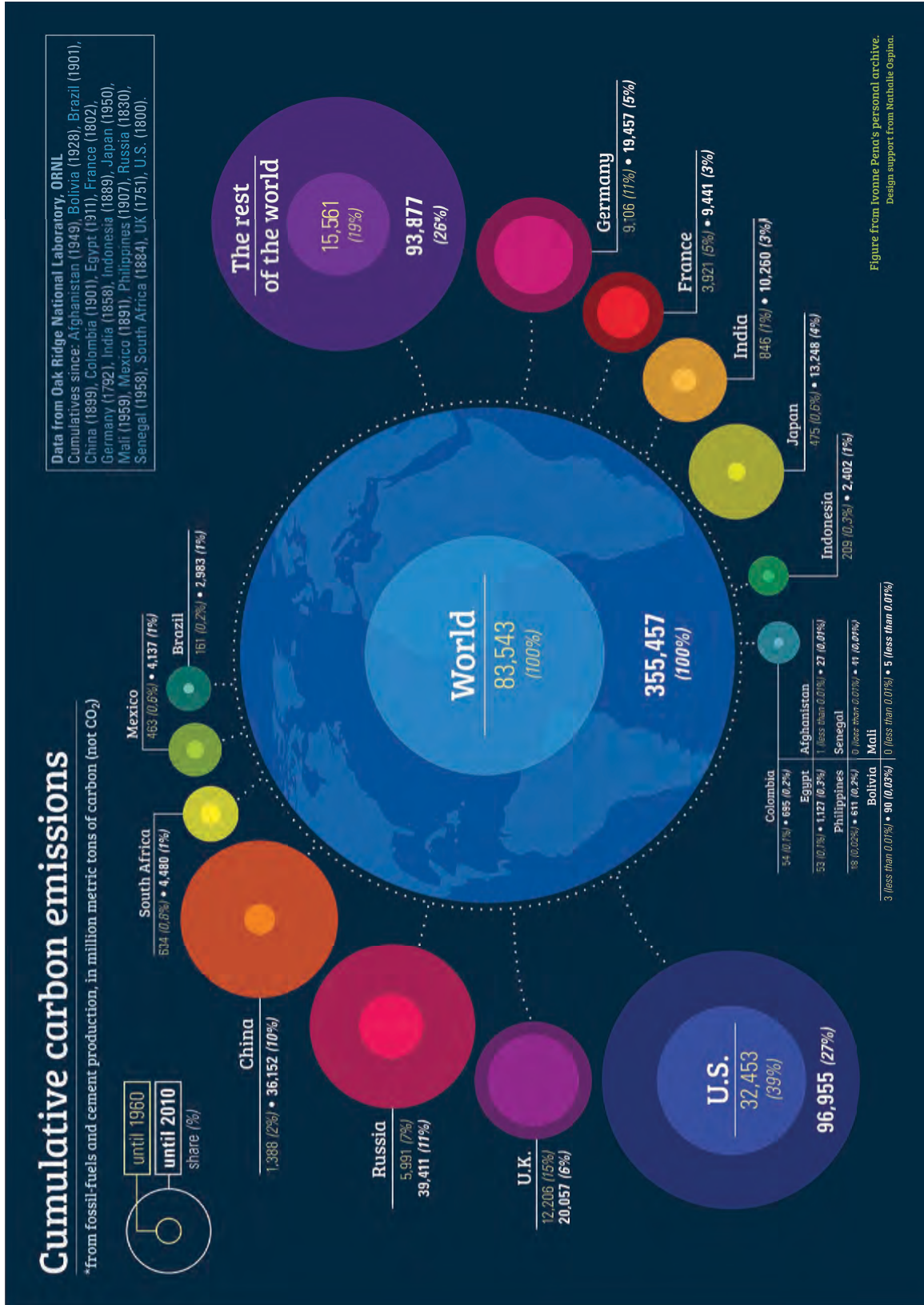


Cumulative Global Carbon Emissions



This infographic shows the cumulative carbon emissions of various countries—both until 1960 and until 2010. These carbon emissions have contributed to global climate change.

Ivonne Peña. Used with permission.

Introduction: The Challenge of a Unified Response

“Coming here today, I have no hidden agenda. I am fighting for my future. Losing my future is not like losing an election or a few points on the stock market. I am here to speak for all generations to come. I am here to speak on behalf of the starving children around the world whose cries go unheard. I am here to speak for the countless animals dying across this planet because they have nowhere left to go. We cannot afford to be not heard.”

—Severn Suzuki, 1992

After addressing delegates of governments from across the world, Severn Suzuki became known as “the girl who silenced the world in five minutes.” Thirteen-year-old Suzuki and three of her peers had raised money to attend the Earth Summit in Rio de Janeiro, Brazil, the largest gathering of international leaders in history. At the Summit, Suzuki stood before this vast audience of international power-holders and urged them to consider the futures of their children—the futures of young people like her.

Ultimately, the Earth Summit resulted in 150 governments agreeing that climate change was a shared and dangerous problem. 196 countries have now signed the United Nations Framework Convention on Climate Change (UNFCCC), promising to work together to reduce or prevent increases in the amounts of greenhouse gases (the gases that cause climate change) in the atmosphere. The UNFCCC set in motion a series of climate change conferences that continue to this day.

Developing responses to climate change that are acceptable to all members of the international community is no easy task. The challenge is to take into account the many different concerns of countries, ordinary people, businesses, and activists in creating an effective set of policies to address this shared

problem. While scientists argue human-caused climate change is an urgent matter, policy makers disagree about the severity of the threat and how to respond.

These disagreements have made it difficult for national governments to develop a unified response to climate change, even after more than twenty years of meetings and conferences. The slow pace of this process has led people and groups outside of national governments to develop their own responses. Just as Severn Suzuki, with her 1992 speech, challenged the idea that only national leaders have a stake in environmental issues, organizations and individuals are finding effective ways to raise their voices and create change. Local governments around the world are designing plans to help their communities adapt to the new conditions caused by climate change.



Country delegates at a 2014 United Nations (UN) Climate Change Conference in Bonn, Germany.

Jan Golinski, UNclimatechange (CC BY 2.0).



Kris Krug (CC BY-SA 2.0).

People marching outside a 2009 UN Climate Change Conference in Copenhagen, Denmark.

Several state governments have voluntarily adopted stricter environmental standards. Nongovernmental organizations (NGOs) work to influence policy and educate the public. Even corporations are seeing business opportunities in providing more environmentally friendly products.

In the coming pages, you will explore the pressing need for an effective response to climate change and take on the challenge of determining what that response should be. You will begin by examining the causes and effects of climate change and by analyzing the efforts to respond to this global problem. You will explore eight case studies that show how different parts of the world are experiencing a changing climate. The readings highlight many of the issues that make developing a unified

response to climate change so difficult. As you read, keep these questions in mind:

- How does climate change affect different regions of the world?
- Who is vulnerable to climate change?
- Who is responsible for climate change?
- How could the international community respond to climate change in a fair and effective way?

After completing your readings, you will have a chance to grapple with these same questions during a climate conference simulation with your classmates. You will take on the roles of national leaders, representatives of NGOs, and technical experts to debate and discuss questions of climate justice.

Part I: The Causes and Effects of Global Climate Change

Understanding Climate Change

Wherever we live, we become familiar with our local climate. Some of us may live in regions where it snows or rains frequently, places where summers are hot and dry, or in tropical or arid regions. Weather, rainfall, temperature, and human activity affect the types of plants, trees, and animals that live in our region and contribute to our local climate.

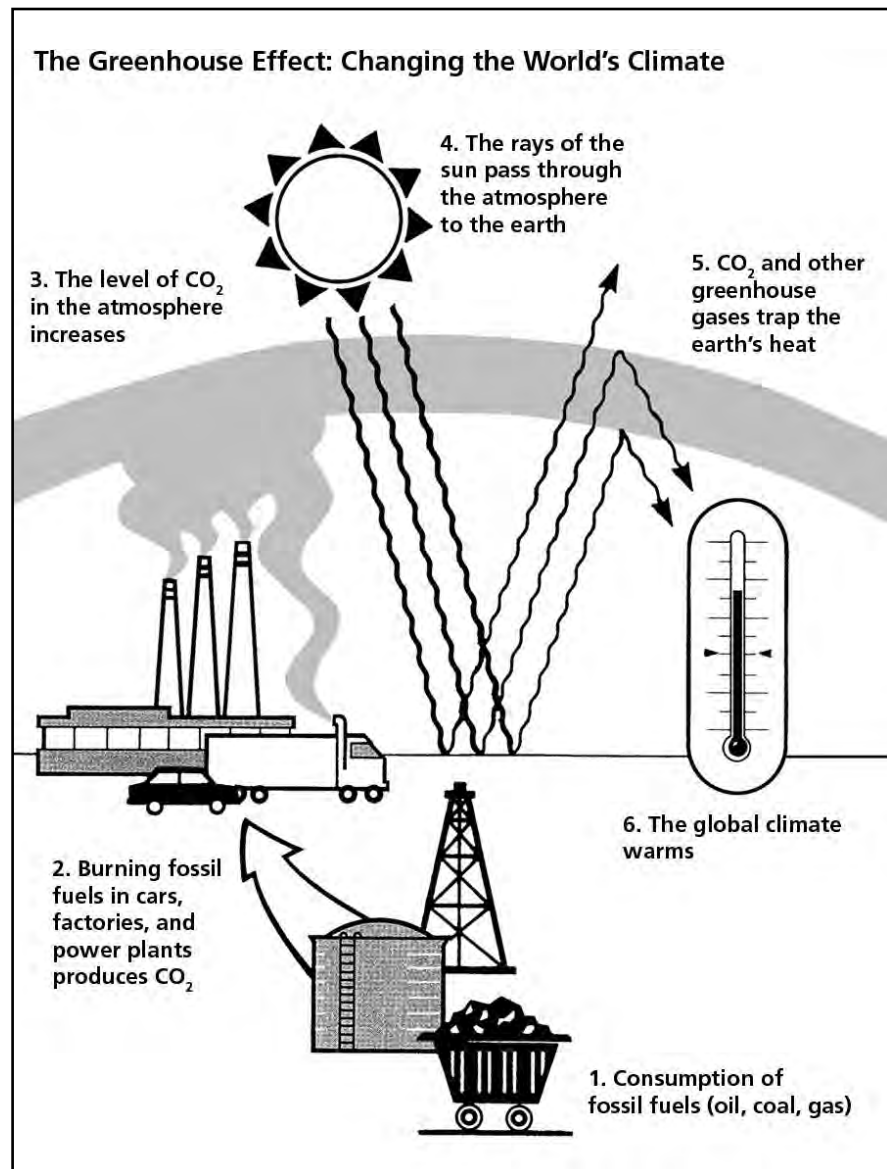
What is climate change?

The term, “climate change” can refer to any significant shifts in temperature, rainfall, wind, and other environmental factors that occur over decades or more. The earth’s climate has undergone natural variations throughout the entire history of the planet. Today, the climate change we hear about most often refers to changes caused primarily by human activity that alters the composition of the atmosphere.

The earth’s atmosphere is made up of numerous gases that make life possible. Gases such as carbon dioxide (CO₂), methane, nitrous oxide, and water vapor exist naturally in the atmosphere and warm the earth to a temperature at which humans can live. These gases make up only a small percentage of the atmosphere. They are called “greenhouse gases” because they trap heat in the atmosphere

by absorbing energy that would otherwise be radiated back into space. The process works the same way that a greenhouse for plants prevents heat from escaping beyond its glass panels.

To get a sense of how important these gases are to life on Earth, we can look at how they affect temperature. The earth’s current average temperature is 59°F. Without greenhouse gases, the earth’s average temperature would drop to around 0°F, potentially making the planet cold enough for all water on Earth to freeze.



Over the past 150 years, human activity, primarily the burning of fossil fuels, has increased the amount of these greenhouse gases in the atmosphere. With more greenhouse gases, the earth gets warmer, which is why climate change today is often referred to as “global warming.”

Often, the topic of climate change will come up after an extreme weather event like a hurricane or a blizzard. When there is a long heat wave or a series of powerful storms, we might think that we are witnessing climate change. But while it is tempting to attribute these weather patterns to “global warming,” in truth, we cannot say climate change is happening based on our own observations over a few days, months, or even years. Scientific data collected over a period of decades has led to the conclusion that the earth’s climate is drastically changing.

“Even with climate change, you will occasionally see cooler-than-normal summers or a typically cold winter. Don’t let that fool you.”

—James E. Hansen, director of the NASA Goddard Institute for Space Studies, 2012

What is causing climate change?

Humans’ use of fossil fuels (coal, oil, and natural gas) produces CO₂ and is the leading cause of climate change. Fossil fuels were formed from plants and animals that lived millions of years ago. In ages past, their remains were buried deep within the earth’s crust and were transformed into petroleum and natural gas by intense heat and pressure. Since the start of the Industrial Revolution in the late

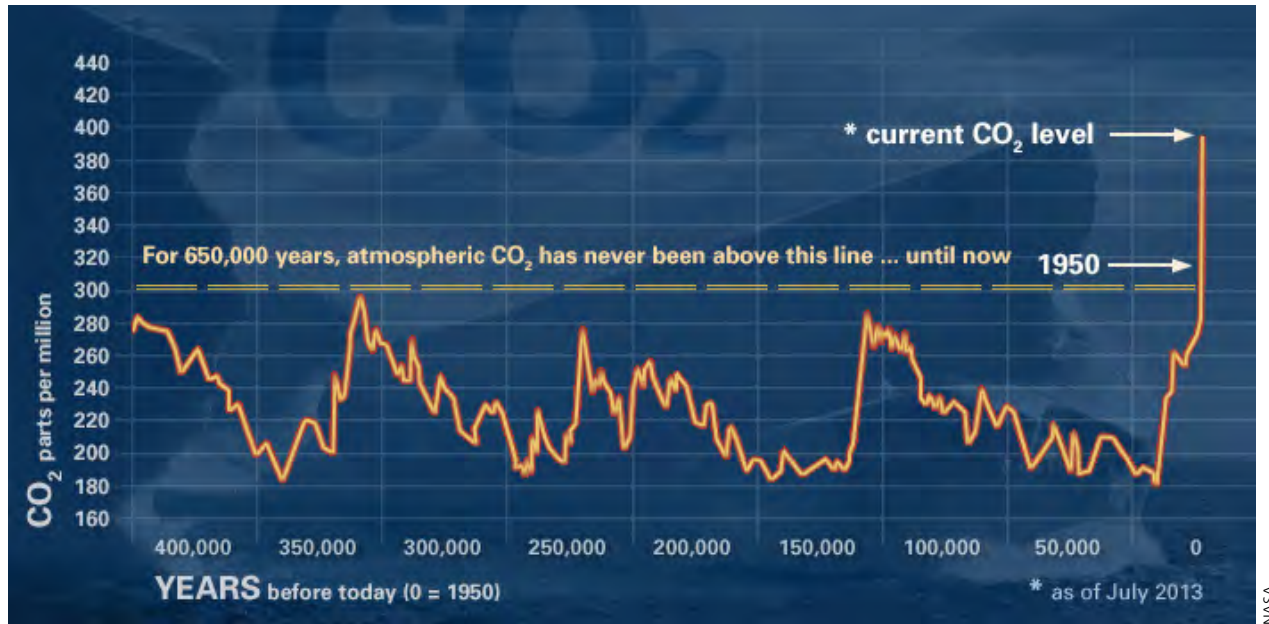


Matties (public domain via Wikimedia Commons).

The roof and glass walls of a greenhouse let the sun’s energy in and keep heat trapped inside, creating an environment warm enough for certain plants to grow. Gases like CO₂ and methane in the Earth’s atmosphere are called “greenhouse gases.” This is because they perform a similar function to the glass of a greenhouse: allowing in sunlight and trapping heat.

eighteenth century, human consumption of fossil fuels has soared, and the amount of CO₂ in the atmosphere has increased by more than 40 percent.

Some scientists say that humans’ impact on the climate traces back to the origins of agriculture. As farming replaced hunting and gathering as the dominant means of survival for humans, people cleared land of trees so that it could be used to grow crops or raise livestock. Farmland now takes up almost half of the earth’s land surface, replacing what were once vast expanses of forest and woodlands. Because trees absorb CO₂, the deforestation meant that less CO₂ was being removed from the atmosphere. As a result, the percentage of greenhouse gases in the atmosphere gradually increased. However, it was not until humans began emitting large amounts of greenhouse gases into the atmosphere by burning fossil fuels for transportation, industry, heat, and electricity that this increase became pronounced.



This graph shows the recent dramatic increase in atmospheric CO₂ levels compared to the past four hundred thousand years.

How did industrialization contribute to the use of fossil fuels?

With the beginning of industrialization in the late 1700s, Britain was the first country to replace wood with fossil fuels as its main source of energy. In addition to clearing forests, people used increasing amounts of coal to meet Britain's ever-growing appetite for energy. In the 1800s, industrialists expanded coal mining and developed oil-drilling techniques. By the turn of the twentieth century, the United States had taken the lead in forging an industrial economy powered by coal and oil. Today, these two fuel sources, along with natural gas, supply roughly 80 percent of the world's energy. In 2012, coal alone was responsible for 43 percent of the total CO₂ emissions from human activity.

CO₂ accounts for the majority of the greenhouse gas emissions from human activity. On the one hand, CO₂ is essential for life on

Earth. For example, plants require it just as animals need oxygen. But it is the large and rapid increase in CO₂ emissions from human activity that is causing the earth to warm more now than it has in the past.

What is the evidence of climate change?

Research shows that the earth's average surface temperature has risen 1.4°F over the past one hundred years. This may not seem



This photograph shows the British Houses of Parliament in the early twentieth century. Visible at the left of the image, factories belching smoke into the atmosphere were only yards away.

like a large change, but it is significant when we consider that a decrease of only 9°F in global average temperature is the difference between our current world temperature and the coldest point of an ice age.

The rapid rate of change also concerns scientists—most of this warming has taken place since 1970. The overwhelming agreement among scientists that the climate is drastically changing is based on rising temperatures and other evidence as well. Ocean temperatures and acidity levels have risen, glaciers (large masses of ice) around the world are shrinking in size, and extreme weather events have increased in frequency.

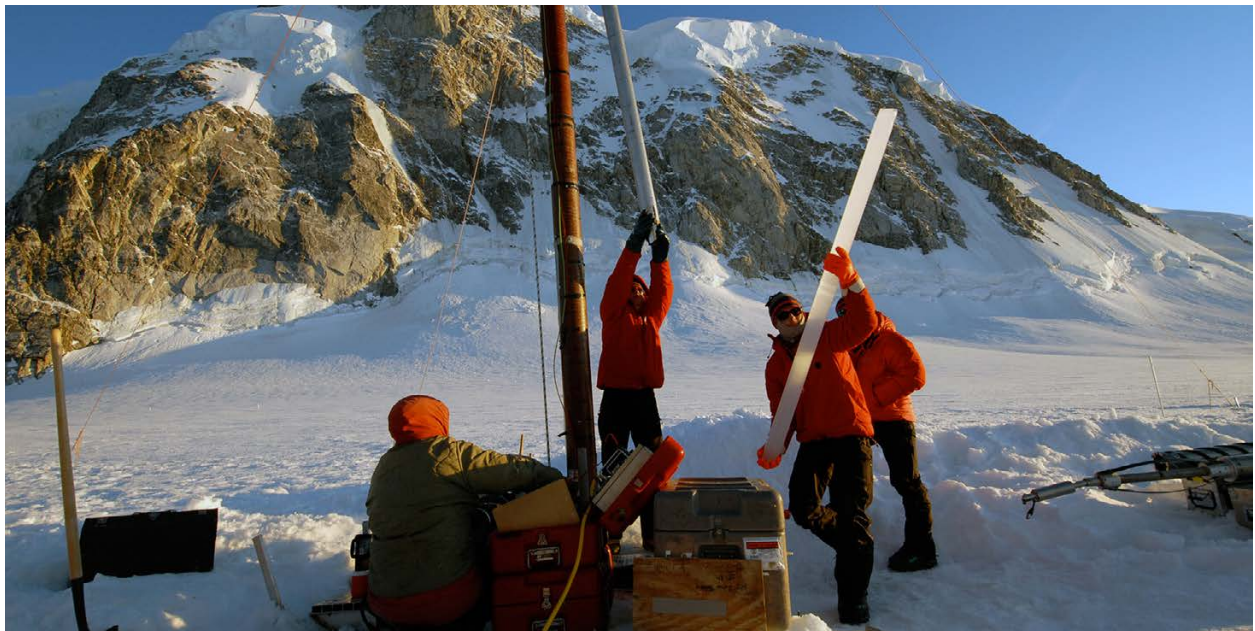
How is climate science produced?

Science is sometimes thought to be a set of permanent facts. But the body of scientific knowledge is ever-changing as scientists continually work to refine our understanding of the natural world. This is also true of climate change science—how it is produced continues to develop and improve.

Climate change is a global phenomenon that has different effects in different regions of the world. Many of these effects will not be fully apparent for decades. This makes it difficult to predict all the impacts climate change will have. Increasingly, scientists are making these projections through climate models—mathematical representations of how human and environmental systems interact.

To construct a climate model, scientists spatially divide each of the earth's components (land, atmosphere, ocean, and ice) into boxes on a computer. For each box, researchers enter known information about those components and how they interact with the others. They test the model's accuracy by running a simulation into the past and comparing the model's results with what we observed actually happened. Once the model is adjusted to be as accurate as possible, scientists run simulations into the future to make projections about how the earth's climate will change in years to come.

Doug Clark, Western Washington University (public domain via U.S. National Ice Core Laboratory).



Scientific researchers extract cores of ice from a glacier in British Columbia, Canada in July, 2010. Scientists can extract ice samples from thousands of feet below the earth's surface. By analyzing the ice cores, they can study variations in climate going back eight hundred thousand years. Using ice samples, scientists have determined that the amount of CO₂ in the atmosphere was relatively constant until 150 years ago, when it began to rise more than it ever had before. The goal of these studies is to increase our understanding of past climate conditions so we can (1) see how the climate has changed up to the present and (2) develop computer models to predict the impact of climate change in the future.

Why do some people doubt climate change science?

Despite an overwhelming consensus among scientists regarding the reality of climate change, some people have expressed doubts about climate change science. They claim that the information from climate models should not be trusted because scientists are just making predictions.

It is true that since we cannot know precisely what the earth's future environment will be like, there is uncertainty associated with climate models' projections. For instance, we cannot know future greenhouse gas emissions levels exactly; they will depend on many factors including international negotiations, regional political decisions, unforeseen natural events, and technological developments. Despite these uncertainties, the scientific community broadly accepts that climate change will have dramatic effects.

Furthermore, making informed predictions to help plan for the future and manage risk is common in many sectors. Public health officials create plans for disease outbreaks even if there is uncertainty about the likelihood of an epidemic. The military prepares for many possible conflicts. School administrators plan for a range of potential disruptions—students arriving late, teachers being out sick, and emergency situations like fires and floods.

In each case, decision makers incorporate the best information they have into planning for the future and continue to adapt their course of action as new information becomes available. This is especially important for climate change, where the decisions we make today will impact the environment we live in for decades.

The Effects of Climate Change

Rising temperatures are just one aspect of climate change. The term “global warming” has sometimes been replaced with “global weirding” because there are so many effects of climate change beyond increasing temperatures.

What are the impacts of climate change?

The effects of climate change include rises in sea level, extreme weather events, and threats to human health. Already, many parts of the world are beginning to feel the effects of climate change, while the risk of even greater impacts multiplies each year.

Oceans: Climate change could raise the level of the world's seas by up to three feet by 2100. Rising sea levels are caused by polar ice caps melting and by ocean waters expanding as they warm (as water increases in temperature, it expands to take up a greater volume of space).

Much of the world's population and many of the planet's most fragile ecosystems could become more vulnerable to coastal flooding. Experts predict that densely-populated coastal cities, such as Calcutta, New York, and Shanghai, could experience more floods. In



Brie LaRow (CC BY 2.0).

A lobster boat off the coast of Maine in the United States. In recent years, lobster populations have suffered dramatic declines in coastal Massachusetts, Rhode Island, and Connecticut. Scientists attribute the decline in southern New England to rising water temperatures associated with climate change.



Sergey Vladimirov (CC BY 2.0).

On July 29, 2010, temperatures in Moscow, Russia reached 100°F for the first time in the 130 years that measurements have been kept. The record temperature came in the midst of a heat wave that lasted for more than three weeks. The heat wave also caused hundreds of forest fires, created smog that blanketed Russia, and contributed to the death of thousands of Russians who were vulnerable to the extreme temperatures and poor air quality. Above, people in Moscow seek relief from the heat by wading in a fountain in a city park.

the southeastern United States, some homes and coastal properties could be under water within the next thirty years as a result of sea level rise.

Numerous low-lying island countries, such as the Carteret Islands, the Marshall Islands, and Kiribati are becoming engulfed by the sea. Some of their residents, often called the first climate change refugees, have begun to leave the islands. People who lived on the Carteret islands have already been forced to evacuate, and Kiribati has purchased land from Fiji, over one thousand miles away, so its citizens seeking refuge from sea level rise have somewhere to go.

The ocean also absorbs some of the excess CO₂ in the atmosphere. With more CO₂, oceans become more acidic, which is harmful to marine life and could negatively affect ocean ecosystems for centuries.

Extreme weather events: Climate change is affecting weather patterns around the world. In recent years, scientists have observed greater extremes of temperatures (conditions that are either extremely hot or extremely cold), increased numbers of heat waves, and more droughts in many regions of the world.

In addition to temperature extremes, the number and strength of powerful storms has increased. This may be caused by rising ocean temperatures increasing the amount of water that evaporates into the atmosphere. The additional warm water vapor makes storms more powerful. Rising sea levels also increase the amount of damage storms cause, meaning storms that have been less of a problem in the past are now becoming more dangerous. For instance, flooding in the Northeastern United States from Hurricane Sandy in 2012 may not have been as widespread and damage may not have been so costly were it not for the impacts of climate change on the seas.

Scientists are generally cautious about saying that climate change caused a particular event. Instead they look for patterns over time and are confident that climate change increases the chance that extreme weather events will occur more frequently.

Health: Climate change impacts human health in many ways. Heat waves and air pollution increase the risk of heat stroke, certain allergies, asthma, and heart disease, especially among people living in urban areas. For example, the 2003 summer heat wave in Europe contributed to over seventy thousand deaths.

In addition, droughts threaten reliable and affordable access to clean water for drinking and food production, which are essential components of good health.

Extreme weather events often have tragic death tolls and destroy the resources needed to promote health among members of affected communities. For instance, powerful storms can restrict transportation, damage medical facilities, and cause power-outages, limiting access to health care. More frequent and intense floods can lead to water contamination and the spread of waterborne diseases like cholera and diarrhoea.

Changes in temperature and rainfall may also shift the geographic ranges of insects that help spread certain diseases. For instance, dengue fever, a mosquito-borne disease of tropical and subtropical regions, returned to the United States in 2009 after being absent for almost seventy-five years.

Species Migration: As drastic and varied environmental changes unfold, some species will be able to adapt to new conditions. Others may have to change their geographic range and relocate to more suitable locations where they have a better chance of survival. Species that cannot adapt or relocate may die out and go extinct.

Plants and animals are generally shifting their habitat ranges either towards the North and South Poles or towards higher altitudes to avoid warming temperatures. Various seasonal aspects of plant and animal life cycles are also being affected, like the migration patterns of birds and insects. For example, moths on Mount Kinabalu in Borneo are flying higher



A hospital in Bangladesh for people afflicted with cholera, a waterborne disease. Increases in water temperatures caused by climate change may contribute to the spread of this disease.

Mark Knobil (CC BY-SA 2.0).

up the mountain (at an average rate of 220 feet in altitude per decade) to escape increasing temperatures.

Many species will not be able to adapt or move fast enough to keep up with the changing climate. Moreover, if species have to move to find new places to live, their migration routes may be blocked by human-made obstacles like dams, roads, and cities or competition with other species. In these cases, the likelihood of species extinction may increase. Each of these effects—species relocations and extinctions—can disrupt entire ecosystems and the valuable services they provide to human societies.

Food and agriculture: The changing climate directly affects food production and could increase costs. With increasing temperatures and changes in rainfall patterns, crop yields in some locations may improve, while in others they may decline. Overall, the negative impacts of climate change will outweigh the positive ones. The yields of major crops like wheat, rice, and corn will decrease in many regions of the world.



USDA (CC BY 2.0).

In August 2012, an official from the U.S. Department of Agriculture and a farmer inspect a soybean field in Missouri affected by drought. At the time, the Department of Agriculture estimated that about 60 percent of the United States was experiencing extreme drought.

More frequent droughts and floods will make food production more difficult for farmers. They may have to completely alter how they approach agriculture in the case of drastic climate change by growing different crops, changing irrigation practices, and using greater quantities of chemical pesticides.

In addition, increasing ocean temperatures associated with climate change will impact fisheries, which are important to both the food supply and economies of many countries. Furthermore, these effects will take place at the same time as global demand for food is increasing, which together can contribute to rising food prices.

Conflict and Security: Climate change and its far-reaching environmental effects may also be contributing to political conflict and security concerns in countries around the world. In less wealthy countries, where governments are often unable to respond quickly or adequately to disasters, a series of poor harvests or the collapse of fisheries could force millions of

refugees across borders, causing violence or governmental collapse.

Alternatively, governments could become more authoritarian in order to deal with the security risks. For example, the Southeast Asian country of Myanmar was devastated by a cyclone (hurricane) in May 2008. Despite nearly 140 thousand deaths, the displacement of one million people from their homes, and widespread disease and starvation, the military rulers did not allow humanitarian aid workers to enter the country until weeks after the storm.

Increasingly severe weather systems such as hurricanes, monsoons, or droughts could lead to military conflicts over access to clean water and food supplies. Many attribute the conflicts in Sudan to disputes over natural resources such as land and oil reserves. The violence in New Orleans, Louisiana after Hurricane Katrina in 2005 is also an example of what some people in desperate situations resort to. Some believe that climate change

contributes to tensions in the Middle East, with warmer, drier conditions leading to increased instances of drought and food scarcity. The U.S. military is particularly concerned about the effects of climate change because many U.S. military bases lie at sea level and are threatened by the prospect of rising oceans.

“The area of climate change has a dramatic impact on national security.... Rising sea levels, severe droughts, the melting of the polar caps, the more frequent and devastating natural disasters all raise demand for humanitarian assistance and disaster relief.”

—Former U.S. Secretary of Defense
Leon Panetta, 2012

Conclusion

You have just read a brief overview of the causes and effects of climate change and have seen that a warming world is already influencing the lives of plants, animals, and people across the globe. While our understanding of how global warming works and why it is happening have steadily improved over the past few decades, the question of what to do about climate change remains.

In Part II of the reading, you will explore how governments and other groups, including businesses and nongovernmental organizations, are working both to prevent dangerous climate change and to cope with its effects. You will begin to consider who is responsible for the problem of climate change, who is most at risk, and why a unified international strategy for dealing with a changing climate has not yet emerged.