

Introduction

The Earth's climate is changing. Scientists are confident that many of the observed changes in the climate can be linked to the increase in greenhouse gases in the atmosphere, caused largely by people burning fossil fuels to generate electricity, heat and cool buildings, and power vehicles (see "The Greenhouse Effect" below to learn about how these gases trap heat). Current and future emissions will continue to increase the levels of these gases in our atmosphere for the foreseeable future.

One way to track and communicate the causes and effects of climate change is through the use of indicators. An indicator, such as a record of Arctic sea ice extent, represents the state or trend of certain environmental conditions over a given area and a specified period of time. Scientists, analysts, decision-makers, and others use environmental indicators, including those related to climate, to help monitor environmental trends over time, track key factors that influence the environment, and identify effects on ecosystems and society.

The **climate change indicators** in this report present compelling evidence that the composition of the

What Is Climate Change?

Climate change refers to any significant change in measures of climate (such as temperature or precipitation) lasting for an extended period (decades or longer). Climate change may result from natural factors and processes or from human activities.

Global warming is a term often used interchangeably with the term "climate change," but they are not the same thing. Global warming refers to an average increase in the temperature of the atmosphere near the Earth's surface. Global warming is just one aspect of global climate change, albeit a very important one.

atmosphere and many fundamental measures of climate in the United States are changing. Temperatures are rising, snow and rainfall patterns are shifting, and more extreme climate events—like heavy rainstorms and record high temperatures—are taking place. Similar changes are occurring around the world.

These observed changes affect people and the environment in important ways. For example, sea levels are rising, glaciers are melting, and plant and animal life cycles are changing. These types of changes can bring about fun-

damental disruptions in ecosystems, affecting plant and animal populations, communities, and biodiversity. Such changes can also affect society, including where people can live, what kinds of crops farmers can grow, and what kinds of businesses can thrive in certain areas.

Indicators of climate change are expected to become even more numerous and depict even clearer trends in the future. Looking ahead, the U.S. Environmental Protection Agency (EPA) will continue to work in partnership with other agencies, organizations, and individuals to collect and communicate useful data and to inform policies and programs based on this knowledge.

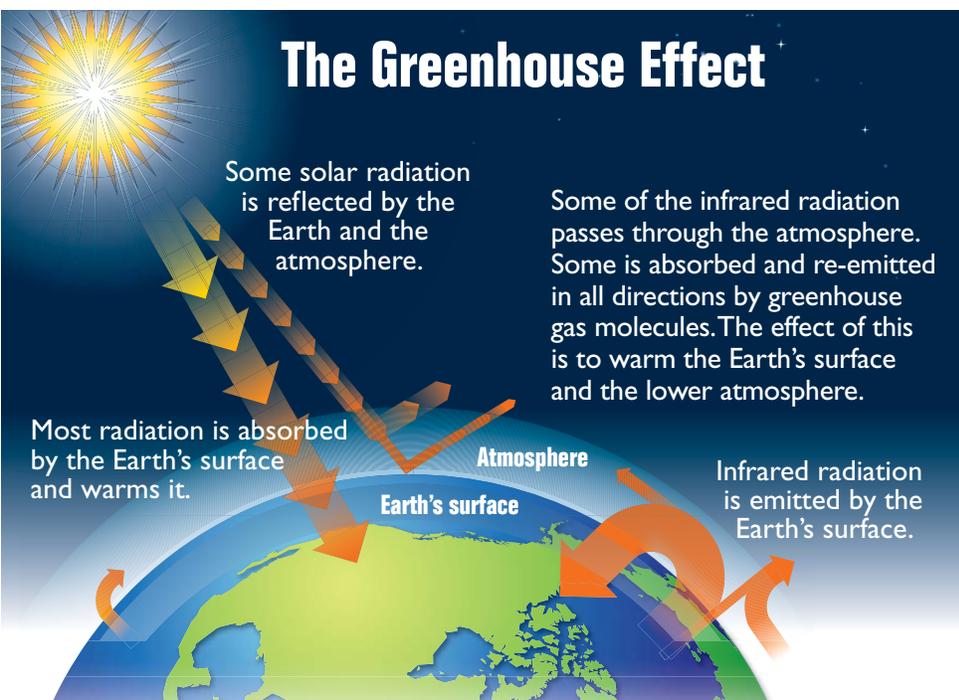
The Greenhouse Effect

Some solar radiation is reflected by the Earth and the atmosphere.

Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.

Most radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted by the Earth's surface.



About This Report

Climate Change Indicators in the United States, 2012, presents 26 indicators to help readers better understand observed trends related to the causes and effects of climate change. This document updates a report published by EPA in 2010.

Various government agencies, academic institutions, and other organizations contributed data critical to the development of this report. EPA also received feedback from a diverse group of scientists, researchers, and communications experts in the public and private sectors. This feedback helped to inform the content and new features of this 2012 report. All of the indicators in this report are based on data that have been collected and compiled according to protocols accepted by the scientific community. The indicators were chosen using a standard set of criteria that considered usefulness, objectivity, data quality, transparency, ability to meaningfully communicate, and relevance to climate change. In addition, the report was peer-reviewed by independent technical experts.

EPA's Greenhouse Gas Reporting Program

EPA is now collecting facility-level data on U.S. greenhouse gas emissions and other relevant information under the Greenhouse Gas Reporting Program. This program requires annual reporting of greenhouse gas data from large emissions sources across a range of industry sectors, as well as suppliers of products that would emit greenhouse gases if released or combusted. This new information will help inform the annual *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, which currently serves as the data source for the U.S. Greenhouse Gas Emissions indicator.

For more information, see: www.epa.gov/climatechange/emissions/ghgdata.



Who Is This Report For?

Climate Change Indicators in the United States, 2012, is written with the primary goal of informing readers' understanding of climate change. In addition to presenting climate change observations and trends in the United States and globally, this report highlights the far-reaching significance of these changes and their possible consequences for people, the environment, and society.

This report is also designed to be useful for scientists, analysts, decision-makers, educators, and others who can use climate change indicators as a tool for:

- Assessing trends in environmental quality, factors that influence the environment, and effects on ecosystems and society.
- Effectively supporting science-based decision-making and communication.
- Evaluating existing and future climate-related policies and programs.

What's New?

The 2012 report reflects the following new features and changes:

- **Three new indicators:** **Snowfall**, **Streamflow**, and **Ragweed Pollen Season**. These additions provide further evidence of climate change and its effects that are being felt by different kinds of ecosystems, as well as by society.
- **Expanded indicators:** **Arctic Sea Ice** was expanded to show changes in the age of ice and **Snow Cover** was expanded to show changes in snow cover for particular seasons. Several decades of historical data were added to **Drought**, and the 2010 **Heat Waves** indicator was converted to **High and Low Temperatures**.
- **Updated indicators:** Nearly all indicators have been updated with additional years of data that have become available since the last report.
- **Regional perspectives:** Several indicators include maps that show how trends vary by region.

A Roadmap to the Report

Most of the indicators in this report focus on the United States, but some include global trends to provide context or a basis for comparison, while others have a regional focus. Geographic coverage depends on data availability and the nature of what is being measured. For example, greenhouse gas concentrations in the atmosphere are studied on a global scale. The indicators span a range of time periods, depending on data availability. Each indicator features five elements:

- One or more graphics depicting changes over time. Some indicators consist of a single metric, while others present multiple metrics (for example, the Drought indicator shows two different ways of calculating drought).
- Key points about what the graphics show.
- Background on how the indicator relates to climate change.
- Information about how the indicator was developed.
- Factors that influence the potential to draw valid conclusions from the indicator.

The indicators are divided into five chapters:



Greenhouse Gases: Greenhouse gases from human activities are responsible for the largest share of climate change since the mid-20th century. The indicators in this chapter

characterize emissions of the major greenhouse gases resulting from human activities, the concentrations of these gases in the atmosphere, and how emissions and concentrations have changed over time.



Weather and Climate: Rising global average temperature is linked to certain widespread changes in weather patterns, which in turn lead to changes in the Earth's climate (the average weather over

time). This chapter focuses on indicators related to weather and climate, including temperature, precipitation, storms, and droughts.



Oceans: The world's oceans have a two-way relationship with weather and climate. The oceans influence the weather on local to global scales, while changes in climate can fundamentally alter certain properties of the ocean. This chapter examines trends in

ocean characteristics that relate to climate change, such as heat storage, temperature, and sea level.



Snow and Ice: Climate change can alter the Earth's snow- and ice-covered areas. These changes, in turn, can affect air temperatures, sea levels, ocean currents, and storm patterns. This chapter focuses on trends in

glaciers and sea ice, snowfall, extent and depth of snow cover, and the freezing and thawing of oceans and lakes.



Society and Ecosystems: Changes in the Earth's climate can affect public health, agriculture, water supplies, energy production and use, land use and development, and recreation. Climate change can also

disrupt the functioning of ecosystems and increase the risk of harm or even extinction for some species. This chapter looks at some of the ways that climate change is affecting society and ecosystems, including changes in allergy seasons, heat-related deaths, streamflows, and bird migration patterns.

The report concludes with a discussion on **climate change indicators and health**, as further development of human health indicators is of increasing importance. Climate change impacts associated with human health include expected increases in heat-related illness and death, worsening air quality, and likely increases in the frequency and strength of certain extreme events such as floods, droughts, and storms. Climate change may also allow some diseases to spread more easily. People most vulnerable to health impacts include the poor, the elderly, those already in poor health, the disabled, and indigenous populations. EPA plans to explore opportunities to work with climate and health experts to develop indicators that communicate the effects of climate change on health and society more broadly.

EPA has compiled an accompanying **technical support document** containing more detailed information about each indicator, including data sources, data collection methods, calculations, statistical considerations, and sources of uncertainty. This document also describes EPA's approach and criteria for selecting indicators for the report. This information is available on EPA's website at: www.epa.gov/climatechange/indicators.

Additional resources that can provide readers with more information appear at the end of the report (see Climate Change Resources on p. 75).

Looking Ahead

As new and more comprehensive indicator data become available, EPA plans to continue to periodically update the indicators presented in this report to document climate change and its effects.