
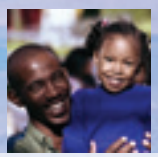
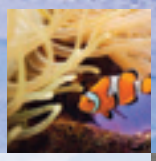
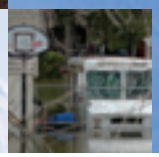

Introduction

Over the last several decades, evidence of human influences on climate change has become increasingly clear and compelling. There is indisputable evidence that human activities such as electricity production and transportation are adding to the concentrations of greenhouse gases that are already naturally present in the atmosphere. These heat-trapping gases are now at record-high levels in the atmosphere compared with the recent and distant past.

Warming of the climate system is well documented, evident from increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. The buildup of greenhouse gases in the atmosphere is very likely the cause of most of the recent observed increase in average temperatures, and contributes to other climate changes.[1]

What Is Climate Change?

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

The term "climate change" is often used interchangeably with the term **global warming**. Global warming refers to an average increase in the temperature of the atmosphere near the Earth's surface, which can contribute to changes in global climate patterns. However, rising temperatures are just one aspect of climate change.

Collecting and interpreting environmental indicators has played a critical role in our increased understanding of climate change and its causes. An indicator represents the state 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 track trends over time in the state of the environment, key factors that influence the environment, and effects on ecosystems and society.

About This Report

The U.S. Environmental Protection Agency (EPA) has published this report, *Climate Change Indicators in the United States*, to help readers interpret a set of important indicators to better understand climate change. The report presents 24 indicators, each describing trends in some way related to the causes and effects of climate change. The indicators focus primarily on the United States, but in some cases global trends are presented in order to provide context or a basis for comparison. The indicators span a range of time periods, depending on

The phrase "climate change" is growing in preferred use to "global warming" because it helps convey that there are changes in addition to rising temperatures.

—The National Academies[2]

Ground-Level Ozone, Particles, and Aerosols

This report does not document trends in various short-lived greenhouse gases (such as ground-level ozone) or particles and aerosols (such as black carbon and sulfate aerosols).

Ground-level ozone is a greenhouse gas: it traps some of the Earth's outgoing energy, thus having a warming effect on the atmosphere and contributing to increases in global temperature. Depending on their composition, particles and aerosols can have net heating or cooling effects at the Earth's surface. For example, airborne sulfate aerosols have a cooling effect on the atmosphere, while airborne black carbon aerosols have a warming effect.

Readers can learn more about ozone, particles, and other air pollutants from EPA's *Our Nation's Air—Status and Trends* report (www.epa.gov/airtrends/2010/index.html). The report presents information on the status and trends of air pollutant emissions and atmospheric concentrations in the United States, but does not interpret those data in the context of climate change.

For more information on the linkages between climate change and air quality, see EPA's April 2009 *Assessment of the Impacts of Global Change on Regional U.S. Air Quality* (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=203459).

data availability. For each indicator, this report presents one or more graphics showing trends over time; a list of key points; and text that describes how the indicator relates to climate change, how the indicator was developed, and any factors that might contribute to uncertainty in the trend or the supporting data (referred to in this report as "indicator limitations").

The report also includes a summary of major findings associated with each indicator (see Summary of Key Findings on p. 4). Additional resources that can provide readers with more information appear at the end of the report (see Climate Change Resources on p. 69).

Although some of the indicators show that fundamental environmental changes are now occurring likely as a result of climate change, others are not as clear. As new or more complete data become available, EPA plans to update the indicators presented in this report and provide additional indicators that can broaden our understanding of climate change.

EPA selected the 24 indicators presented in this report from a broader set of 110 indicators, many of which were identified at an expert workshop (November 30 to December 1, 2004) on climate change indicators convened by the National Academy of Sciences and funded by EPA. The indicators in this report were chosen using a set of screening criteria that considered usefulness, objectivity, data quality, transparency, ability to show a meaningful trend, and relevance to climate change.

All of the indicators selected for this report are based on data that have been collected and compiled by following rigorous protocols that are widely accepted by the scientific community. Various government agencies, academic institutions, and other organizations collected the data.

The indicators are divided into five chapters:

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.

—Intergovernmental Panel on Climate Change[3]

Greenhouse Gases: The indicators in this chapter characterize the amount of greenhouse gases emitted into the atmosphere through human activities, the concentrations of these gases in the atmosphere, and how emissions and concentrations have changed over time.

Weather and Climate: This chapter focuses on indicators related to weather and climate patterns, including temperature, precipitation, storms, droughts, and heat waves. These indicators can reveal long-term changes in the Earth's climate system.

Oceans: The world's oceans have a two-way relationship with climate. The oceans influence climate on regional and 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 acidity, temperature, heat storage, and sea level.

Snow and Ice: Climate change can dramatically 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; the 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, 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 just a few of the impacts that may be linked to climate change, including heat-related illnesses and changes in plant growth. EPA looks forward to expanding this chapter in future reports as the science evolves and the capacity to report on these types of indicators is broadened.

Looking Ahead

Environmental indicators are a key tool for evaluating existing and future programs and supporting new decisions with sound science. In the years to come, the indicators in this report will provide data to help the Agency decide how best to use its policy-making and program management resources to respond to climate change. Ultimately, these indicators will help EPA and its constituents evaluate the success of their climate change efforts.

Indicator Updates

Suggestions for new indicators are welcome. To provide input or to get more information on climate change indicators, visit: www.epa.gov/climatechange/indicators.html.