

Climate Change Indicators in the United States, 2012

EPA's *Climate Change Indicators in the United States, 2012*, presents compelling evidence that 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 already affecting society and ecosystems. Similar changes are occurring around the world. EPA's report presents 26 indicators, which are organized into the five categories listed at right.

Observed Changes



Greenhouse Gases:

Greenhouse gas emissions are increasing as a result of people's activities. Consequently, average concentrations of these heat-trapping gases in the atmosphere are also increasing.



Weather and Climate:

Average U.S. and global temperatures are increasing. Other attributes of weather and climate, such as precipitation, drought, and tropical cyclone activity, are changing.



Oceans:

The oceans are getting warmer. Sea levels are rising around the world, and the oceans are becoming more acidic.



Snow and Ice:

The extent of Arctic sea ice is declining. Glaciers in the United States and around the world are generally shrinking, while snowfall and snow cover in the United States have decreased overall.



Society and Ecosystems:

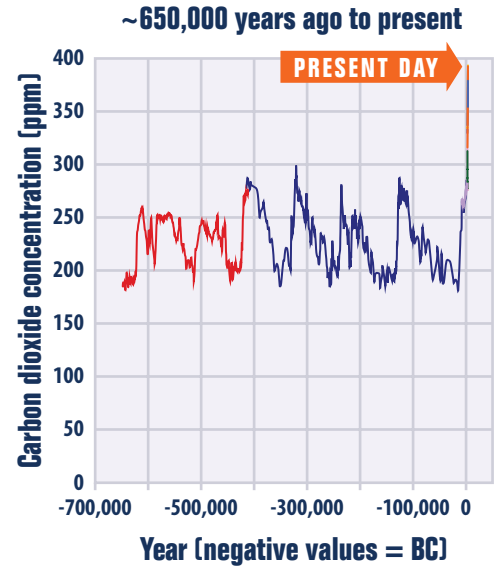
Ragweed pollen season is lengthening, as is the growing season for crops. Winter habitats of bird species have shifted northward as temperatures have risen.



Atmospheric Concentrations of Greenhouse Gases

Before the industrial era began in the late 1700s, global carbon dioxide concentrations in the atmosphere measured approximately 280 parts per million (ppm). Concentrations have risen steadily since then, reaching 391 ppm in 2011—a 40 percent increase. Current global atmospheric concentrations of carbon dioxide are unprecedented compared with the past 650,000 years.

Global Atmospheric Concentrations of Carbon Dioxide Over Time

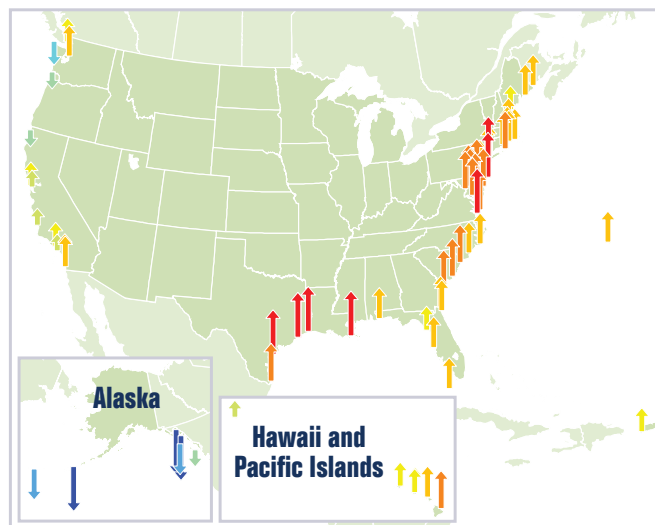


Data source: Compilation of 12 underlying datasets

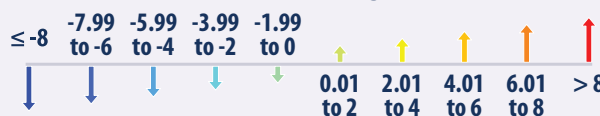
Sea Level

As temperatures rise, seawater warms up and expands, and ice melts. This raises sea level worldwide. Sea level rose relative to the land along much of the U.S. coastline between 1960 and 2011, particularly along the Mid-Atlantic and Gulf Coasts. Some parts of the Gulf Coast have registered a relative sea level rise of more than 8 inches since 1960.

Relative Sea Level Change Along U.S. Coasts, 1960–2011



Relative sea level change (inches):



Data source: NOAA, 2012

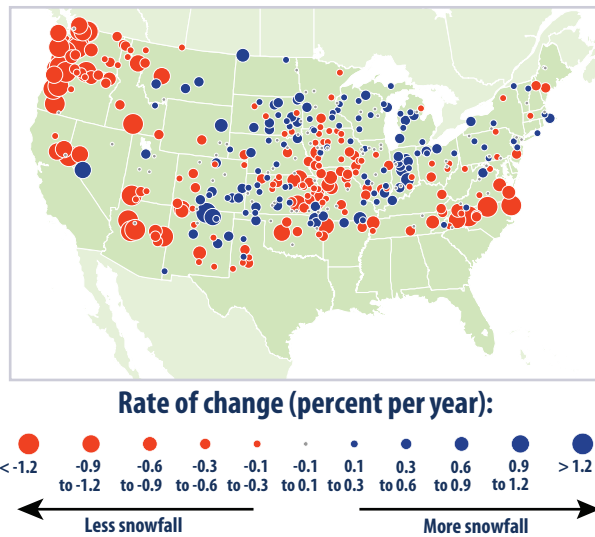


Indicator Highlights

Snowfall

With warming temperatures and changing weather patterns, snowfall amounts have decreased in many parts of the country (as indicated by the red circles on the map), with 57 percent of weather stations showing a decline. The Pacific Northwest has seen the largest consistent decline in snowfall, but some regions have experienced modest increases, including areas near the Great Lakes.

Change in Total Snowfall in the Contiguous 48 States, 1930–2007



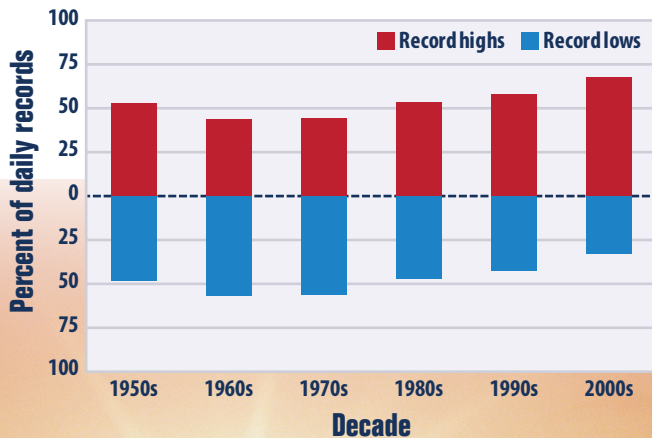
Data source: Kunkel et al., 2009



High and Low Temperatures

Since the 1970s, record-setting daily high temperatures have become more common than record lows across the United States. The most recent decade had twice as many record highs as record lows.

Record Daily High and Low Temperatures in the Contiguous 48 States, 1950–2009

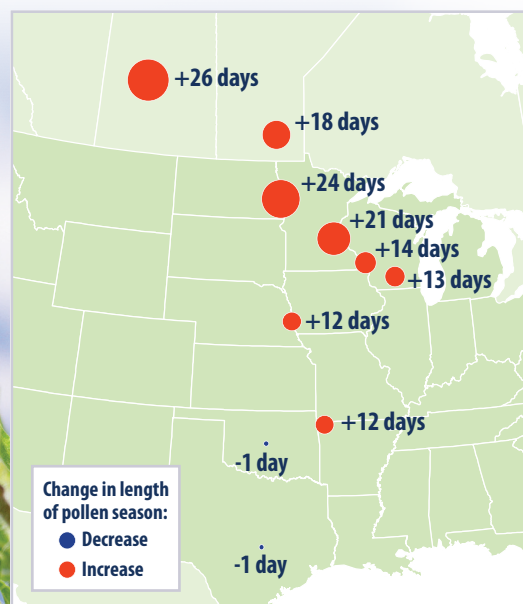


Data source: Meehl et al., 2009

Ragweed Pollen Season

The length of the ragweed pollen season is closely related to the timing of the first fall frost, which is occurring later than it used to in northern areas. Since 1995, the ragweed pollen season has grown longer at eight of the 10 locations studied. The red circles represent a longer pollen season, with larger circles indicating larger changes.

Change in Ragweed Pollen Season, 1995–2011



Data source: Ziska et al., 2012

2012 Climate Indicators

Greenhouse Gases

U.S. Greenhouse Gas Emissions
Global Greenhouse Gas Emissions
Atmospheric Concentrations of Greenhouse Gases
Climate Forcing

Weather and Climate

U.S. and Global Temperature
High and Low Temperatures
U.S. and Global Precipitation
Heavy Precipitation
Drought
Tropical Cyclone Activity

Oceans

Ocean Heat
Sea Surface Temperature
Sea Level
Ocean Acidity

Snow and Ice

Arctic Sea Ice
Glaciers
Lake Ice
Snowfall
Snow Cover
Snowpack

Society and Ecosystems

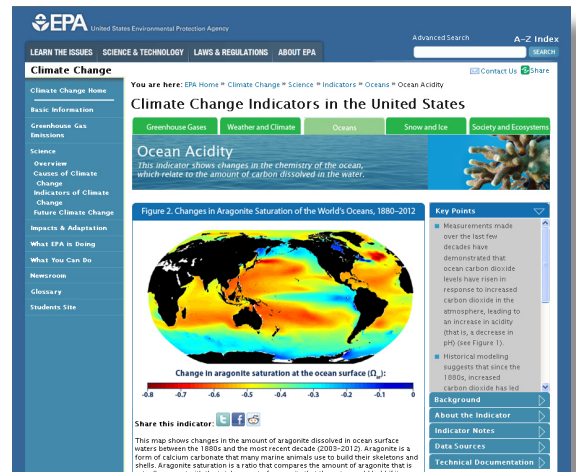
Streamflow
Ragweed Pollen Season
Length of Growing Season
Leaf and Bloom Dates
Bird Wintering Ranges
Heat-Related Deaths

Access the 2012 Report Online

www.epa.gov/climatechange/indicators

For each of the 26 indicators, the report presents graphics depicting changes over time, key points about what the graphics show, background on how the indicator relates to climate change, and information about how the indicator was developed.

The website also features technical documentation that provides additional details about each indicator. Visitors to the website can share report content through social media outlets like Facebook and Twitter.



A print version of the report is available by request or for download from the website.

U.S. and Global Precipitation

This indicator describes trends in average precipitation for the United States and the world.

Background

Precipitation can have wide-ranging effects on human well-being and ecosystems. Rainfall, snowfall, and the timing of snowmelt can all affect the amount of water available for drinking, irrigation, and industry and can also determine what types of animals and plants (including crops) can survive in a particular place. Changes in precipitation can disrupt a wide range of natural processes, particularly if these changes occur more quickly than plants and animals species can adapt.

As average temperatures at the Earth's surface rise (see the U.S. and Global Temperature indicator on p. 24), more evaporation occurs, which, in turn, increases overall precipitation. Therefore, a warming climate is expected to increase precipitation in many areas. However, just as precipitation patterns vary across the world, so will the effects of climate change. By shifting the wind patterns and ocean currents that drive the world's climate system, climate change will also cause some areas to experience decreased precipitation. In addition, higher temperatures lead to more evaporation, so increased precipitation will not necessarily increase the amount of water available for drinking, irrigation, and industry (see the Drought indicator on p. 32).

About the Indicator

This indicator examines U.S. and global precipitation patterns from 1901 to the present, based on rainfall and snowfall measurements from land-based weather stations worldwide.

This indicator shows annual anomalies, or differences, compared with the average precipitation from 1901 to 2000. These anomalies are presented in terms of percent change compared with the baseline. Annual anomalies are calculated for each weather station. Anomalies for broader regions have been determined by dividing the country (or the world) into a grid, averaging the data for all weather stations within each cell of the grid, and then averaging the grid cells together (for Figures 1 and 2).

(Continued on page 29)

Figure 1. Precipitation in the Contiguous 48 States, 1901–2011

This figure shows how the total annual amount of precipitation in the contiguous 48 states has changed since 1901. The graph uses the 1901 to 2000 average as a baseline for depicting change. Choosing a different baseline period would not change the shape of the data over time.

Data source: NOAA, 2012*

Figure 2. Precipitation Worldwide, 1901–2011

This figure shows how the total annual amount of precipitation over land worldwide has changed since 1901. The graph uses the 1901 to 2000 average as a baseline for depicting change. Choosing a different baseline period would not change the shape of the data over time.

Data source: NOAA, 2012*

Figure 3. Rate of Precipitation Change in the United States, 1901–2011

This figure shows the rate of change in total annual precipitation in different parts of the United States since the early 20th century since 1901 for the contiguous 48 states, FRES for Hawaii, and 1918 for Alaska.

Data source: NOAA, 2012*

Key Points

- On average, total annual precipitation has increased over land areas in the United States and worldwide (see Figures 1 and 2). Since 1901, global precipitation has increased at an average rate of 2.3 percent per century, while precipitation in the contiguous 48 states has increased at a rate of 5.9 percent per century.
- Some parts of the United States have experienced greater increases in precipitation than others. A few states such as Hawaii and parts of the Southwest have seen a decrease in precipitation (see Figure 3).

Indicator Notes

Data for this indicator were provided by the National Oceanic and Atmospheric Administration's National Climate Data Center, which maintains a large collection of climate data online at: www.ncdc.noaa.gov/inreach.html. Global, U.S., and regional precipitation anomalies were calculated based on monthly values from a network of long-term monitoring stations.

or displaying them on a map (Figure 3). This method ensures that the results are not biased toward regions that happen to have many stations close together.

Data Sources

The data for this indicator were provided by the National Oceanic and Atmospheric Administration's National Climate Data Center, which maintains a large collection of climate data online at: www.ncdc.noaa.gov/inreach.html. Global, U.S., and regional precipitation anomalies were calculated based on monthly values from a network of long-term monitoring stations.

Order Print Copies

Print copies of *Climate Change Indicators in the United States, 2012*, are available upon request. To order a copy, please submit a written request to:

climateindicators@epa.gov



Connect with EPA!

facebook.com/EPA
youtube.com/user/USEPAgov
twitter.com/epagov
flickr.com/photos/usepagov