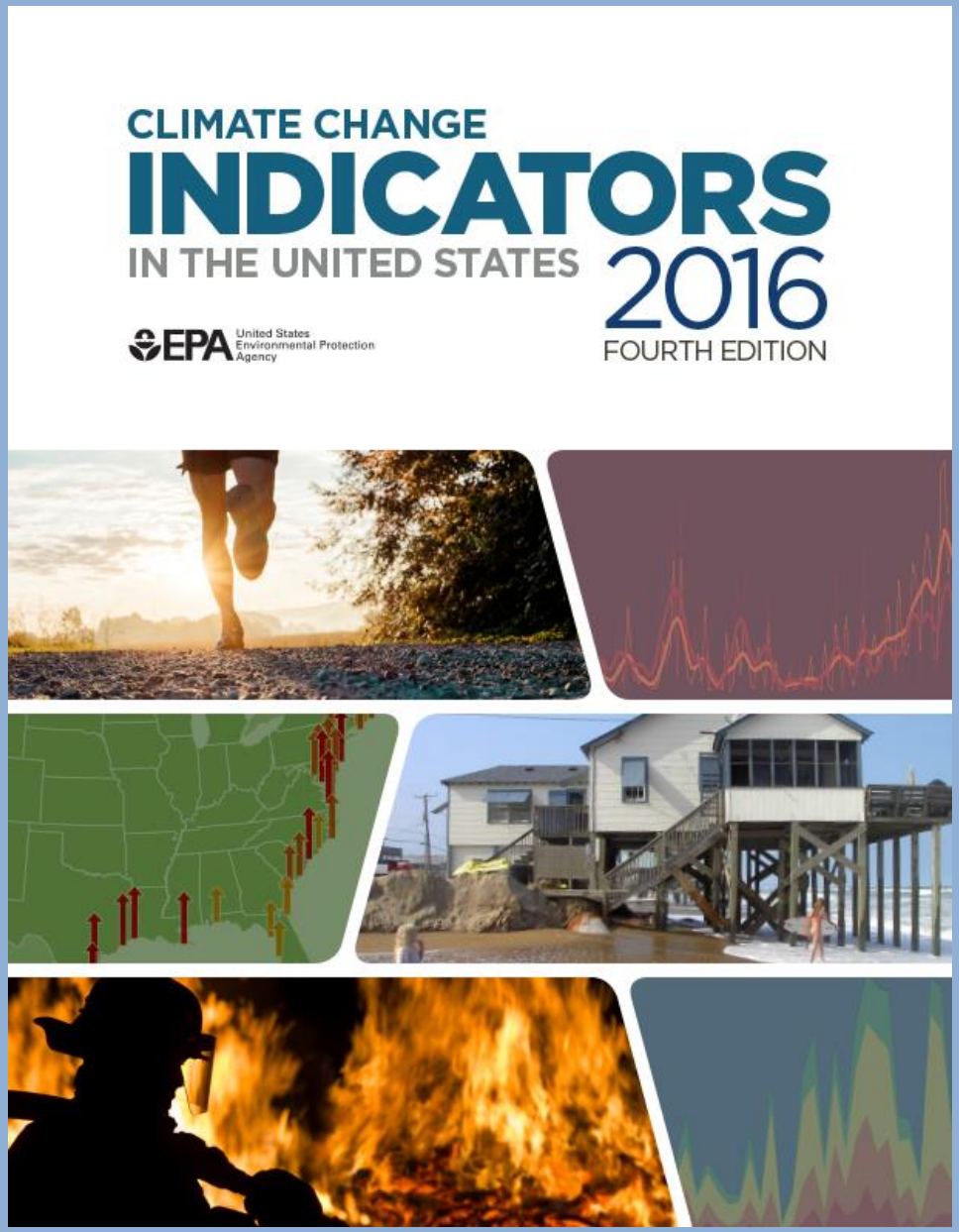


EPA's Climate Change Indicators: Overview

Chesapeake Bay Program: STAR team

September 22, 2016

Mike Kolian, U.S. Environmental Protection Agency

Climate Change Division

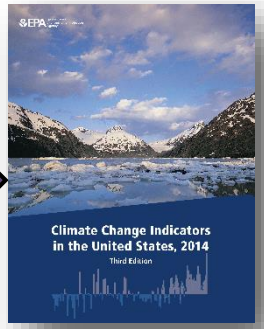
Office of Atmospheric Programs

Today's Discussion

- About EPA's Indicators Project
- New Report
- What's New in 2016
- Preview of a Few Indicators
- Resources

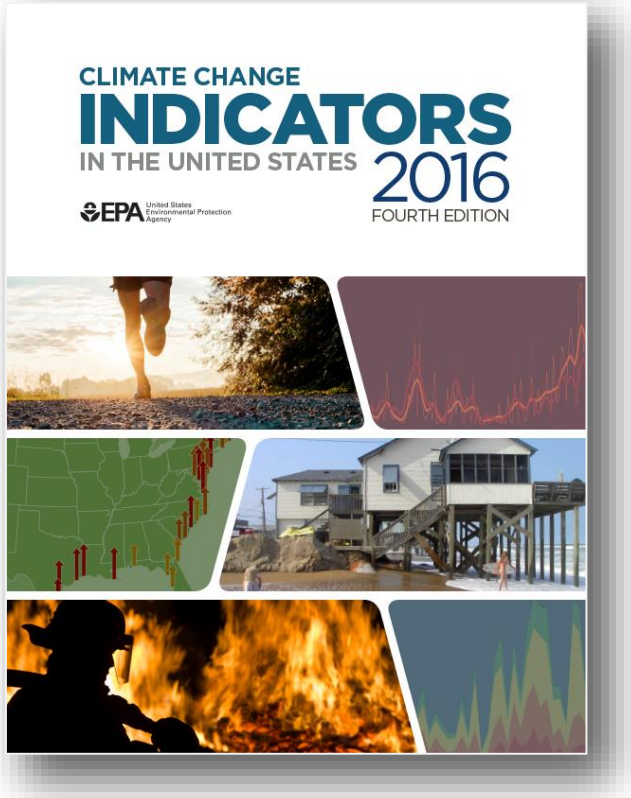
2010

2012



2014

Released August 2nd 2016!

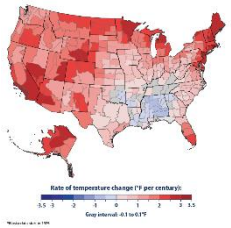


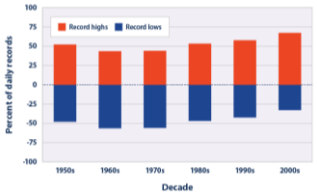
EPA's Climate Change Indicators

EPA's Climate Change Indicator Project

Tracking

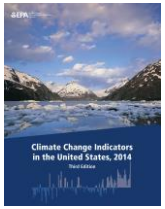
Key climate change indicators across multiple impact sectors and scales





Publication

Peer-reviewed products, downloadable graphics and data, online data tools



Development and Outreach

Add new indicators, connections to society, vulnerability, adaptation; form new partnerships

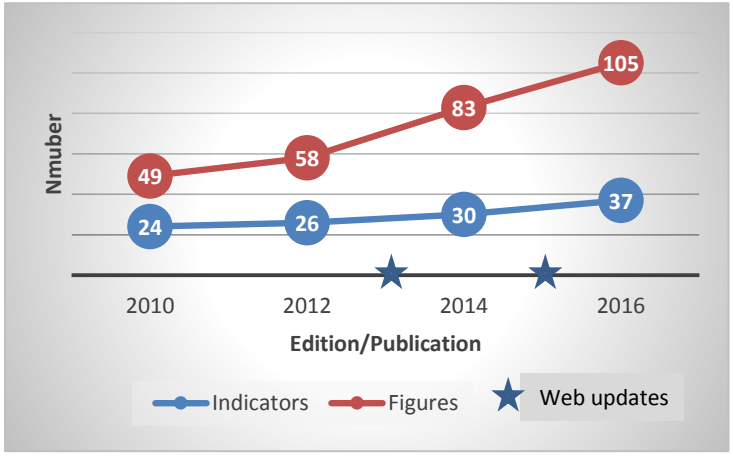
About the Report

EPA's Climate Change Indicators Report (4th Edition)

- Primary goal is to communicate the causes and effects of climate change
- The 2016 report features 37 climate indicators in the areas of GHGs, weather and climate, oceans, snow and ice, human health and ecosystems
- EPA partners with over 40 agencies/organizations
- Credible, vetted resource: peer review of each indicator and full report

Highlights

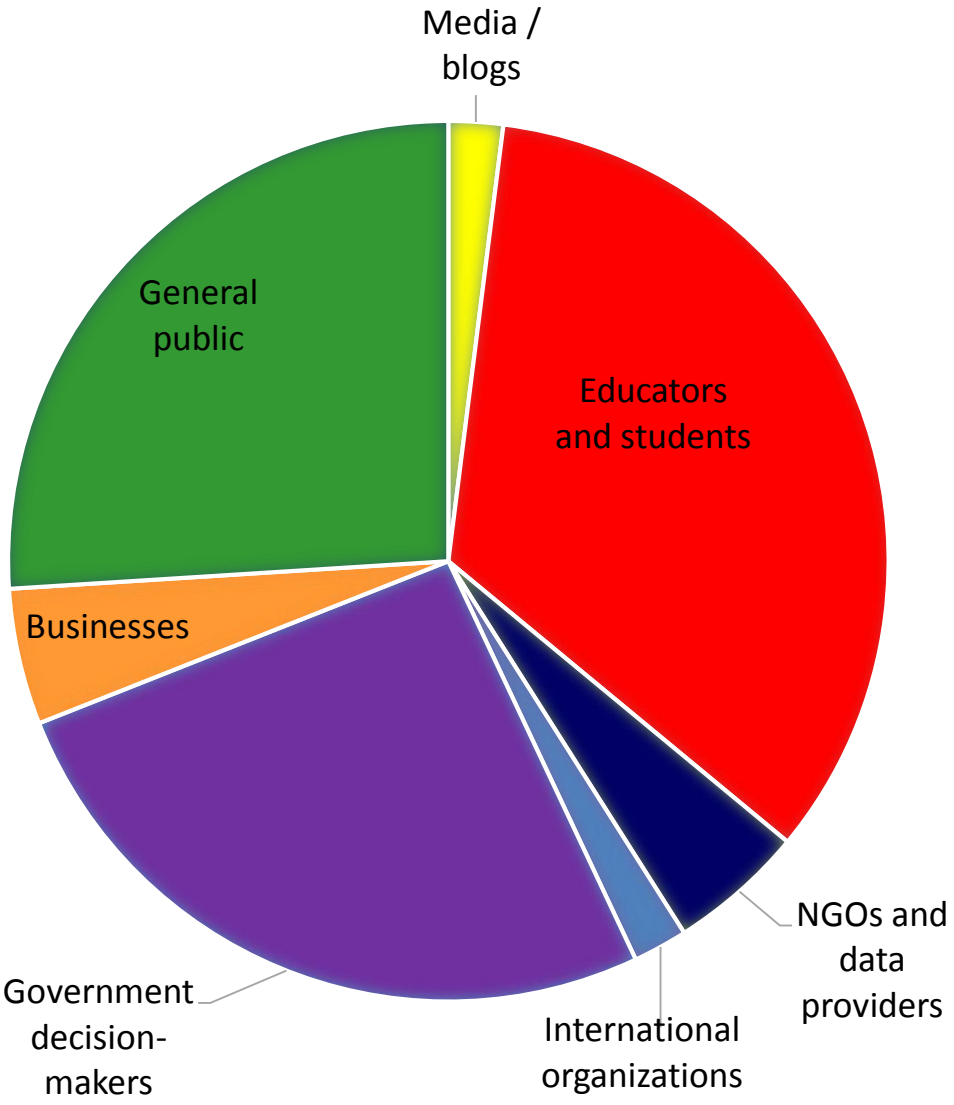
- Growing body of evidence that climate change is happening now in the U.S. and globally
- Leverages new science and highlights the important ways climate change affects human health
- New partnerships and new indicators



Who Uses This Information/Report?

The report is a ready-to-use, accessible resource!

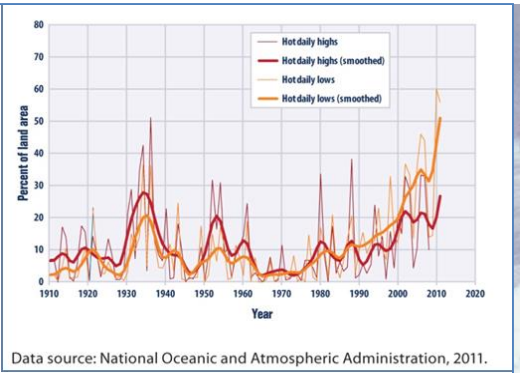
- General public
- Educators and students (K-12 and college)
- Government agencies at various levels
- NGOs and data providers and contributors
- Businesses
- International organizations
- Media, blogs



What Makes a Good Indicator?

Criteria used to select indicators:

- Trends over time
- Based on observed data
- Broad geographic coverage
- Published or peer-reviewed data
- Usefulness
- Relevance to climate change
- Feasible to construct
- Transparency, reproducibility, and objectivity
- Ability to communicate to the public



Current Suite of Climate Change 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 *
- ❑ River Flooding *
- ❑ Drought *
- ❑ *A Closer Look: Temperature and Drought in the Southwest*
- ❑ Tropical Cyclone Activity

Oceans

- ❑ Ocean Heat
- ❑ Sea Surface Temperature *
- ❑ Sea Level
- ❑ *A Closer Look: Land Loss Along the Atlantic Coast*
- ❑ Coastal Flooding *
- ❑ Ocean Acidity

Snow and Ice

- ❑ Arctic Sea Ice
- ❑ Antarctic Sea Ice
- ❑ Glaciers
- ❑ Lake Ice
- ❑ *Community Connection: Ice Breakup in Two Alaskan Rivers*
- ❑ Snowfall
- ❑ Snow Cover
- ❑ Snowpack

Understanding the Connections Between Climate Change and Human Health

Health and Society

- ❑ Heating and Cooling Degree Days
- ❑ Heat-Related Deaths *
- ❑ Heat-Related Illnesses
- ❑ Lyme Disease *
- ❑ West Nile Virus *
- ❑ Length of Growing Season
- ❑ Ragweed Pollen Season *

Ecosystems

- ❑ Wildfires *
- ❑ Streamflow
- ❑ Stream Temperature
- ❑ *Tribal Connection: Water Temperature in the Snake River*
- ❑ Great Lakes Water Levels
- ❑ Bird Wintering Ranges
- ❑ Marine Species Distribution
- ❑ Leaf and Bloom Dates
- ❑ *Community Connection: Cherry Blossom Bloom Dates in Washington, D.C.*

Indicators in red are new
** Includes a health connections box*

A Few Key Observed Changes

- **Average annual carbon dioxide levels** exceeded 400 parts per million for the first time in at least 800,000 years.

- **Average temperatures** have risen across the U.S. since 1901, with an increased rate of warming over the past 30 years. Eight of the top 10 warmest years on record for the contiguous 48 states have occurred since 1998, and 2012 and 2015 were the two warmest years on record.

- **Sea level** (relative to the land) rose along much of the U.S. coastline between 1960 and 2015, particularly the Mid-Atlantic coast and parts of the Gulf coast, where some stations registered increases of more than 8 inches.

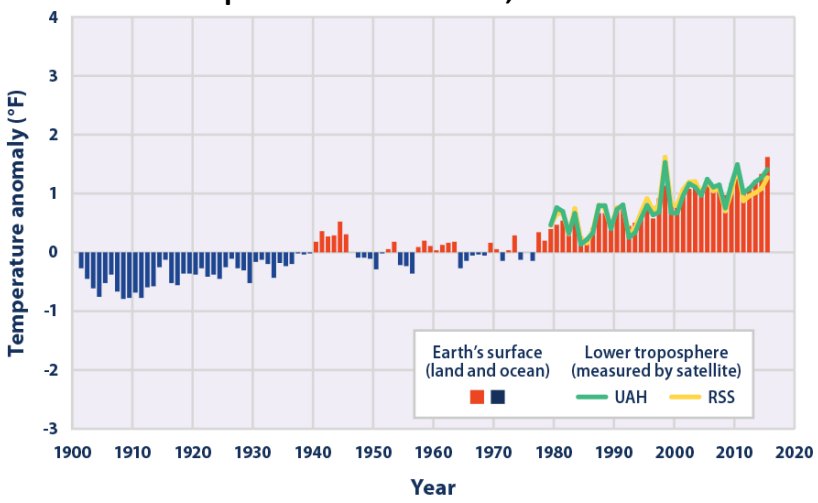
- **Coastal Flooding** – Tidal flooding is becoming more frequent along the U.S. coastline. Nearly every city with a long-term measurement site has experienced an increase in tidal flooding since the 1950s.

- **Arctic Sea Ice** - March sea ice extent reached the lowest extent on record in 2015 and hit roughly the same low again in 2016—about 7 percent less than the 1981–2010 average. Since 1979, the length of the melt season for Arctic sea ice has grown by 37 days.

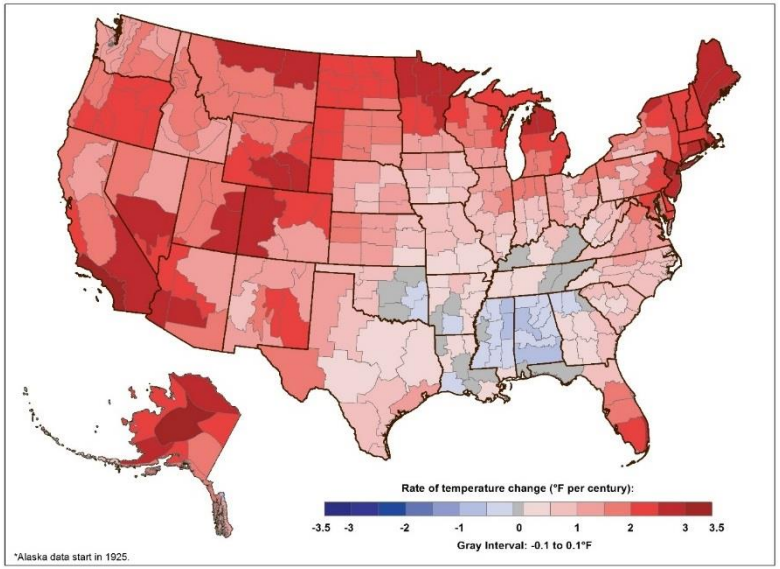
- **Ragweed Pollen Season** — Warmer temperatures and later fall frosts are increasing the length of ragweed pollen season, which has increased at 10 out 11 locations studied in the central United States and Canada since 1995.

U.S. and Global Temperature

Temperatures Worldwide, 1901–2015



Rate of Temperature Change in the United States, 1901–2015



This indicator describes trends in average surface temperature across the United States and the world.

- Worldwide, 2015 was the warmest year on record and 2006–2015 was the warmest decade on record since thermometer-based observations began. Global average surface temperature has risen at an average rate of 0.15°F per decade since 1901.
- U.S. temperatures have warmed at a similar rate. Eight of the top 10 warmest years on record for the contiguous 48 states have occurred since 1998, and 2012 and 2015 were the two warmest years on record.

This indicator is based on data provided by NOAA's National Centers for Environmental Information (NCEI).

Data source: NOAA, 2016

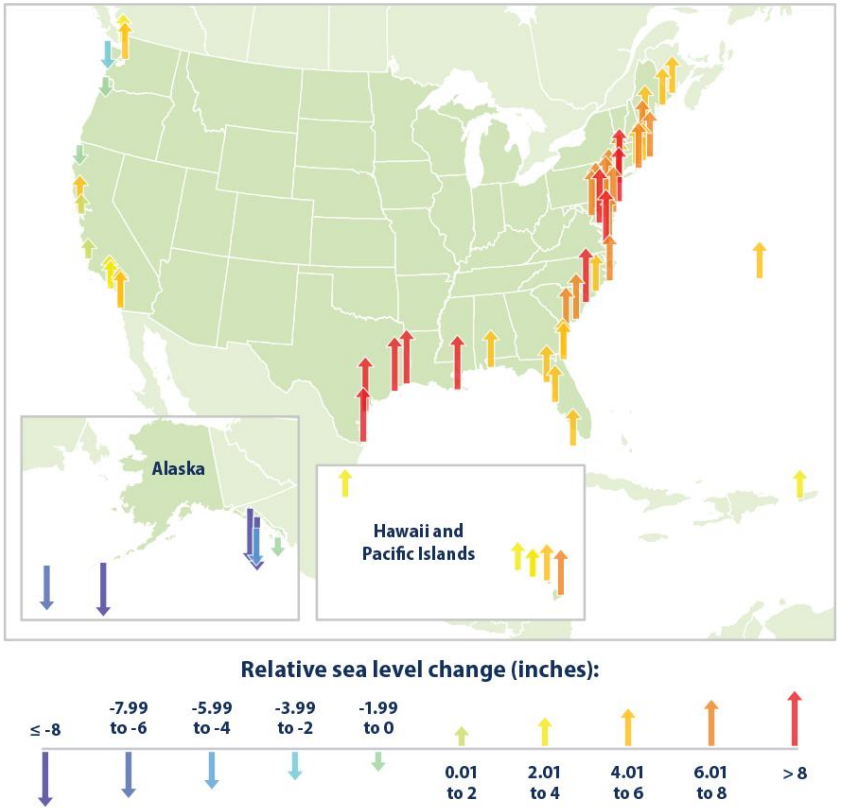
Sea Level

This indicator shows how sea level has changed over time. The indicator describes two types of sea level changes: absolute and relative.

- Relative sea level rose along much of the U.S. coastline between 1960 and 2015, particularly the Mid-Atlantic coast and parts of the Gulf coast, where some stations registered increases of more than 8 inches. Meanwhile, relative sea level fell at some locations in Alaska and the Pacific Northwest. At those sites, even though absolute sea level has risen, land elevation has risen more rapidly.

- Relative sea level also has not risen uniformly because of regional and local changes in land movement and long-term changes in coastal circulation patterns.

Relative Sea Level Change Along U.S. Coasts, 1960-2015



This map shows cumulative changes in relative sea level from 1960 to 2015 at tide gauge stations along U.S. coasts. Relative sea level reflects changes in sea level as well as land elevation.

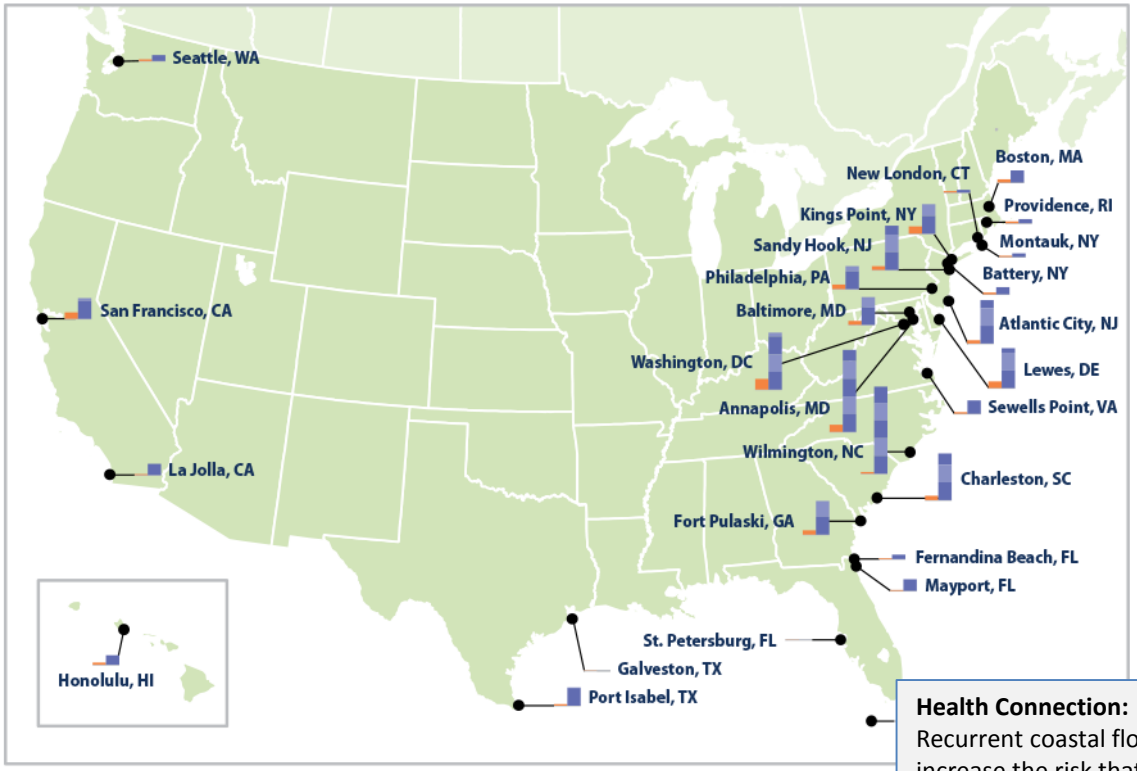
This indicator is based on long-term tide gauge data that have measured water levels along U.S. coasts since 1960, Data are collected by NOAA's National Ocean Service.

Data source: NOAA, 2016

New!

Coastal Flooding

Frequency of Flooding Along U.S. Coasts, 2010-2015 Versus 1950-1959



Average number of flood days per year:

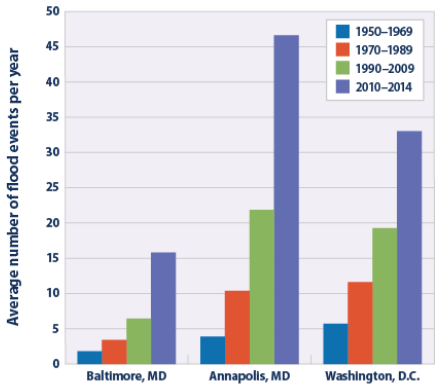
Data source: NOAA, National Ocean Service

This indicator shows how the frequency of coastal flooding has changed over time.

- Tidal flooding is becoming more frequent along the U.S. coastline. Nearly every site measured has experienced an increase in tidal flooding since the 1950s. The rate is accelerating in many locations along the East and Gulf Coasts.
- The Mid-Atlantic region suffers the highest number of tidal flood days and has also experienced the largest increases in flooding.

Health Connection:
Recurrent coastal flooding can increase the risk that drinking water, wastewater, and drainage infrastructure will fail, putting people at risk of being exposed to pathogens, disease vectors, and harmful chemicals.

Average Number of Coastal Flood Events per Year, 1950–2014



EPA developed this indicator in partnership with NOAA and focuses on 27 long-term tide gauge locations in the U.S. from 1950-2015.

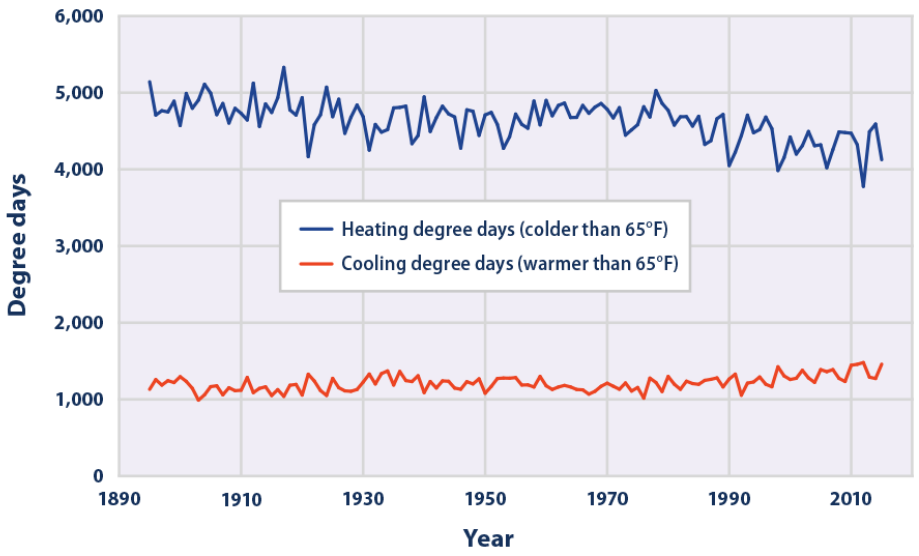
Heating and Cooling Degree Days

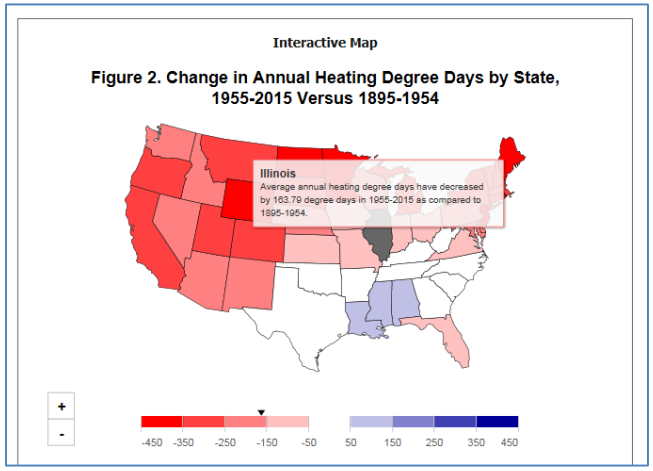
This indicator examines changes in temperatures from the perspective of heating and cooling needs for buildings.

- Heating degree days have declined in the contiguous United States, particularly in recent years, as the climate has warmed. This change suggests that heating needs have decreased overall.

- Overall, cooling degree days have increased over the past 100 years. The increase is most noticeable over the past few decades, suggesting that air conditioning energy demand has also been increasing recently.

Heating and Cooling Degree Days in the Contiguous U.S., 1895-2015





The data for this indicator were provided by the National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NOAA, NCEI).

Data source: NOAA, 2016

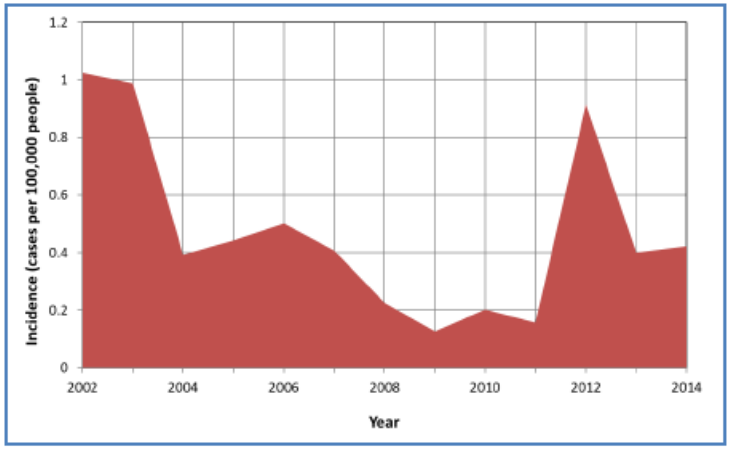
New!

West Nile Virus

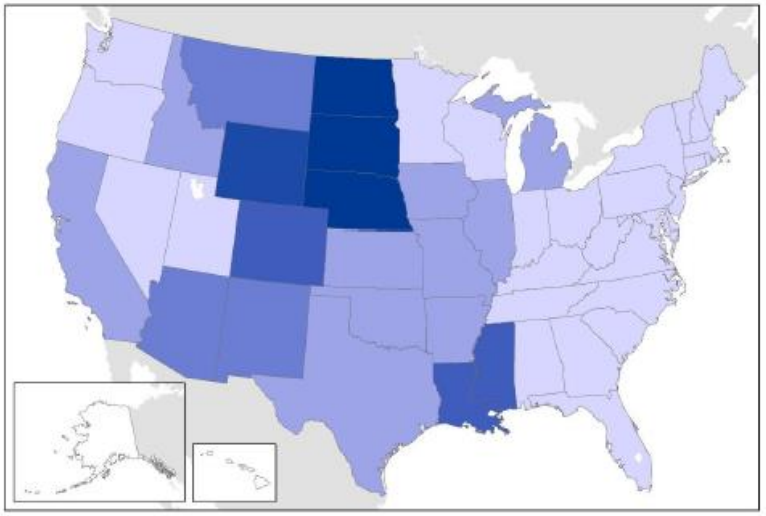
This indicator tracks the rate of reported West Nile virus disease cases across the United States.

- Climate change is expected to alter the geographic and seasonal distributions of existing vectors and vector-borne diseases.
- The incidence of neuroinvasive West Nile virus disease in the United States has varied widely from year to year. No obvious trend can be detected yet.
- The years 2002, 2003, and 2012 had the highest reported incidence rates, around one case per 100,000 people.
- Average annual incidence is highest in parts of the South, the Great Plains, and the Rocky Mountain region.

Reported Neuroinvasive Cases of West Nile Virus in the U.S., 2002-2014



Reported Neuroinvasive Cases of West Nile Virus by State, 2002-2014



West Nile became a nationally notifiable disease in 2002. CDC compiles these reported data and calculates national and state-level totals and rates.

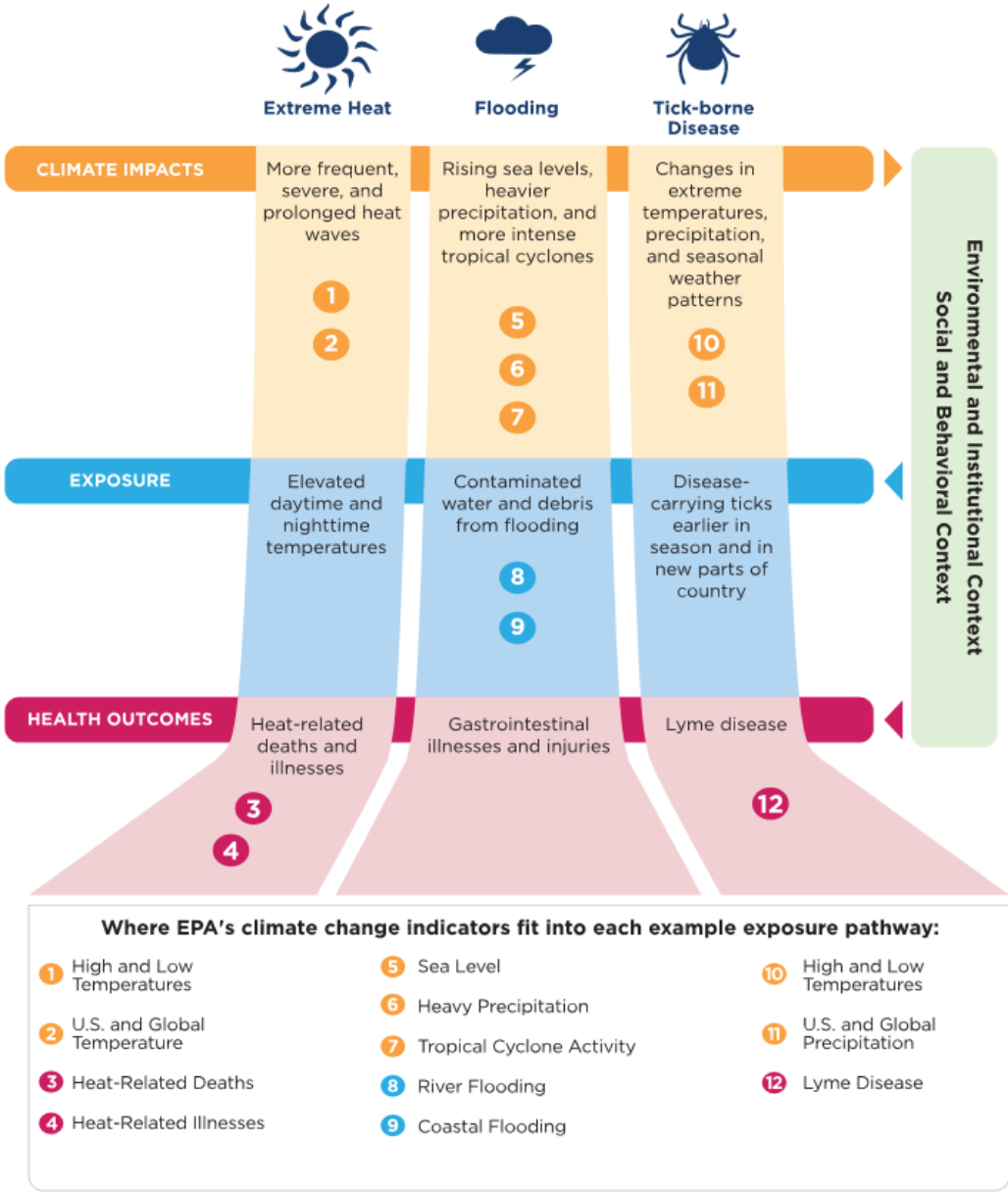
Data source: CDC, 2014

Understanding the Connections Between Climate Change and Human Health

6 pages
4 new figures

- Highlights key concepts from USGCRP's recent *Climate Change and Human Health Assessment*
- Helps people better make the connections between climate impacts and human health effects.

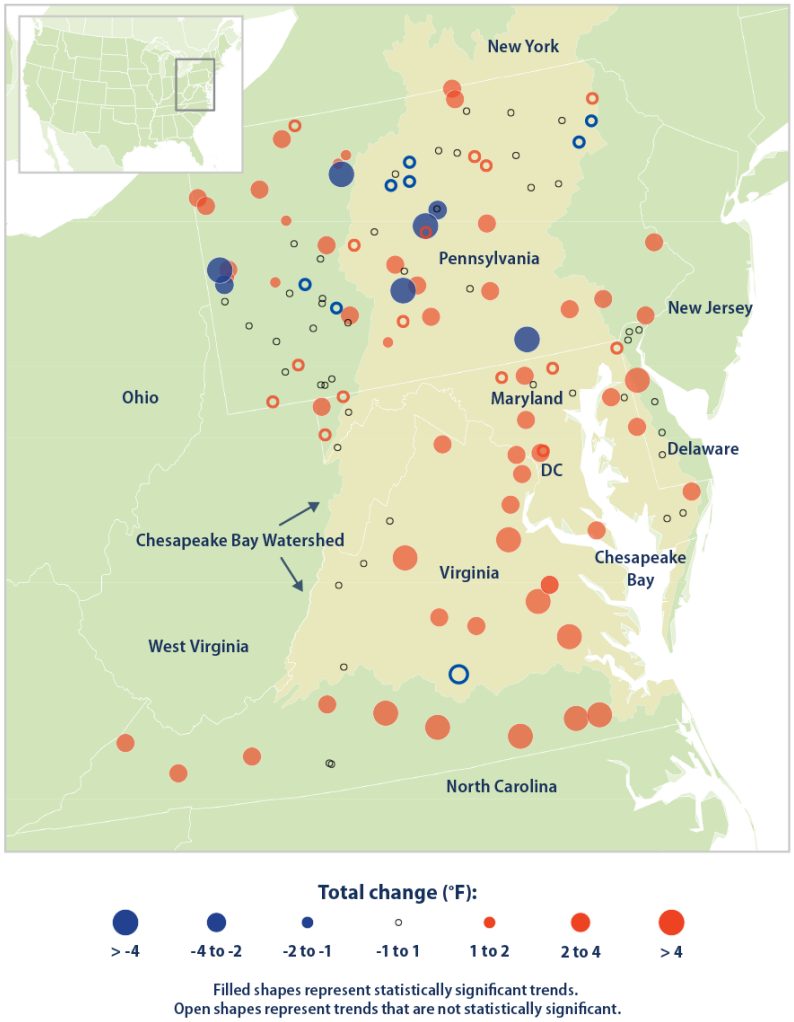
- The section covers the following key topics:
  - **How does climate change affect human health?**
  - **What can indicators tell us about climate change and human health?**
  - **Who's at risk?**



New!

Stream Temperature

Changes in Stream Temperatures in the Chesapeake Bay Region, 1960–2014



This indicator shows changes in stream temperature across the Chesapeake Bay region.

- Stream temperatures have risen throughout the Chesapeake Bay region. From 1960 through 2014, water temperature increased at 79 percent of stream sites in the region.
- Temperature has risen by an average of 1.2°F across all sites and 2.2°F at the sites where trends were statistically significant.

EPA developed this indicator in partnership with USGS and is based on an analysis of water temperature data from about 130 stream gauges across the Chesapeake Bay region.

Data source: USGS; Jastram and Rice 2015

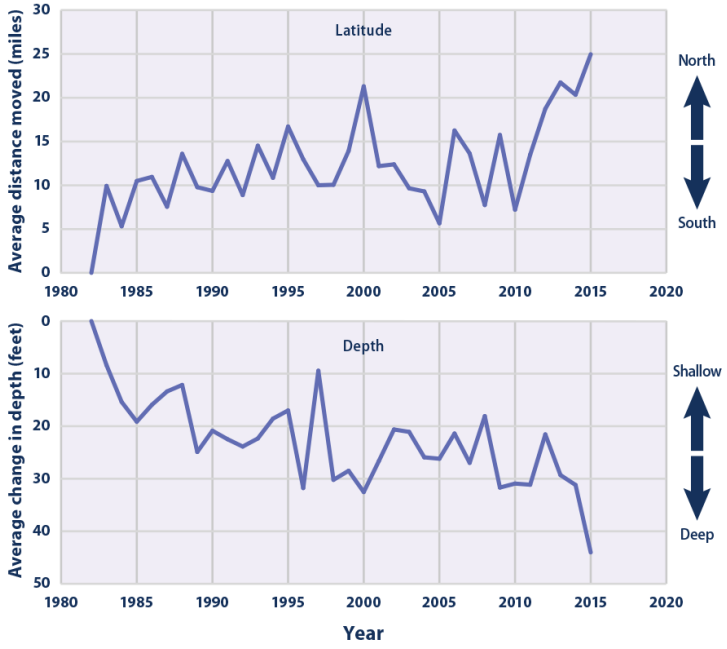
New!

Marine Species Distribution

This indicator examines changes in the location of fish, shellfish, and other marine species along U.S. coasts.

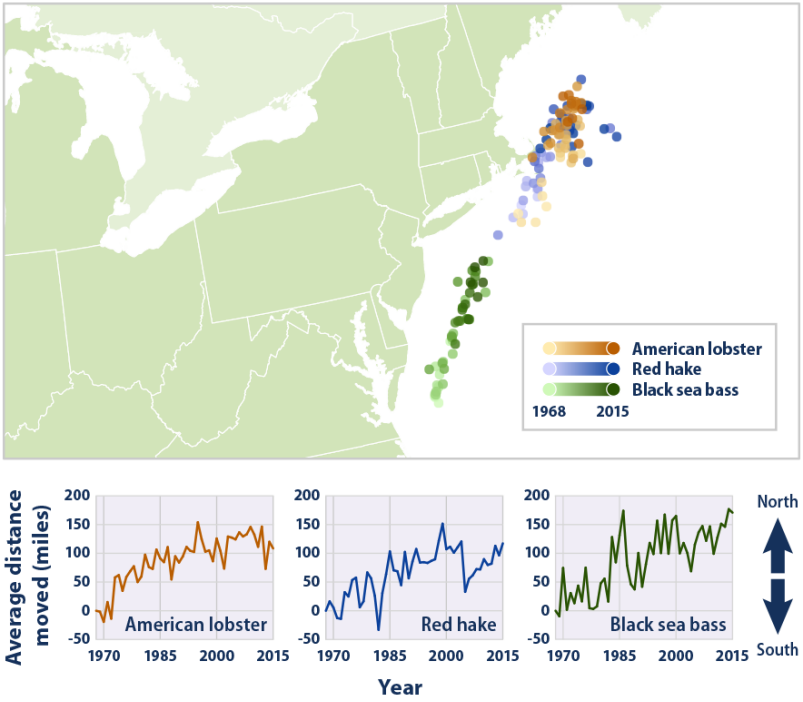
- As ocean waters have warmed, the average center of biomass for 105 marine species shifted northward by about 10 miles between 1982 and 2014. These species also moved an average of 20 feet deeper.
- In waters off the northeastern U.S., several economically important species have shifted northward since the late 1960s. The three species shown have moved northward by an average of 119 miles.

Change in Latitude and Depth of Marine Species, 1982-2015



Data for this indicator were collected by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service and other agencies.

Change for Three Fish and Shellfish Species in the Northeast, 1982-2015

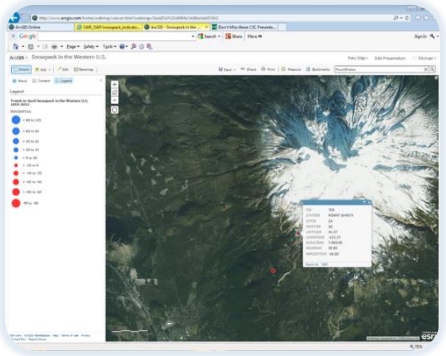


Data source: NOAA, National Fisheries Service; Rutgers University-OceanAdapt, 2016

EPA Climate Change Indicators Resources

- WEBSITE www.epa.gov/climate-indicators
  - Download figures
  - Download data (CSV)
  - Get detailed technical documentation
  - Sign up for our email updates (newsletter)

- Order copies of the report: climateindicators@epa.gov



- Web maps of 30 indicators on EPA's Geoplatform and embedded on website (coming soon).

What's Next for EPA Indicators?

- Continue update and expand upon the current set of indicators.
- More regional indicators likely to be developed or highlighted (e.g., topic of interest in a particular region).
- Facilitate the application of the indicators in the context of adaptation and planning.
- Continue to engage with other important indicators efforts (e.g., indicators being developed and leveraged by U.S. Global Change Research Program).

Thank You!

Mike Kolian
Office of Air & Radiation (OAR)
Office of Atmospheric Programs (OAP)
Climate Change Division
202.343.9261
kolian.michael@epa.gov