EPA's Climate Change Indicators in the U.S.

Webinar: Impacts of Climate Change on Tribal Health

June 24th, 2015

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Office of Atmospheric Programs

Climate Change Division

Washington, DC

Linking Climate Change and Health

- Climate change is happening now.
  - The evidence is clear across a wide range of observations.
- Our lives are connected to the climate.
  - Critical need to communicate the relevance of climate change to human health and society.
- Indicators are a powerful tool for communicating complex science and understanding the effects of climate.

Why Use Indicators?

An effective means for communicating the science.

- Simplifies the science: makes it accessible to a range of audiences.
- Provides context: helps explain the changes happening (i.e., patterns of change, rates of change, timing, frequency, and intensity of events).

Helps people understand the relevance of these changes.

- 'Connects the dots' between climate change and our lives and values (e.g., Why does this this matter to me?).
- Provides a foundation for informing decisions and further investigation.

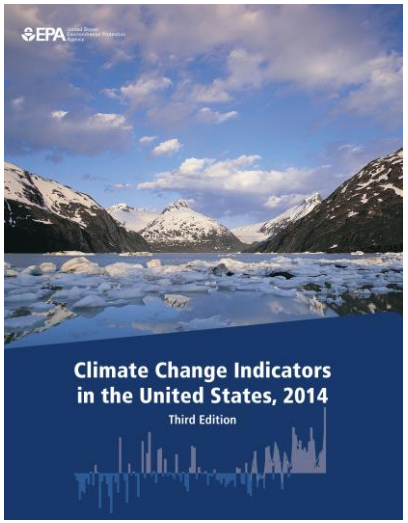
Observed data over time → Analysis

Ragweed Pollen Season 1995-2013

EPA's Climate Change Indicators Report

- Communicates the causes and effects of climate change
  - Summarizes 30 indicators related to climate change
  - All indicators are based on observations (no future projections)
  - Over 80 figures, maps and graphics
- Includes data from over 20 federal and non-federal agencies
- Consistent with the latest climate science (i.e., IPCC-AR5 and USGCRP's (NCA) 3rd assessment report, 2014)

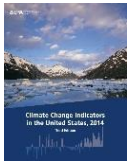
www.epa.gov/climatechange/science/indicators/index.html



Climate Change Indicators in the United States

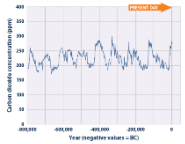
U.S. Environmental Protection Agency
Office of Atmospheric Programs
Climate Change Division
http://www.epa.gov/climatechange/indicators.html

EPA 430-R-14-004
May 2014

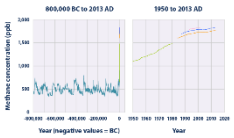


Greenhouse Gases

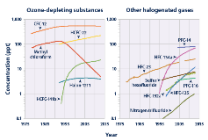
Global Atmospheric CO2 Concentrations



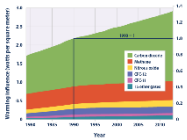
Global Atmospheric CH4 Concentrations



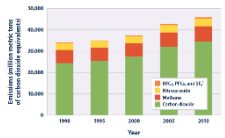
Global Atmospheric Concentrations of Halogenated Gases, 1978-2012



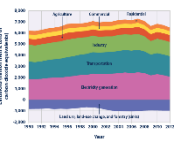
Climate Forcing, 1979-2013



Global GHG Emissions by Gas, 1990-2010



U.S. GHG Emissions and Sinks, 1990-2012

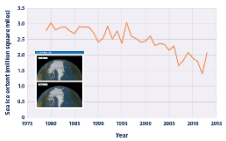


Snow and Ice

U.S. Benchmark Glaciers, 1958-2012

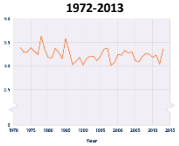
Reference Glaciers Worldwide, 1945-2012

Arctic Sea Ice Extent, 1979-2012

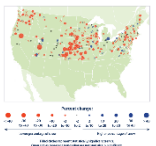


Lake Ice Thaw Dates, 1905-2012

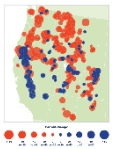
Snow Cover in North America, 1972-2013



Snow to Precipitation Ratio, 1949-2014

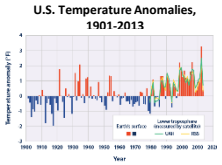


April Snowpack, 1955-2013

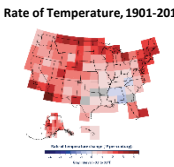


Weather and Climate

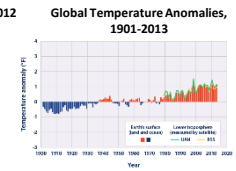
U.S. Temperature Anomalies, 1901-2013



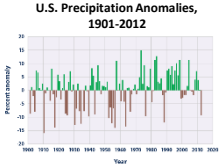
Rate of Temperature, 1901-2012



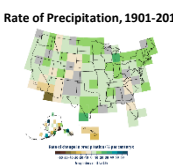
Global Temperature Anomalies, 1901-2013



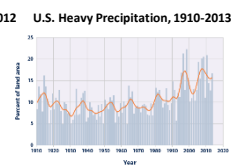
U.S. Precipitation Anomalies, 1901-2012



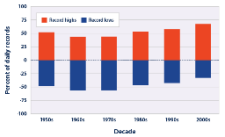
Rate of Precipitation, 1901-2012



U.S. Heavy Precipitation, 1910-2013

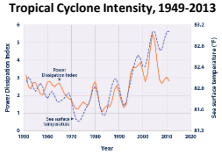


Record Temperatures, 1949-2009

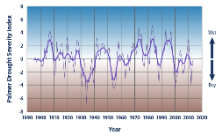


Hot Summer Temperatures, 1910-2012

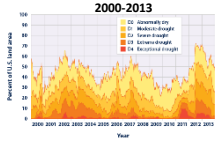
Tropical Cyclone Intensity, 1949-2013



Average Drought Conditions, 1895-2013

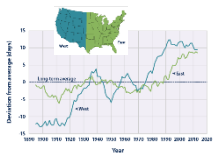


U.S. Lands Under Drought Conditions, 2000-2013



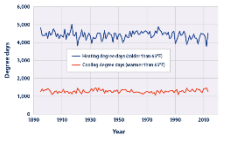
Health and Society

U.S. Growing Season, 1895-2013



Ragweed Pollen Season, 1995-2013

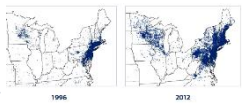
U.S. Heating and Cooling Degree Days, 1895-2013



U.S. Heat-Related Deaths, 1979-2010

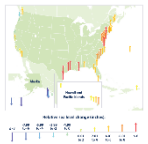
U.S. Lyme Disease Incidence, 1991-2012

Example: Reported Lyme Disease Cases in 1996 and 2012

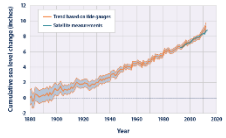


Oceans

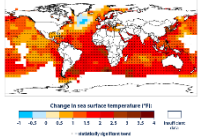
Relative Sea Level, 1960-2013



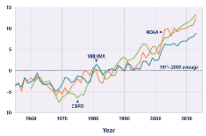
Global Sea Level, 1880-2013



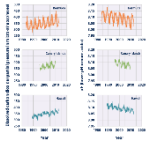
Sea Surface Temperature, 1901-2013



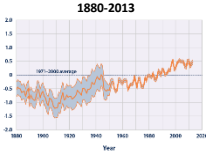
Ocean Heat Content, 1955-2013



Ocean Acidity, 1983-2012

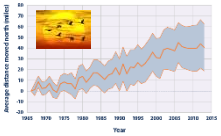


Global Sea Surface Temperature, 1880-2013

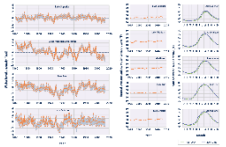


Ecosystems

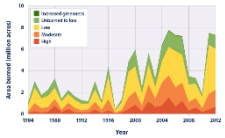
U.S. Bird Wintering Range, 1966-2013



Great Lakes Water Levels and Temperatures



Wildfire Area by State, 1984-2012



Wildfire Burned Area by State, 1984-2012

U.S. First Leaf and Bloom Dates, 1900-2013

Change in First Leaf Date, 1951-60 and 2004-2013

Changes in Streamflow, 1940-2012

Seven Day Low Streamflow

Three-Day High Streamflow

Timing of Winter-Spring Runoff

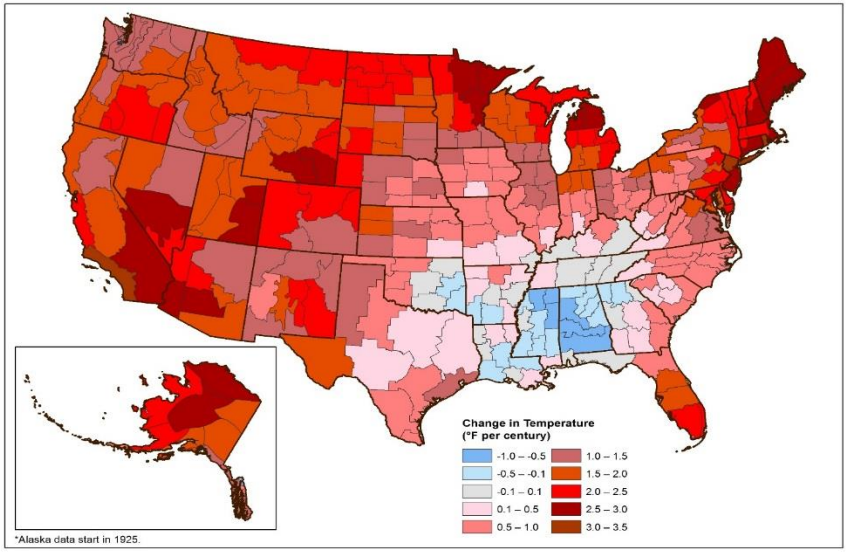
Data Sources*

* See EPA's report, *Climate Change Indicators in the United States*, for a complete list citations and associated references.

Preview of Health-Relevant Indicators

- Extreme Temperature and Precipitation
- Heat-Related Deaths
- Sea Level rise
- Snowpack
- Wildfires
- Ragweed Pollen Season
- Incidence of Lyme disease
- Changes at regional and local scales

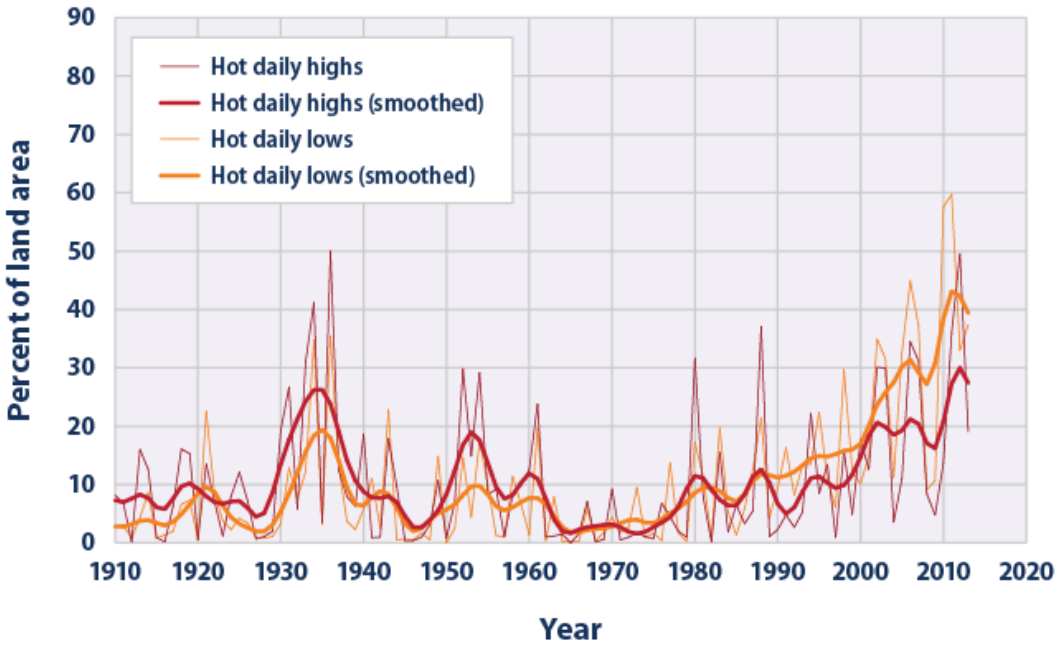
Figure 3. Rate of Temperature Change in the United States, 1901–2014*



High and Low Temperatures

This indicator describes trends in unusually hot and cold temperatures across the United States.

Area of the Contiguous 48 States with Unusually Hot Summer Temperatures, 1910-2013



This graph shows the percentage of the land area of the contiguous 48 states with unusually hot daily high and low temperatures during the months of June, July, and August. The thin lines represent individual years, while the thick lines show a nine-year weighted average. The term "unusual" in this case is based on the long-term average conditions at each location.

Key Points:

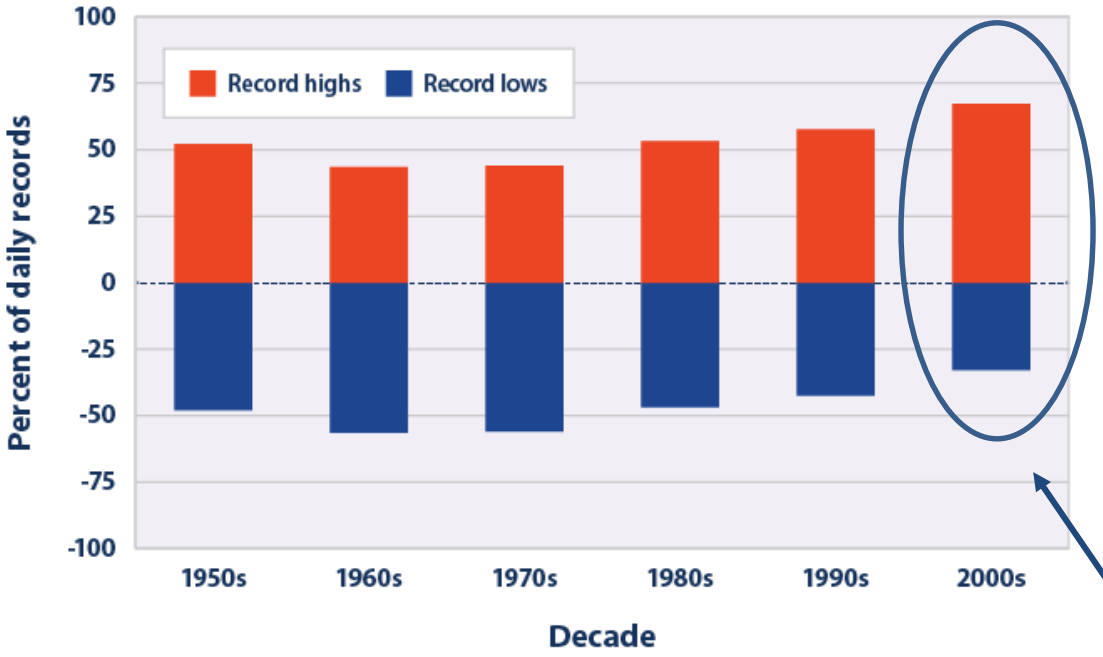
- Nationwide, unusually hot summer days (highs) have become more common over the last few decades.
- The occurrence of unusually hot summer nights (lows) has increased at an even faster rate. This trend indicates less "cooling off" at night.

Data source: NOAA, 2014.
National Climatic Data Center (NCDC), U.S. Historical Climatology Network (USHCN), U.S. Climate Extremes Index (CEI).

High and Low Temperatures

This indicator describes trends in unusually hot and cold temperatures across the United States.

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



This figure shows the percentage of daily temperature records set at weather stations across the contiguous 48 states by decade. Record highs (red) are compared with record lows (blue).

Key Points:

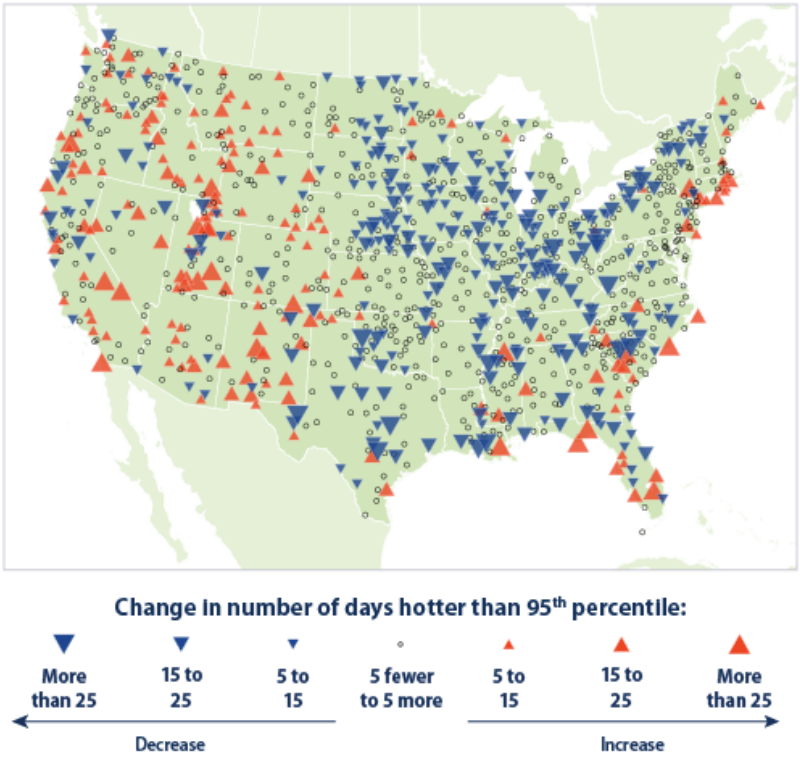
- If the climate were completely stable, one might expect to see highs and lows each accounting for about 50 % of the records set. However, since the 1970s, record-setting daily high temperatures have become more common than record lows across the U.S.
- The most recent decade had twice as many record highs as record lows.

Data source: Meehl et al., 2009.; NOAA, National Climatic Data Center (NCDC)

High and Low Temperatures

This indicator describes trends in unusually hot and cold temperatures across the United States.

Change in Unusually Hot Temperatures in the U.S. 1948-2013



This map shows trends in unusually hot temperatures at individual weather stations that have operated consistently since 1948. In this case, the term "unusually hot" refers to a daily maximum temperature that is hotter than the 95th percentile temperature during the 1948–2013 period. Thus, the maximum temperature on a particular day at a particular station would be considered "unusually hot" if it falls within the warmest 5 percent of measurements at that station during the 1948–2013 period. The map shows changes in the total number of days per year that were hotter than the 95th percentile. Red upward-pointing symbols show where these unusually hot days are becoming more common. Blue downward-pointing symbols show where unusually hot days are becoming less common.

Key Points:

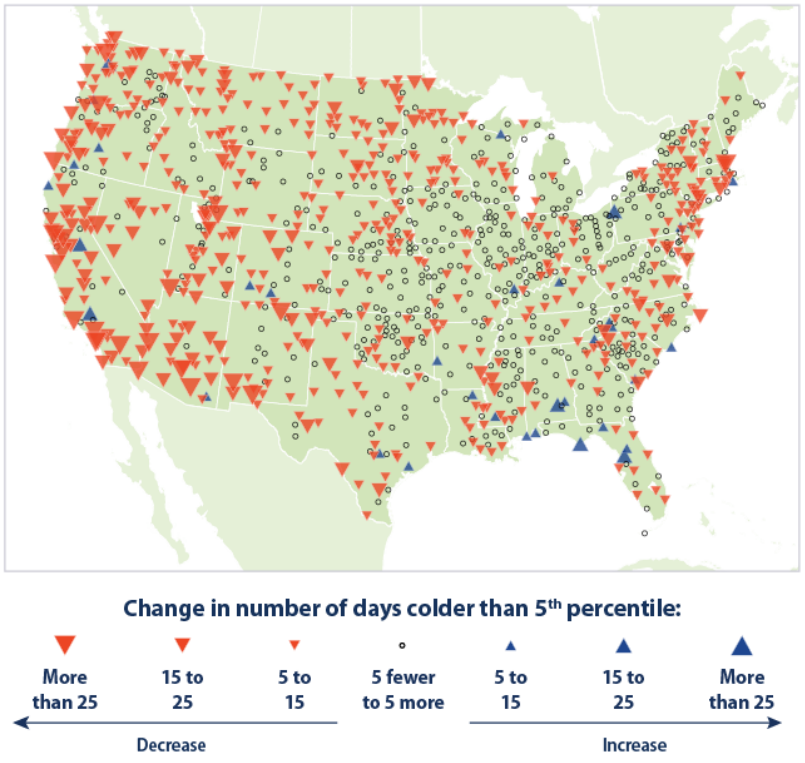
- The map shows where changes in the number of days with unusually hot (above the 95th percentile) days have occurred since 1948.
- Unusually high temperatures have increased in the western United States and in several areas along the Gulf and Atlantic coasts, but decreased in much of the middle of the country

Data source: NOAA, 2014.
National Climatic Data Center (NCDC).

High and Low Temperatures

This indicator describes trends in unusually hot and cold temperatures across the United States.

Change in Unusually Cold Temperatures in the U.S. 1948-2013



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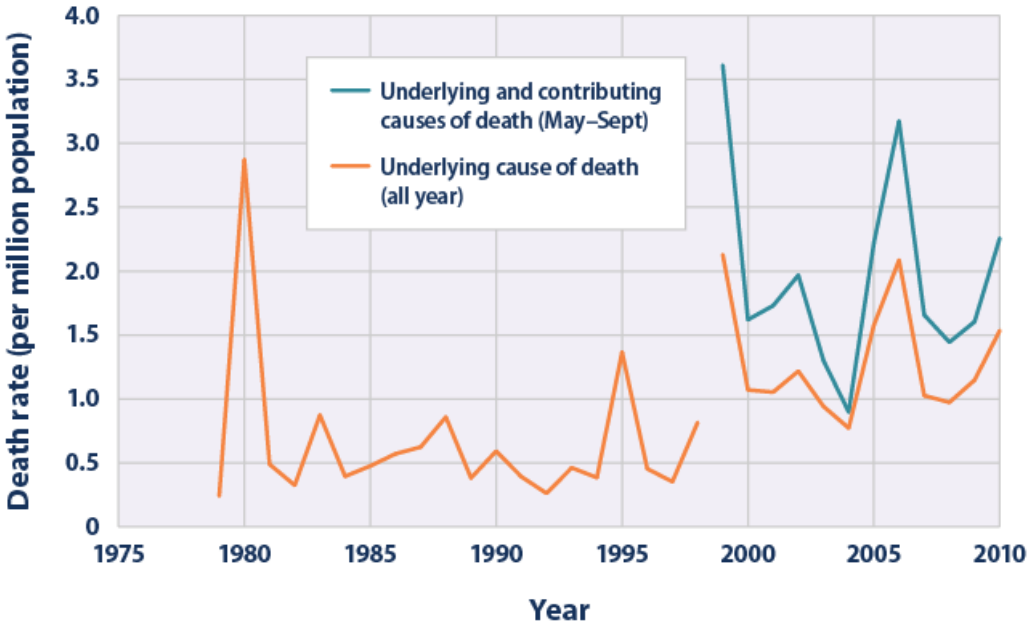
Data source: NOAA, 2014.
National Climatic Data Center (NCDC).

Heat-Related Deaths

This indicator presents data on deaths classified as "heat-related" in the United States.

Deaths Classified as Heat-Related in the U.S., 1979-2010



This figure shows the annual rates for deaths classified as "heat-related" by medical professionals in the 50 states and the District of Columbia. The orange line shows deaths for which heat was listed as the main (underlying) cause.* The blue line shows deaths for which heat was listed as either the underlying or contributing cause of death during the months from May to September, based on a broader set of data that became available in 1999.

* Between 1998 and 1999, the World Health Organization revised the international codes used to classify causes of death. As a result, data from earlier than 1999 cannot easily be compared with data from 1999 and later.

Key Points:

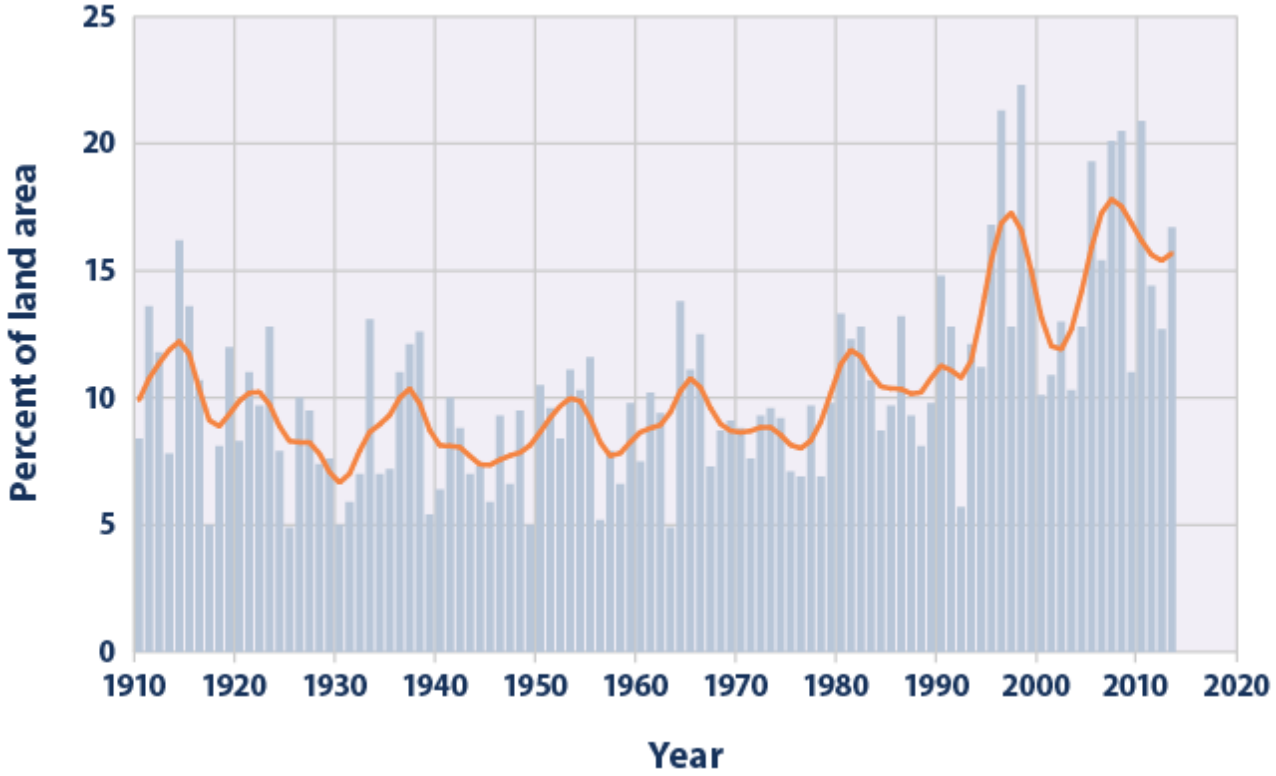
- Overall, nearly 8,000 Americans suffered heat-related deaths since 1979.
- The indicator shows a peak in heat-related deaths in 2006, a year that was associated with widespread heat waves and was the second-hottest year on record in the contiguous 48 states.
- Dramatic increases in heat-related deaths are closely associated with both the occurrence of hot temperatures and heat waves, though these deaths may not be reported as "heat-related" on death certificates.

Data source: Centers for Disease Control and Prevention (CDC), 2014

Heavy Precipitation

This indicator tracks the frequency of heavy precipitation events in the United States.

Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910-2013



This figure shows the percentage of the land area of the contiguous 48 states where a much greater than normal portion of total annual precipitation has come from extreme single-day precipitation events. The bars represent individual years, while the line is a nine-year weighted average.

Data source: NOAA, 2014.
National Climatic Data Center, U.S. Historical Climatology Network (USHCN), U.S. Climate Extremes Index (CEI).

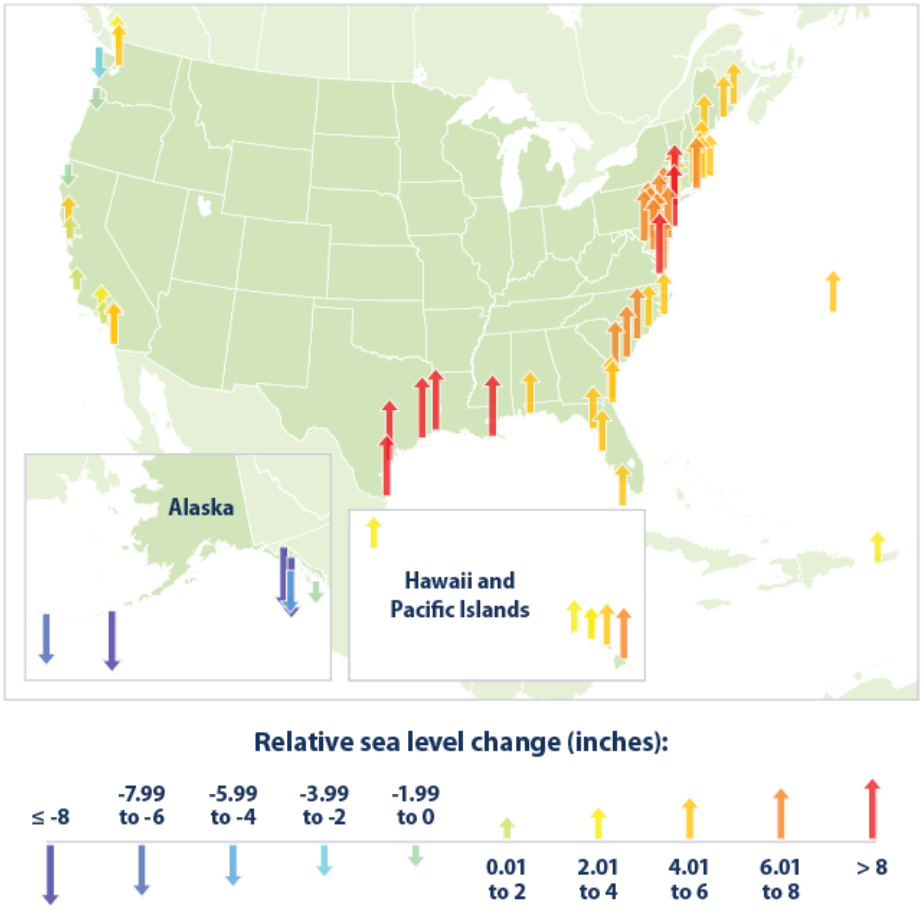
Key Points:

- In recent years, a larger percentage of precipitation has come in the form of intense single-day events.
- Nine of the top 10 years for extreme one-day precipitation events have occurred since 1990.

Sea Level

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

Relative Sea Level Change Along U.S. Coasts, 1960-2013



This map shows cumulative changes in relative sea level from 1960 to 2013 at tide gauge stations along U.S. coasts. Relative sea level reflects changes in sea level as well as land elevation.

Data source: NOAA, 2014
National Water Level Observation Network (NWLON) within NOAA's National Ocean Service (NOS).

Key Points:

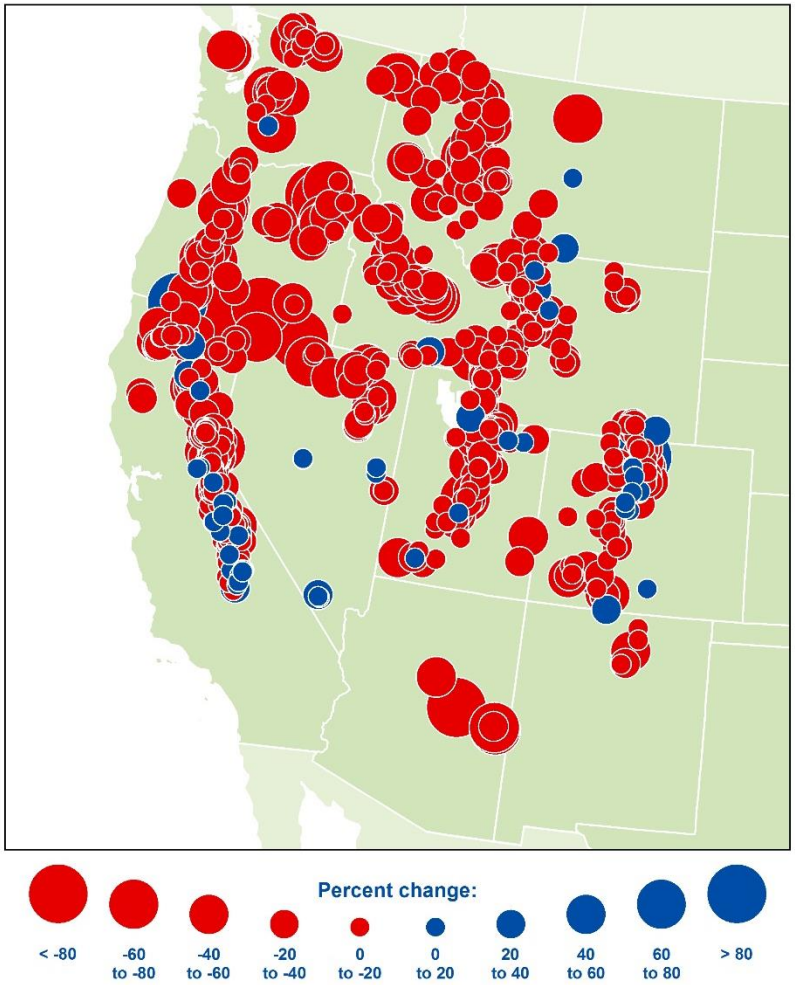
- Relative sea level rose along much of the U.S. coastline between 1960 and 2013, particularly the Mid-Atlantic coast and parts of the Gulf coast, where some stations registered increases of more than 8 inches.

- 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.

Snowpack

This indicator measures trends in mountain snowpack in western North America.

Trends in April Snowpack in the Western U.S., 1955-2015



Key Points:

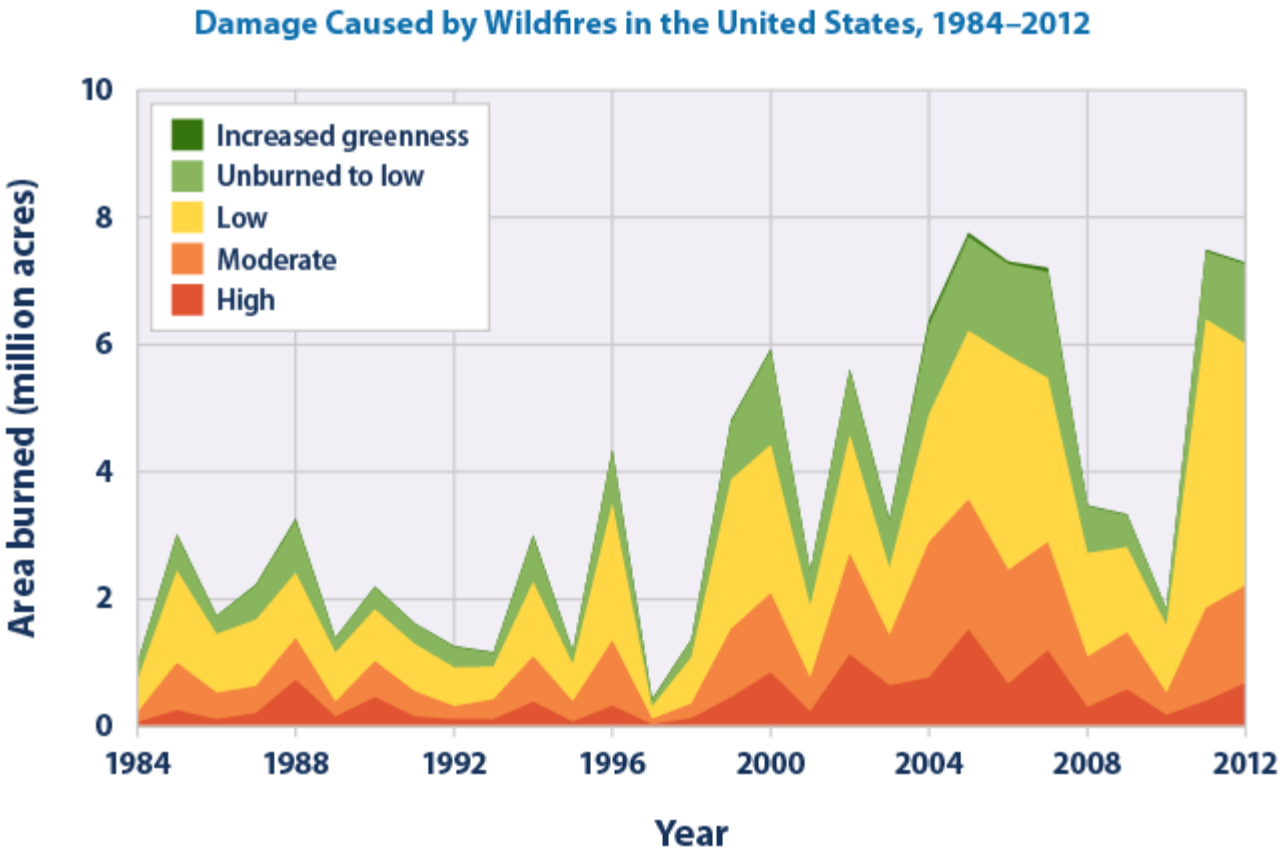
- From 1955 to 2015, April snowpack declined at about 90% of the sites measured. The average change across all sites amounts to about a 22 percent decline.
- In general, the largest and most consistent decreases were observed in Washington, Oregon, and the northern Rockies.
- Some areas have seen increases in snowpack, such as in the southern Sierra Nevada of California.

This map shows trends in April snowpack in the western United States, measured in terms of snow water equivalent. Blue circles represent increased snowpack; red circles represent a decrease.

Data sources: U.S. Department of Agriculture's Natural Resources Conservation Service Water and Climate Center and the California Department of Water Resources. Mote et al (2005) updated 2015.

Wildfires

This indicator tracks the frequency, extent, and severity of wildfires in the United States.



Data source: MTBS (Monitoring Trends in Burn Severity). 2014. MTBS data summaries. www.mtbs.gov/data/search.html.

Key Points:

Of the total area burned each year from 1984 to 2012, the proportion of burned land suffering severe damage has ranged from 5 to 22%.

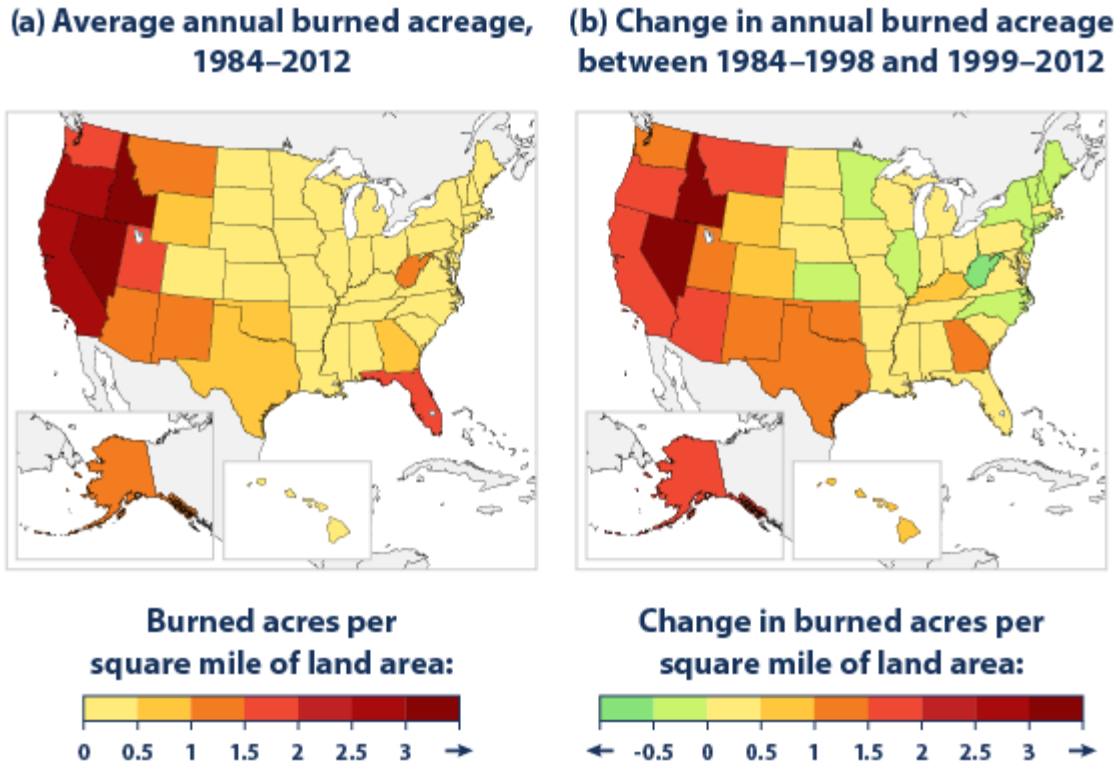
Wildfires

This indicator tracks the frequency, extent, and severity of wildfires in the United States.

Key Points:

Land area burned by wildfires varies by state. Fires burn more land in the western United States than in the East, and parts of the West and Southwest show the largest increase in burned acreage between the first half of the record (1984–1998) and the second half (1999–2012).

Land Area Burned by Wildfires by State, 1984–2012

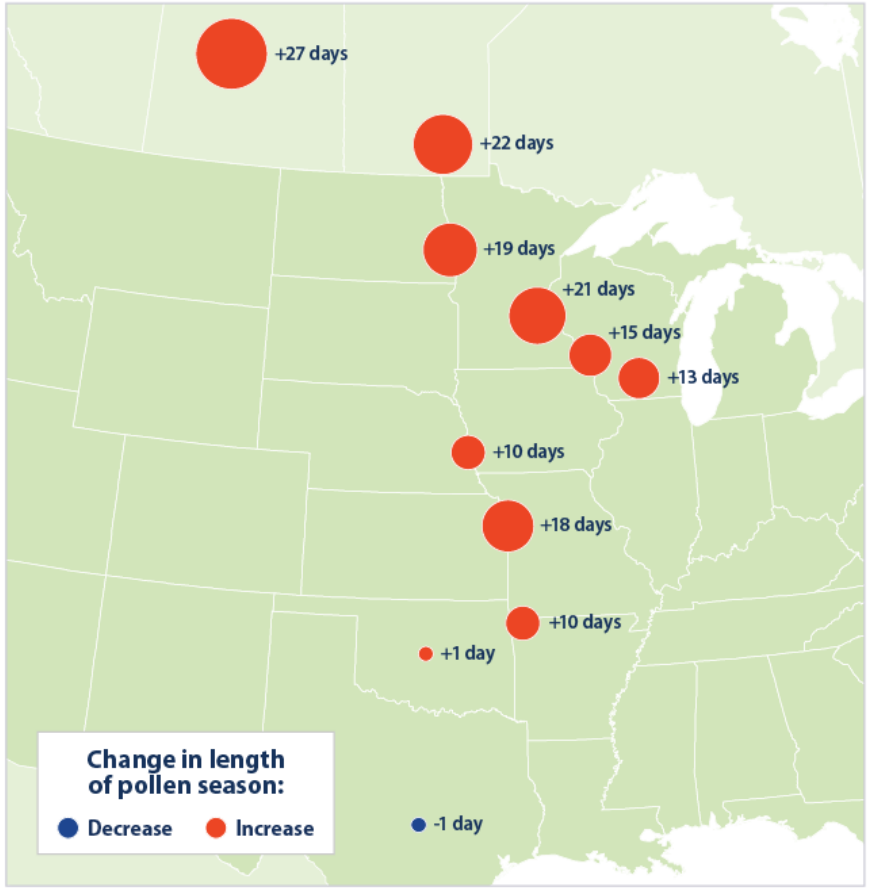


Data source: MTBS (Monitoring Trends in Burn Severity). 2014. MTBS data summaries. www.mtbs.gov/data/search.html.

Ragweed Pollen Season

This indicator depicts changes in the length of ragweed pollen season in the United States and Canada.

Change in Ragweed Pollen Season, 1995-2013



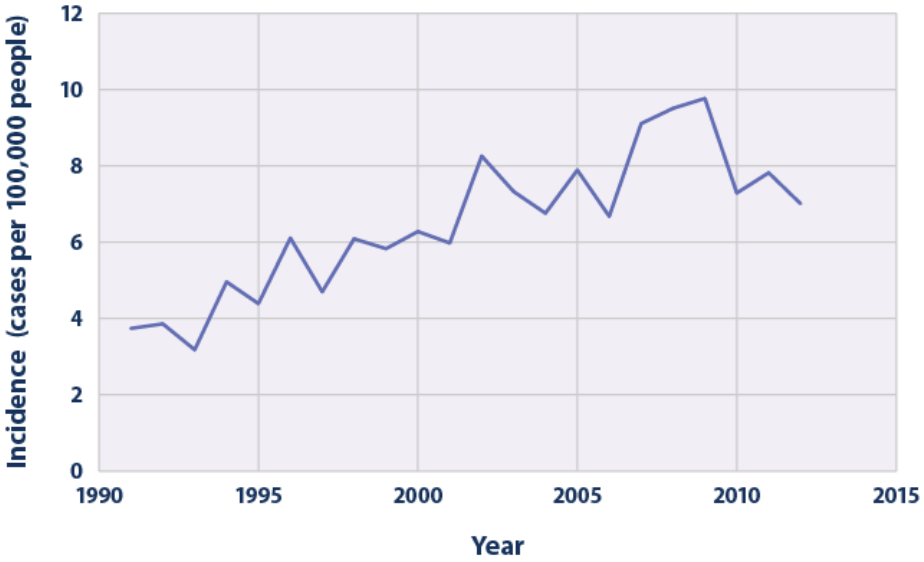
This figure shows how the length of ragweed pollen season changed at 11 locations in the central United States and Canada between 1995 and 2013. Red circles represent a longer pollen season; the blue circle represents a shorter season. Larger circles indicate larger changes.

Data source: Ziska et al., 2014
Underlying data: National Allergy Bureau, American Academy of Allergy, Asthma, and Immunology's Aeroallergen Network.

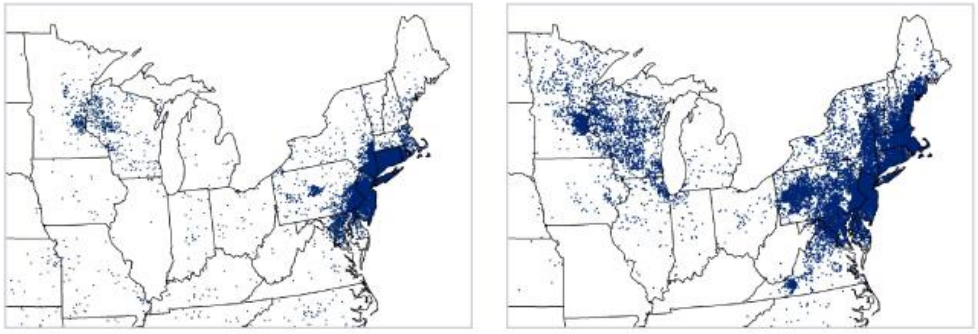
Key Points:

- Warmer temperatures and later fall frosts allow ragweed plants to produce pollen later into the year, potentially prolonging the allergy season.
- Since 1995, ragweed pollen season has grown longer at 10 of the 11 locations studied and generally more pronounced from south to north.
- This trend is consistent with many other observations showing that climate is changing more rapidly at higher latitudes.

Reported Cases of Lyme Disease in the United States, 1991-2012



Example: Report Lyme Disease Cases in 1996 and 2012



Key Points:

- The annual incidence of Lyme disease in the United States has approximately doubled since 1991, from 3.74 reported cases per 100,000 people to 7.01 reported cases per 100,000 people in 2012.
- Driven by multiple factors, the number and distribution of reported cases of Lyme disease appear to be increasing over time (maps).

The graph is based on cases that local and state health departments report to CDC's national disease tracking system.

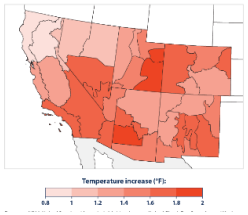
Data source: CDC, 2014
Centers for Disease Control and Prevention, Lyme disease data and statistics: www.cdc.gov/lyme/stats/index.html

‘Closer Look’ - ‘Community Connection’

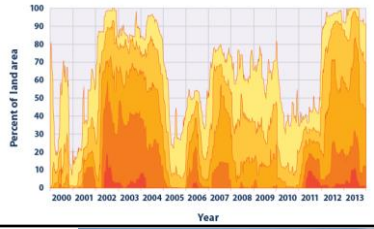
Temperature and Drought in the SW

A Closer Look:
The Southwest provides an important perspective as it is particularly sensitive to changes in temperature and drought. Changes in water availability can threaten natural systems and society.

Temperatures in the Southwest 2000–2013 vs. 1895-2013



Southwestern U.S. Lands Under Drought Conditions, 2000–2013

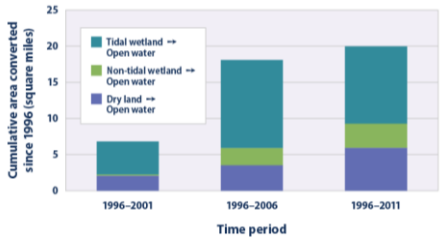


Land Loss Along the Atlantic Coast

A Closer Look:
As sea level rises, dry land and wetland along the coast can turn into open water.

Roughly 20 square miles of dry land and wetland were converted to open water along the Atlantic coast between 1996 and 2011.

Land Submergence Along the Atlantic Coast, 1996–2011

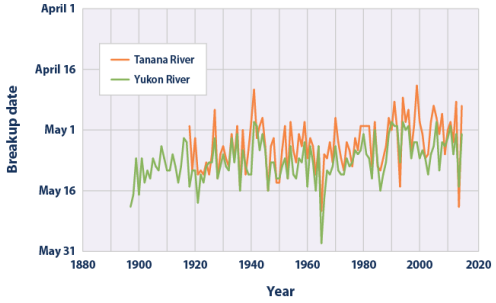


Ice Breakup in Two Alaskan Rivers

Community Connection:
Two northern communities have compiled long-term data records on river ice breakup dates

The ice breakup dates for both the Tanana and Yukon rivers have shifted earlier by approximately six days over their respective periods of record.

Ice Breakup Dates for Two Alaskan Rivers, 1896–2013

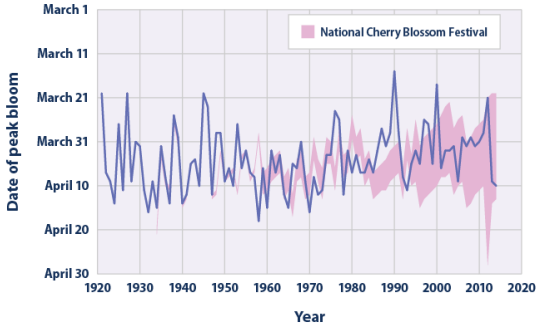


Cherry Blossom Bloom Dates in Washington, D.C.

Community Connection:
DC’s Cherry Blossom Festival has led to long-term data records (94 years) on “Peak” Bloom Dates.

Since 1921, peak bloom dates have shifted earlier by approximately 5 days.

Peak Bloom Dates for Cherry Trees in Washington, DC , 1921-2014



Coming Soon and Resources!

- Updates to the website this summer
  - Nearly all indicators will be updated with newly available data.
  - New interactive figures and maps.
  - Indicators available in Google Earth and GIS file formats.
  - Downloadable datasets for each figure.
  - Slide deck of all indicator figures and key points.

- EPA is assembling new indicators and content for the next report in 2016.

- Upcoming information webinar to solicit feedback specifically from tribes on July 2nd, 2015.

- Contact us or to order free copies of the report and other materials at: climateindicators@epa.gov

EPA's Climate Change Indicators in the U.S.

www.epa.gov/climatechange/indicators