U.S. EPA's State and Local Climate and Energy Webinar Series

EPA United States Environmental Protection Agency

Overview of EPA's Climate Change Indicators

June 17, 2021
1 PM ET

Three audio options:

1. Listen via computer
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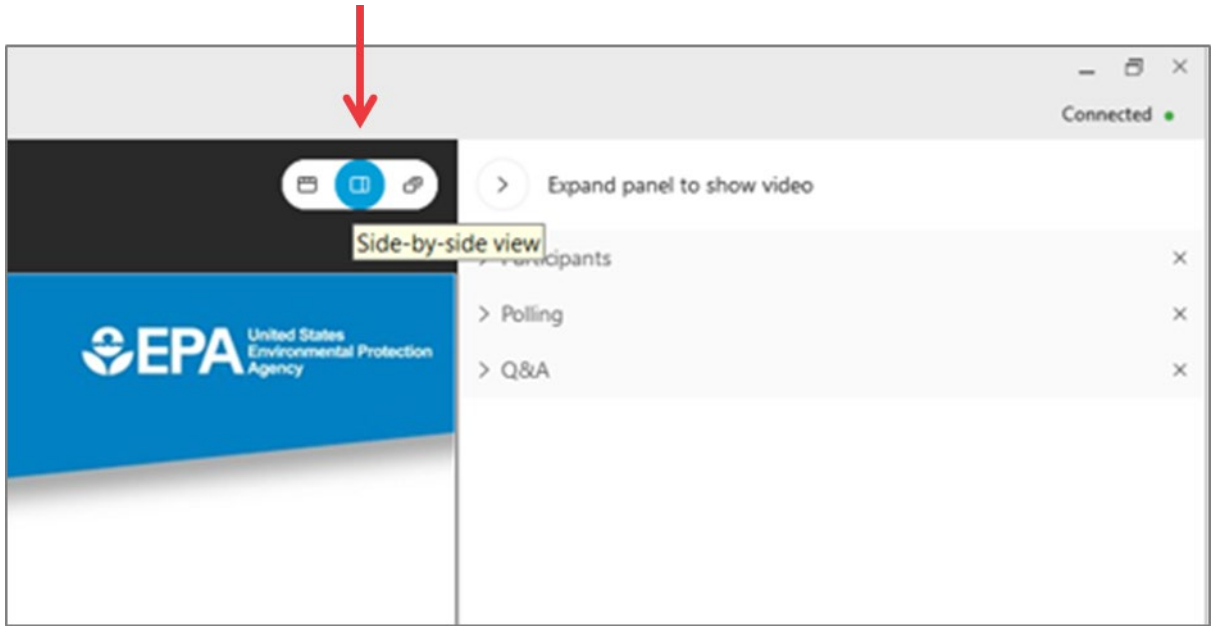
3. Dial 1-415-655-0002 or 1-855-797-9485
   Event number: 161 078 9086

Screen View

- There are several layout options
- We recommend the side-by-side view



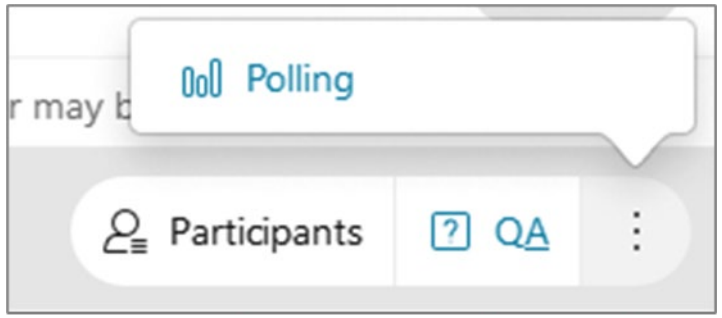
Webinar Panels

We'll use three panels

- Participants, Polling, and Question & Answer (Q&A)
- Use the arrow to expand or collapse the panels

Adding Panels

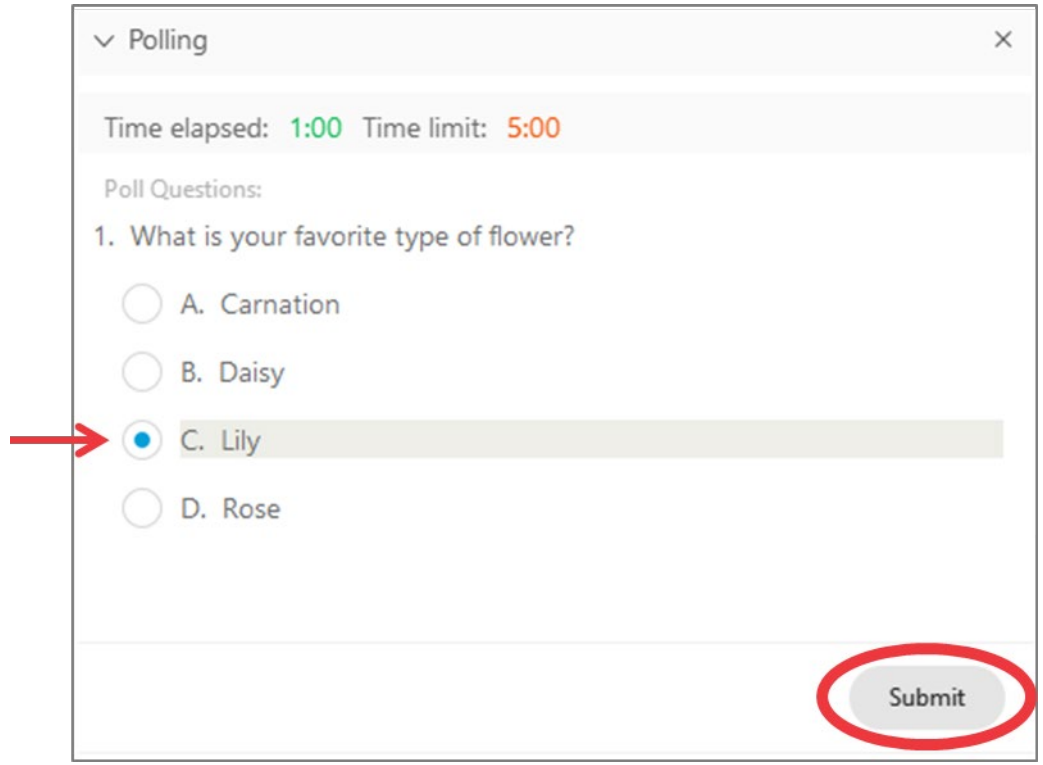
- If some panels don't appear, select the desired panels in the lower right
- Select More Options (…) for additional panels



Polling and Feedback

Polling

- We'll ask several poll questions during the webinar
- The polling panel will appear when we open the first poll
- Select your desired response and hit "Submit"



Webinar Feedback

- A feedback form will pop-up when you exit today's webinar

Q&A

- **Participants are muted**
- **Questions will be moderated at the end**
- To ask a question:
  1. Select “All Panelists” from the drop-down menu
  2. Enter your question in the Q&A box
  3. Hit “Send”

- **EPA will post responses on the Webinar Series page**
  www.epa.gov/statelocalenergy/state-local-and-tribal-webinar-series

Today's Agenda

- **Maggie Molina,** Branch Chief, State and Local Climate and Energy Program, U.S. EPA
- **Mike Kolian,** Physical Scientist/Climate Analyst, U.S. EPA
- **Lisa Bacanskas,** Environmental Scientist, U.S. EPA
- Question and Answer Session

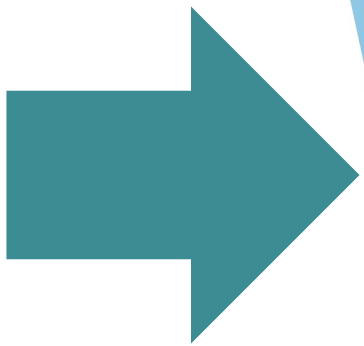
Introduction

Maggie Molina

U.S. Environmental Protection Agency

To what extent to do you use climate change indicators in your work? (select one)

- Frequently
- Occasionally
- Rarely
- Never
- I have not yet used indicators, but am considering using them



Poll 1

Overview of EPA's Climate Indicators

Mike Kolian
Lisa Bacanskas

U.S. Environmental Protection Agency

Overview of EPA's Climate Indicators

June 17, 2021

U.S. State and Local Climate and Energy Program Webinar Series

Climate Change Indicators in the United States

www.epa.gov/climate-indicators

Overview: EPA's Climate Change Indicators

- Current and comprehensive resource on climate science
- Observations only (no projections)
- Focuses on the U.S. with global changes for context
- Highlights federal government data but also a broader collaboration of over 50 agencies and organizations
- Peer-reviewed, transparent documentation
- Ongoing updates and development of new indicators
- EPA indicators are well-integrated into U.S. Global Change Research Program's (USGCRP's) National Climate Assessment (EPA co-leads indicators Interagency Workgroup)

Published Reports

2010 2012 2014 2016 2018

Website

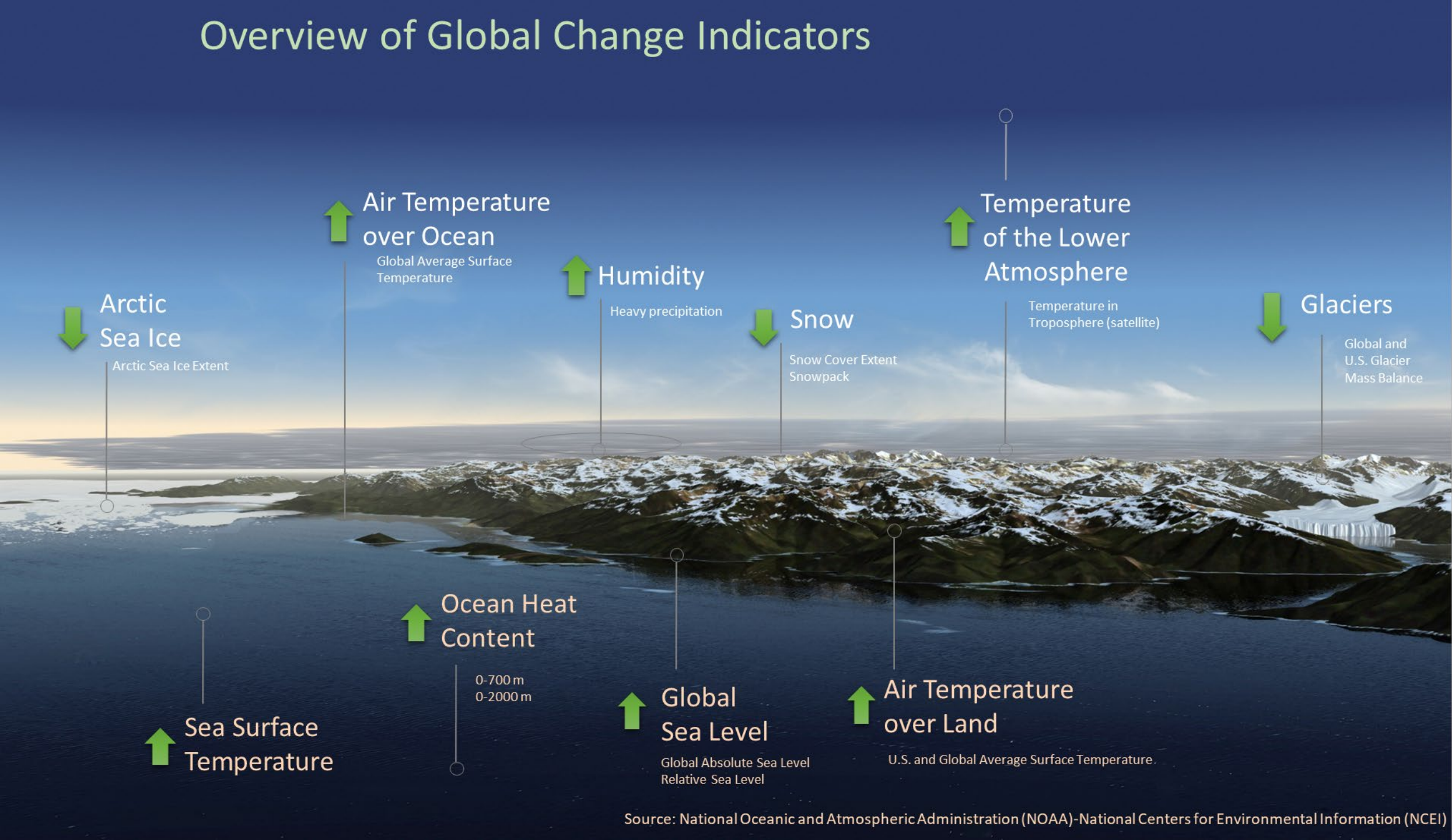
A Growing Body of Scientific Evidence

- 54 indicators; 140 figures; 275 datasets
- Downloadable, sharable and accessible: data, graphics, interactive tools, and documentation.

Importance of Indicators

- Indicators provide multiple lines of evidence that climate change is occurring now and here in the U.S., affecting public health and the environment
- Allows for routine tracking of observed changes and the latest science and data
- Indicator and data are relevant at national, regional, state and community levels in U.S.
- Climate indicators facilitate examination of risk, exposure and vulnerability, and Environmental Justice considerations

Overview of Global Change Indicators



Source: National Oceanic and Atmospheric Administration (NOAA)-National Centers for Environmental Information (NCEI)

What the Data Show

- Changes are more evident, changing faster, and becoming more extreme

- Recent observations are eclipsing historical thresholds, setting records is now common

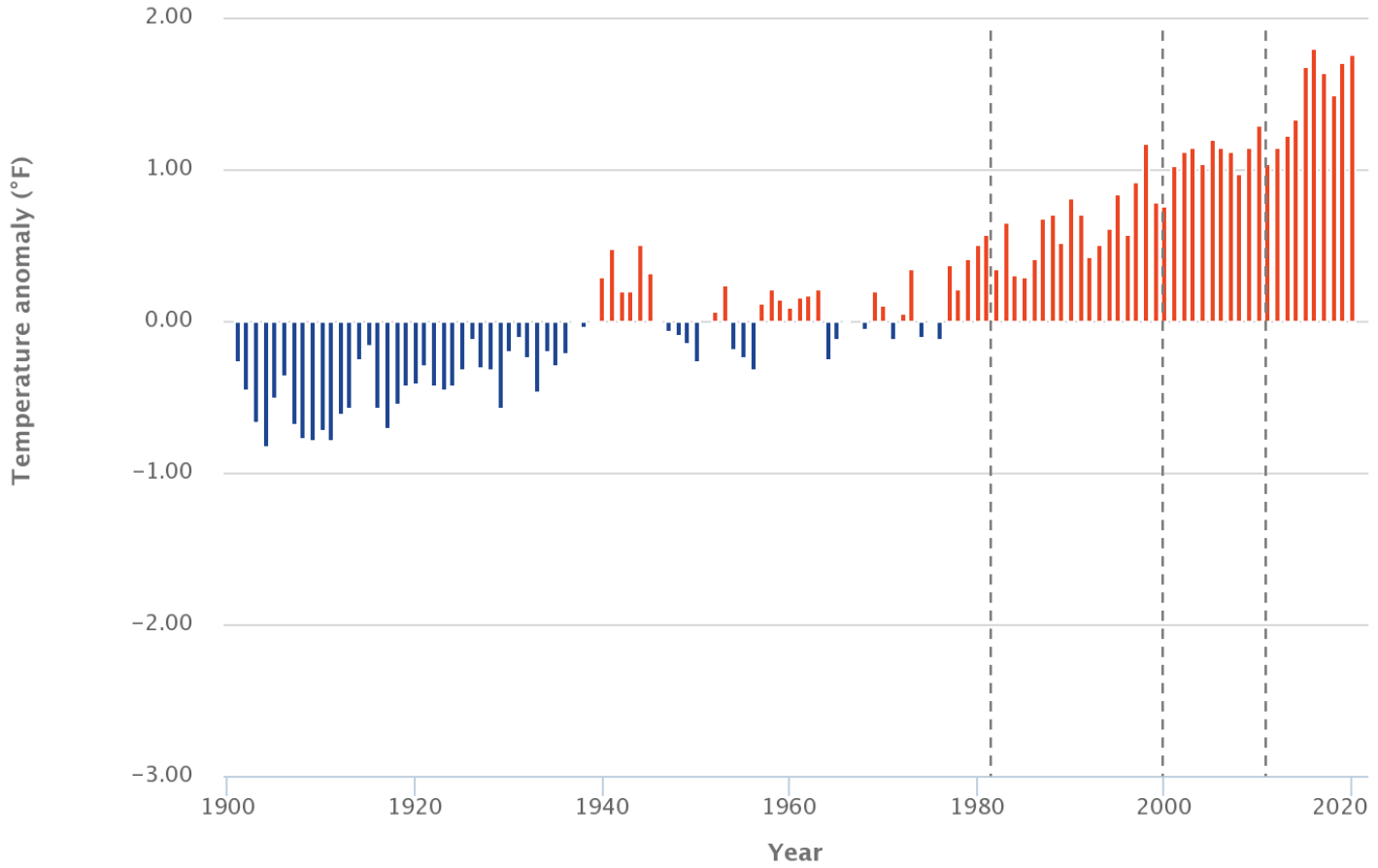
  - In 2020, ocean heat content reached the highest level ever in recorded history (impacting sea level, marine heat waves, and coral beaching)
  - Global average temperature in 2020 was among three warmest; 2011-2020 warmest decade in 141 years
  - 2020 Arctic Sea ice extent was the second smallest on record (since 1979)
  - Winter and northern regions experienced most change (areas of Alaska warmed more than 4 degrees F since 1925)
  - Changes in seasonality: The wildfire season, pollen season are starting earlier, lasting longer

Global Temperature

- 2020 was the second-warmest year on record
- 2011–2020 was the warmest decade on record

- Global average temperature has increased at an average rate of 0.13°F per decade since 1880; however, since 1981 the average rate of increase is 0.32°F -more than twice that rate (NOAA, 2021)

Global Temperature, 1901-2020



The combined land and ocean temperature with a 1901-2000 baseline

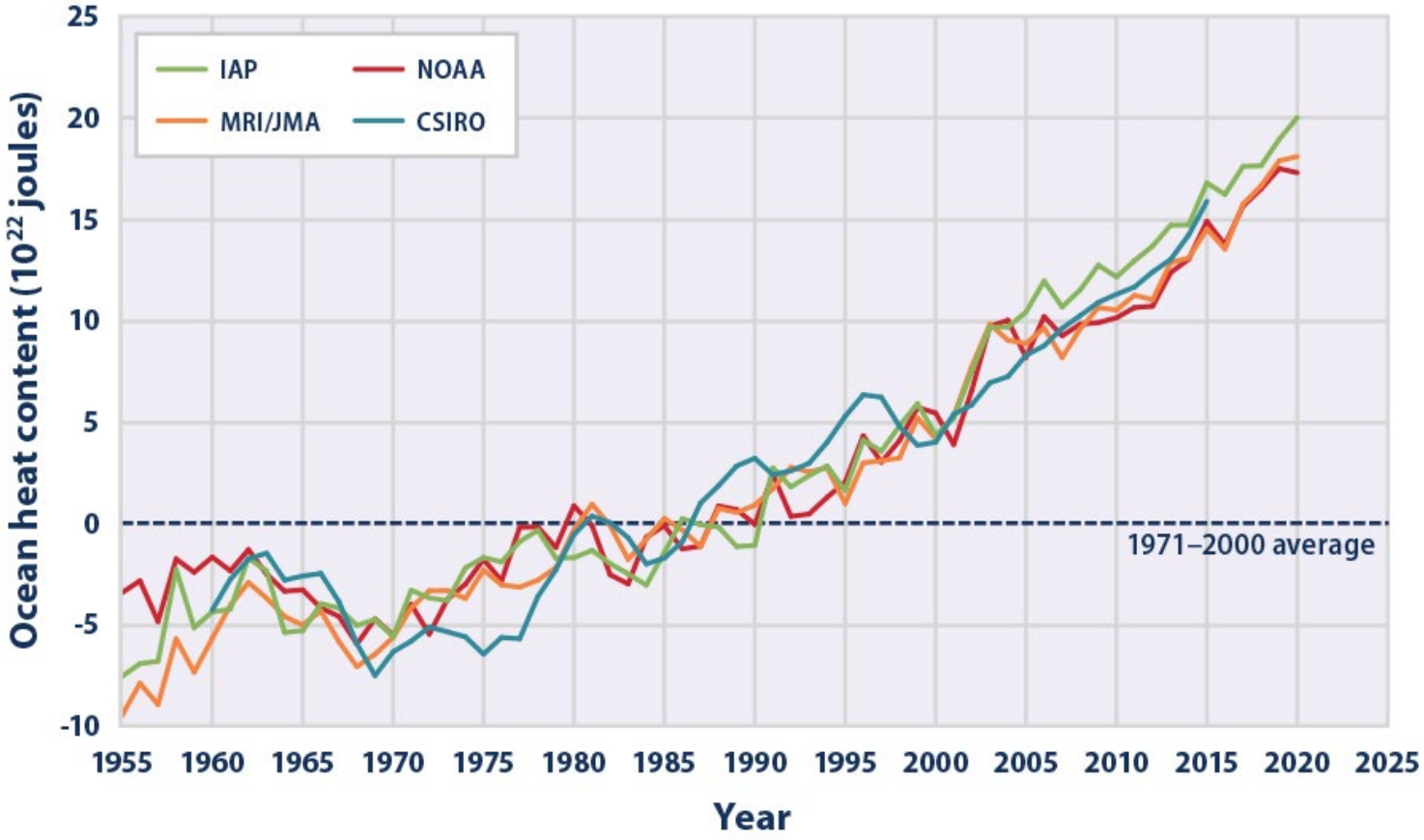
Data source: NOAA, 2021

Ocean Heat Content

- Four different data analyses show that the top 700 meters of the oceans have become warmer since 1955. Warming is occuring in the top 2000 meters as well

- All data sets agree that ocean warming rates show a **particularly strong increase in the past two decades** across all depths (2019 and 2020 both set records (World Meteorological Organization, 2021)

Ocean Heat Content, 1955-2020



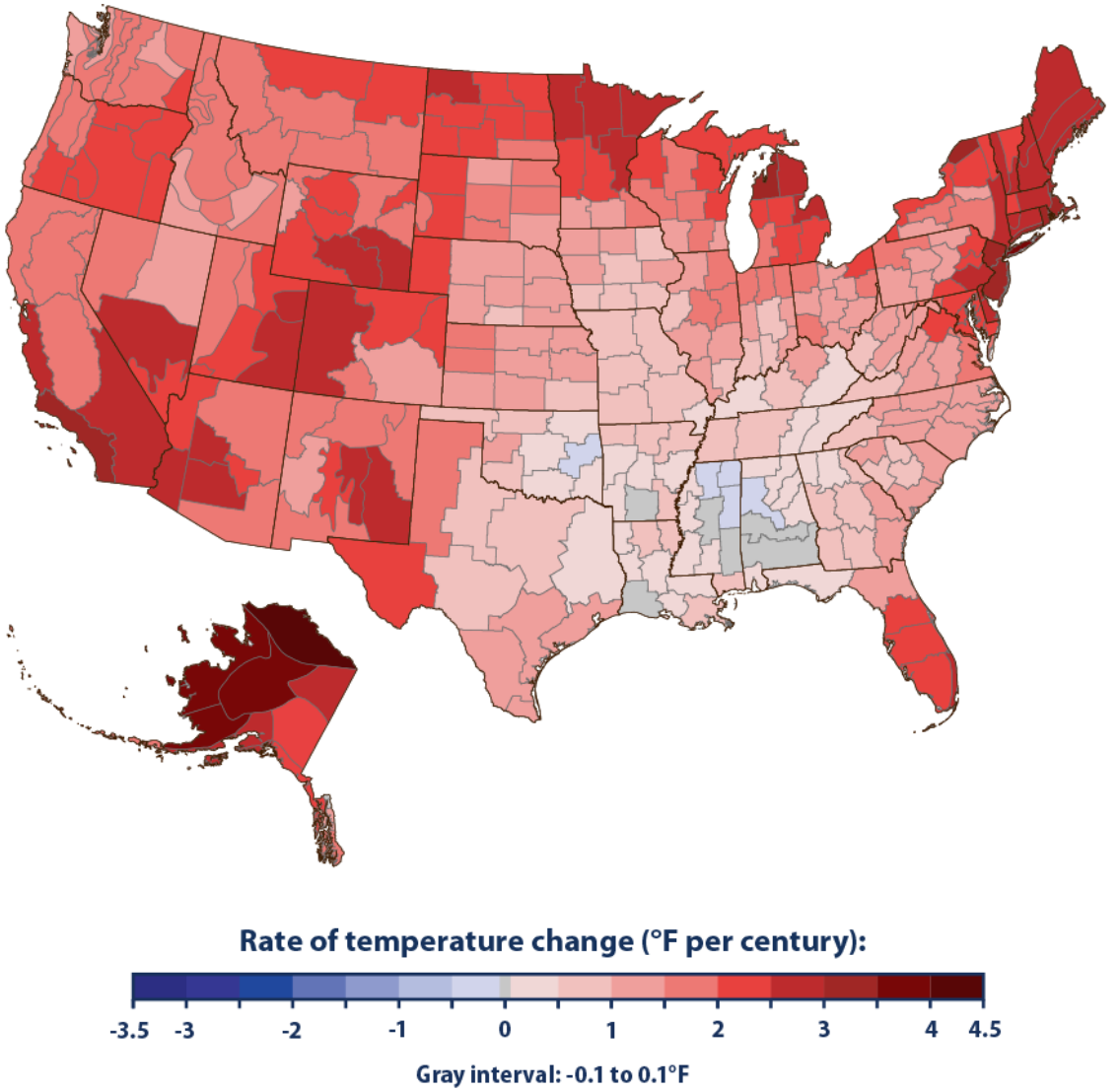
Ocean heat content in the top 700 meters compared against the 1971-2000 average

Data source: Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2016; Institute of Atmospheric Physics (IAP), 2021; Meteorological Research Institute/Japan Meteorological Agency (MRI/JMA), 2021; NOAA, 2021

U.S. Temperatures

- Since 1901, the average surface temperature across the contiguous 48 states has risen at an average rate of 0.16°F per decade and more quickly since the late 1970s (0.31 to 0.54°F per decade since 1979)
- Eight of the top 10 warmest years on record for the contiguous 48 states have occurred since 1998, and 2012 and 2016 were the two warmest years on record
- We also look at changes in seasonal temperatures, extreme temperature (hot and cold), and heat waves

Rate of Temperature Change in the U.S., 1901-2020

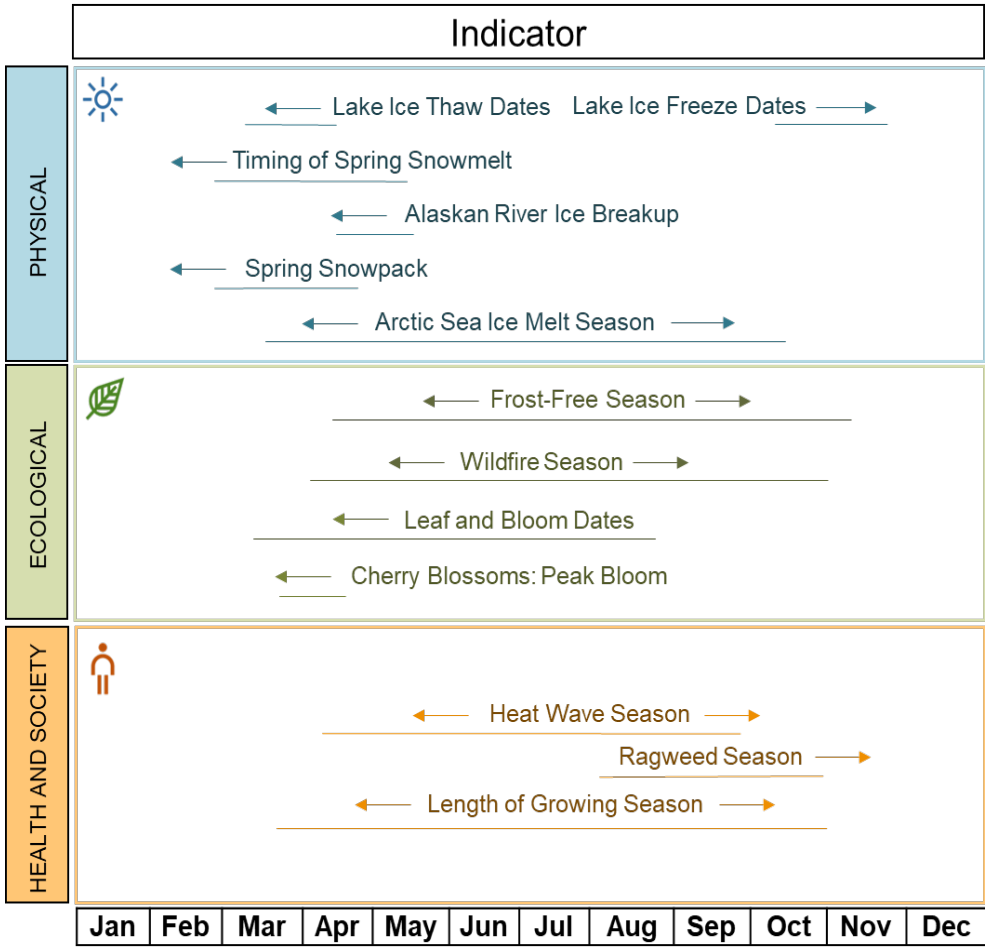


Data source: NOAA, 2021

Seasonal Changes and Climate: Observed evidence in the United States

- Seasonal changes in temperature and precipitation
- Early season warming and related impacts
- Biological responses and phenology
- Changes to seasonal conditions and extreme events

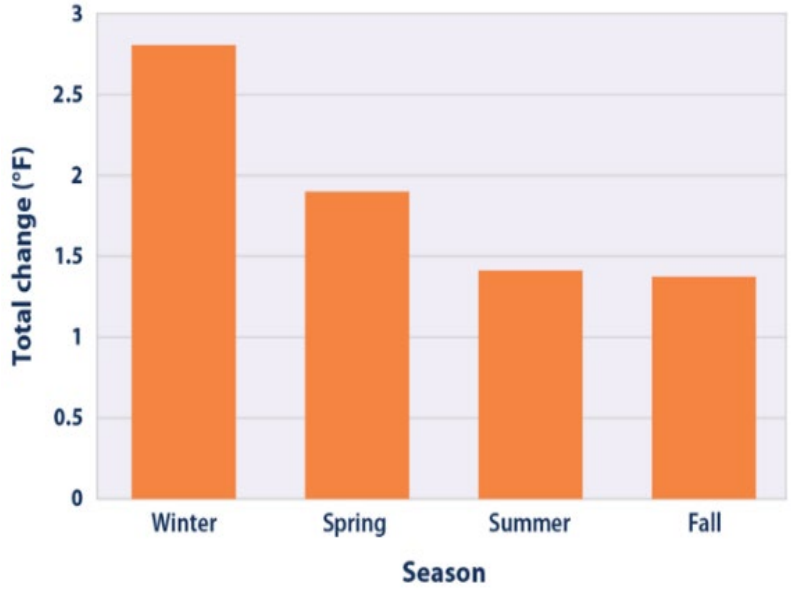
Key Evidence of Seasonality with a Timing Aspect



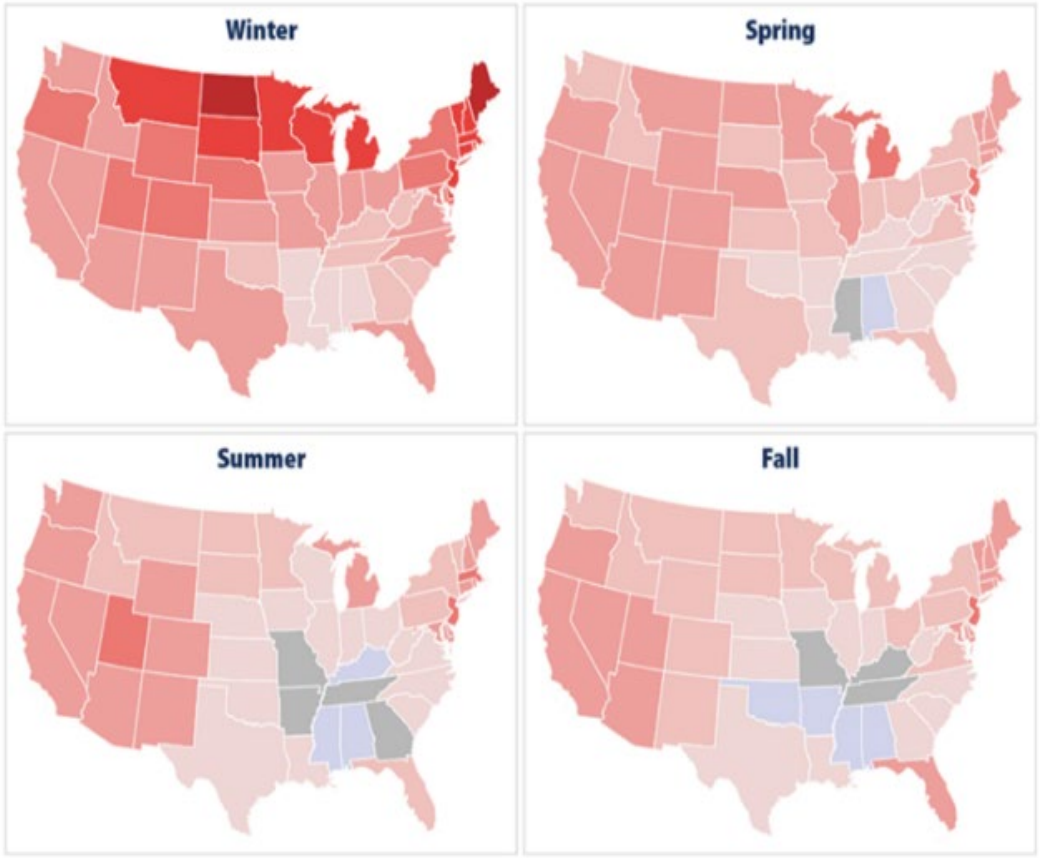
Seasonal Temperatures

- All seasons are warming
- Winter is warming the fastest

Change in Temperature by Season, 1896-2020

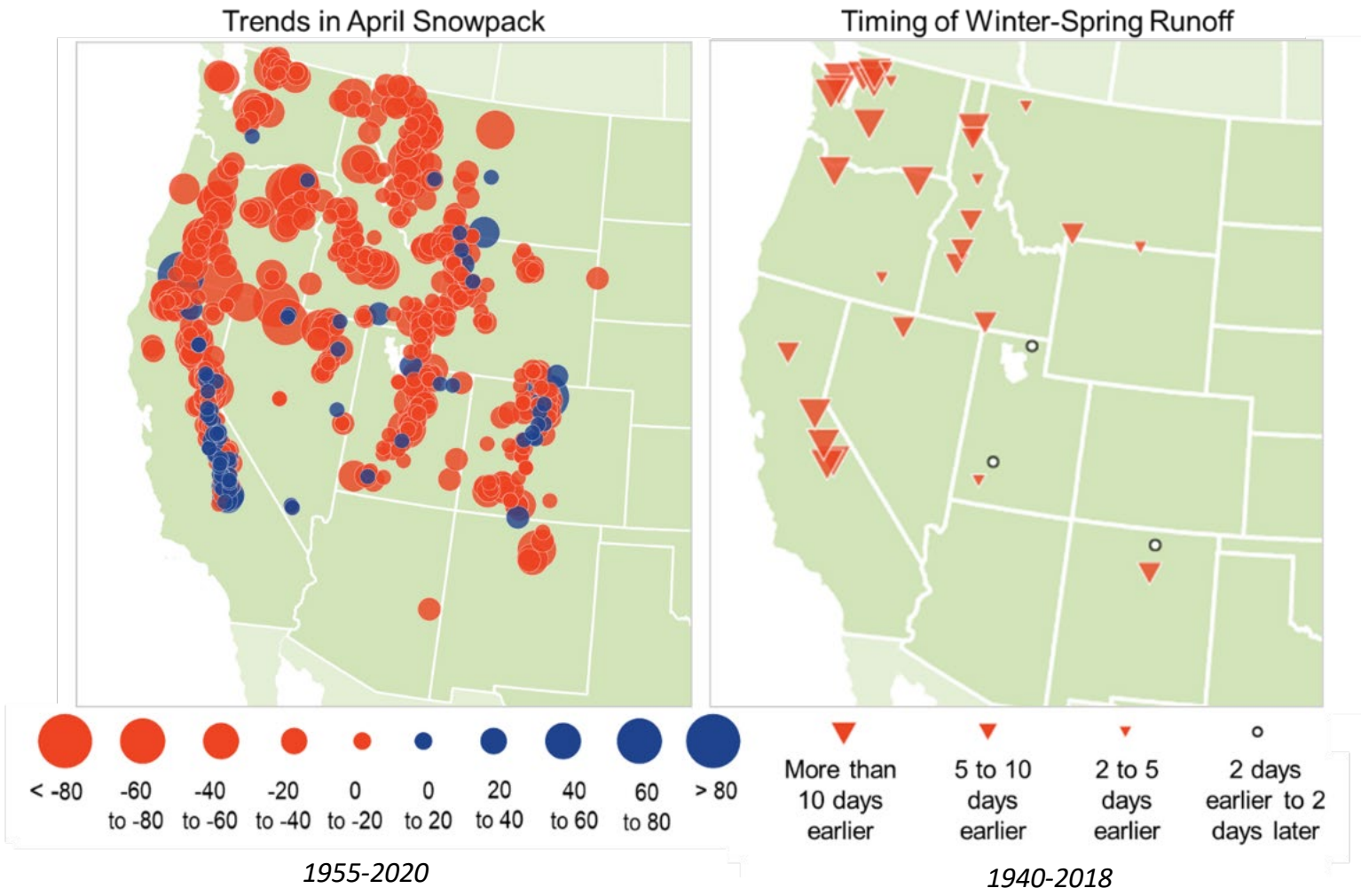


Change in Seasonal Temperatures by State, 1896-2020



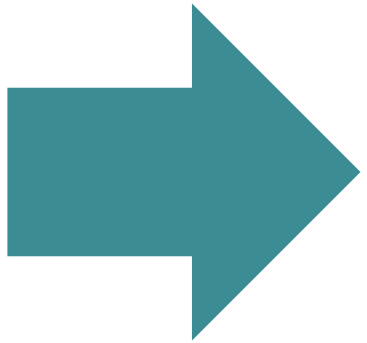
Changes in Seasonality: Winter-Spring Transition

- Declines in spring (April 1st) snowpack
- Most locations also experiencing an earlier 'peak' snowpack
- Trend toward earlier snowmelt runoff in streams
- Implications: impacts water supply and streamflow. Early season drying is associated with wildfire risk



In what application are you most likely to use climate change indicators? (select one)

- Setting context for decision making or planning
- Building support for decision making or planning
- Public outreach and education
- Informing decision making or planning
- Implementing actions or plans
- Evaluating actions or plans

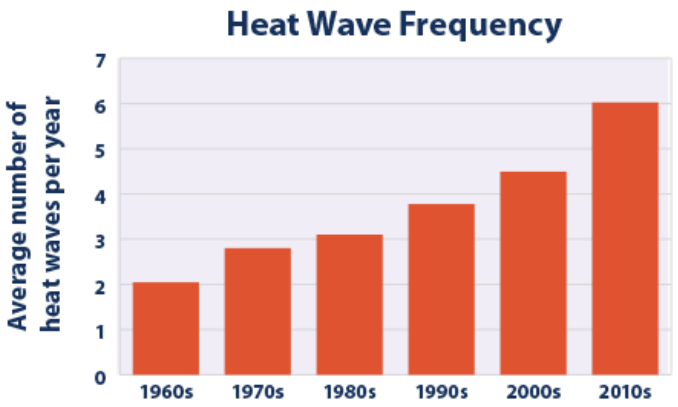


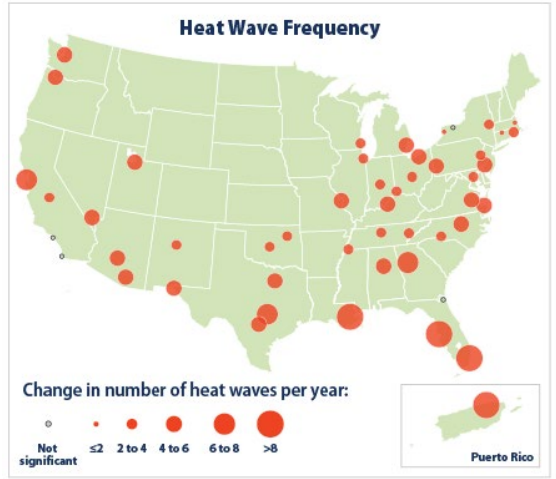
Poll 2

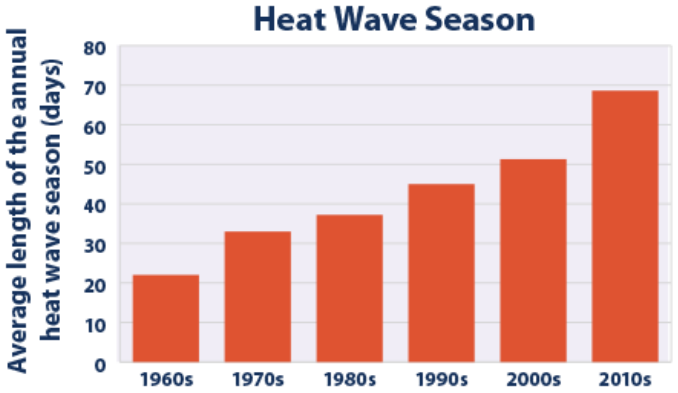
U.S. Heat Waves

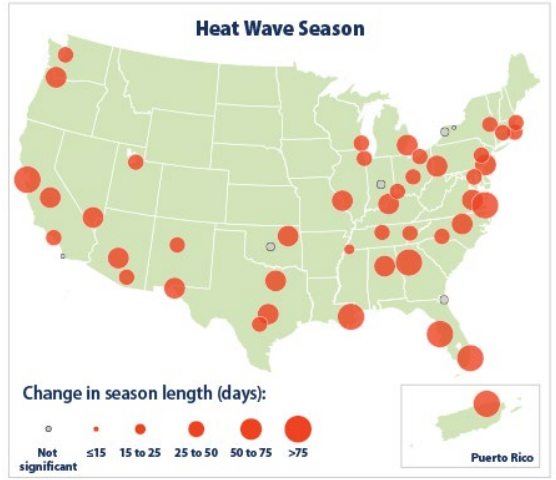
- Defined as: Two or more consecutive days in which the coolest temperature (adjusted for humidity) at night is warmer than that of 85 percent of July and August nights averaged over a 30-year period
- Heat waves are occurring three times more often than they did in the 1960s—about six per year compared to two per year. The average season length is 47 days longer
- Hot summer days and nights are also increasing across the U.S. (twice the rate of summer days in the United States)

Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2019







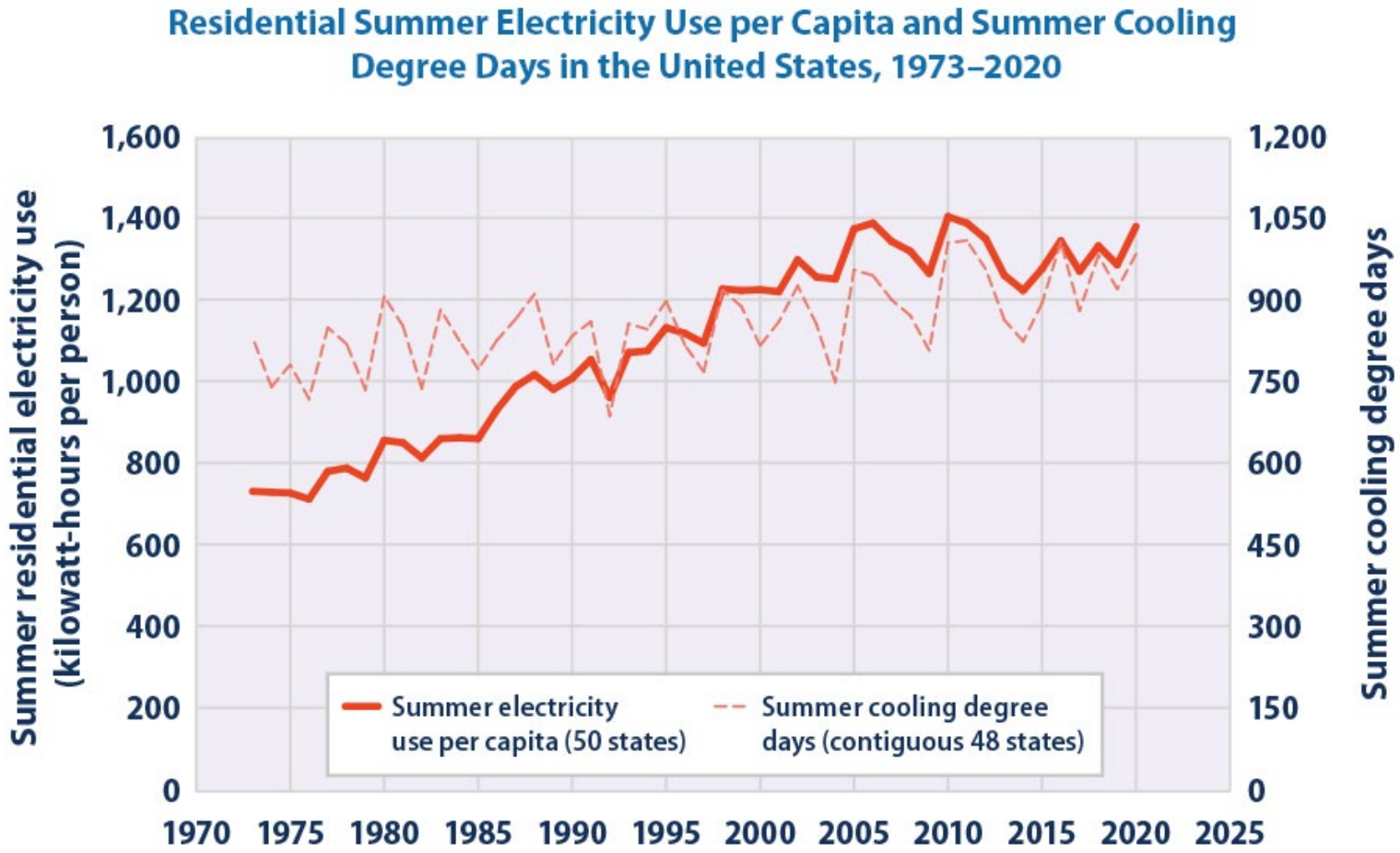


The maps show changes in the number of heat waves per year (frequency) and the number of days between the first and last heat wave of the year (season length). The graphs show averages across all 50 metropolitan areas by decade.

Data Source: NOAA, 2020

U.S. Residential Energy Use

- The amount of electricity used by the average American at home during the summer has nearly doubled since 1973, but it appears to have leveled somewhat in recent years
- Outdoor temperatures are not the only factor that influence energy use. Distribution of the population, energy efficiency, utility rates, and other factors



This graph shows the amount of electricity used by the average American during the summer months. The solid line shows average summer electricity use per capita, and it represents all 50 states plus D.C. For reference, the dashed line shows the average number of cooling degree days for the same months across the contiguous 48 states plus D.C.

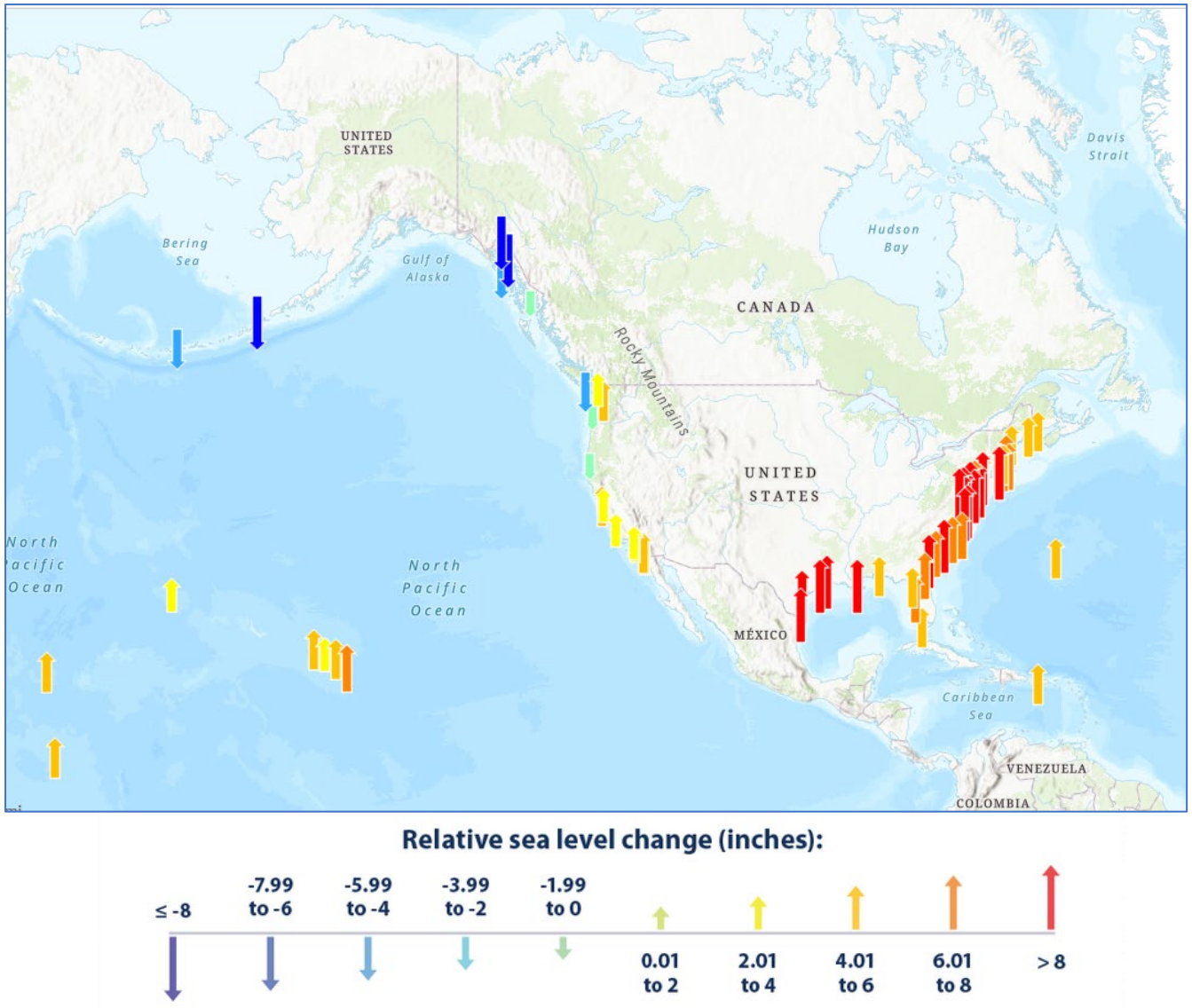
Data source: Energy Information Administration, NOAA, Bureau of Economic Analysis, 2021

U.S. Sea Level

- Rising sea levels are linked to climate change through two main mechanisms: changes in the volume of ice on land (shrinking glaciers and ice sheets) and thermal expansion of the ocean as it absorbs more heat from the atmosphere
- Relative sea level (RSL) rose along much of the U.S. coastline, particularly the Mid-Atlantic coast and parts of the Gulf coast. RSL fell at some locations in Alaska and the Pacific Northwest. There, while absolute sea level has risen, land elevation has risen more rapidly
- Globally, since 1993, average sea level has risen at a rate of 0.12 to 0.14 inches per year—roughly twice as fast as the long-term trend

This map shows cumulative changes in relative sea level from 1960 to 2020 at tide gauge stations along U.S. coasts.

Relative Sea Level Change Along U.S. Coasts, 1960-2020

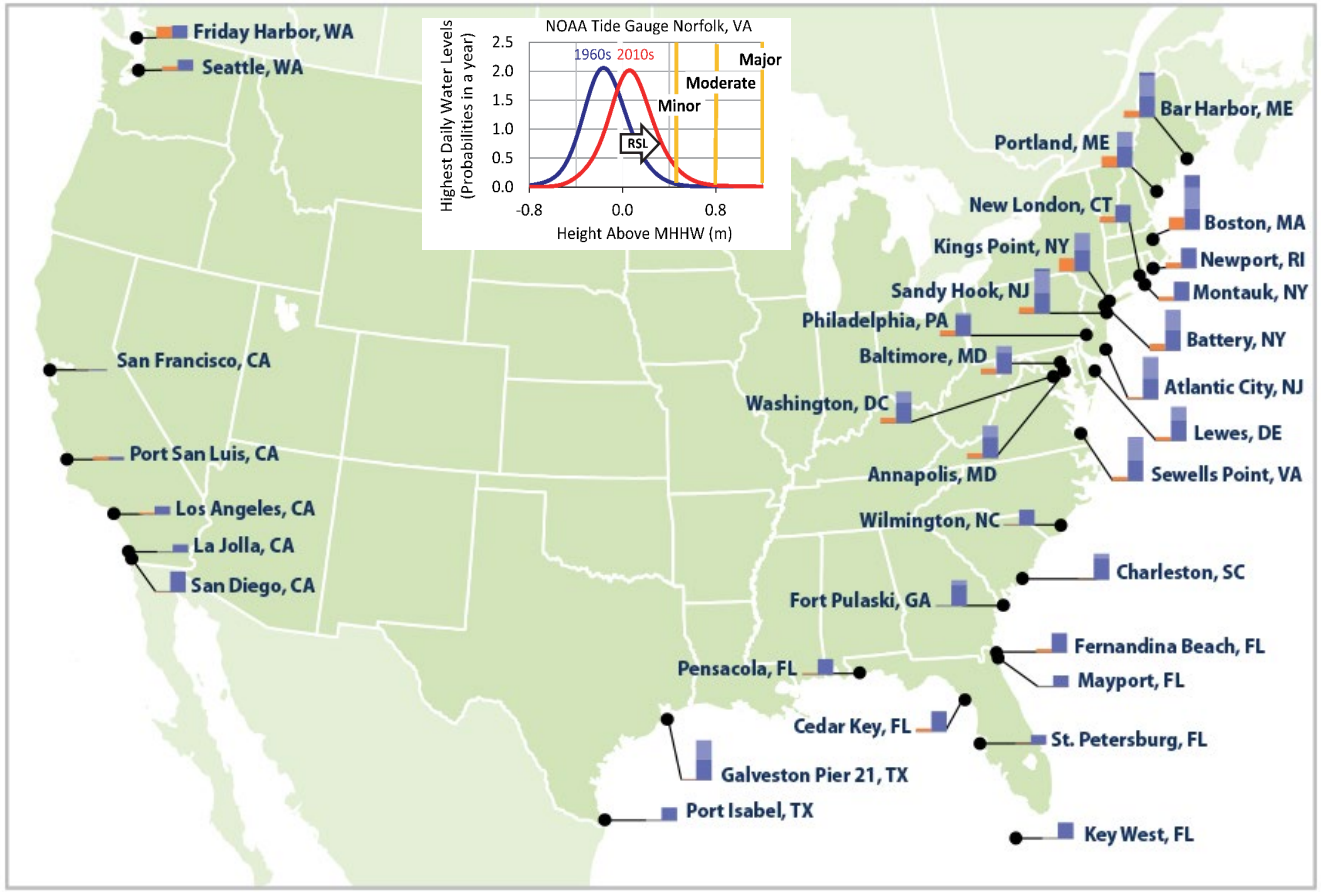


Data Source: NOAA, 2021

Coastal Flooding

- Relevance: As relative sea level rises one noticeable consequence is an increase in coastal flooding. Rising sea level increases the reach of tides and storm surge
- Flooding is becoming more frequent along the U.S. coastline. Every site measured has experienced an increase in coastal flooding since the 1950s. The rate of increase is accelerating at most locations along the East and Gulf Coasts
- The East Coast suffers the most frequent coastal flooding and has generally experienced the largest increases in the number of flood days. At several locations, floods are now at least five times more common than they were in the 1950s

Frequency of Flooding Along U.S Coasts, 2011-2020 Versus 1950-1959



This map shows the average number of days per year in which coastal waters rose above a local threshold for flooding at 33 sites along U.S. coasts.

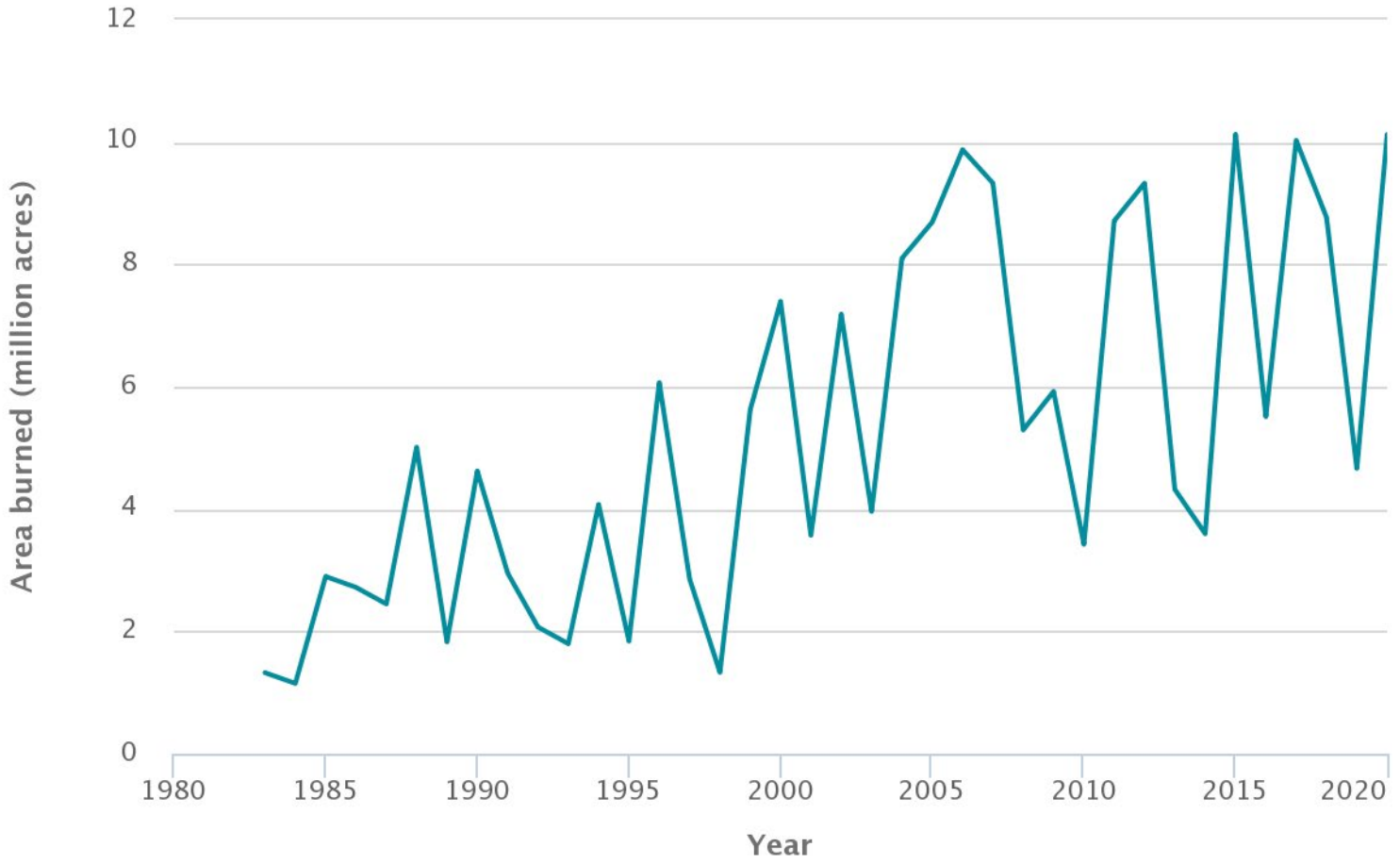
Data Source: NOAA, 2021

U.S. Wildfires

- Relevance: The timing, extent and severity of wildfire in western US forests is strongly influenced by climate particularly temperature and drought: over seasonal to decadal time scales. Earlier spring melting and reduced snowpack are also factors

- The extent of area burned by wildfires each year appears to have increased since the 1980s. According to National Interagency Fire Center data, of the 10 years with the largest acreage burned, all have occurred since 2004, including the peak year in 2015. This period coincides with many of the warmest years on record nationwide

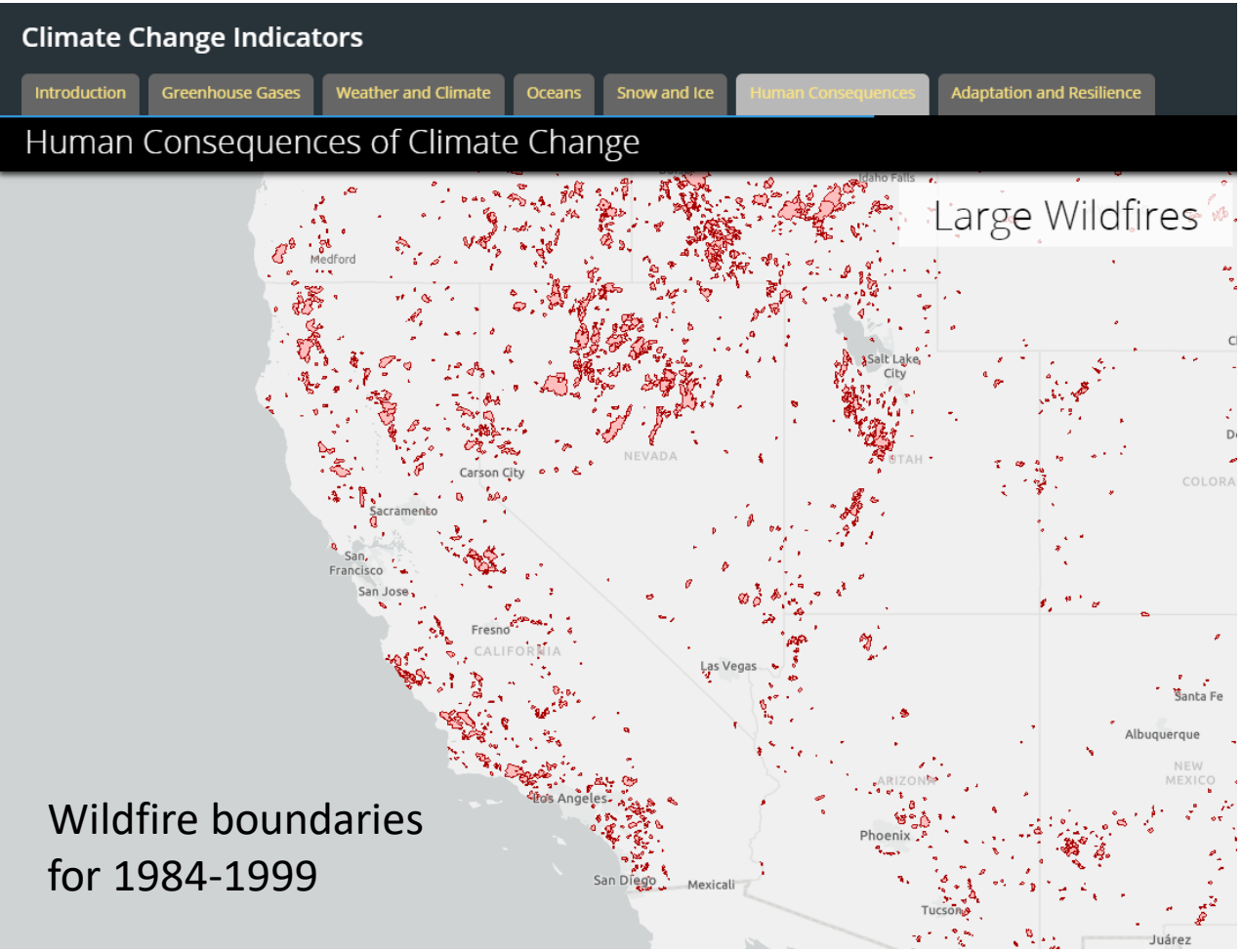
Wildfire Extent in the United States, 1983-2020



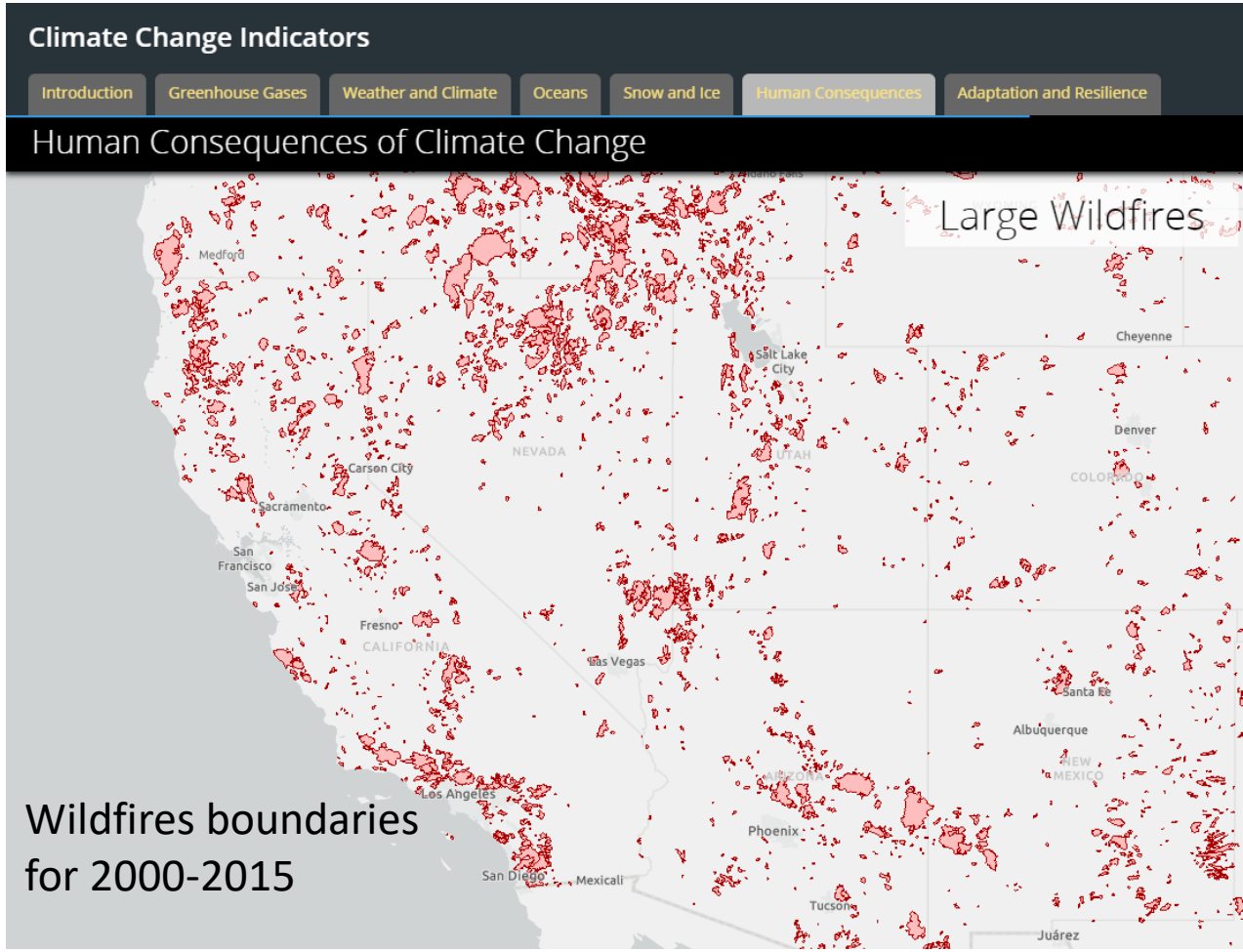
Data Source: National Fire Information Council, United States Forest Service

Wildfire Extent (area burned)

Wildfires from 2000-2015 more than doubled in area burned, compared with the 1984-1999 fires



Wildfire boundaries for 1984-1999



Wildfires boundaries for 2000-2015

List of all Indicators

Red = new since 2016
Year = data currency

Greenhouse Gases

- ❑U.S. Greenhouse Gas Emissions (2018)
- ❑Global Greenhouse Gas Emissions (2015, 2018)
- ❑Atmospheric Concentrations of GHGs (2018, 2019)
- ❑Climate Forcing (2019)

Weather and Climate

- ❑U.S. and Global Temperature (2020)
- ❑High and Low Temperatures (2009, 2020)
- ❑**Heat Waves in U.S. Cities (2019)**
- ❑**Seasonal Temperatures (2020)**
- ❑U.S. and Global Precipitation (2020)
- ❑Heavy Precipitation (2020)
- ❑River Flooding (2015)
- ❑ Drought (2020)
  - ❑**SP-Evapotranspiration Index (2020)**
- ❑Tropical Cyclone Activity (2019, 2020)

Oceans

- ❑Ocean Heat (2020)
- ❑Sea Surface Temperature (2020)
- ❑Sea Level (2020)
- ❑Coastal Flooding (2020)
- ❑Ocean Acidity (2015, 2018)

Health and Society

- ❑ Heating and Cooling Degree Days (2020)
- ❑ Heat-Related Deaths (2018)
- ❑ **Cold-Related Deaths (2016)**
- ❑ Heat-Related Illnesses (2010)
- ❑ Lyme Disease (2018)
- ❑ West Nile Virus (2019)
- ❑ **Residential Energy Use (2020)**
- ❑ Length of Growing Season (2020)
- ❑ Ragweed Pollen Season (2015)
- ❑ **Growing Degree Days (2020)**

Snow and Ice

- ❑Arctic Sea Ice (2019, 2020)
- ❑Antarctic Sea Ice (2018)
- ❑**Ice Sheets (2018-2019)**
- ❑Glaciers (2019)
- ❑**Permafrost (2019)**
- ❑Lake Ice (2019)
- ❑Snowfall (2007, 2020)
- ❑**Freeze - Thaw Conditions (2019)**
- ❑Snow Cover (2013, 2020)
- ❑Snowpack (2020)
  - ❑**Peak Snowpack (2020)**

Ecosystems

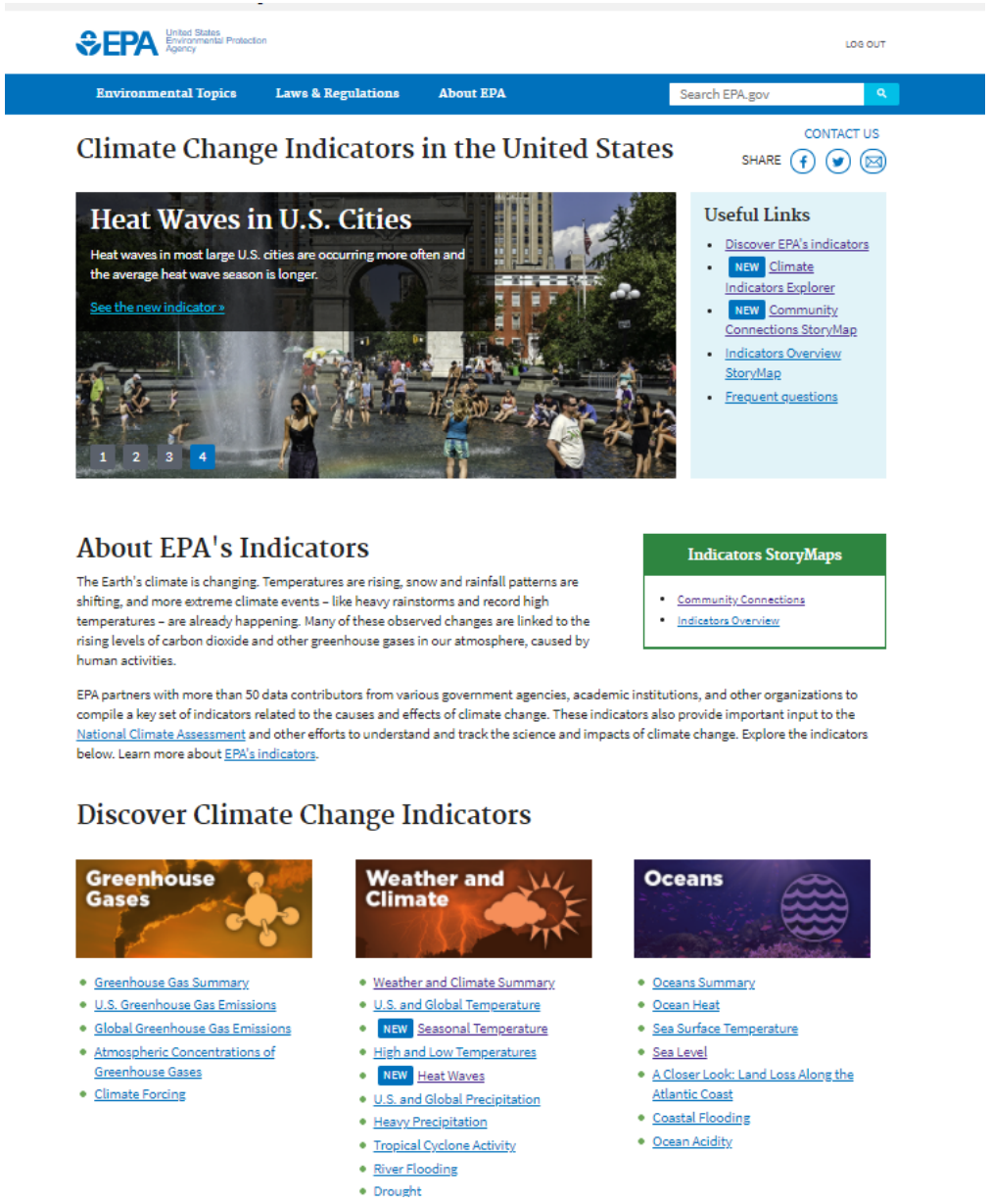
- ❑ Wildfires (2018-2020)
  - ❑ **Wildfire Season (2017)**
- ❑ Streamflow (2018)
- ❑ Stream Temperature (2014)
- ❑ Great Lakes Water Levels (2020)
- ❑ **Great Lakes Ice Cover (2019)**
- ❑ **Lake Temperature (2009)**
- ❑ Bird Wintering Ranges (2013)
- ❑ Marine Species Distribution (2018, 2019)
- ❑ Leaf and Bloom Dates (2020)

Features

- ❑*Community Connection: Ice Breakup in **Three** Alaskan Rivers (2020)*
- ❑*Community Connection: Cherry Blossom Bloom Dates in Washington, D.C (2020)*
- ❑*A Closer Look: Land Loss Along the Atlantic Coast (2011)*
- ❑*A Closer Look: Temperature and Drought in the Southwest (2019)*
- ❑***A Closer Look: Glaciers in Glacier National Park (2015)***
- ❑***A Closer Look: Black Guillemots of Cooper Island (2018)***
- ❑*Tribal Connection: Water Temperature in the Snake River (2020)*

What's Available?

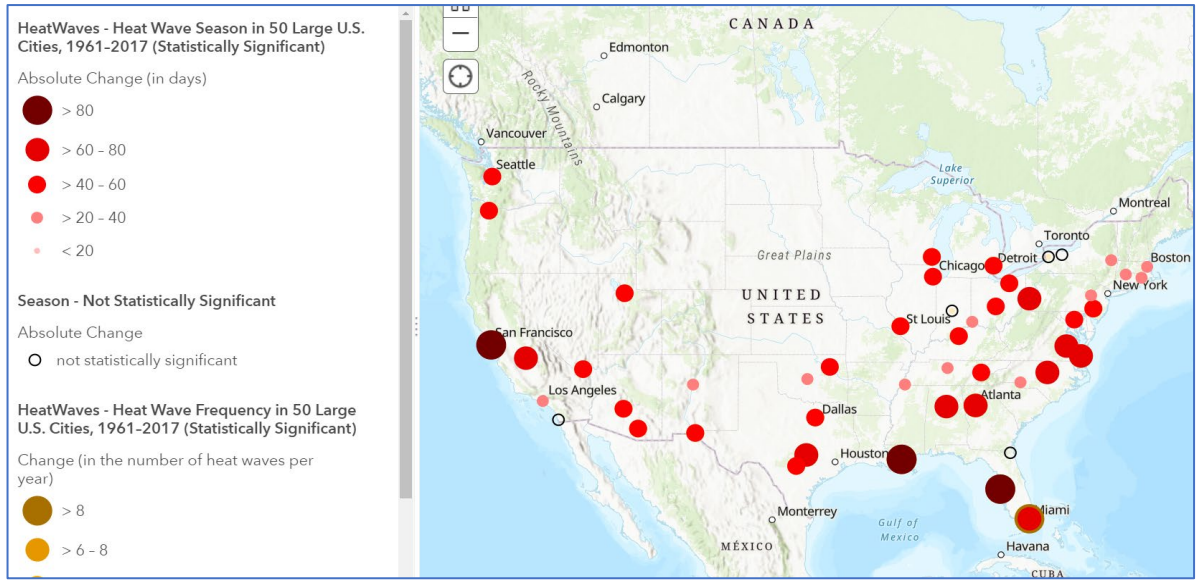
- Several new indicators (based on new science, data, and work with partners)
- More years of data for nearly all indicators (most through 2020)
- Technical documentation
- Interactive tools
- Downloadable figures, images, and data for all indicators



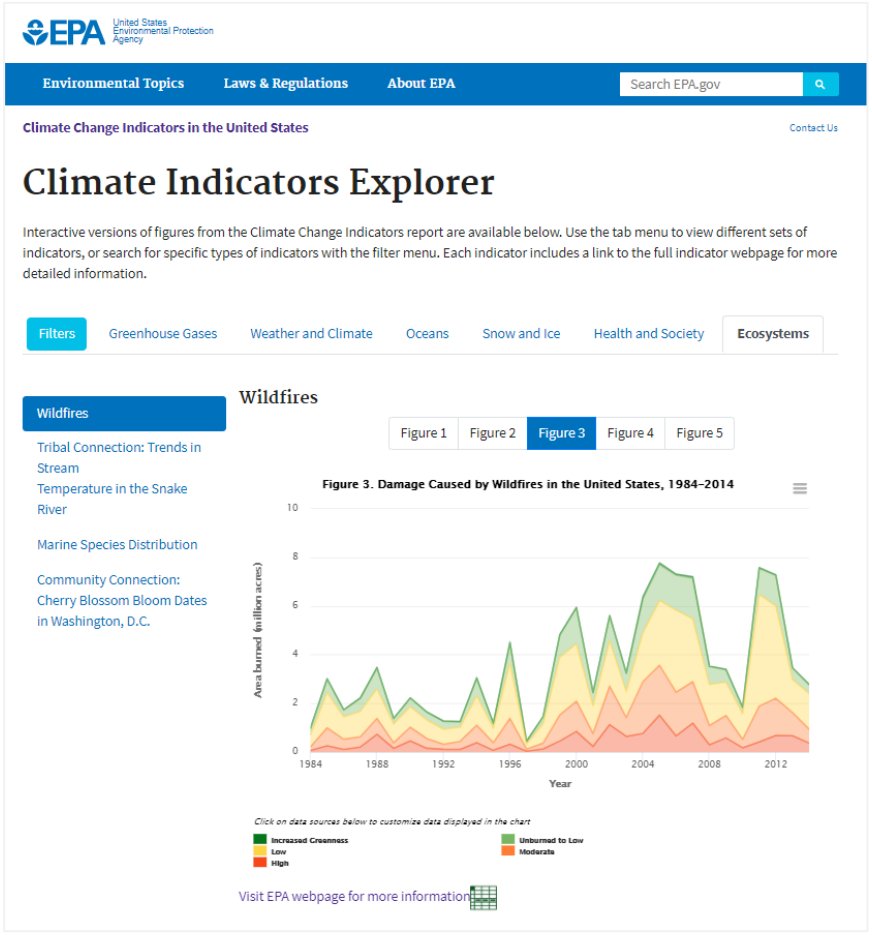
Ways to Explore, Share and Use the Indicators

- On-line Mapping - use in web tools, Story Maps, geographic information system-based platforms (e.g., EJSCREEN), and analysis
- New data visualization with the Climate Indicators Explorer tool

On-line Mapping



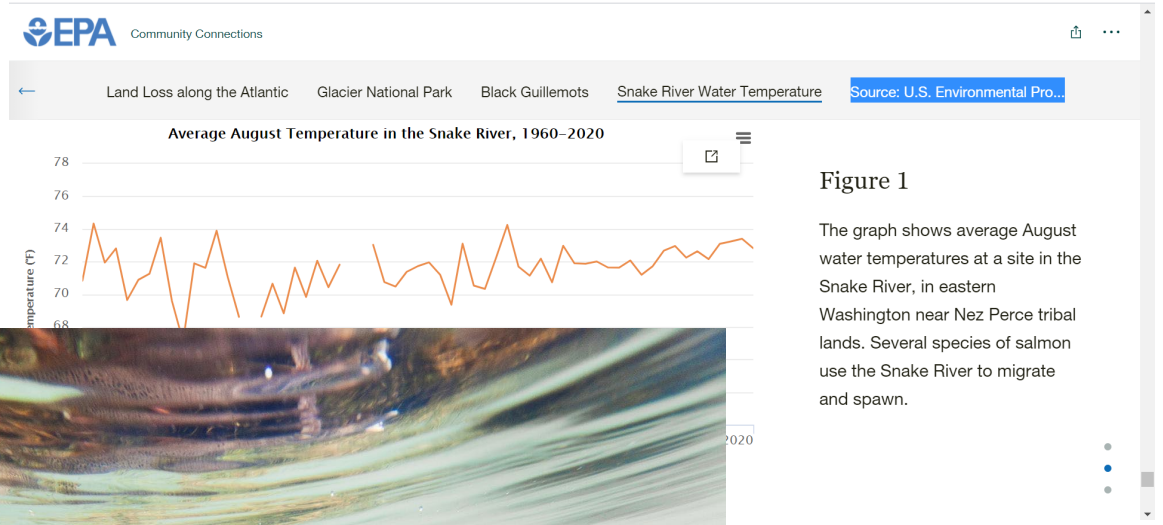
Visualization tool

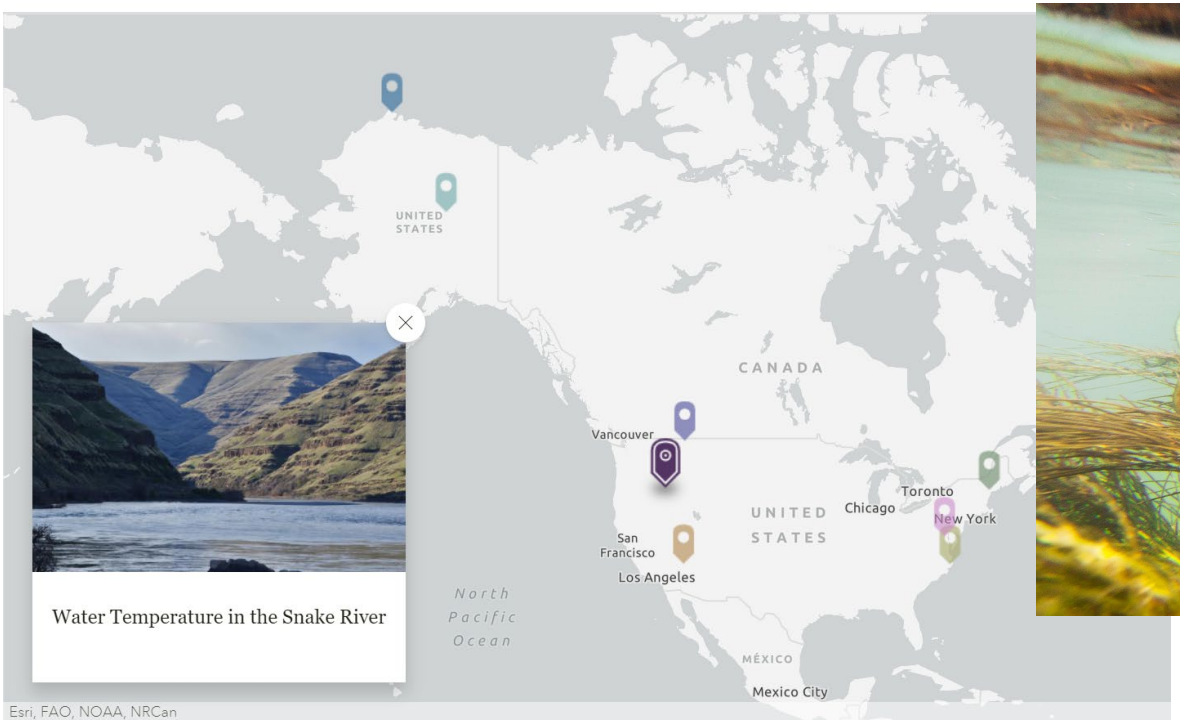


Ways to Explore, Share and Use the Indicators

Interactive Story Maps: [Community Connections]

Tour various regions and communities for a closer look at climate-related changes





Examples of Regional Observations

Leaf and Bloom Dates	Earlier leaf and bloom dates at a majority of sites, with some shifting earlier by more than a week (1951-1960 vs. 2011-2020)
West Nile Virus	Between 1 and 4 cases per 100,000 per year (2002-2019) [avg number of cases for region is 2.5]

Growing Season	9-20 days longer (1895-2020) [+14 days regional average]
Seasonal Temperature	Winter months have warmed by more than 3°F (1896-2020)

Permafrost Temperatures	Permafrost temperatures are warming, particularly in northern Alaska (1978-2020)

Snowpack	97% of long-term measurement sites show a decline in spring snowpack (1955-2020)
Sea Surface Temperature	1.5-2.0°F warmer ocean waters off the coast of the Pacific Northwest (1901-2020)

Marine Fisheries	Key species have shifted northward—e.g., lobster has shifted 99 miles (1973-2019)
Lyme Disease	Increase in incidence (cases per 100,000) in ME, NH, VT (1991-2018)

Sea Level	Has risen 7-11 inches since 1960 for sites in the Mid-Atlantic

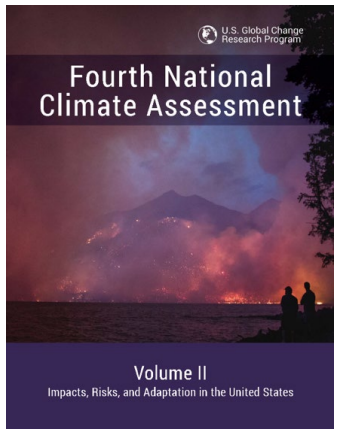
Drought	Persistent periods of high severity drought in the last two decades.
Temperature	Temperature in the region has warmed by 2.6°F, with some areas up to 4.1°F warmer (1901-2020)

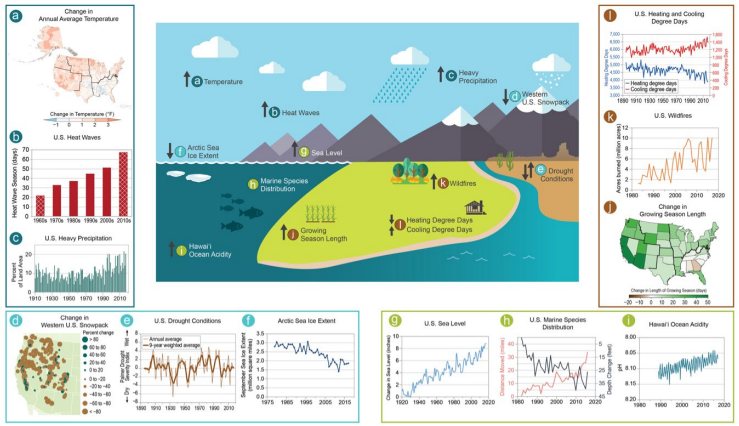
Heat Waves	Heat waves are becoming more frequent and the season length is increasing in many large cities in the region (1961-2019)
Coastal Flooding	Flooding is more frequent along the Southeast Atlantic and Gulf coasts, and the rate is accelerating (2011-2020 vs. 1950-1959)

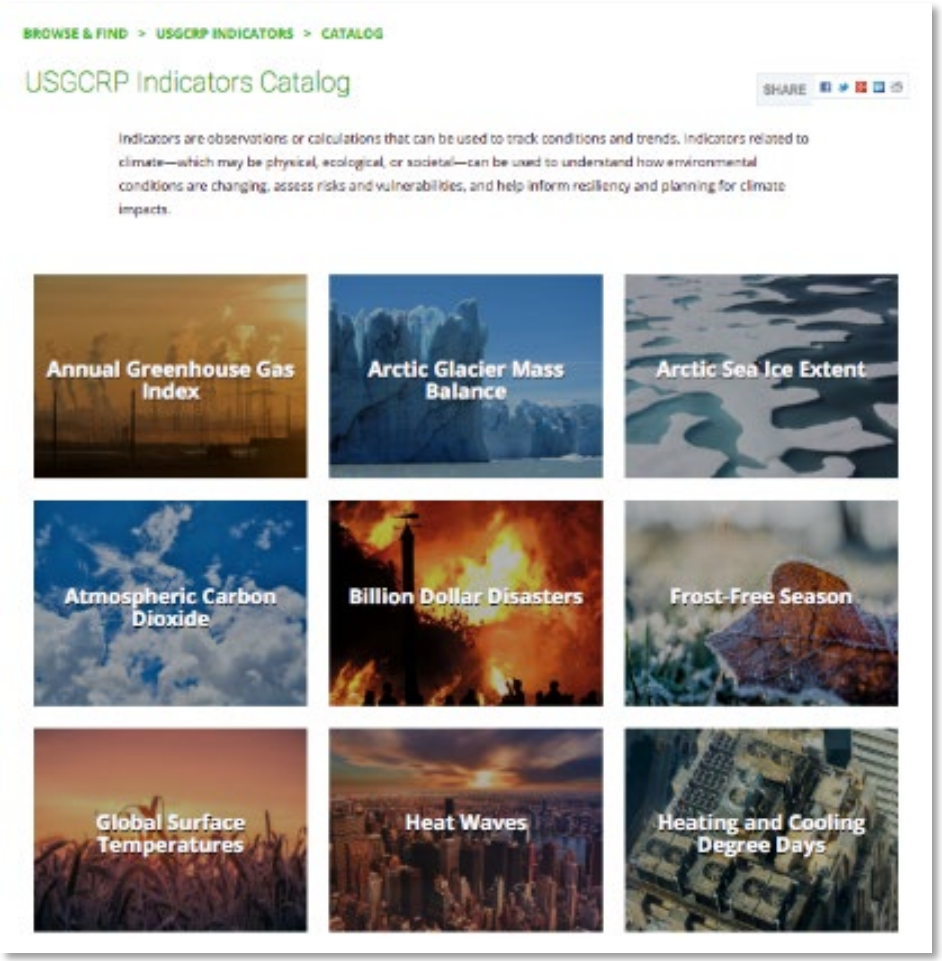
Growing Season	Has risen 10-16 inches along the TX coast (1960-2020)
Wildfires	Average annual burned acreage was more than six times higher in 2002-2018 than in 1984-2001.

USGCRP Indicators and Interagency Workgroup

- Provides science in support of the National Climate Assessment (NCA). NCA5 will include a chapter on indicators (due 2023)
- Showcase of Federal agency-specific indicator efforts, research and development
- A platform website for updated, well-documented science







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Thank You for Attending!

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Question and Answer Session

Maggie Molina
Molina.Maggie@epa.gov

Mike Kolian
kolian.michael@epa.gov

Lisa Bacanskas
Bacanskas.Lisa@epa.gov

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