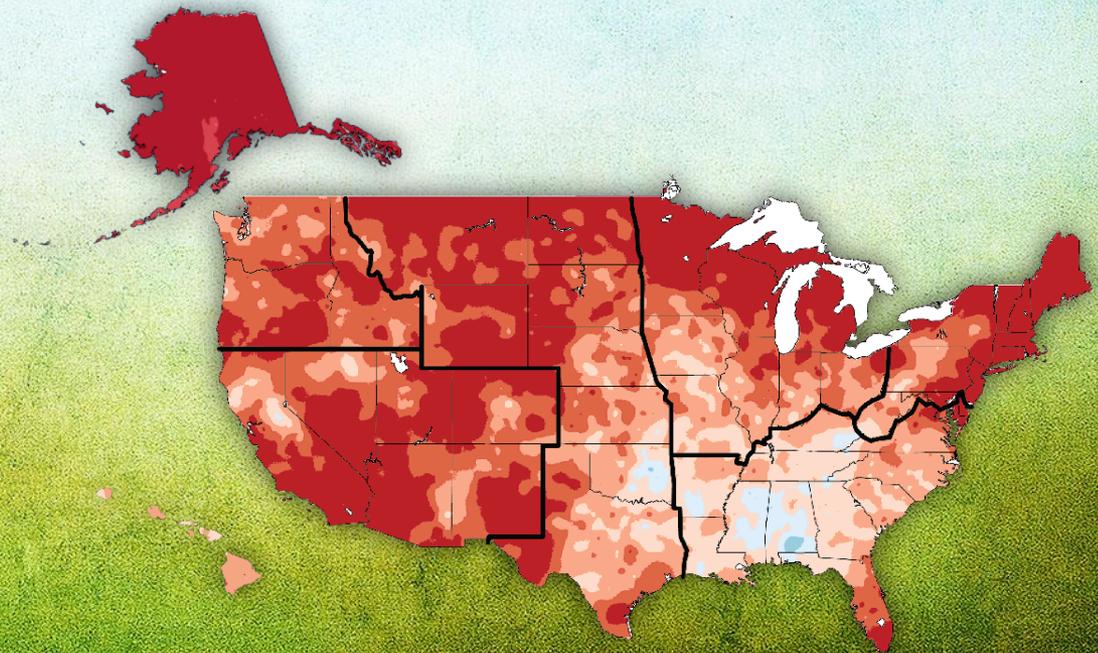


# Third National Climate Assessment

## Climate Change Impacts in the United States

- Assessment Process -

Charles W. Downer  
South Florida  
Hydrologic Society  
May 21, 2014



# US Global Change Research Program



Global Change Research Act (1990):

“To provide for development and coordination of a comprehensive and integrated United States research program which will assist the Nation and the world to **understand, assess, predict, and respond** to human-induced and natural processes of global change.”



United States  
Global Change  
Research Program

13 Federal Departments & Agencies +  
Executive Office of the President

More information at  
<http://www.globalchange.gov>



U.S. Global Change Research Program  
**National Climate  
Assessment**

# National Climate Assessment: GCRA (1990), Section 106

...not less frequently than every 4 years, the Council... shall prepare... an assessment which –

- integrates, evaluates, and interprets the findings of the Program (USGCRP) and discusses the scientific uncertainties associated with such findings;
- analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and
- analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.

# The Third National Climate Assessment



## Goal

- Enhance the ability of the United States to **anticipate, mitigate, and adapt** to changes in the global environment.

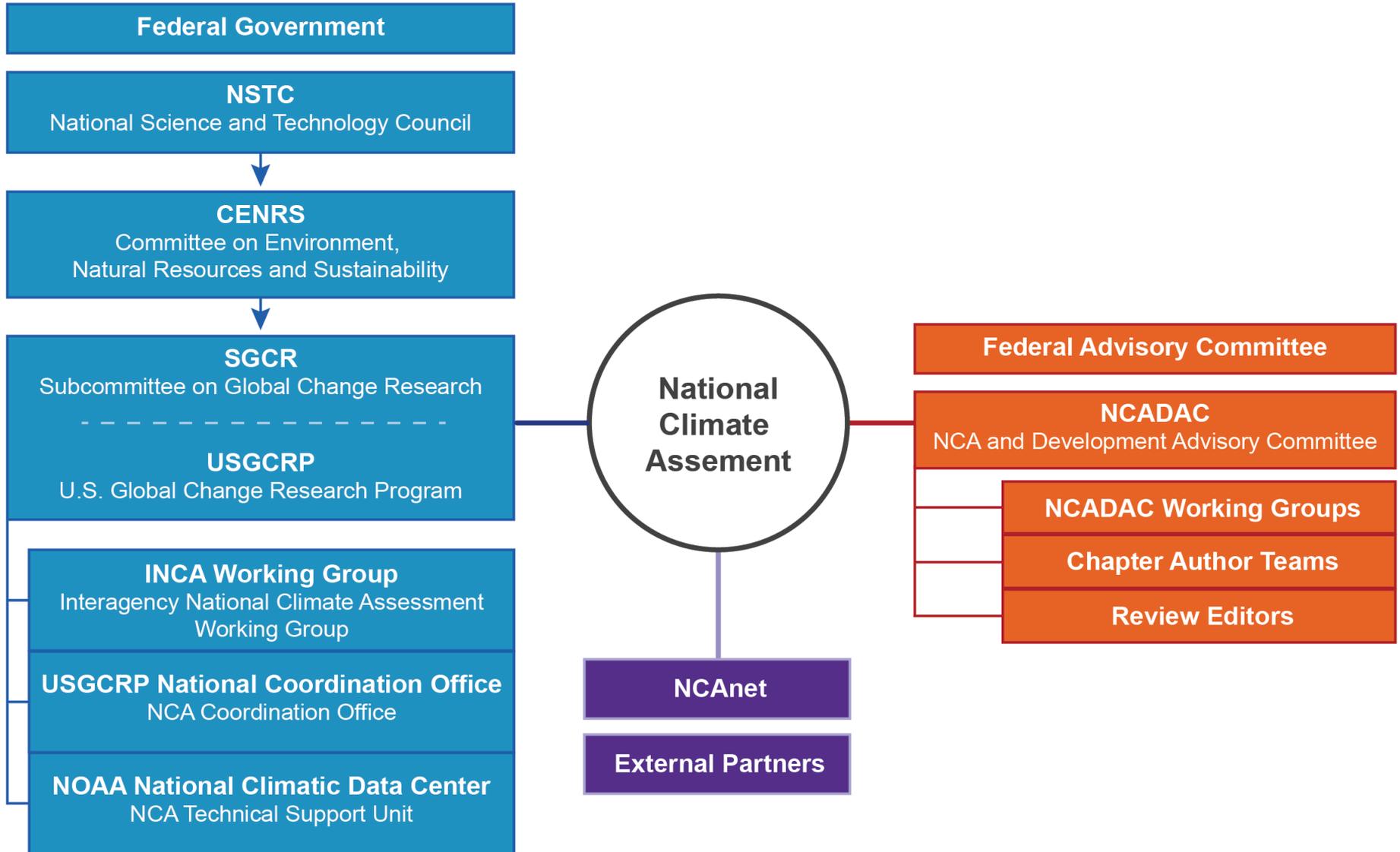
## Vision

- Advance an **inclusive, broad-based, and sustained process** for assessing and communicating scientific knowledge of the impacts, risks, and vulnerabilities associated with a changing global climate in support of decision-making across the United States.



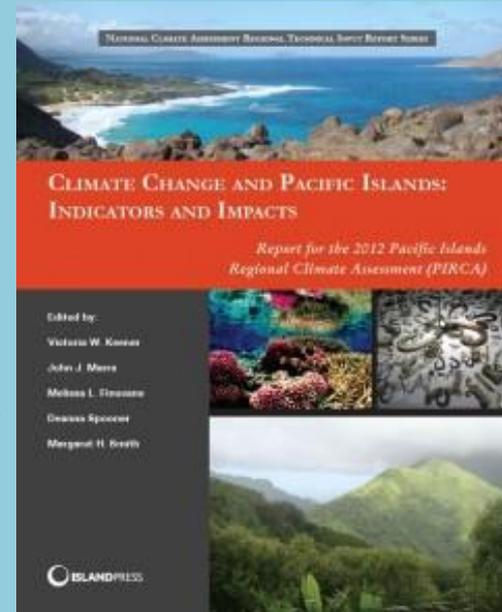


# NCA Structure



# Public and Technical Inputs to NCA

- Workshops, listening sessions, and symposia
- First “request for information”: 250+ technical inputs from 100+ individuals and teams, including:
  - New regional climate histories and projections for each region
  - New sea level rise scenarios
  - **In-depth foundational assessments** for each region and most sectors
- Public comments on draft report January 14 – April 12, 2013



Island Press published revised versions of most of the regional technical inputs:

<http://www.cakex.org/NCAreports>

Federal agency-sponsored technical input reports are available at: [www.globalchange.gov](http://www.globalchange.gov)

Regional climatologies, projections, and scenarios: <http://scenarios.globalchange.gov>

# NCA Authors

- More than 300 authors were involved in writing the 3<sup>rd</sup> NCA
- Selected base on expertise in many knowledge areas
  - Climate science
  - Hydrology
  - Water resources
  - Water quality
  - Agriculture
  - Ecology
  - Biology
  - Public Health
  - Energy
  - Transportation
  - Economics
- Funded by individual agencies/organizations
- Chapter Lead Authors use the Technical Input, and their collective expertise, to develop the chapter narrative and shepherd it through the review process.



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# Third NCA Report Process

## Third National Climate Assessment Report Process

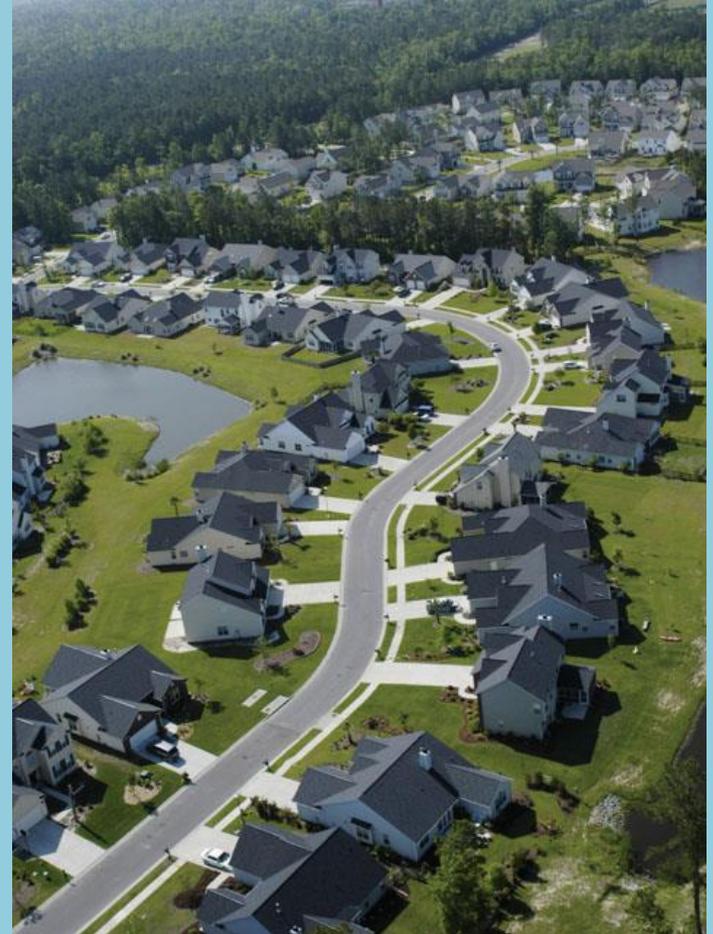


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# Outline for Third NCA Report

- Climate Change and the American People
- Overview and Report Findings
- Our Changing Climate
- Sectors & Sectoral Cross-cuts
- Regions & Biogeographical Cross-cuts
- Responses
- Appendices



# Sectors

- Water Resources
- Energy Supply and Use
- Transportation
- Agriculture
- Forestry
- Ecosystems and Biodiversity
- Human Health



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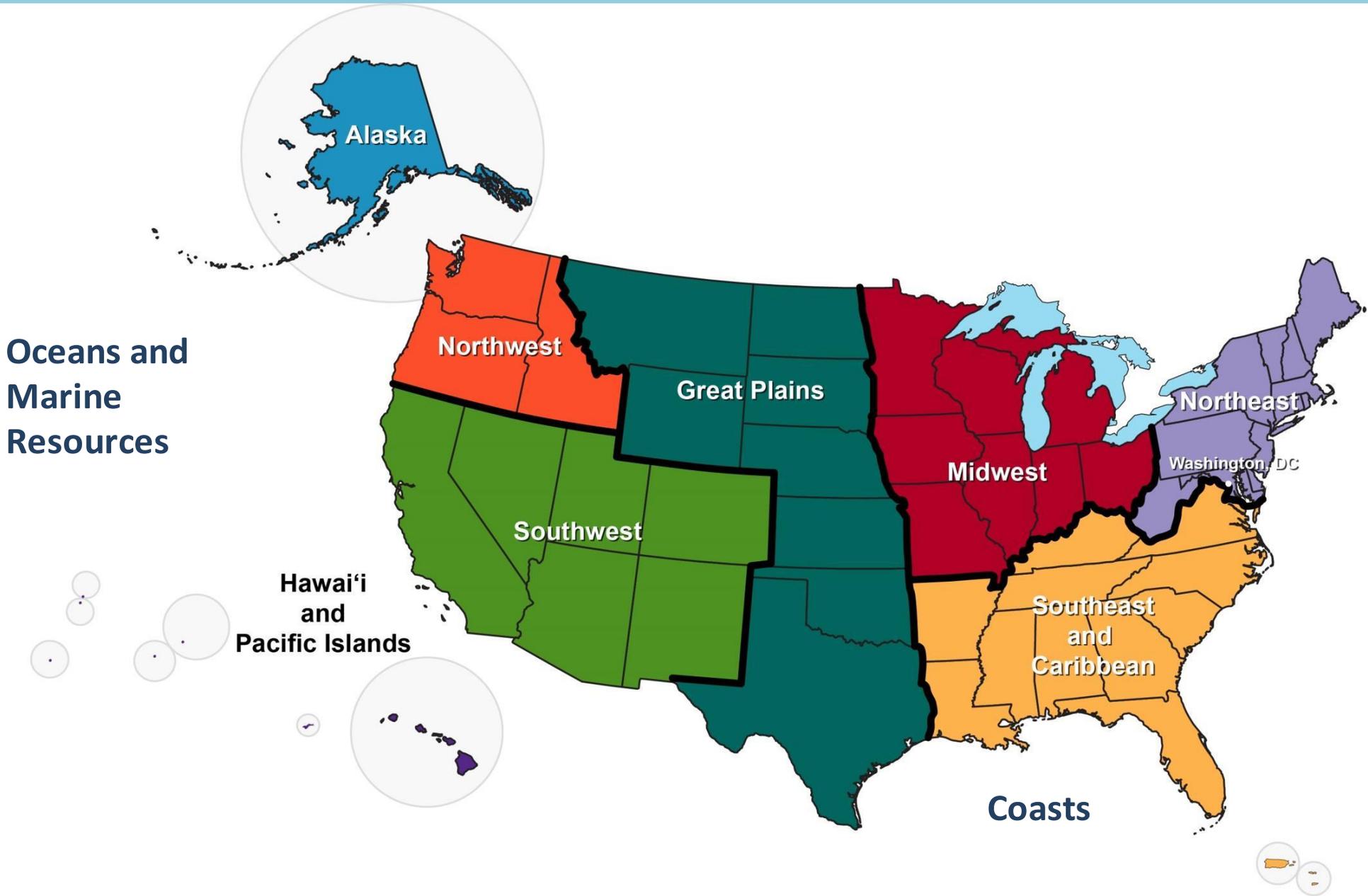
# Sectoral Cross-Cuts



- Water, Energy, and Land Use
- Urban Systems, Infrastructure, and Vulnerability
- Impacts of Climate Change on Tribal, Indigenous, and Native Lands and Resources
- Land Use and Land Cover Change
- Rural Communities
- Biogeochemical Cycles



# Regions & Biogeographical Cross-Cuts



# Response to Climate Change

- Decision Support
- Mitigation
- Adaptation
- Research Needs
- The Sustained Assessment Process



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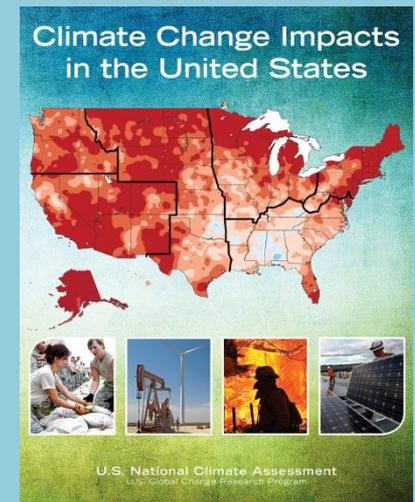
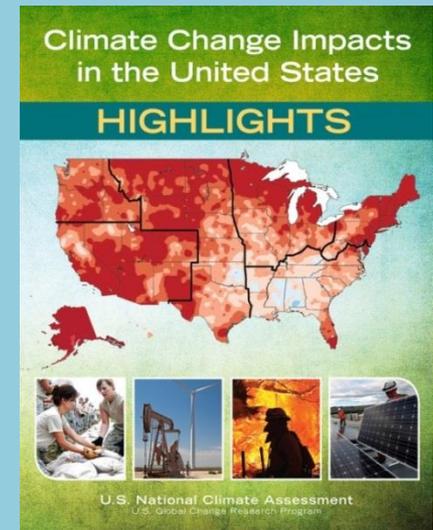
# Appendices

- Process and Engagement
- Information Quality
- Extended Climate Science
- Frequently Asked Questions
- Scenarios and Models
- Topics for Future Consideration



# Climate Change Impacts in the U.S.

- Full report (digital)
  - Interactive, web-based
  - Includes traceable accounts
  - Linked to data and sources
- Website (<http://nca2014.globalchange.gov>)
  - Full report & Highlights in HTML
  - Graphics (high-resolution files, interactive figures)
  - Supporting information
- Highlights (148 pp) (printed & pdf)
- Overview (20 pp) (printed & pdf)
- Climate Science & Regional Fact Sheets
- (2 pp each) (pdf)



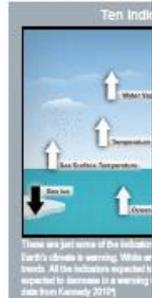
# OVERVIEW

Climate change is already affecting the American people in far-reaching ways. Certain types of extreme weather events with links to climate change have become more frequent and/or intense, including prolonged periods of heat, heavy downpours, and, in some regions, floods and droughts. In addition, warming is causing sea level rise and glaciers and Arctic sea ice to melt, and oceans are becoming more acidic as they absorb carbon dioxide. Today, these and other aspects of climate change are disrupting people's lives and damaging our economy.

### Climate Change: Present and Future

Evidence for climate change above the atmosphere to the depths of the oceans and engineers from around the world collected this evidence, using a variety of weather balloons, thermal observing systems. Evidence of visible in the observed and model and behavior of species and human taken together, this evidence that the planet is warming, and over warming has been driven primarily

Multiple lines of independent evidence show that human activities are the primary cause of the warming.

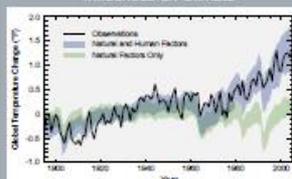


Coal-fired power plants emit heat-trapping carbon dioxide to the atmosphere.

variations in climate, warming is not uniform over time. Short-term fluctuations in the long-term upward trend are thus natural and expected. For example, a recent slowing in the rate of surface air temperature rise appears to be related to cyclic changes in the oceans and in the sun's energy output, as well as a series of small volcanic eruptions and other factors. Nonetheless, global temperatures are still on the rise and are expected to rise further.

U.S. average temperature has increased by about 1.3°F since 1880, and most of this increase has occurred since 1970. The most recent decade was the nation's and the world's hottest on record, and 2012 was the hottest year on record.

### Separating Human and Natural Influences on Climate



# Sample pages from Highlights

# CLIMATE TRENDS

These two pages present the Key Messages from the "Our Changing Climate" chapter of the full report. They pertain to Report Findings 1, 2, and 3, evidence for which appears on the following pages.



### Temperature

U.S. average temperature has increased by about 1.3°F since record keeping began in 1880; most of this increase has occurred since about 1970. The most recent decade was the nation's warmest on record. U.S. temperatures are expected to continue to rise. Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.



### Extreme Weather

There have been changes in some types of extreme weather events. Heat waves have become more frequent and intense across the United States. Droughts in the Southwest and heat waves are less intense everywhere.



### Hurricanes

The intensity, frequency, and duration of the strongest (category 3 and above) hurricanes have increased substantially since the early 1980s. The natural causes of these increases are storm intensity and rainfall rates are expected to increase as climate continues to warm.



### Severe Storms

Winter storms have increased in frequency and intensity since the 1950s, and their tracks shifted northward over the U.S. Other types of severe storms, including the highest frequency of tornadoes, hail, and dust/thunderstorm winds are uncertain and studied intensively.



### Ocean Acidification

The oceans are currently absorbing about one-third of the carbon dioxide emitted to the atmosphere annually and are becoming more acidic. This acidification is expected to have significant impacts on marine ecosystems.

# FINDING 6 INFRASTRUCTURE

Infrastructure is being damaged by sea level rise, heavy downpours, and extreme heat; damages are projected to increase with continued climate change.

Sea level rise, storm surges, and heavy downpours, in combination with the pattern of continued development in coastal areas, are increasing damage to U.S. infrastructure including roads, buildings, and industrial facilities, and are also increasing risks to ports and coastal military installations. Flooding along rivers, lakes, and in cities following heavy downpours, prolonged rains, and rapid melting of snowpack is exceeding the limits of flood protection infrastructure designed for historical conditions. Extreme heat is damaging transportation infrastructure such as roads, rail lines, and airport runways.



(Top Left) Heavy rain knock out power in Lakeview Terrace, California, in December 2010. (Top Right) Hurricane Sandy destroys this road in Rockville, on the North Carolina coast in October 2012. (Bottom Left) Blackout in New York City in October, 2012. (Bottom Right) Heavy rainfall leads to flooding, destroying this bridge in Lyons, Colorado, September 2013.

### KEY MESSAGES: URBAN SYSTEMS, INFRASTRUCTURE, AND VULNERABILITY

Climate change and its impacts threaten the well-being of urban residents in all U.S. regions. Essential infrastructure systems such as water, energy supply, and transportation will increasingly be compromised by intensified climate change impacts. The nation's economy, society, and culture all depend on the resilience of urban infrastructure systems.

In urban settings, climate-related disruptions of services in one infrastructure system will almost always result in disruptions in one or more other infrastructure systems.

Climate vulnerability and adaptive capacity of urban residents and communities are influenced by pronounced social inequalities that reflect age, ethnicity, gender, income, health, and disability differences.

City government agencies and organizations have started adaptation plans that focus on infrastructure systems and public health. To be successful, these adaptation efforts require cooperative private sector and governmental activities, but face many barriers to implementing these combined efforts.



New York City's subway system, the nation's busiest, sustained the worst damage in its 108 years of operation on October 29, 2012, as a result of Hurricane Sandy. Millions of people were left without service for at least a week.

Climate change poses a series of interrelated challenges to the country's most densely populated places: its cities. The U.S. is highly urbanized, with about 80% of its population living in cities and metropolitan areas. Cities depend on infrastructure, like water and sewerage systems, roads, bridges, and power plants, much of which is aging and in need of repair or replacement. Rising sea levels, storm surges, heat waves, and extreme weather events will compound these issues, stressing or even overwhelming these essential services.

Urban dwellers are particularly vulnerable to disruptions in essential infrastructure services, in part because many of these infrastructure systems are reliant on each other. For example, electricity is essential to multiple systems, and a failure in the electrical grid can affect water treatment, transportation services, and public health. These infrastructure systems – lifelines to millions – will continue to be affected by various climate-related events and processes.

Cities have become early responders to climate change challenges and opportunities. Integrating climate change action in everyday city and infrastructure operations and governance is an important planning and implementation tool for advancing adaptation in cities.<sup>6</sup> By integrating climate-change considerations into daily operations, these efforts can forestall the need to develop a new and isolated set of climate-change-specific policies or procedures.<sup>6</sup> This strategy enables cities and other government agencies to take advantage of existing funding sources and programs, and achieve co-benefits in areas such as sustainability, public health, economic development, disaster preparedness, and environmental justice. Pursuing low-cost, no-regrets options is a particularly attractive short-term strategy for many cities.<sup>6</sup>

# Report Findings

- *Our changing climate:* Global climate is changing and this is apparent across the United States in a wide range of observations. The global warming of the past 50 years is primarily due to human activities, predominantly the burning of fossil fuels.
- *Extreme weather:* Some extreme weather and climate events have increased in recent decades, and new and stronger evidence confirms that many of these increases are related to human activities.
- *Future climate:* Human-induced climate change is projected to continue, and it will accelerate significantly if global emissions of heat-trapping gases continue to increase.



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# Report Findings

- *Widespread impacts:* Impacts related to climate change are already evident in many sectors and are expected to become increasingly disruptive across the nation throughout this century and beyond.
- *Human health:* Climate change threatens human health and well-being in many ways, including through more extreme weather events and wildfire, decreased air quality, and diseases transmitted by insects, food, and water.
- *Infrastructure:* Infrastructure is being damaged by sea level rise, heavy downpours, and extreme heat; damages are projected to increase with continued climate change.



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# Report Findings

- *Water:* Water quality and water supply reliability are jeopardized by climate change in a variety of ways that affect ecosystems and livelihoods.
- *Agriculture:* Climate disruptions to agriculture have been increasing and are projected to become more severe over this century.
- *Indigenous peoples:* Climate change poses particular threats to Indigenous Peoples' health, wellbeing, and ways of life.



# Report Findings

- *Ecosystems:* Ecosystems and the benefits they provide to society are being affected by climate change. The capacity of ecosystems to buffer the impacts of extreme events like fires, floods, and severe storms is being overwhelmed.
- *Oceans:* Ocean waters are becoming warmer and more acidic, broadly affecting ocean circulation, chemistry, ecosystems, and marine life.
- *Responses:* Planning for adaptation (to address and prepare for impacts) and mitigation (to reduce future climate change, for example by cutting emissions) is becoming more widespread, but current implementation efforts are insufficient to avoid increasingly negative social, environmental, and economic consequences.



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## Climate Change Impacts in the United States

- <http://nca2014.globalchange.gov> -

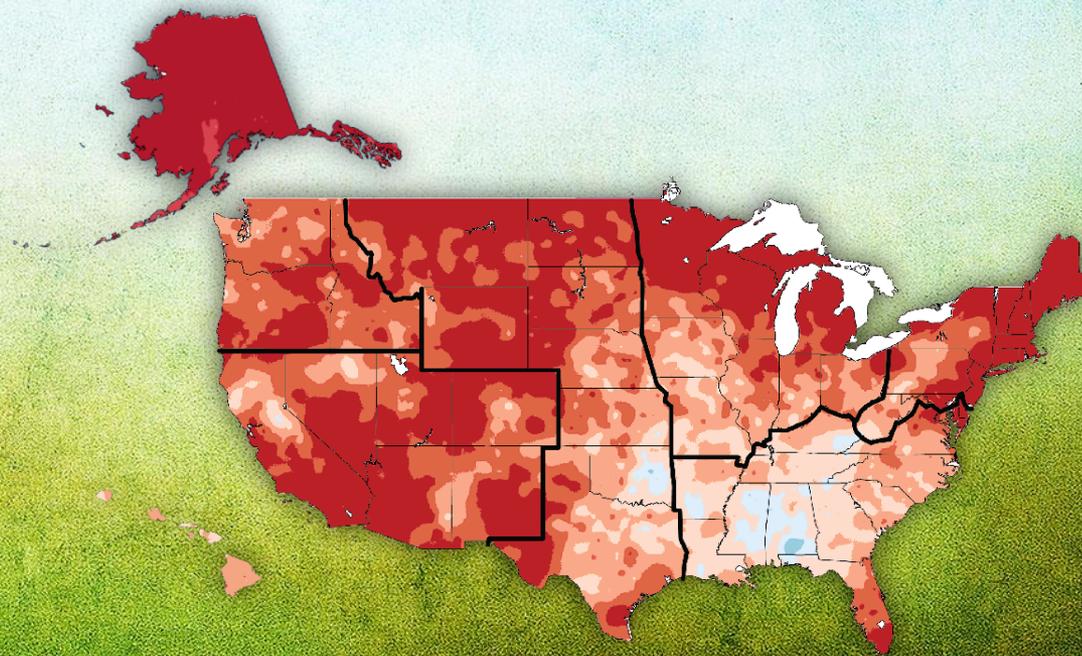
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