
The Fourth National Climate Assessment

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Earth System Prediction Capability Workshop



U.S. Global Change
Research Program

Legislative origins for the NCA

Global Change Research Act of 1990, Section 106:

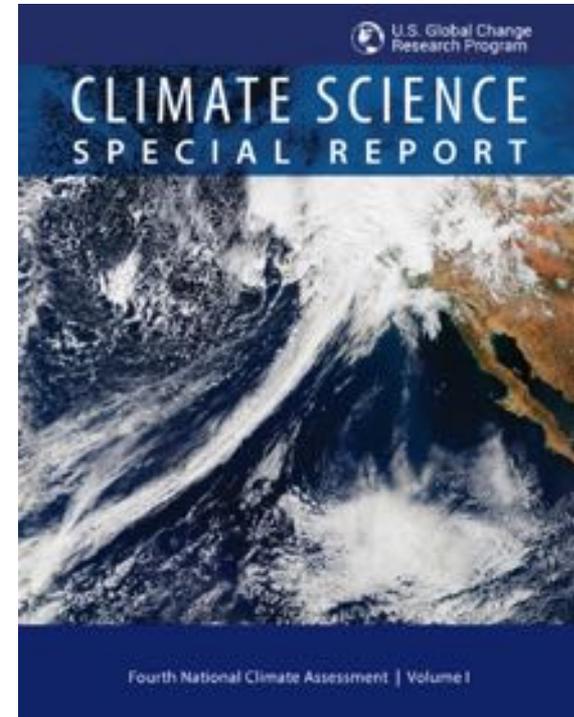
Not less frequently than every 4 years [USGCRP] shall prepare and submit to the President and Congress an assessment which:

- Integrates, evaluates, and interprets the findings of [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
- Analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.



NCA4 Vol I: *Climate Science Special Report*

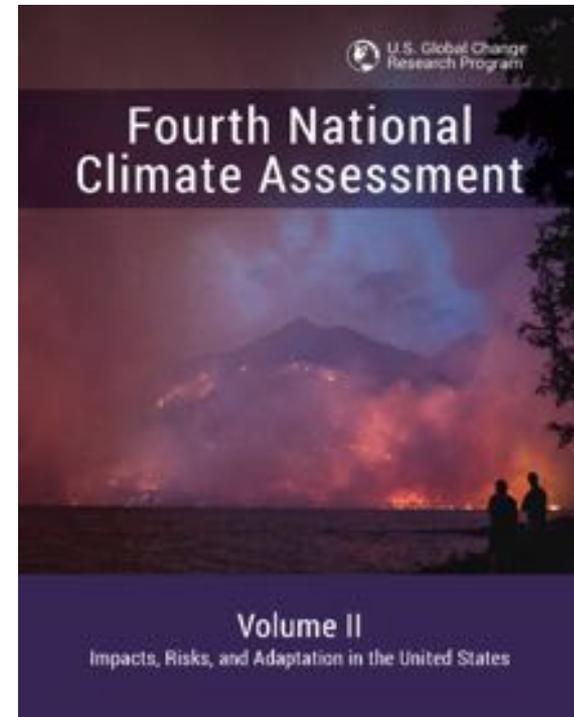
- Released Nov 3, 2017
- Key advances:
 - Detection and attribution
 - Extreme events (tropical cyclones, tornadoes, atmospheric rivers)
 - Downscaled information (including sea level rise)
 - Potential surprises
 - Climate model weighting
- Summarized in Ch. 2 (Our Changing Climate) of NCA4 Vol II



Read and download the report at
science2017.globalchange.gov

NCA4 Vol II: *Impacts, Risks, & Adaptation in the U.S.*

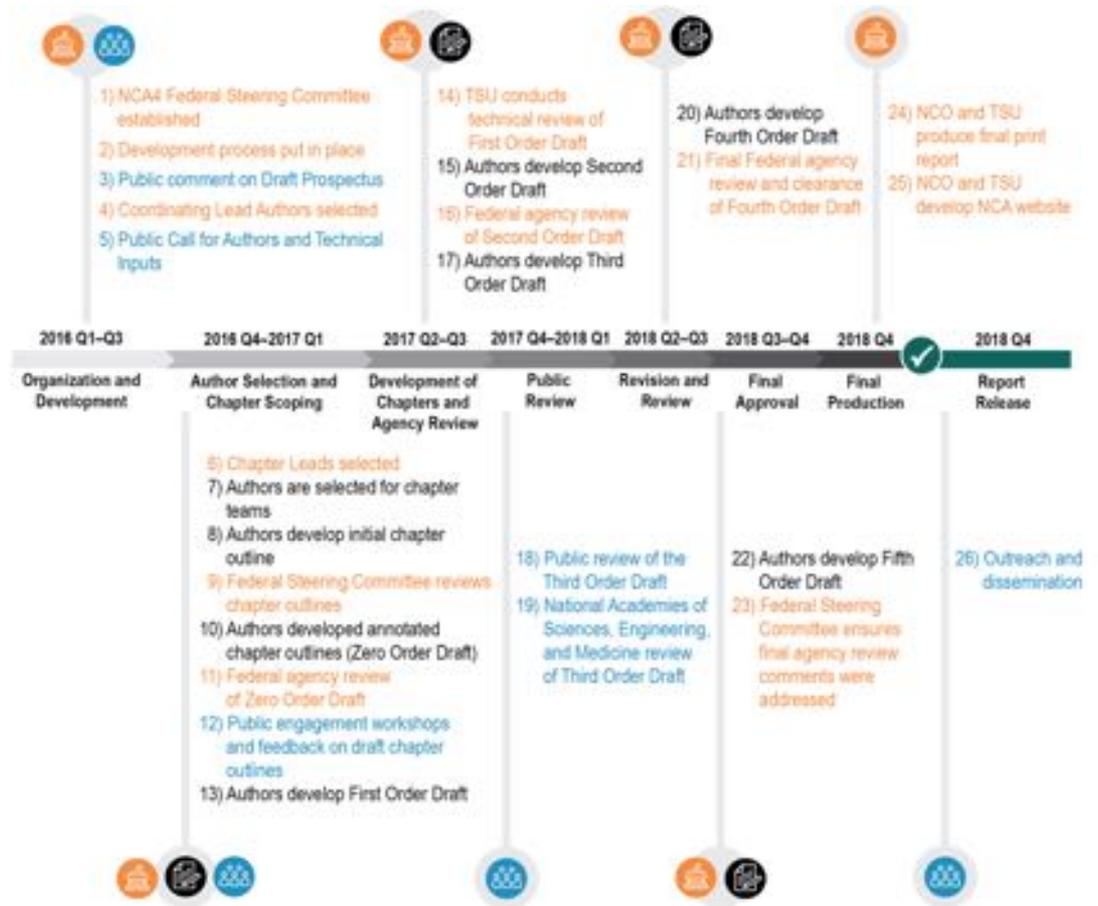
- Released Nov 23, 2018
- **Policy relevant**, but not policy prescriptive
- Places a strong emphasis on **regional information**
- Quantifies **impacts in economic** terms
- Integrates **international** considerations
- Assesses a **range of potential impacts**, helping decision makers better identify risks that could be avoided or reduced
- Uses **case studies** to provide additional context and to showcase community success stories



Read and download the report at
nca2018.globalchange.gov

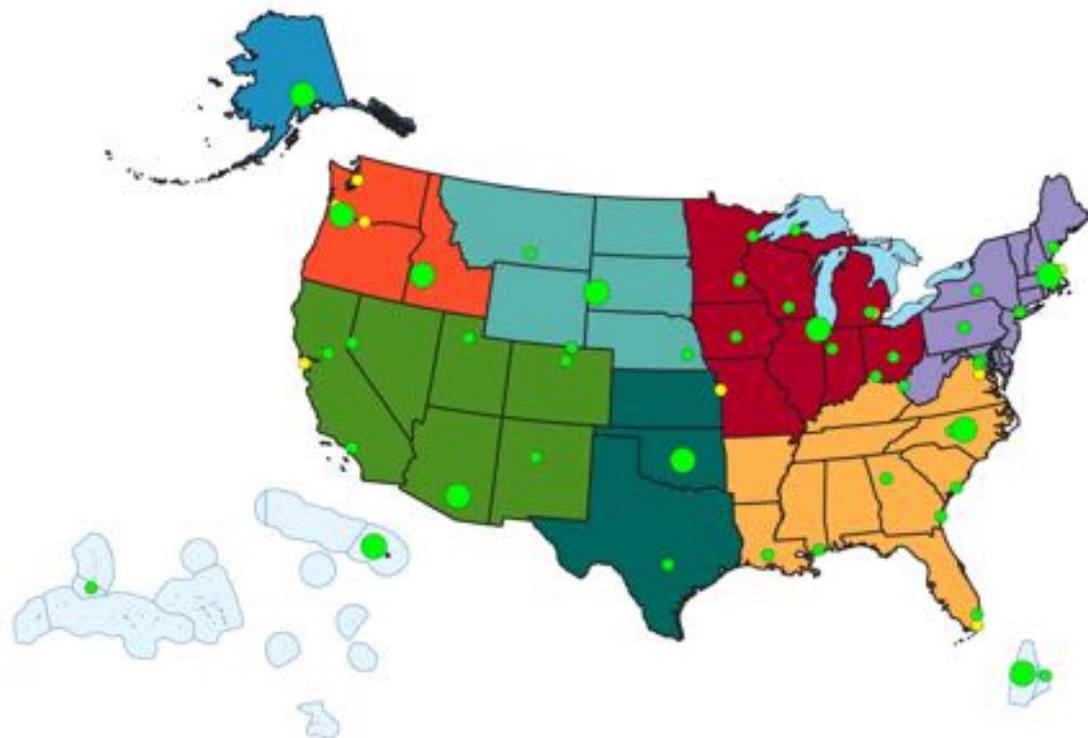
Report Development Process

- Multiple points of **federal review and decision** (*orange icons*) were present throughout the process.
- In addition, **public engagement** (*blue icons*) was a cornerstone of the NCA4 development process.
- Authors used these feedback mechanisms to inform their **chapter's development** (*black icons*).



Public Engagement

- Public feedback on the draft prospectus
- Public call for author nominations
- Public call for technical inputs
- A series of Regional Engagement Workshops (REWs) and sector-specific webinars
- Public call for Review Editors
- A 90-day public review & comment period



Large green dots illustrate the hub locations for the 11 REWs in early 2017. Small green dots indicate satellite locations for those workshops. Small yellow dots show locations of some additional engagement activities, such as presentations or listening sessions at professional society meetings.



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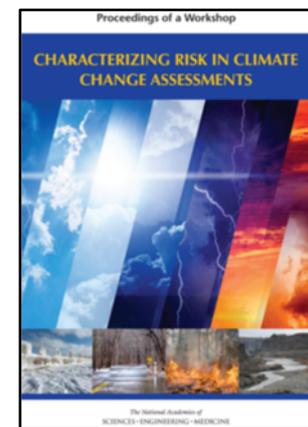
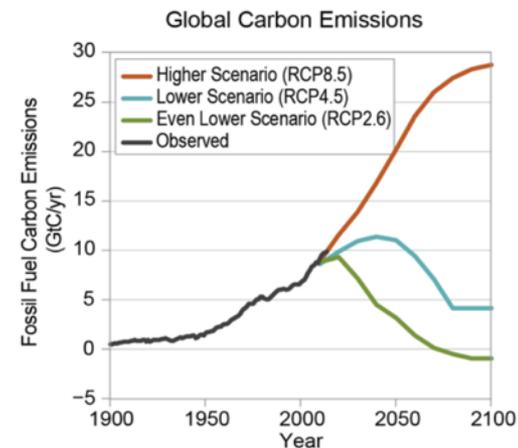
VI. Appendices

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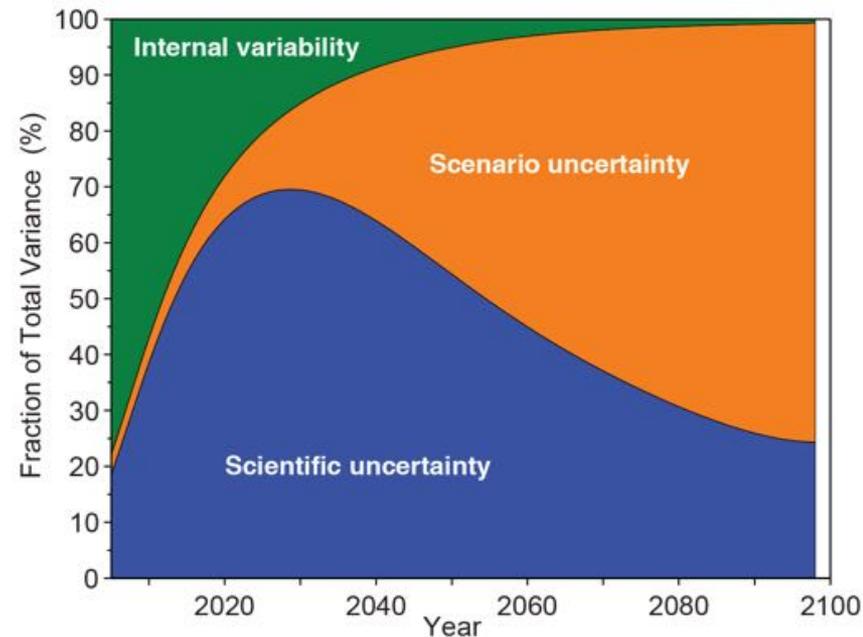
Risk framing in Key Messages

- A “**risk-based framing**” is used to ensure NCA4 focuses on issues of high importance to decision-making and to help with communicating assessment outcomes
- In response to user needs and with guidance from a workshop of the National Academies, NCA4 Key Messages addressed:
 - ✓ What do stakeholders value/what is at risk in a given sector or region?
 - ✓ What outcomes do we wish to avoid with respect to these valued things?
 - ✓ What do we expect to happen in the absence of adaptive action and/or mitigation?
 - ✓ How bad could things plausibly get/are there important thresholds or tipping points in the unique context of a given region, sector, etc.?



Uncertainty in climate science

- Many decisions we make every day are based on less-than-perfect knowledge
- Quantifying uncertainties can help decision-makers plan for a range of outcomes
- NCA4 uses specific language to address scientific uncertainty associated with findings, thereby improving the relevance to risk analysis and decision-making
- The largest uncertainty in projecting future climate conditions is the level of GHG emissions going forward (which depend on economic, political, and demographic factors)

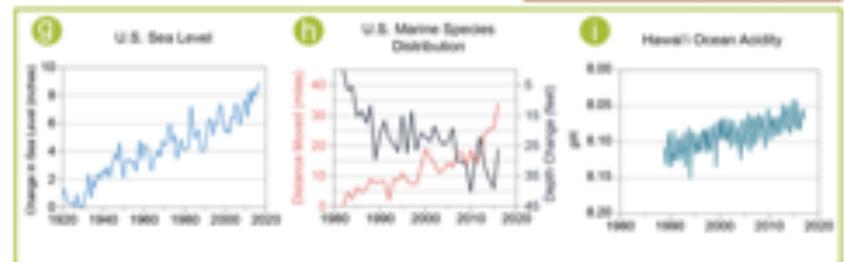
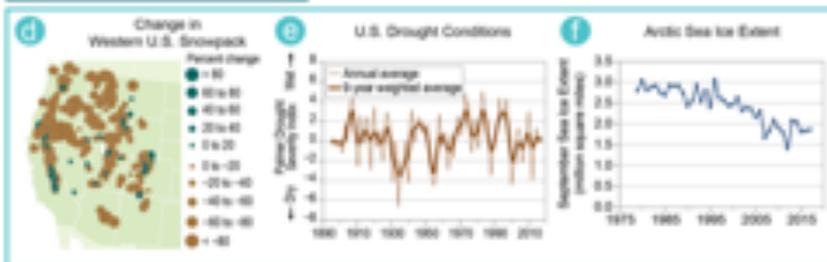
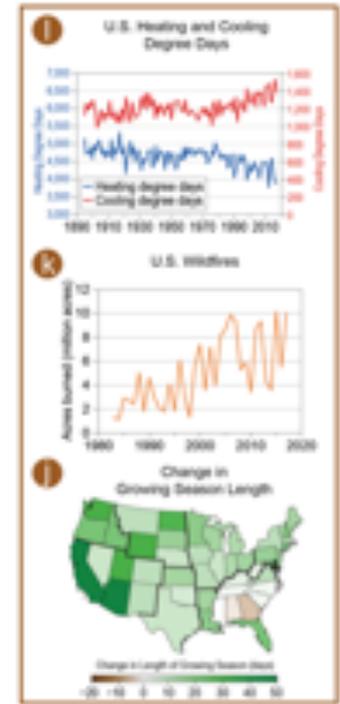
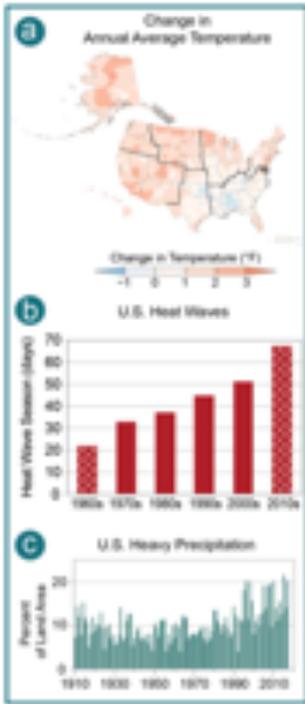


The fraction of total variance in decadal mean surface air temperature predictions explained by the three components of total uncertainty for the lower 48 states.

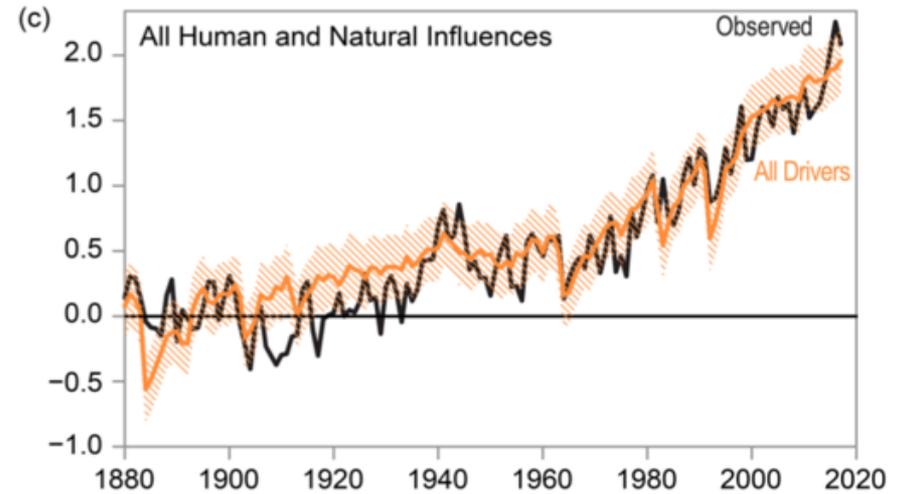
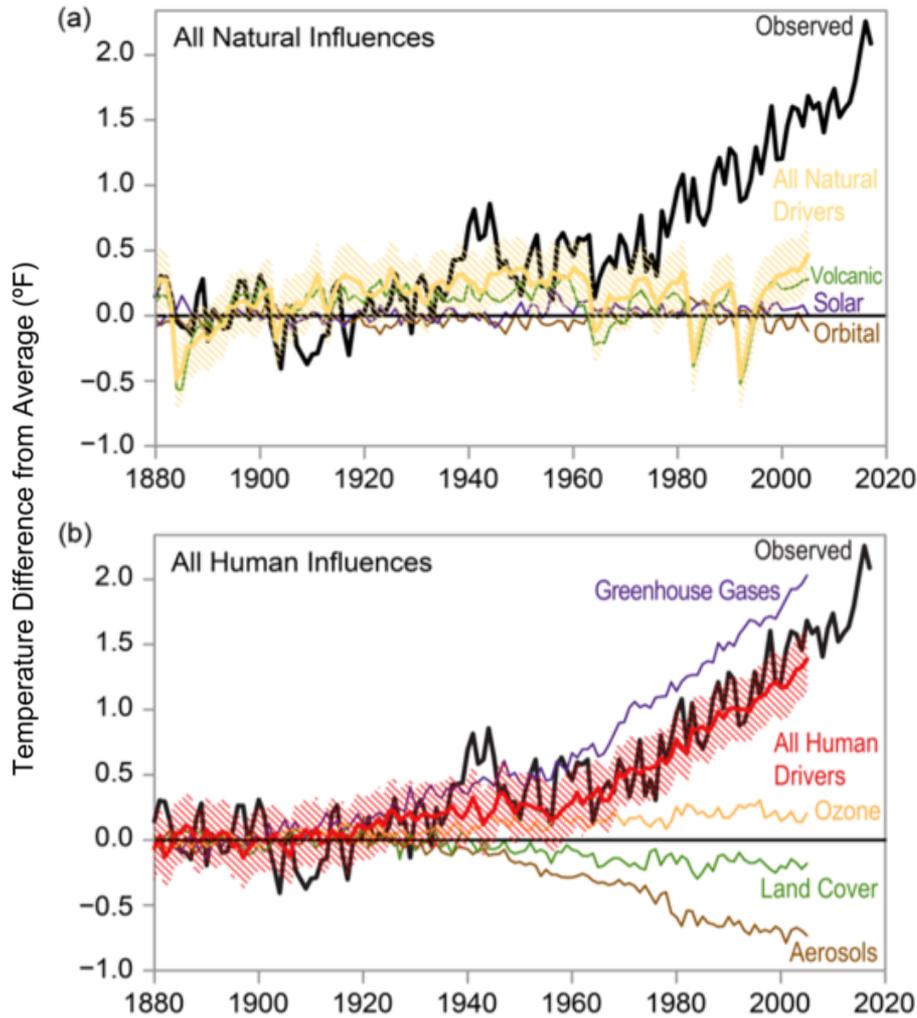
NCA4 Volume II in 5 bullets

- Earth's climate is now changing faster than at any point in modern civilization.
- These changes are primarily the result of human activities, the evidence of which is overwhelming and continues to strengthen
- The impacts of climate change are already being felt across the country, and climate-related threats to Americans' physical, social, and economic well-being are rising
- Americans are responding in ways that can bolster resilience and improve livelihoods
- Neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades

Observed Change

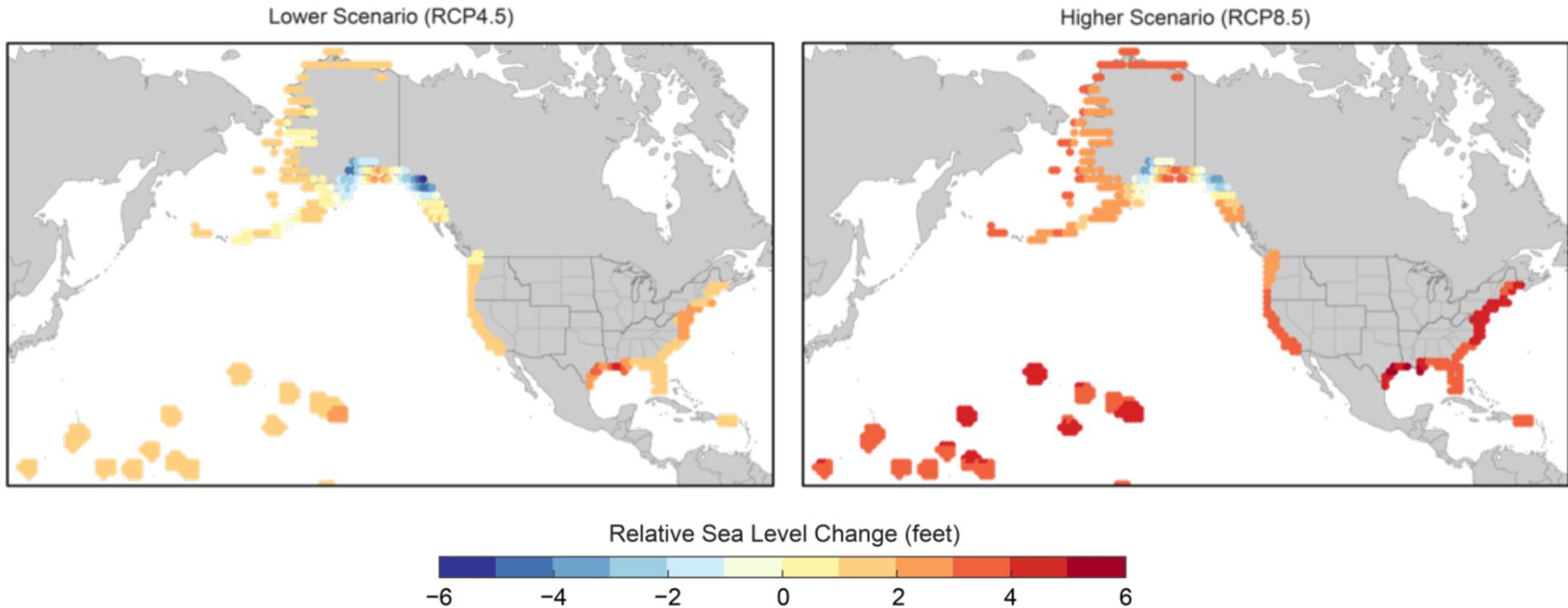


Attribution of Change



Projected Change

Sea Level Rise (in 2100 vs. 2000)



Thermal Expansion + Land-Based Ice Melt + Vertical Land Movement + Ocean Circulation...

USGCRP Scenario Products: scenarios.globalchange.gov/sea-level-rise

NCA4 Vol. I (CSSR), Ch. 12: science2017.globalchange.gov/chapter/12/



Current and Future Risk

Economy and Infrastructure

- **Regional natural resource-based economies**
 - Crops, Tourism, Fisheries, Timber
- **Labor productivity in outdoor sectors**
 - Agriculture, Construction
- **Energy supply disruptions**
 - Heat waves, Drought, Extreme events
- **International considerations**
 - Supply chains, Commodity prices
- **Risks to airports, roads, ports, homes**
 - (High-tide) Flooding, Heat-induced buckling, Wildfires



Increasing heavy rains are leading to more soil erosion and nutrient loss on midwestern cropland. Integrating strips of native prairie vegetation into row crops has been shown to reduce soil and nutrient loss while improving biodiversity.



Floodwaters from the Missouri River surround the Omaha Public Power District's Fort Calhoun Station, a nuclear power plant just north of Omaha, on June 20, 2011.



Current and Future Risk

Natural Environment and Ecosystem Services

- **Safe and reliable water supplies**
 - Harmful algal blooms, Drought, Saltwater intrusion, Heavier downpours, Mountain snowpack
- **Protection from flooding and erosion**
 - Reef death, mangrove shifts
- **Changes in recreation and subsistence activities**
 - Species shifts, Wildfires, Pest & disease outbreaks, Ocean warming & acidification, Arctic sea ice declines



Razor clamming draws crowds on the coast of Washington State. This popular recreation activity is expected to decline due to ocean acidification, harmful algal blooms, warmer temperatures, and habitat degradation.



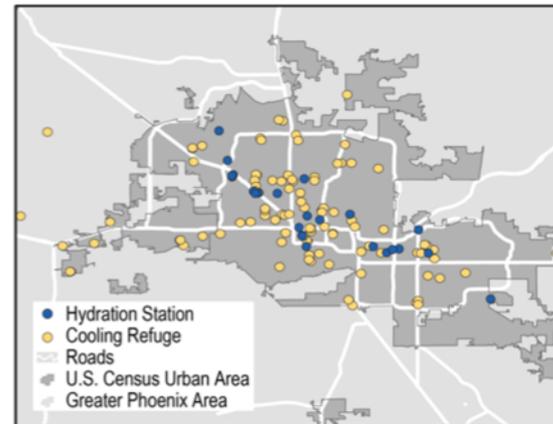
Examples of coral farming in the U.S. Caribbean and Florida demonstrate different types of structures used for growing fragments from branching corals. Coral farming is a strategy meant to improve the reef community and ecosystem function.

Current and Future Risk

Human Health and Well-Being

- **Higher temperatures**
 - Heat exposure
- **Changes in air quality**
 - Asthma, Cardiovascular effects
- **Changes in extreme events**
 - Exposures to waterborne, vectorborne, and foodborne diseases
- **Food quality and availability**
 - Micronutrient levels, drought / flood-induced supply disruptions
- **Mental health**
 - Forced dislocation or relocation, Loss of traditional practices

Hydration Stations and Cooling Refuges



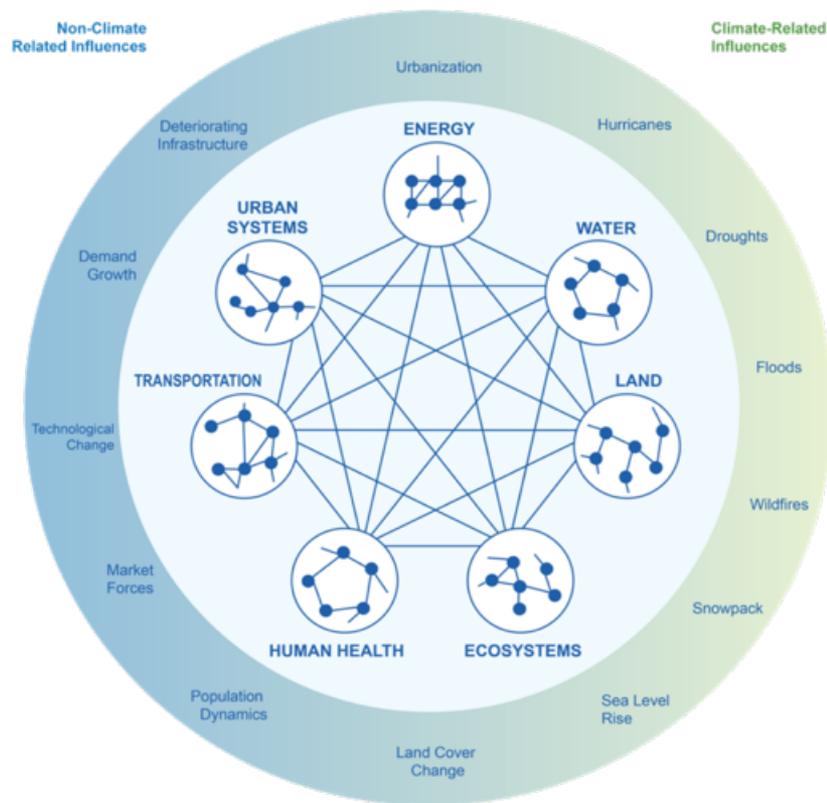
Response measures for high heat events, such as hydration stations and cooling refuges in Phoenix, are expected to be needed at greater scales in the coming years if the adverse health effects of more frequent and severe heat waves are to be minimized.



State, local, and tribal leaders discuss the relocation of the tribal community of Isle de Jean Charles, LA, in response to severe land loss, sea level rise, and coastal flooding.



Interconnected Systems



Sectors are interacting and interdependent through physical, social, institutional, environmental, and economic linkages.

These sectors and the interactions among them are affected by a range of climate-related and non-climate influences.

Example

1. Wildfire chars California hillside
2. Atmospheric river dumps heavy rain
3. Rainfall induces a landslide
4. Landslide cuts off roadways
5. Services and economic activity are disrupted



Reducing Risks

Through Adaptation Action

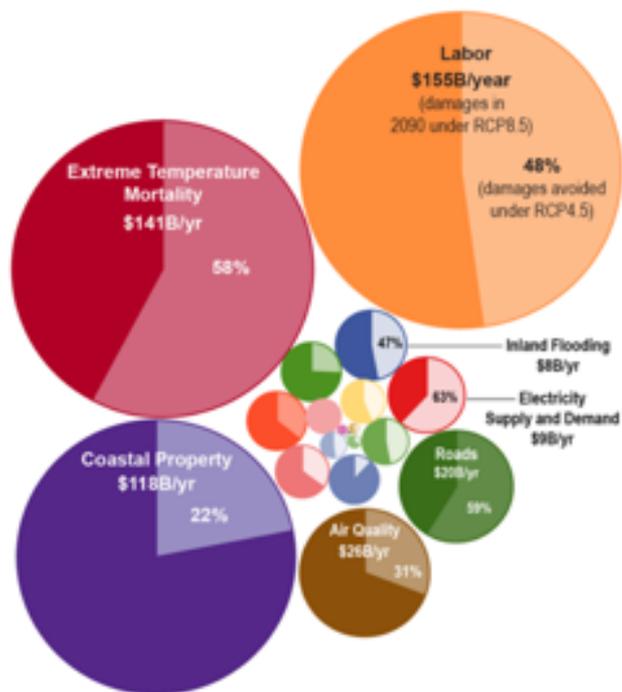


- Adaptation is an ongoing, iterative process
- Since NCA3, the scale and scope of adaptation implementation has increased
- It remains difficult to tally the extent of adaptation implementation since there are no common reporting systems, and many actions that reduce climate risk are not labeled as climate adaptation
- Enough is known, however, to conclude that adaptation implementation is neither uniform nor commonplace across the U.S.



Reducing Risks

Through Emissions Mitigation

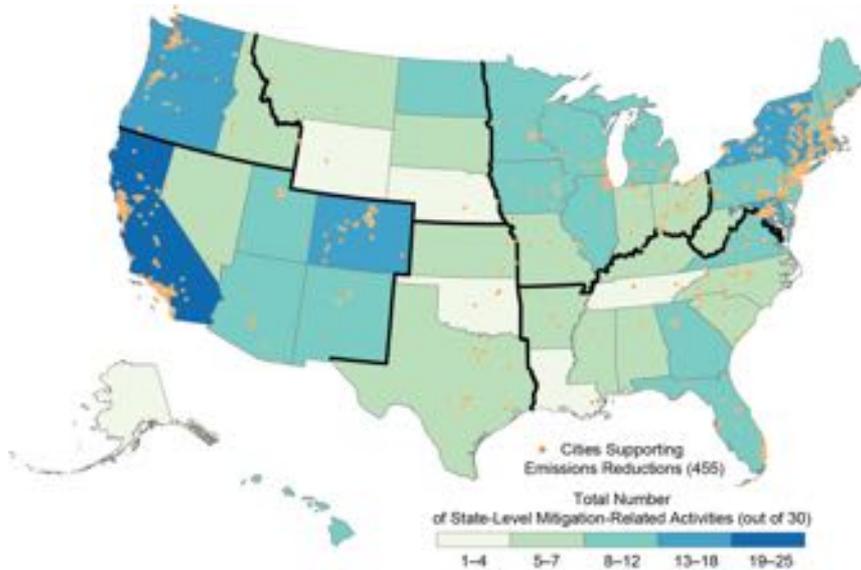


Annual Economic Damages in 2090		
Sector	Annual damages under RCP8.5	Damages avoided under RCP4.5
Labor	\$155B	48%
Extreme Temperature Mortality ⁰	\$141B	58%
Coastal Property ⁰	\$118B	22%
Air Quality	\$26B	31%
Roads ⁰	\$20B	59%
Electricity Supply and Demand	\$9B	63%
Inland Flooding	\$8B	47%
Urban Drainage	\$6B	26%
Rail ⁰	\$6B	36%
Water Quality	\$5B	35%
Coral Reefs	\$4B	12%
West Nile Virus	\$3B	47%
Freshwater Fish	\$3B	44%
Winter Recreation	\$2B	107%
Bridges	\$1B	48%
Munic. and Industrial Water Supply	\$316M	33%
Harmful Algal Blooms	\$199M	45%
Alaska Infrastructure ⁰	\$174M	53%
Shellfish*	\$23M	57%
Agriculture*	\$12M	11%
Aeroallergens*	\$1M	57%
Wildfire	-\$106M	-134%

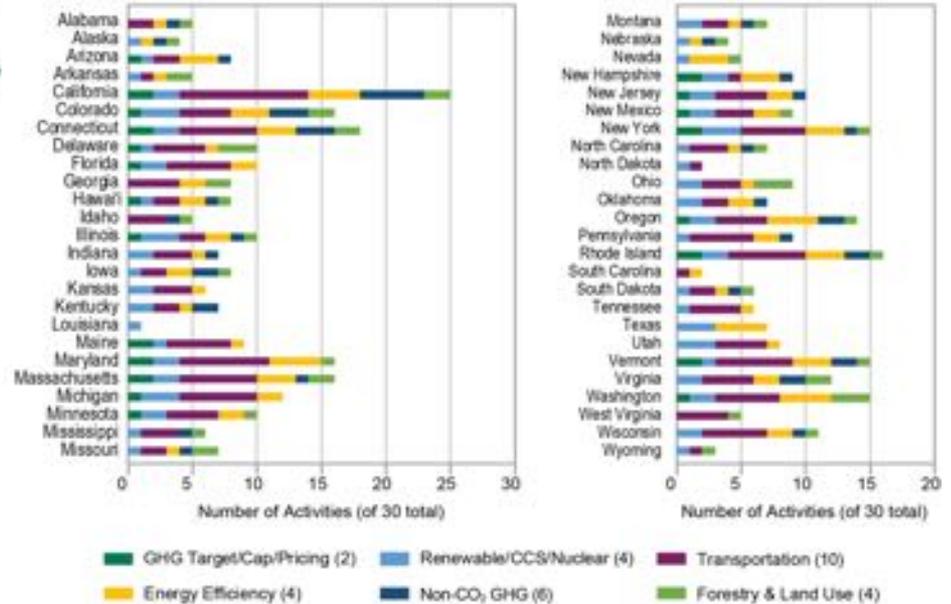
- The total area of each circle represents the projected annual economic damages under a higher warming scenario (RCP8.5) in 2090 relative to a no-change scenario.
- The decrease in damages under a lower warming scenario (RCP4.5) compared to RCP8.5 is shown in the lighter-shaded area of each circle.

Reducing Risks

Through Emissions Mitigation



Source: EPA



Source: America's Pledge 2017

- Sub-national mitigation-related activities are growing across all sectors of the economy
- The magnitude and rate of these activities (both domestically and abroad) do not yet approach the scale needed to avoid the worst impacts

THANK YOU!

nca2018.globalchange.gov

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*Thank you to the hundreds of volunteer federal
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