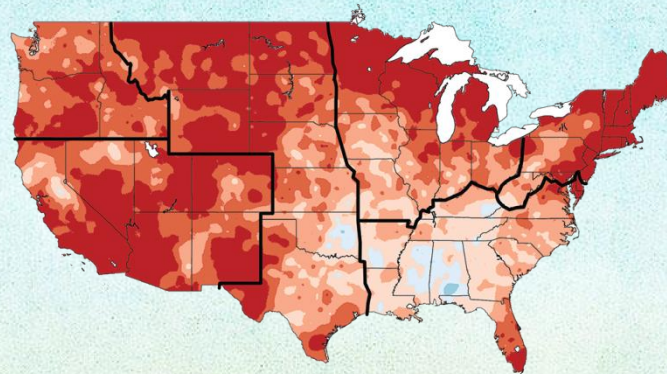


Third National Climate Assessment

Climate Change Impacts in the United States



Charles W Downer, PhD, PE, PMP

US Army Engineer Research and Development Center

May 21, 2014

“Climate change, once considered an issue for a distant future, has moved firmly into the present.”

- Third National Climate Assessment,
2014



Americans are already feeling the effects of increases in some types of extreme weather and sea level rise.



© Stan Honda/AFP/Getty Images

Impacts are apparent in every region and in important sectors including health, water, agriculture, energy, and more.



© Scott Olson/Getty Images

There are many actions we can take to reduce future climate change and its impacts and to prepare for the impacts we can't avoid.



©Dennis Schroeder, NREL



©Esperanza Stancioff, UMaine Extension and Maine Sea Grant

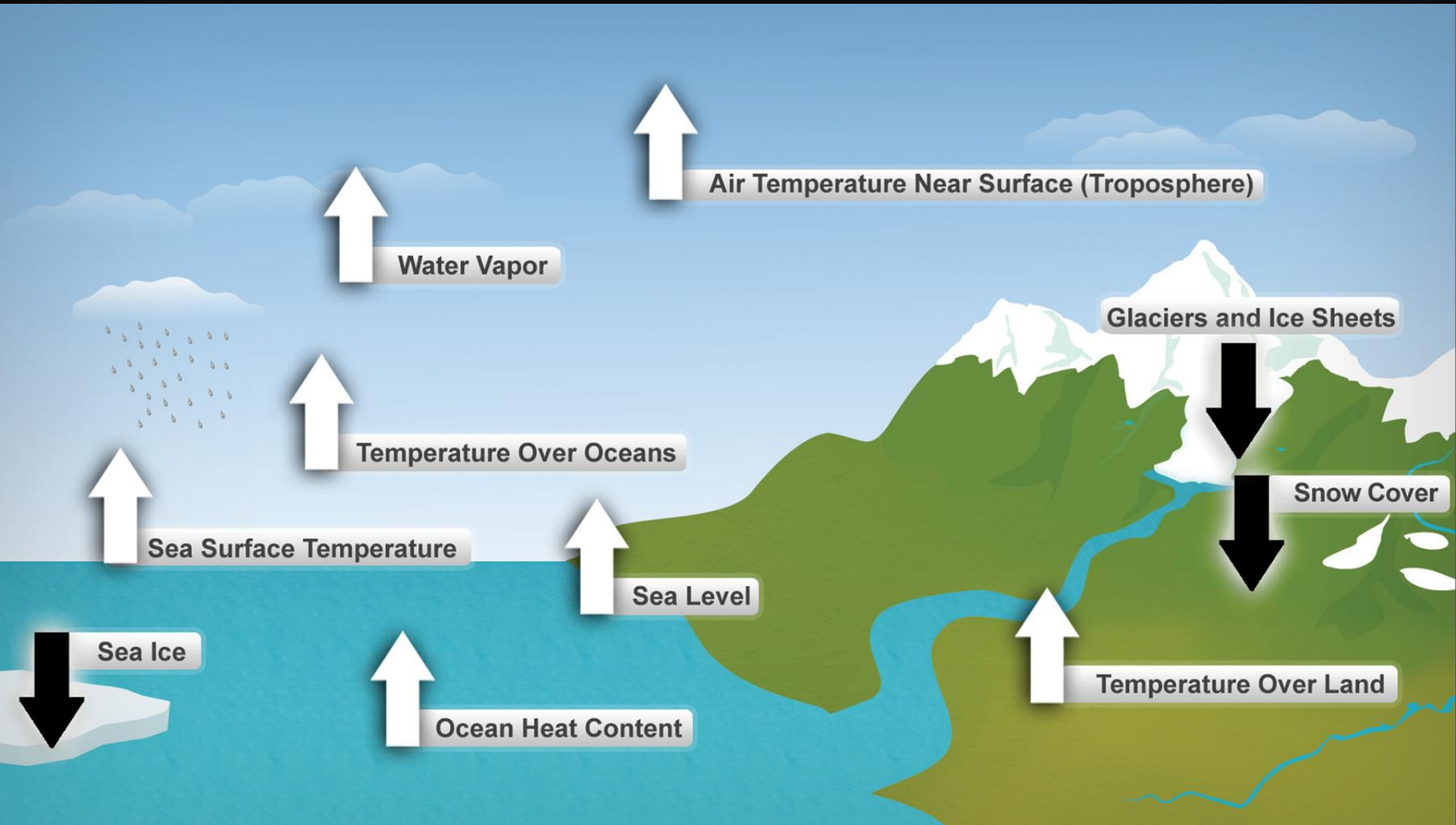
The World is Warming

It's Hot and Getting Hotter!

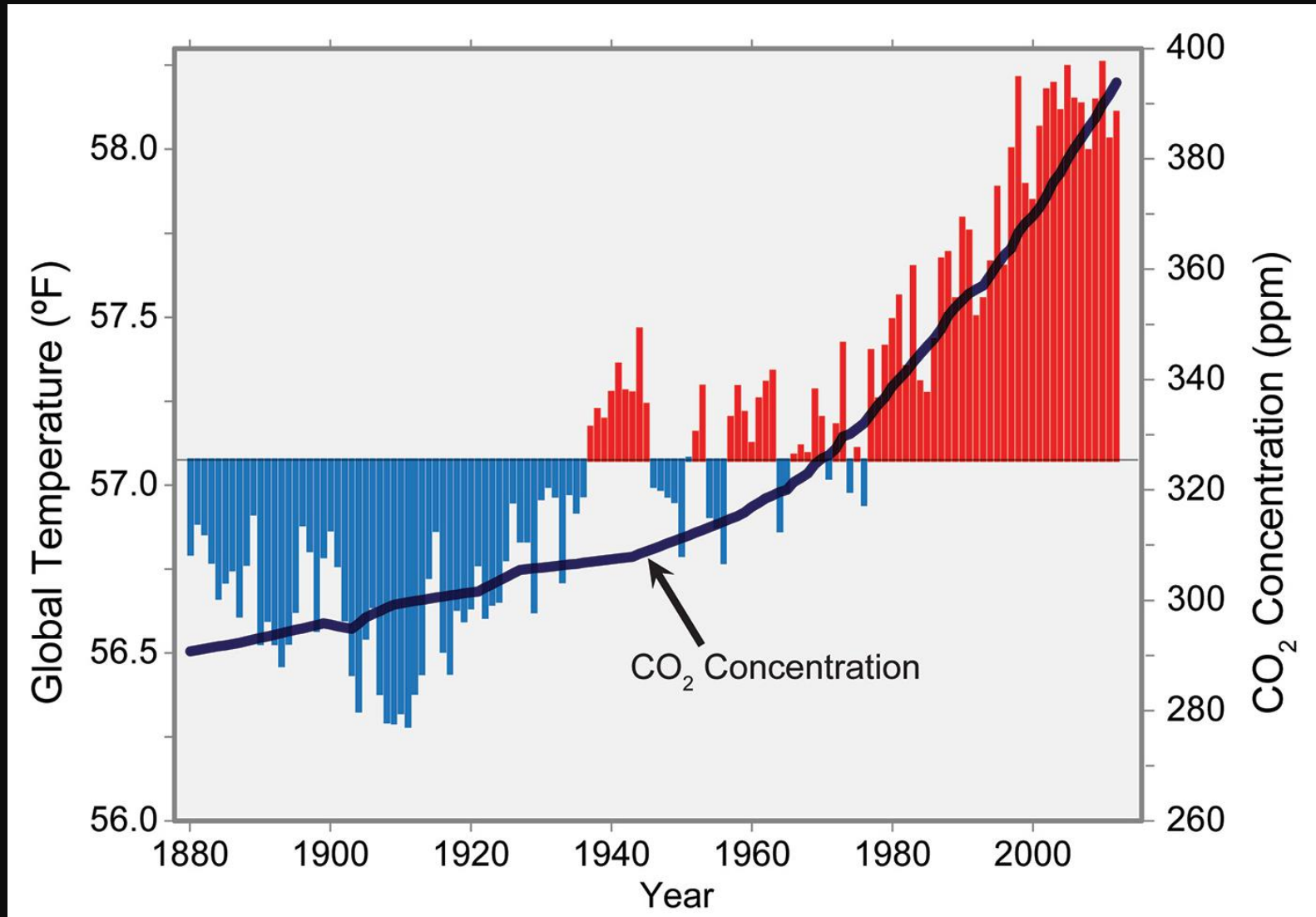
Numerous independent lines of evidence demonstrate that warming has continued.

Because human-induced warming is superimposed on a naturally varying climate, rising temperatures are not evenly distributed across the globe or over time.

Ten Indicators of A Warming World

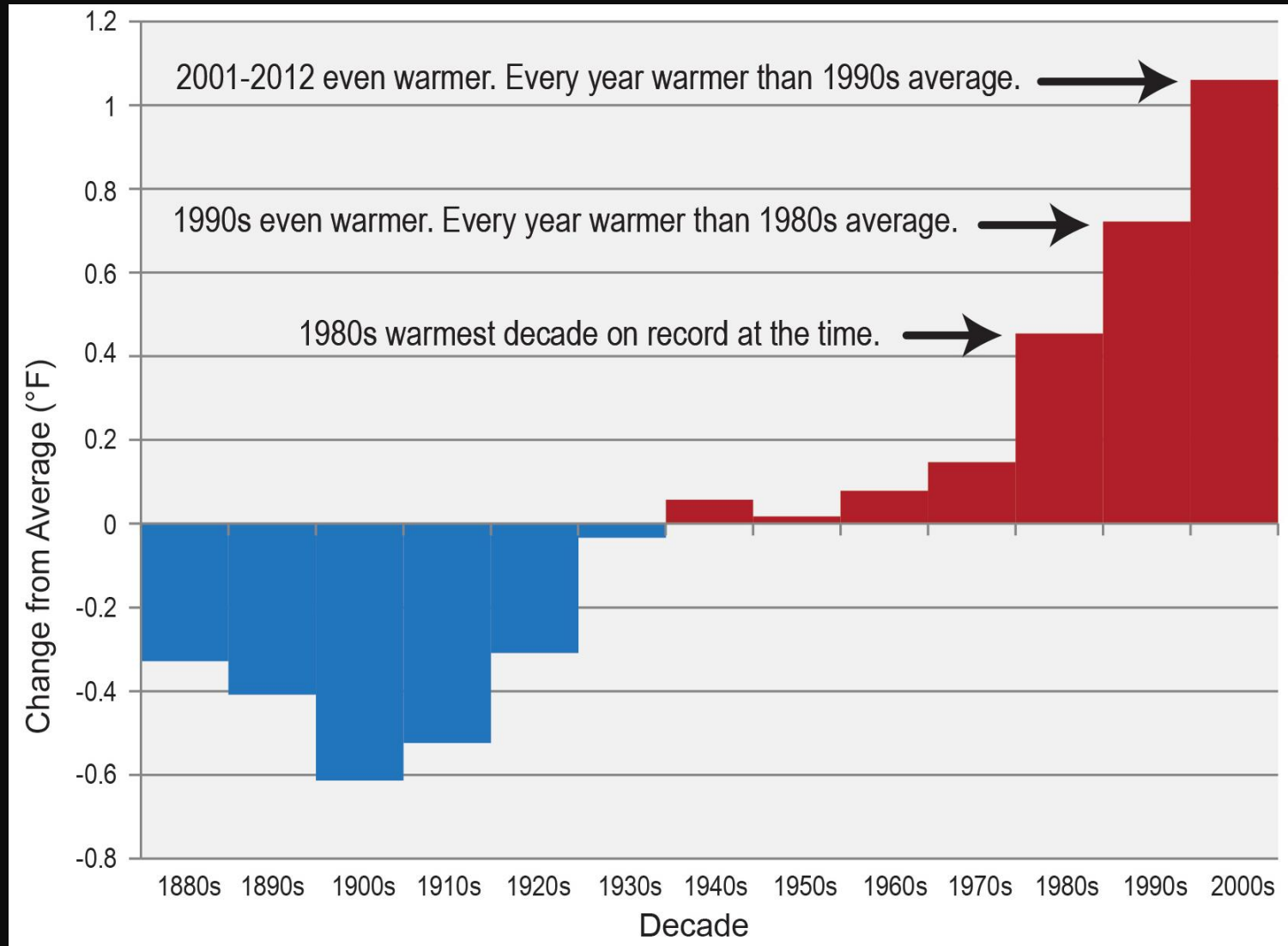


Global Temperature and Carbon Dioxide

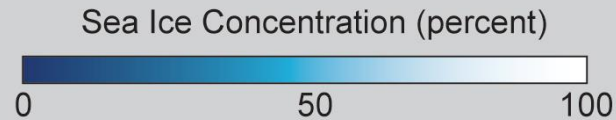
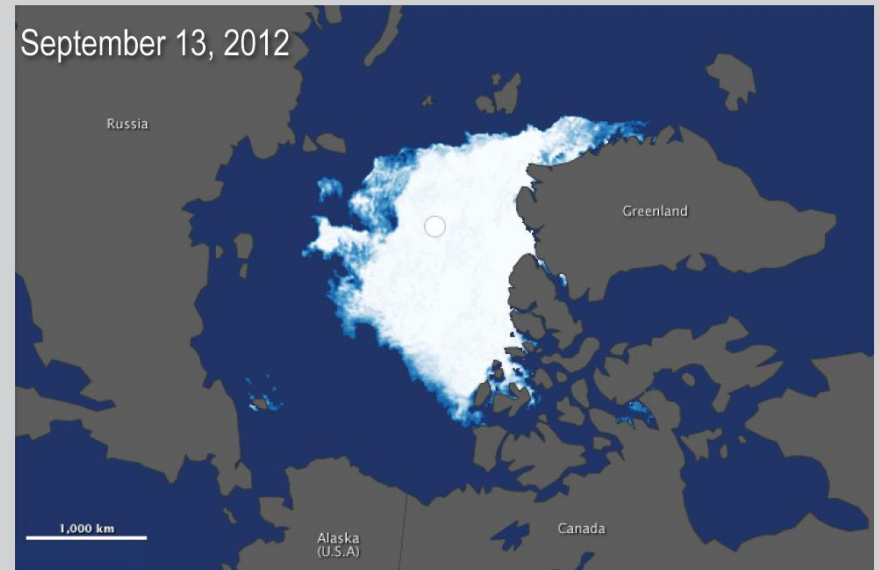
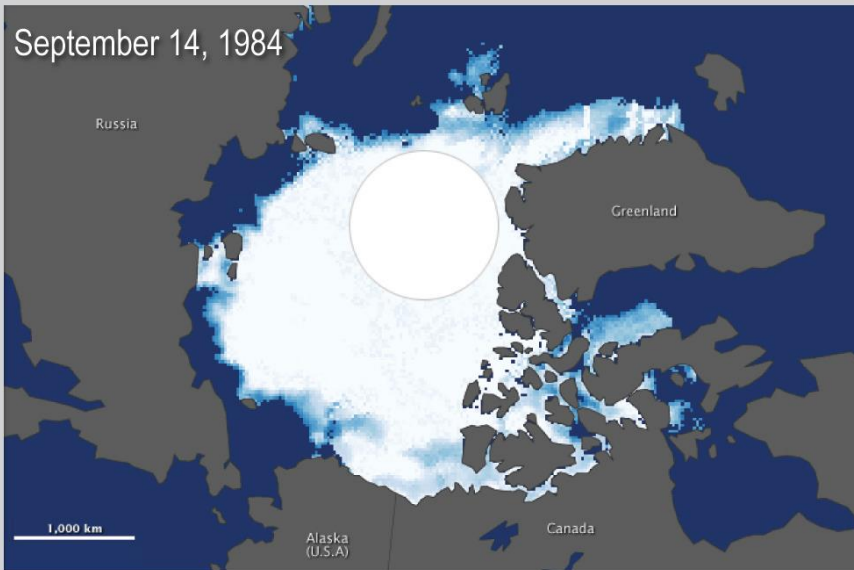


Temperature Change by Decade

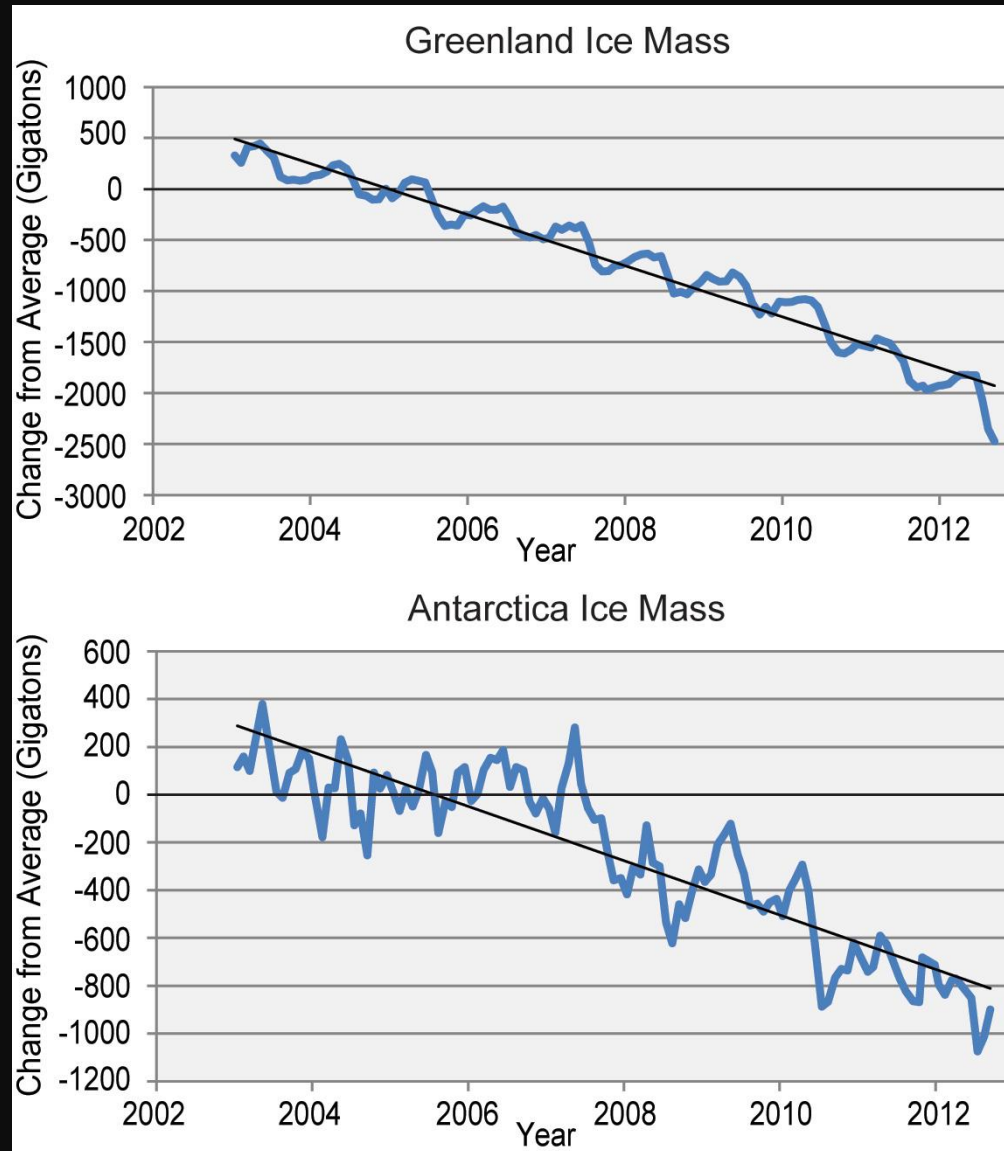
Starting in 1980 Each Successive Decade Warmest Ever



Arctic Sea Ice Decline



Ice Loss from the Two Polar Ice Sheets



Human activity is the primary cause

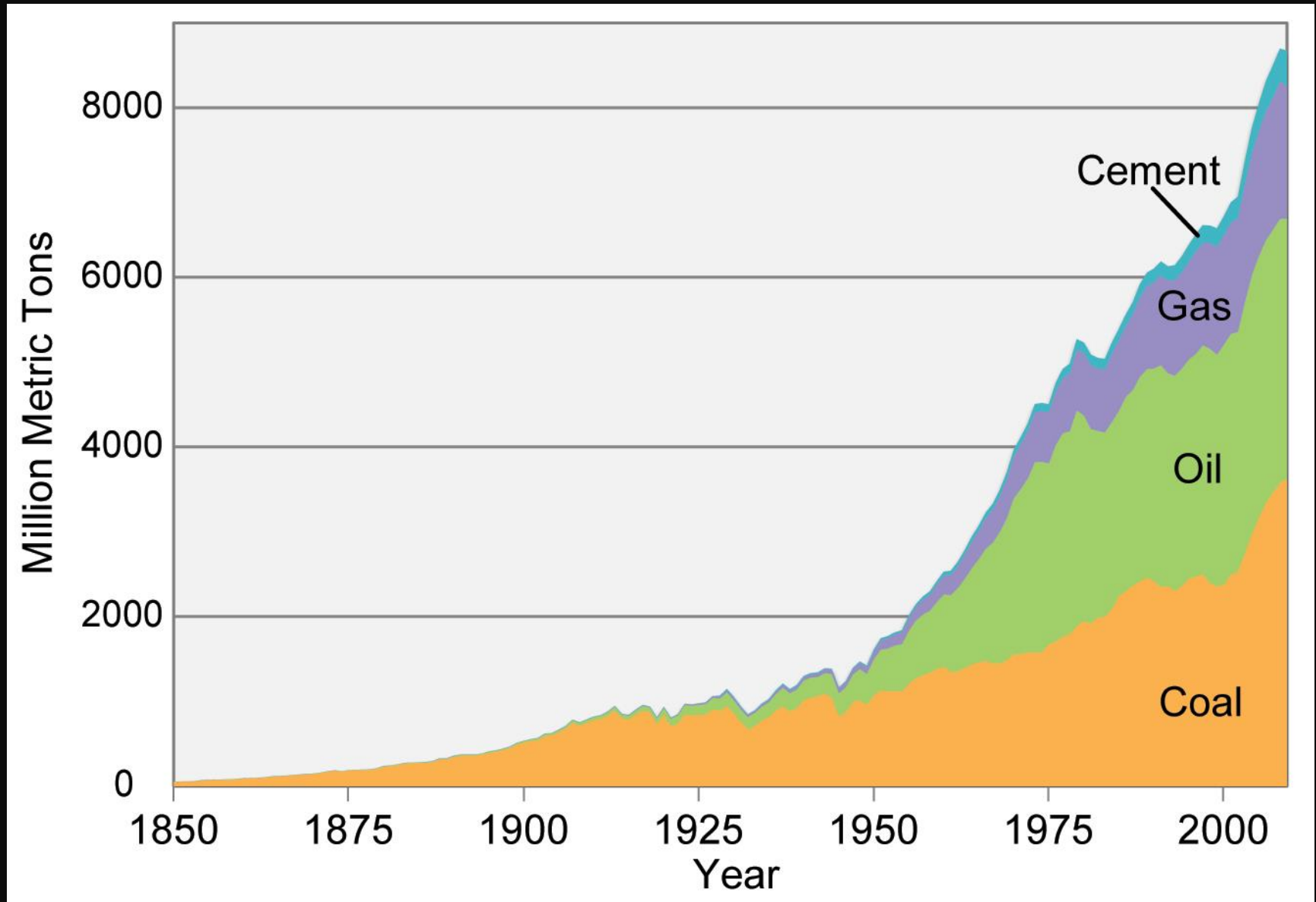


©Tom Mihalek/Reuters/Corbis

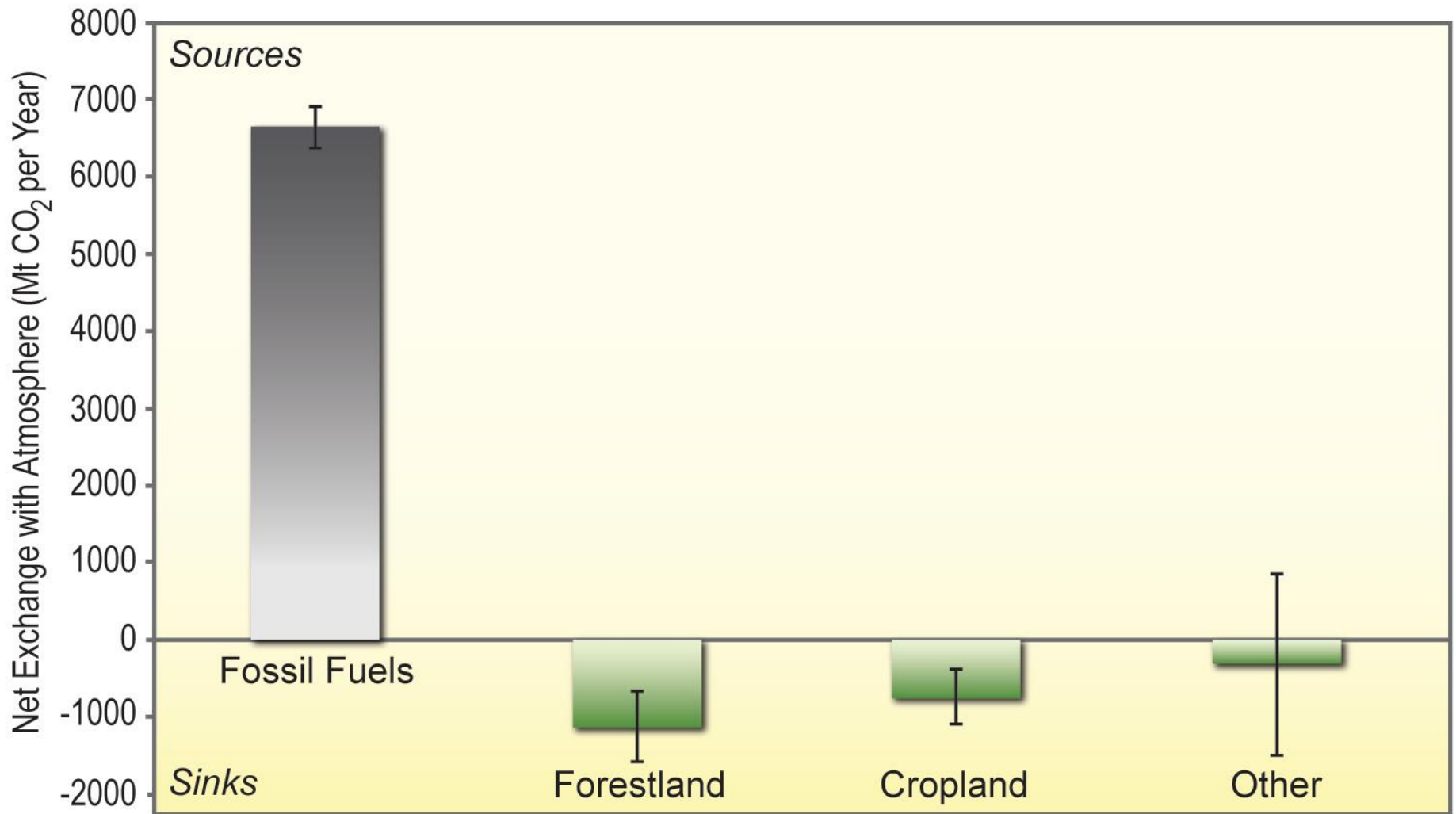


© Phillip J. Redman, U.S. Geological Survey

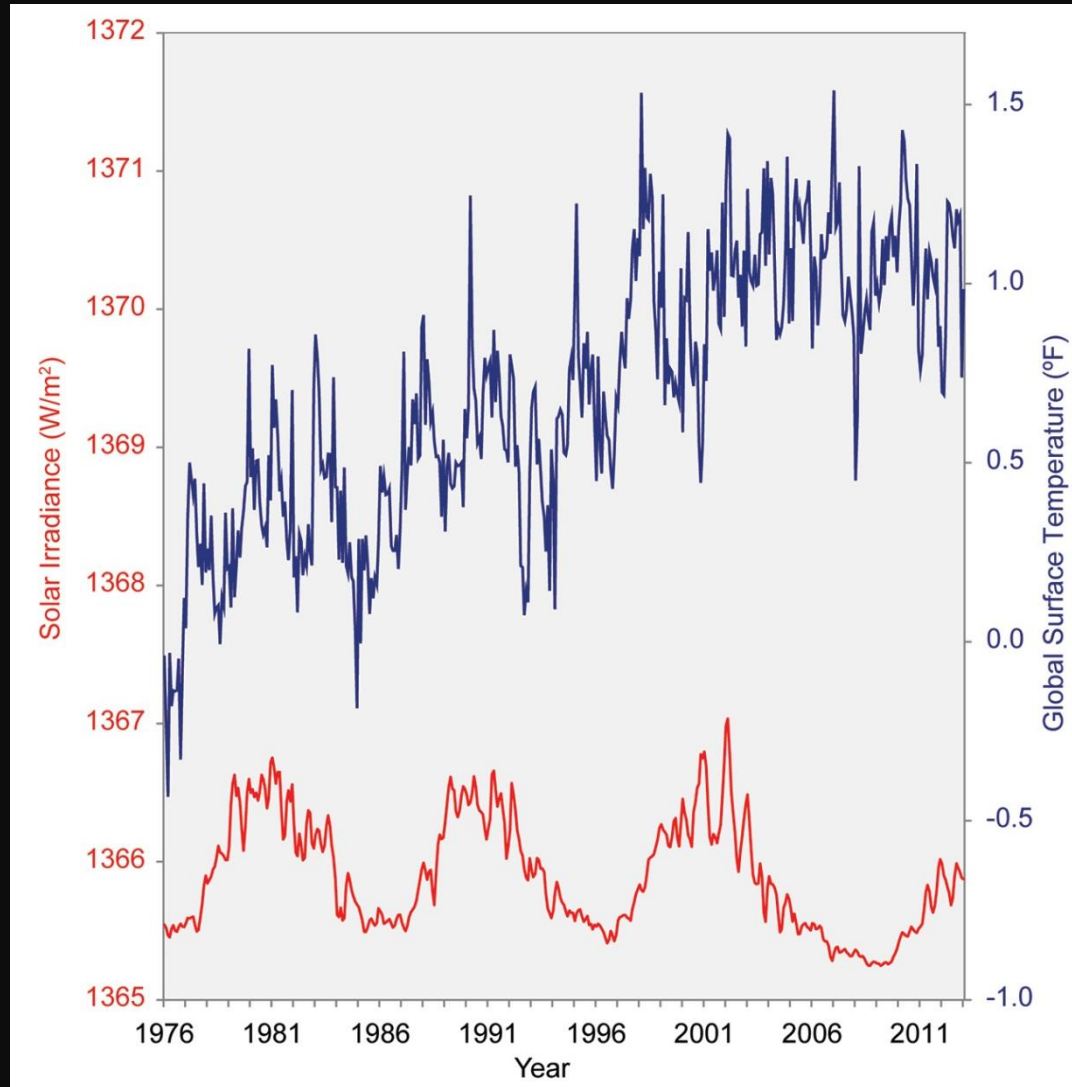
Carbon Emissions in the Industrial Age



Major North American CO₂ Sources and Sinks



Surface Temperature and Sun's Energy

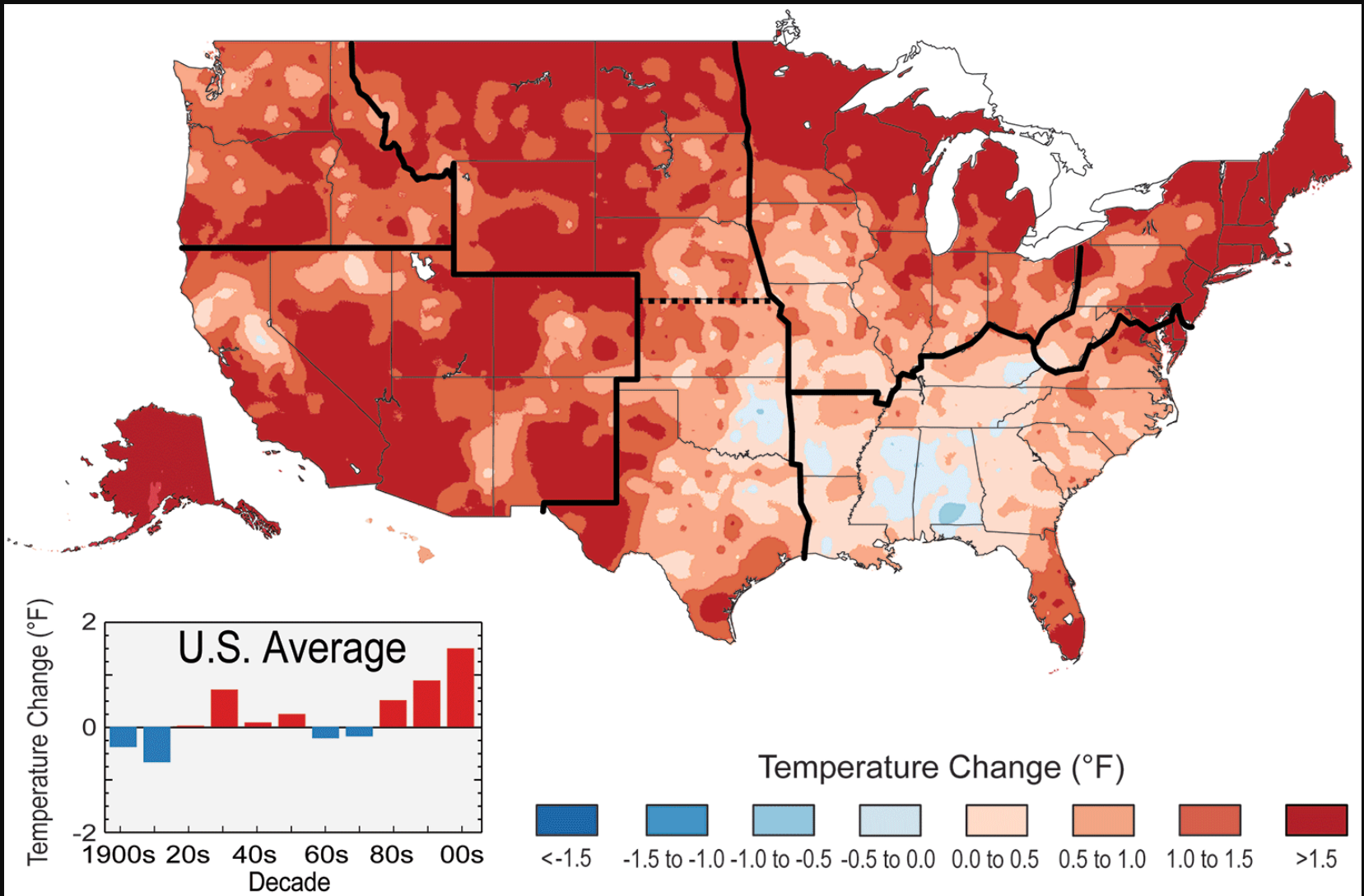


U.S. Climate is Changing and Some Extremes are Increasing

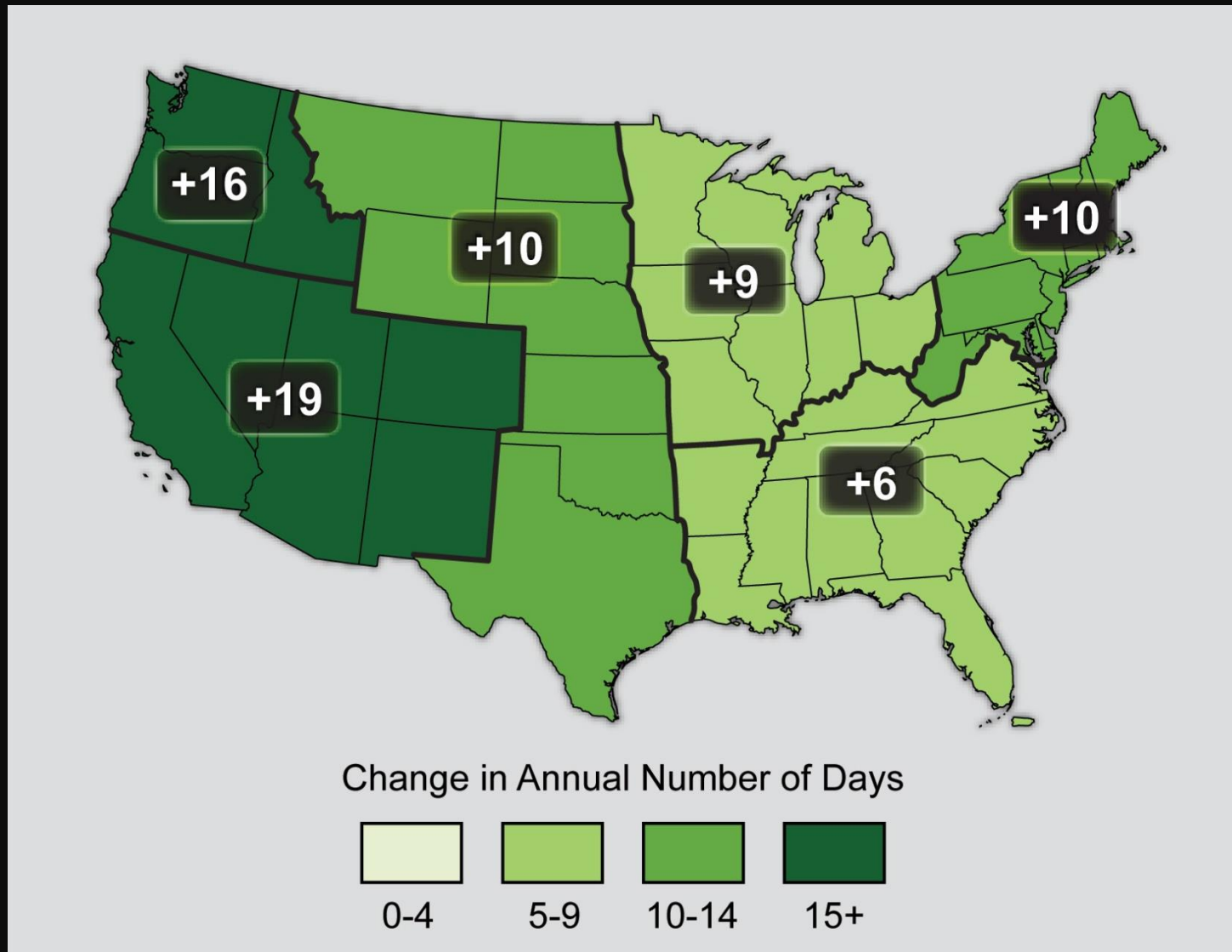


© John Mark/AP/Corbis

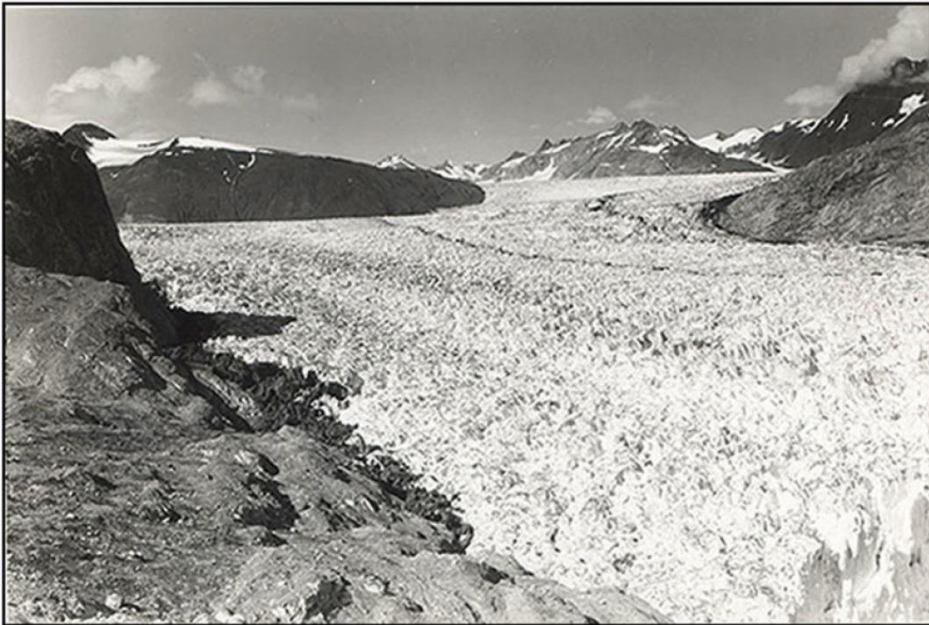
Observed U.S. Temperature Change



Observed Increases in Frost-Free Season



Glacier Decline Muir Glacier Alaska



August 1941

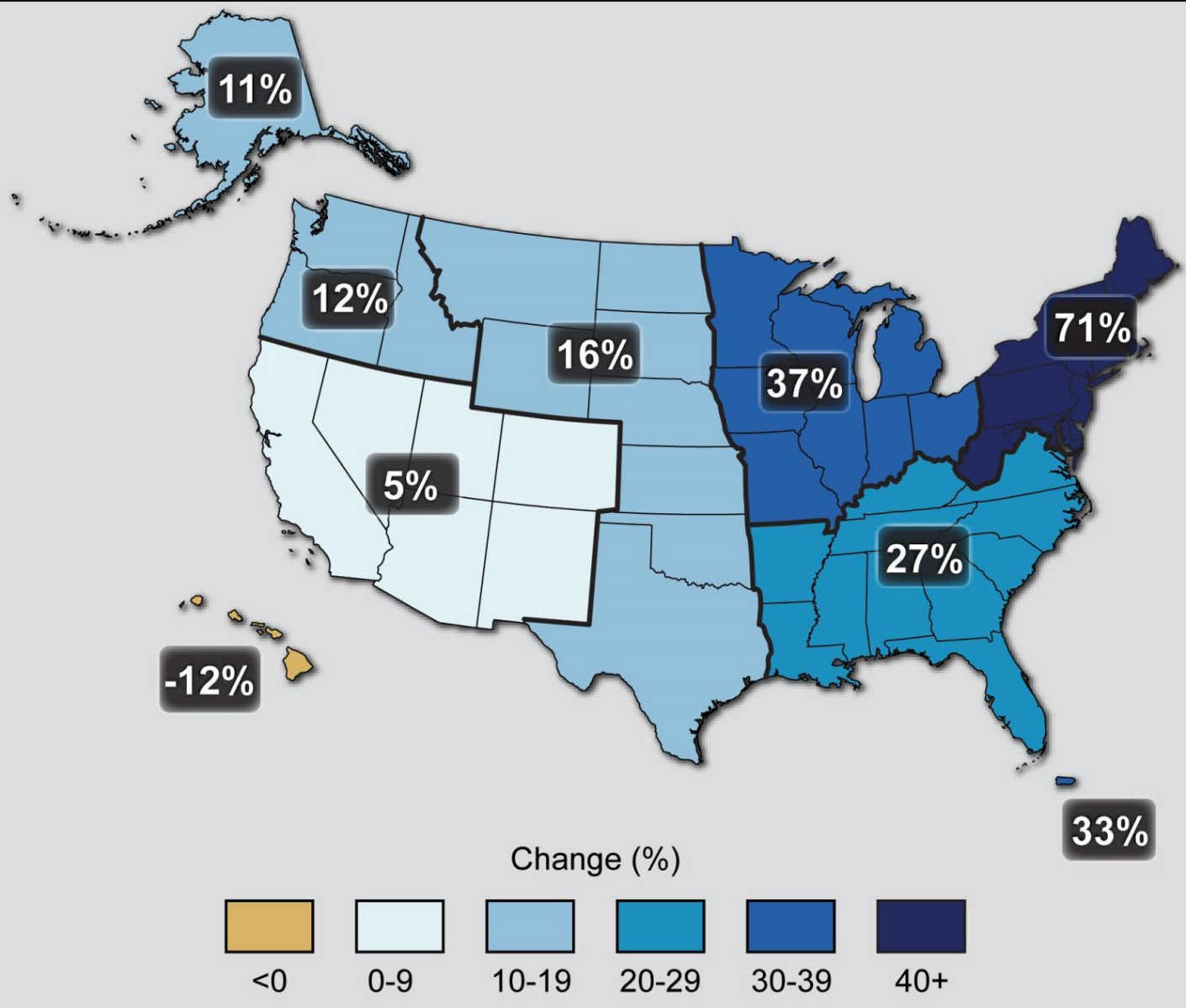


August 2004

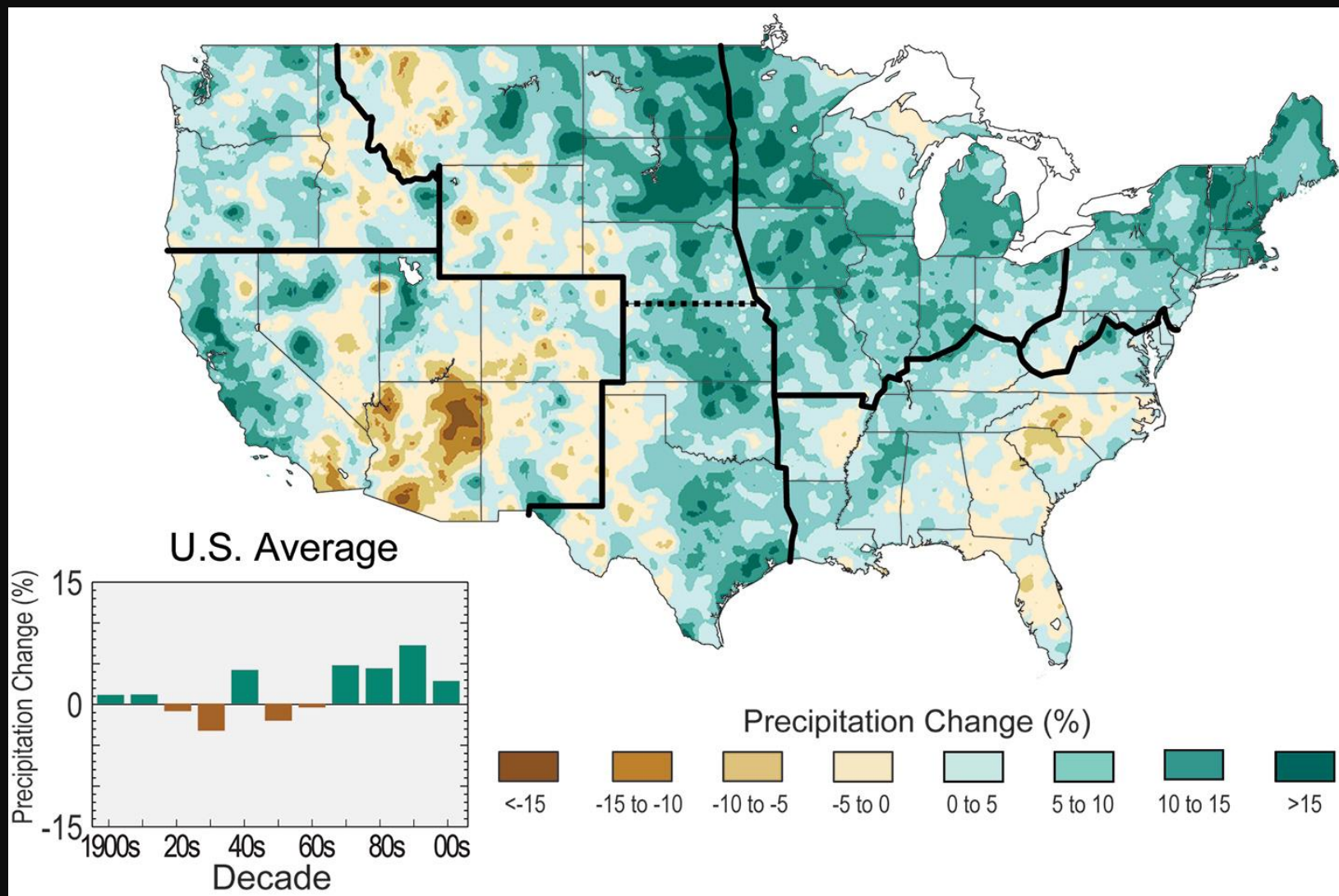
Observed U.S. Trends in Heavy Precipitation (2d 5yr Event)



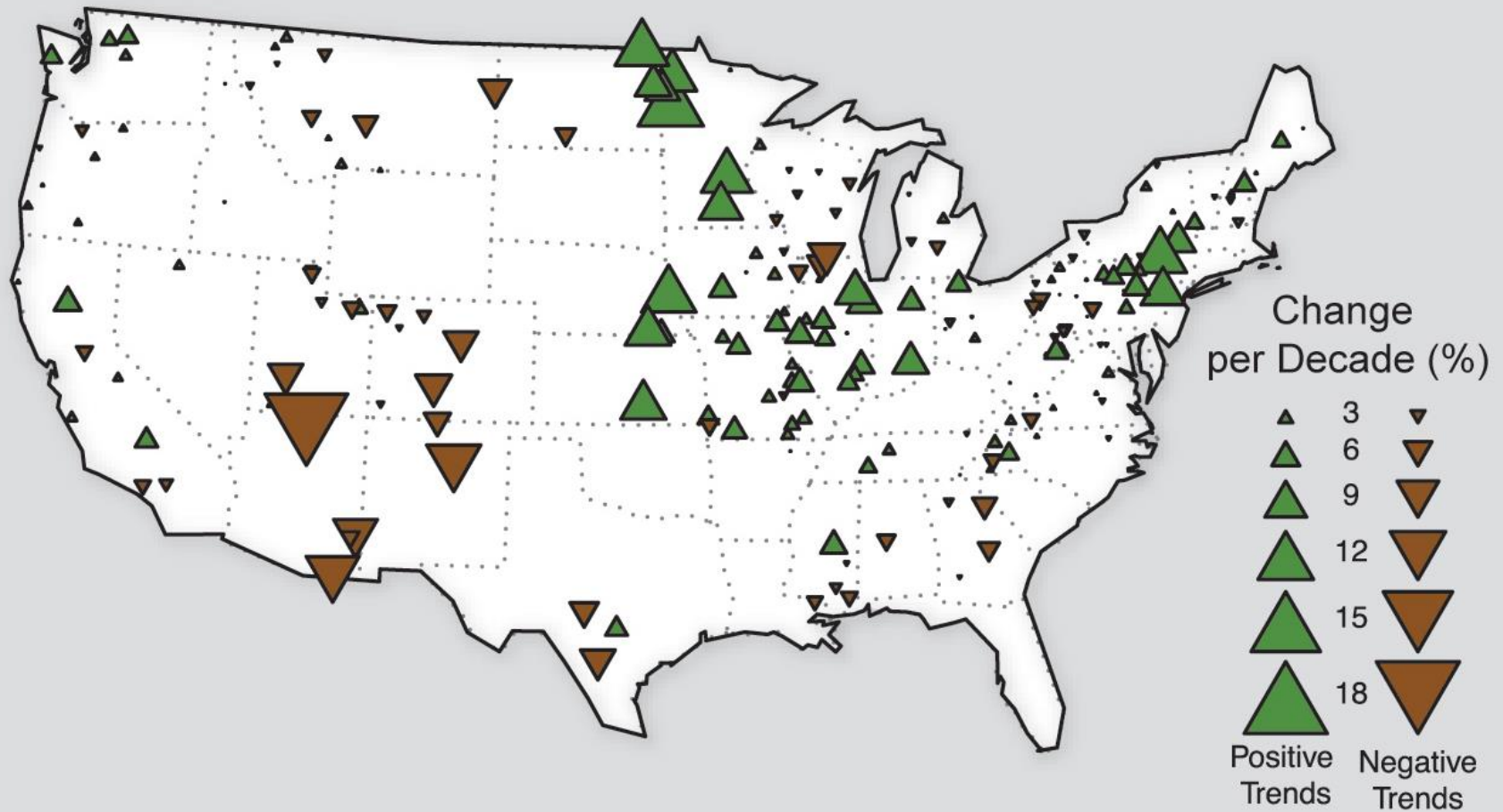
Observed Change in Very Heavy Precipitation



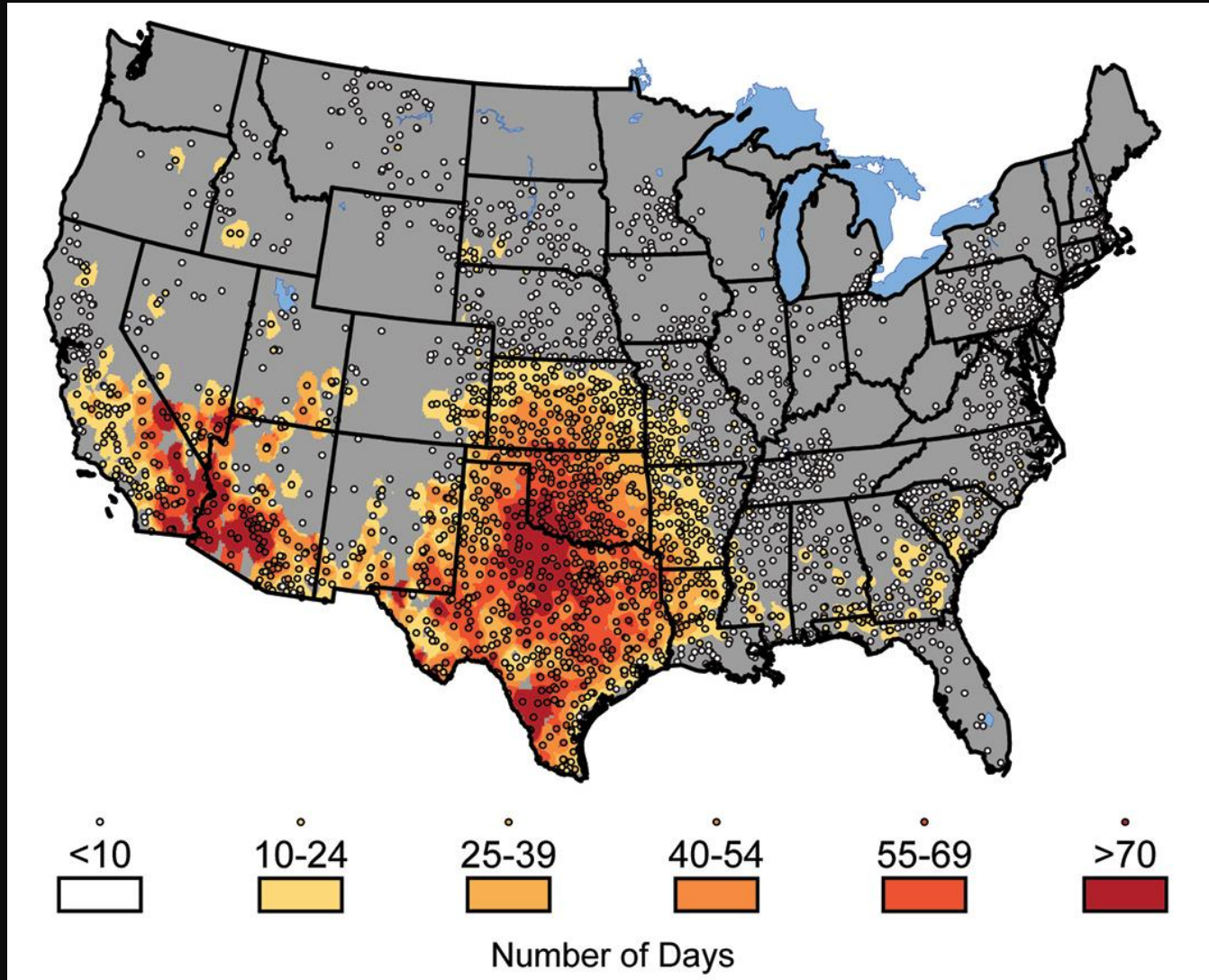
Observed U.S. Precipitation Change



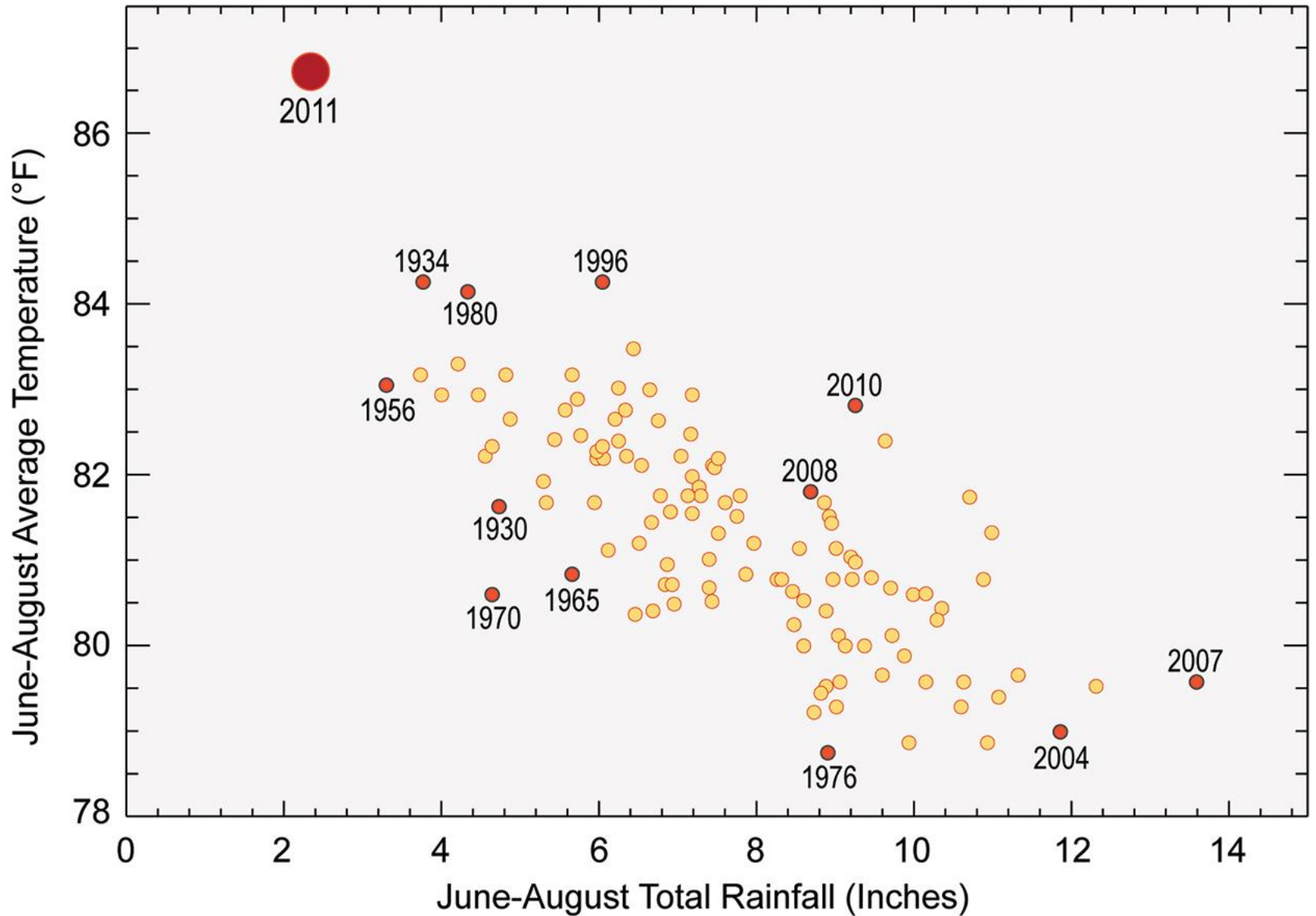
Trends in Flood Magnitude



100-degree Days in 2011



Texas Summer 2011: Record Heat and Drought

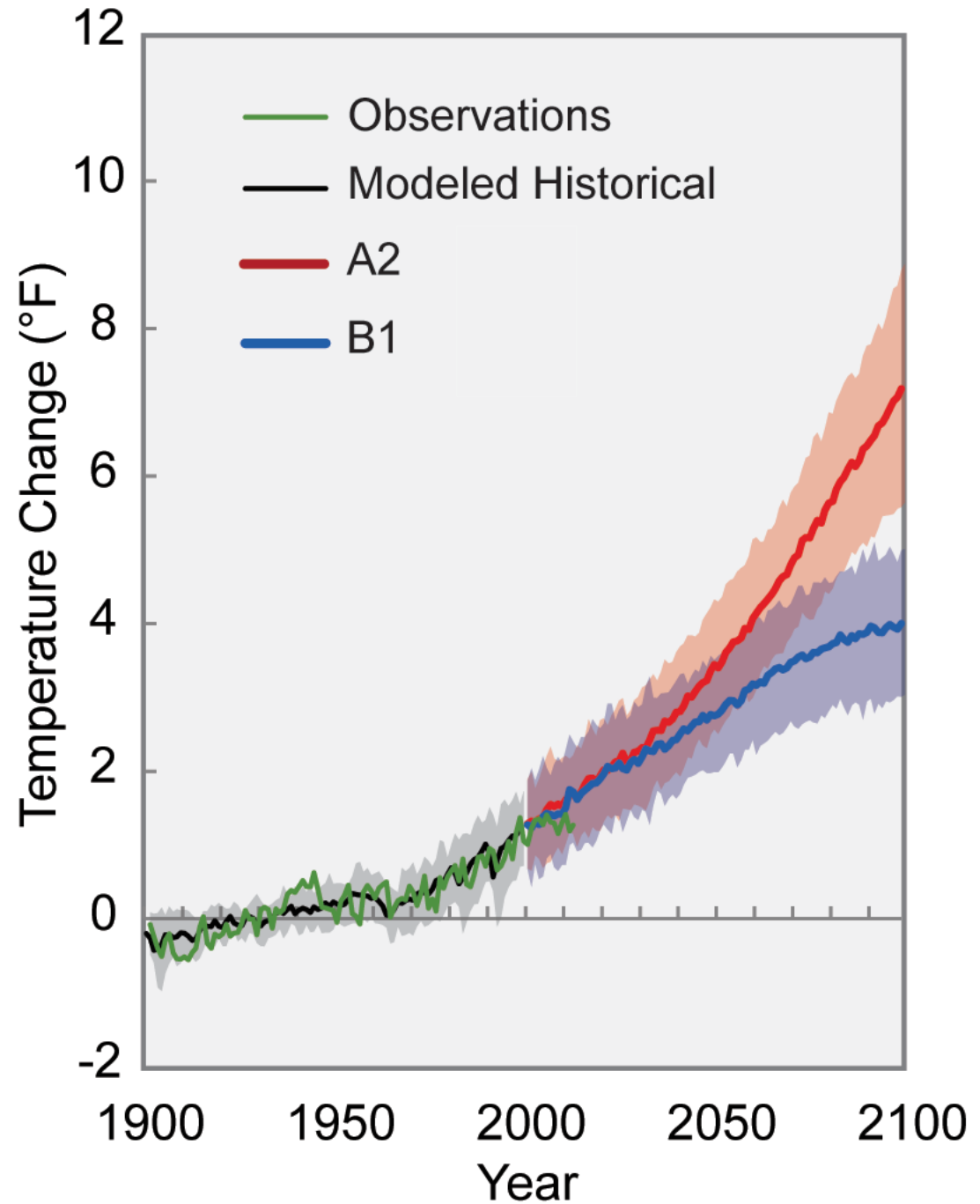


Future Climate Change Depends Primarily on Emissions Levels



© Jim West/Imagebroker/Corbis

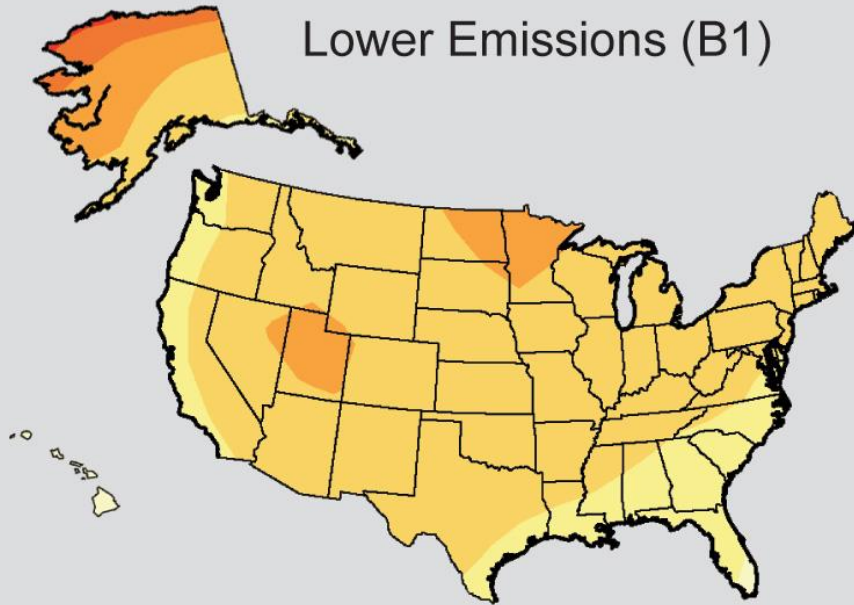
Projected Global Temperature Change



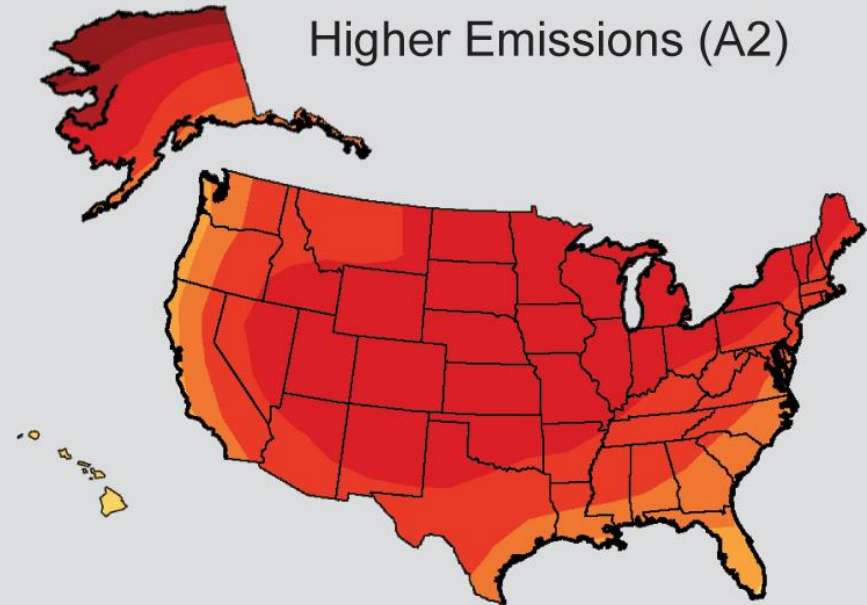
Projected Temperature Change

2071-2099 relative to 1970-1999

Lower Emissions (B1)



Higher Emissions (A2)

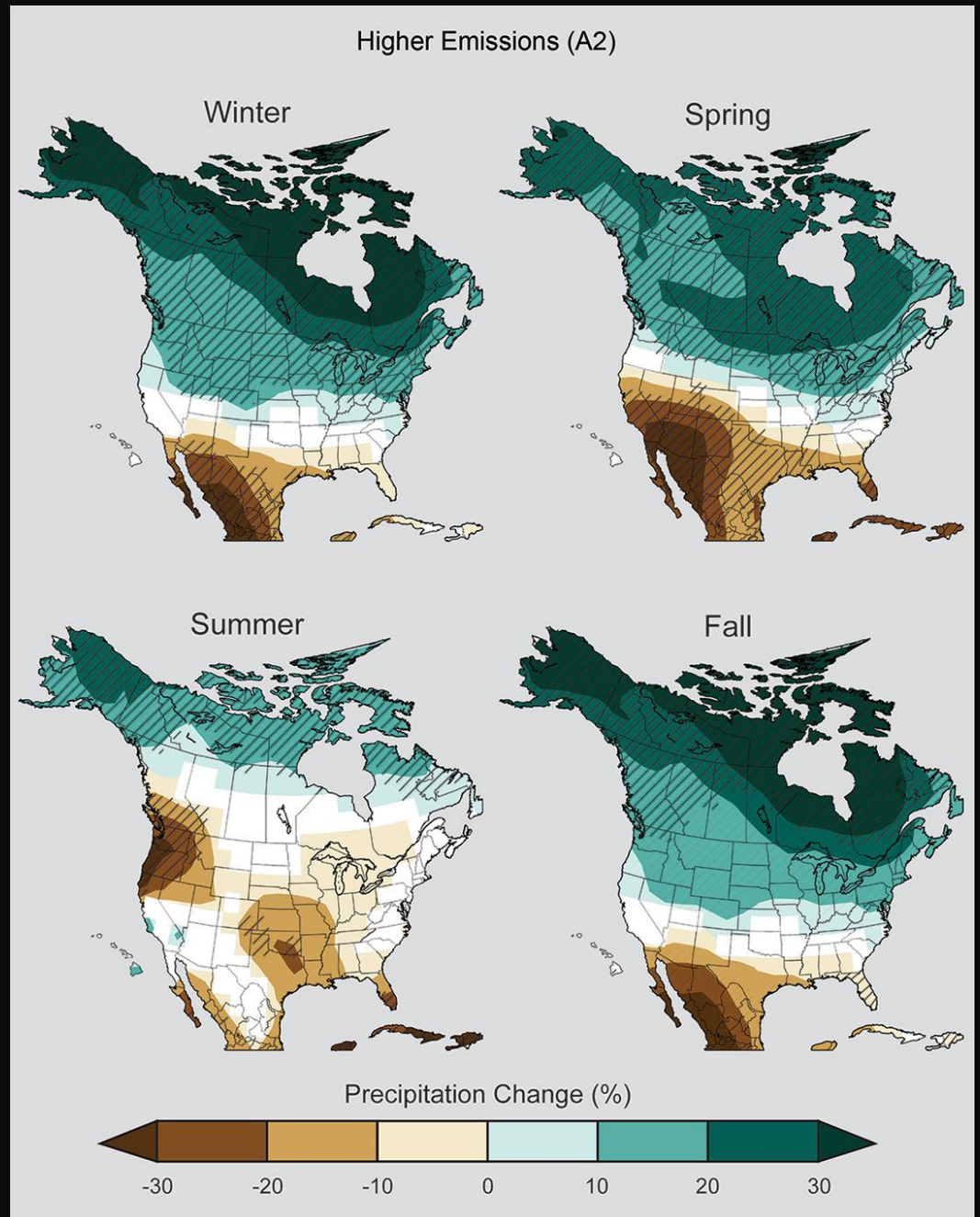


Temperature Change (°F)

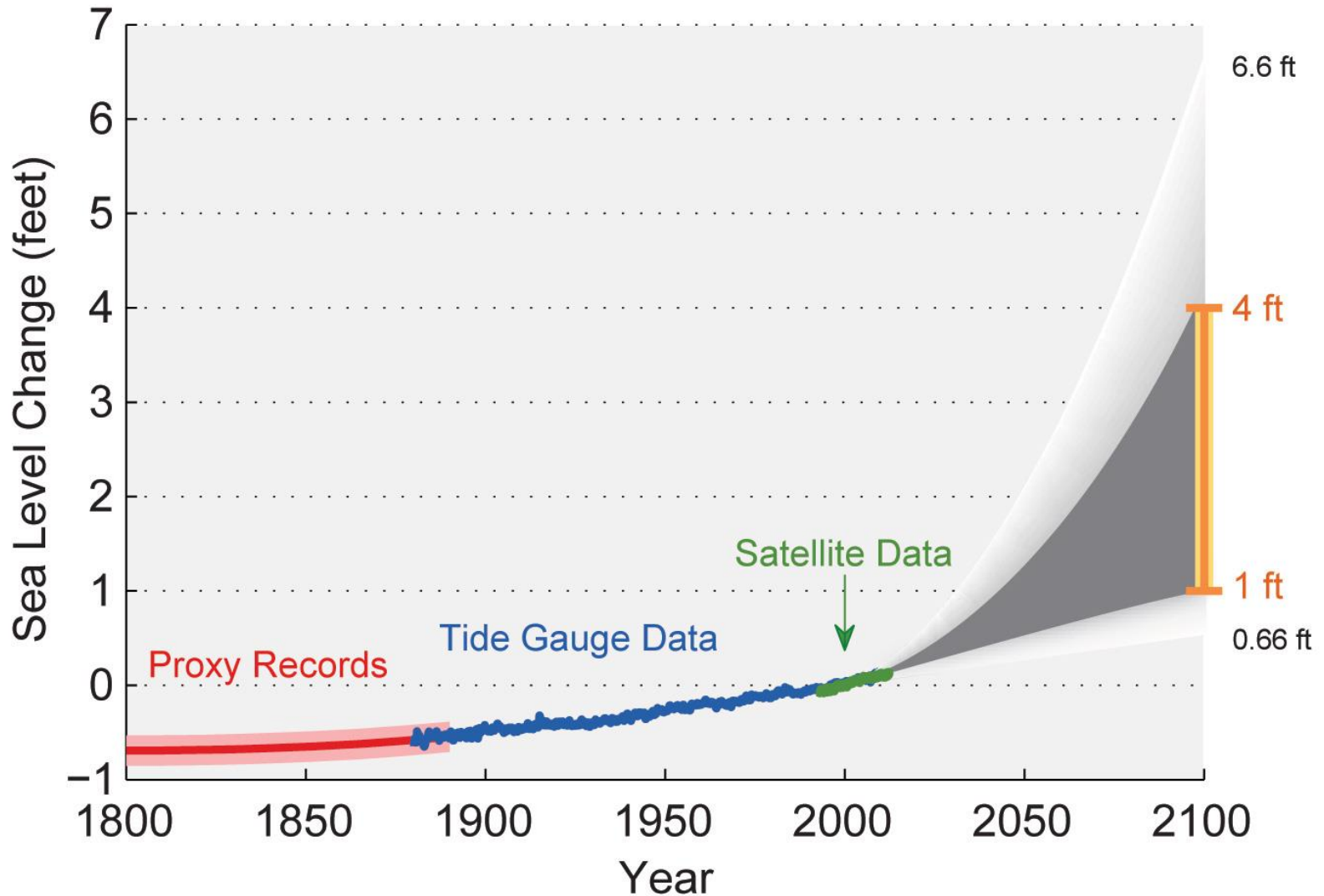


Projected Precipitation Change by Season

More winter/spring precip in the north
Wet regions wetter
Dry regions drier



Past and Projected Changes in Global Sea Level

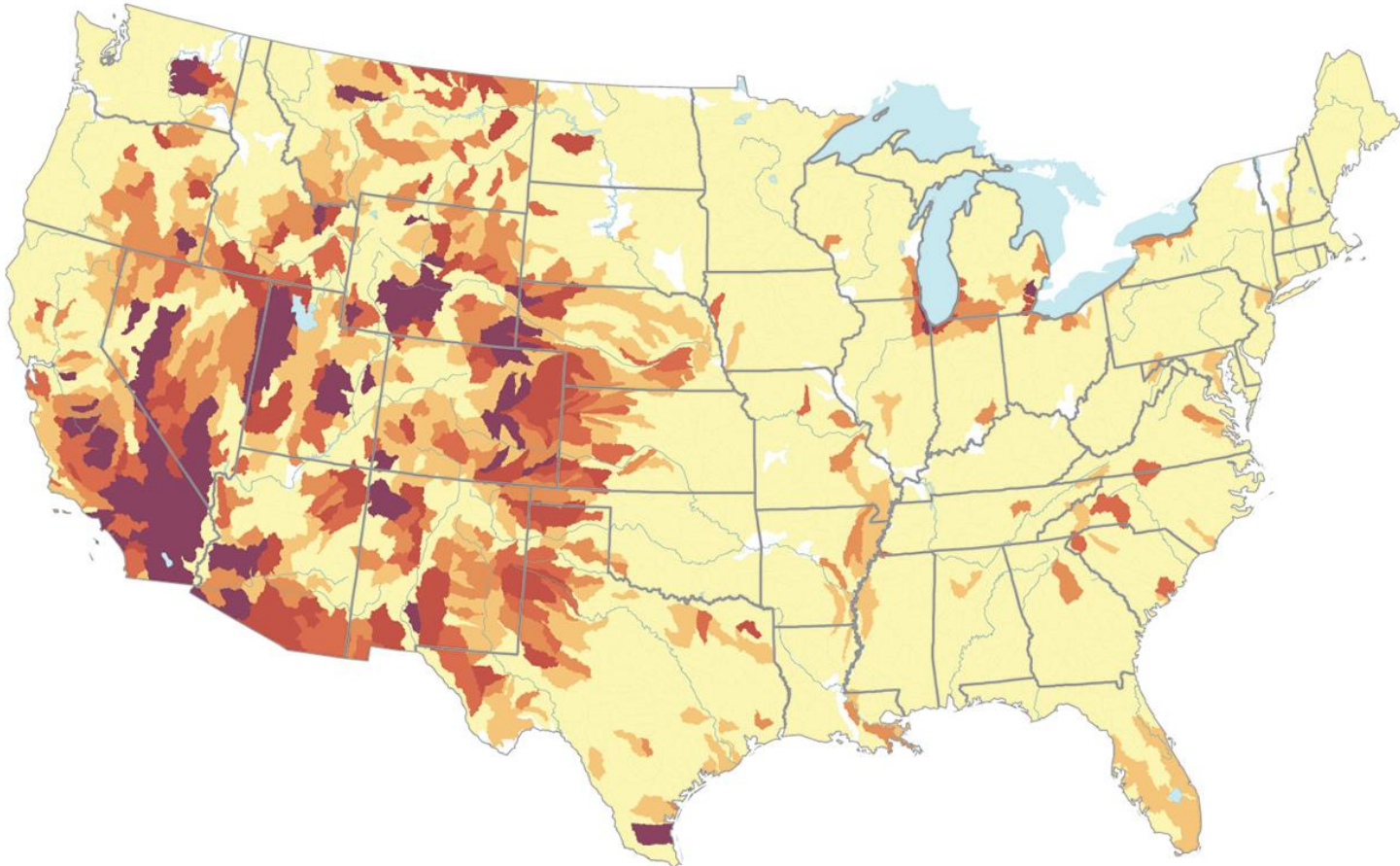


Impacts Are Already Widespread

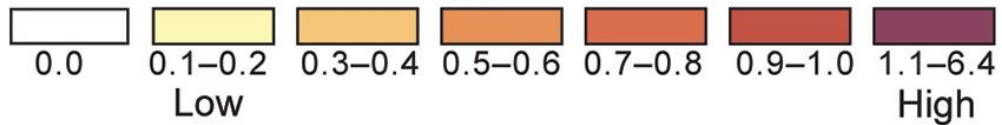


© AP Photo/The Virginian-Pilot, Steve Earley

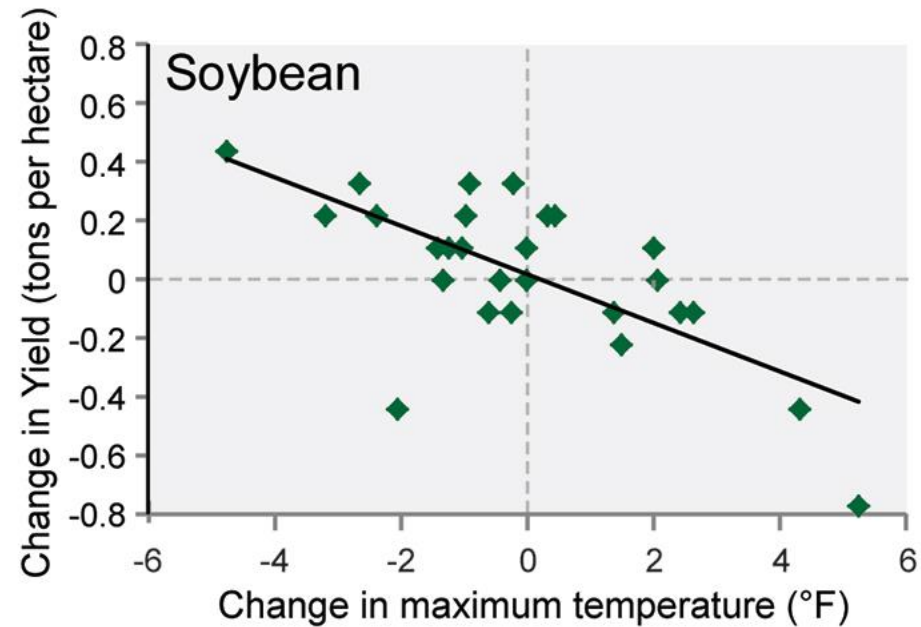
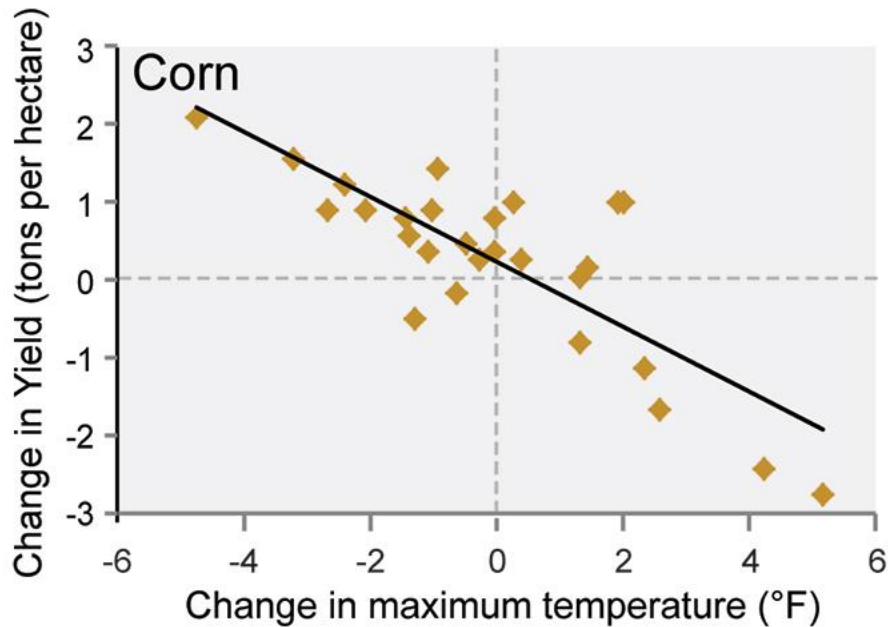
Water Stress in the U. S.



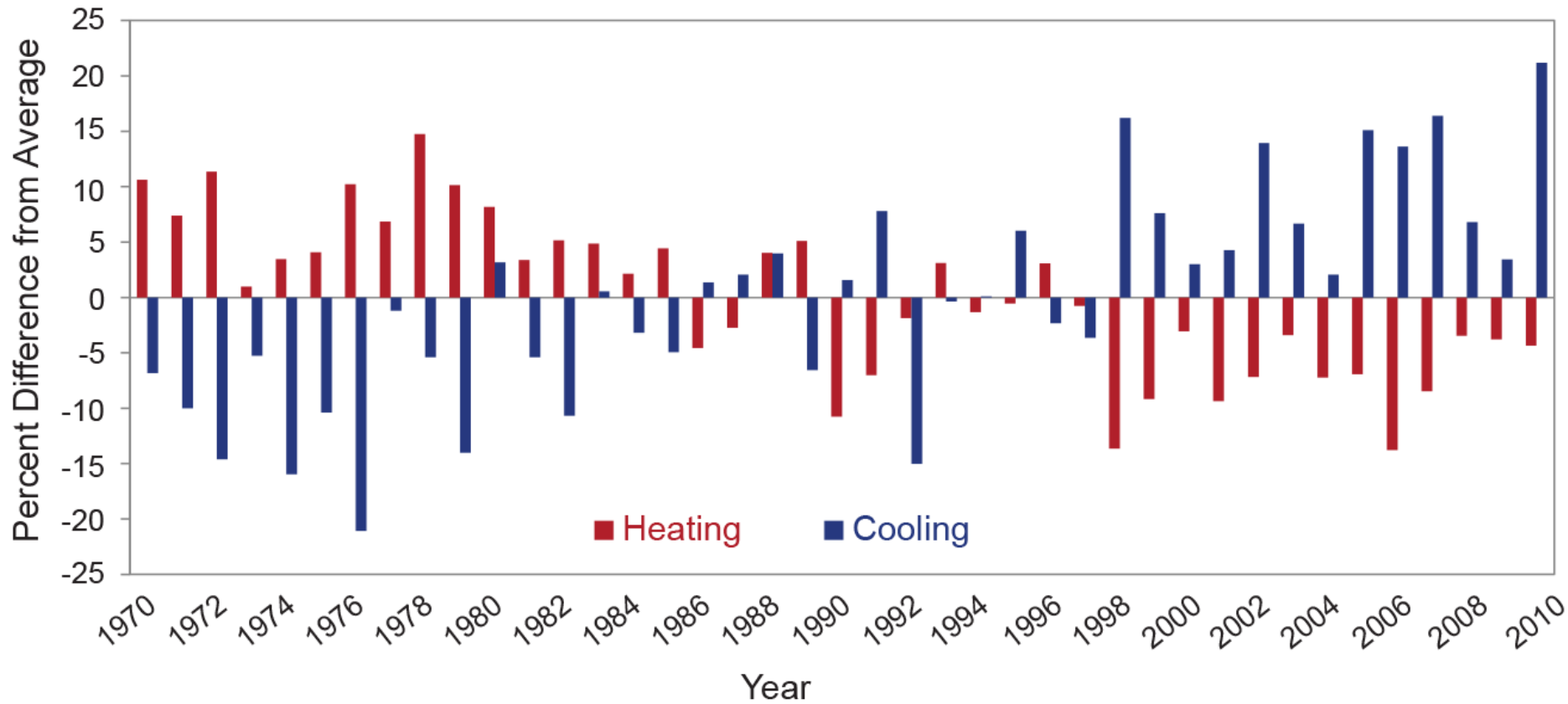
Water Supply Stress Index



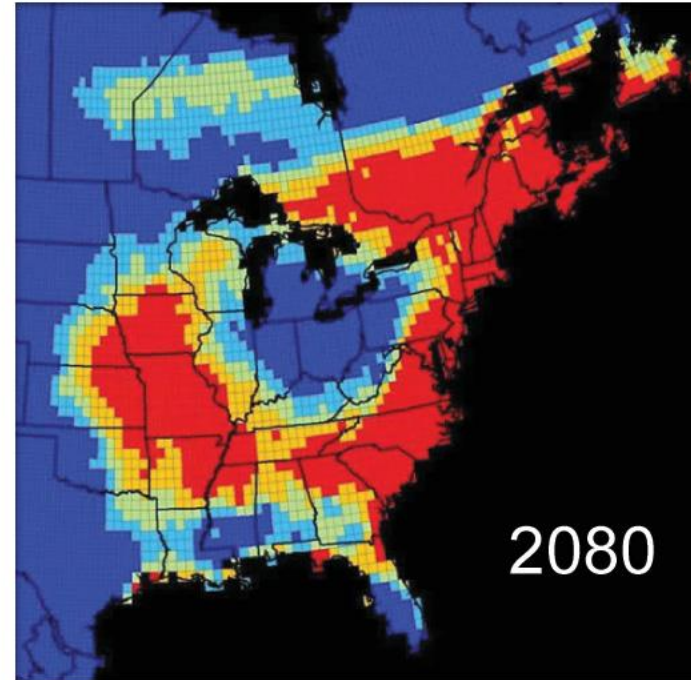
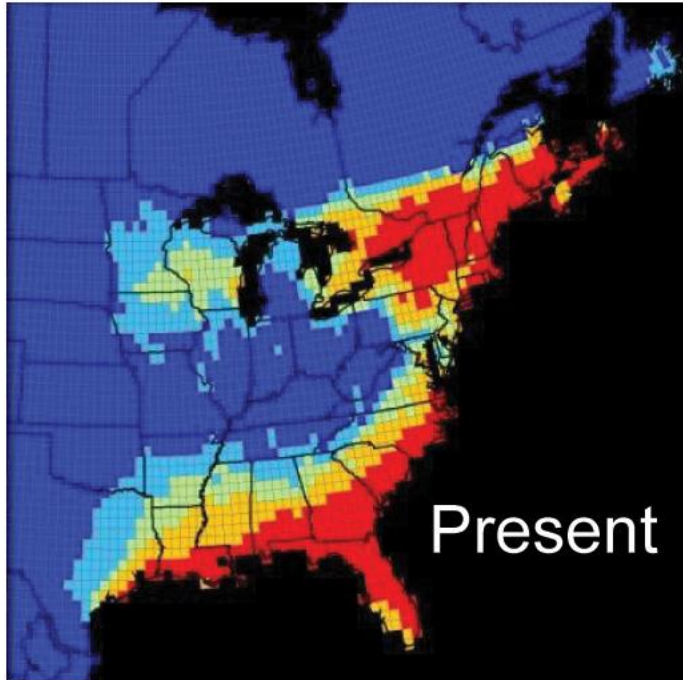
Crop Yields Decline under Higher Temperatures



Increase in Cooling Demand and Decrease in Heating Demand



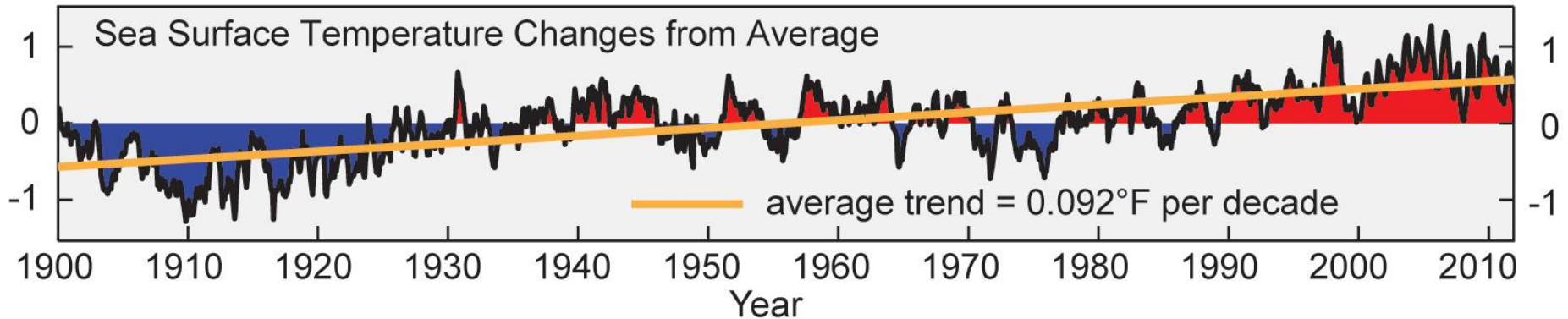
Projected Changes in Tick Habitat



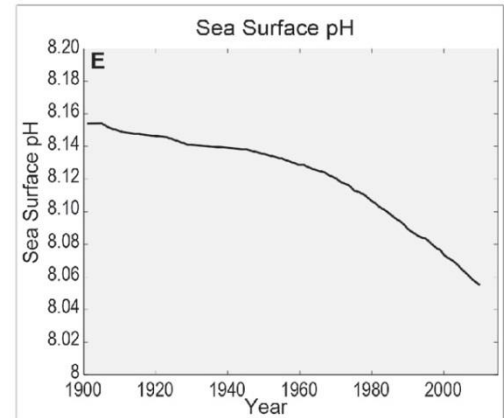
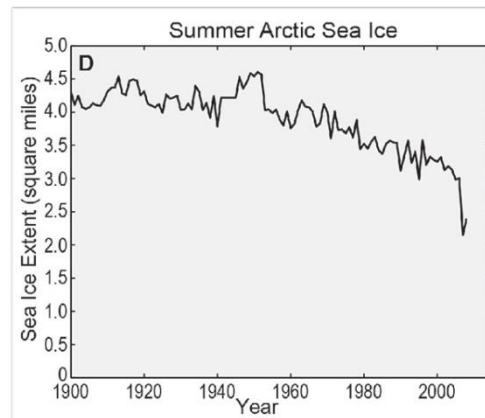
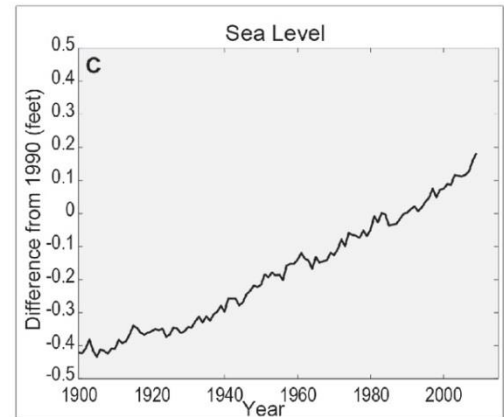
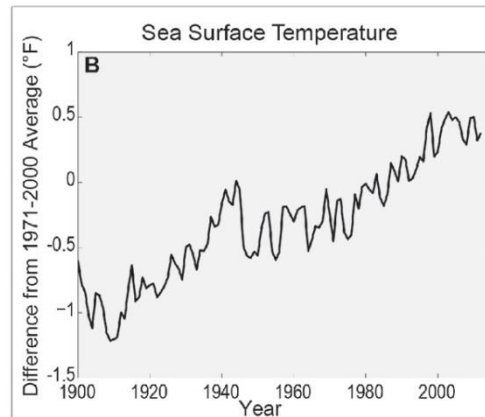
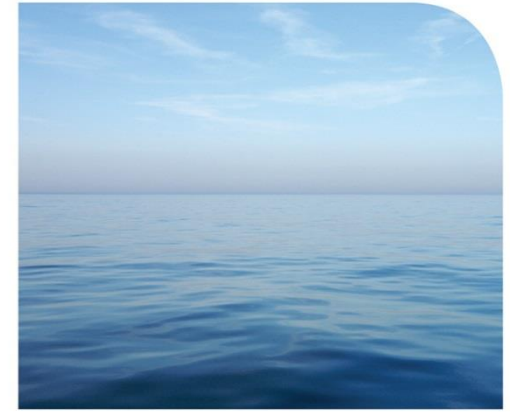
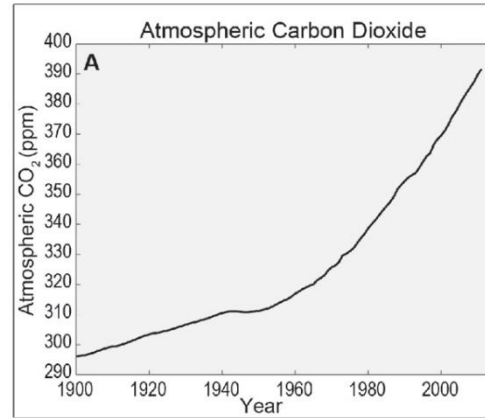
Tick Establishment Probability (%)



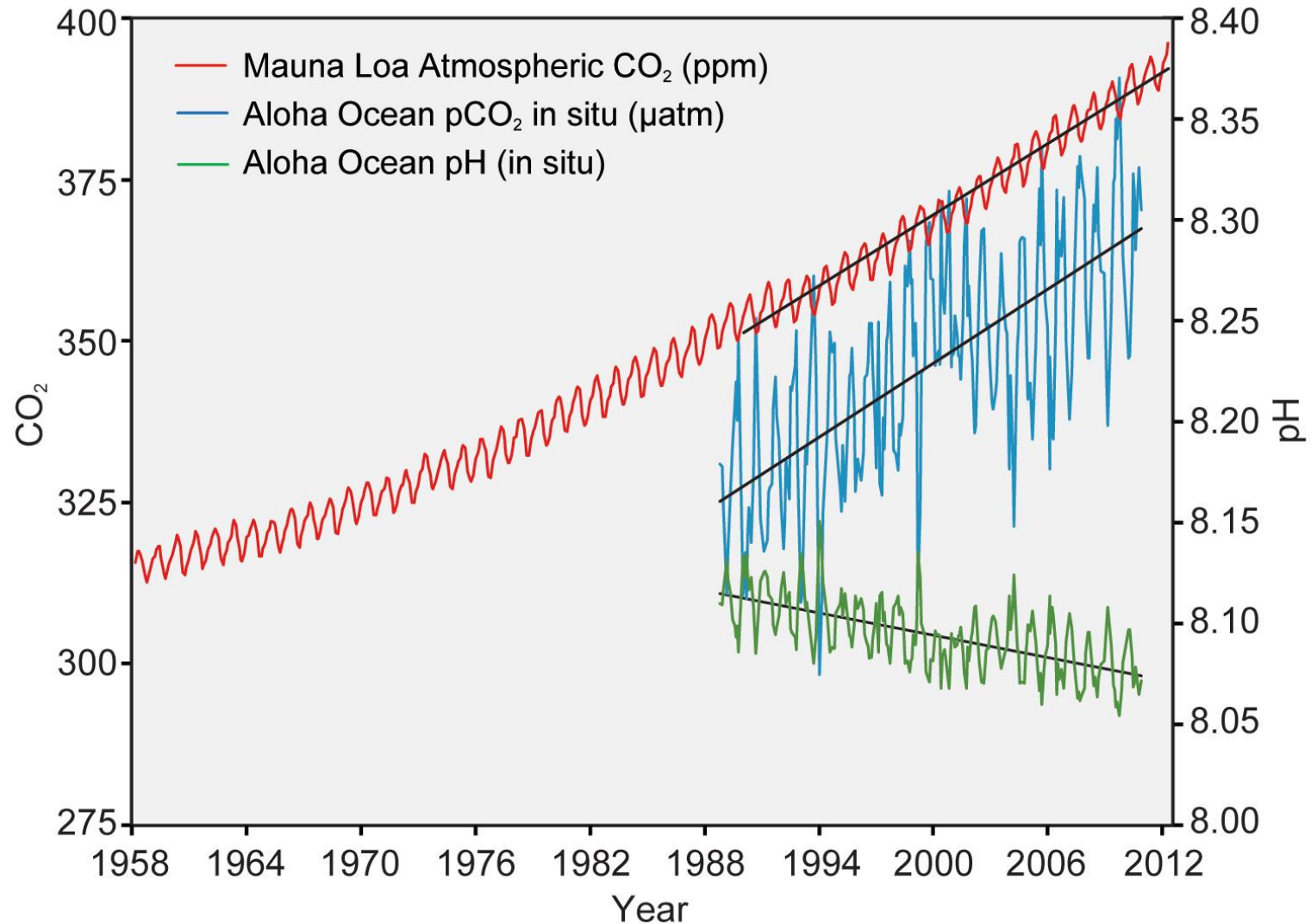
Observed Ocean Warming



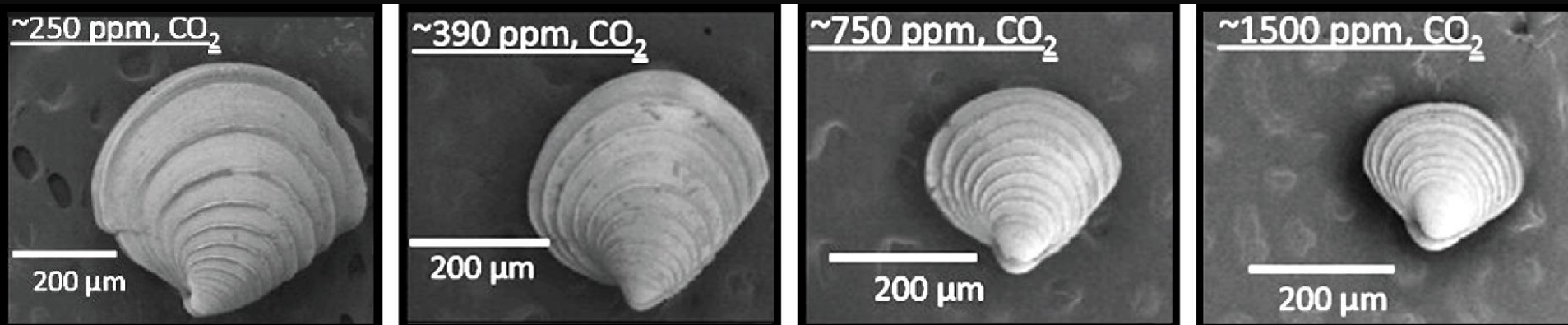
Ocean Impacts of Increased Atmospheric Carbon Dioxide



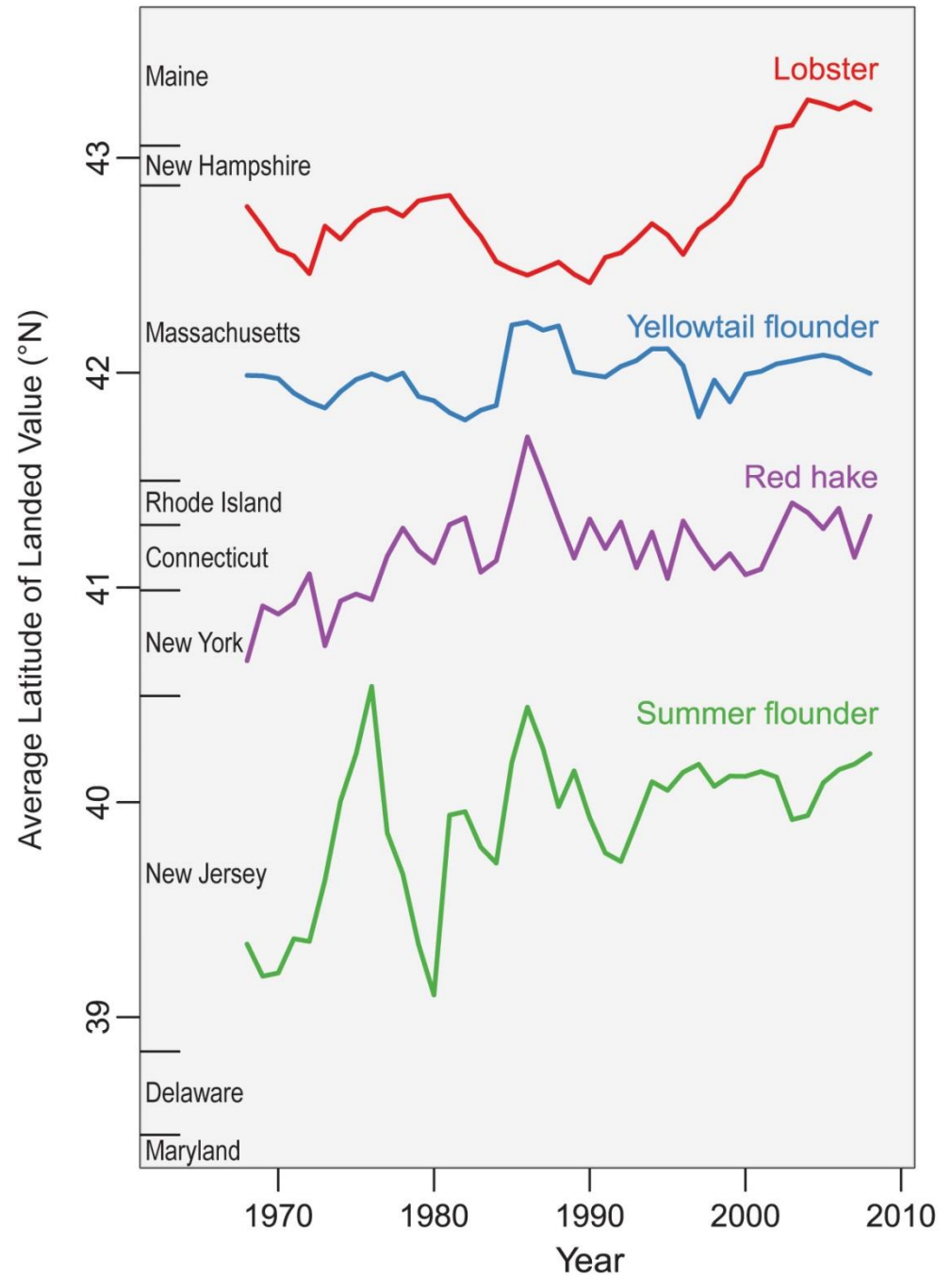
As Oceans Absorb CO₂ They Become More Acidic



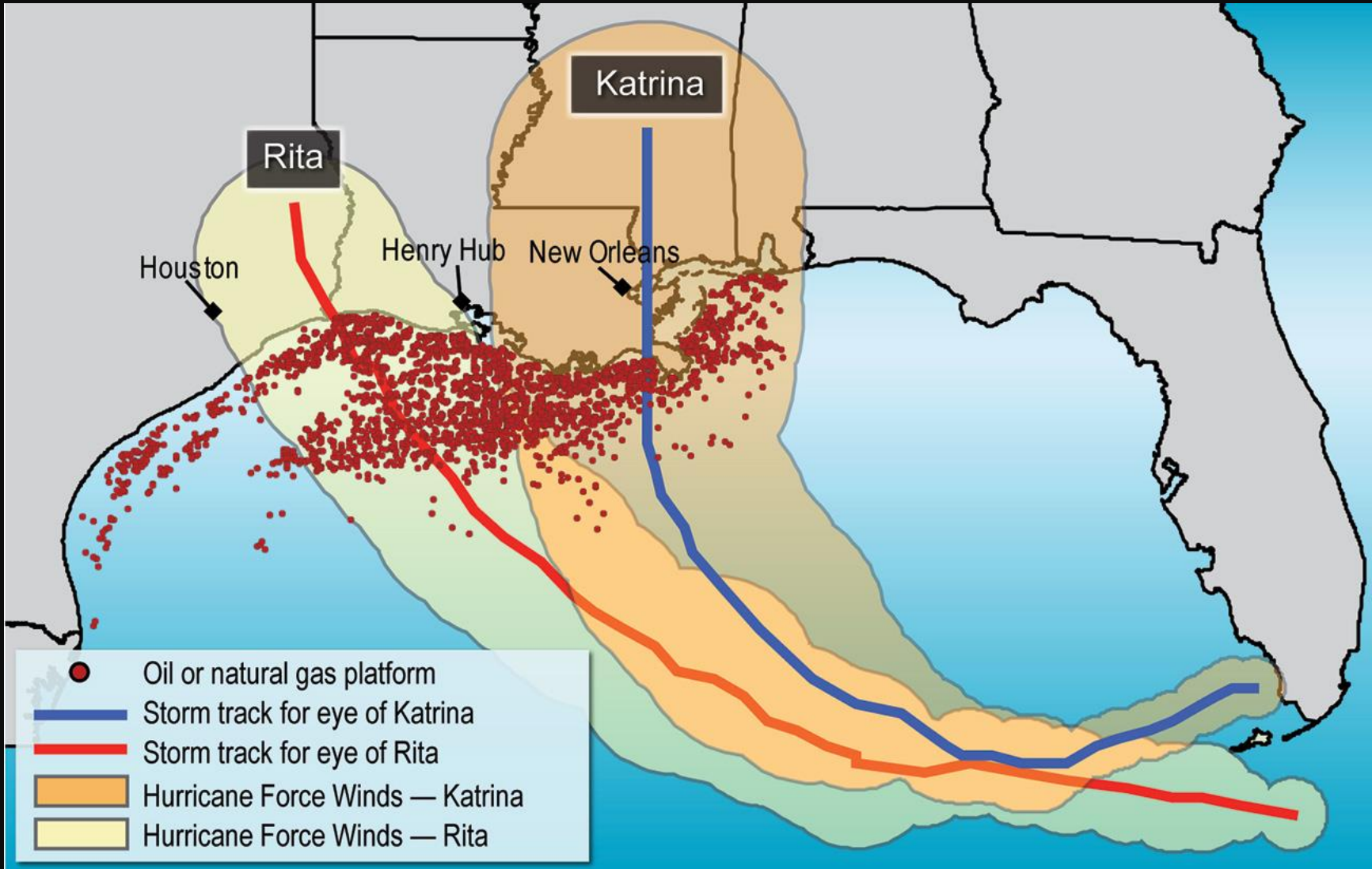
Ocean Acidification Reduces Size of Clams



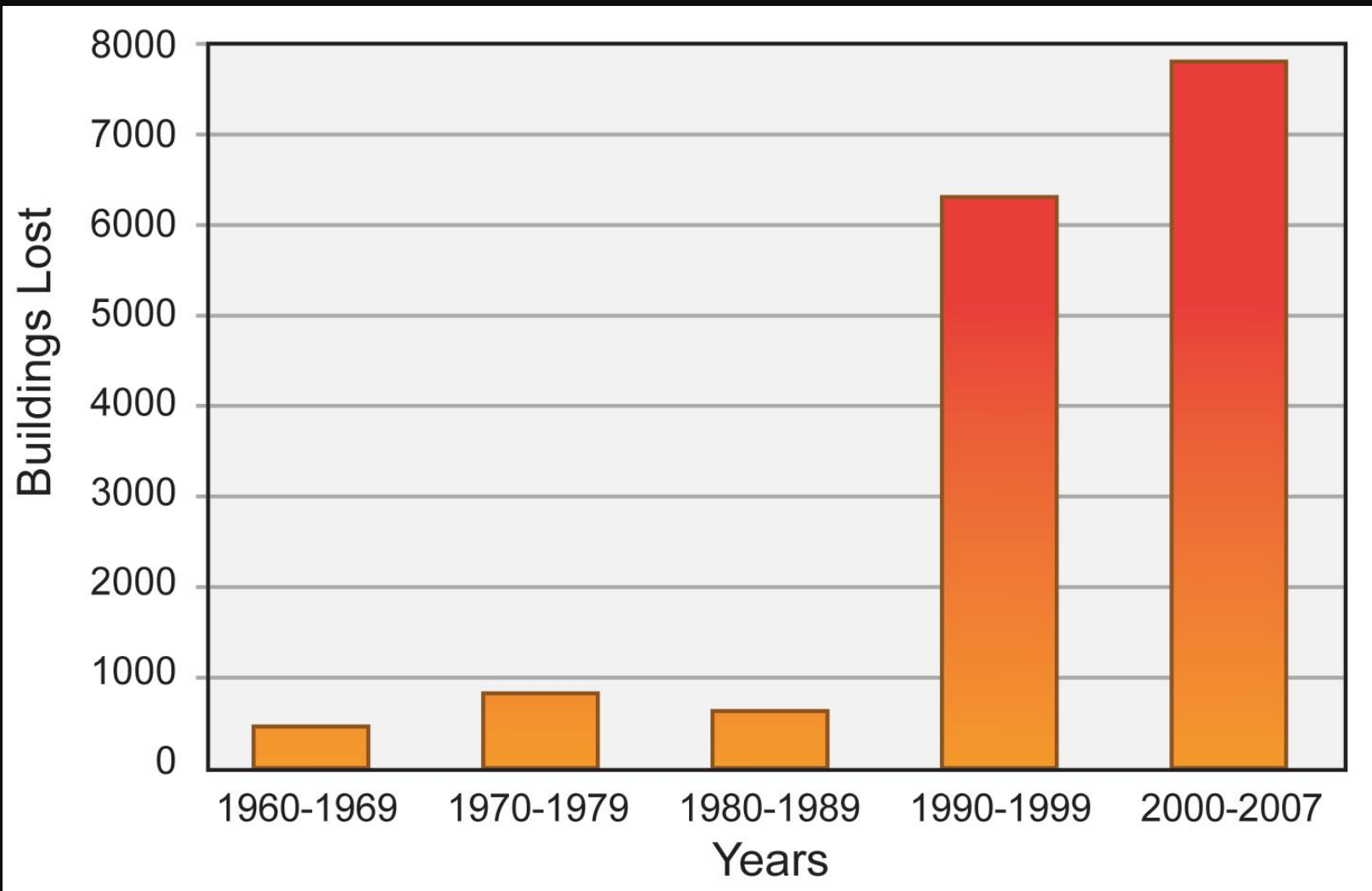
Fisheries Shifting North



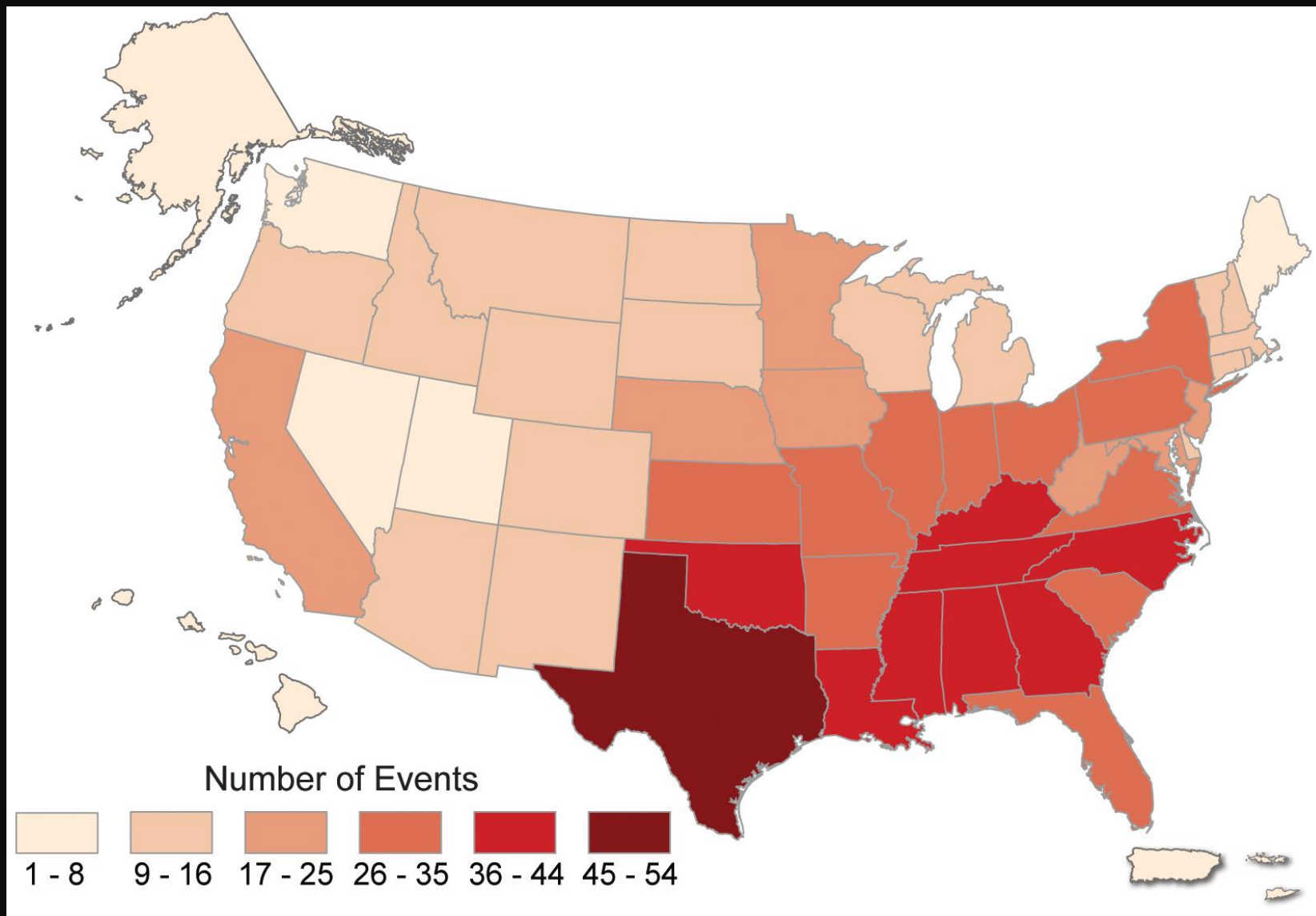
Paths of Hurricanes Katrina and Rita Relative to Oil and Gas Production Facilities



Building Loss by Fires at California Wildland-Urban Interfaces



Billion Dollar Weather/Climate Disasters 1980-2012



Impacts are Projected to Increase

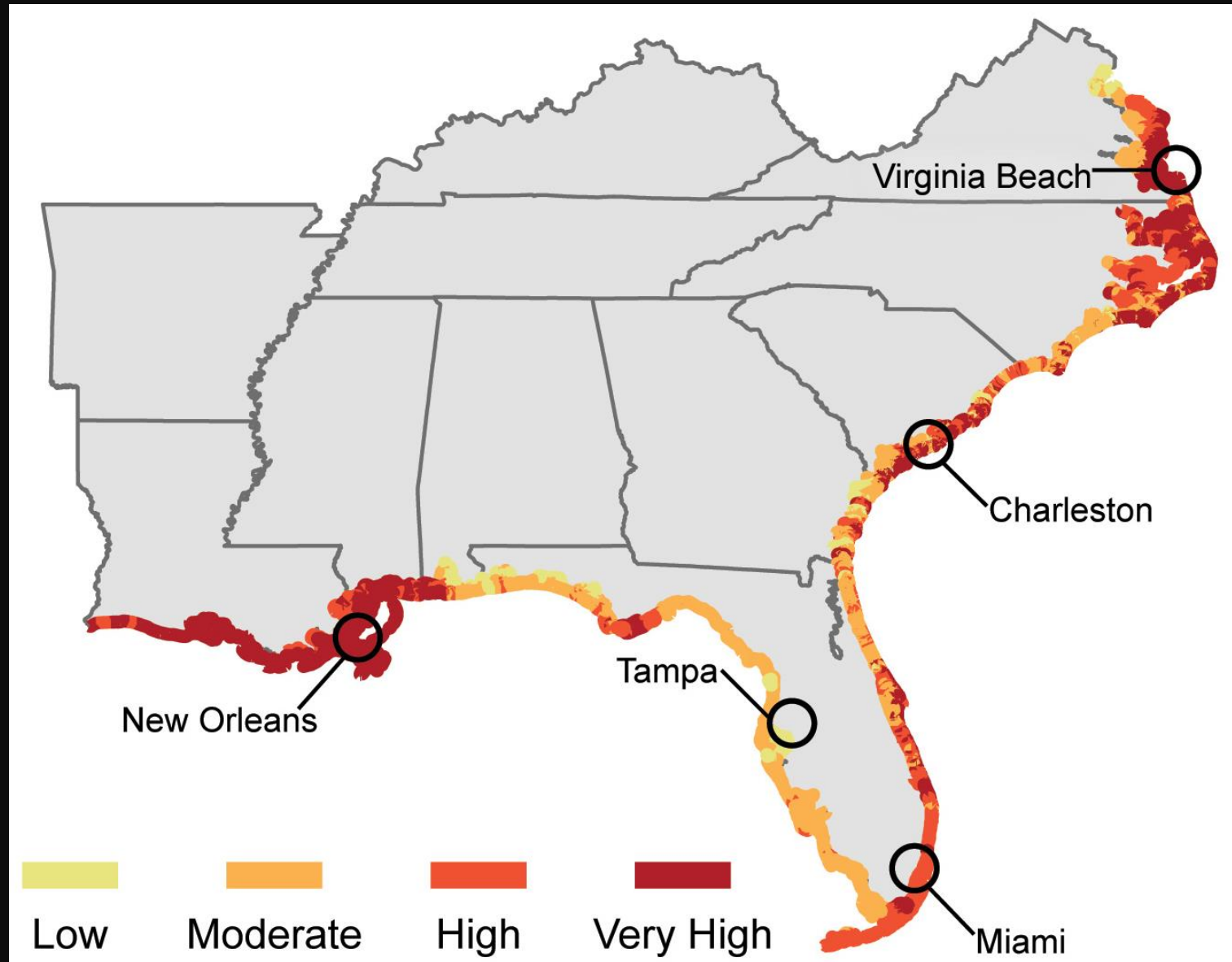


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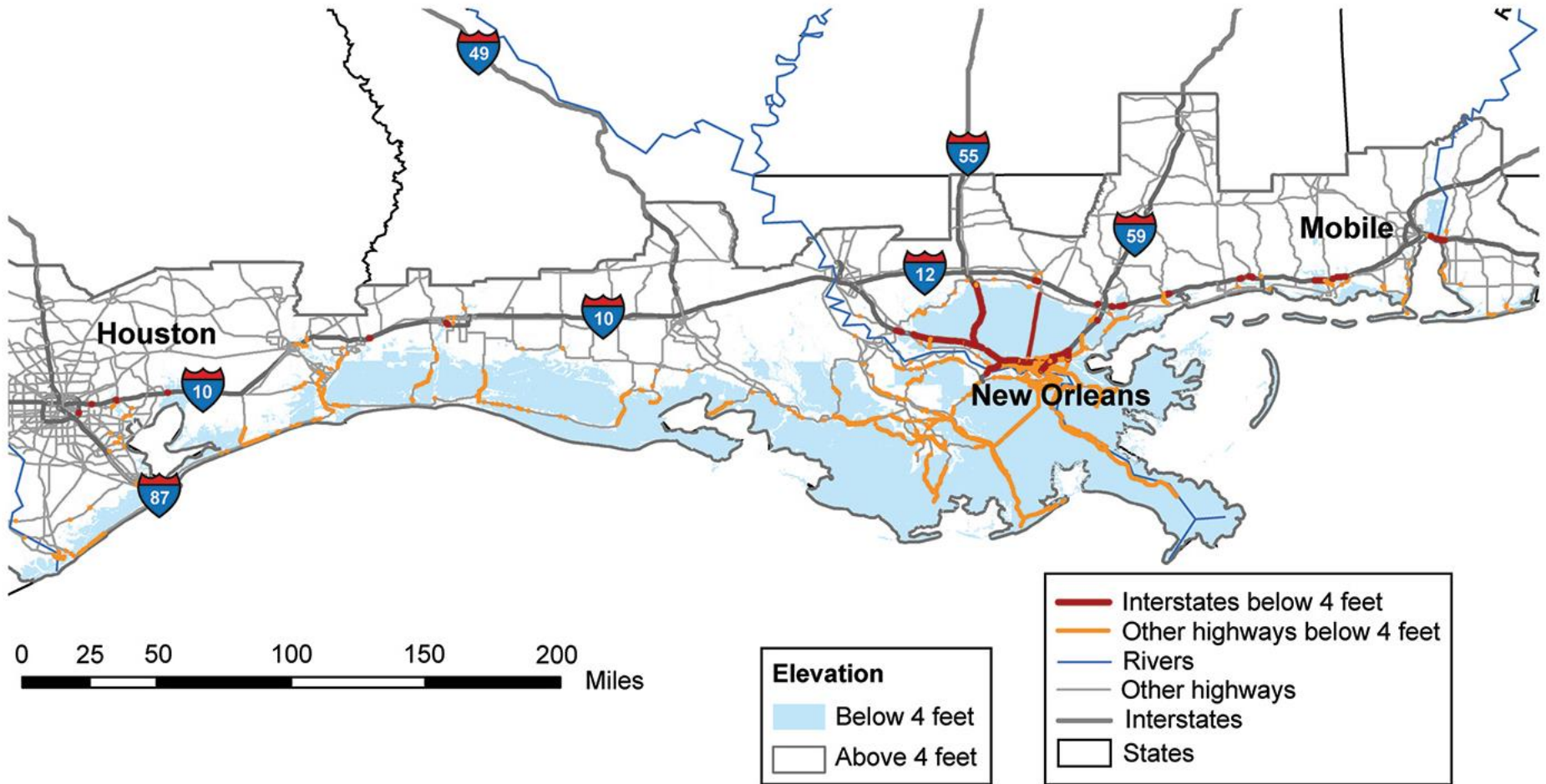


NOAA

Vulnerability to Sea Level Rise



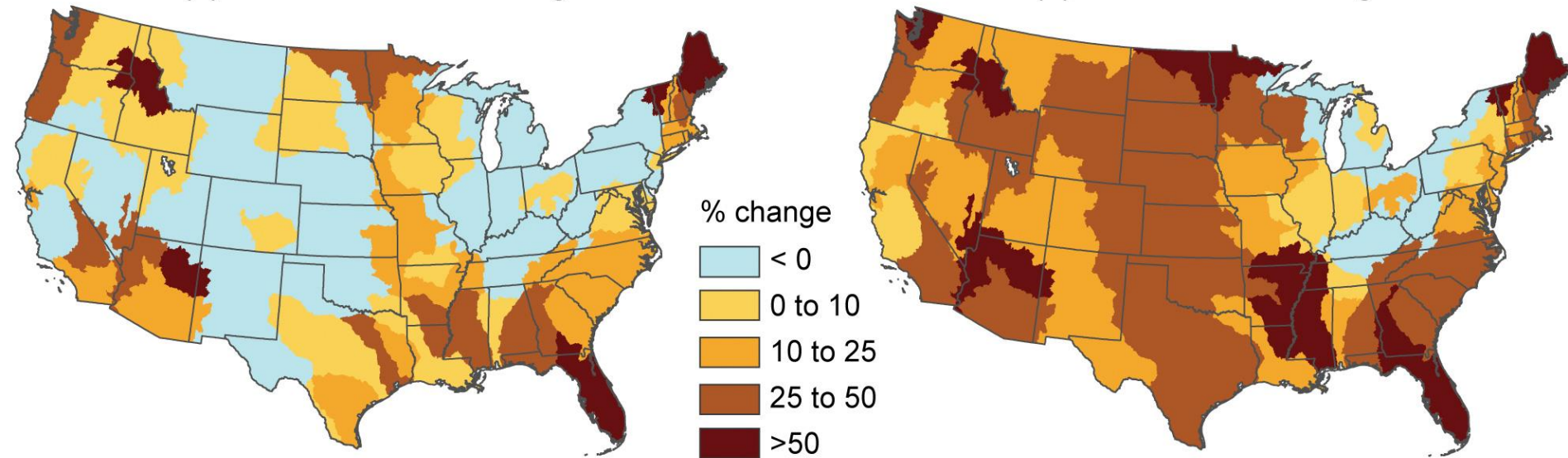
Gulf Coast Transportation Hubs at Risk



Projected Changes in Water Withdrawals

(a) Without Climate Change

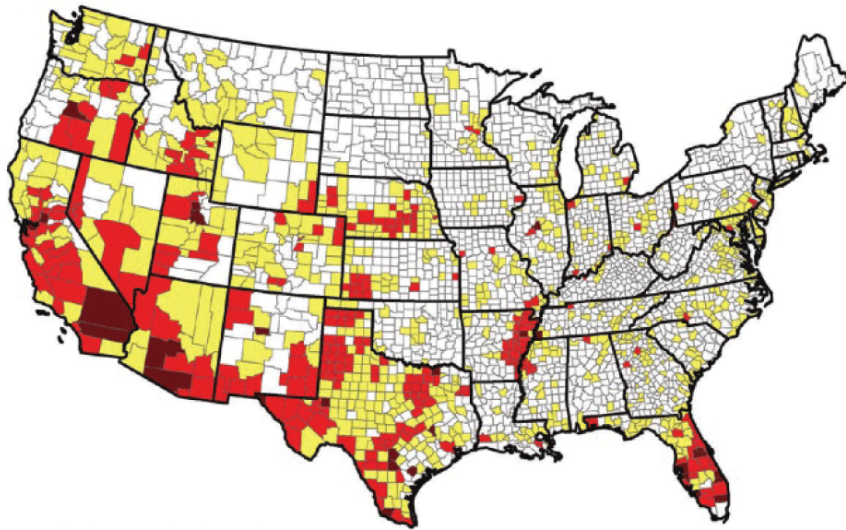
(b) With Climate Change



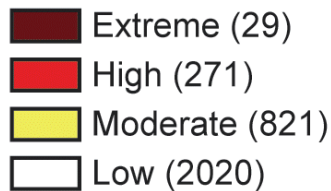
Both scenarios include projected population and land use change effects

Water Supplies Projected to Decline

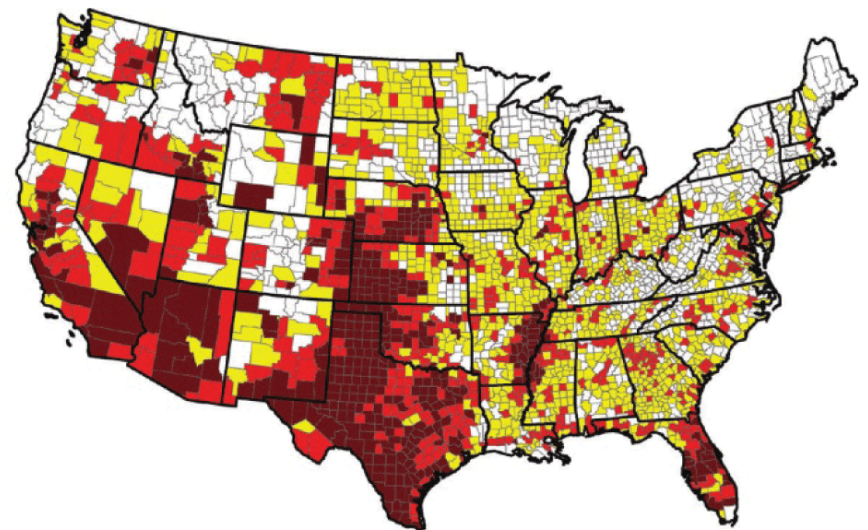
(a) No Climate Change Effects



Water Supply Sustainability Risk Index (2050)



(b) Climate Change Effects



Water Supply Sustainability Risk Index (2050)



Responses

There are important opportunities to reduce future warming by reducing greenhouse gas emissions and increasing carbon dioxide uptake.

There are also actions we can take to prepare for impacts that are already unavoidable.

Some actions are already underway.

Mitigation



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© Najlah Fearnny/Corbis

Adaptation



©Esperanza Stancioff, UMaine Extension and Maine Sea Grant



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FEMA photo by Wendell A. Davis Jr.

Date

Name of Meeting

Questions

Climate Change Impacts
in the United States

The National Climate Assessment

Thank you