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Concerned Scientists**



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Energy Study Institute



How Climate Change Affects the United States

Exploring the NCA and IPCC Reports

February 25, 2019

Materials will be available at:

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EESI

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- Founded in **1984** by a **bipartisan** Congressional caucus.
- Now an **independent**, bipartisan **nonprofit** with no Congressional funding.
- We provide **fact-based information** on **energy** and **environmental** policy for Congress and other policymakers.
- We focus on **win-win solutions** to make our energy, buildings, and transportation sectors **sustainable** and **resilient**.

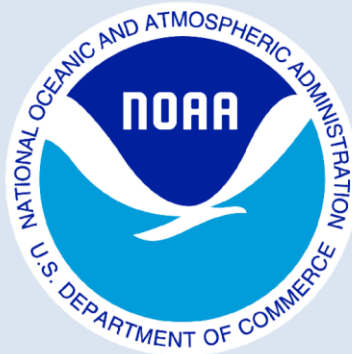
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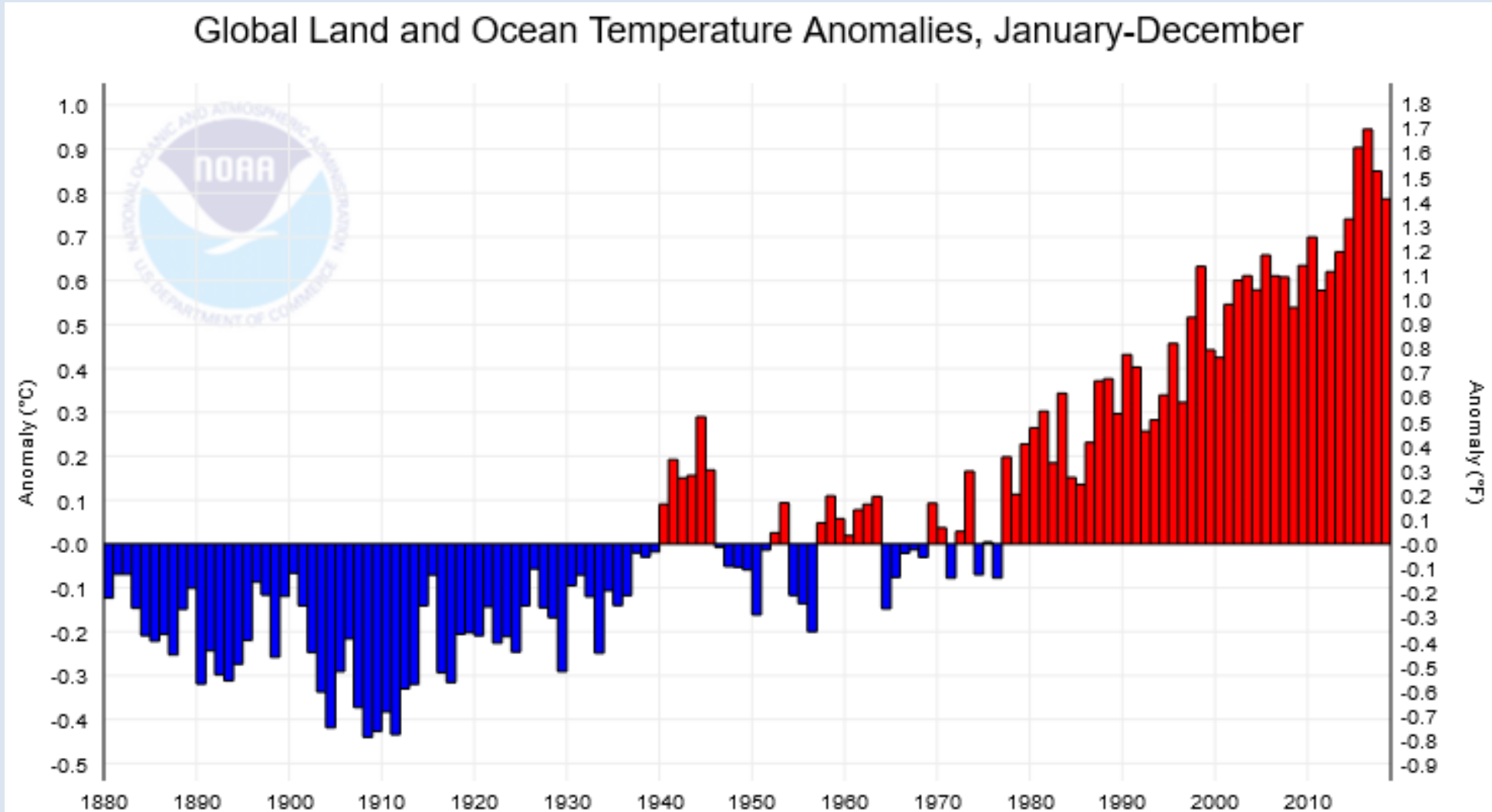
The Fourth National Climate Assessment: Observed Climate Change

David R. Easterling, Ph.D.

**NOAA/NESDIS/National Centers for
Environmental Information
Asheville, NC**



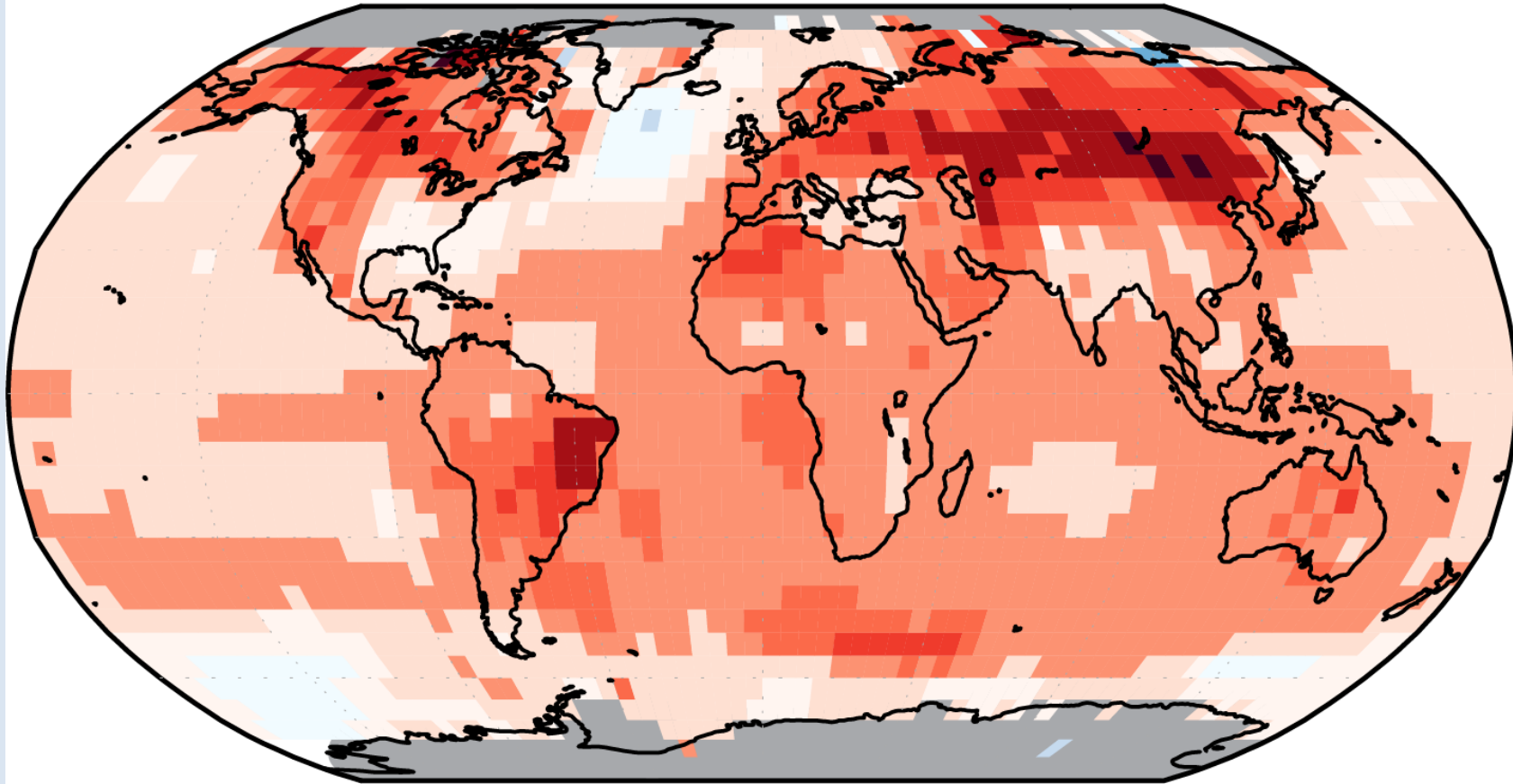
2018 Was 4th Warmest Year on Record



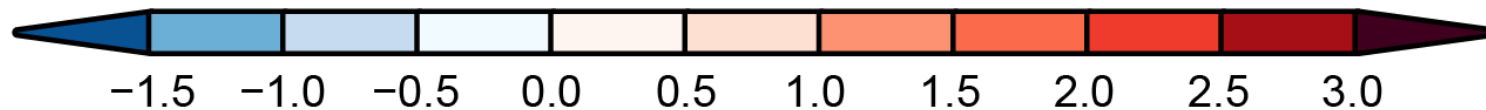
Where Has It Warmed?

Annual Temperature Change Since 1901

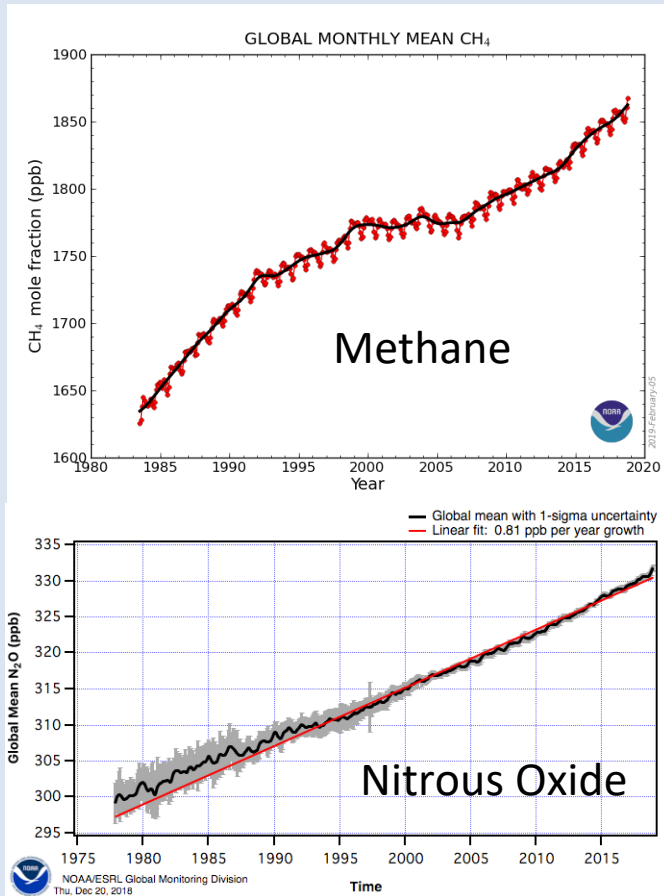
Surface Temperature Change



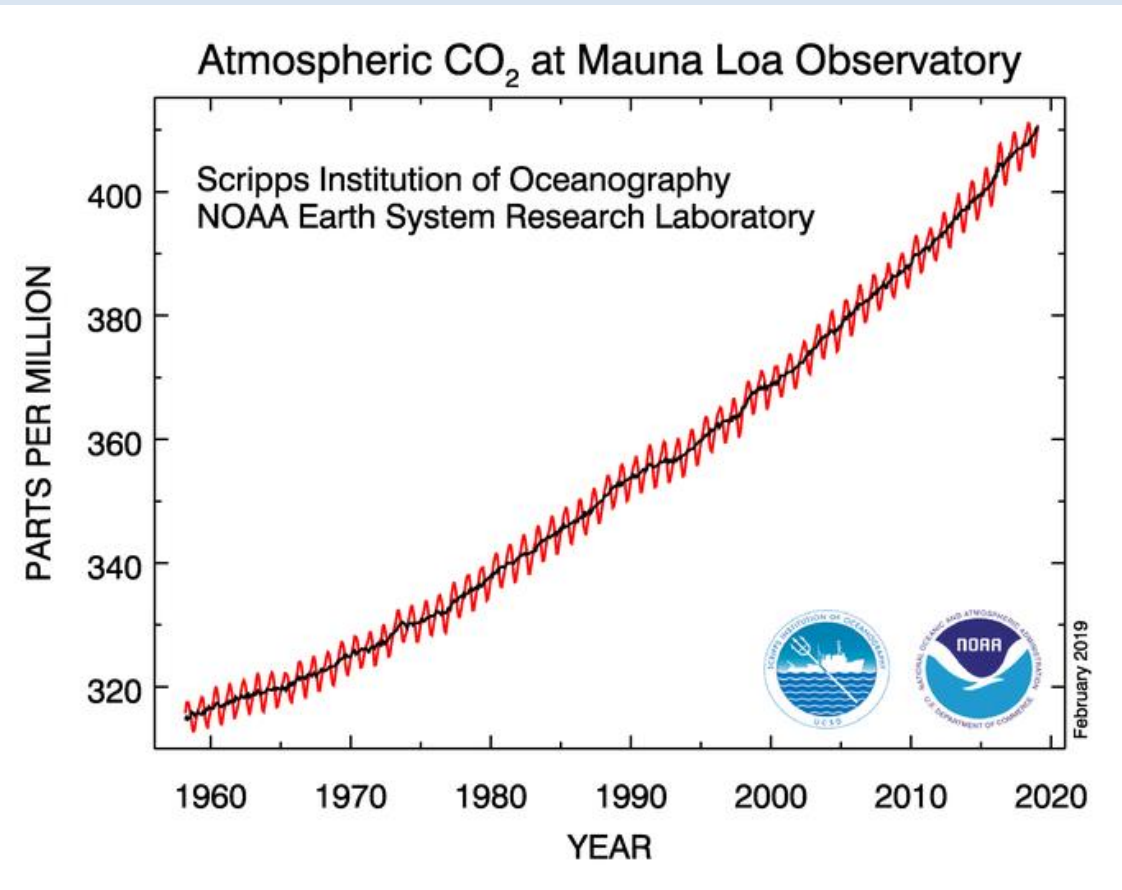
Change in Temperature (°F)



Recent Greenhouse Gas Trends



CO₂ is now over 411 PPM



Most major greenhouse gases are

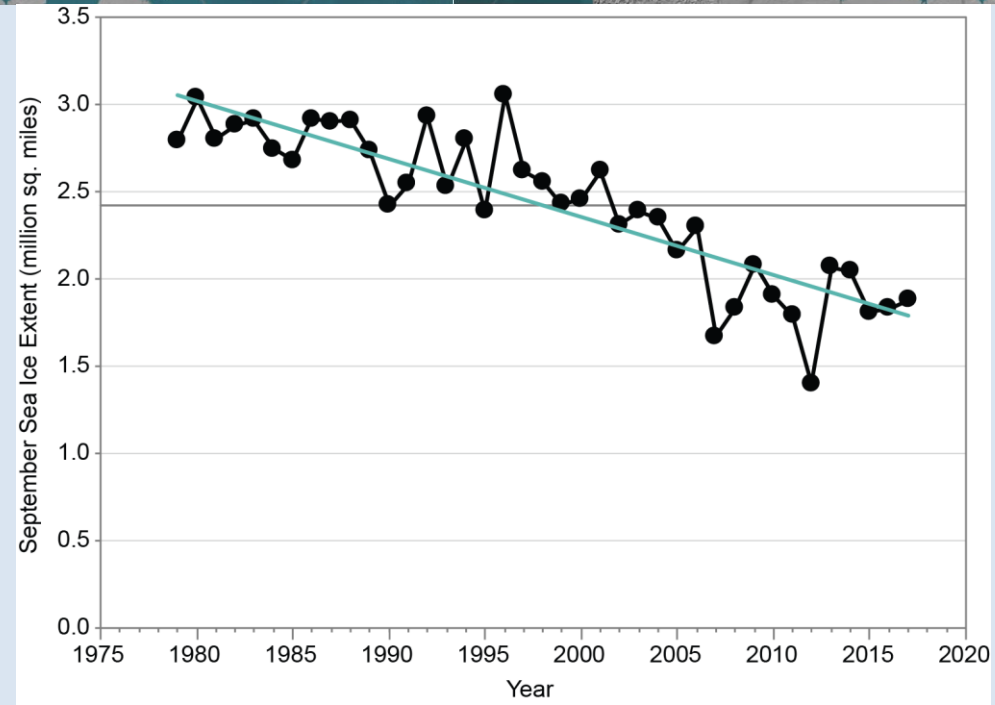
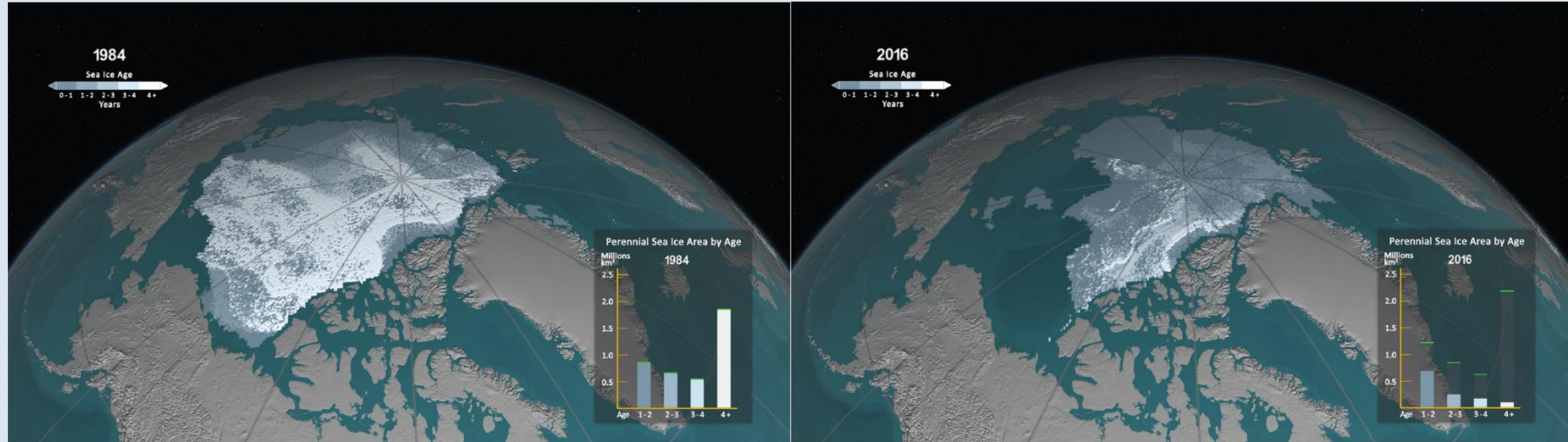
- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)

Other Indicators of Climate Change

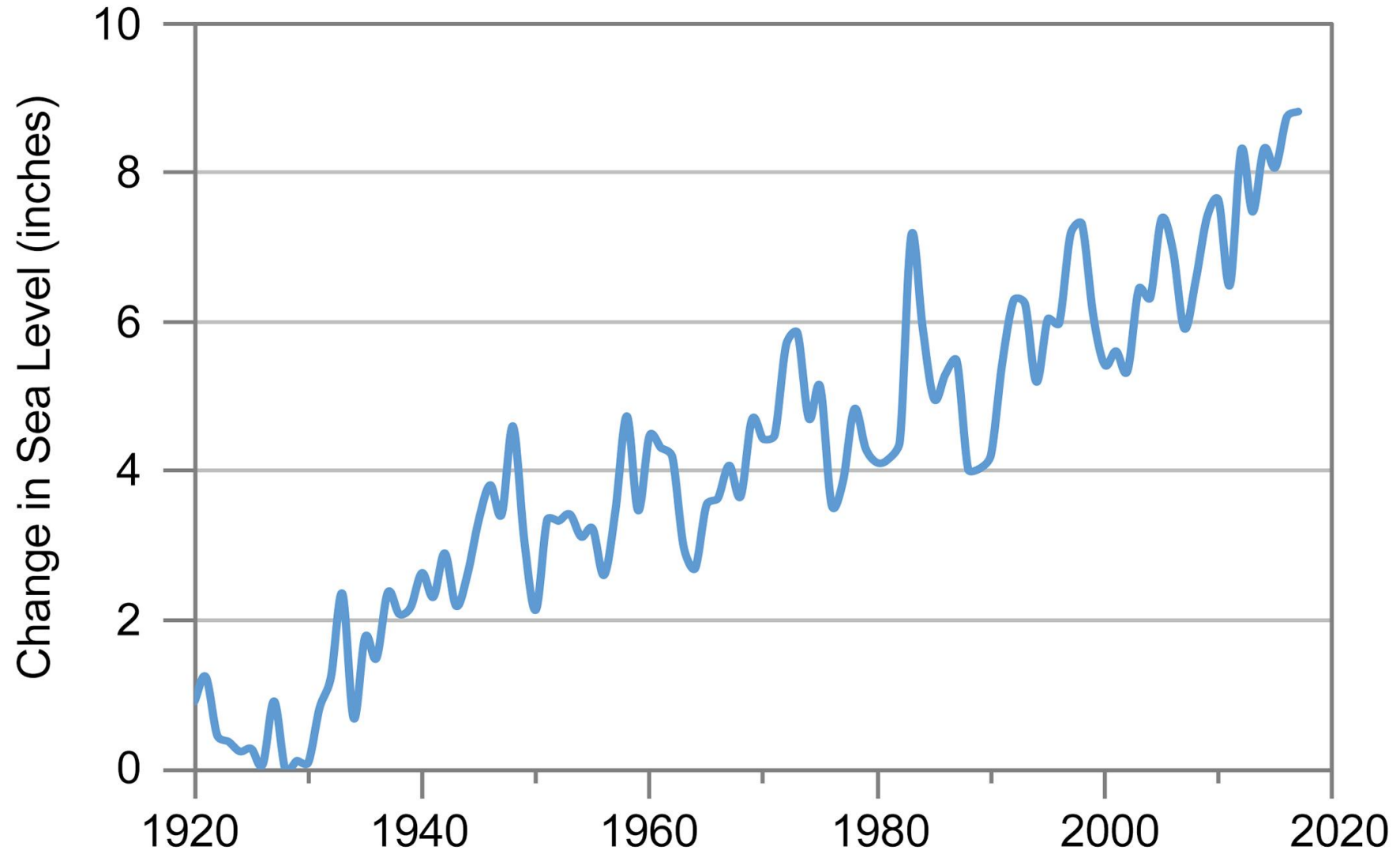
Arctic Sea Ice Decline

1984

2016



U.S. Sea Level

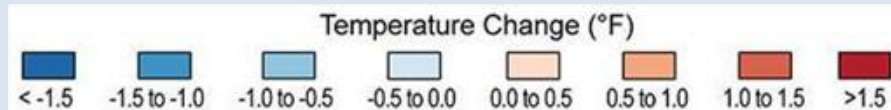
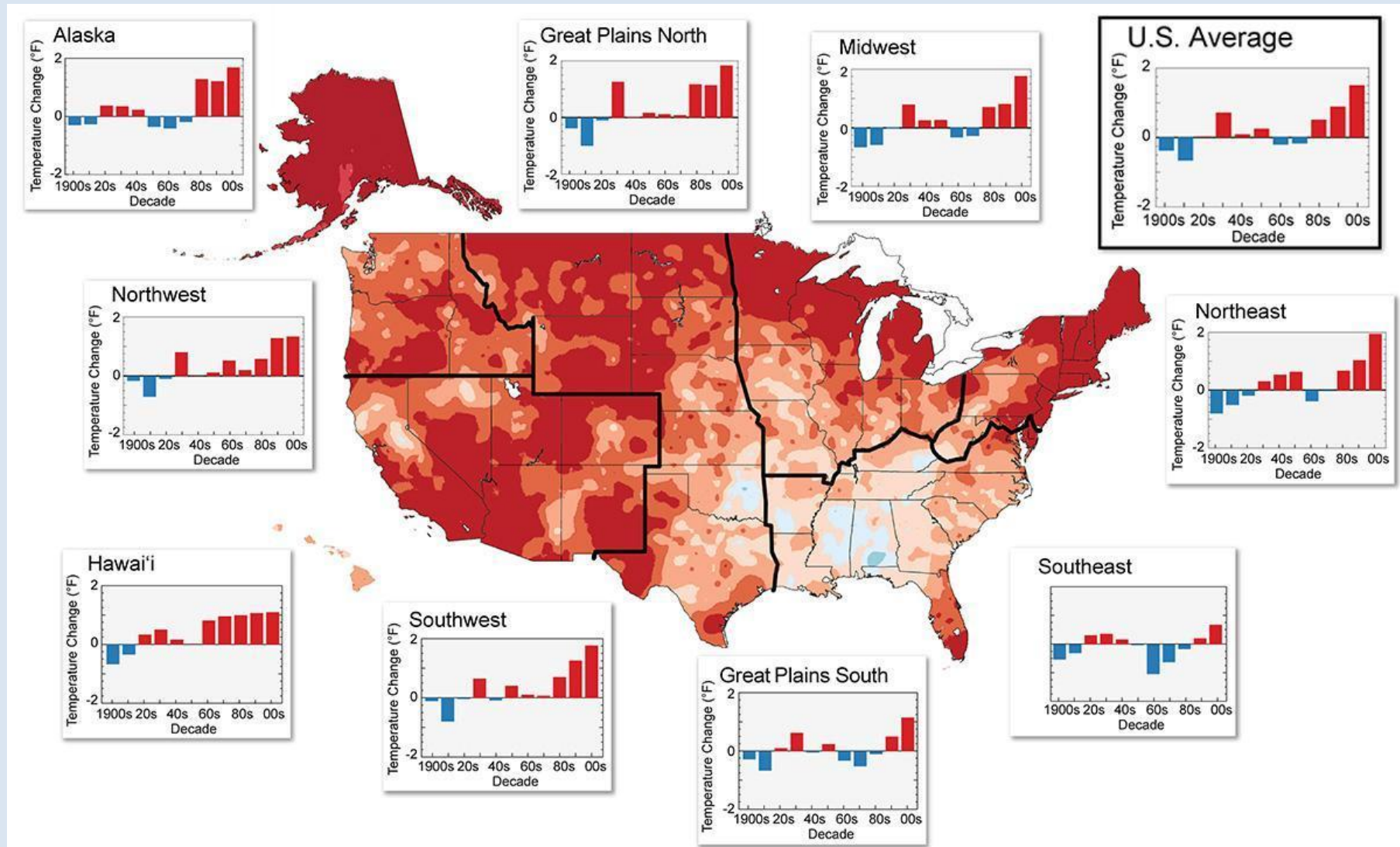


Tidal Flooding in Charleston, SC

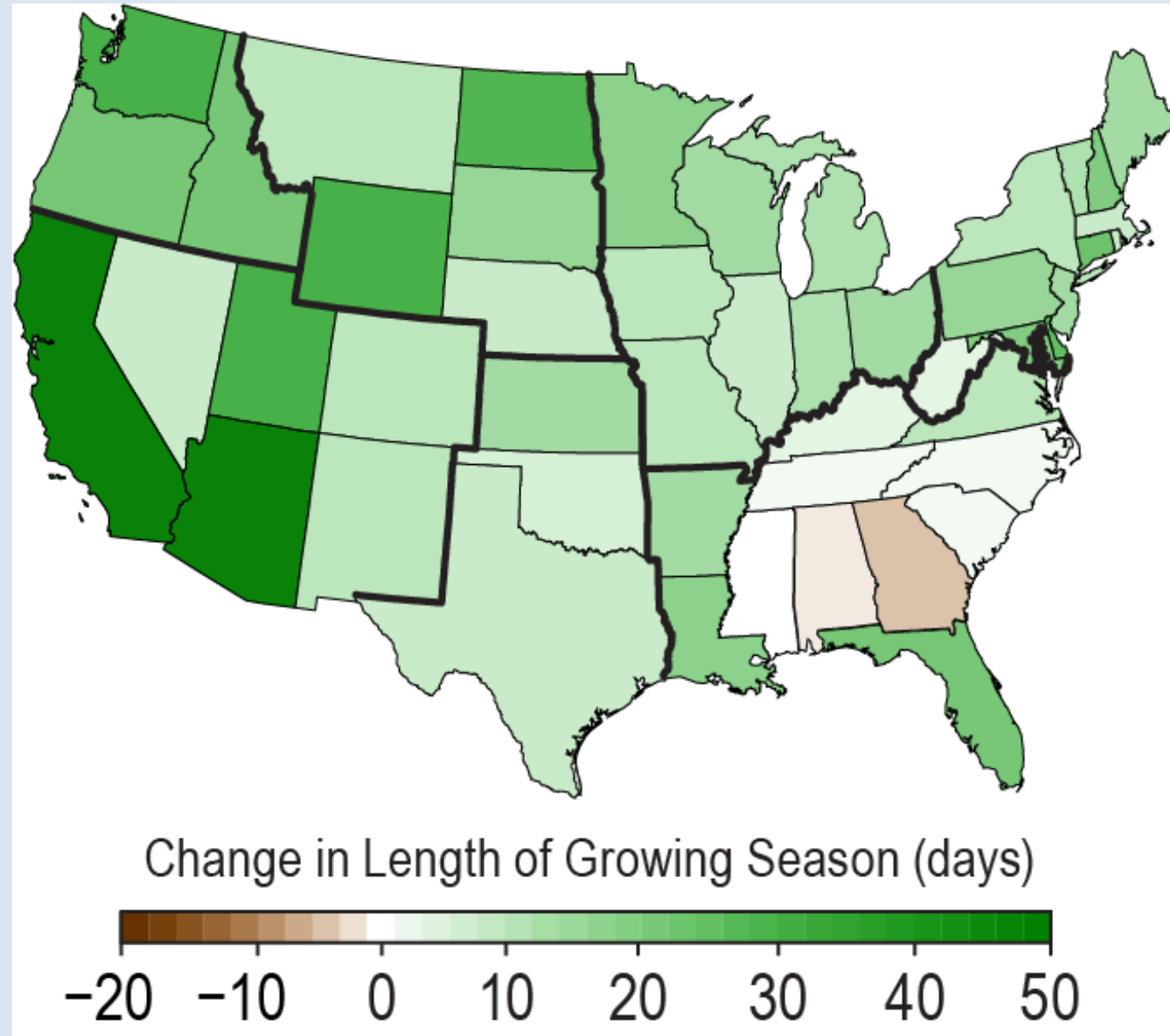
As sea levels have risen, the number of tidal floods each year that cause minor impacts (also called “nuisance floods”) have increased 5- to 10-fold since the 1960s in several U.S. coastal cities.



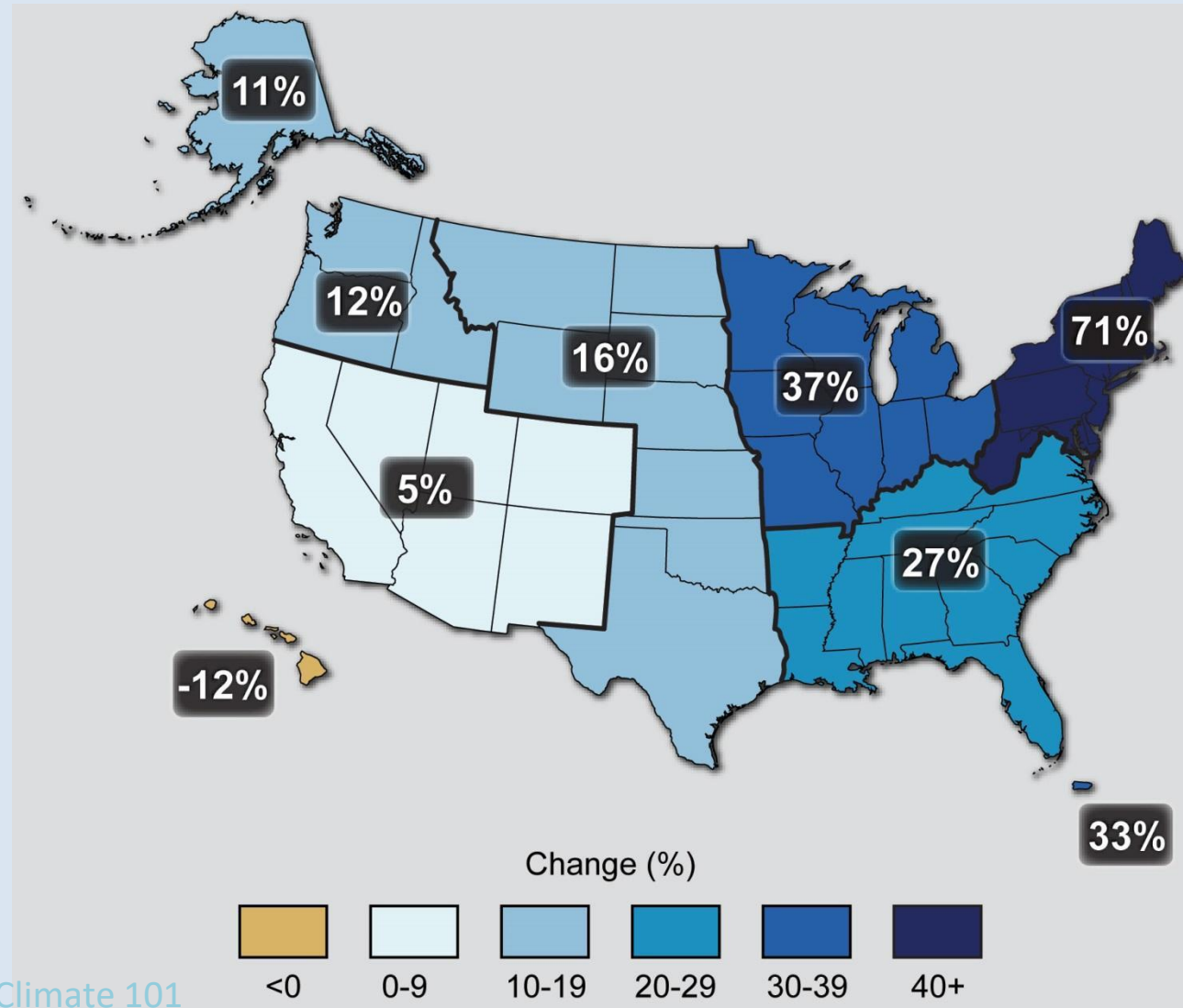
Observed US Temperature Change, 1901-2015



Change in Growing Season Length Since 1895



Observed Change in Very Heavy Precipitation

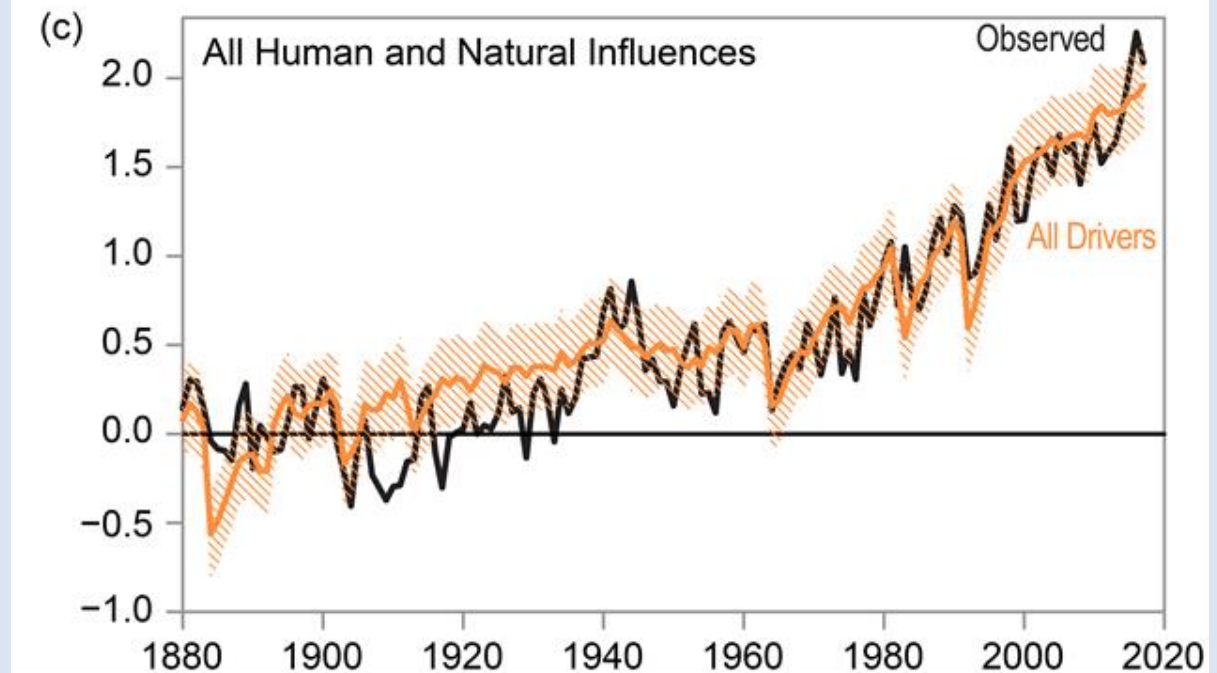
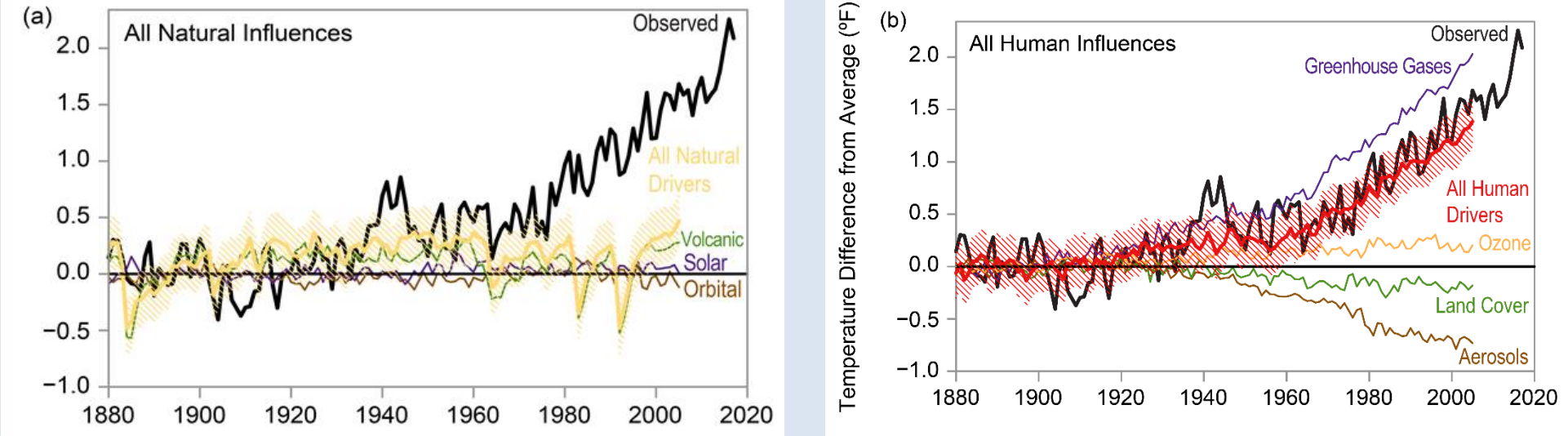


Hurricane Harvey Flooding, Houston, 2017

Some Areas Received Almost 50 Inches of Rain Over Four Days



Why Are We Confident That Human Emissions of GHGs Is The Dominant Cause of Warming?



Thank You

Climate Science Special Report

Fourth National Climate Assessment (NCA4), Volume I

This report is an authoritative assessment of the science of climate change, with a focus on the United States. It represents the first of two volumes of the Fourth National Climate Assessment, mandated by the Global Change Research Act of 1990.

📄 Recommended Citation

science2017.globalchange.gov

Volume I is the most comprehensive and up-to-date assessment of the state of climate science today.

Volume I is the most comprehensive and up-to-date assessment of the state of climate science today.

12 federal agencies, 50 authors, almost 500 pages

** It was subject to public review, two agency reviews, and a National Academy review*

VOLUME I TELLS US THAT

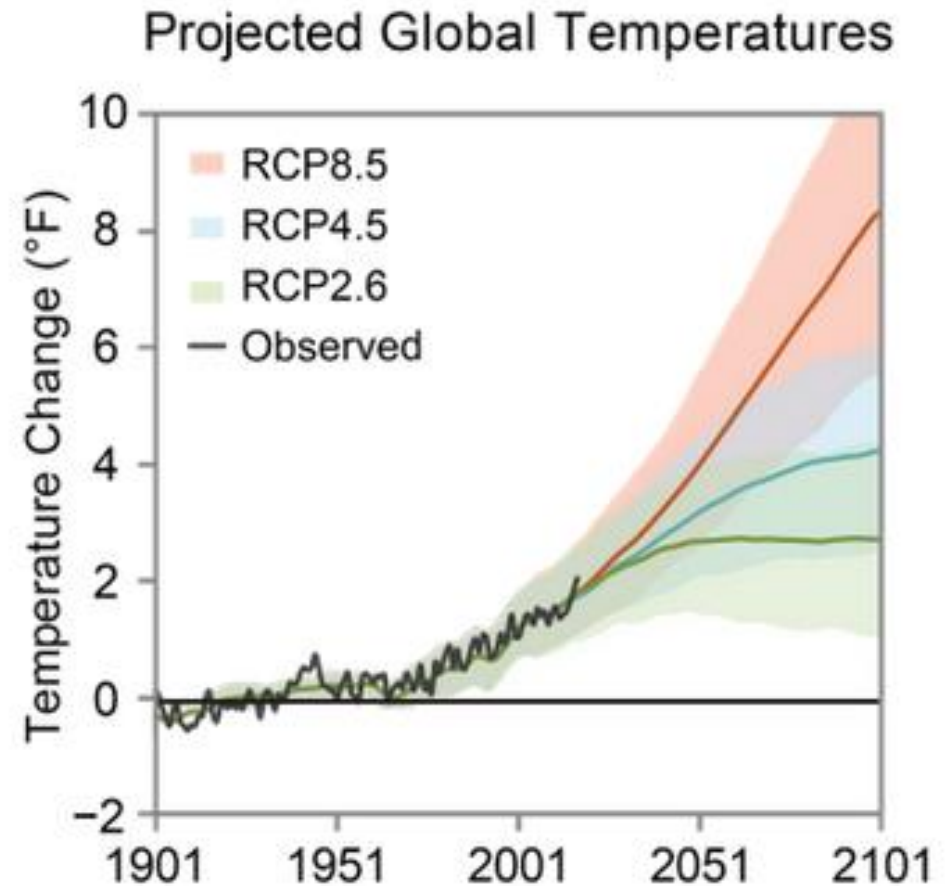
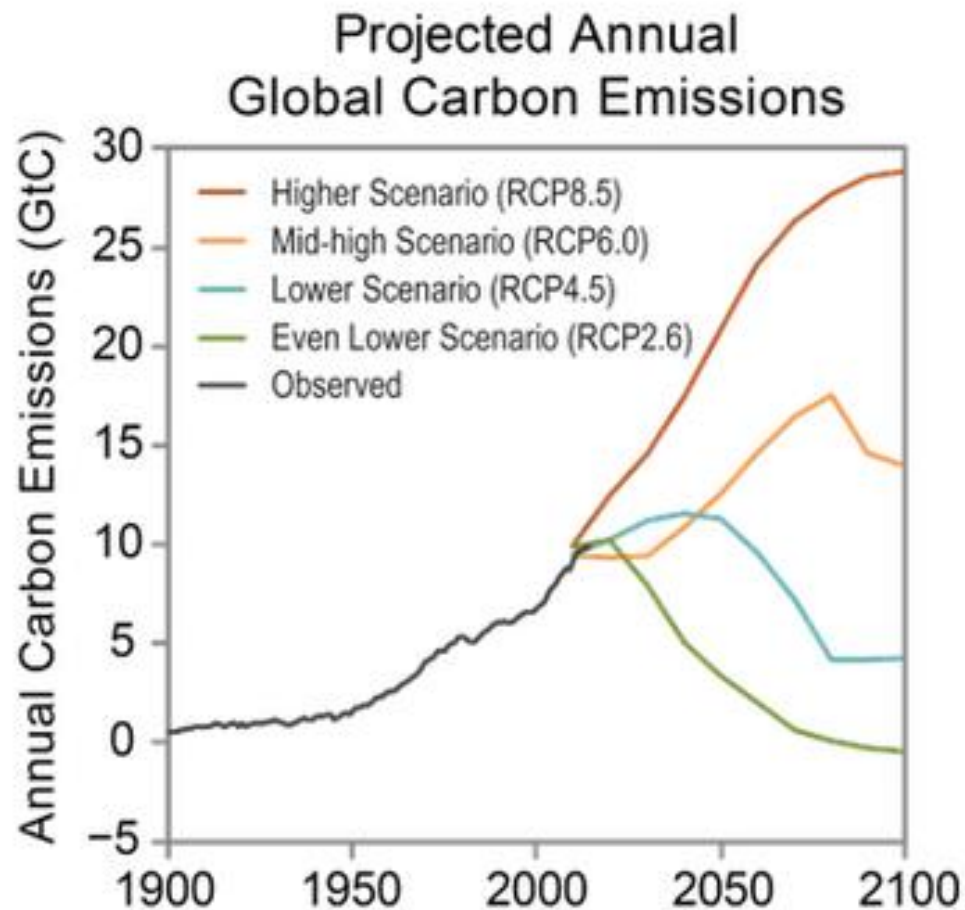
It's real

It's us

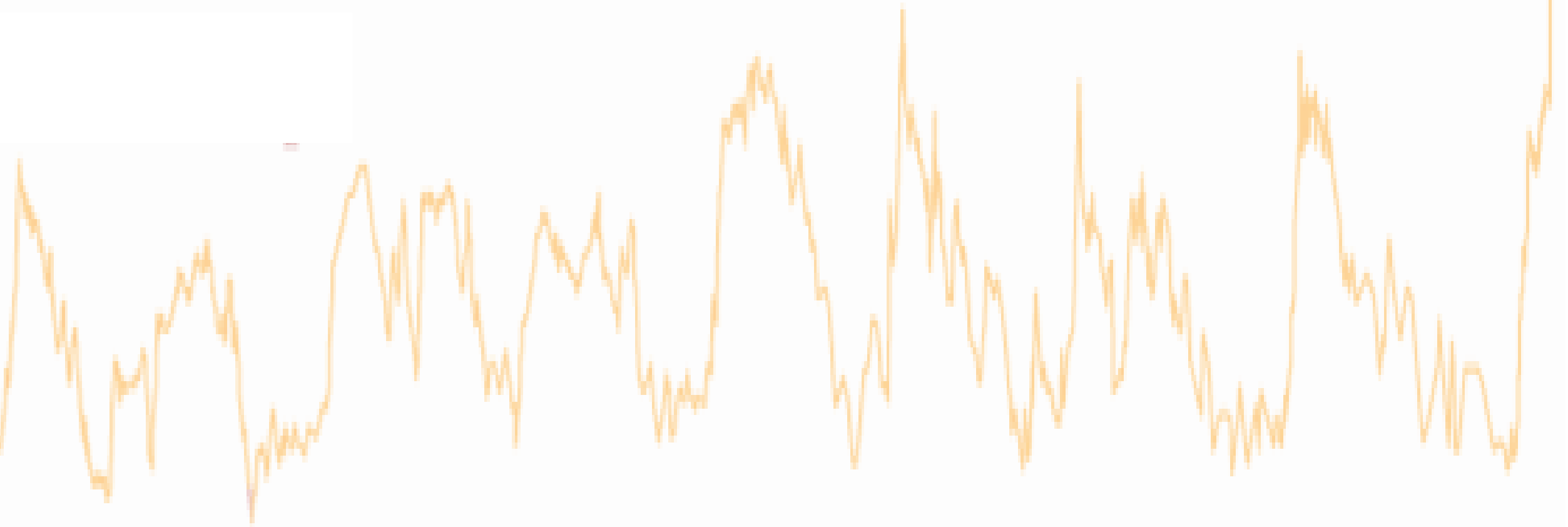
It's serious

.. and the window of time to prevent widespread dangerous impacts is closing fast.

Climate change beyond the next few decades depends primarily on the **heat-trapping gases emitted** and the remaining uncertainty in the **sensitivity of Earth's climate** to those emissions.



CO₂ concentration has now passed 400 ppm, a level that last occurred about **3 million years ago**, when global average temperature and sea level were significantly higher than today.



CO₂ concentration has now passed 400 ppm, a level that last occurred about **3 million years ago**, when global average temperature and sea level were significantly higher than today.

Continued growth in CO₂ emissions over this century and beyond would lead to an atmospheric concentration not experienced in **tens of millions of years**.

The present-day emissions rate of nearly 10 GtC per year suggests that there is no climate analog for this century any time in at least the last 50 million years. (update: now **100 million years**)

*MOST PEOPLE DON'T REALLY HAVE A
PROBLEM WITH...*

*THE SCIENCE THAT EXPLAINS WHY
CLIMATE IS CHANGING.*

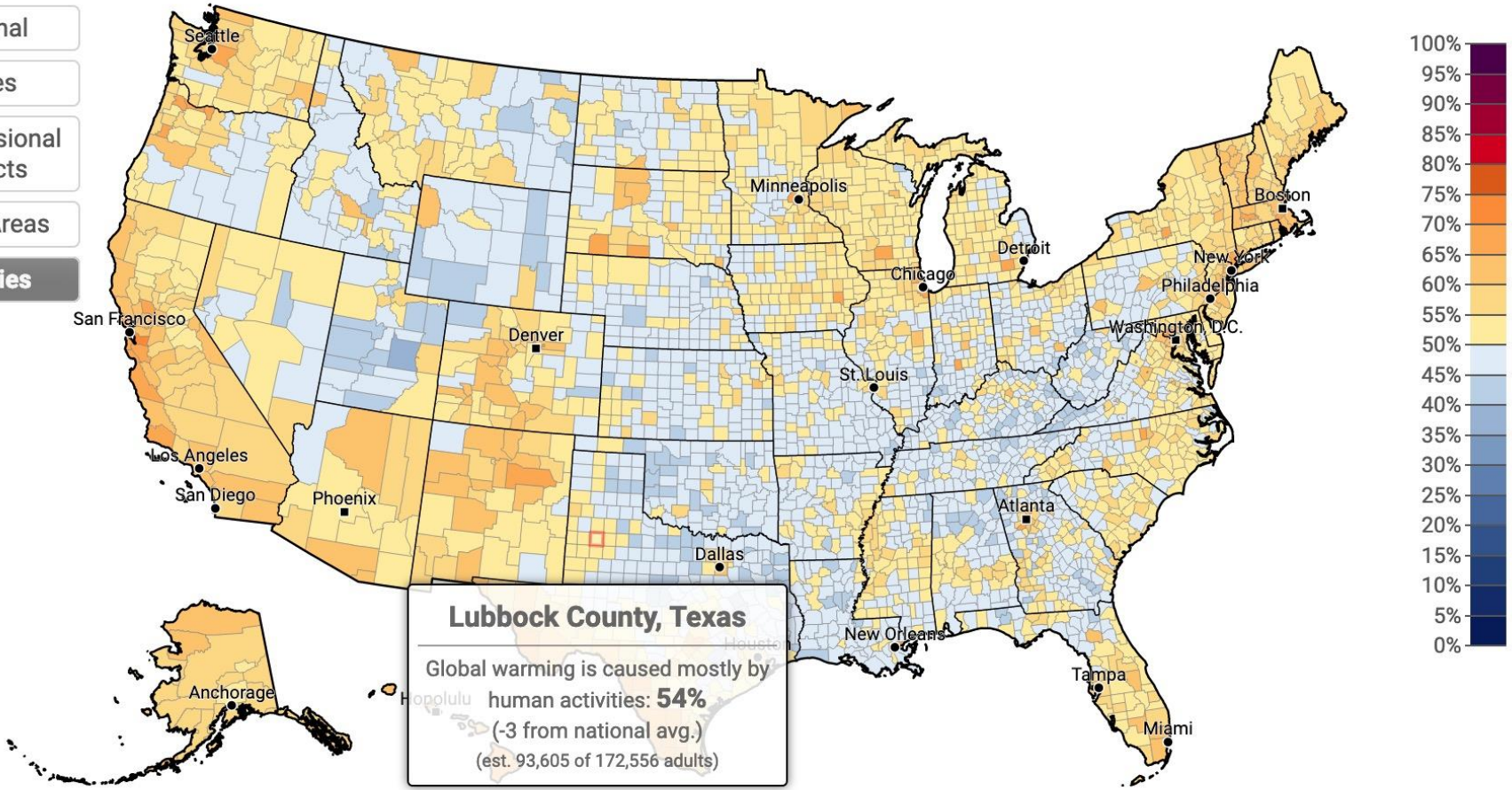
Estimated % of adults who think global warming is mostly caused by human activities, 2018

Select Question:

[Permalink](#)

Click on map to select geography, or:

- National
- States
- Congressional Districts
- Metro Areas
- Counties**



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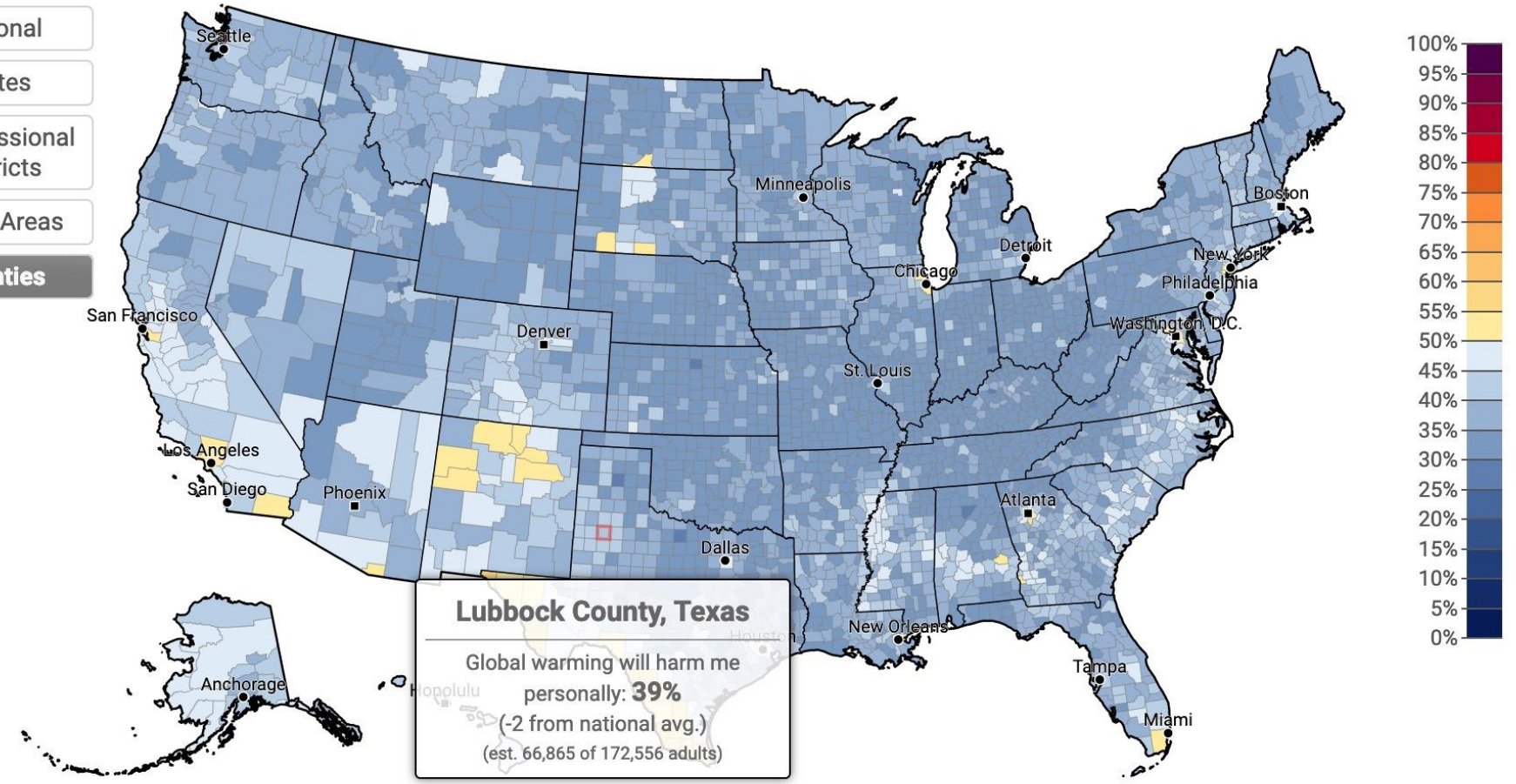
Estimated % of adults who think global warming will harm them personally, 2018

Select Question:

[Permalink](#)

Click on map to select geography, or:

- National
- States
- Congressional Districts
- Metro Areas
- Counties**



Lubbock County, Texas
Global warming will harm me personally: **39%**
(-2 from national avg.)
(est. 66,865 of 172,556 adults)







EXTRA HIGH TIDE FLOODS ROAD, FUNAFUTI, TUVALU (PACIFIC OCEAN) © 2005 GARY BRAASCH
RISING SEA LEVEL DOCUMENTED BY WORLD VIEW OF GLOBAL WARMING

*THE MOST DANGEROUS MYTH WE'VE
BOUGHT INTO IS ...*

*CLIMATE CHANGE IS A DISTANT ISSUE, ONLY
AFFECTING FUTURE GENERATIONS + PLACES
THAT ARE FAR AWAY.*

VOLUME 2

FOURTH NATIONAL CLIMATE ASSESSMENT

Volume II: Impacts, Risks, and Adaptation in the United States

The National Climate Assessment (NCA) assesses the science of climate change and variability and its impacts across the United States, now and throughout this century.

SUMMARY FINDINGS

REPORT CHAPTERS

OVERVIEW

DOWNLOADS

Volume I presents an assessment of the physical science underlying this report: science2017.globalchange.gov

nca2018.globalchange.gov

Volume II is the most comprehensive and up-to-date assessment of how climate change is affecting the U.S. and how we are responding.

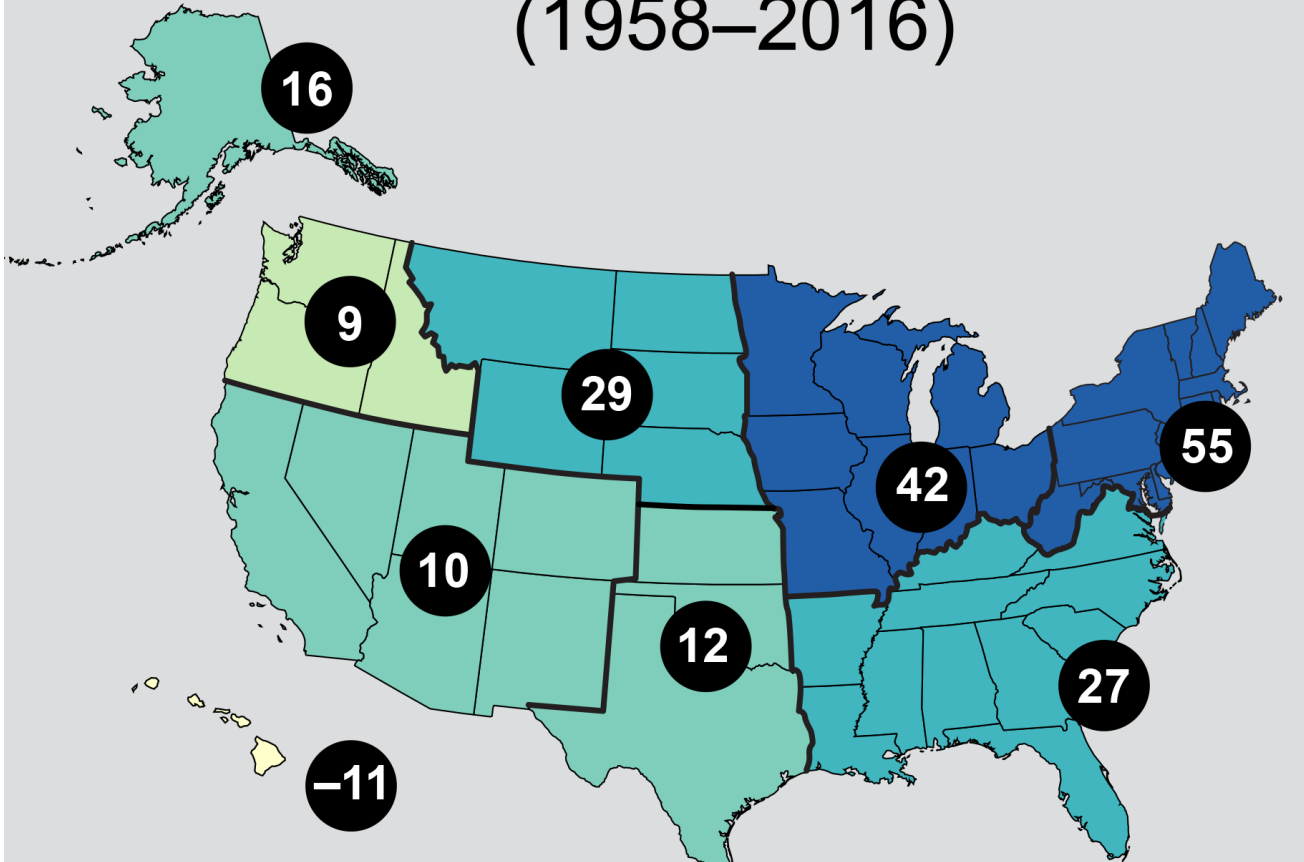
12 federal agencies, 350 authors, over 1600 pages

VOLUME I I TELLS US THAT

*Climate change isn't a distant issue any more.
It's affecting every single one of us, in every part of
the U.S., across almost every sector.*

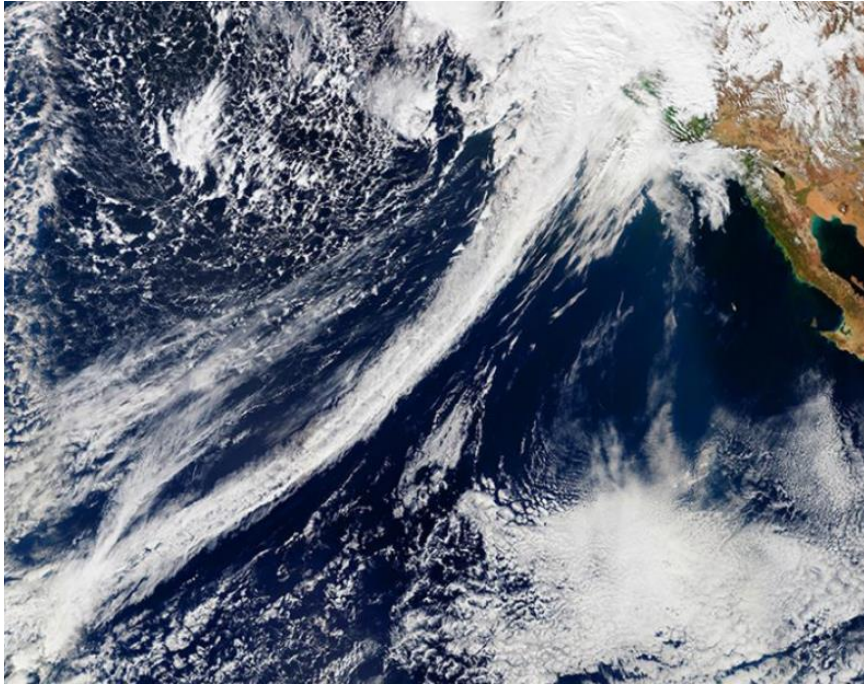
*And the more climate changes, the more serious and
even dangerous the impacts will be come.*

99th Percentile Precipitation (1958–2016)

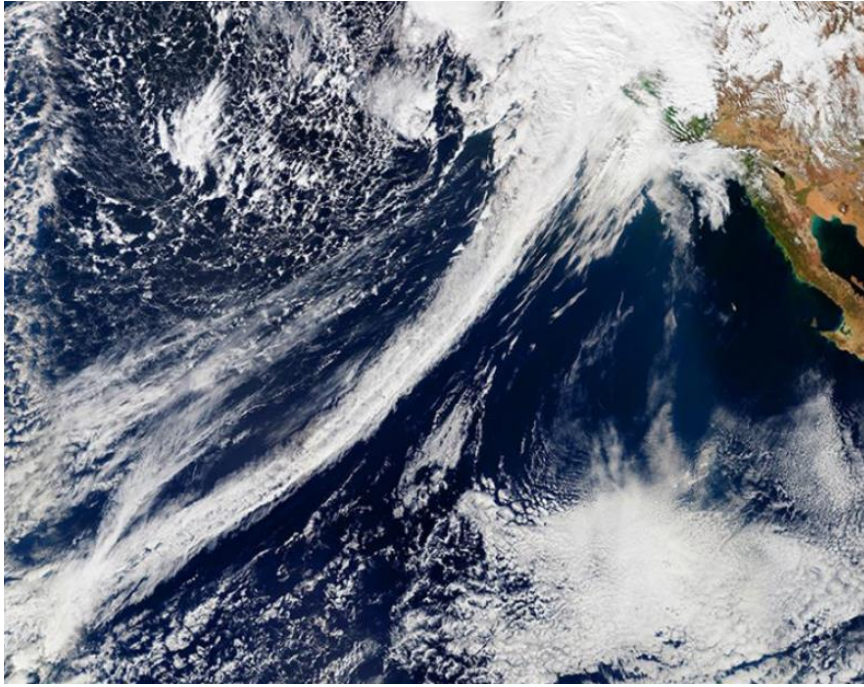


The frequency + intensity of

- Extreme high temperature events are *virtually certain* to increase
- Extreme precipitation events are *very likely* to continue to increase



The frequency and severity of land-falling “atmospheric rivers” on the U.S. West Coast will increase.



The frequency and severity of land-falling “atmospheric rivers” on the U.S. West Coast will increase.

Hurricanes aren't more frequent: but they are stronger, bigger, slower, and their rainfall is much more intense than it used to be.



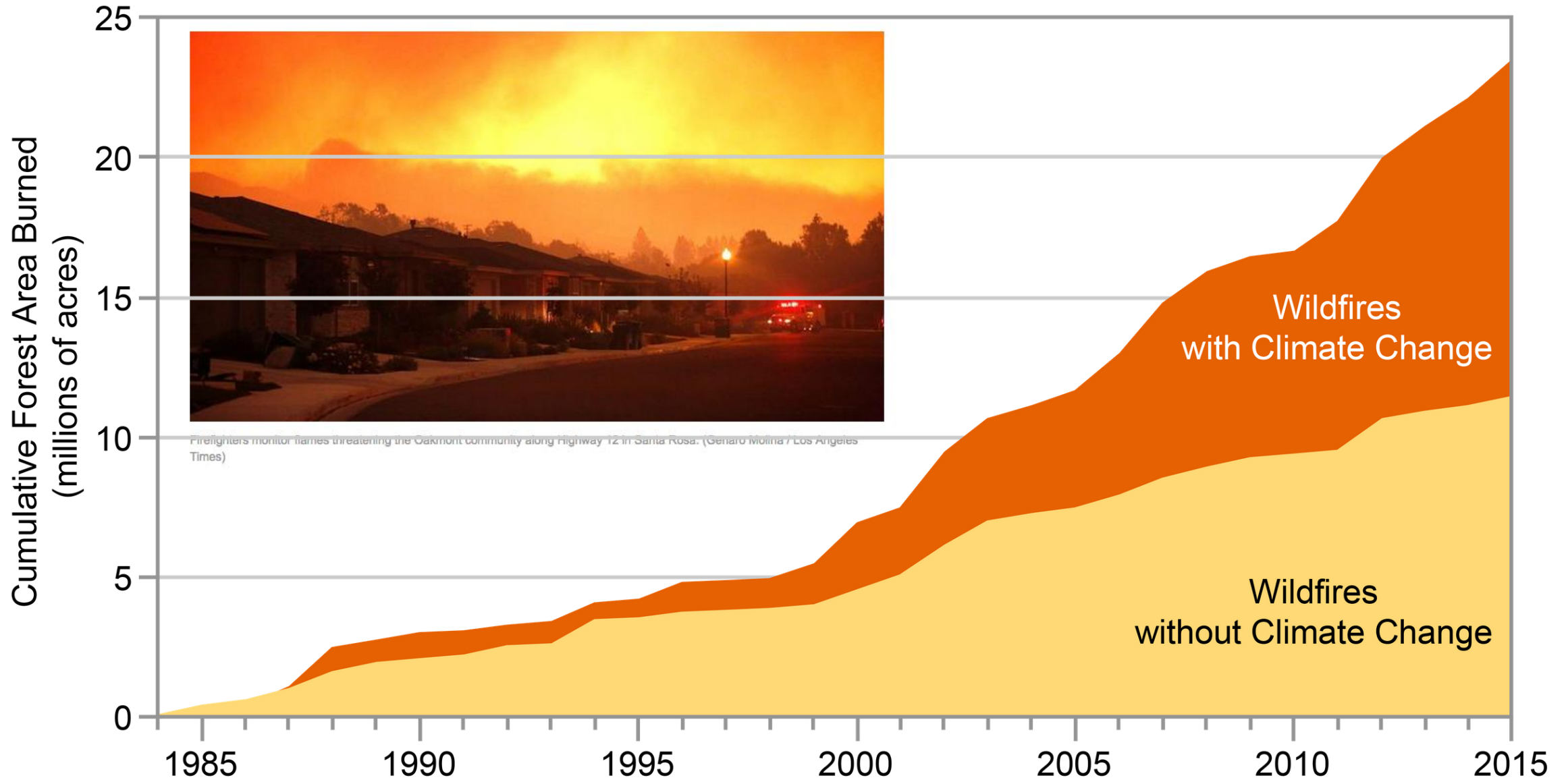
On the Atlantic Coast ...



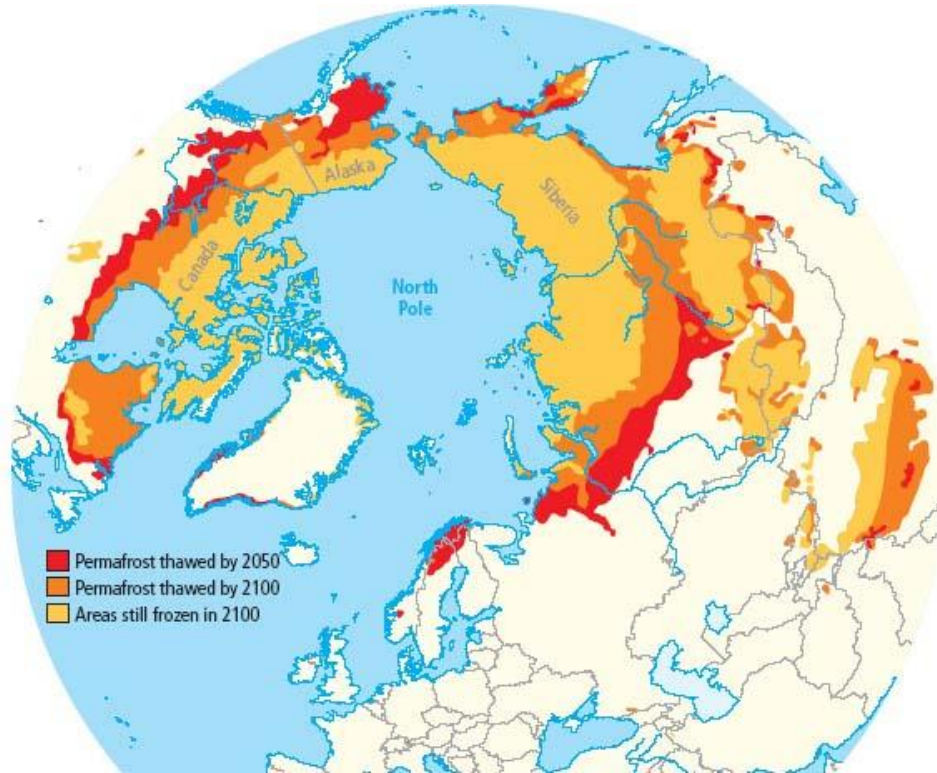
Louisiana Climate Refugees



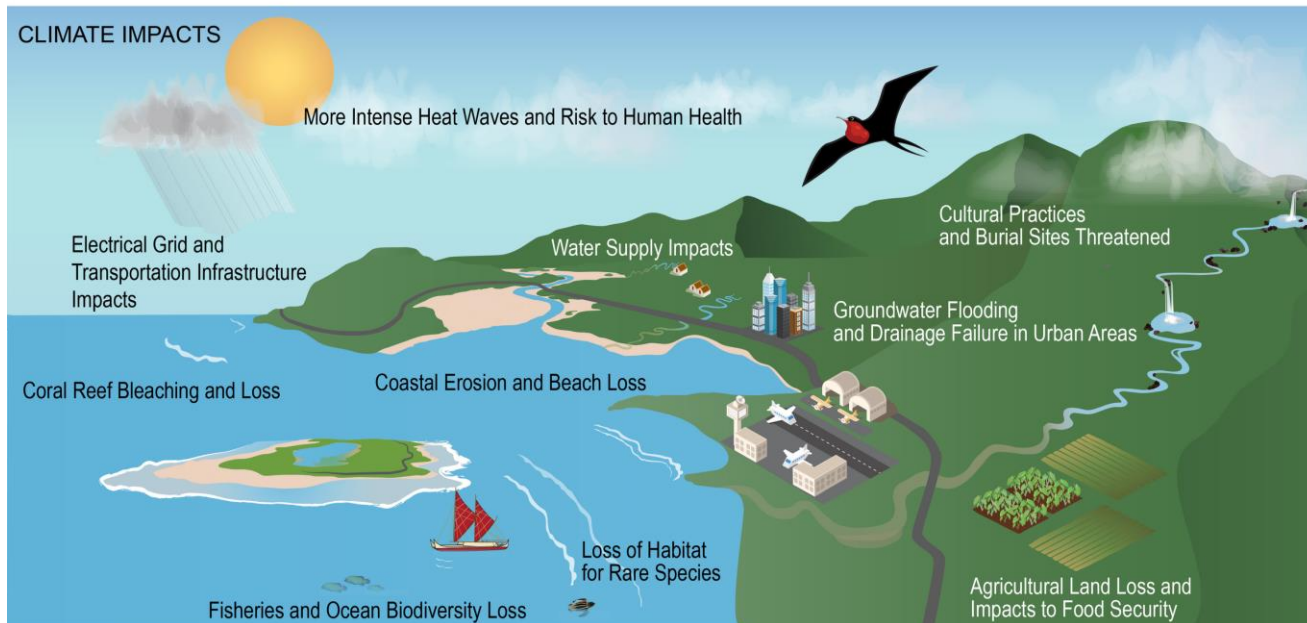
In the western states ...



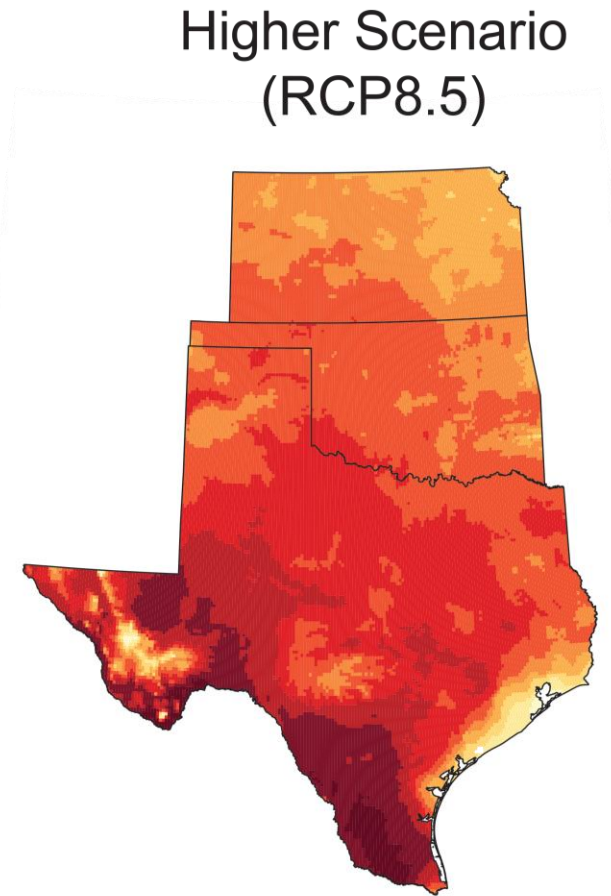
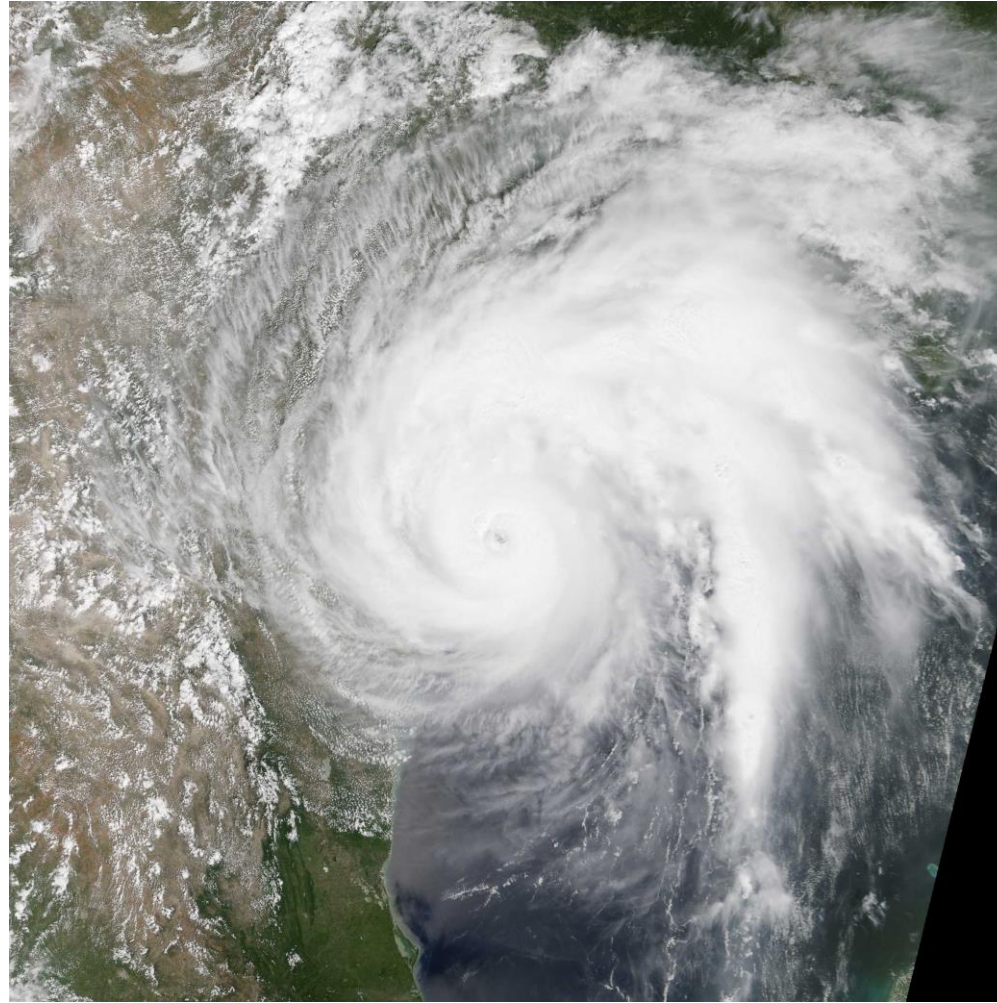
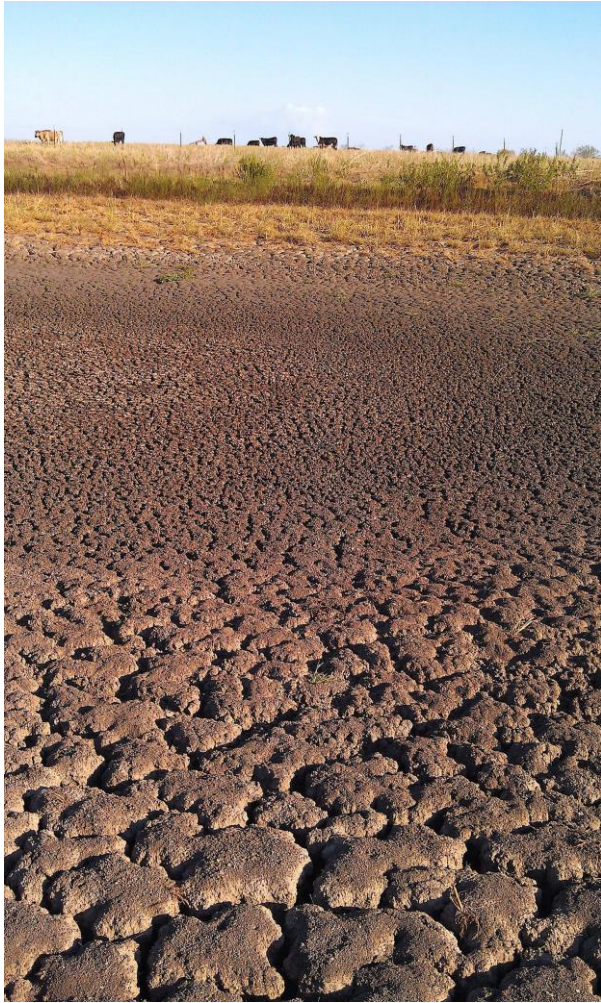
Up in Alaska ...



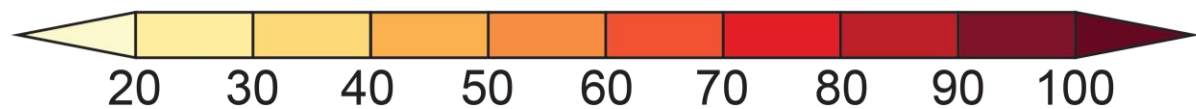
On the islands



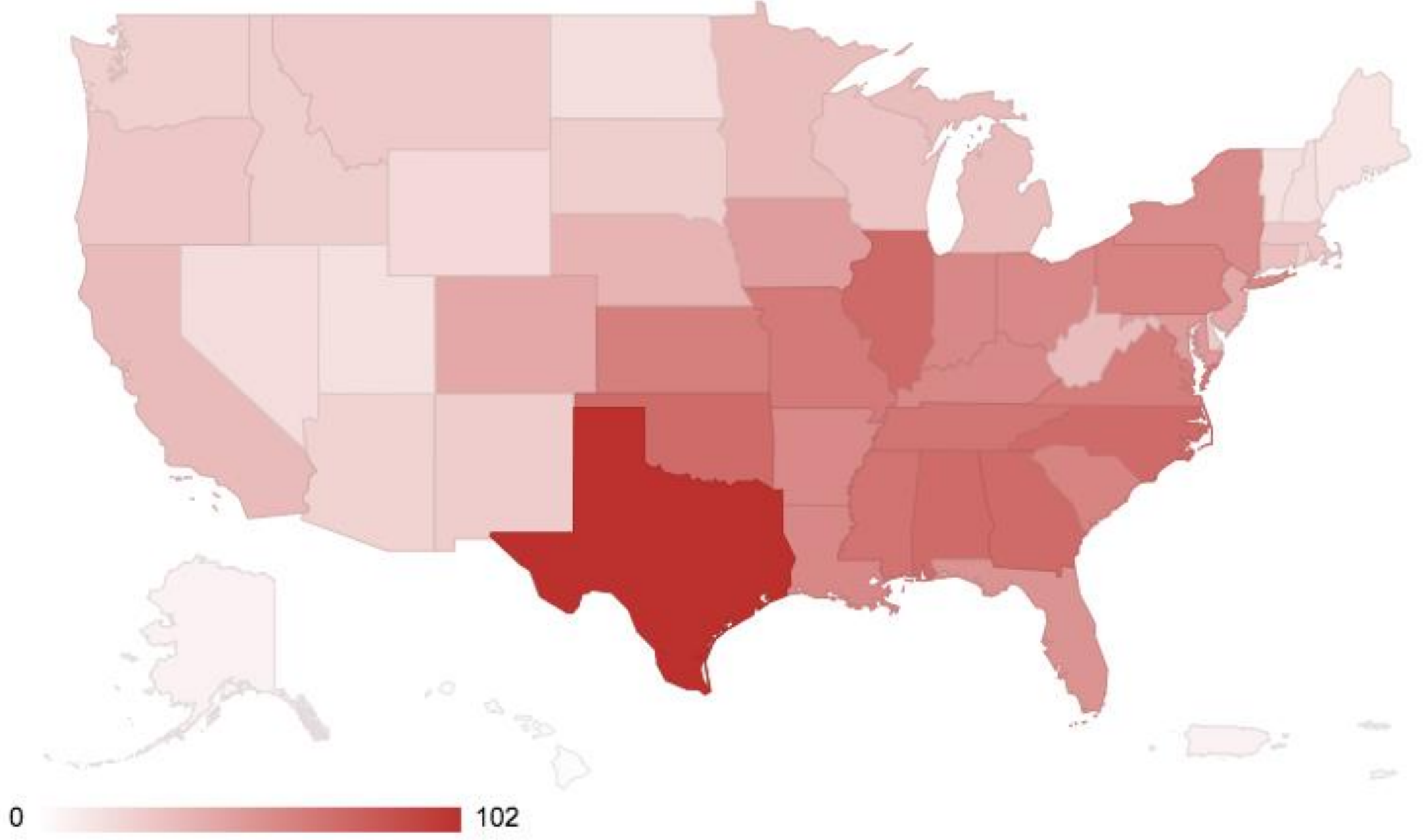
Even down in Texas ...



Change in Number of Days



NOAA billion-dollar weather and climate events (1980-2018)





*We care about a changing climate
because it exacerbates the risks we
already face today.*




www.katharinehayhoe.com



Reducing Risks Through Emissions Mitigation and Adaptation

Brenda Ekwurzel, Ph.D.

NCA4 co-author Chapter 29 Mitigation

Director of Climate Science []

25 February 2019
Washington, DC

USGCRP 2018 NCA4 fig 27-17

Fourth National Climate Assessment

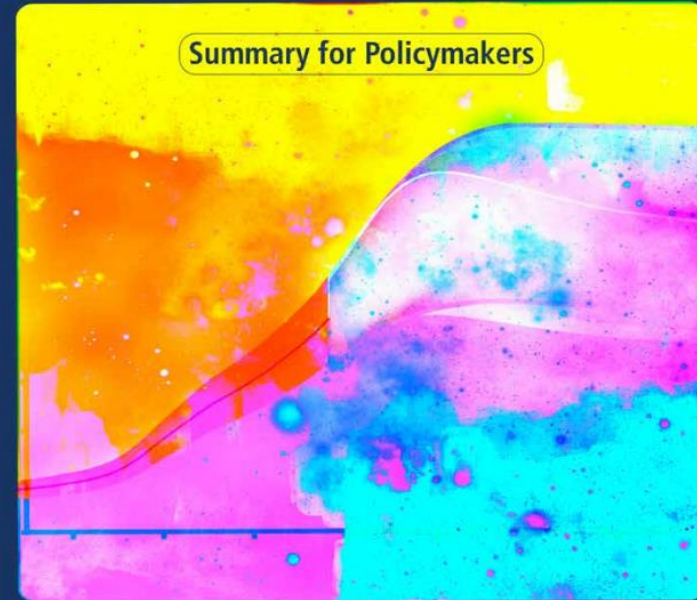


Volume II
Impacts, Risks, and Adaptation in the United States

Global Warming of 1.5°C

An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Summary for Policymakers



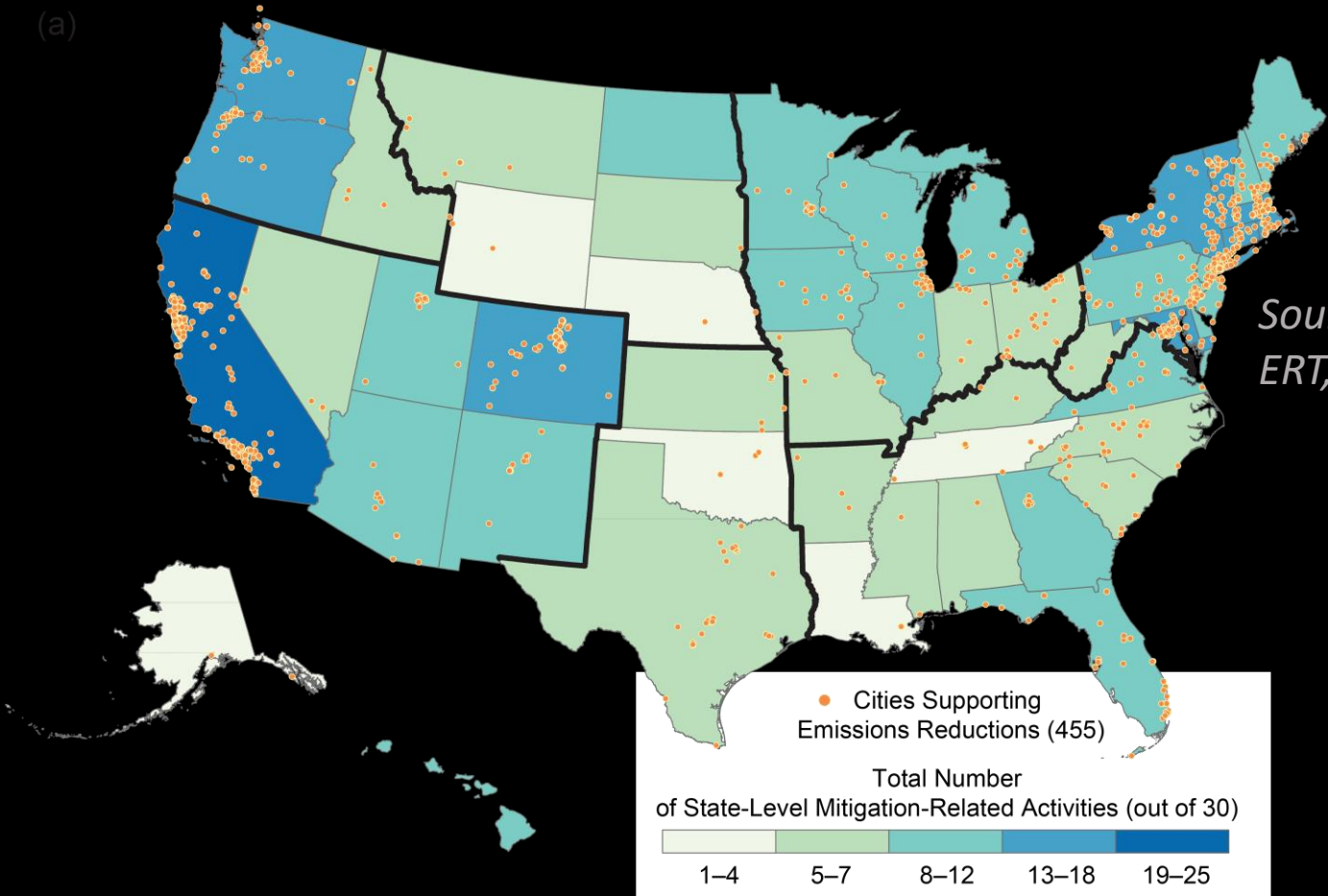
29

Key Message #1

Mitigation-Related Activities

Mitigation-related activities are taking place across the United States at the federal, state, and local levels as well as in the private sector.

(a)



Sources: EPA and ERT, Inc.

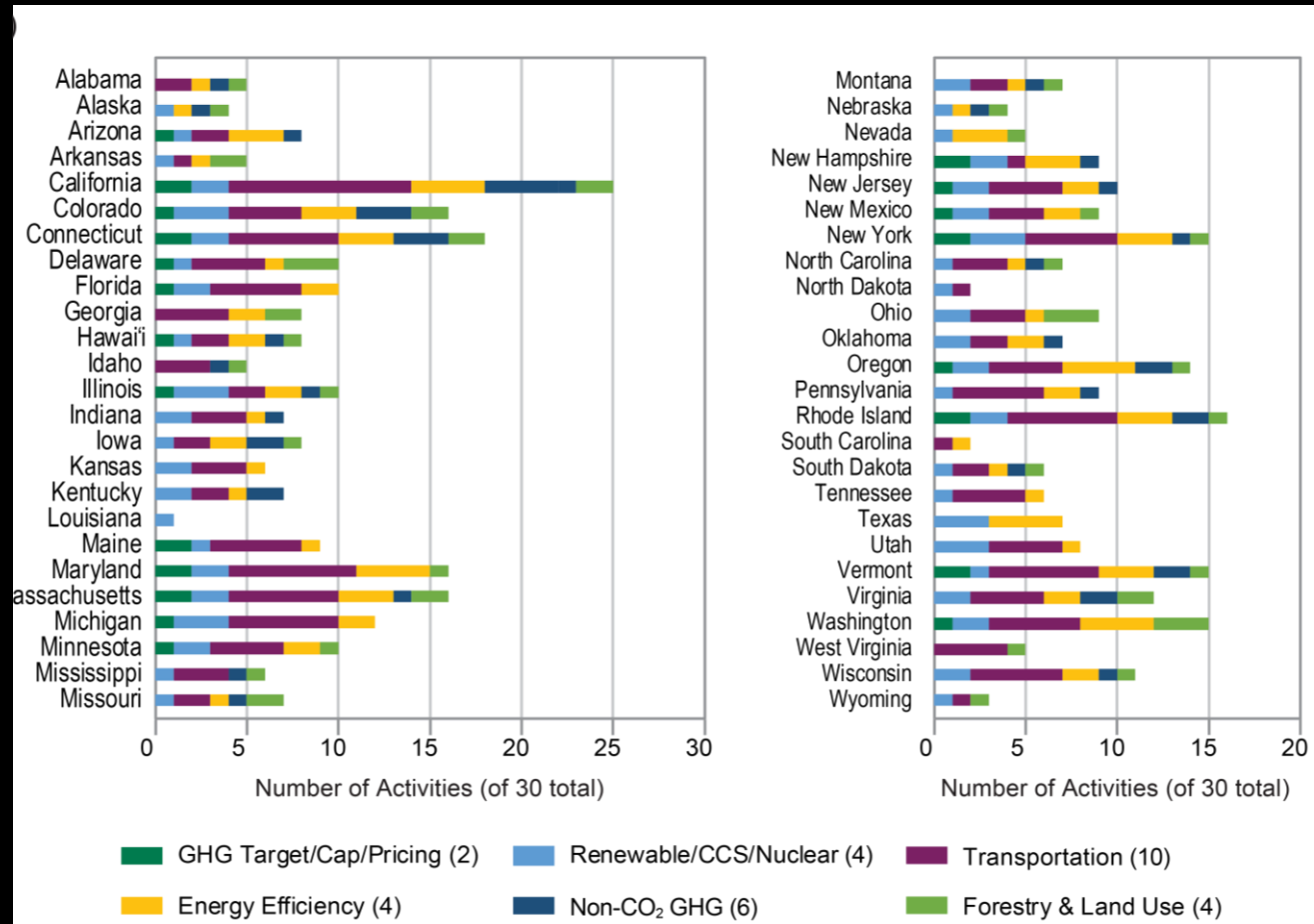
(h)

29

Key Message #1

Mitigation-Related Activities

Since the Third National Climate Assessment, a growing number of states, cities, and businesses have pursued or deepened initiatives aimed at reducing emissions.



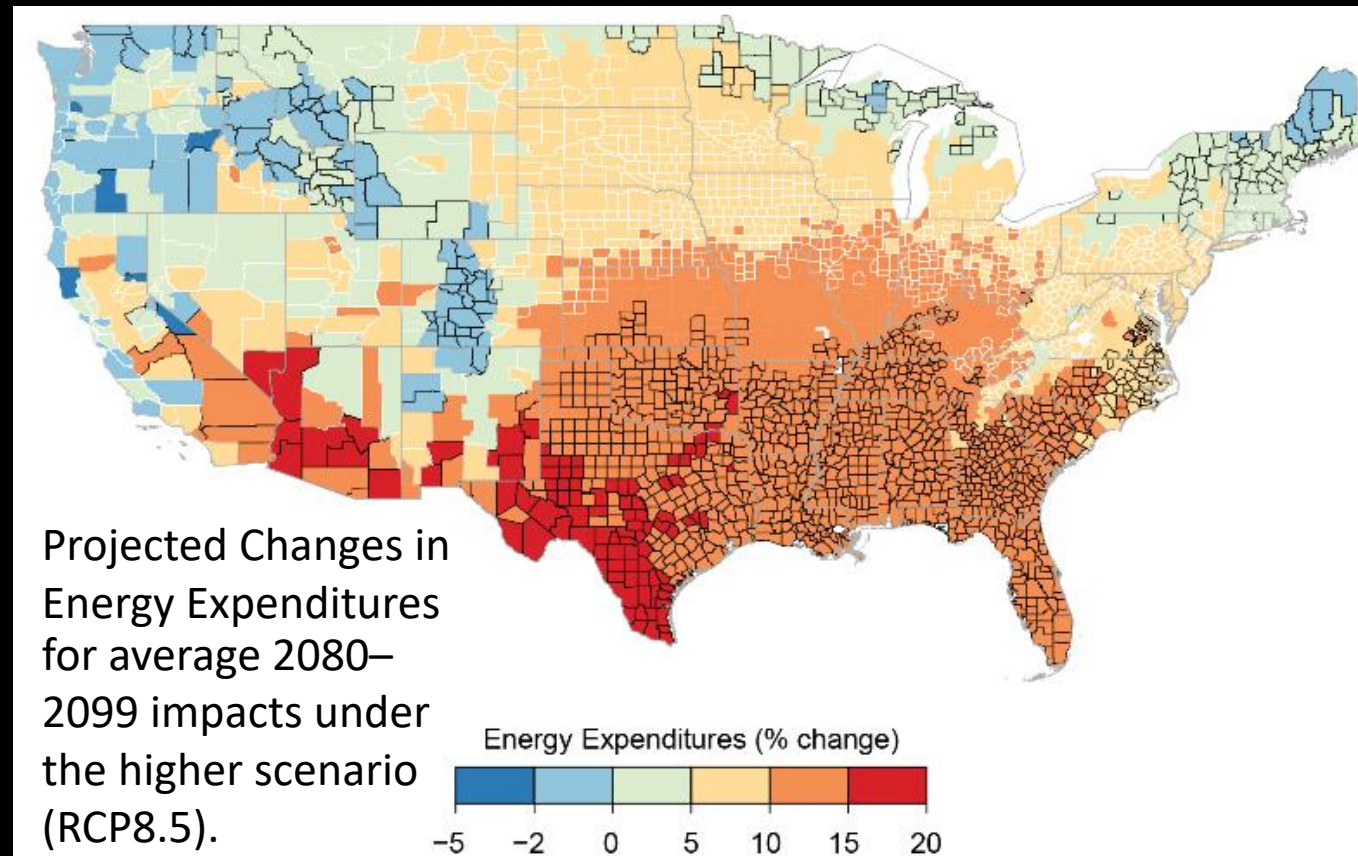
Sources:
adapted
from
America's
Pledge
2017

29

Key Message #2

The Risks of Inaction

In the absence of more significant global mitigation efforts, climate change is projected to impose substantial damages on the U.S. economy,



Source:
Hsiang et
al. 2017

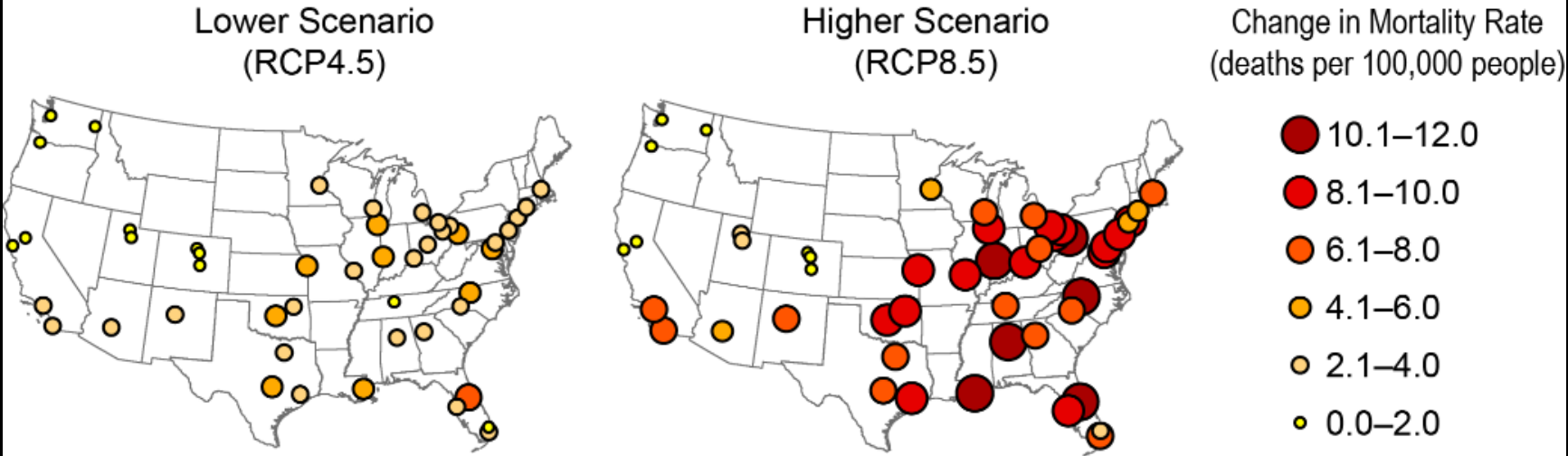
29

Key Message #2

The Risks of Inaction

In the absence of more significant global mitigation efforts, climate change is projected to impose substantial damages on the U.S. economy, human health,

Net mortality due to extremely hot and cold days in 49 U.S. cities for 2080–2099 as compared to 1989–2000



+3,900 deaths each year

+9,300 deaths each year

Source: adapted from EPA 2017

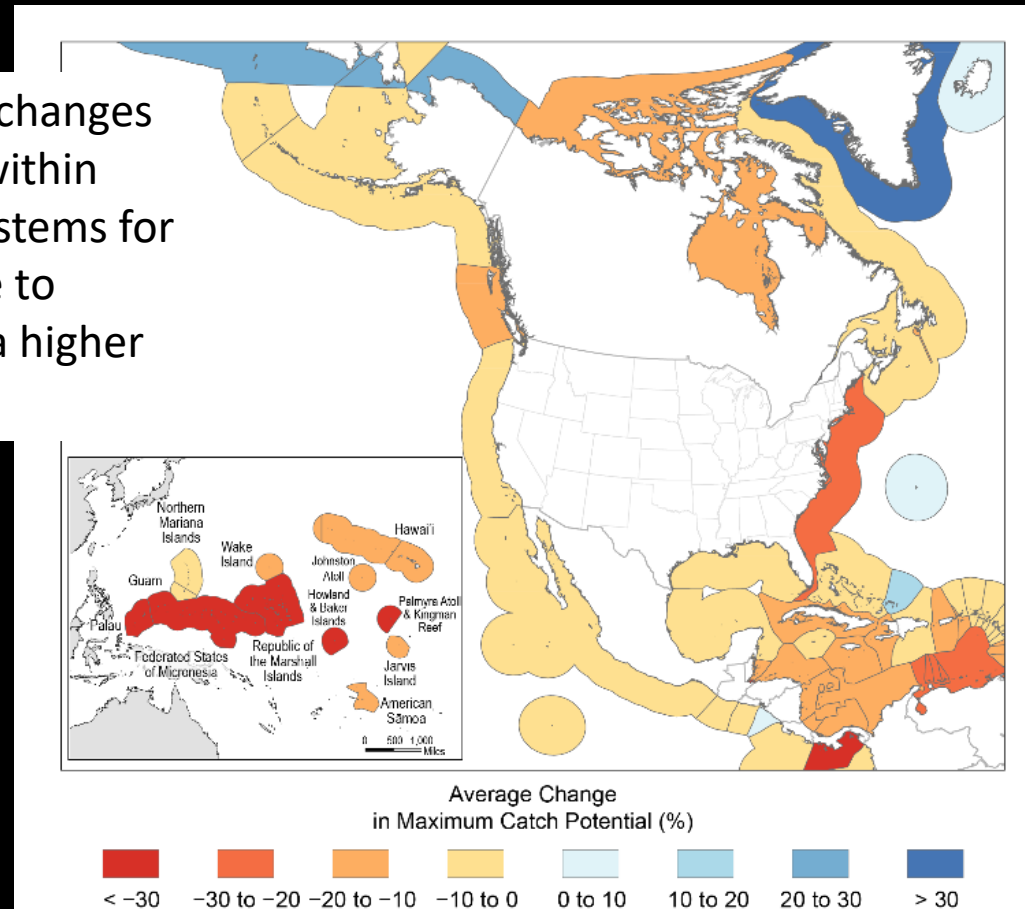
29

Key Message #2

The Risks of Inaction

In the absence of more significant global mitigation efforts, climate change is projected to impose substantial damages on the U.S. economy, human health, and the environment.

Average projected changes in fishery catches within large marine ecosystems for 2041–2060 relative to 1991–2010 under a higher scenario (RCP8.5).



Source:
adapted from
Lam et al.
2016

29

Key Message #2

Under scenarios with high emissions and limited or no adaptation, annual losses in some sectors are estimated to grow to hundreds of billions of dollars by the end of the century.

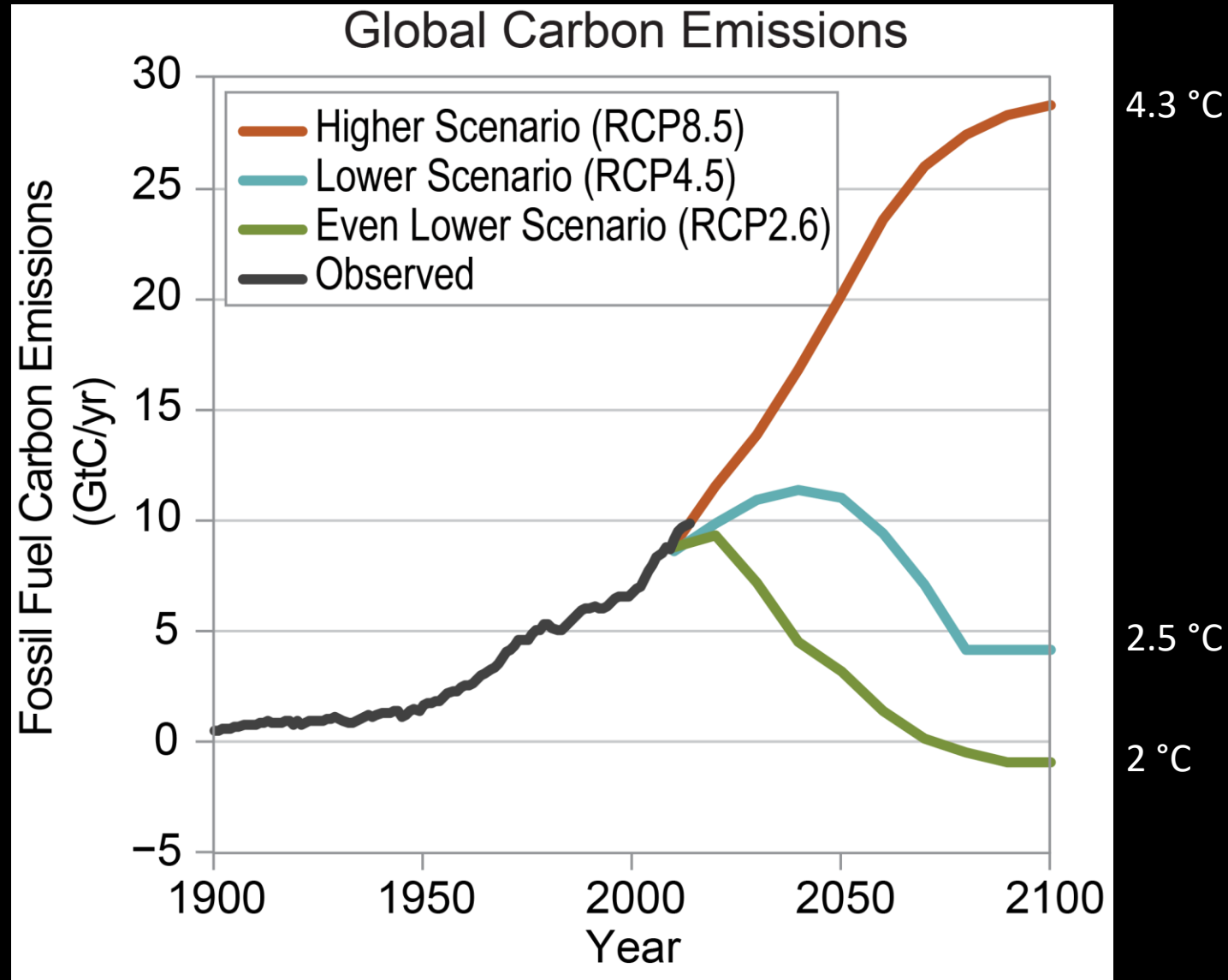
The Risks of Inaction

Annual Economic Damages in 2090	
Sector	Annual damages under RCP8.5
Labor	\$155B
Extreme Temperature Mortality Δ	\$141B
Coastal Property Δ	\$118B
Air Quality	\$26B
Roads Δ	\$20B
Electricity Supply and Demand	\$9B
Inland Flooding	\$8B
Urban Drainage	\$6B
Rail Δ	\$6B
Water Quality	\$5B
Coral Reefs	\$4B
West Nile Virus	\$3B
Freshwater Fish	\$3B
Winter Recreation	\$2B
Bridges	\$1B
Munic. and Industrial Water Supply	\$316M
Harmful Algal Blooms	\$199M
Alaska Infrastructure Δ	\$174M
Shellfish*	\$23M
Agriculture*	\$12M
Aeroallergens*	\$1M

(in 2015 dollars)

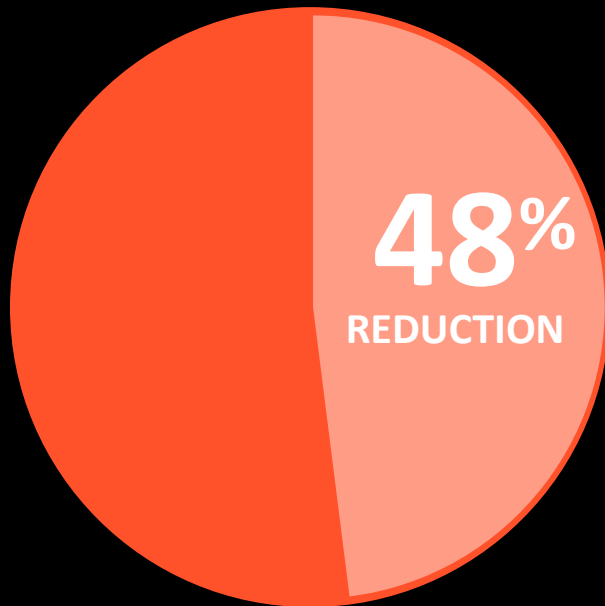
Source:
adapted from
EPA 2017

Projections based on future emissions scenarios

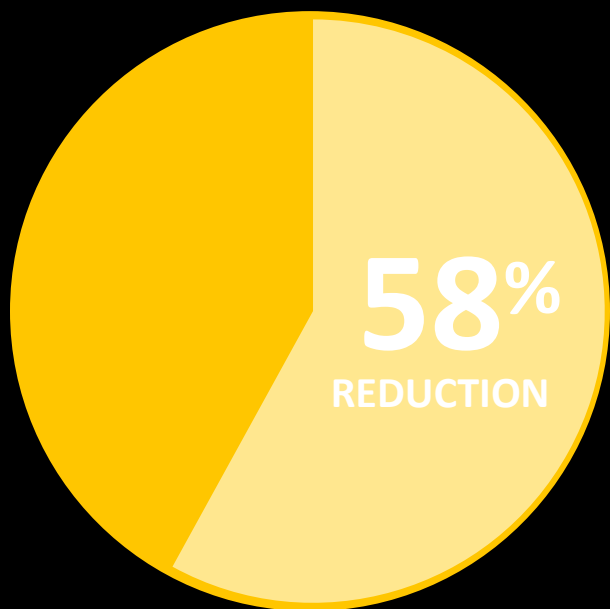


Adapted from
Wuebbles
et al.
2017

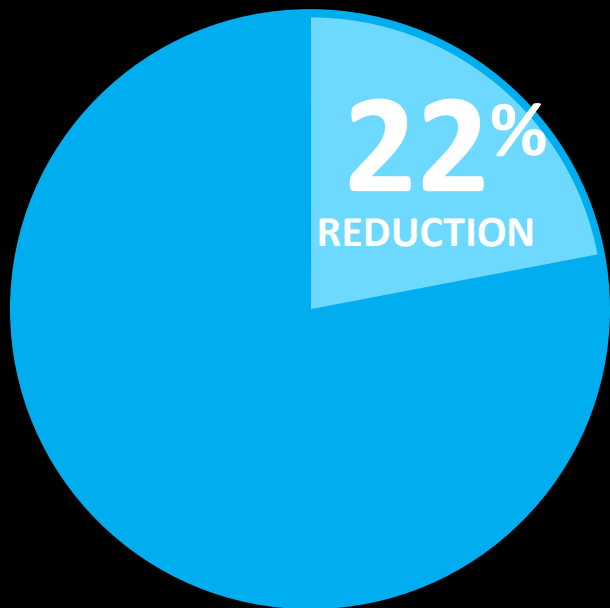
LABOR



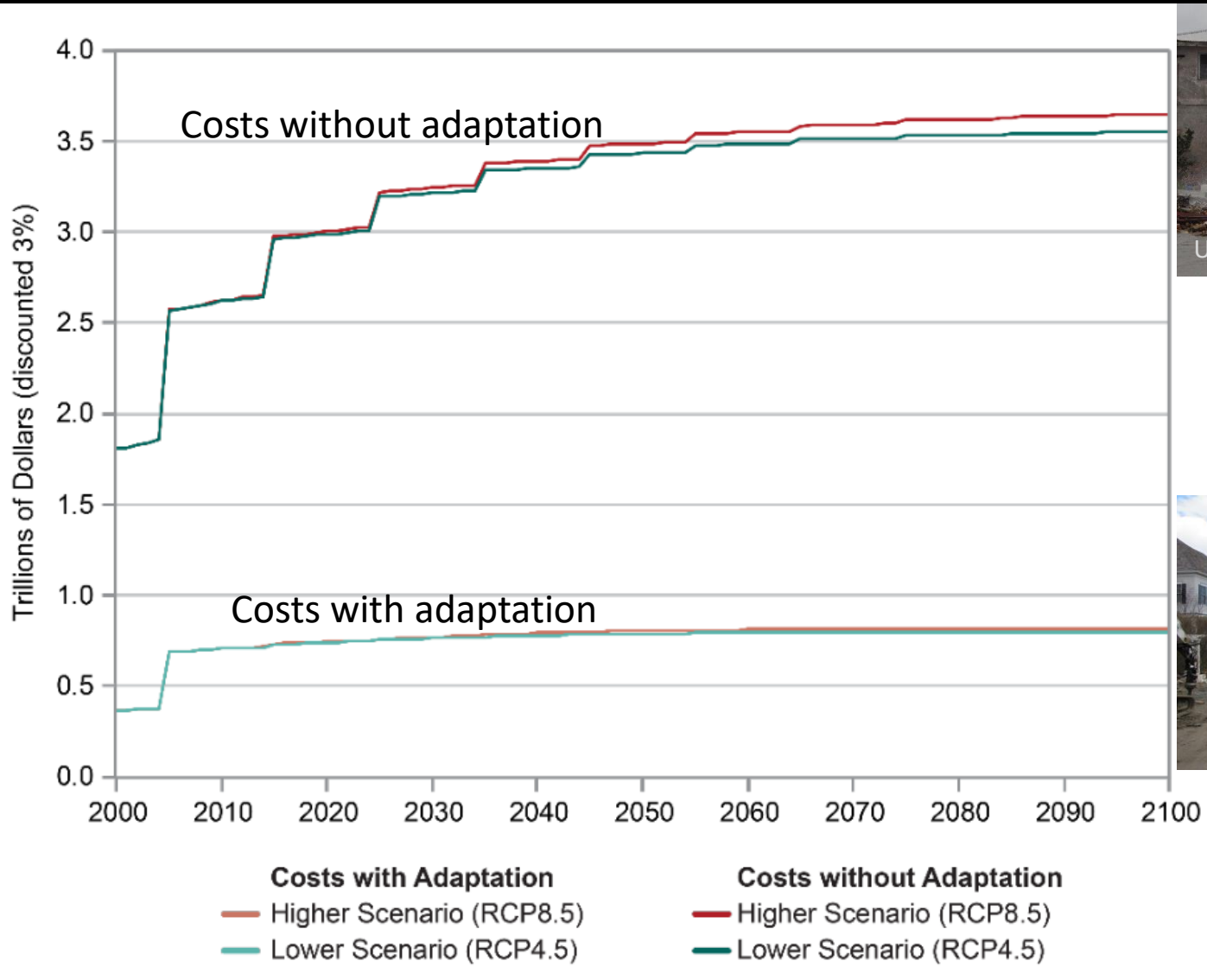
EXTREME TEMPERATURE MORTALITY



COASTAL PROPERTY



Cumulative costs of sea level rise and storm surge



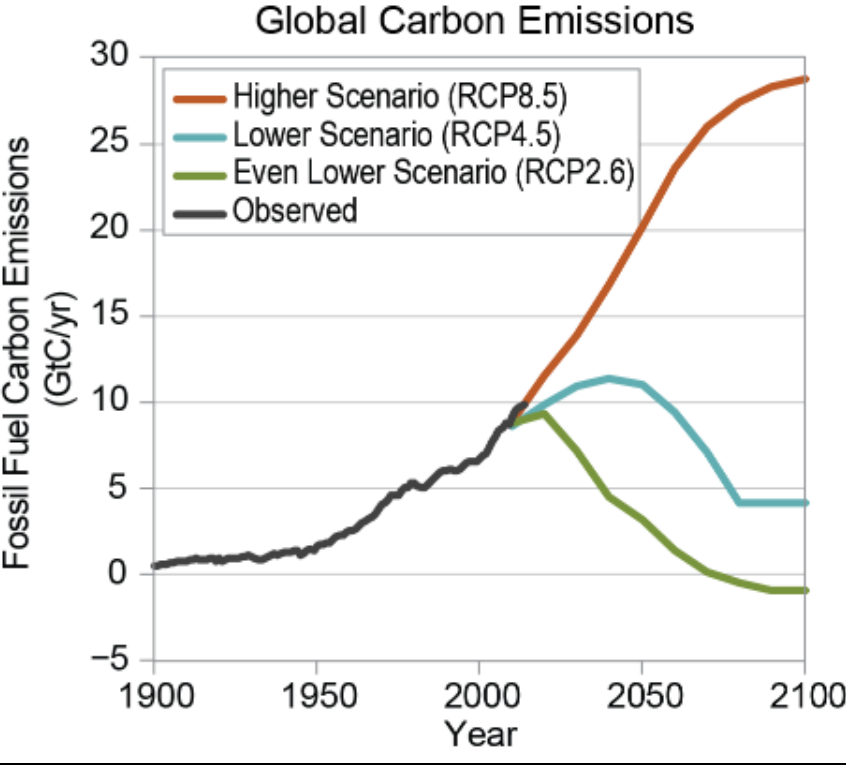
NCA4; Volume II, Ch. 8

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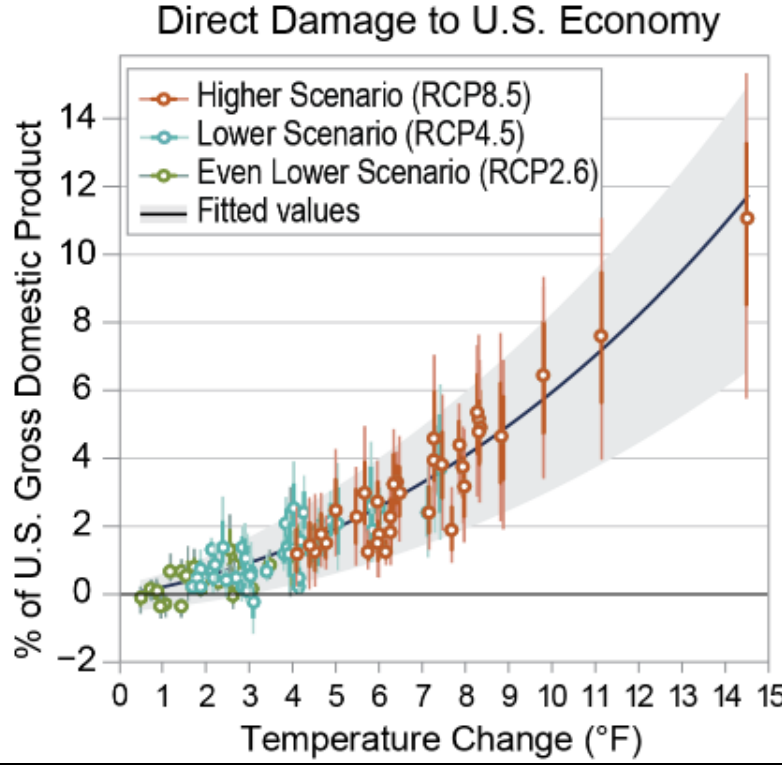
Key Message #3

Avoided or Reduced Impacts

The effect of near-term emissions mitigation on reducing risks is expected to become apparent by mid-century and grow substantially thereafter.



Adapted from Wuebbles et al. 2017



Adapted from Hsiang et al. 2017³ and republished with permission AAAS

29 Key Message #4

Interactions Between Mitigation and Adaptation

Interactions between mitigation and adaptation are complex and can lead to benefits, but they also have the potential for adverse consequences.



Source: adapted from National Research Council, 2010.¹ Used with permission from the National Academies Press, ©2010, National Academy of Sciences. Image credits, clockwise from top: National Weather Service; USGS; Armando Rodriguez, Miami-Dade County; Dr. Neil Berg, MARISA; Bill Ingalls, NASA.

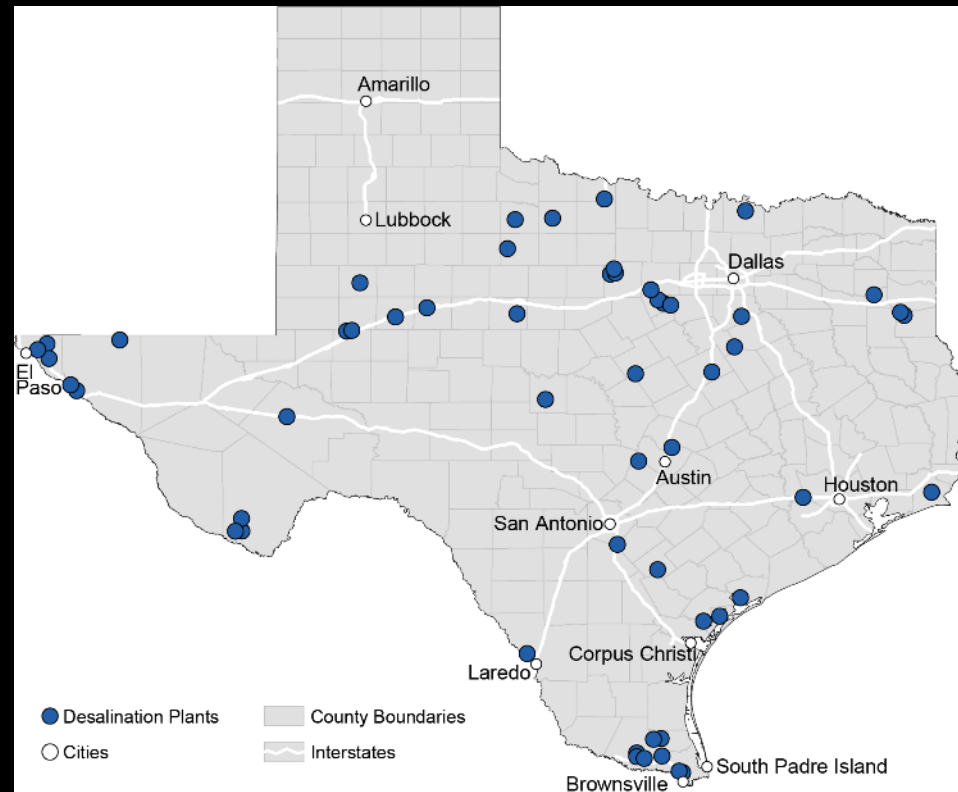
29 Key Message #4

Interactions Between Mitigation and Adaptation

Adaptation can complement mitigation to substantially reduce exposure and vulnerability to climate change in some sectors.

Texas Desalination Plants

Source: adapted from Texas Water Development Board 2017.



29 Key Message #4

Interactions Between Mitigation and Adaptation

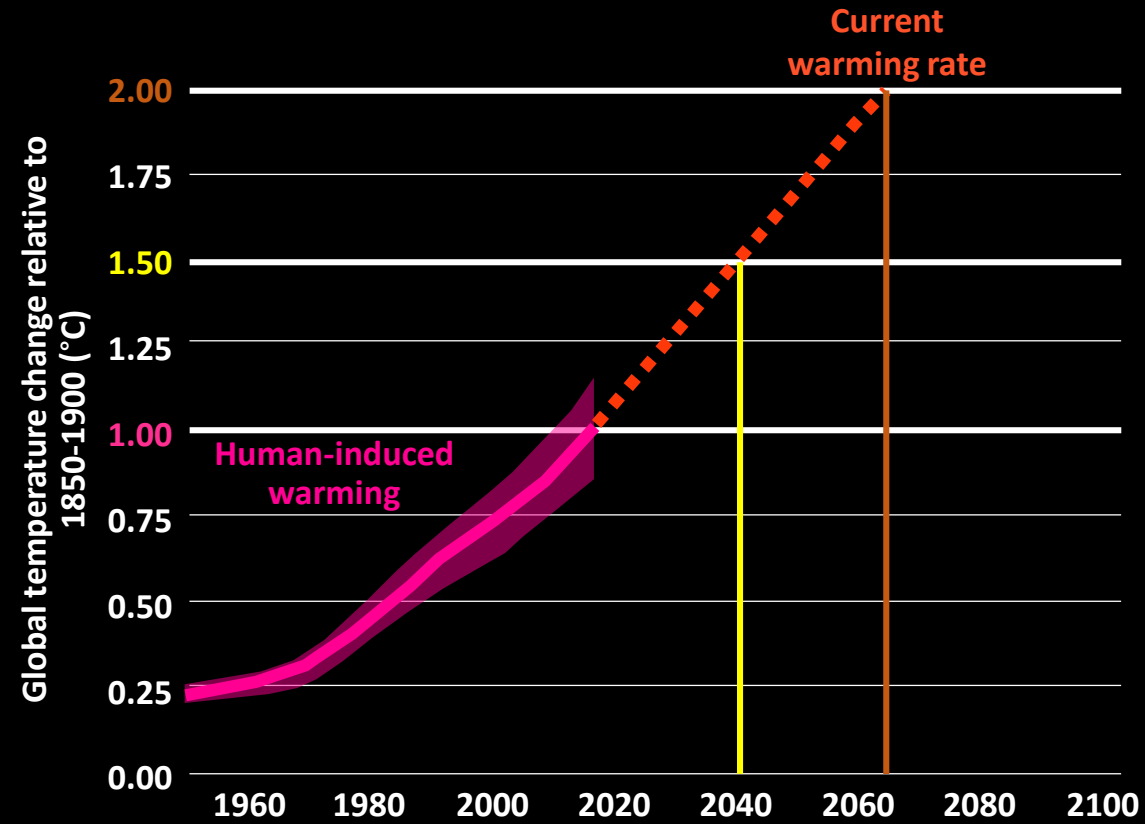
This complementarity is especially important given that a certain degree of climate change due to past and present emissions is unavoidable.



*Photo
credit:
Marshall
Islands
Journal*

A photograph of the Eiffel Tower at night, illuminated with golden lights. The tower is centered in the upper half of the image. A dark grey horizontal bar with white text is overlaid across the middle of the image. The lower half of the image shows a close-up, low-angle view of the tower's lattice structure, looking up through the arches.

1.5 °C or 2 °C World



IPCC 2018 SR15 Fig FAQ 1.2



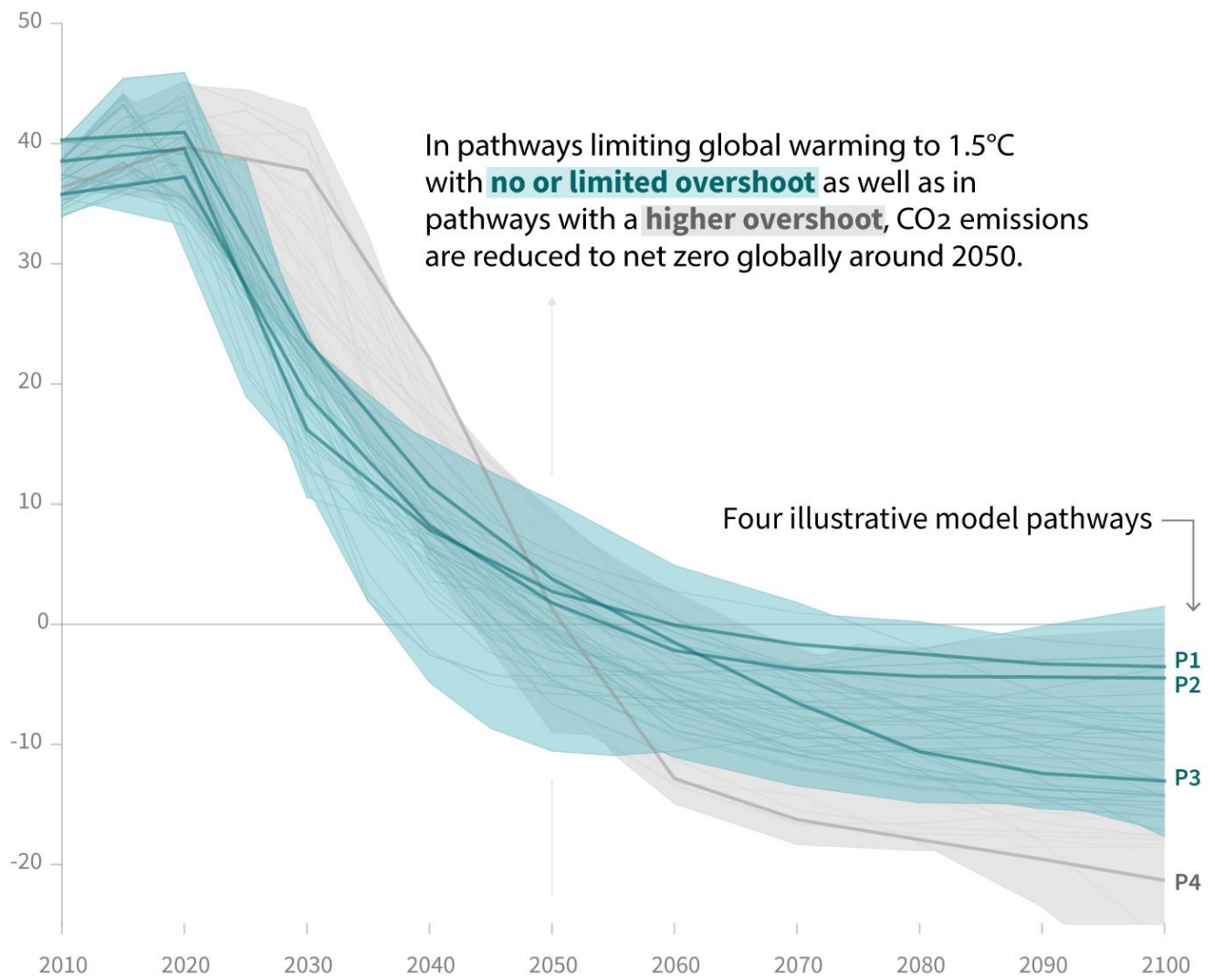
ultramarinfoto / Getty Images



Chasing Coral

Global total net CO₂ emissions

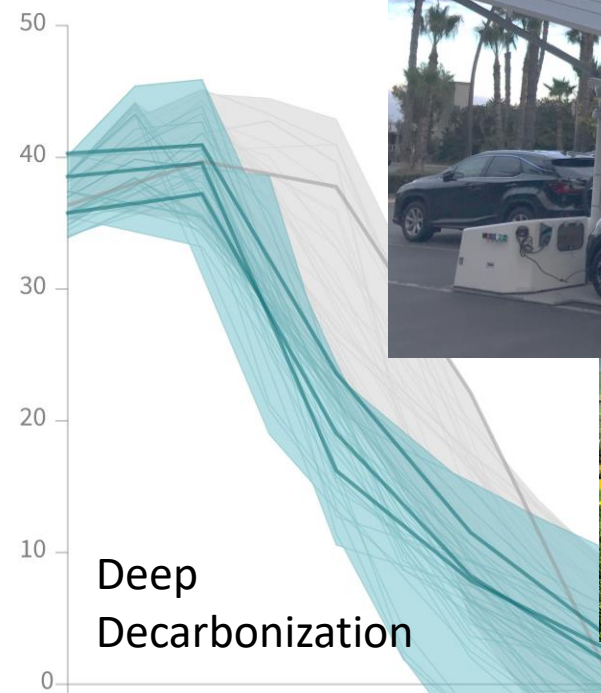
Billion tonnes of CO₂/yr



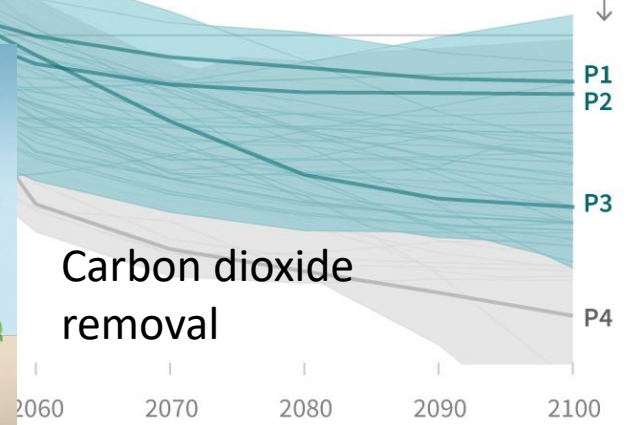
IPCC Special Report 1.5C Fig SPM 3a

Global total net CO₂ emissions

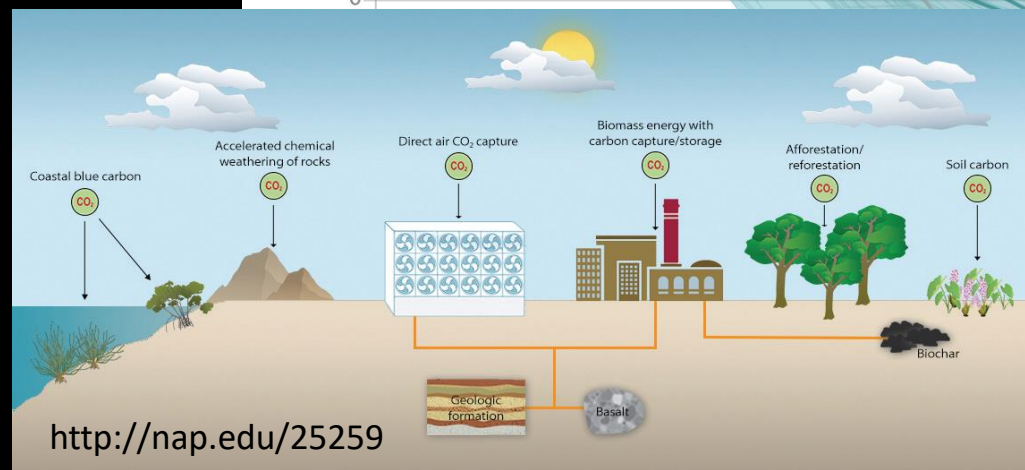
Billion tonnes of CO₂/yr



USGCR 2018 NCA4 fig 23-12



Carbon dioxide removal



<http://nap.edu/25259>

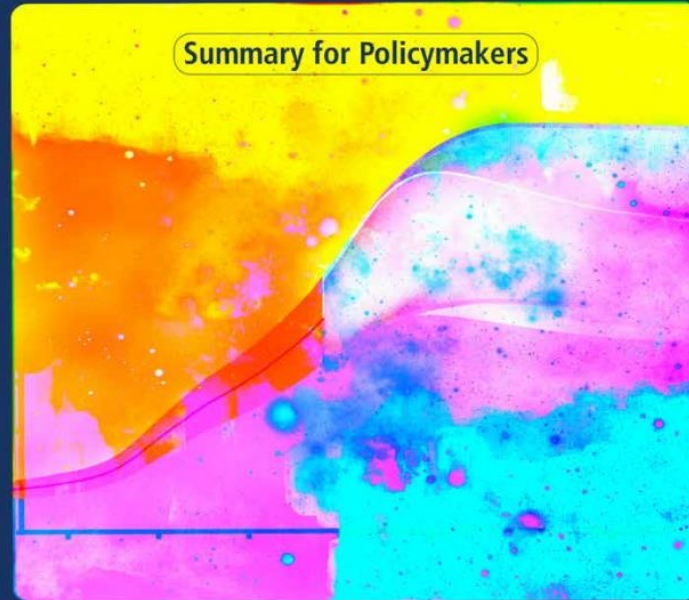
ipcc

INTERGOVERNMENTAL PANEL ON climate change

Global Warming of 1.5°C

An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty

Summary for Policymakers



WG I WG II WG III





U.S. Global Change
Research Program

Recommended chapter citation

Martinich, J., B.J. DeAngelo, D. Diaz, B. Ekwurzel, G. Franco, C. Frisch, J. McFarland, and B. O'Neill, 2018: Reducing Risks Through Emissions Mitigation. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: [10.7930/NCA4.2018.CH29](https://doi.org/10.7930/NCA4.2018.CH29)

Read the full chapter

<https://nca2018.globalchange.gov/chapter/mitigation>

nca2018.globalchange.gov

**[Union of
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Environmental and
Energy Study Institute



How Climate Change Affects the United States: Exploring the NCA and IPCC Reports

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www.eesi.org/022519climate

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