

# THE FIRST STEP TO TACKLING CLIMATE CHANGE

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KATHARINE HAYHOE




OR SMART  
THERMOSTATS



WE OFTEN  
THINK IT'S  
ABOUT  
PERSONAL  
ACTIONS LIKE  
RECYCLING



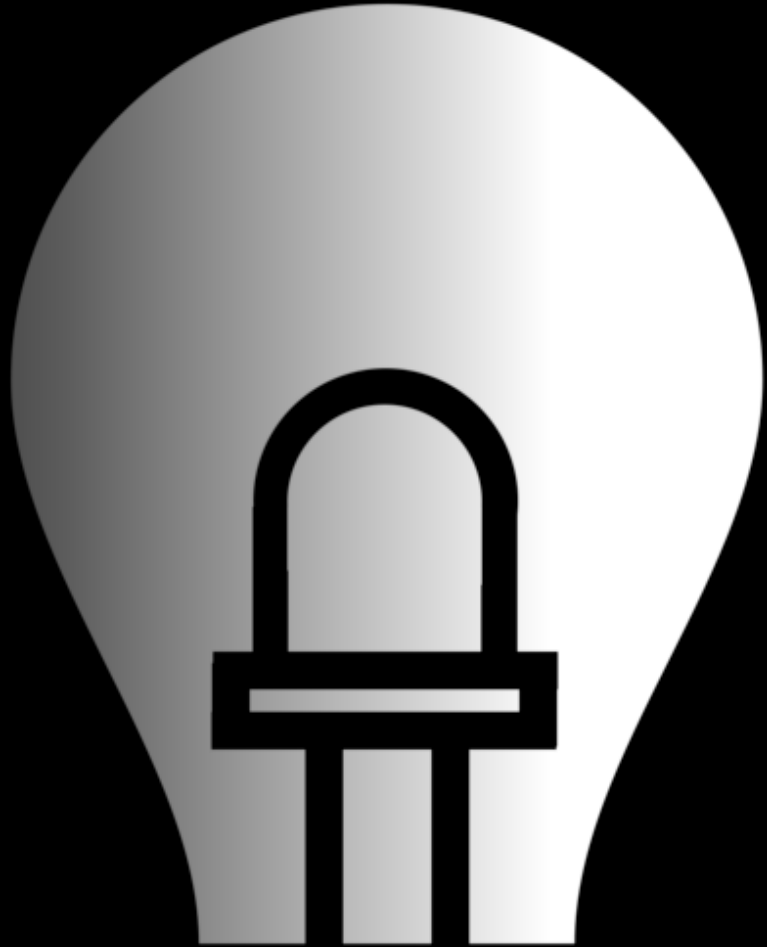
OR  
LIGHTBULBS



570 million tons of CO2 per year are cut by using LED bulbs. This is like shutting down 162 coal-fired power plants around the world.

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**BUT GLOBAL EMISSIONS ARE 33,000 MILLION TONS. SO LEDs JUST FIX 1.7% OF THE PROBLEM.**





MICHAEL MANN (2019)

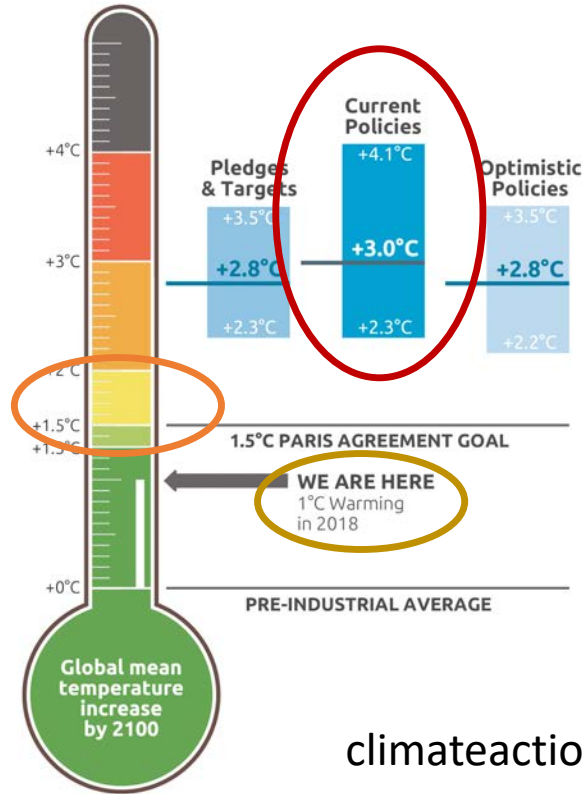
We don't need to ban cars; we need to electrify them with clean energy. We don't need to ban burgers; we need climate-friendly beef. A single scientist, or even hundreds of scientists, choosing to never fly again is not going to change the system.

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THE TRUE SOLUTION REQUIRES  
POLICY CHANGE.

[time.com/5669071/lifestyle-changes-climate-change/](https://time.com/5669071/lifestyle-changes-climate-change/)

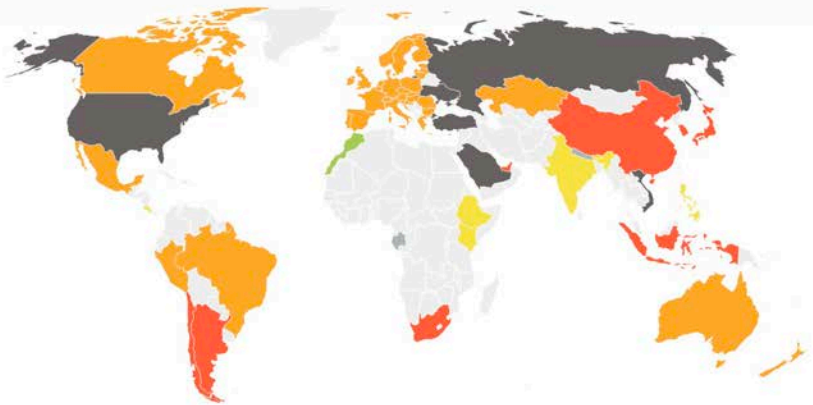




CAT warming projections  
**Global temperature increase by 2100**

December 2019 Update

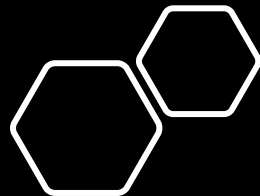
[climateactiontracker.org/](https://climateactiontracker.org/)



Assessments of:

 **AVIATION**  
[Find out more](#)

 **SHIPPING**  
[Find out more](#)



The maps displayed are for reference only.

LAST UPDATE: June 2020

CRITICALLY INSUFFICIENT	HIGHLY INSUFFICIENT	INSUFFICIENT	2°C COMPATIBLE	1.5°C PARIS AGREEMENT COMPATIBLE	ROLE MODEL
4°C+ WORLD	< 4°C WORLD	< 3°C WORLD	< 2°C WORLD	< 1.5°C WORLD	<< 1.5°C WORLD
RUSSIAN FEDERATION	ARGENTINA	AUSTRALIA	BHUTAN	MOROCCO	
SAUDI ARABIA	CHILE	BRAZIL	COSTA RICA	THE GAMBIA	
TURKEY	CHINA	CANADA	ETHIOPIA		
USA	INDONESIA	EU	INDIA		
UKRAINE	JAPAN	KAZAKHSTAN	KENYA		
VIET NAM	SINGAPORE	MEXICO	PHILIPPINES		
	SOUTH AFRICA	NEW ZEALAND			
	SOUTH KOREA	NORWAY			
	UAE	PERU			
		SWITZERLAND			

[climateactiontracker.org/](https://climateactiontracker.org/)

# PEOPLE DON'T UNDERSTAND ENOUGH SCIENCE



“If I just explain the facts they’ll get it, right?”  
[www.globalweirdingseries.com](http://www.globalweirdingseries.com)



MORE  
SCIENCE!

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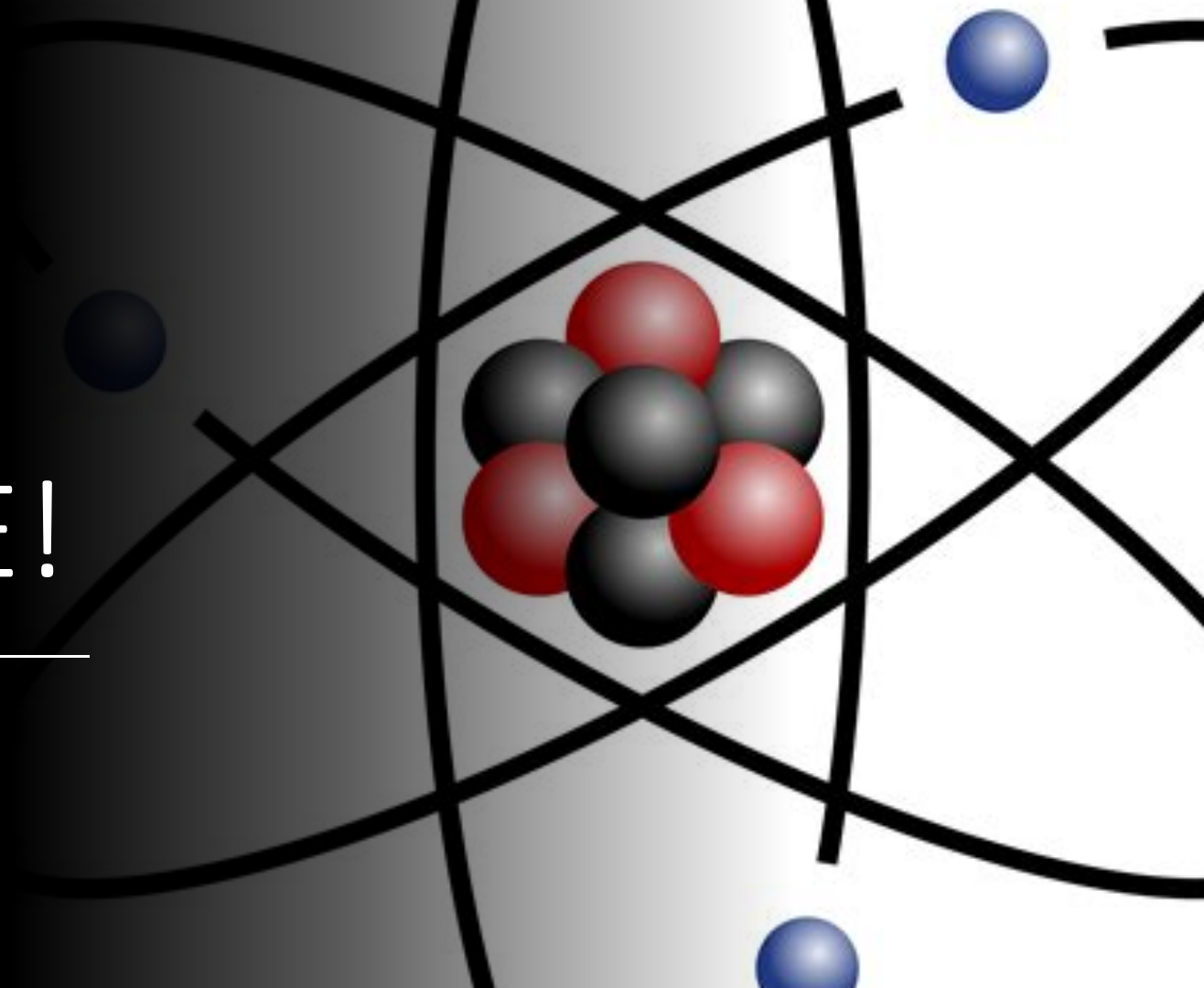
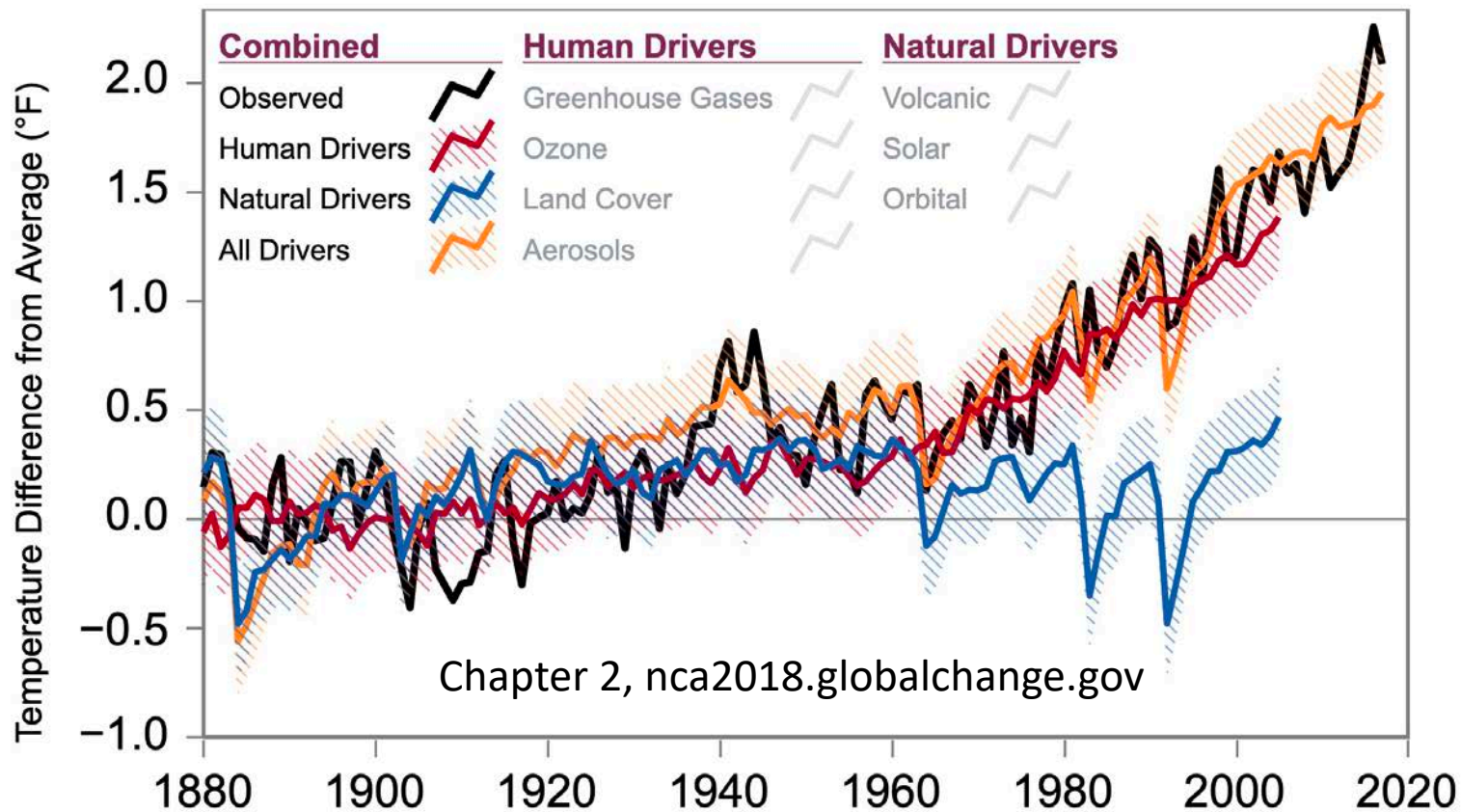




Figure 2.1: Human and Natural Influences on Global Temperature



Click legend item names to toggle graph lines.



NEWS | MARCH 16, 2020

## Greenland, Antarctica Melting Six Times Faster Than in the 1990s



An aerial view of the icebergs near Kulusuk Island, off the southeastern coastline of Greenland, a region that is exhibiting an accelerated rate of ice loss. Credit: NASA Goddard Space Flight Center

[Larger view](#)

EXPLAINERS | 14 July 2020 | 13:18

## Explainer: How climate change is affecting wildfires around the world



# Methane Emissions Continue to Rise

oogle Scholar

"climate change"

cles

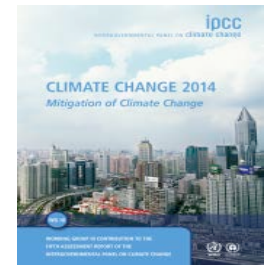
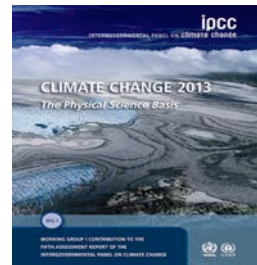
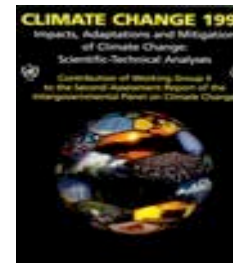
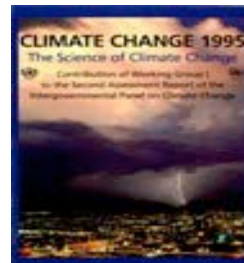
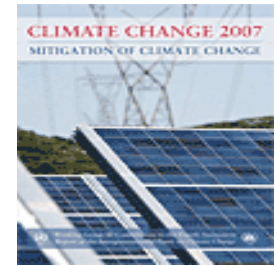
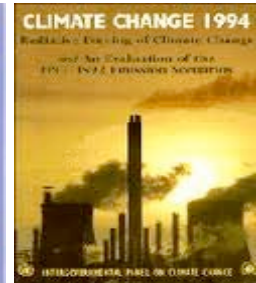
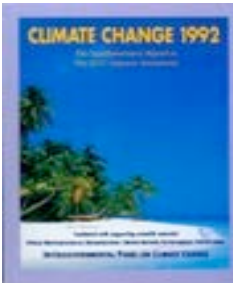
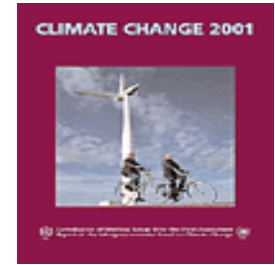
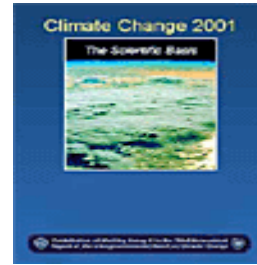
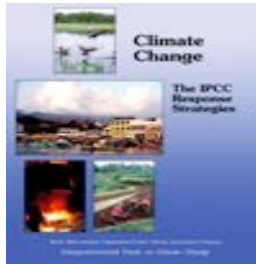
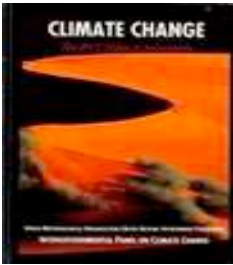
About 2,620,000 results (0

THE SCIENTIFIC LITERATURE HAS THE FACTS

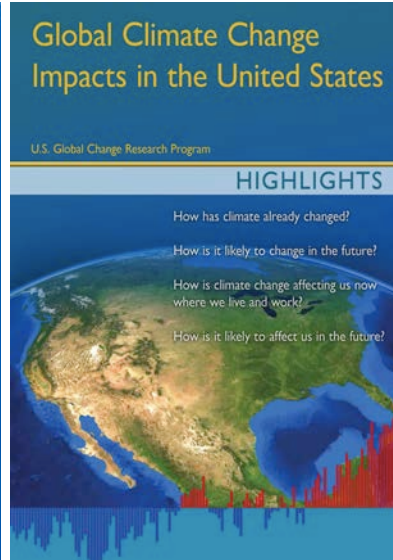
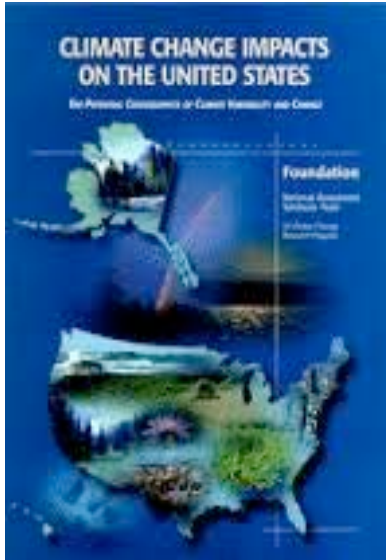
[scholar.google.com](https://scholar.google.com)

# 6 IPCC ASSESSMENTS HAVE THE FACTS

## IPCC.CH



# 4 NATIONAL CLIMATE ASSESSMENTS HAVE THE FACTS



[usgcrp.gov](http://usgcrp.gov)

# 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.

500+ pages

▣ Recommended Citation

[science2017.globalchange.gov](https://science2017.globalchange.gov)

## 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 II presents an assessment of the physical science underlying this report: [science2017.globalchange.gov](https://science2017.globalchange.gov)

# 1,600+ pages

[nca2018.globalchange.gov](https://nca2018.globalchange.gov)

# ESRI HAS THE FACTS

## Hot Numbers

It's a fact: Human impacts are warming our climate and changing our planet

12.8%

1.8

409

9

25%

30%

60%

17

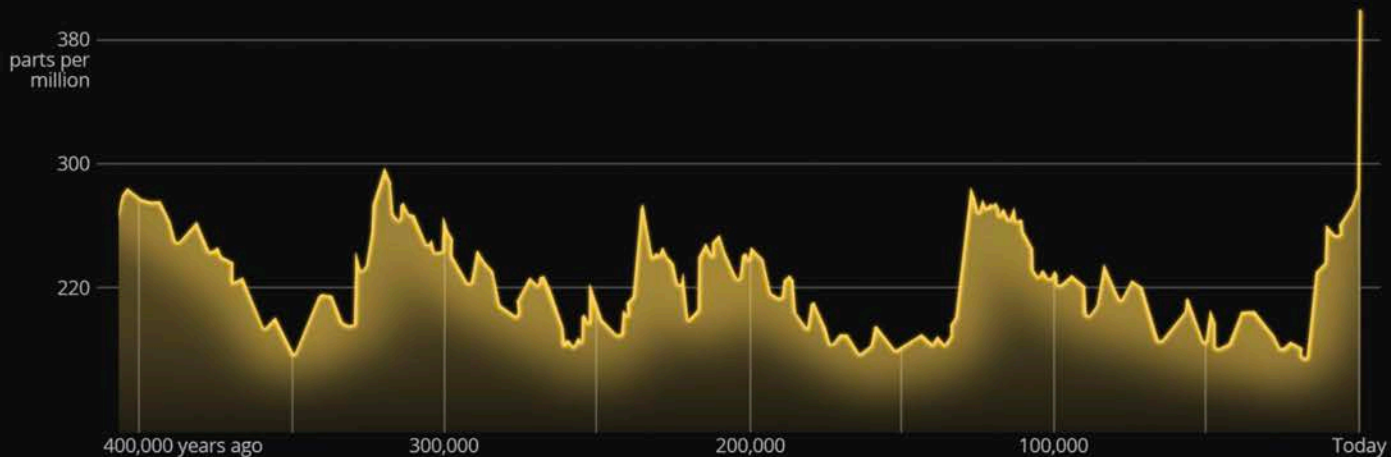




## Carbon dioxide levels in the atmosphere are at their highest in 650,000 years.

Ice sheets in Greenland and Antarctica have trapped samples of ancient atmospheres. Extracting and analyzing ice cores reveals a pulsing, planetary heartbeat that shows how carbon dioxide levels have waxed and waned with the ice ages... until now.

Source: NASA

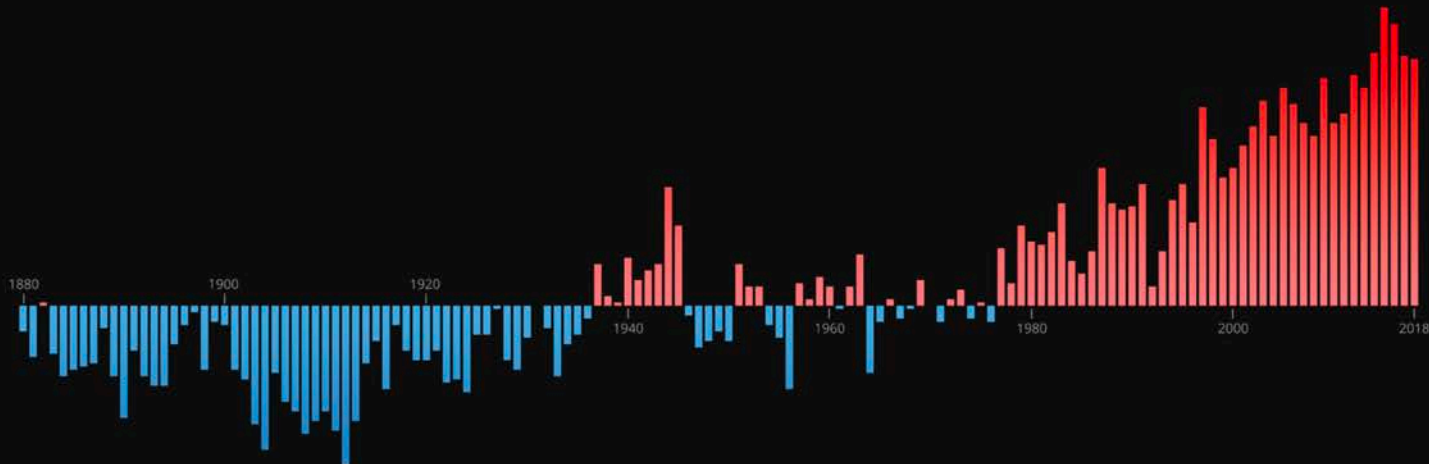


In the planetary equivalent of a blink of an eye, humans have supercharged the atmosphere with heat-trapping CO<sub>2</sub>. We've barely begun to see the impacts of our unintentional—and dangerous—planet-wide experiment.

## The Earth's average temperature has risen 1.8 degrees Fahrenheit since 1880.

With the exception of 1998, 17 of the 18 warmest years in the 136-year record all have occurred since 2001.

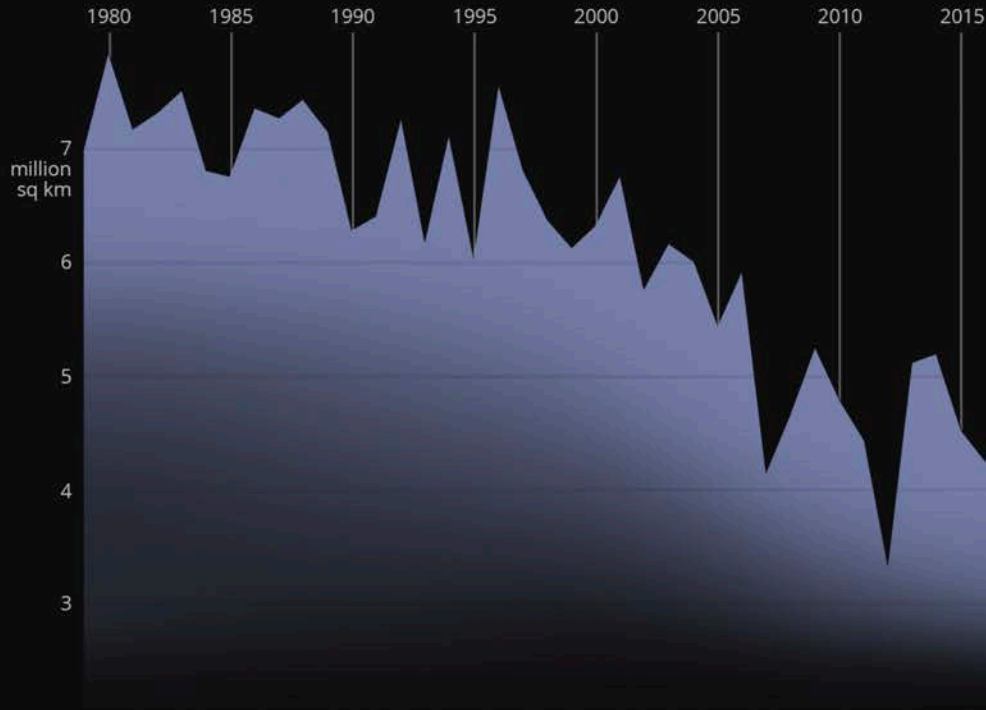
Source: NASA/GISS



Graphing average global surface temperature relative to the 1951-1980 average reveals a striking, undeniable planet-wide warming. That this trend will continue into the future is without doubt; the question is whether greenhouse gas emissions can be reduced rapidly enough to avoid catastrophic impacts on croplands, cities, and ecosystems.

## Every 10 years the extent of Arctic sea ice in September declines by 12.8 percent.

Arctic sea ice reaches its minimum extent each September. That extent is declining at a rate of 12.8 percent per decade relative to the 1981-2010 average.



# World Scientists' Warning of a Climate Emergency FREE

William J Ripple ✉, Christopher Wolf ✉, Thomas M Newsome,  
Joëlle Barnard, William R Moomaw [Author Notes](#)

*PNAS*, Volume 70, Issue 1, January 2020, Pages 8–12, <https://doi.org/10.1093/biosci/biz088>

Received: 05 November 2019

THE FACTS HAVE BEEN  
COMMUNICATED BY  
THOUSANDS OF SCIENTISTS

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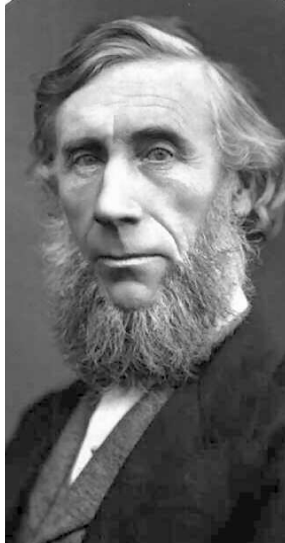
scientistswarning.org

... have a moral obligation to clearly warn humanity of  
... threat and to “tell it like it is.” On the basis of the  
... physical indicators presented below, we declare, with  
... scientist signatories from around the world, clearly and  
... ally that planet Earth is facing a climate emergency

# ... OVER MULTIPLE CENTURIES



JOSEPH  
FOURIER  
1820s



JOHN  
TYNDALL  
1850s



EUNICE  
FOOTE  
1850s



SVANTE  
ARRHENIUS  
1890s



GUY  
CALLENDAR  
1930s

“How long have we known about climate change?” [www.globalweirdingseries.com](http://www.globalweirdingseries.com)

CO<sub>2</sub> concentration is nearly at 420 ppm, a level that last occurred more than **15 million years ago**, when global average temperature and sea level were significantly higher than today.

Continued growth in CO<sub>2</sub> 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 about 10 GtC per year suggests that there is no climate analogue for this century any time in at least the last 100 million years.

Aristotle might argue humans were not responsible for the choices made at the beginning of the Industrial Era, when collective scientific and societal knowledge limited our capacity to choose wisely and well.

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Hayhoe and Kopp, Environmental  
Research Letters (2016)



Regardless of our original ignorance, however, over the last few centuries we have been conducting an unprecedented experiment with the Earth's climate system, the only home we have.

Hayhoe and Kopp, Environmental Research Letters (2016)



A close-up photograph of a large pile of discarded cigarettes. The cigarettes have orange and white filters, and some are lit, showing the brown ash and tobacco. The background is dark, making the cigarettes stand out.

There's no magic amount of carbon emissions we can remain below that ensures we avoid all risk.

But the faster + the further we cut our emissions, the better off we'll all be.

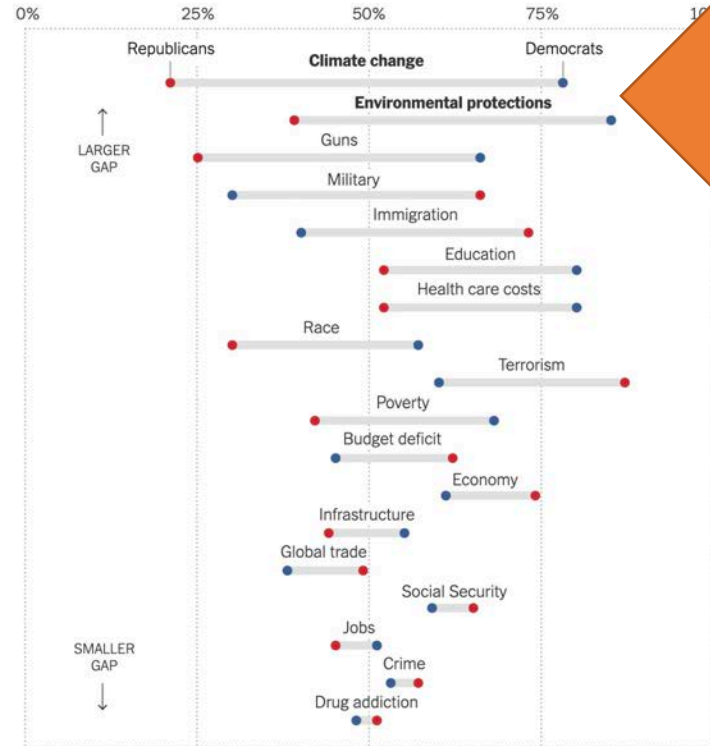
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KATHARINE HAYHOE

# AND YET HERE WE ARE

Pew Research Center 2020  
Graphic by the NY Times

Percentage of Americans in each party who say the issue is a top priority in 2020

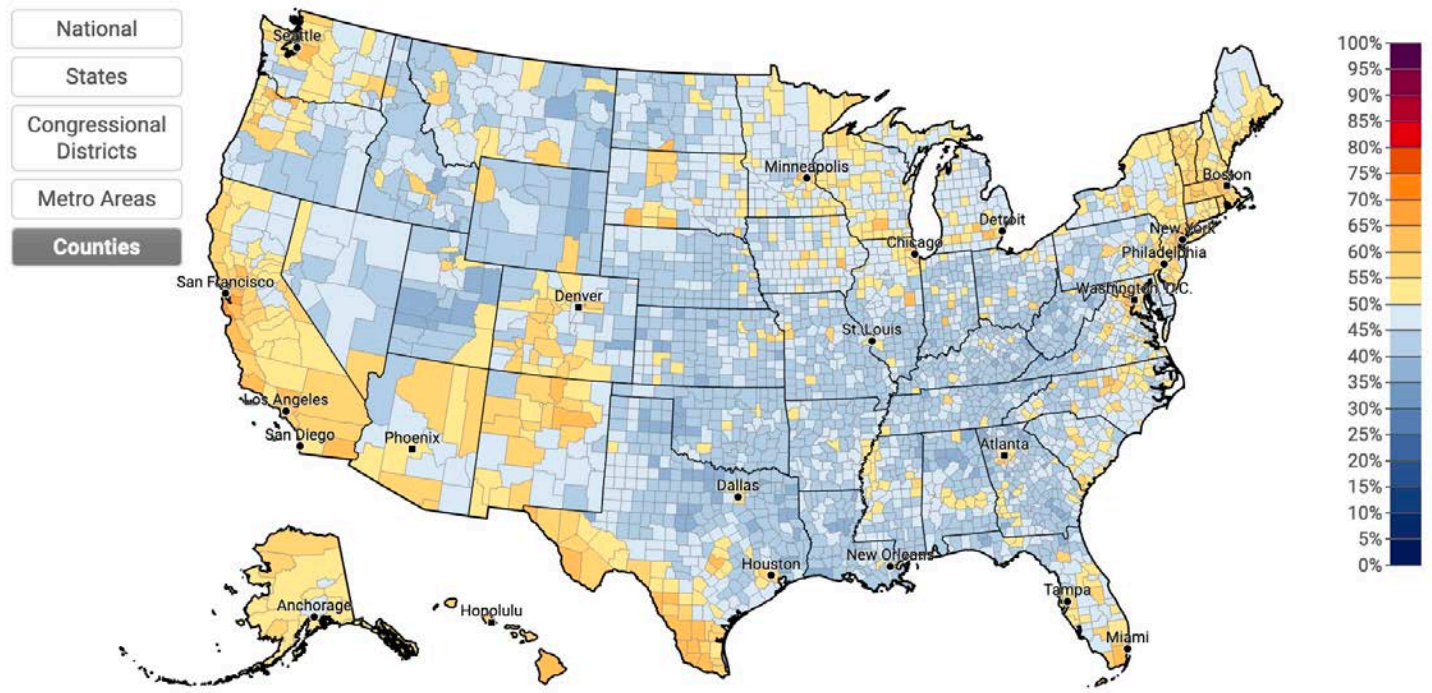


Independents who say they lean toward a given party are categorized under that party. - Source: [Pew Research Center](#)

# Estimated % of adults who think global warming is mostly caused by human activities (53%), 2019

Select Question:

Click on map to select geography, or:

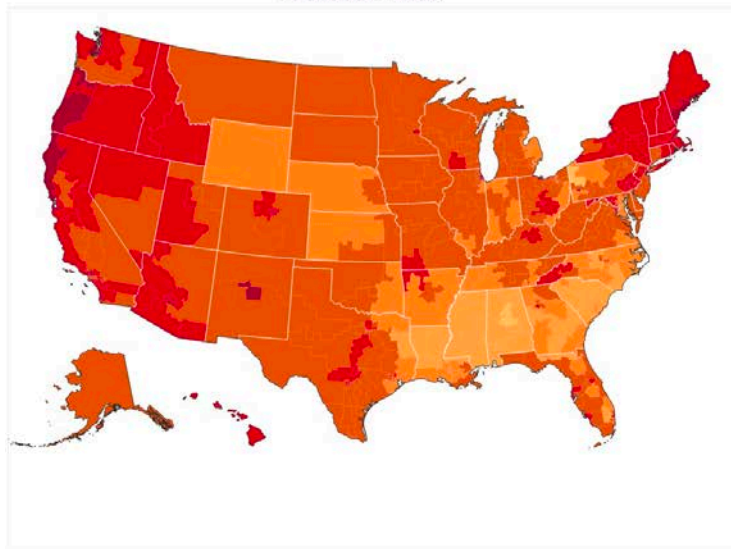


# Estimated % of registered voters who think global warming is mostly caused by human activities

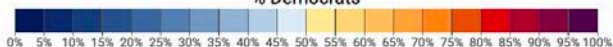
Select Question: Global warming is caused mostly by human activities

Show:     Show population centres

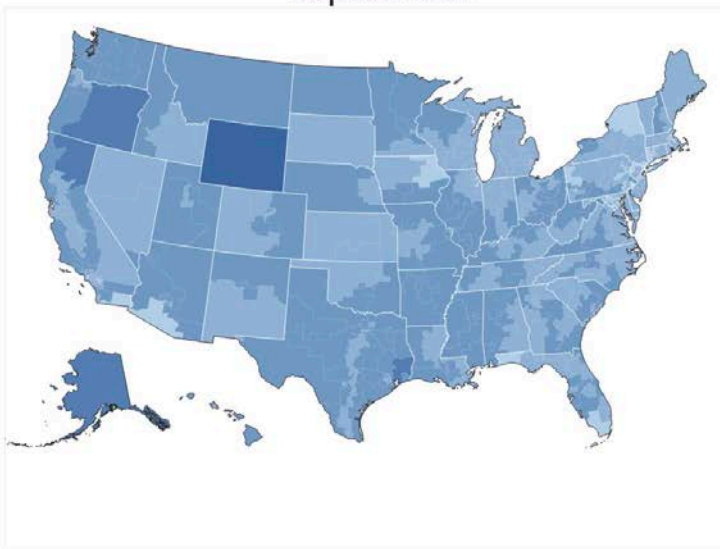
## Democrats



% Democrats



## Republicans



% Republicans



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?

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# TALI SHAROT

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Our brains are programmed to get a kick out of information ...but when we give people new info, they typically only accept it if they already believe it. If it contradicts what they believe, their brain “shuts off.”

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“The Influential Mind” (2017)





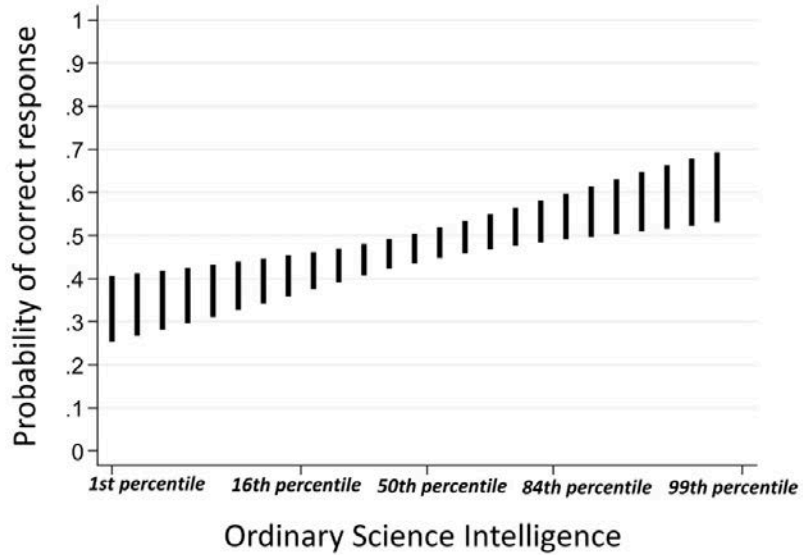
## DAN KAHAN

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Members of the public with the highest degrees of science literacy are not most concerned about climate change. Rather, they are the ones among whom **cultural polarization** is greatest.

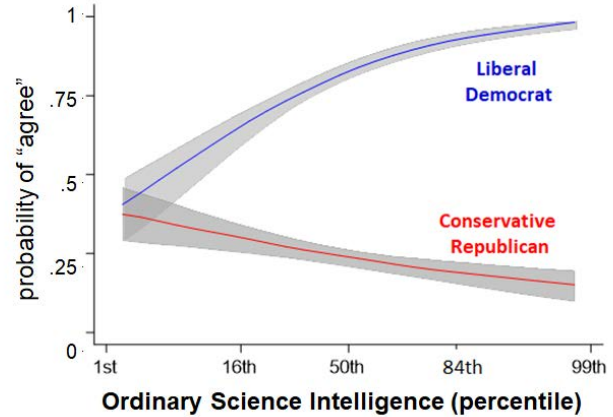
Kahan et al. Nature (2012)





Kahan, Journal of Risk Research (2017)

There is “solid evidence” of recent global warming due “mostly” to “human activity such as burning fossil fuels.” [agree, disagree]



*N* = 1905. Nationally representative sample. Source: Adapted from Kahan, D.M. Climate-Science Communication and the Measurement Problem. *Advances in Political Psychology* 36, 1-43 (2015).

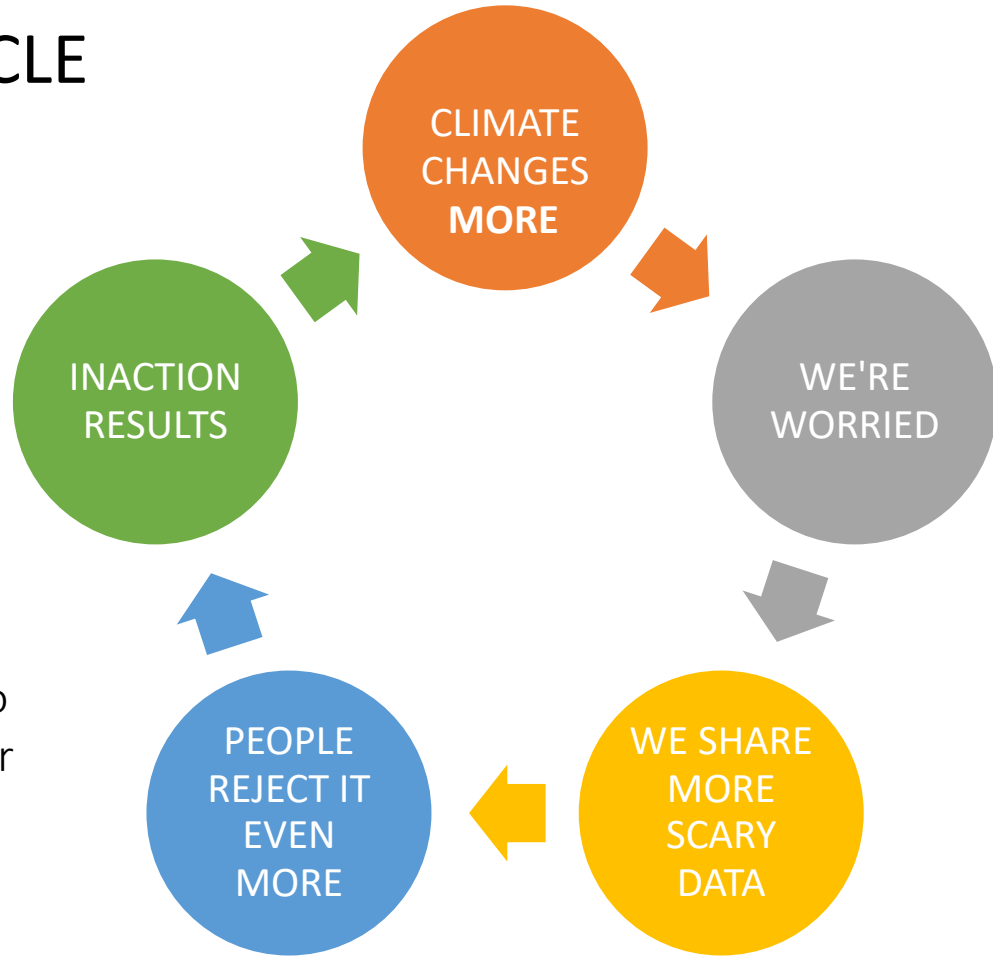


This wealth of information available makes us more resistant to change, because it is so easy to find data that supports our pre-existing opinion

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TALI SHAROT  
THE INFLUENTIAL MIND (2017)

# THE VICIOUS CYCLE



Fear and anxiety will cause us to withdraw, to freeze, to give up, rather than take action.

– Tali Sharot

THE INFLUENTIAL MIND (2017)

KATHARINE HAYHOE

# HOW DO WE BREAK THIS VICIOUS CYCLE?

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BY SHARING THE *RIGHT KIND* OF DATA

What is the right  
kind of data?

Data that  
addresses  
the REAL  
PROBLEMS



We don't think it  
matters to us



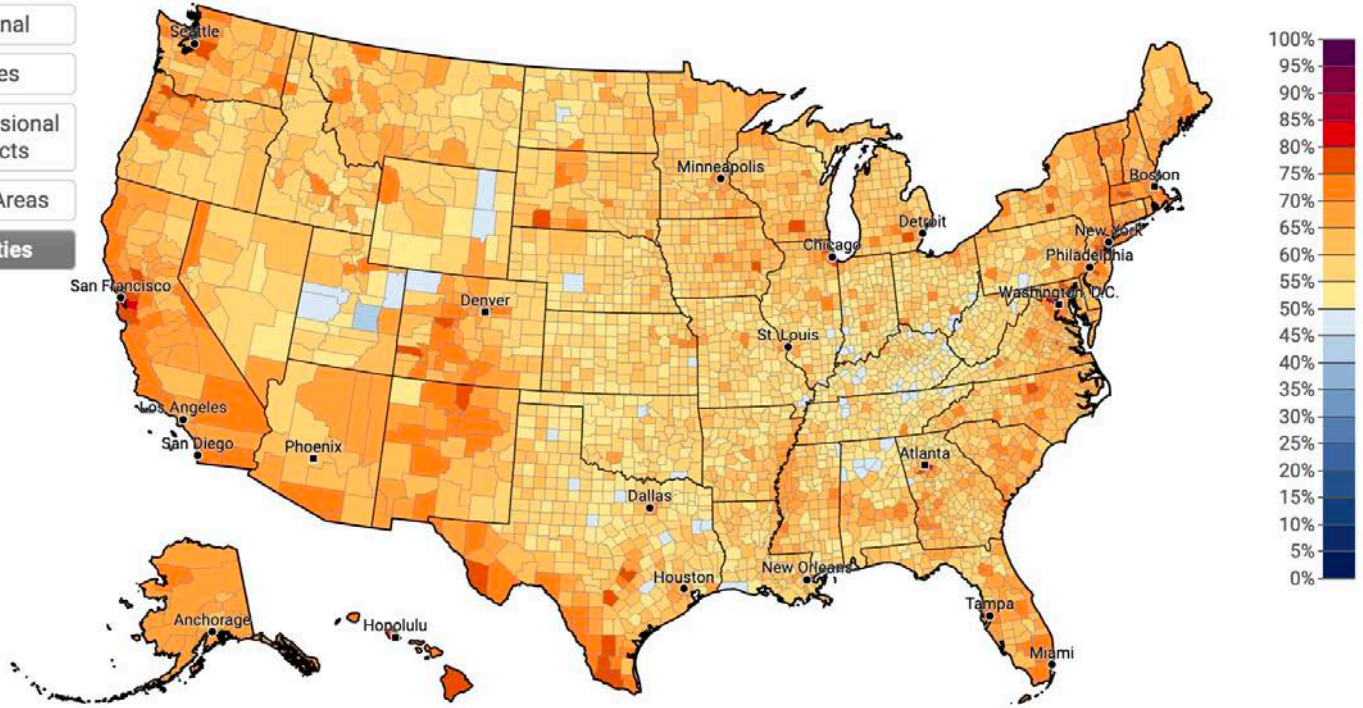
And we don't think  
there's anything positive  
we can do to fix it

# Estimated % of adults who think global warming is happening (67%), 2019

Select Question:  Absolute Value

Click on map to select geography, or:

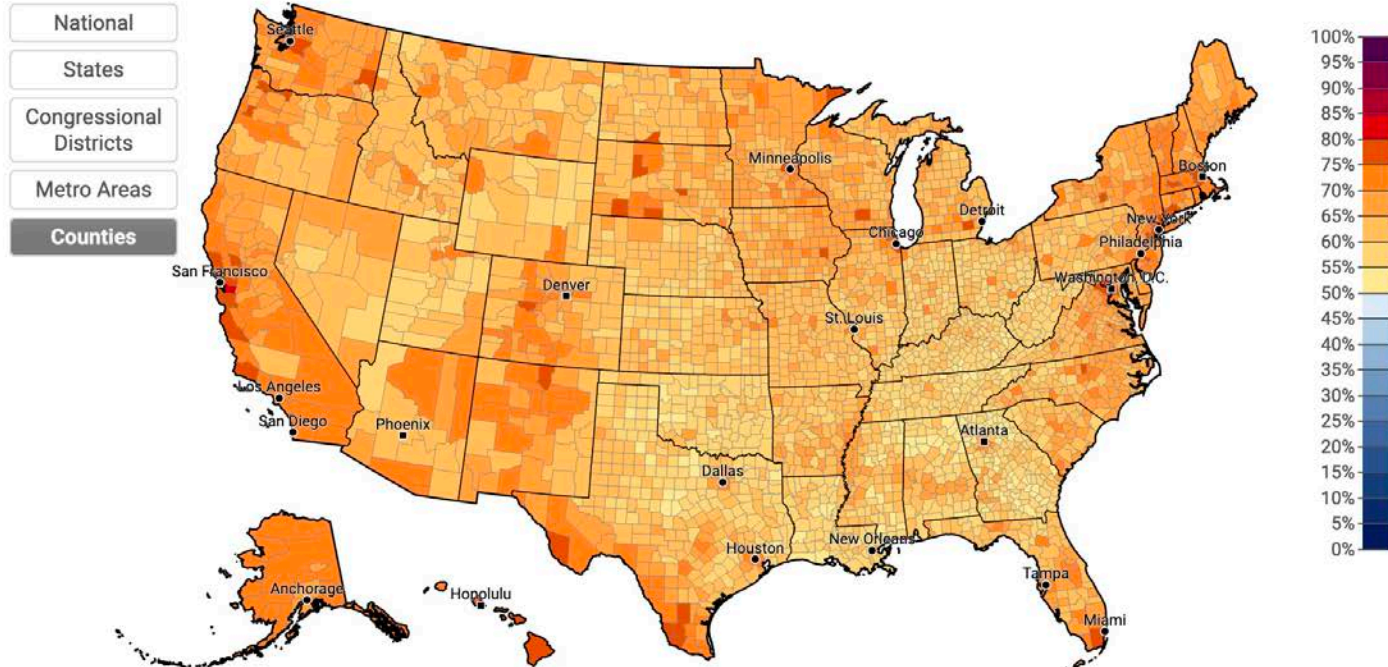
- National
- States
- Congressional Districts
- Metro Areas
- Counties**



# Estimated % of adults who think global warming will harm plants and animals (69%), 2019

Select Question:

Click on map to select geography, or:

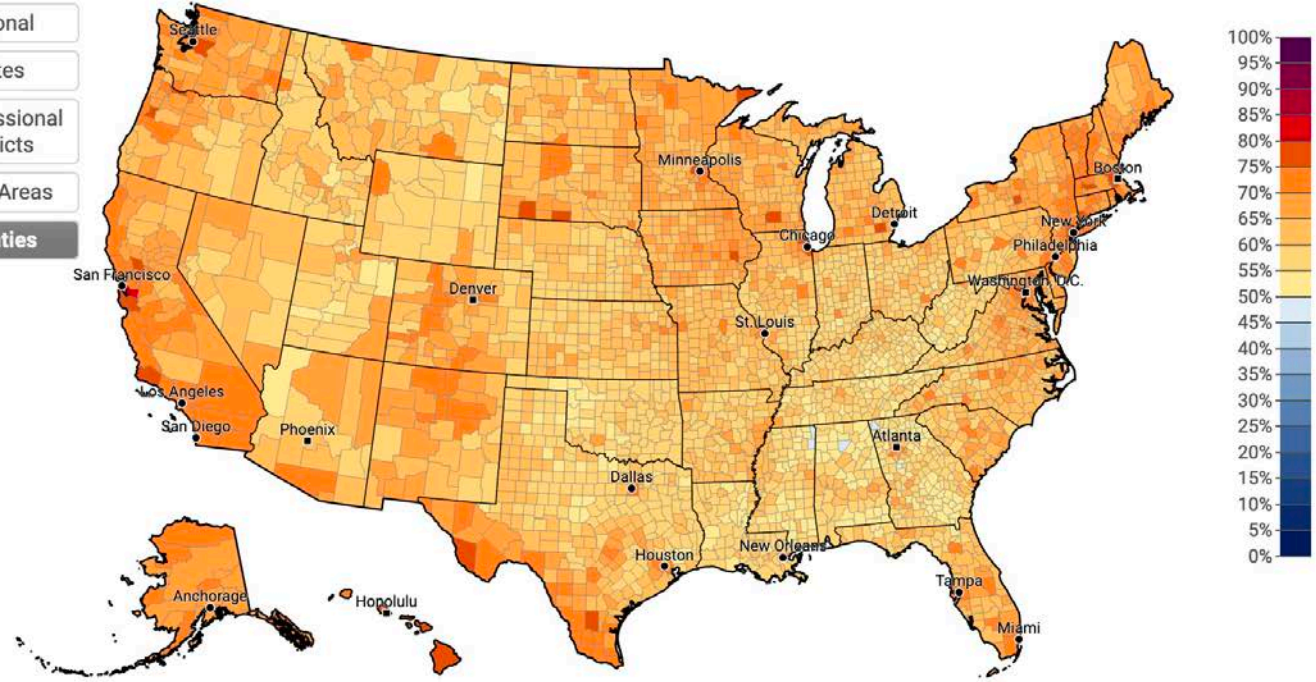


# Estimated % of adults who think global warming will harm future generations (67%), 2019

Select Question:

Click on map to select geography, or:

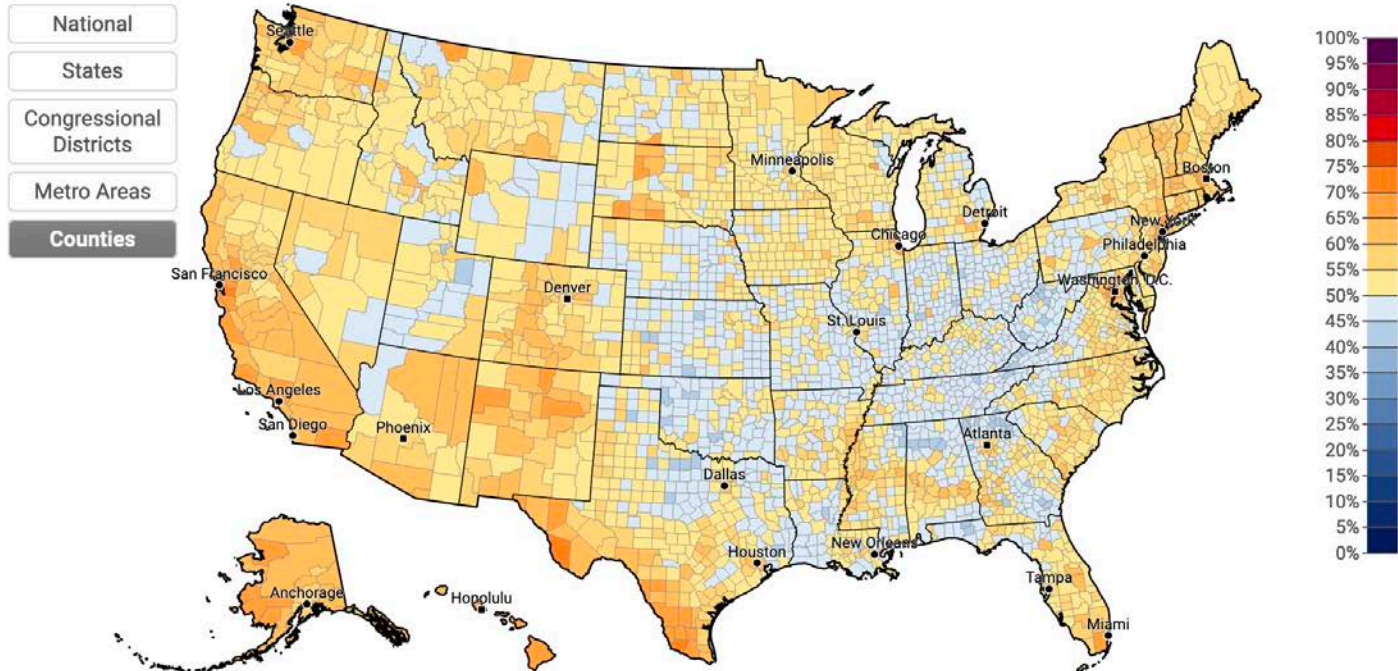
- National
- States
- Congressional Districts
- Metro Areas
- Counties**



# Estimated % of adults who think global warming will harm people in the US (57%), 2019

Select Question:  Absolute Value

Click on map to select geography, or:

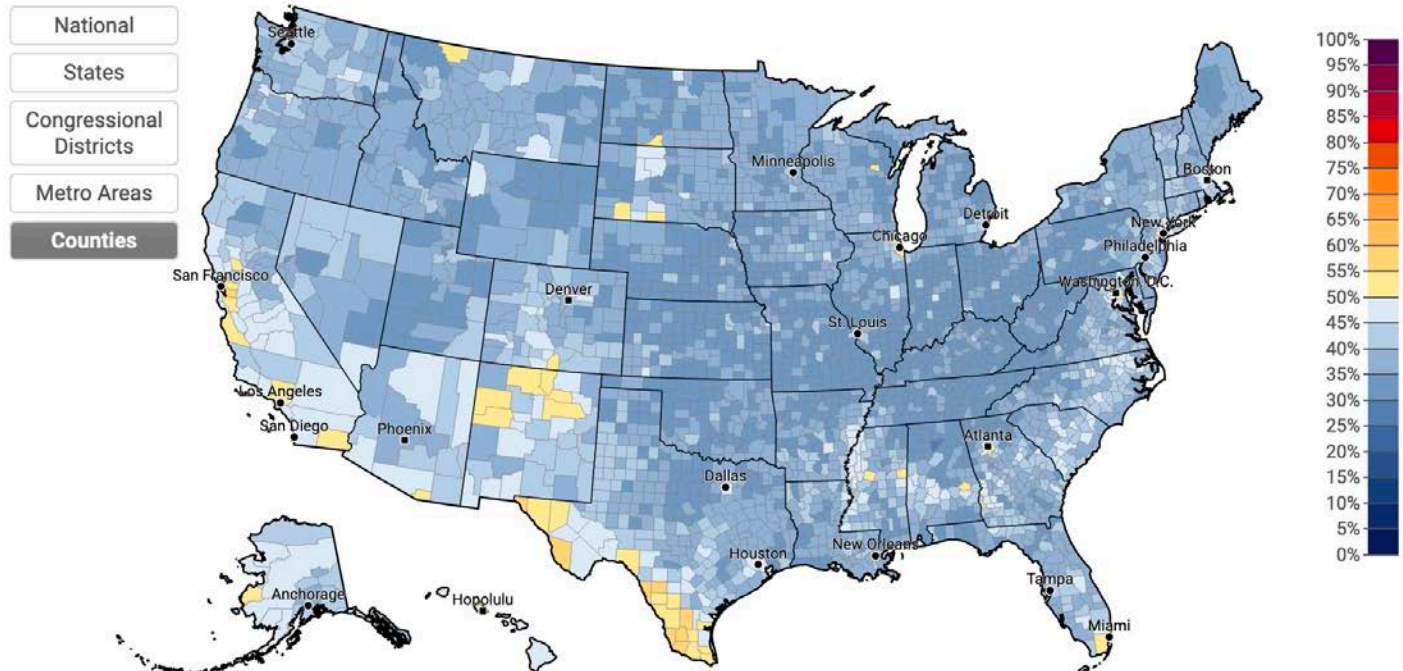




# Estimated % of adults who think global warming will harm them personally (42%), 2019

Select Question:

Click on map to select geography, or:



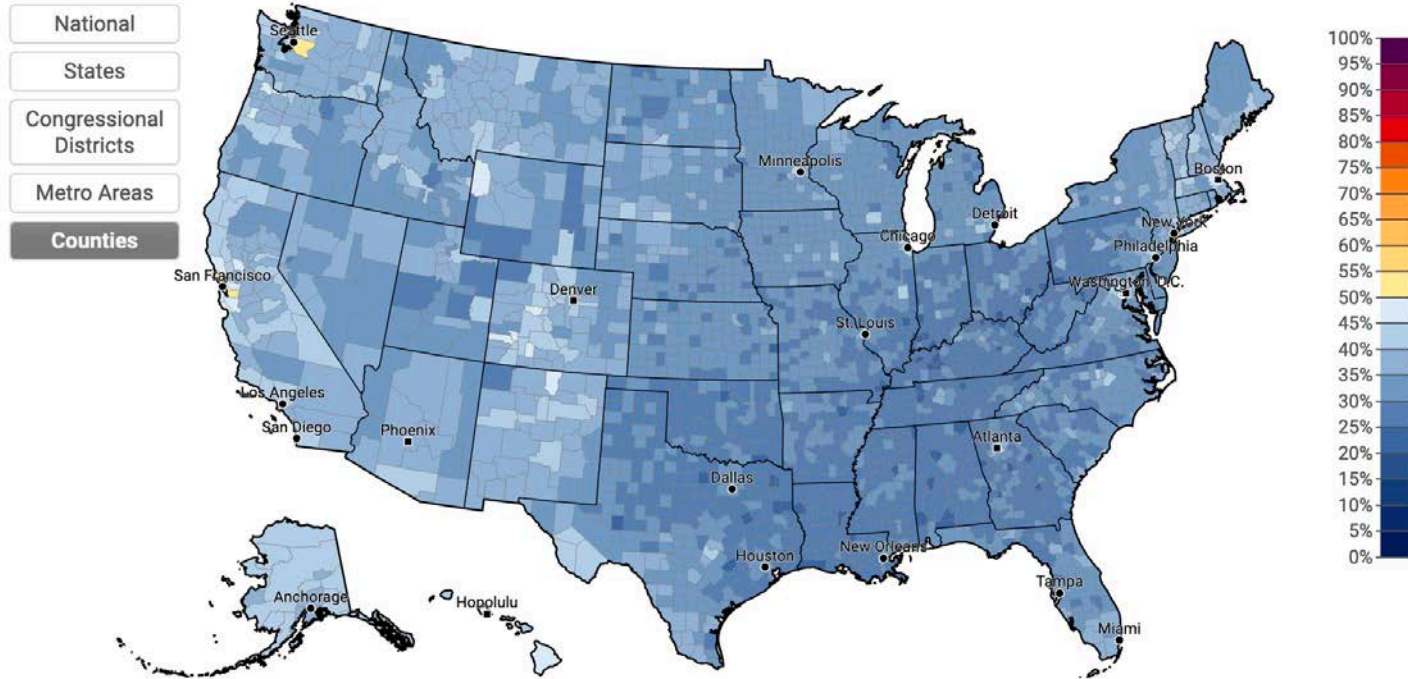




# Estimated % of adults who discuss global warming at least occasionally (36%), 2019

Select Question:  Absolute Value

Click on map to select geography, or:



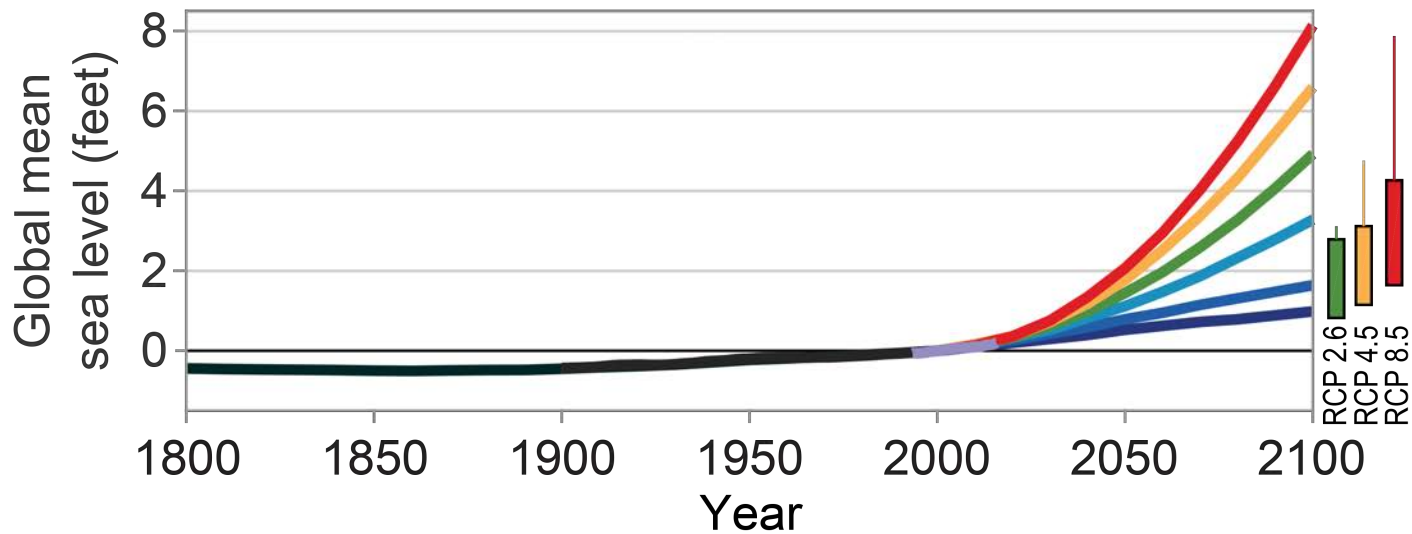
THE REAL  
SOLUTION:

TALK ABOUT IT

Why and how climate  
change matters to us

And all the positive  
things we can do to fix it

# SEA LEVEL IS RISING



# SEA LEVEL IS RISING

SCITECH

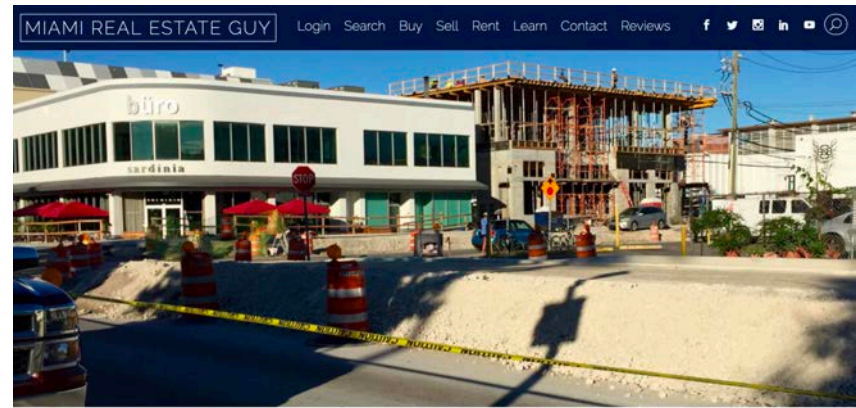
## Sea level rise has already sunk Carolinas beach property values — by \$1.6 billion, study finds

BY ABBIE BENNETT

JULY 25, 2018 08:30 AM , UPDATED JULY 25, 2018 08:44 PM



The Atlantic Ocean is eroding parts of North Topsail Beach by about five feet per year. The town of 800 residents is running out of cash and solutions in its efforts to protect its north shore. Whose job is to save this popular North Carolina tour BY BRITTANY PETERSON



Miami Beach is Raising Streets by 2 Feet to Combat Rising Seas

Posted by Stavros Mitchelides | Miami Beach Realtor in News


### NEWS / REAL ESTATE

## Your Florida coastal home could lose 15% of its value by 2030 due to sea rise

And it could lose up to 35 percent of its value by 2050, according to a new report.







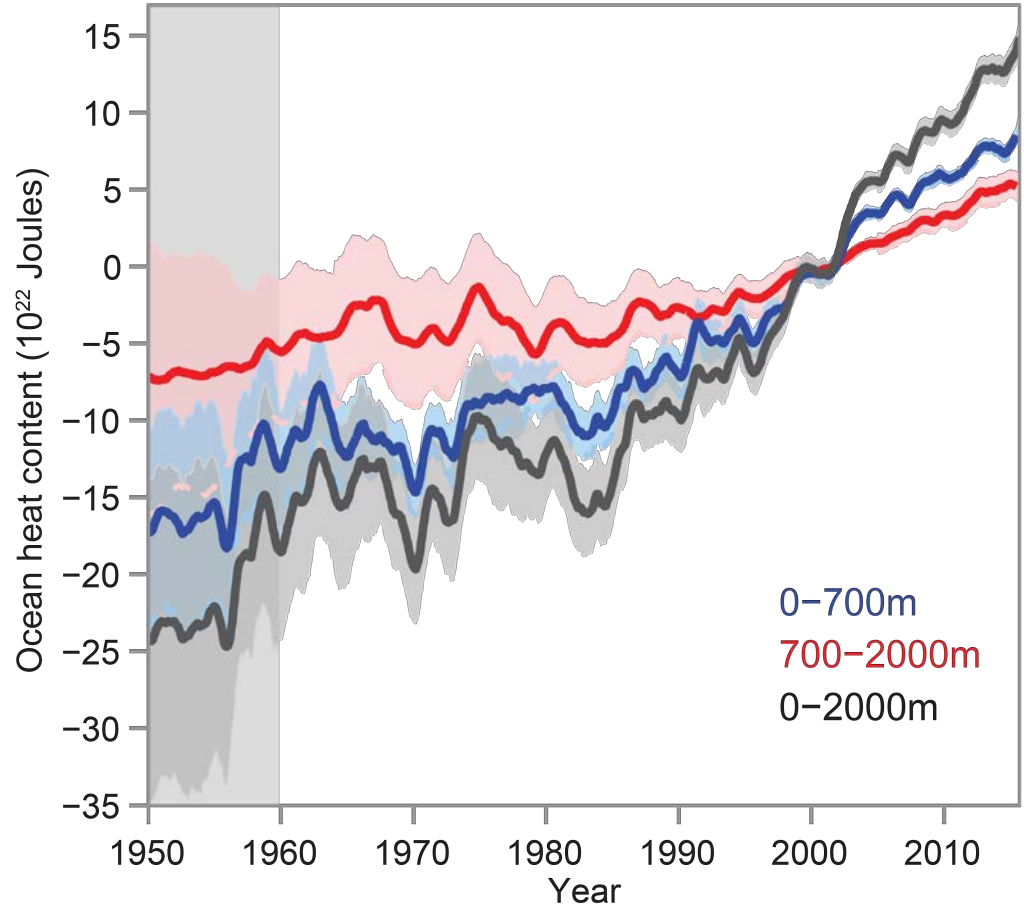
700 MILLION  
PEOPLE LIVE IN  
THE LOW  
ELEVATION  
COASTAL ZONE

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300 MILLION  
REFUGEES BY 2100

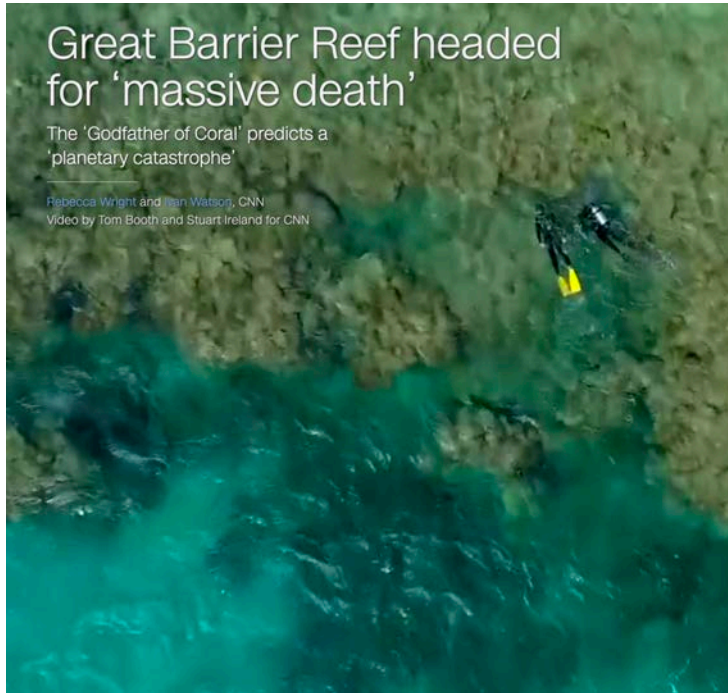
# OCEANS ARE WARMING

[science2017.globalchange.gov](http://science2017.globalchange.gov)





# OCEANS ARE WARMING



THESE ALGAE CAN CAUSE DEADLY DIARRHETIC AND PARALYTIC POISONING IN HUMANS —

## Toxic algae on the rise as our oceans warm

The rapidly warming Atlantic sees a big boost in toxic algae.

ROHEENI SAXENA - 4/29/2017, 3:00 PM



## Sea Surface Temperatures Drive Hurricane Strength

As oceans warm up, hurricanes will grow more severe.



AS OCEANS WARM,  
HURRICANES ARE

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- INTENSIFYING  
FASTER
- GETTING BIGGER
- AND STRONGER
- AND SLOWER

# HURRICANE HARVEY

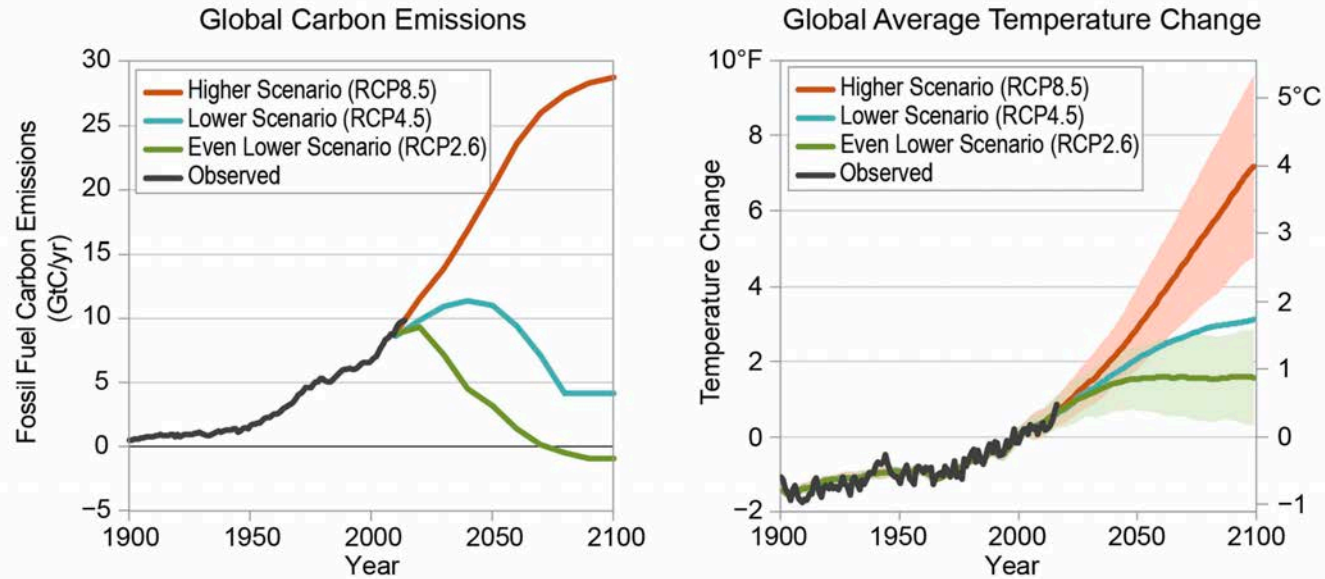
- Up to 40% more rainfall
- 4 times more economically damaging

Risser and Wehner, Geophysical Research Letters (2017)  
Frame et al., Climatic Change (2020)



# TEMPERATURE IS INCREASING

Figure 2.2: Observed and Projected Changes in Carbon Emissions and Temperature

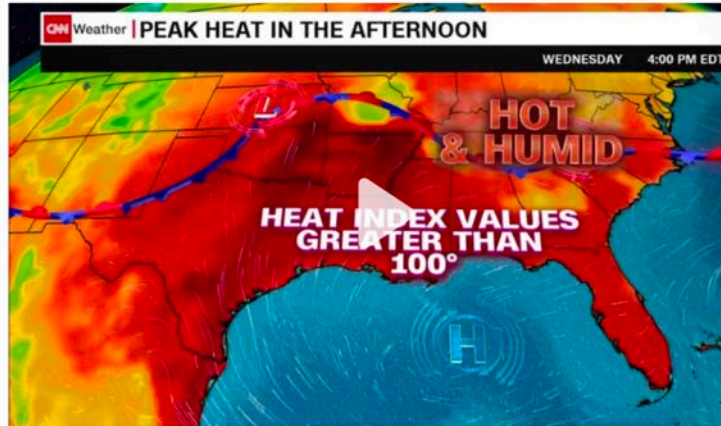


# TEMPERATURE IS INCREASING

## A potentially deadly weather pattern across the central US

By **Pedram Javaheri**, CNN Meteorologist

Updated 8:23 PM ET, Wed July 1, 2020



## Phoenix Tries To Reverse Its 'Silent Storm' Of Heat Deaths

July 9, 2018 - 5:01 AM ET

Heard on Morning Edition

## Climate change made European heatwave at least five times likelier



The New York Times

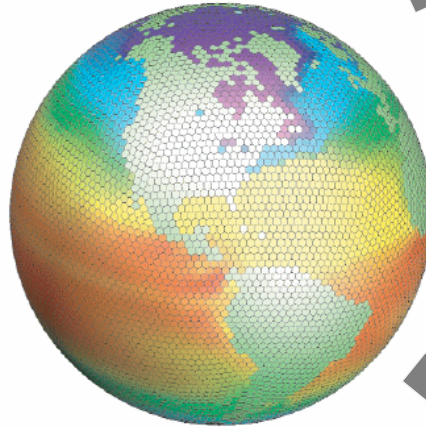
## *Wildfires Are Pushing Californians Out of the State: 'If It's Gone, We're Gone'*

Tuesday: More updates from the Kincade and Getty fires; and how to help.

Firefighters dug a containment line on the Kincade fire in Windsor on Sunday night.  
Max Whittaker for The New York Times



Increase the relevance by DOWNSCALING climate projections to individual weather stations or fine-scale local grids

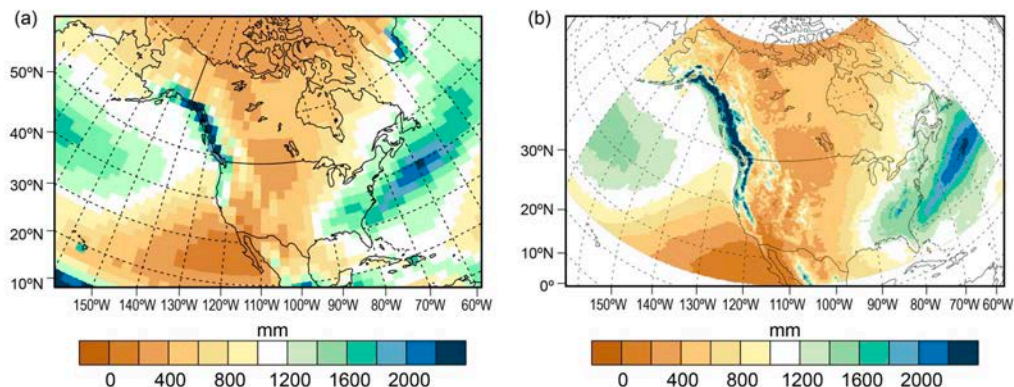


KATHARINE HAYHOE

## Chapter 4: Climate Models, Scenarios, and Projections

### WHY IS DOWNSCALING AND TRANSLATION NEEDED?

- Spatial and temporal scale needs to be relevant to the impacts being studied
- Impacts often depend on secondary rather than primary variables

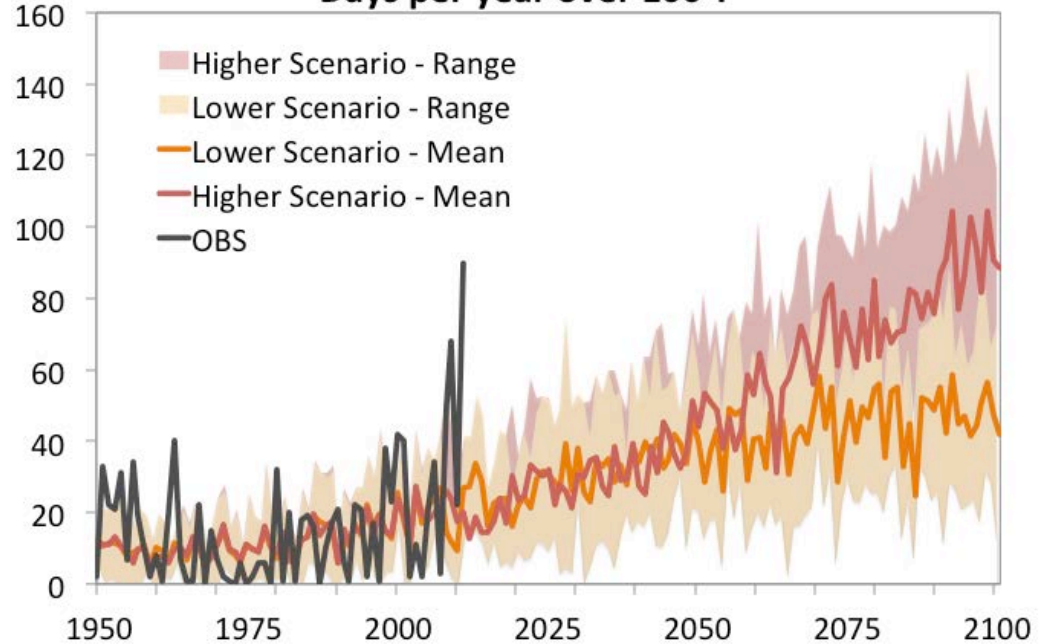


CMIP5 global climate models typically operate at coarser horizontal spatial scales on the order of 30 to 200 miles (50 to 300 km), while regional climate models have much finer resolutions, on the order of 6 to 30 miles (10 to 50 km). This figure compares annual average precipitation (in millimeters) for the historical period 1979–2008 using (a) a resolution of 250 km or 150 miles with (b) a resolution of 15 miles or 25 km to illustrate the importance of spatial scale in resolving key topographical features, particularly along the coasts and in mountainous areas. In this case, both simulations are by the GFDL HIRAM, an experimental high-resolution model. (Figure source: adapted from Dixon et al. 2016<sup>108</sup>).

What will  
summer look  
like where I  
live?

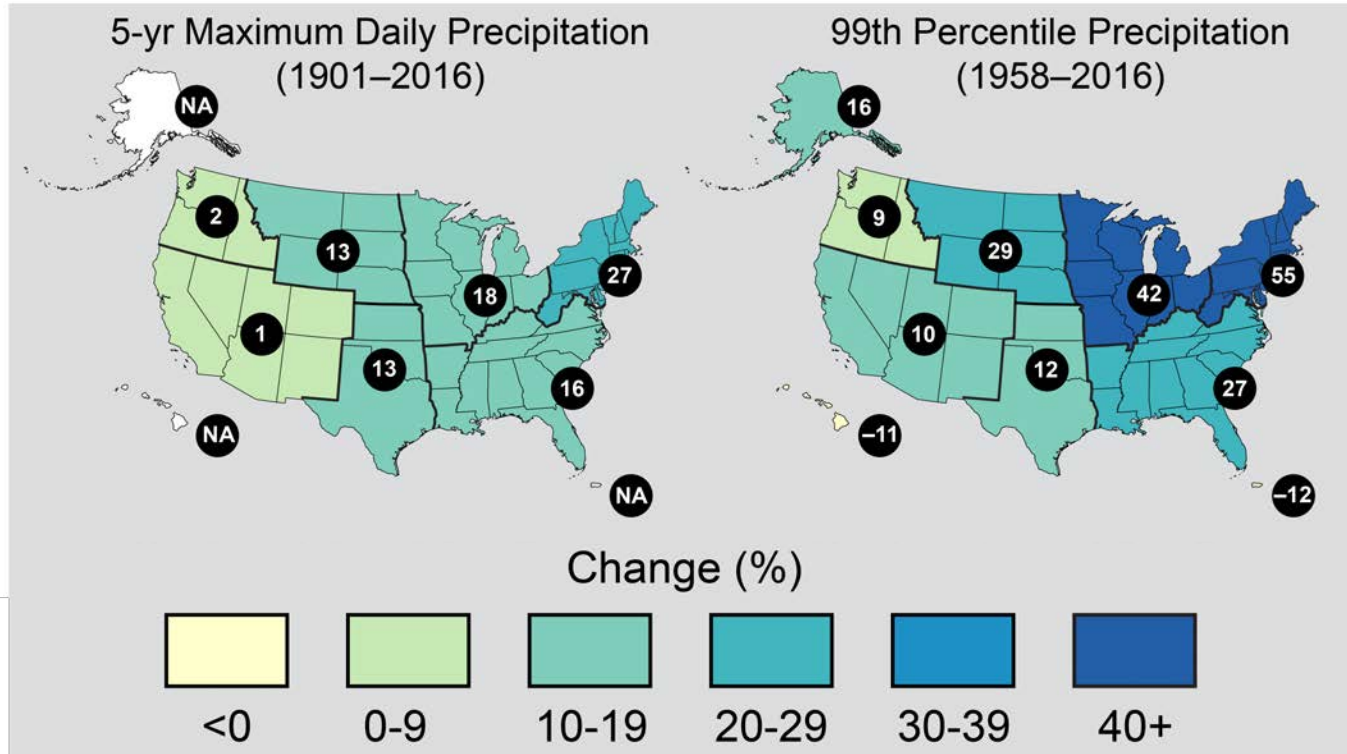
## AUSTIN, TEXAS

### Days per year over 100°F



KATHARINE HAYHOE

# HEAVY PRECIPITATION IS INCREASING



HEAVY PRECIPITATION  
IS INCREASING



Massive rainfall has put millions of people at risk of flooding and kept farmers out of their fields, harming the nation's ability to produce food. SCOTT ELSON/GETTY IMAGES

🕒 JULY 14, 2020

## China rushes to contain floods after record rainfall



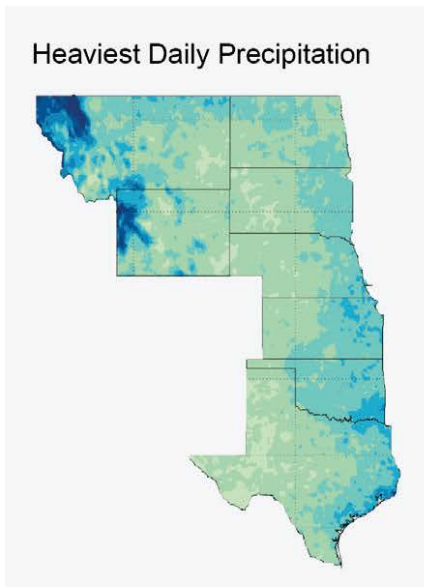
Chinese soldiers erect a sandbag barrier along the shore of Poyang lake after heavy seasonal rains in J...

## For the Midwest, Epic Flooding Is the Face of Climate Change

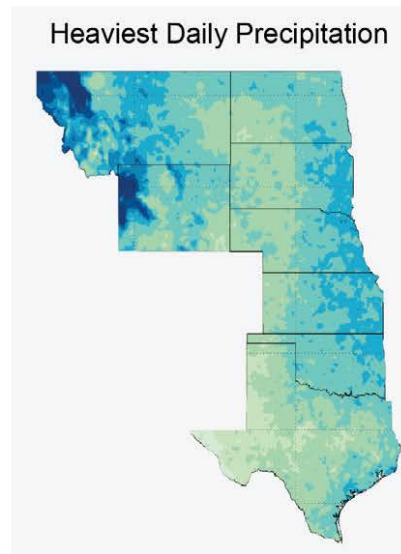
We often focus on coastal cities when we talk about rising waters, but massive rainfall in the middle of the US has put millions at risk, harming the nation's ability to produce food.

# How will heavy precipitation change where I live?

Lower Scenario



Higher Scenario

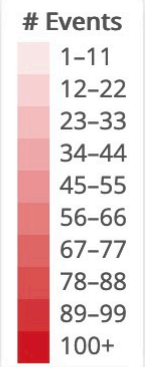
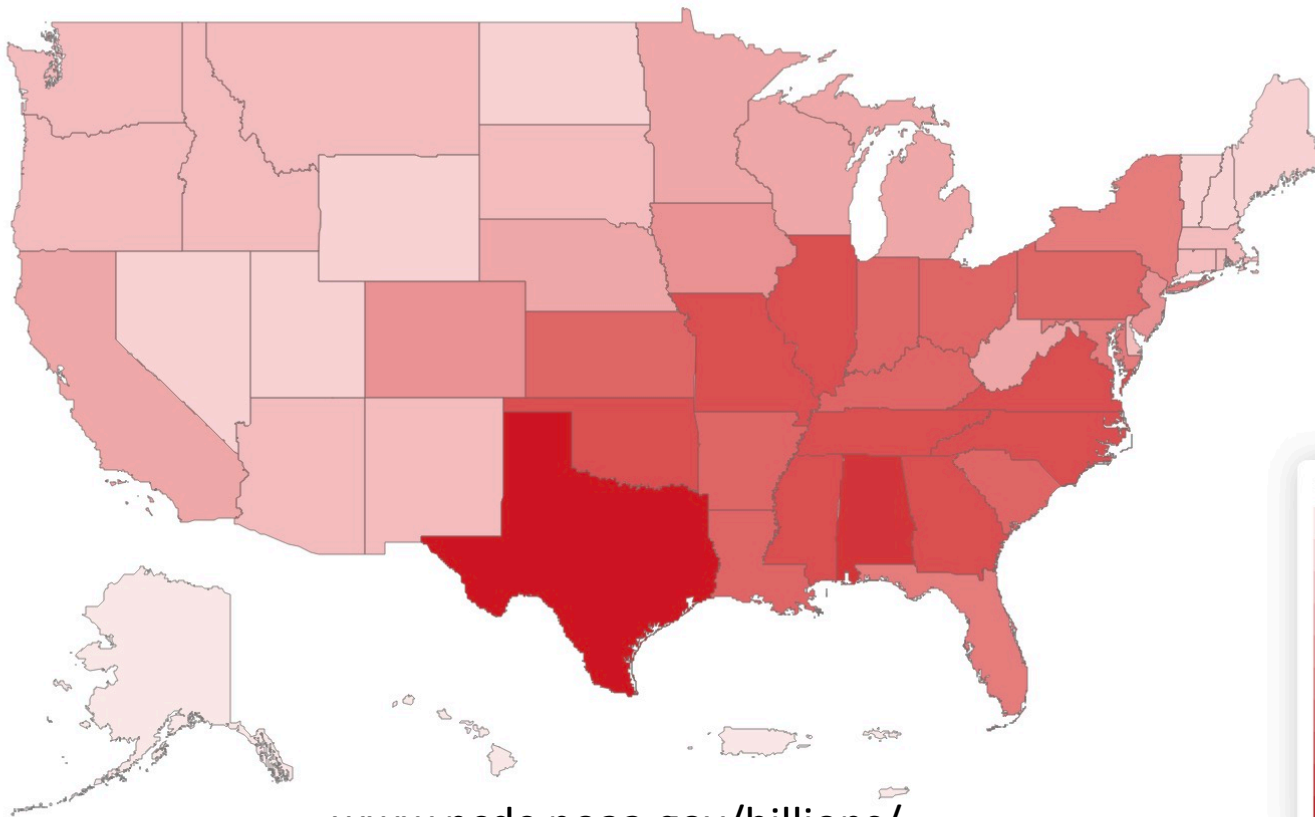


Number of Days



[nca2018.globalchange.gov](http://nca2018.globalchange.gov)

# 1980-2020\* Billion-Dollar Weather and Climate Disasters (CPI-Adjusted)



[www.ncdc.noaa.gov/billions/](http://www.ncdc.noaa.gov/billions/)

## United States

27	Flooding:	33	Freeze:	9	Severe Storm:	125
45	Wildfire:	17	Winter Storm:	17	All Disasters:	273
	Drought:					
	Tropical Cyclone:					

We care about  
a changing climate

**BECAUSE IT EXACERBATES  
MANY OF THE RISKS WE  
ALREADY FACE TODAY**

KATHARINE HAYHOE



**SIX**



**SIX**



**SEVEN**

# **THREAT MULTIPLIER**

KATHARINE HAYHOE

# WE CARE ABOUT CLIMATE CHANGE *BECAUSE IT AFFECTS OUR*



WATER



FOOD



SECURITY



ECONOMY



HEALTH

KATHARINE HAYHOE

## 'To deny climate change is to deny a truth we have just lived' says Prime Minister of storm-hit Dominica



Prime Minister Roosevelt Skerrit of the Commonwealth of Dominica addresses the general debate of the General Assembly's seventy-second session. UN Photo/Cia Pak

FEATURE

# Yeah, the Weather Has Been Weird

People already care about climate change —  
the trick is getting them to realize it.

---

BY KATHARINE HAYHOE  
ILLUSTRATION BY JUSTIN METZ

The reality is that we  
are the ones on the  
rapidly melting iceberg.

KATHARINE HAYHOE



# THESE ARE THE PROBLEMS WE NEED TO TACKLE



PSYCHOLOGICAL DISTANCE



SOLUTION AVERSION

KATHARINE HAYHOE



# CHRIS CHU

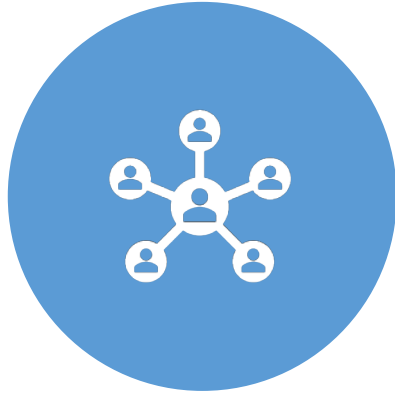
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Ideological polarization in climate change perception is reduced when climate change impact is portrayed as influencing a spatially close and familiar exemplar, as compared to a spatially distant and novel exemplar.

Chu and Yang, *Global Environmental Change* (2018)



# AND HERE'S HOW WE CAN DO IT



**CONNECT**

TO ADDRESS PSYCHOLOGICAL DISTANCE

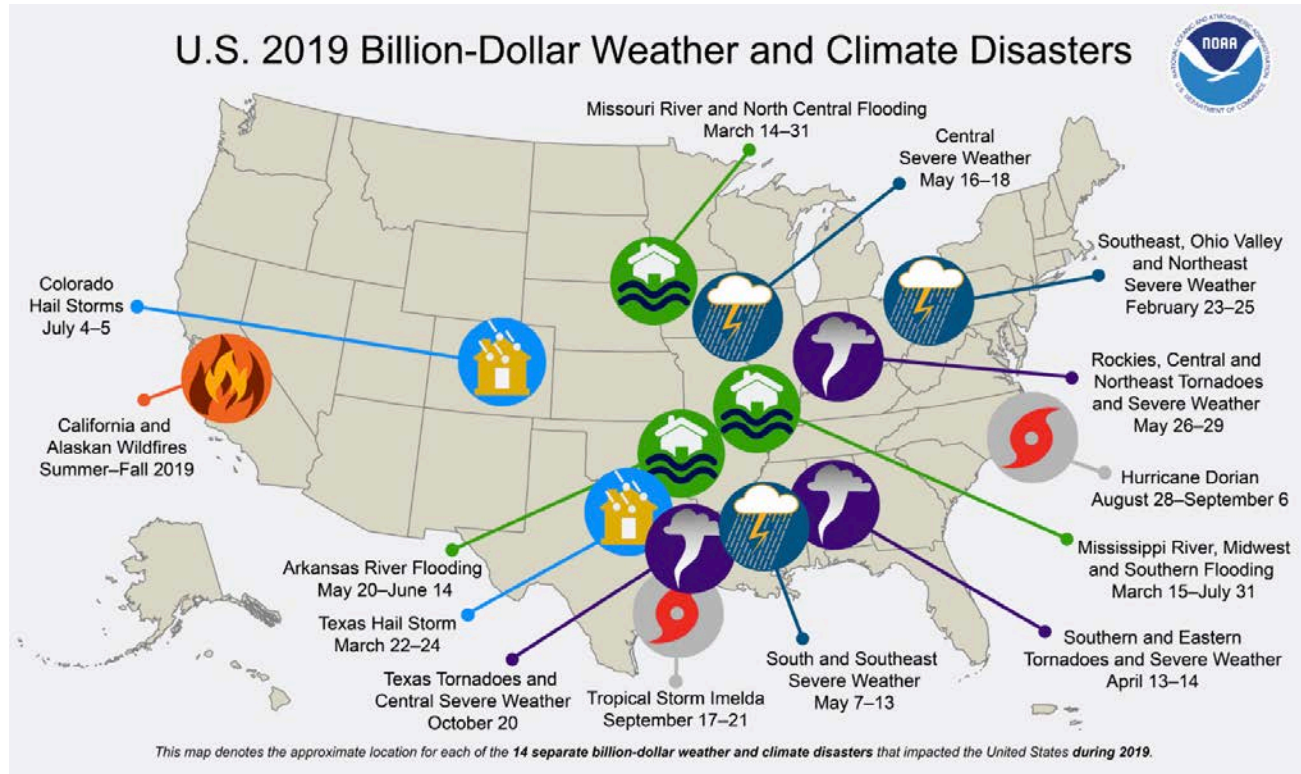


**INSPIRE**

TO ADDRESS SOLUTION AVERSION

KATHARINE HAYHOE

# EXPLAIN why it matters... where WE live



[www.ncdc.noaa.gov/billions/](http://www.ncdc.noaa.gov/billions/)



# INSPIRE WITH REAL SOLUTIONS ... IN INDUSTRY

RETAIL • WALMART

## Walmart Aims to Generate Half Its Energy From Renewable Sources by 2025



Solar panels cover the roof of a Sam's Club in Glendora, Calif. Photograph by David McNew — Getty Images

PRESS RELEASE

APRIL 9, 2018

## Apple now globally powered by 100 percent renewable energy



Sunseap, a clean energy provider, manages 32 megawatts of solar panels on more than 800 rooftops in Singapore.



## Solar, wind provide renewable, secure energy to Fort Hood

By Heather Ashley, Sentinel News Editor Jun 8, 2017 Updated Jun 9, 2017



Fort Hood, Department of Defense leadership and stakeholders cut a ribbon, symbolically turning on the Fort Hood hybrid renewable energy project during a ceremony held in the Phantom Solar farm Friday on West Fort Hood.

Photo by Todd Pruden, Sentinel Editor

## 8minute Solar Energy completes Texas debut with 280MW Duke collaboration

By Liam Stoker Jul 08, 2020 12:37 PM BST 0

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The Holstein solar project in Texas during construction. Image: 8minute Solar Energy

... IN TEXAS

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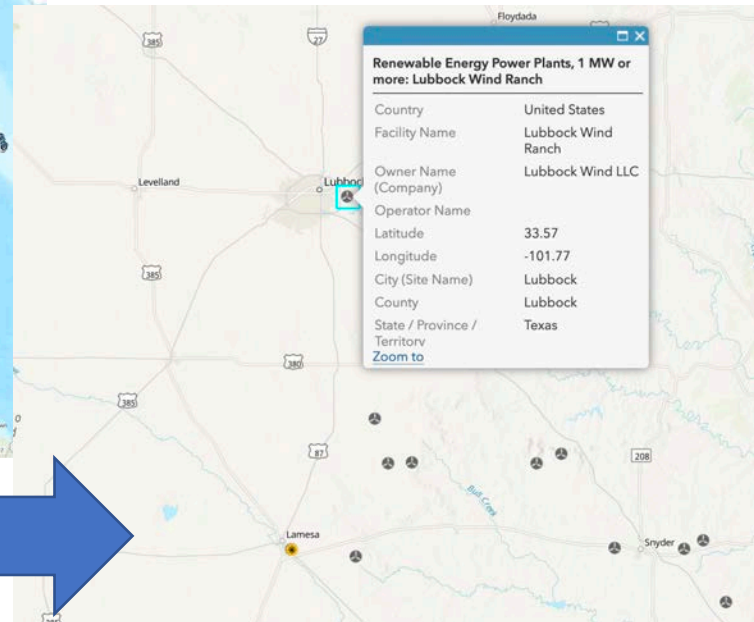
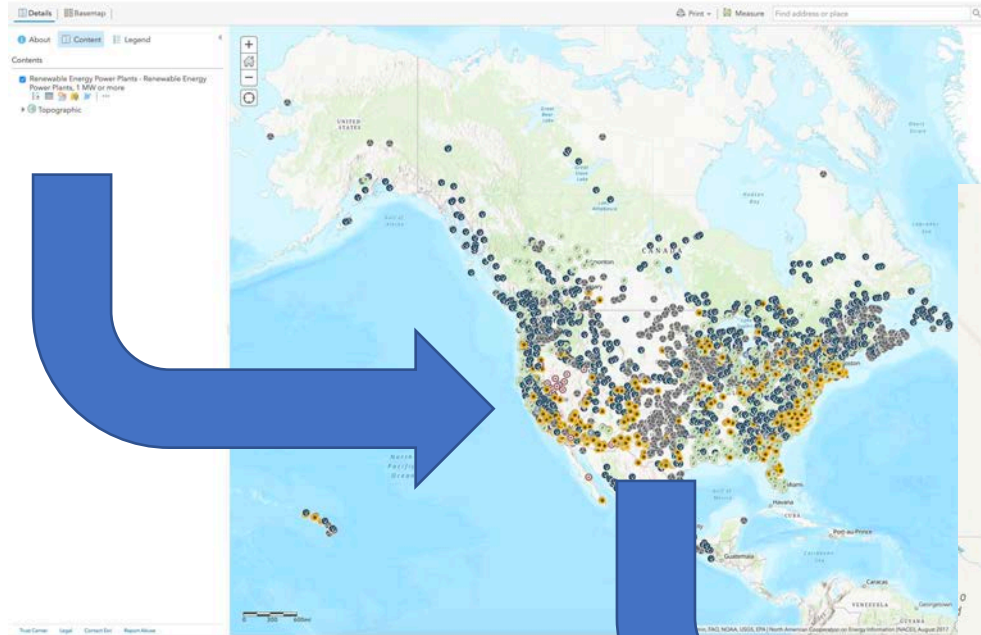
ArcGIS Living Atlas of the World is the foremost collection of geographic information from around the globe. It includes maps, apps, and data layers to support your work.

- Renewable Energy Power Plants
- Active Renewable Energy Leases in U.S. Offshore Waters
- Coastal Renewable Energy Facilities
- Renewable Energy Atlas

ArcGIS - Renewable Energy Power Plants

Modify Map Sign In



# ...IN FAITH COMMUNITIES

**First community of faith solar**

**garden announced in**

**Minnesota at Bethel**

**Evangelical Lutheran Church**

Metro, MN

ENVIRONMENT

## Powered By Faith, Religious Groups Emerge As A Conduit For A Just Solar Boom

December 15, 2019 · 7:00 AM ET

EVERY ELLFELDT



The Monastery of Our Lady of Mt. Carmel in Washington, D.C. is the new host of a 151 kW community solar garden. The panels will provide roughly 50 nearby households with green energy.

Mhari Shaw/NPR

# Kentucky coal museum goes solar (and miners made it happen)



**BENHAM, KY.**  
Harlan County



All News Business

# As Only US Airline to Use Biofuel on Regular Basis, All United Flights From LA Are Now Powered By Biofuel

By Good News Network - Jun 10, 2019

# ...AND AROUND THE WORLD



**17-Year-Old Builds Algae Biofuel Lab in Her Bedroom to Win \$100K Intel Science Talent Search Prize**



# WHAT'S THE FIRST STEP TO TACKLING CLIMATE CHANGE?

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TALK ABOUT IT





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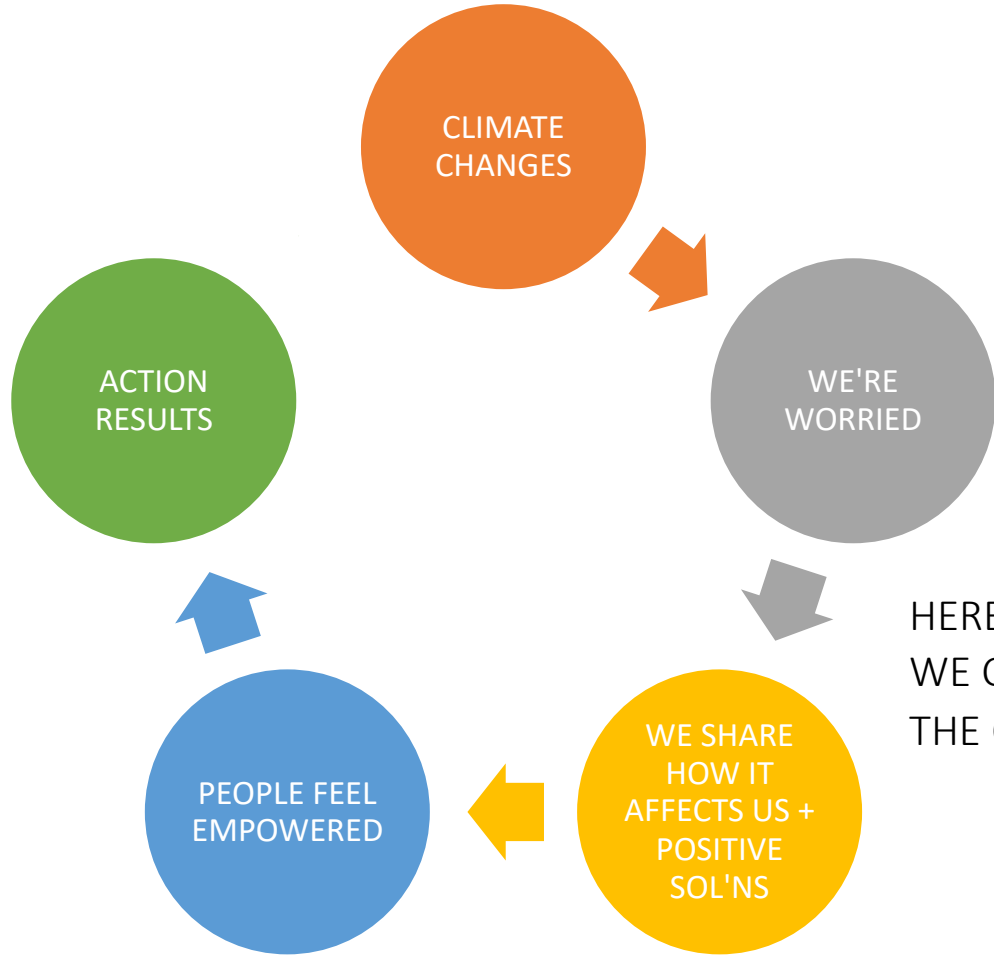
## MATTHEW GOLDBERG

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Discussing global warming with friends and family leads people to learn influential facts. These increase beliefs that climate change is happening and human-caused, as well as worry about climate change.

Climate conversations with friends and family enter people into a “pro-climate social feedback loop.”

Goldberg et al. Proceedings of the National Academy of Sciences (2019)



HERE IS WHERE WE CAN BREAK THE CYCLE

The human brain is built to associate “forward” action with a reward, not with avoiding harm. [So] reframe your message so that the information you provide will induce hope, not dread.

– Tali Sharot, The Influential Mind (2017)

KATHARINE HAYHOE

# HOW?

---

BY EXPLAINING WHY IT MATTERS TO  
US HERE AND NOW

... AND POSITIVE WAYS WE CAN  
WORK TOGETHER TO FIX IT

*USING THE RIGHT KIND OF DATA*



Share



Add to list



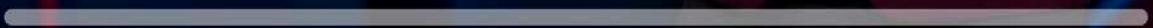
Like



Recommend

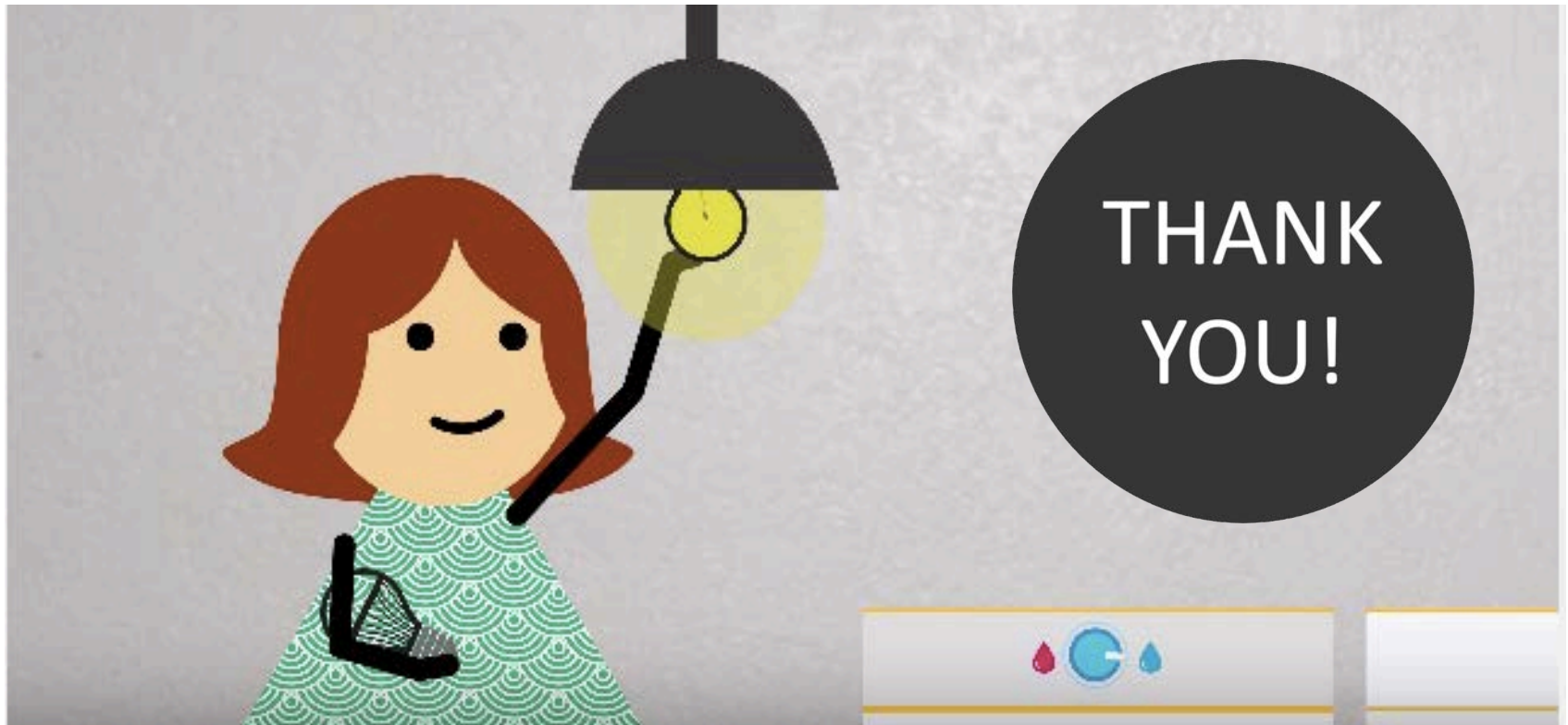
Katharine Hayhoe | TEDWomen 2018

# The most important thing you can do to fight climate change: talk about it



0:00





[www.katharinehayhoe.com](http://www.katharinehayhoe.com)