The University of Texas at Austin
Environmental Science Institute

Hot Science - Cool Talk # 124

Climate Change: Science to Solutions

Dr. Geeta Persad

February 24, 2023

Climate Change: Science to Solutions

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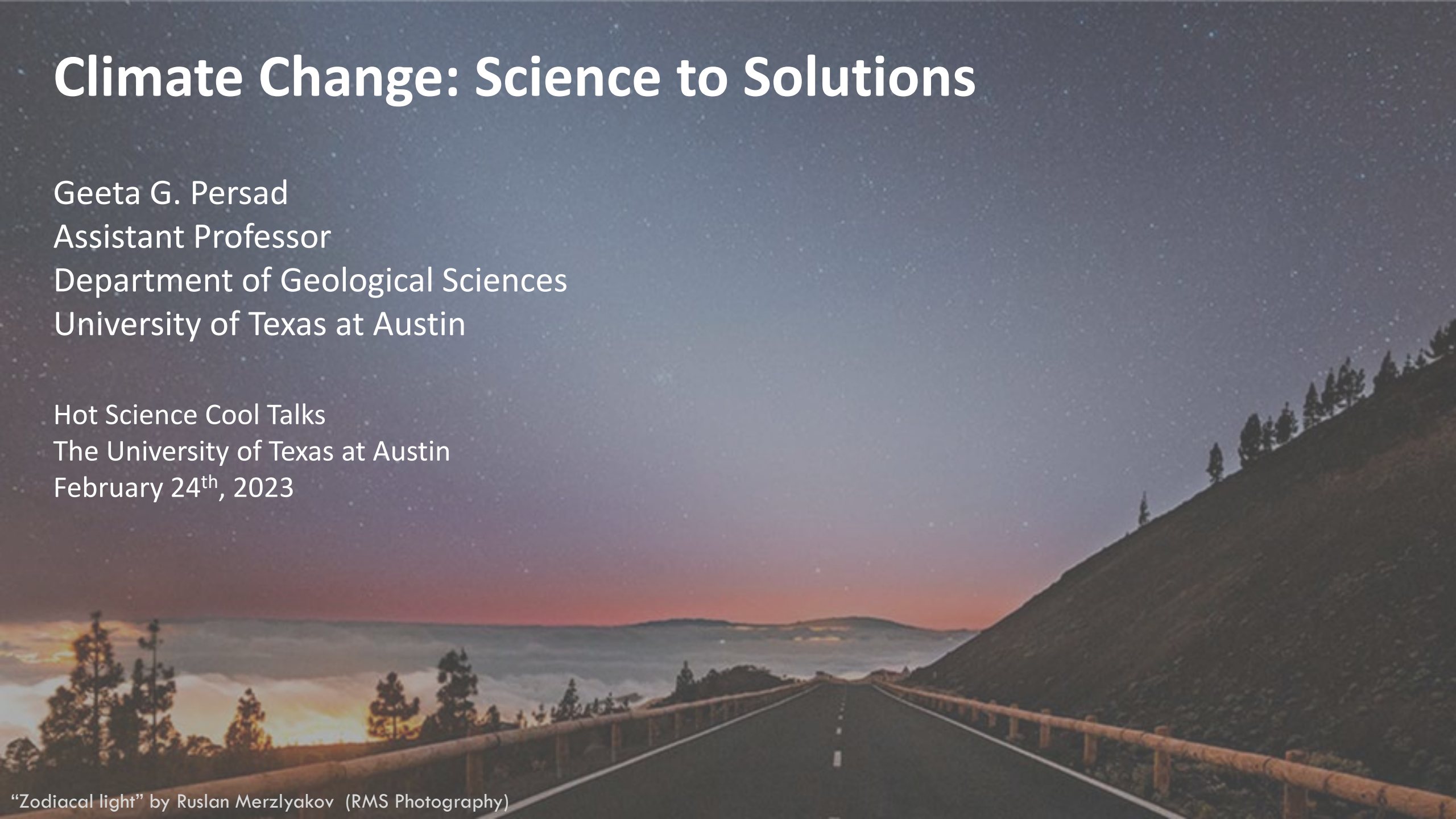
Assistant Professor
Department of Geological Sciences
University of Texas at Austin

Hot Science Cool Talks
The University of Texas at Austin
February 24th, 2023

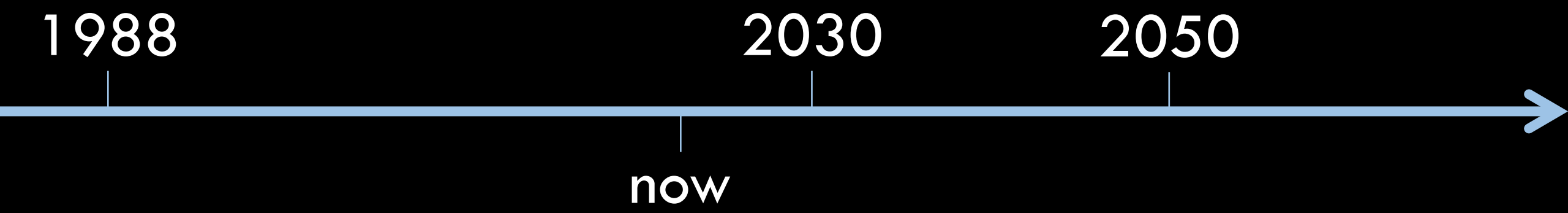


"Zodiacal light" by Ruslan Merzlyakov (RMS Photography)

Consider time…

Source: NASA

Consider time…



Me

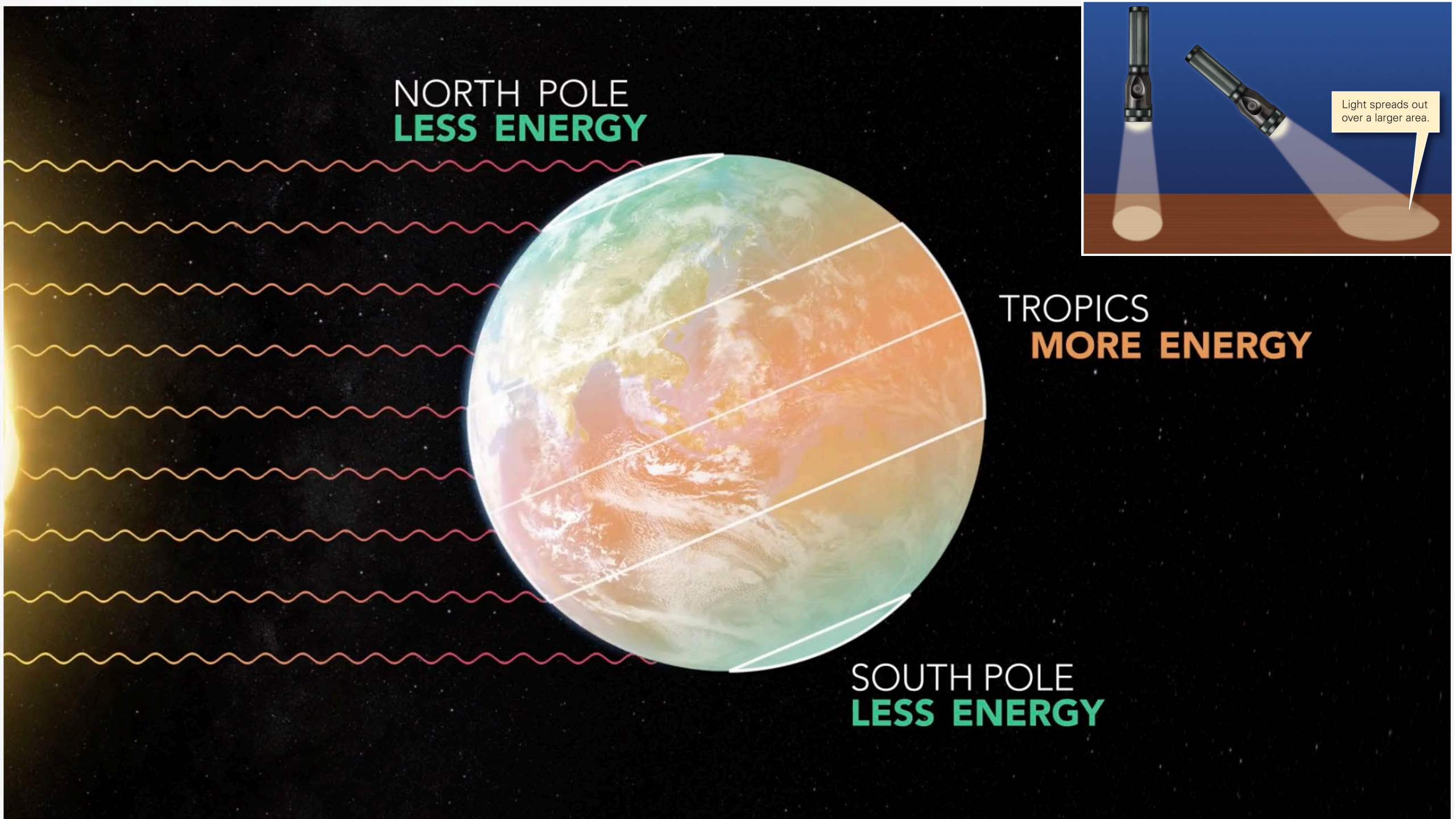
Time


Me
Time


Me
Time

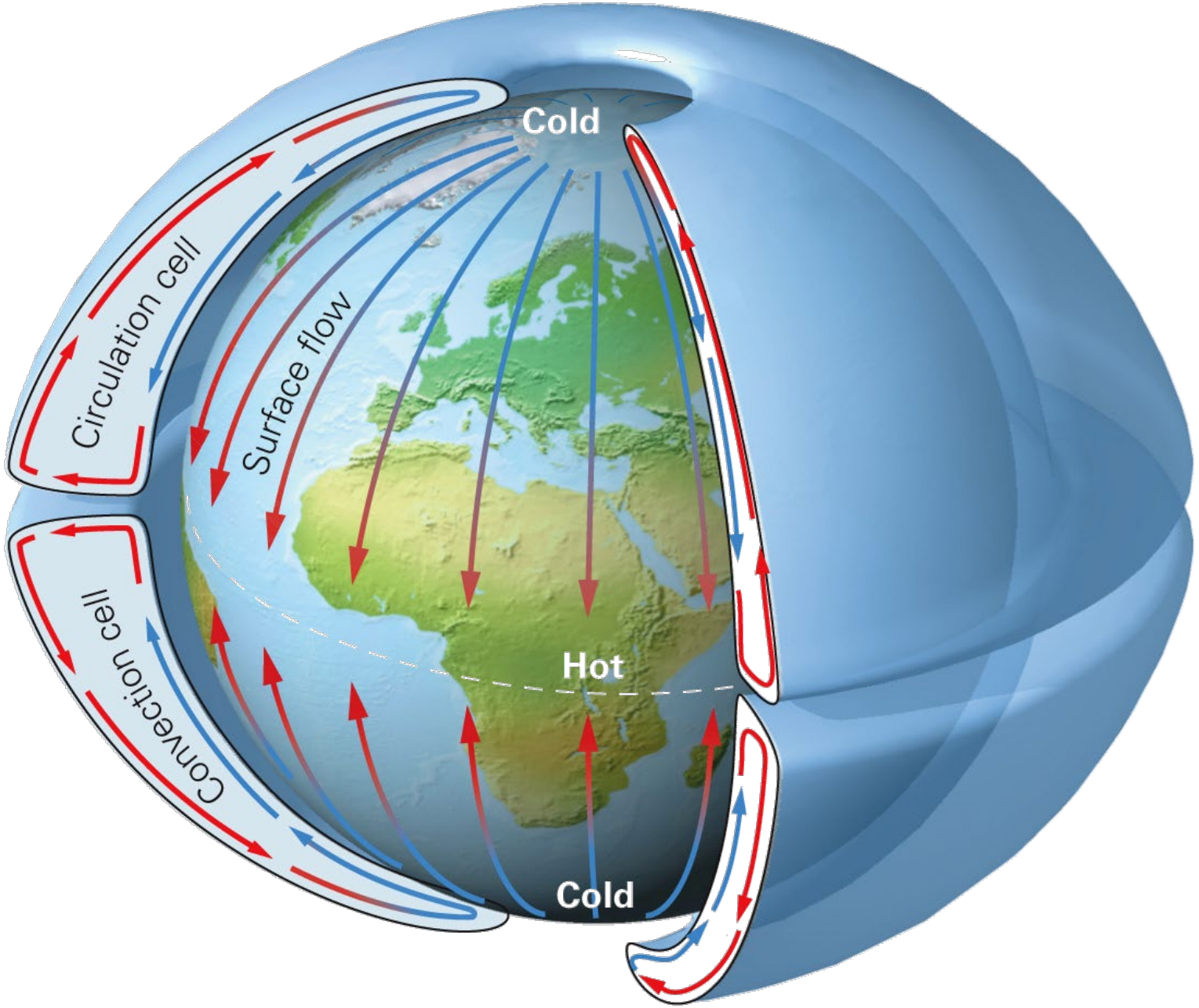
Climate science is fascinating and powerful!

Why are our deserts where they are?


NORTH POLE
LESS ENERGY
TROPICS
MORE ENERGY
SOUTH POLE
LESS ENERGY
Light spreads out over a larger area.

Atmospheric motion smooths out the gradient

If Earth didn't rotate, atmospheric motion would look like this…

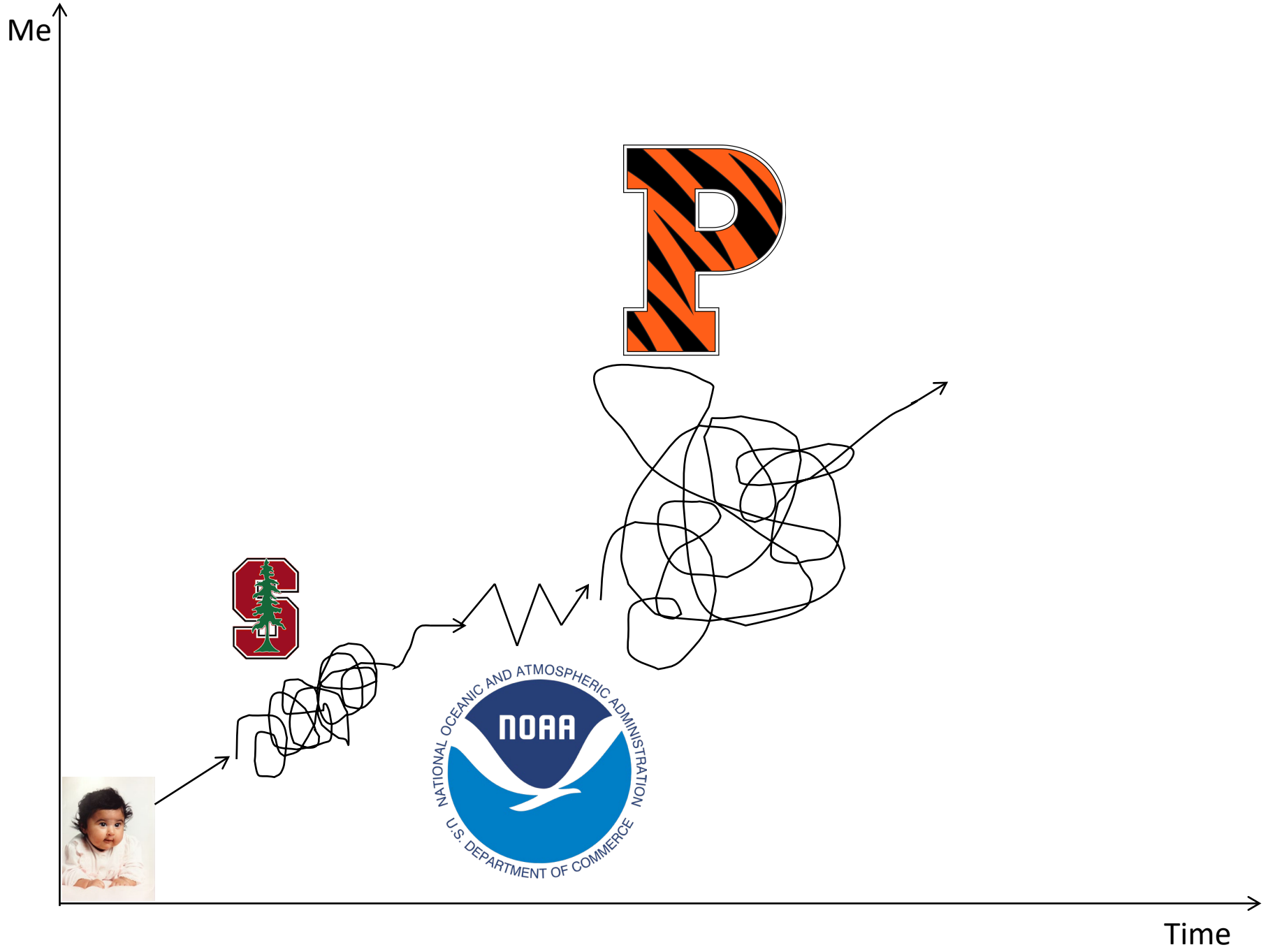


Instead, Earth's rotation splits atmospheric circulation into three "cells"

Sinking air makes it harder for rainstorms to form and dries out the surface

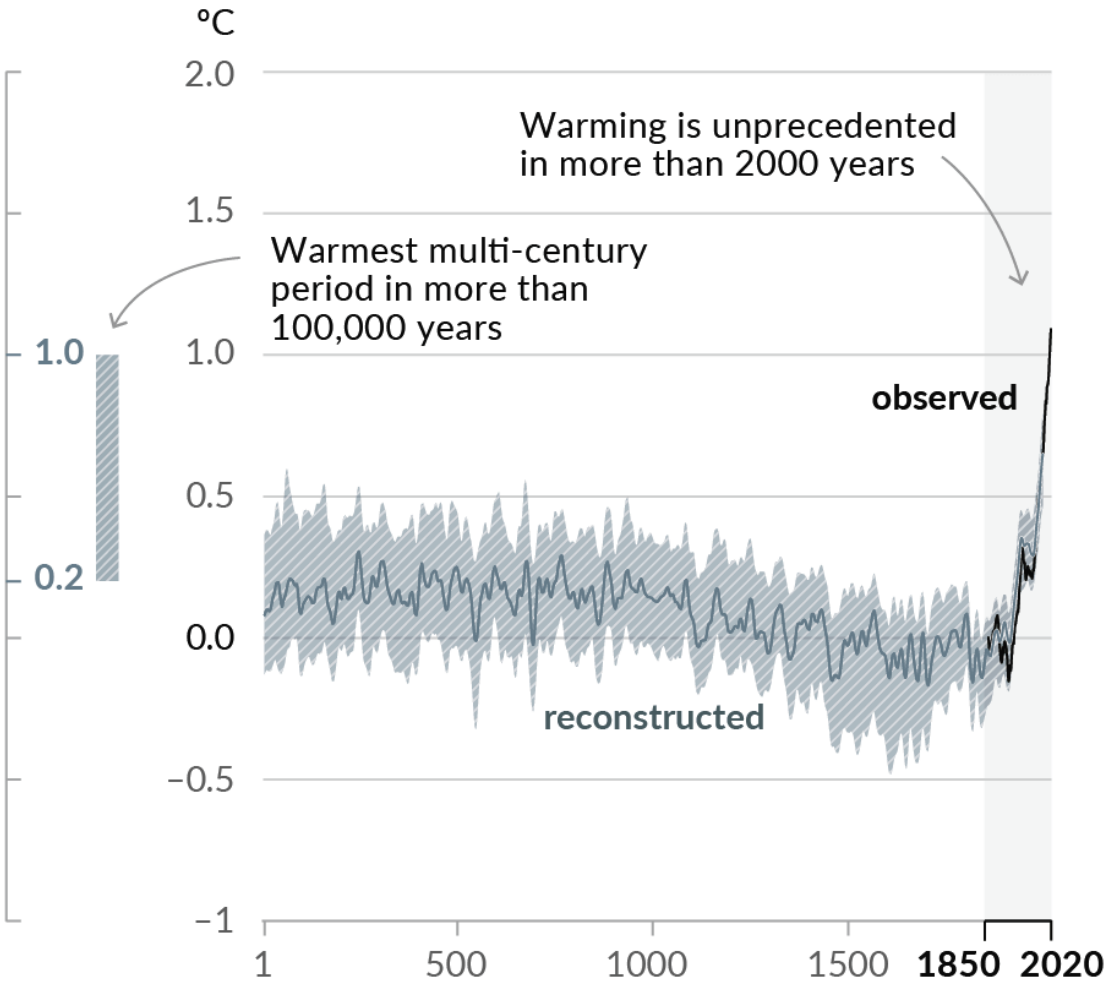
Climate science is fascinating and powerful!

The deserts are where they are for a reason!

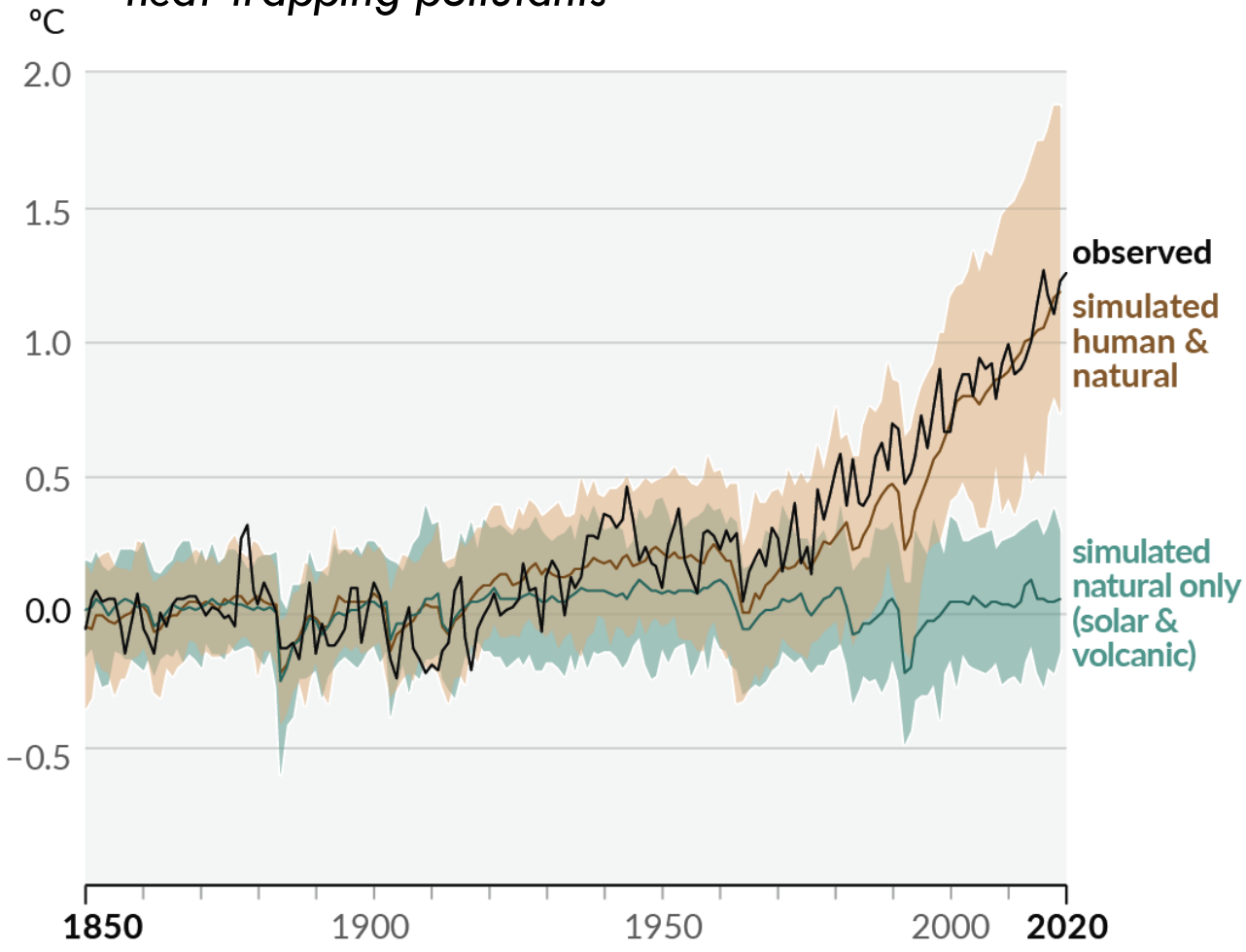

Me
Time
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

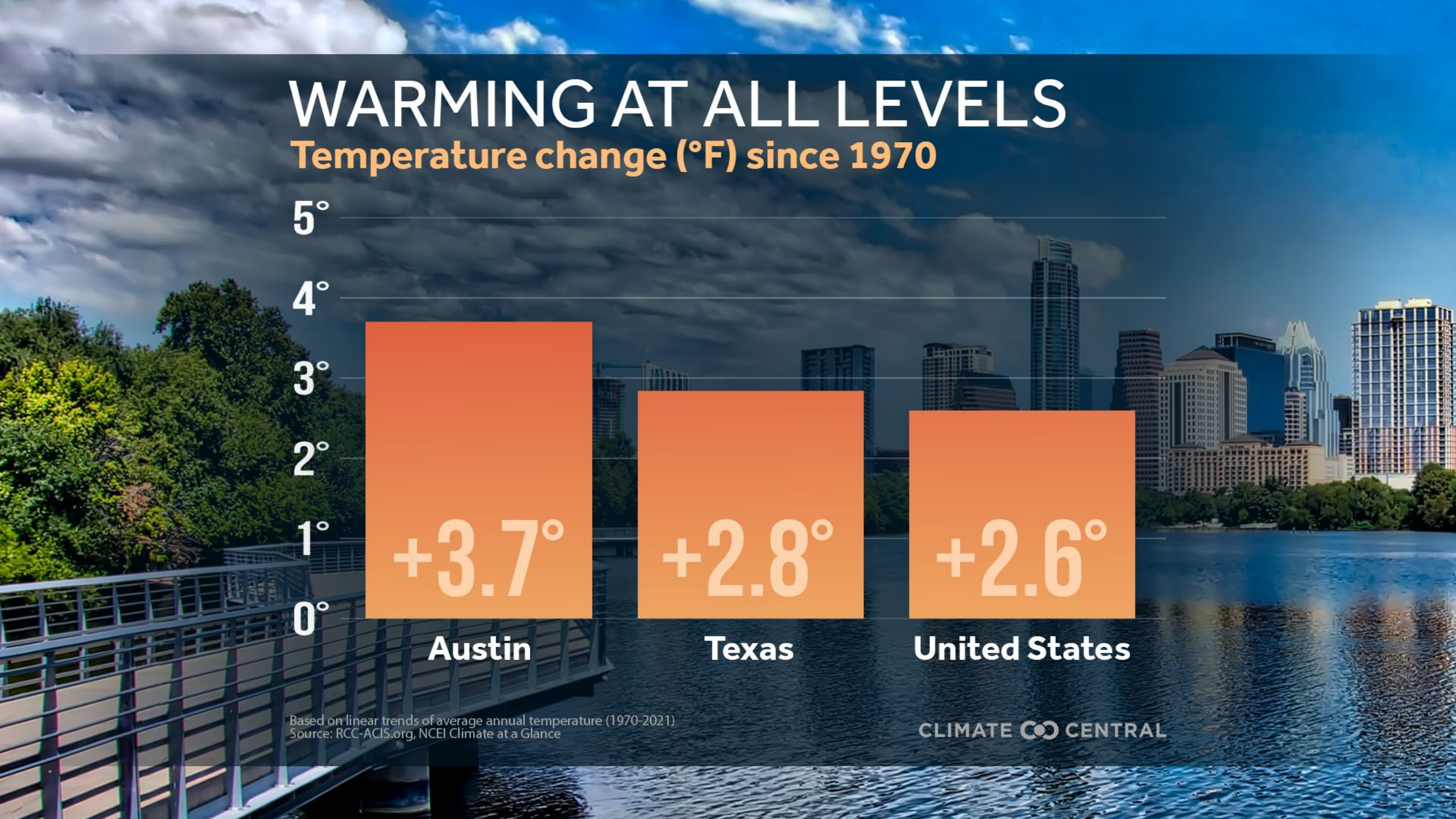
Our climate system is awesome, so what's the problem?

It's warming faster than any time since the start of modern human civilization



We can't explain the current warming without human emissions of carbon dioxide and other heat-trapping pollutants



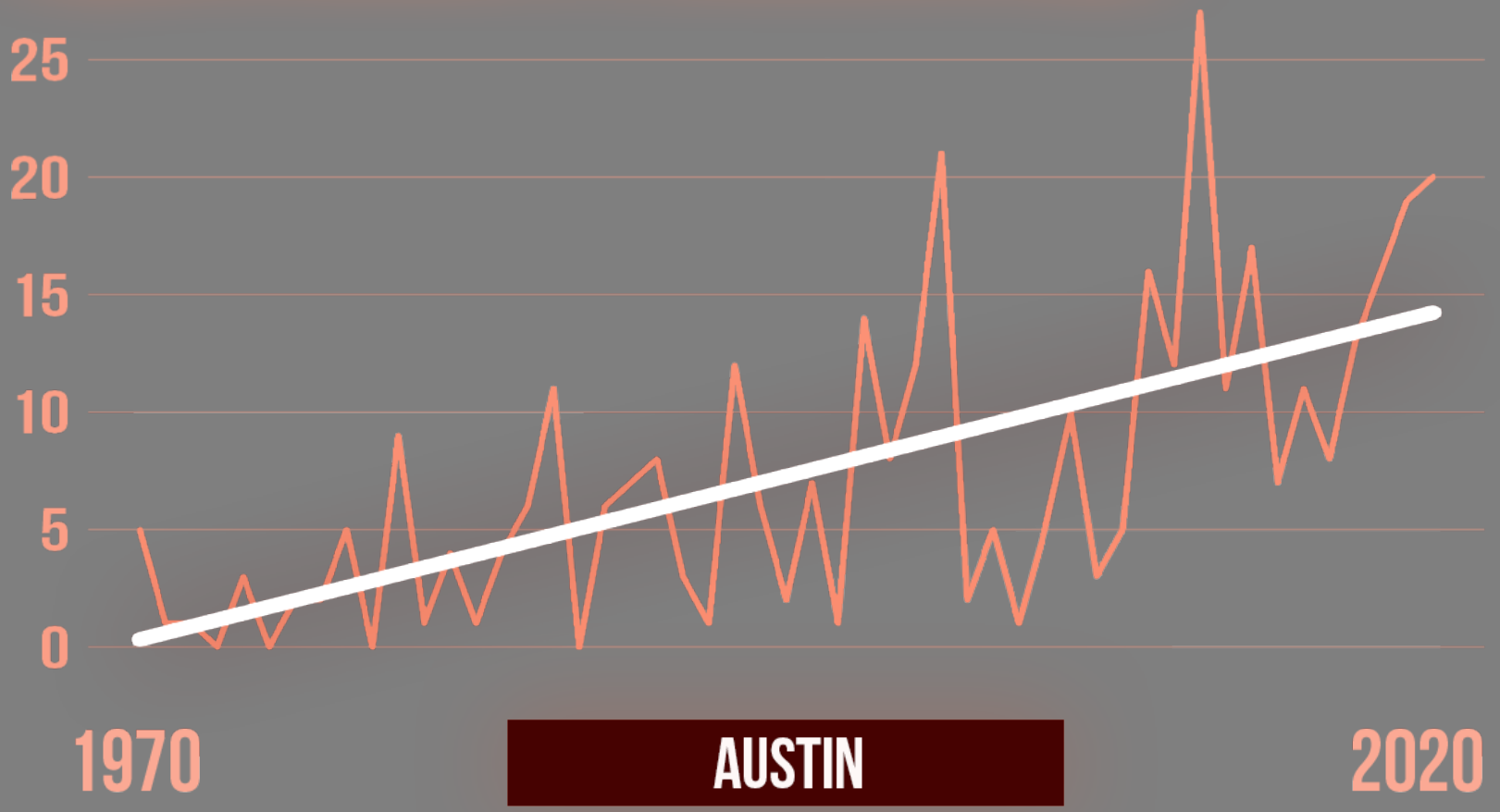

WARMING AT ALL LEVELS
Temperature change (°F) since 1970
5°
4°
3°
2°
1°
0°
+3.7°
+2.8°
+2.6°
Austin
Texas
United States
Based on linear trends of average annual temperature (1970-2021)
Source: RCC-ACIS.org, NCEI Climate at a Glance
CLIMATE CENTRAL

We are in the changed climate now now

Image: New Yorker; Data: Oldenborgh et al., 2018

LONGER STREAKS OF 100°+

Highest Number of Consecutive Days

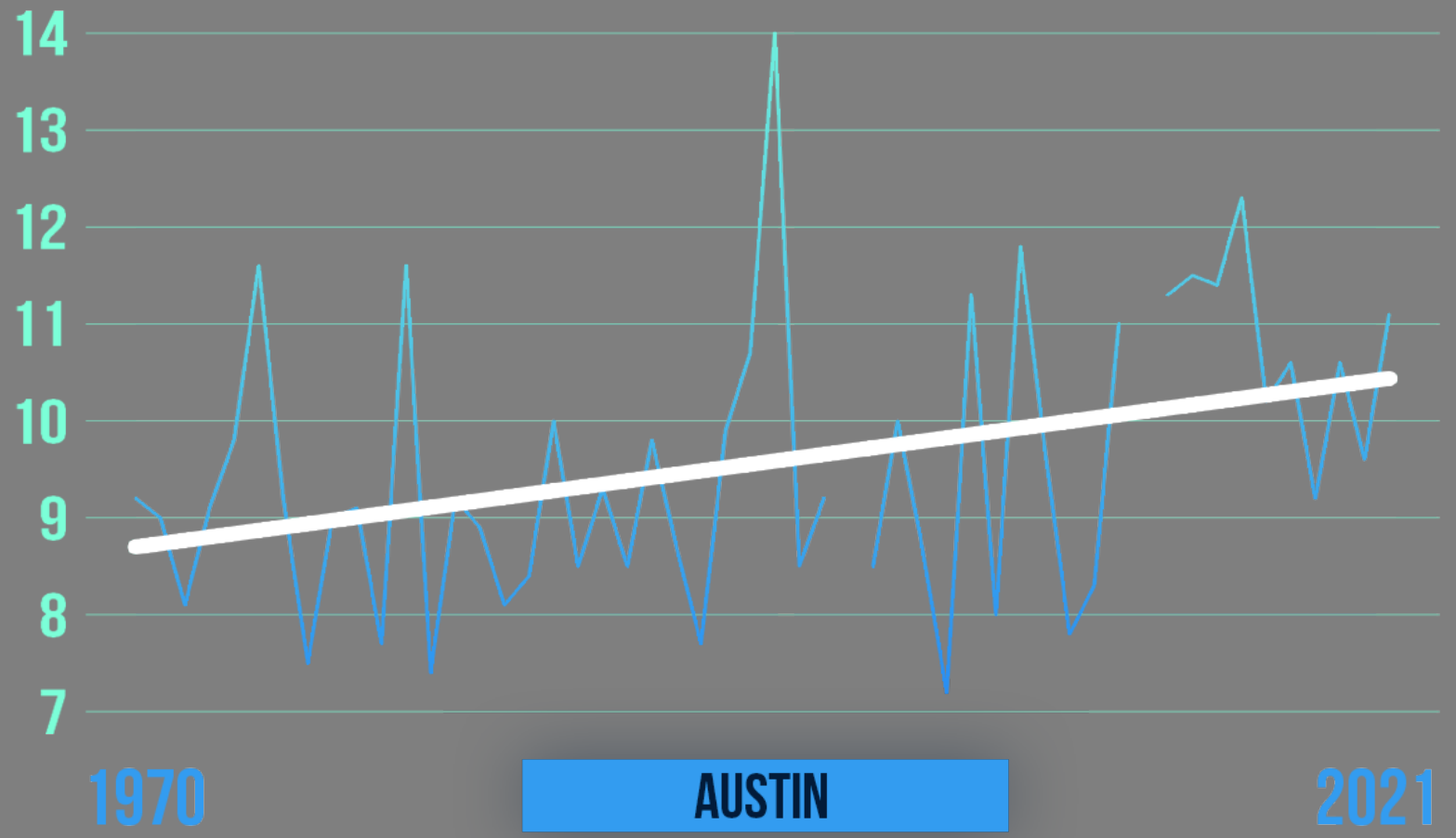


Longest streak of high temperatures of 100°+ each year.
Source: RCC-ACIS.org

CLIMATE CENTRAL

MORE INTENSE RAINFALL

Annual average hourly rainfall (hundredths of inches)



Average hourly rainfall is the total annual rainfall divided by the number of hours with rainfall.
Source: NCEI and RCC-ACIS

CLIMATE CENTRAL

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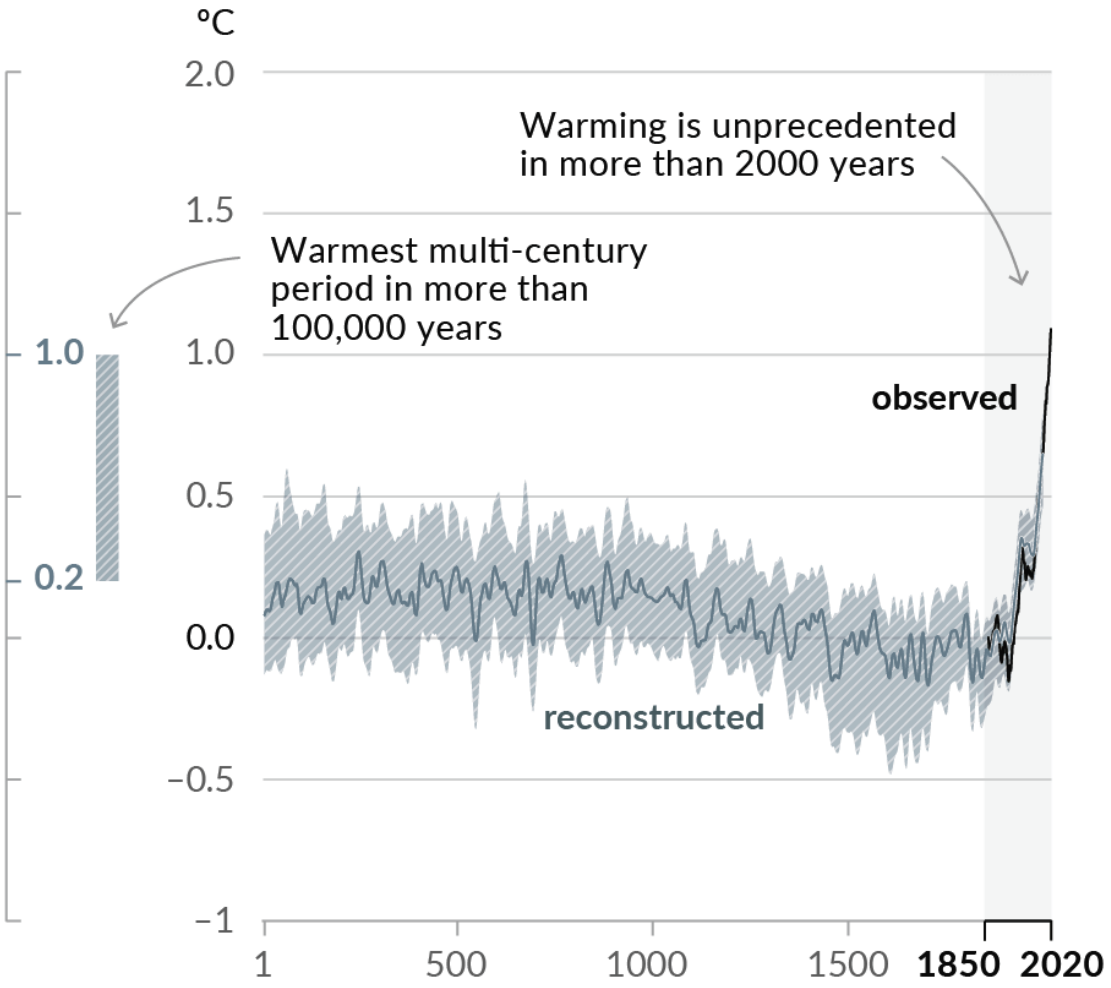

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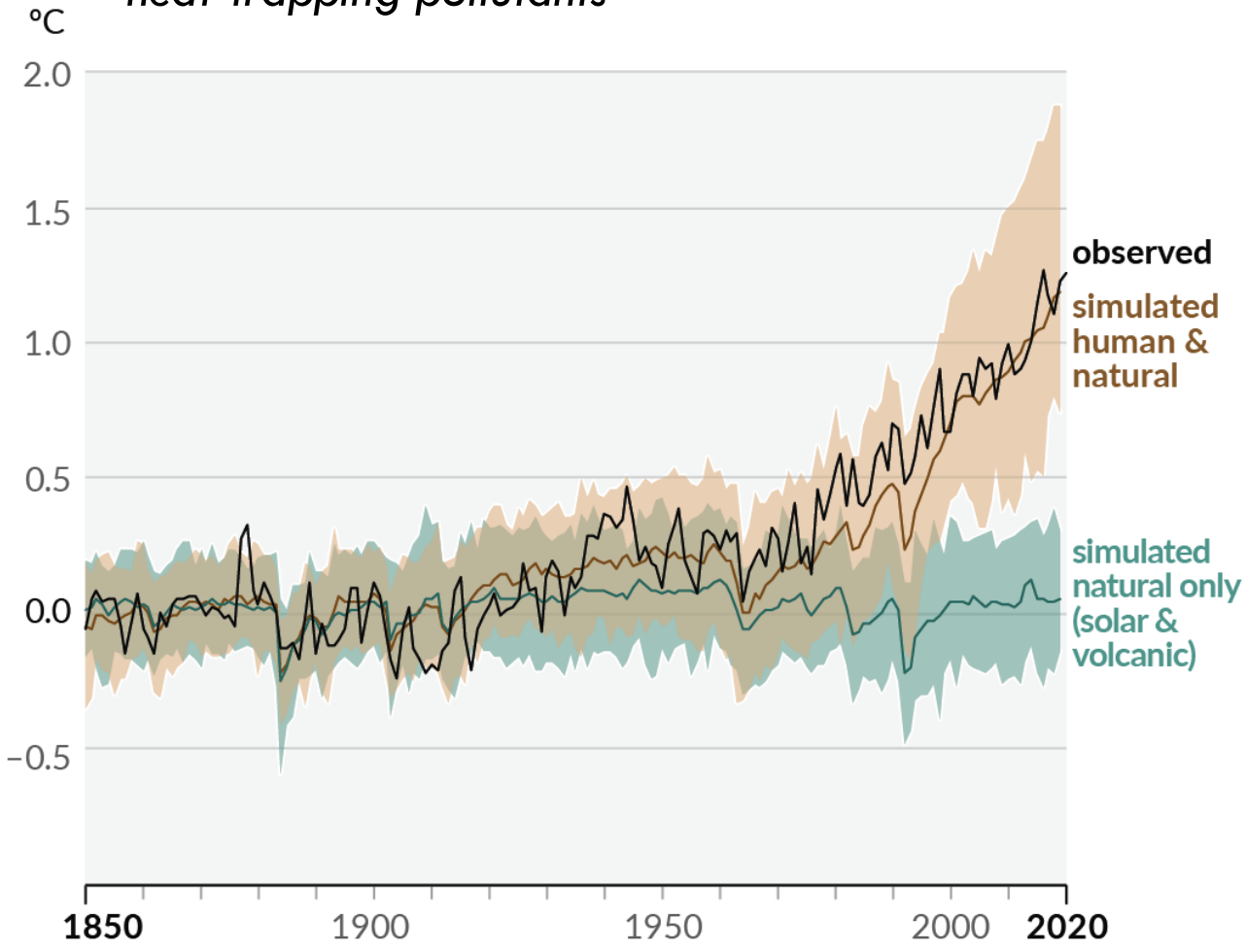

1824
Greenhouse effect first described

1856
CO_2 traps heat from sunlight

1896
Burning coal produces CO_2 and traps heat

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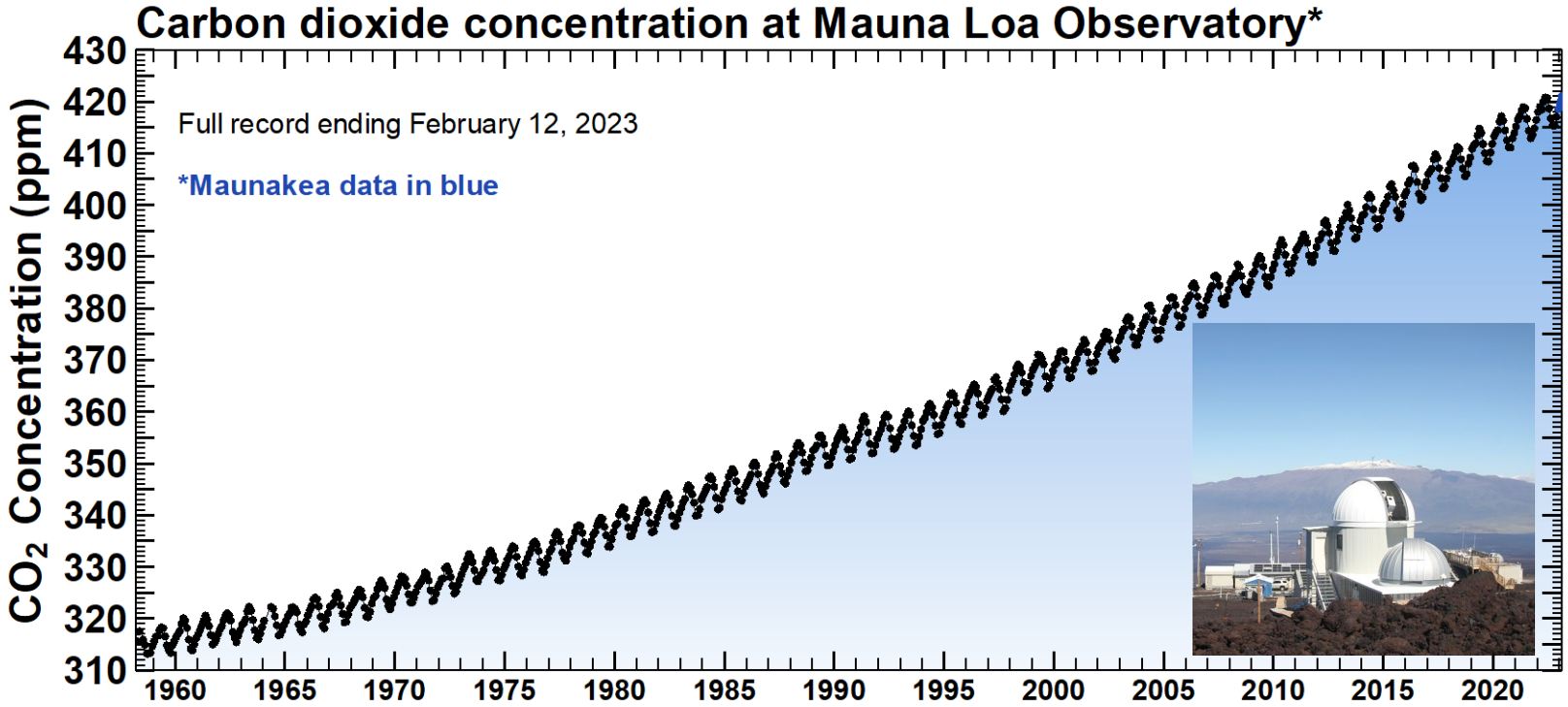
1958



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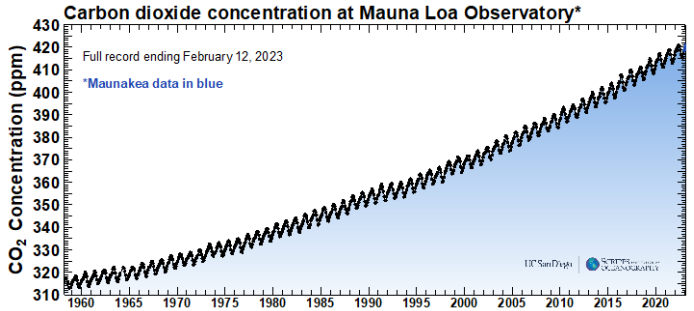
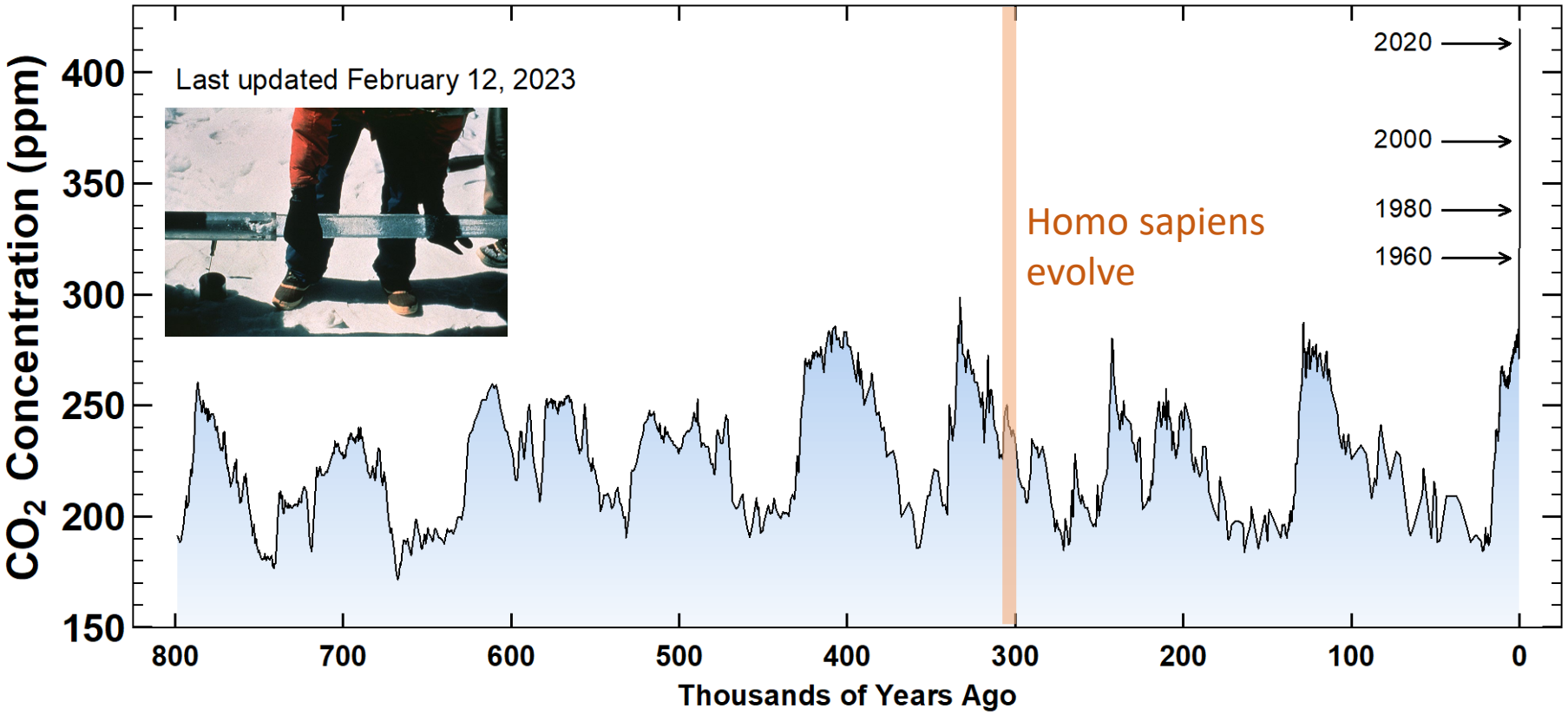


1970s and 80s: Ice cores drilled in Antarctica reveal 100,000s of years of CO_2



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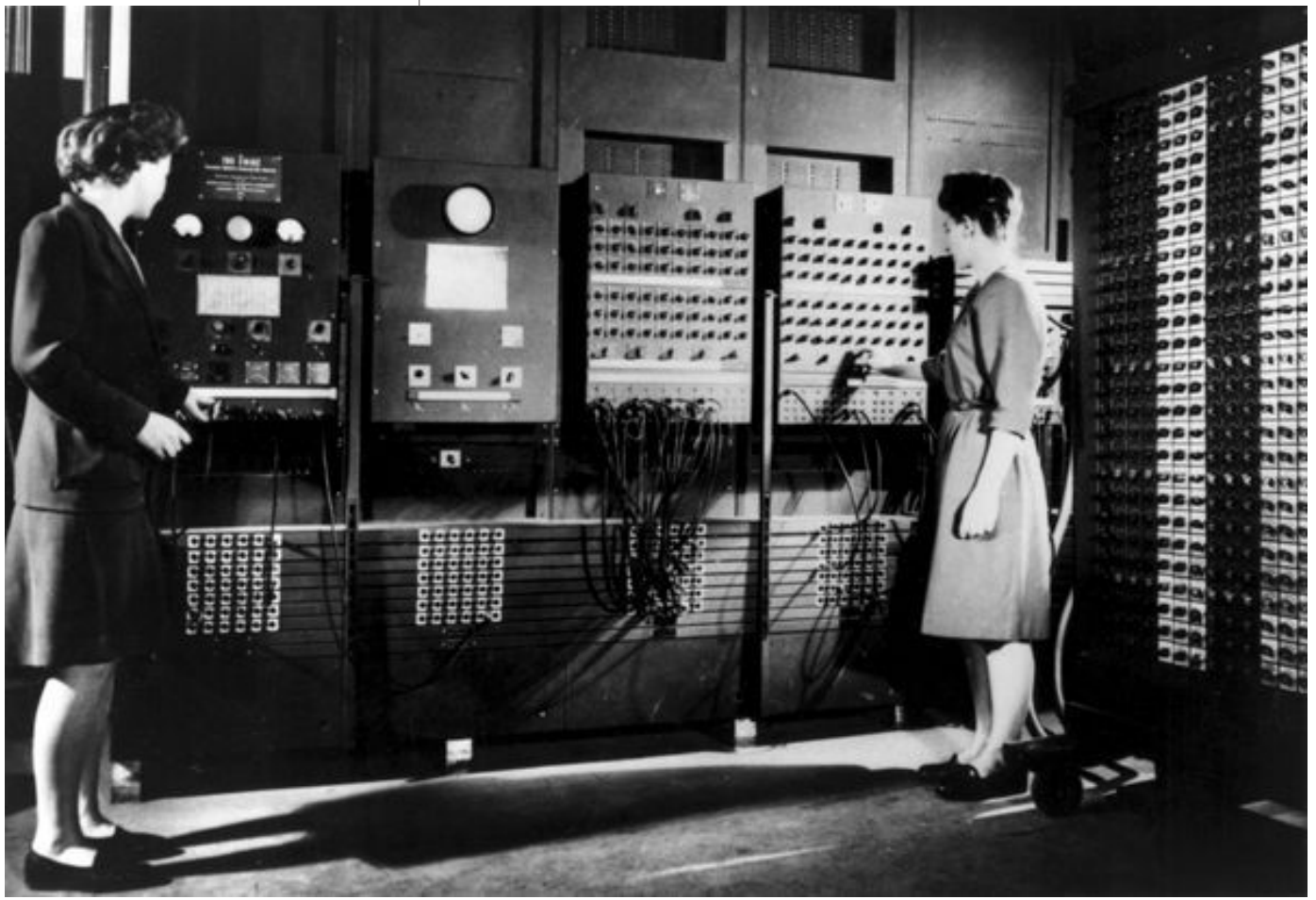

1950: First numerical weather forecast using the ENIAC computer

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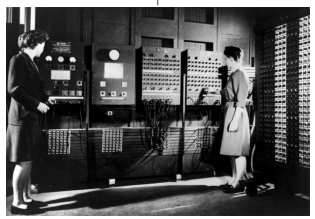

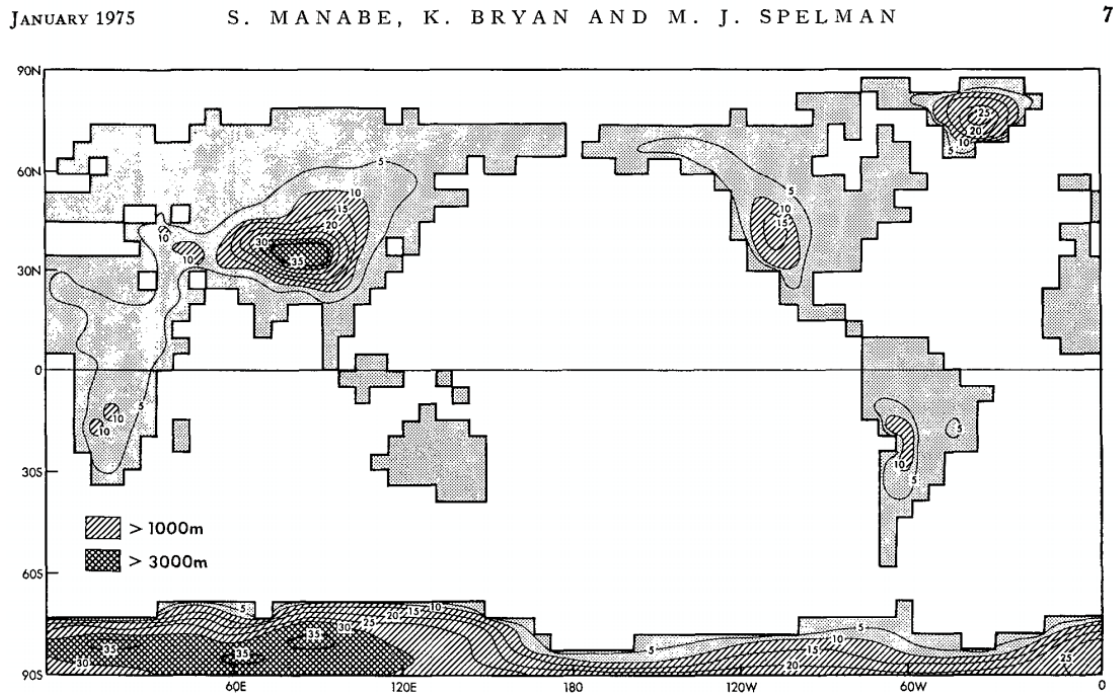

1975: 3D computer model of Earth's climate system shows that doubling CO_2 in the atmosphere will warm climate by several degrees

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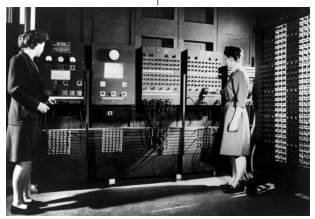
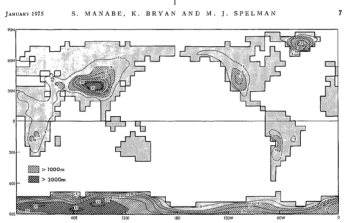
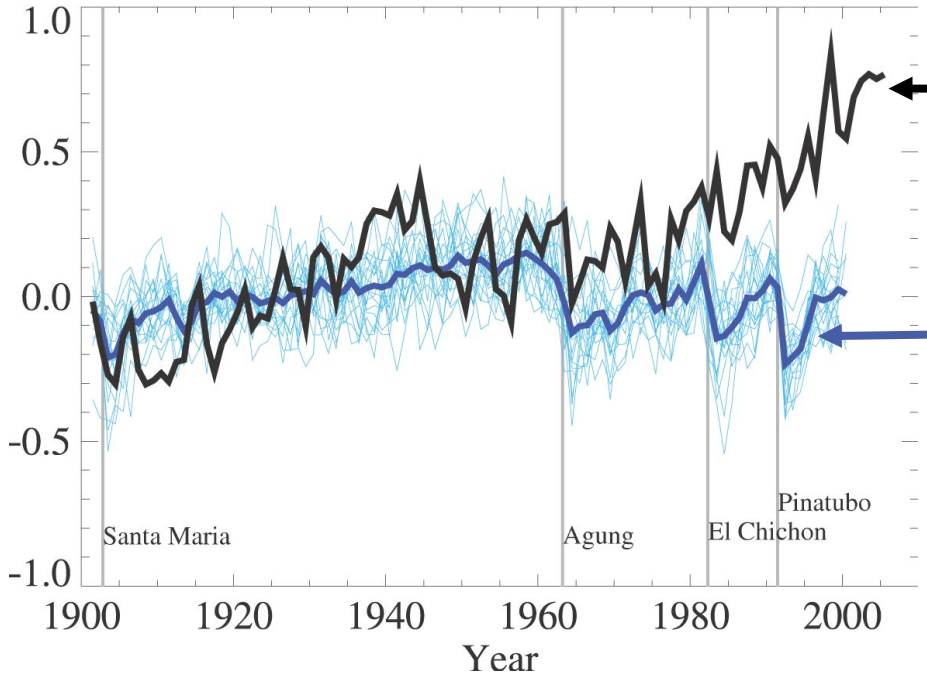




Global-average temperature change (°C)



What's actually happened to temperature

If only natural forces were affecting temperature (the sun, volcanoes, etc.)

1990s-2000s: Global Climate Models affirm that current observed warming trends cannot be explained without the influence of human emissions

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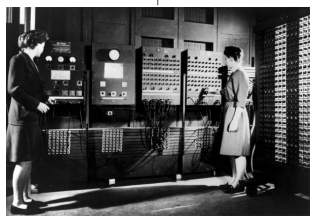

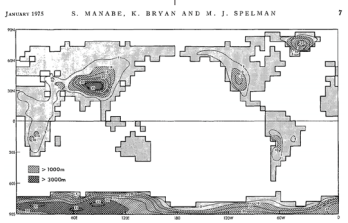

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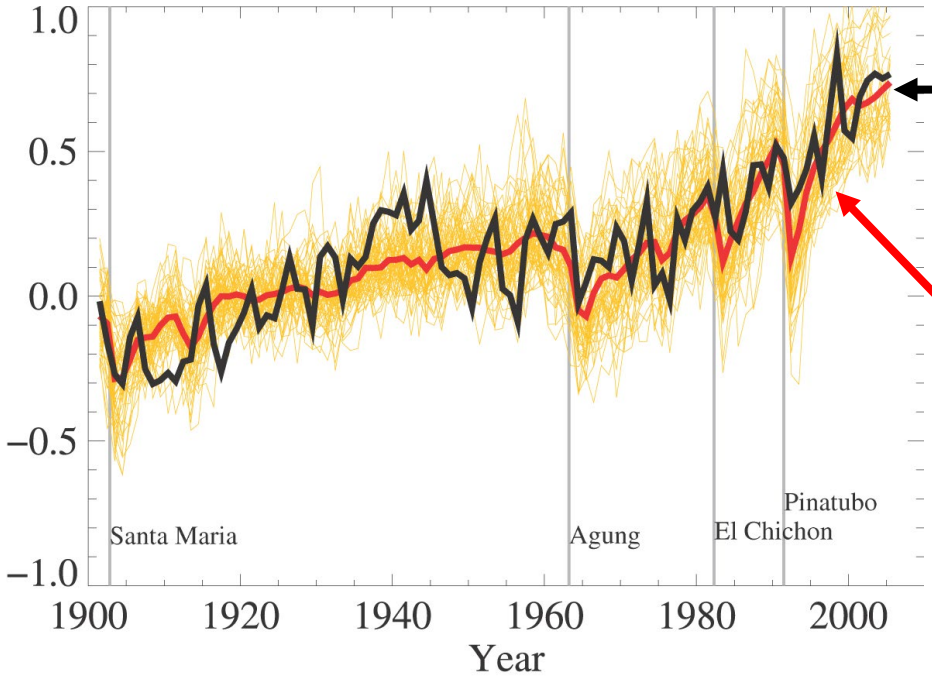

What's actually happened to temperature

With both natural and human influences

1990s-2000s: Global Climate Models affirm that current observed warming trends cannot be explained without the influence of human emissions

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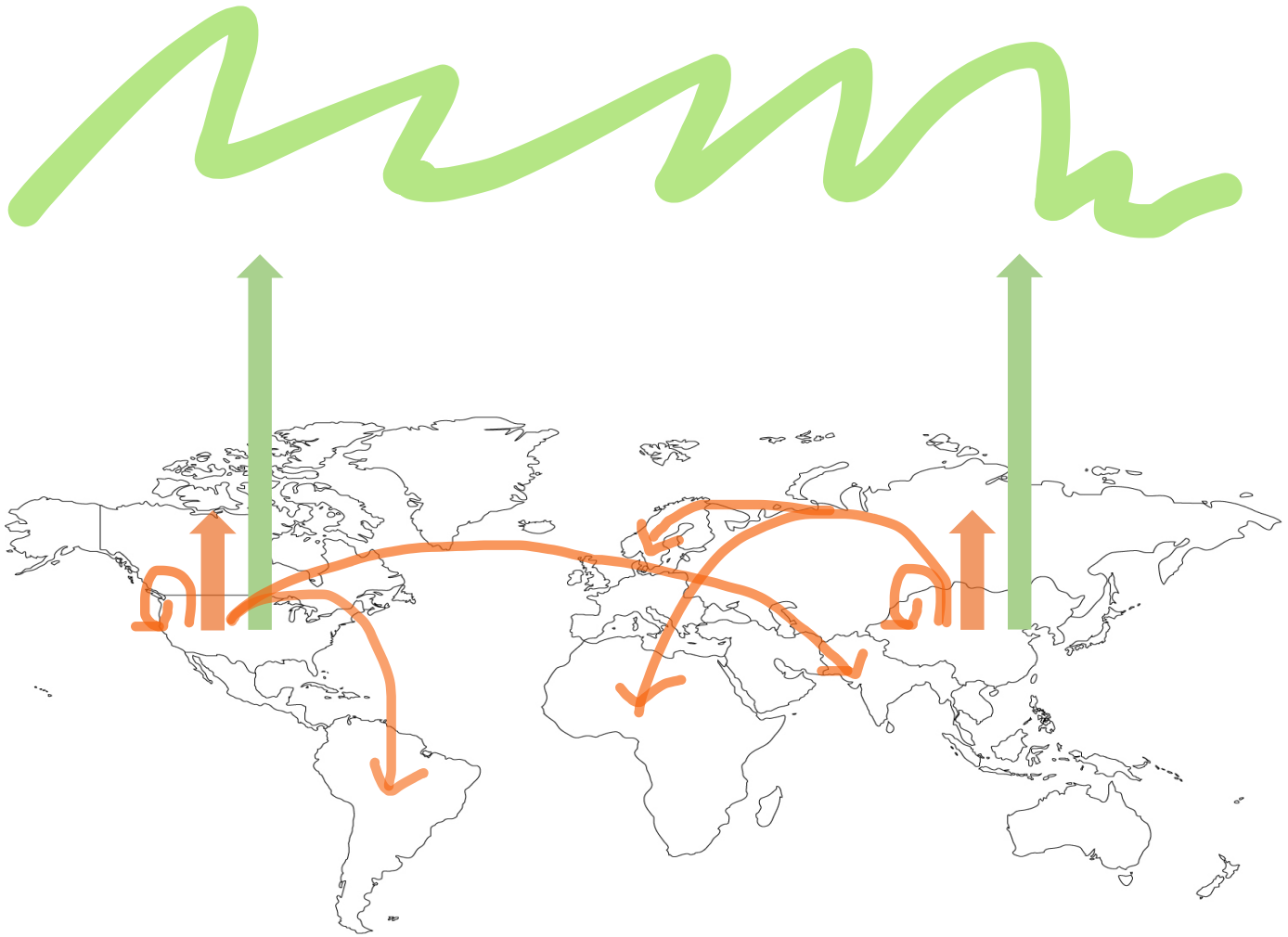
Now: Full 3-D simulation of the entire Earth System down to the scale of individual storms.

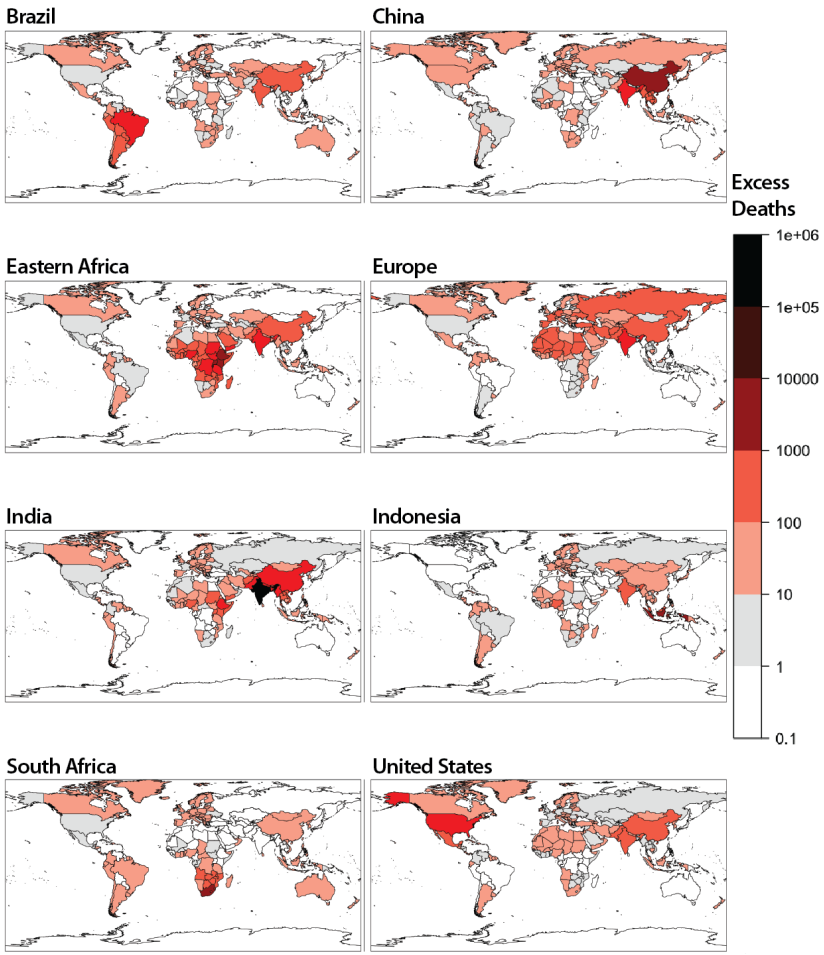
The same activities that emit heat-trapping gasses also emit toxic air pollutants, which also affect climate



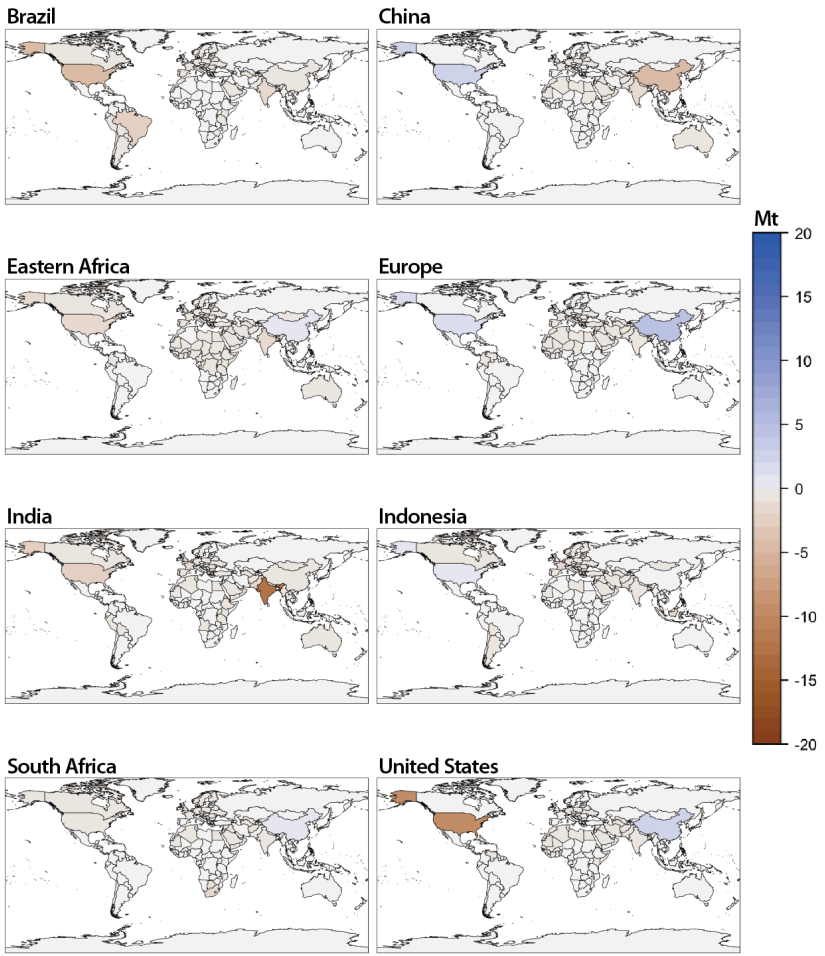
Persad and Caldeira (2018, *Nature Communications*); Burney, Persad et al. (2022, *Science Advances*); Persad et al., (2022, *Nature*)

Reducing the co-emitted pollutants produces societal benefits that make climate action an even better deal!

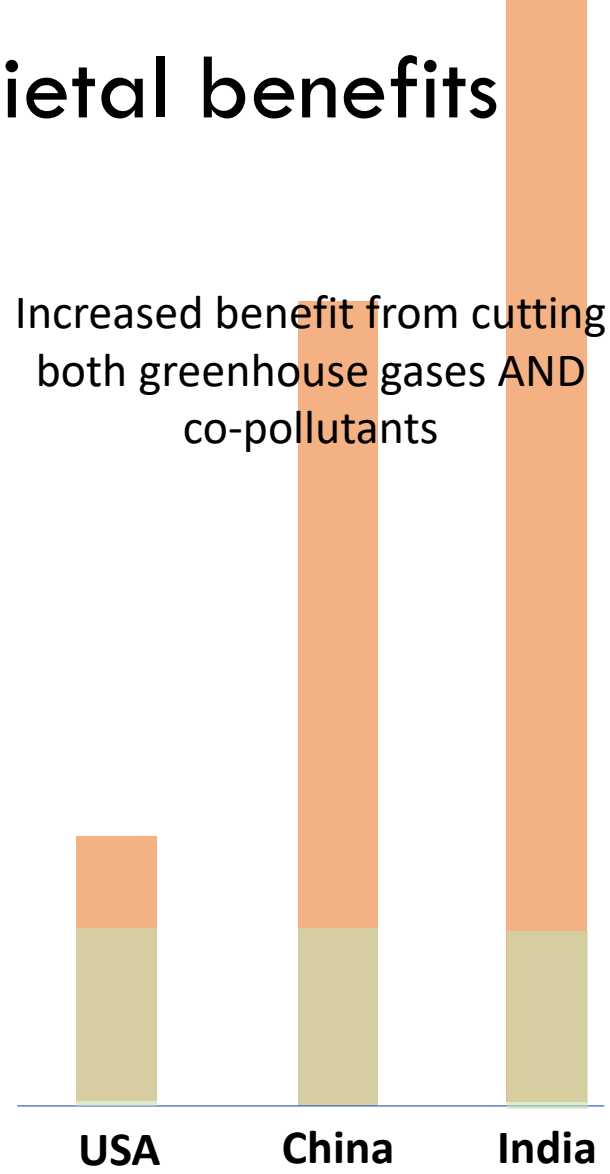
Global benefits to infant health



Global benefits to agriculture



Increased benefit from cutting both greenhouse gases AND co-pollutants



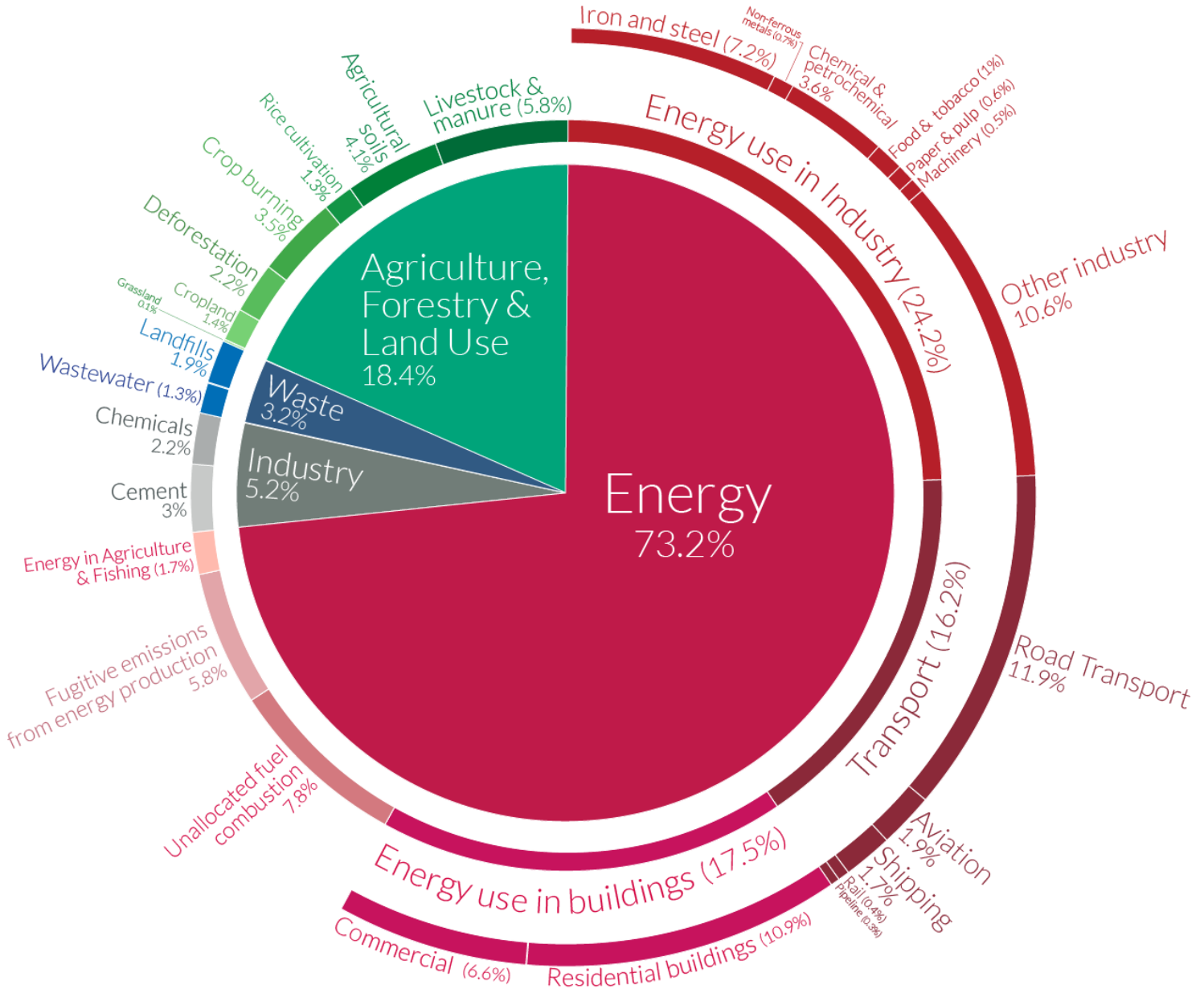
Persad and Caldeira (2018, *Nature Communications*); Burney, Persad et al. (2022, *Science Advances*); Persad et al., (2022, *Nature*)

So, how do we get there??

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.

Our World in Data



Source: Climate Watch, the World Resources Institute (2020).

HOW CAN EACH OF US TAKE ACTION?

SIMPLE CHOICES IN OUR DAILY LIVES CAN MAKE A DIFFERENCE.

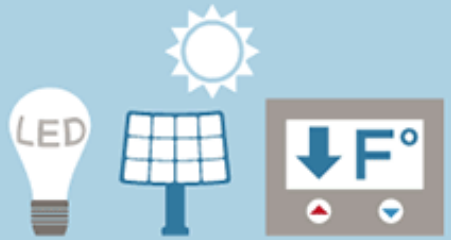
GREEN UP YOUR TRAVEL

PLANT & PROTECT TREES

CUT FOOD WASTE & SAVE

BUY WISELY & RECYCLE MORE

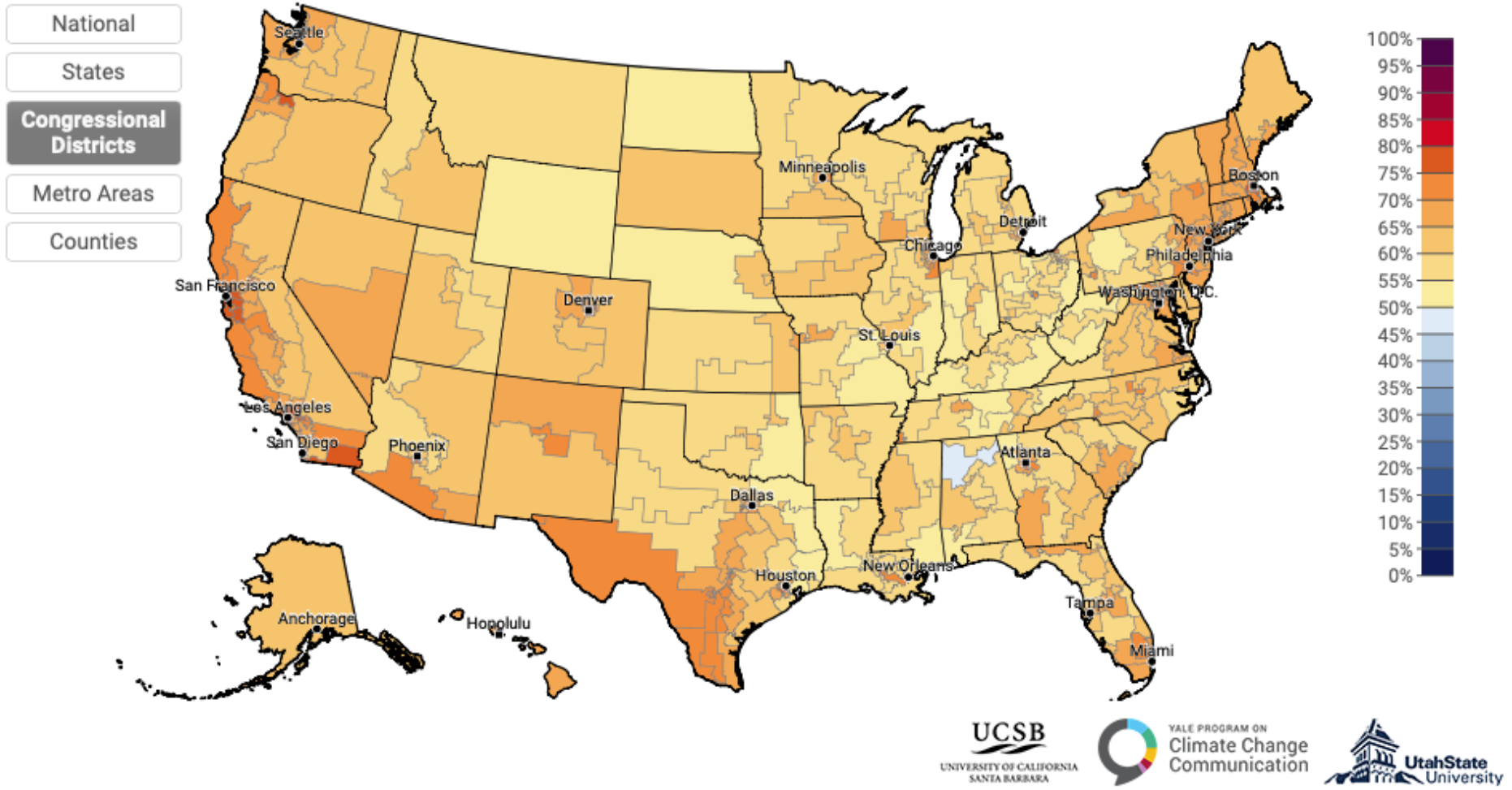
REDUCE ENERGY USE

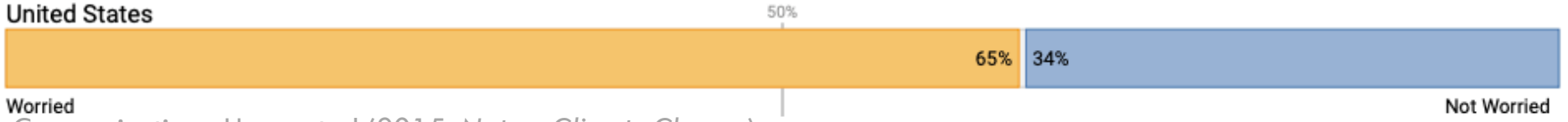


SPEAK UP!

Talk about it!

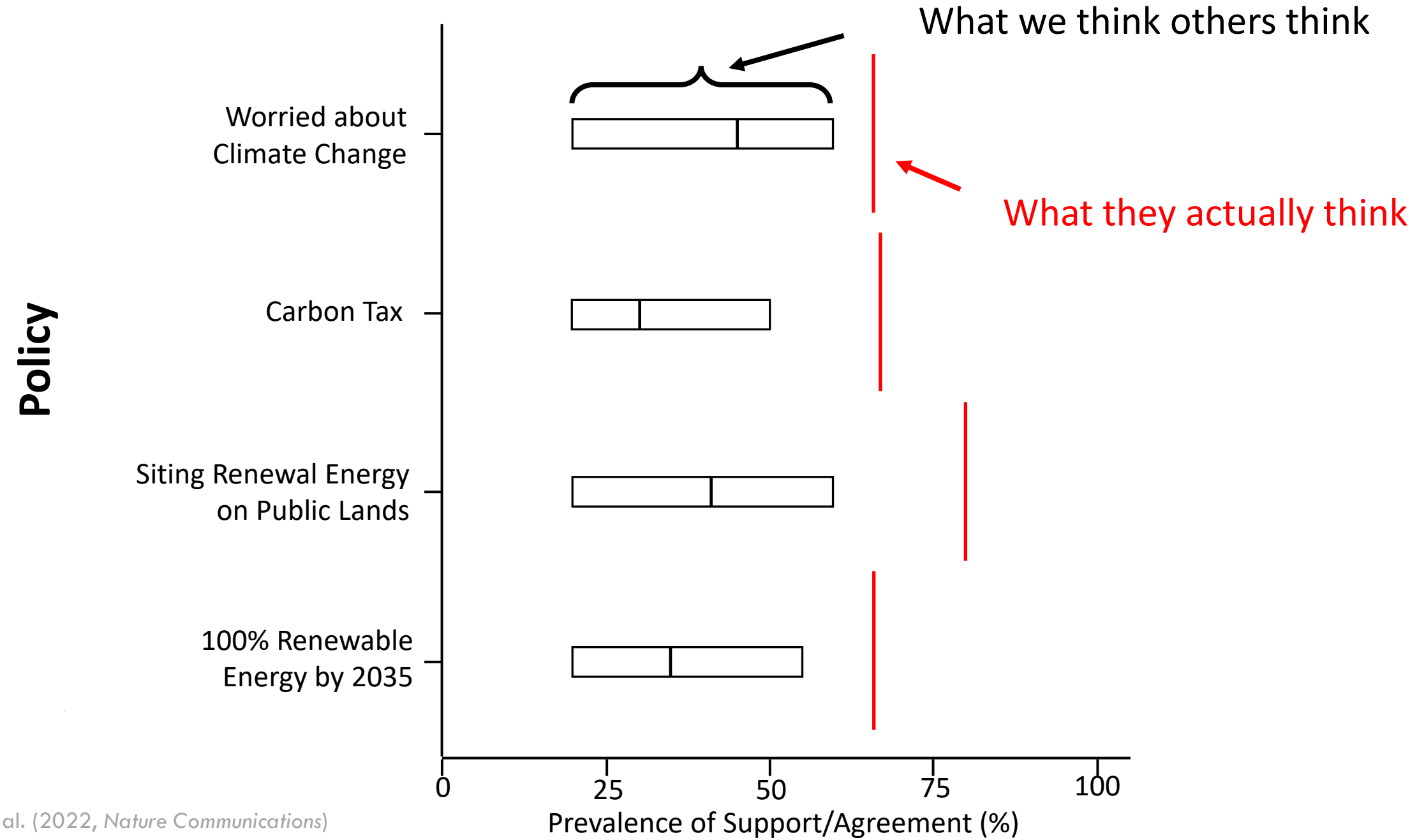
More than half of Americans in almost every congressional district are worried about climate change





Yale Program on Climate Communications, Howe et al (2015, *Nature Climate Change*)

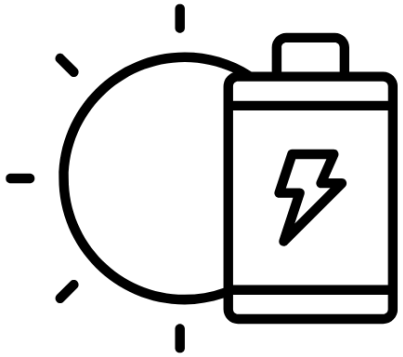
But we each underestimate how much everyone else cares



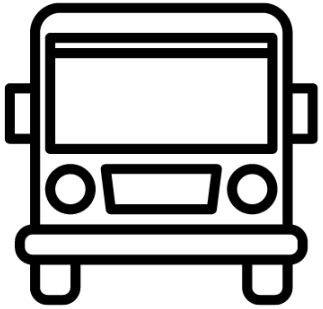
Sparkman et al. (2022, *Nature Communications*)

We have the technologies already to slow climate change

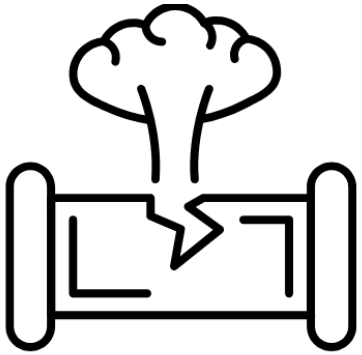
Reduce food waste



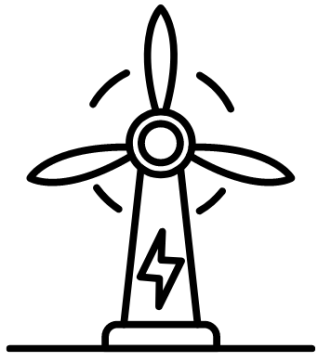
Expand utility-scale solar power



Increase public transit



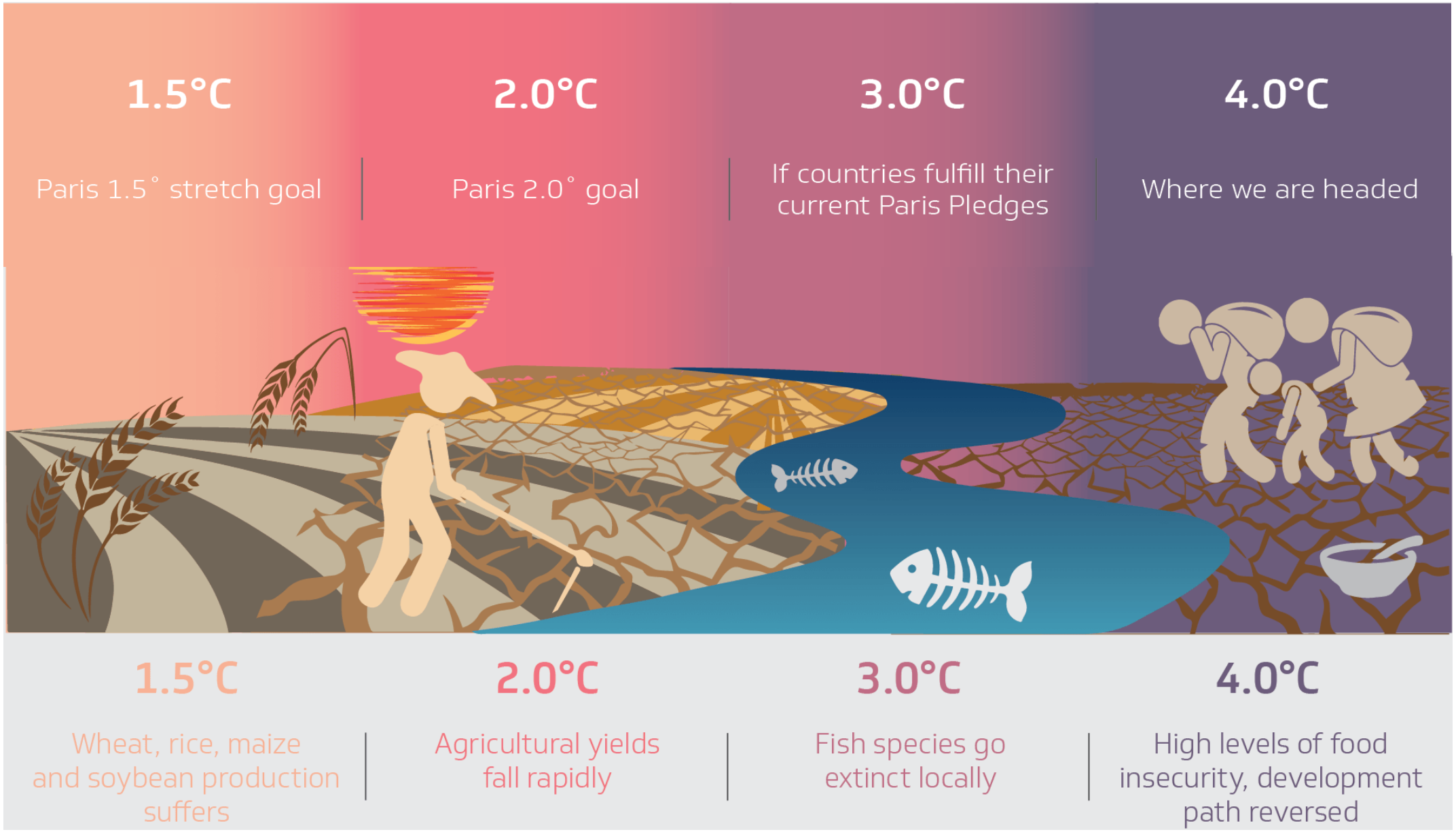
Eliminate heat-trapping refrigerant leaks



Invest in onshore wind power

Manage supply-chain methane leakage

Every bit of climate action helps



Engineer or technician? Build climate-safe infrastructure and implement climate solution tech!

Finance? Help build funds that invest in climate-safe infrastructure or climate solutions!

Marketing? Help make climate action cool!

Artist? Help tell the story of what a climate-safe future could look like!

Calling All Artists at the Sundance Film Festival

Consider time…