

Climate Change Solutions

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Commercial Regional Sales Manager



City of Houston Energy Code Chair

International Vice Chair ASHRAE Grassroots Government
Activities Committee

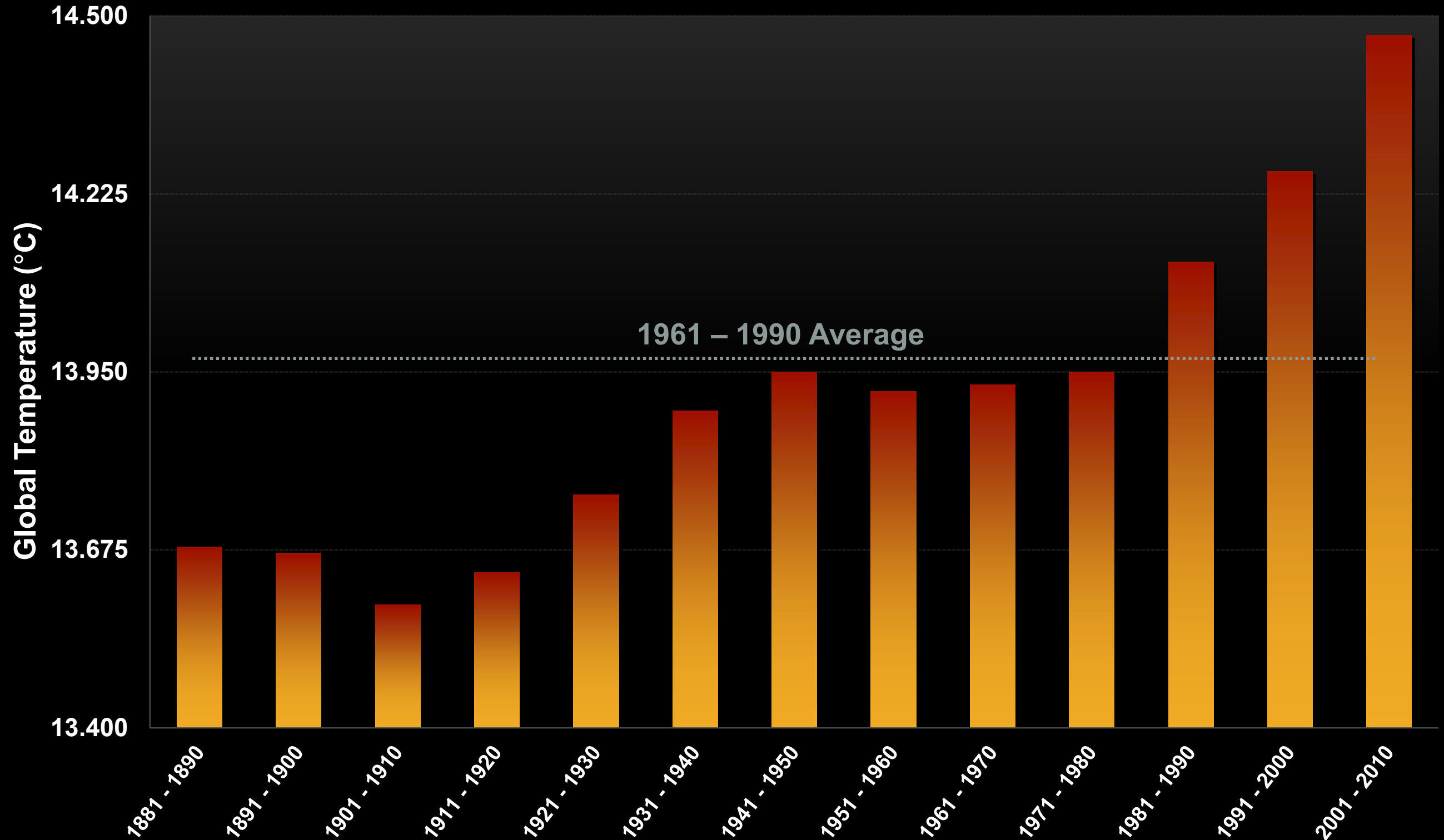
Secretary Construction Industry Council

Past Chair USGBC TGC

Past President ASHRAE Houston

Global Temperature by Decade

1881 – 2010



2012: A Year for the Record Books



Globally, September 2012 tied with 2005 as the hottest September ever recorded



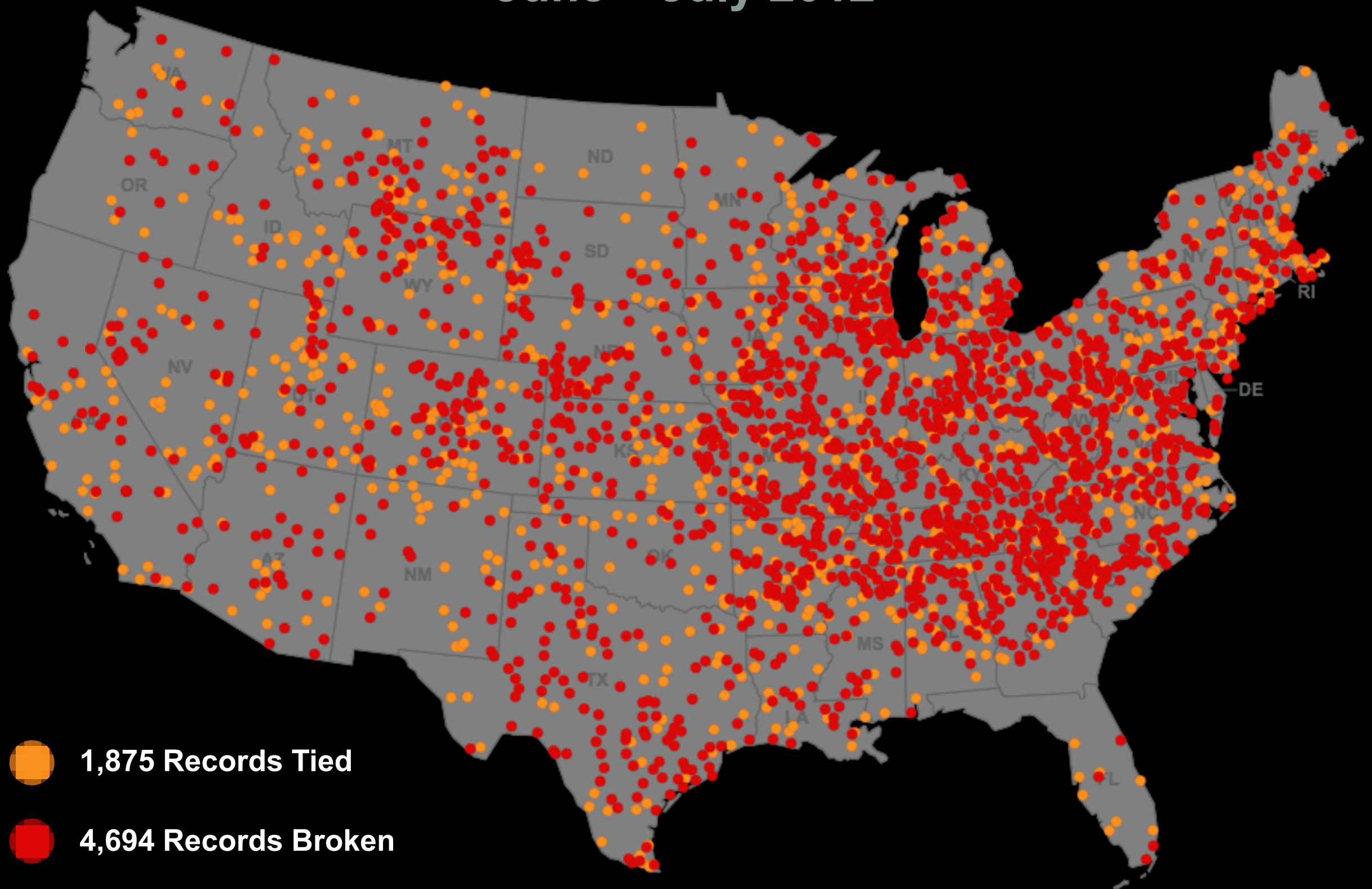
On September 16, 2012, the Arctic reached its all-time lowest daily extent on record



In the contiguous United States, 2012 was the hottest year in recorded history

Daily Heat Records

June – July 2012



U.S. Daily Temperature Records

Hot

Cold

1 : 1

1950 – 1999

U.S. Daily Temperature Records

Hot

Cold

2 : 1

2000 – 2011

U.S. Daily Temperature Records

Hot

Cold

10 : 1

January – July 2012

U.S. **All-Time** Temperature Records

Hot

Cold

115 : 1

January – July 2012

**The Hottest MONTH
Ever Measured in the U.S.**

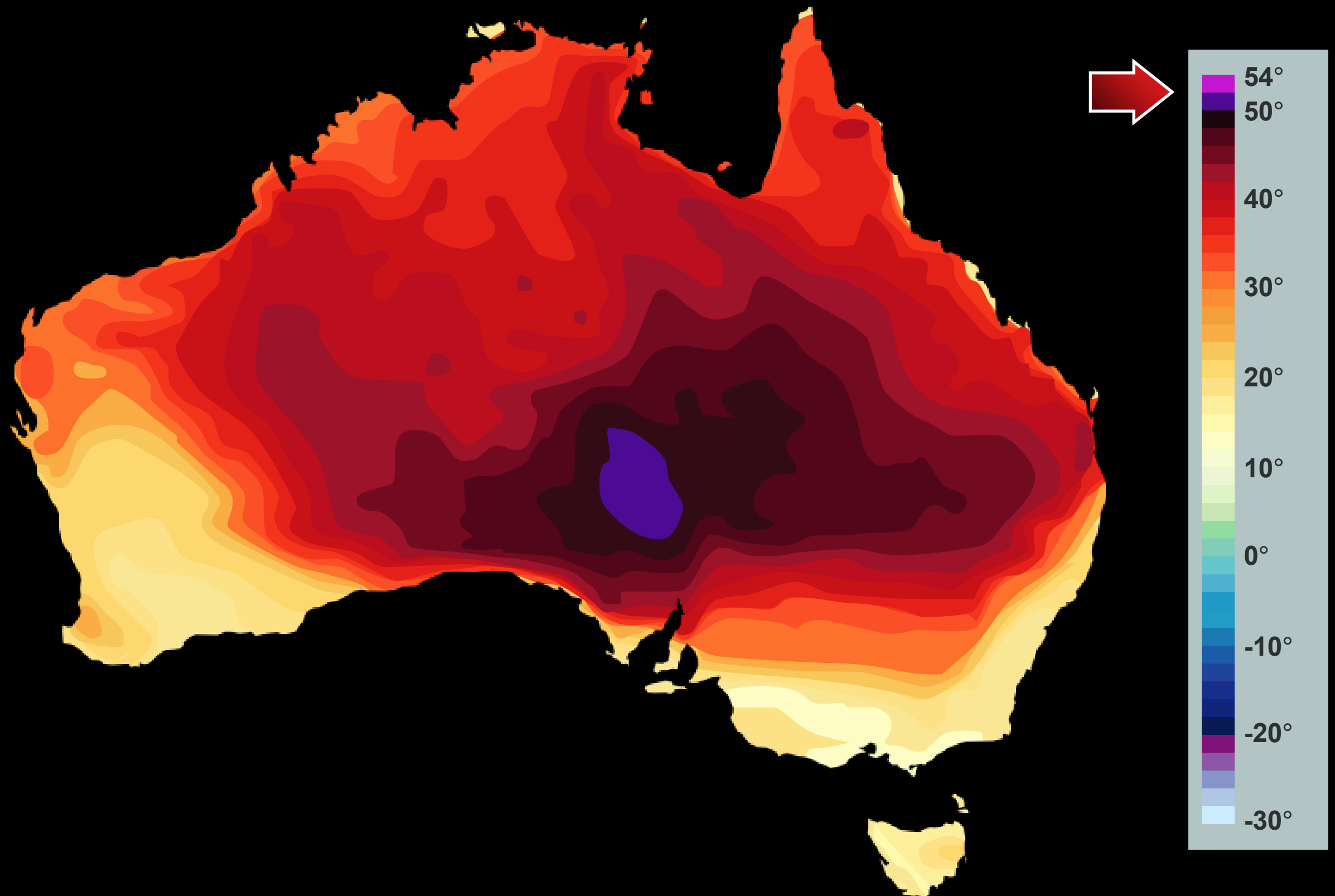
JULY, 2012

Reagan National Airport, Washington, D.C.

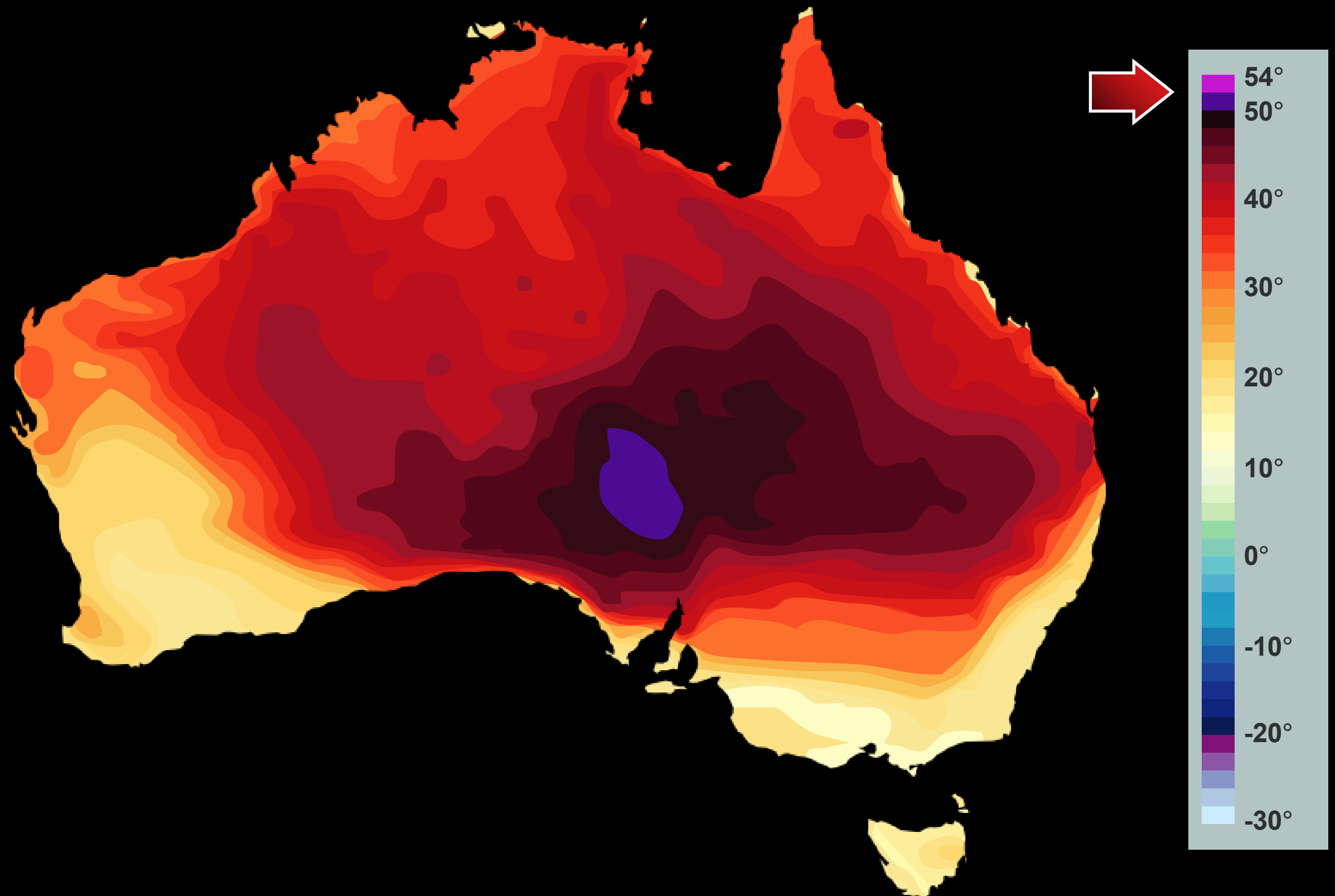
July 6, 2012



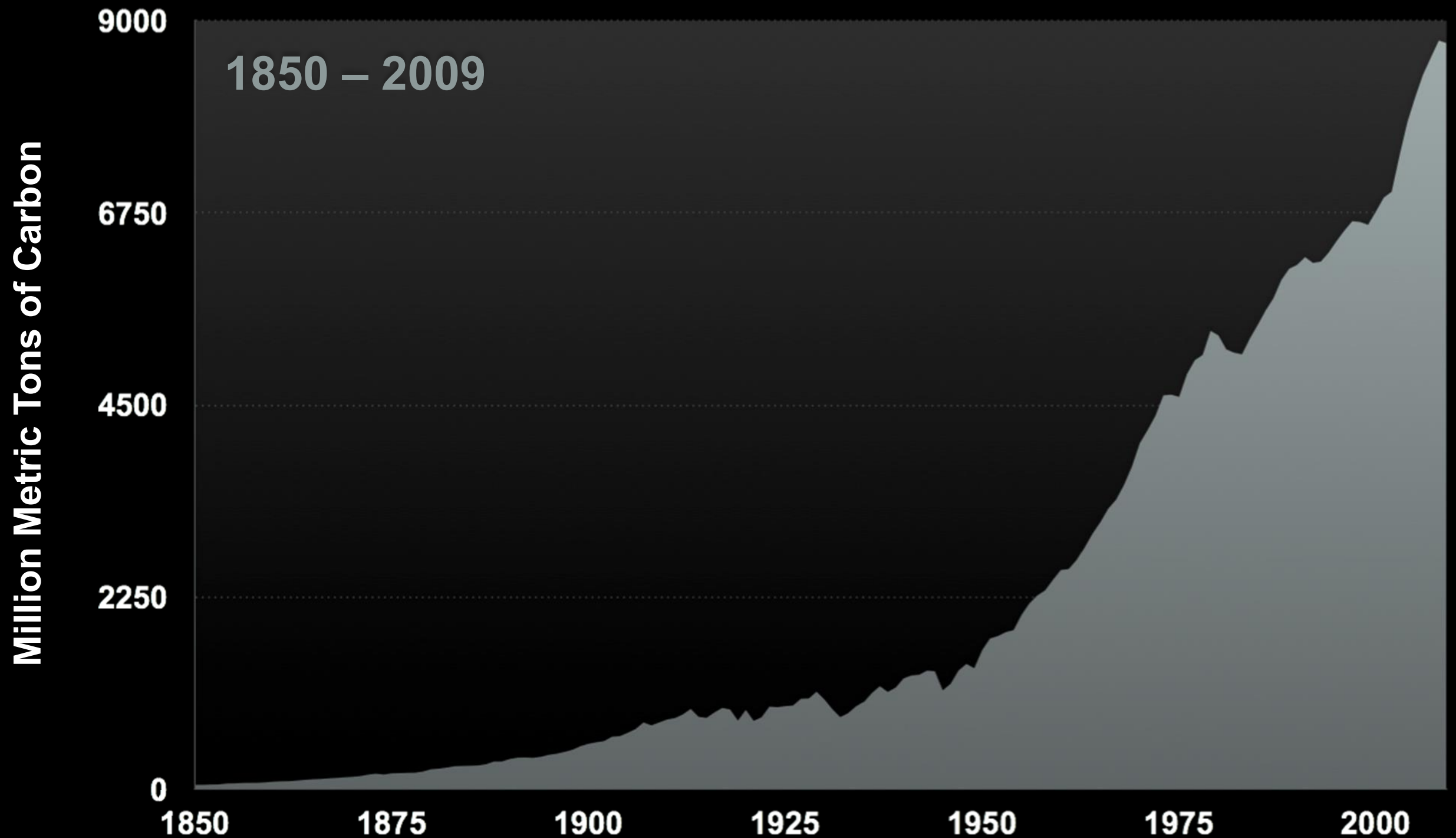
Two New Colors Had to Be Added to the Map



Australia Heat Forecast: January 14, 2013



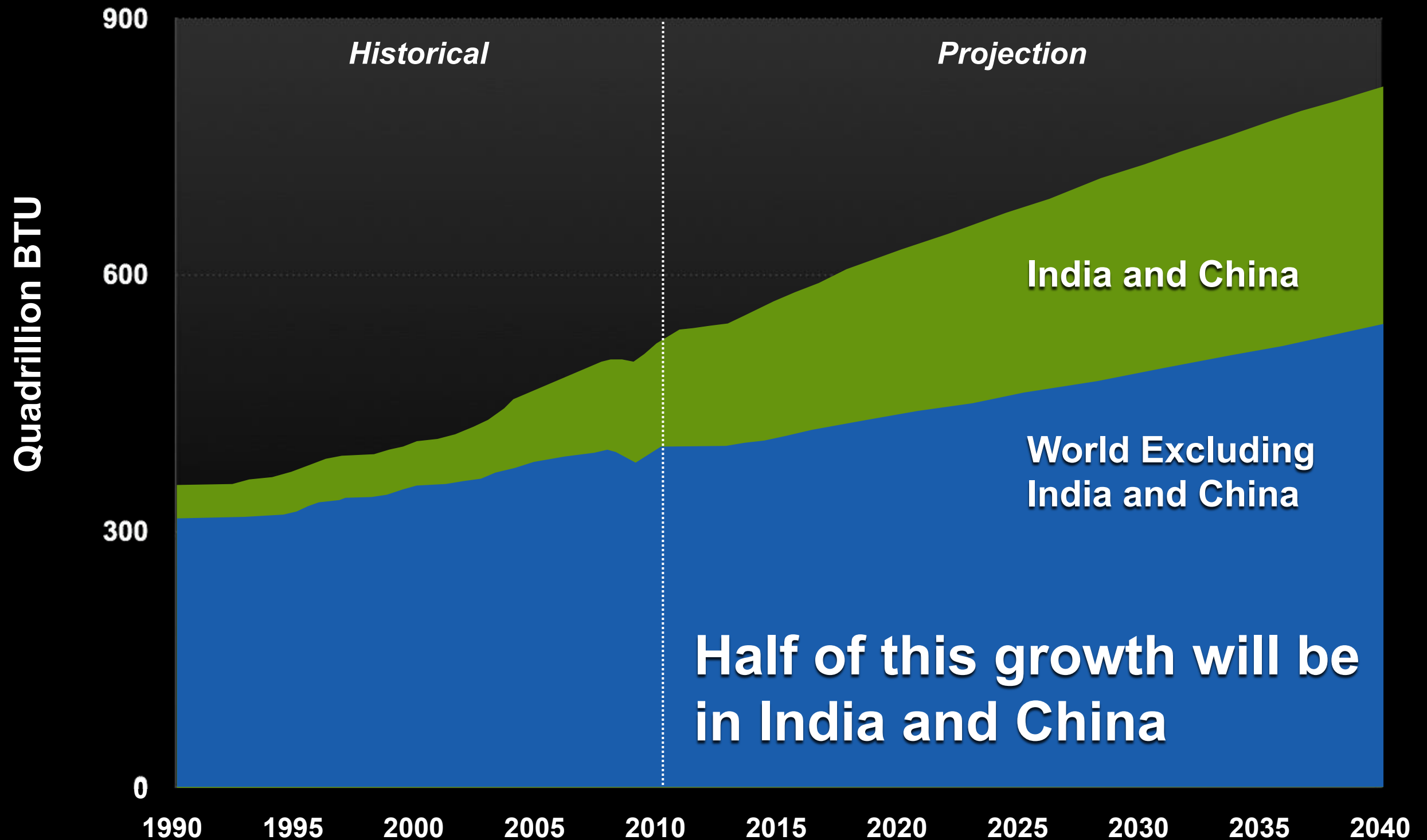
Global Carbon Emissions from Fossil Fuels

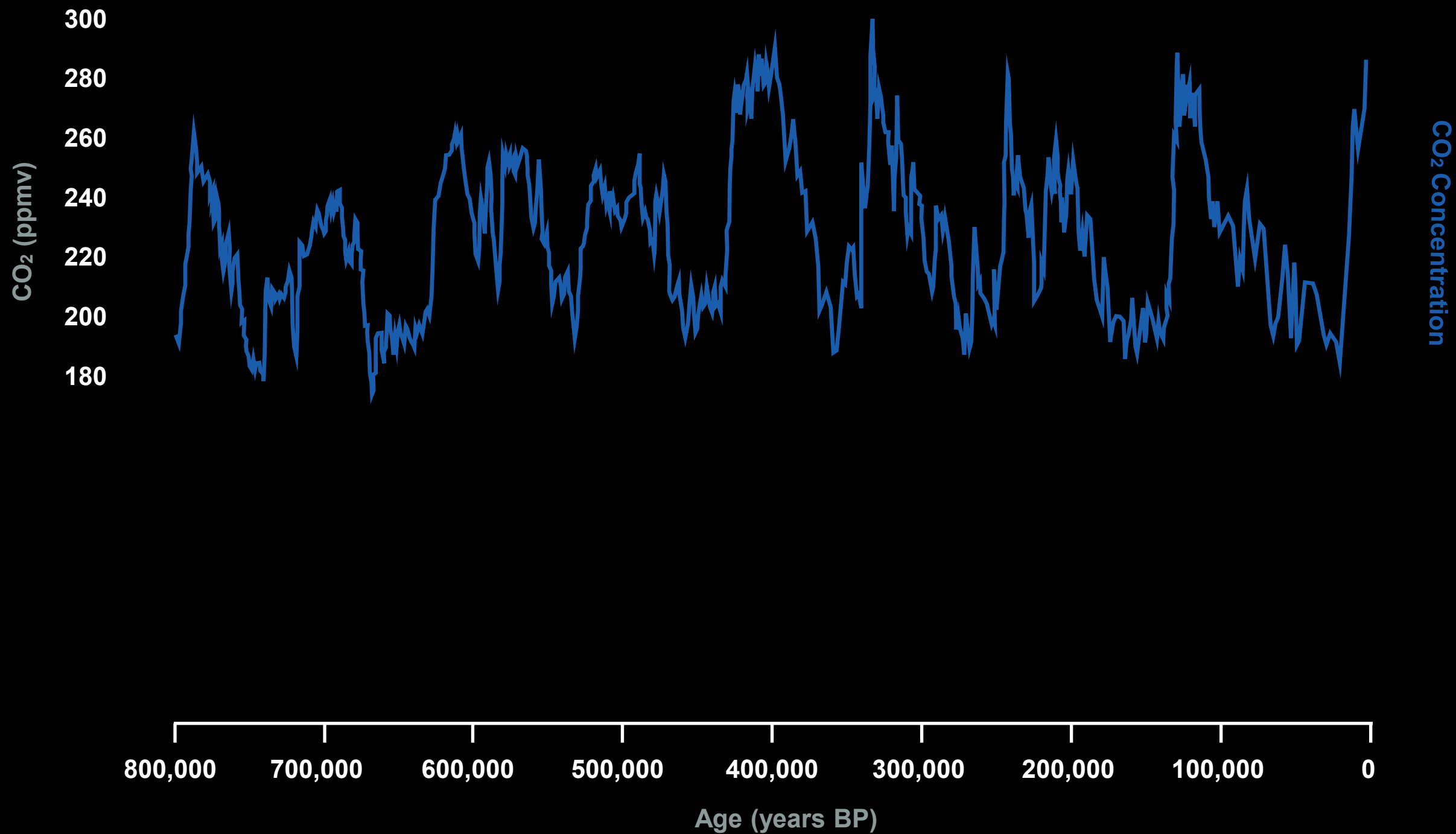


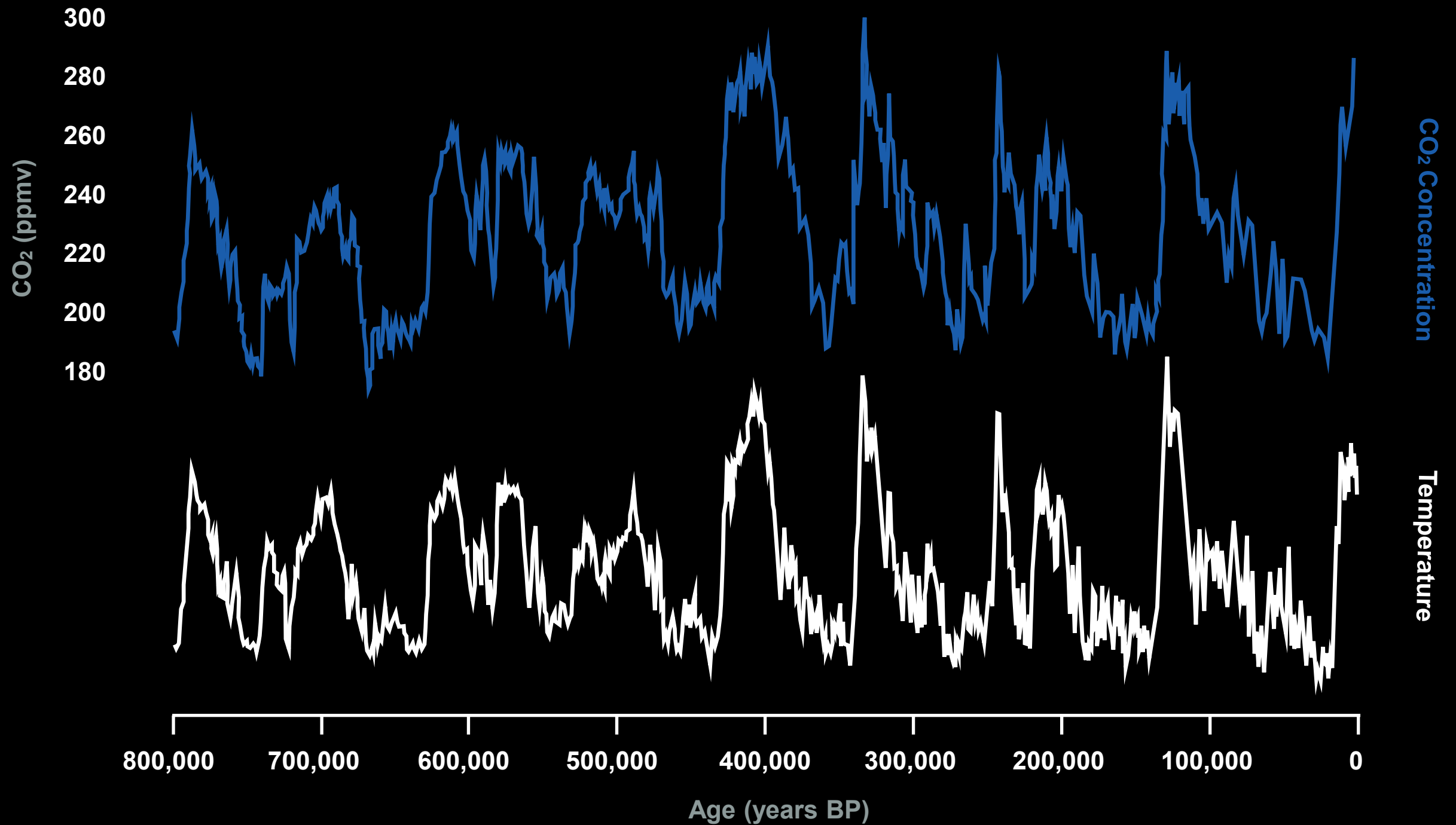
Where Do Greenhouse Gases Come From?

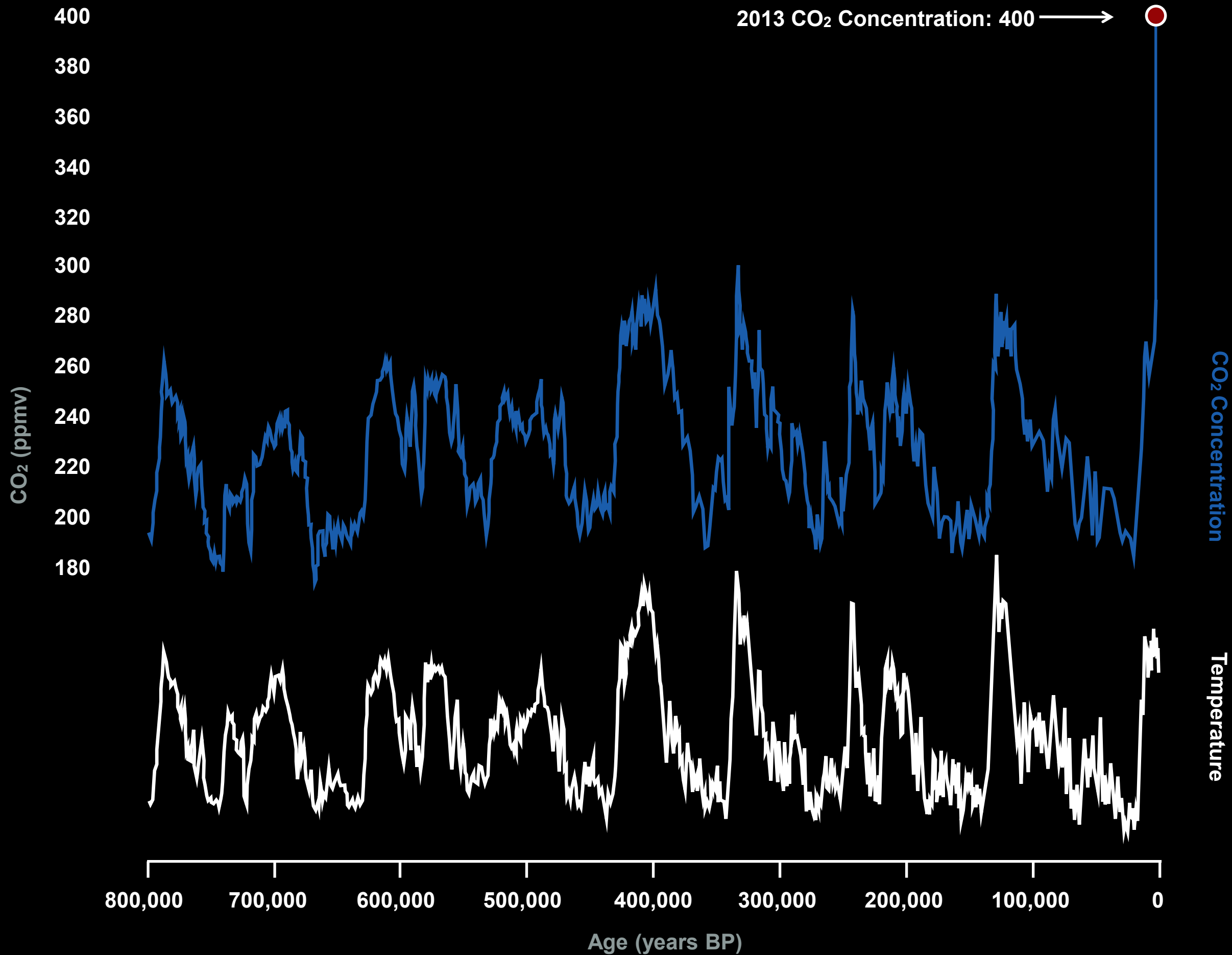


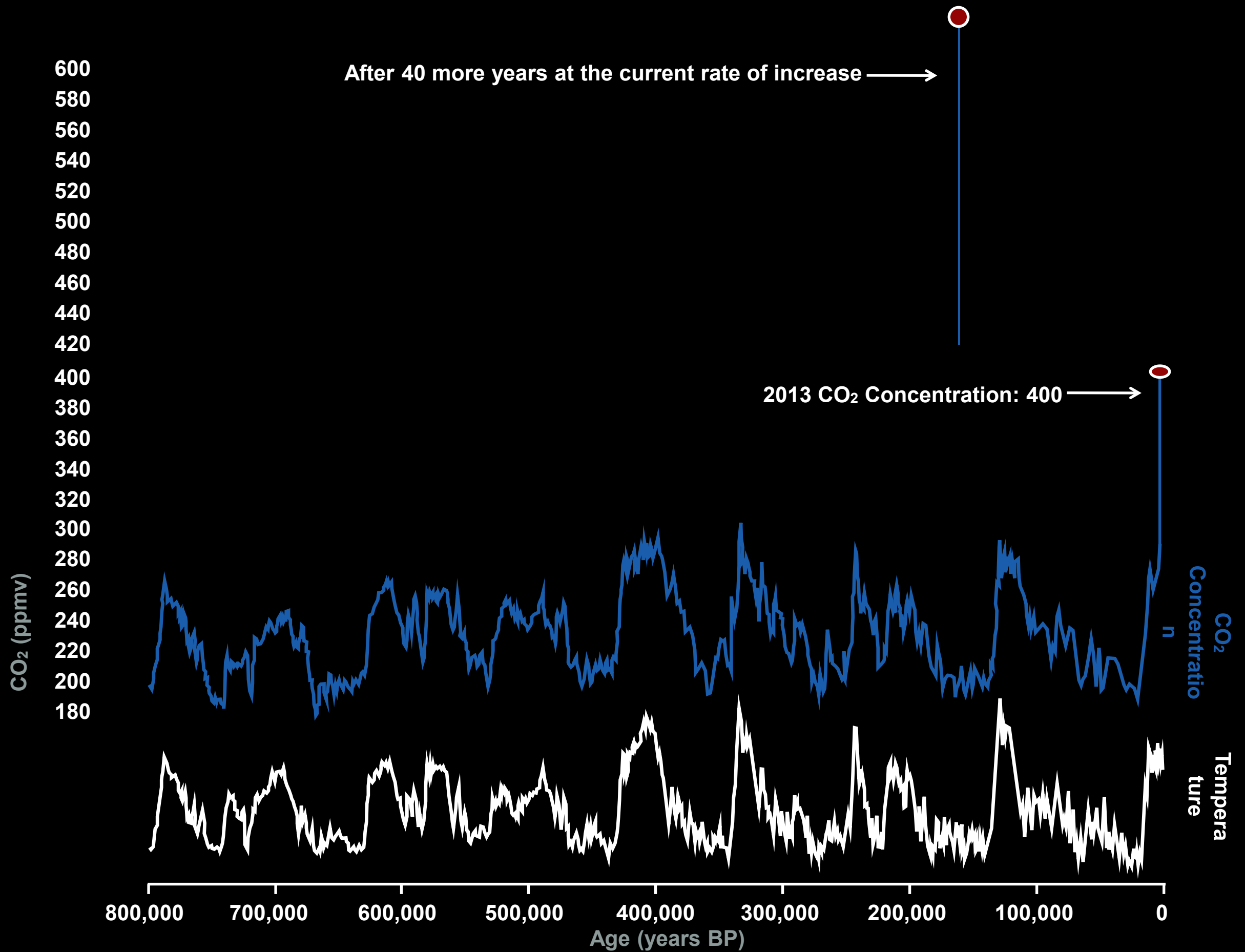
Increase in Global Energy Consumption





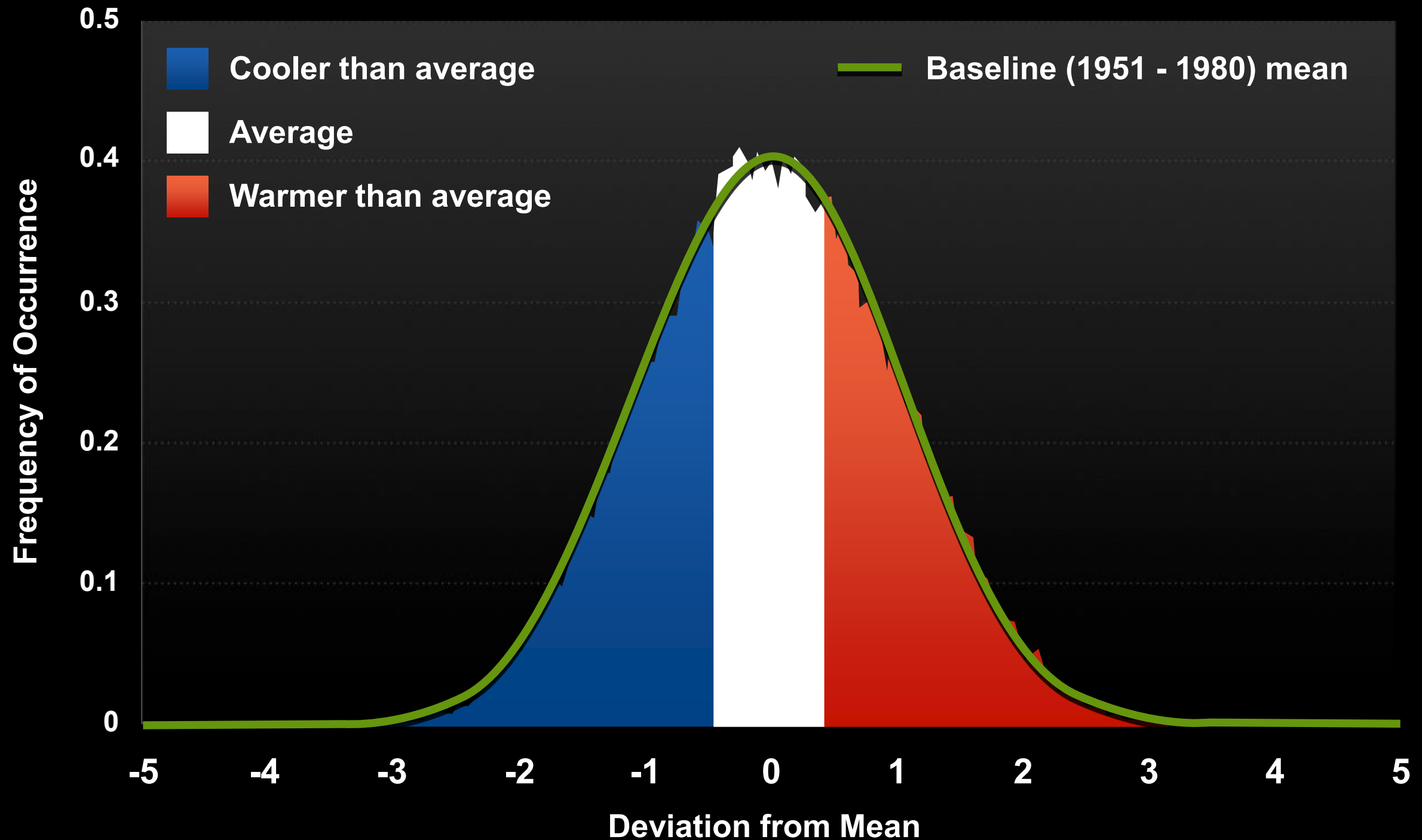






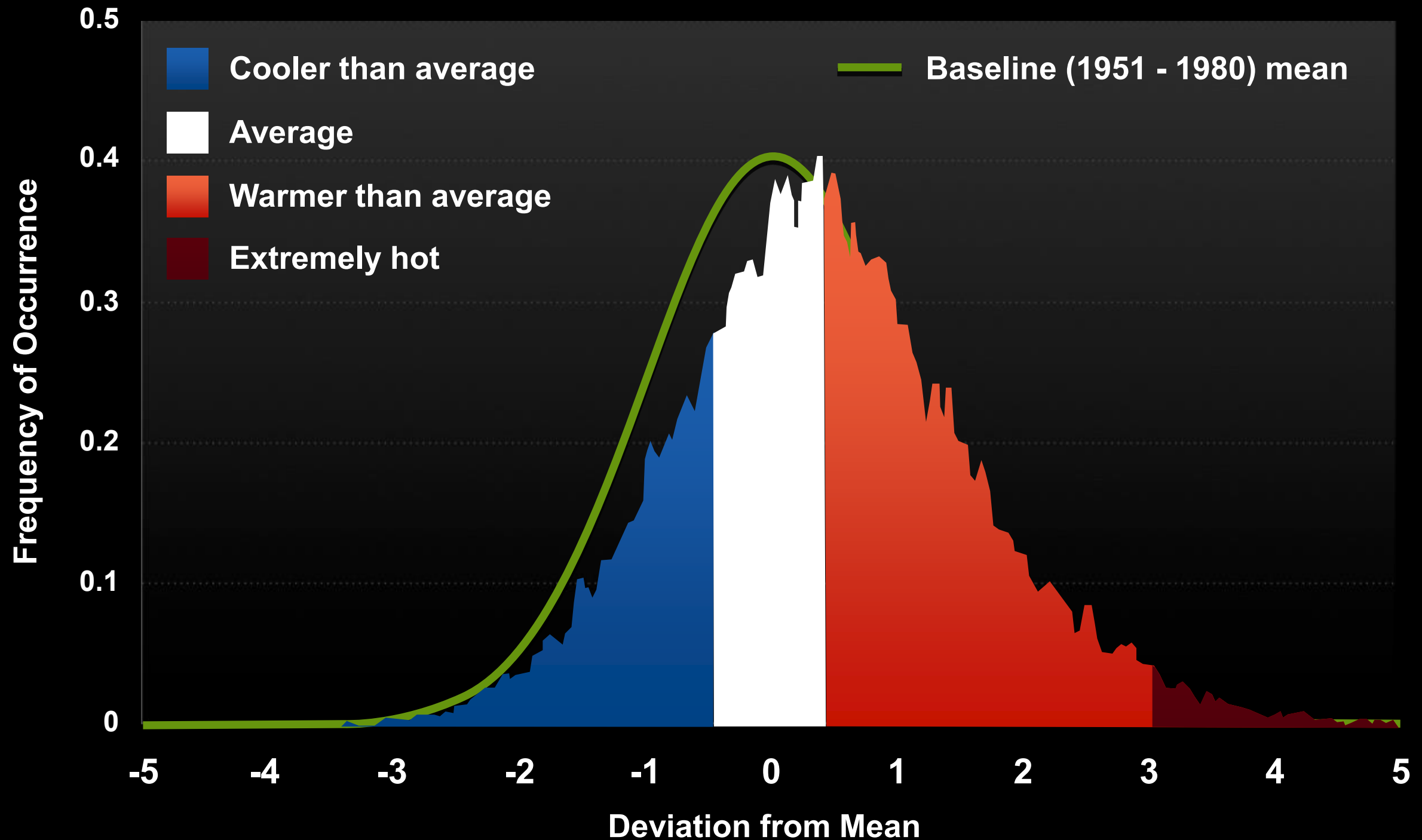
Summer Temperatures Have Shifted

1951 – 1980



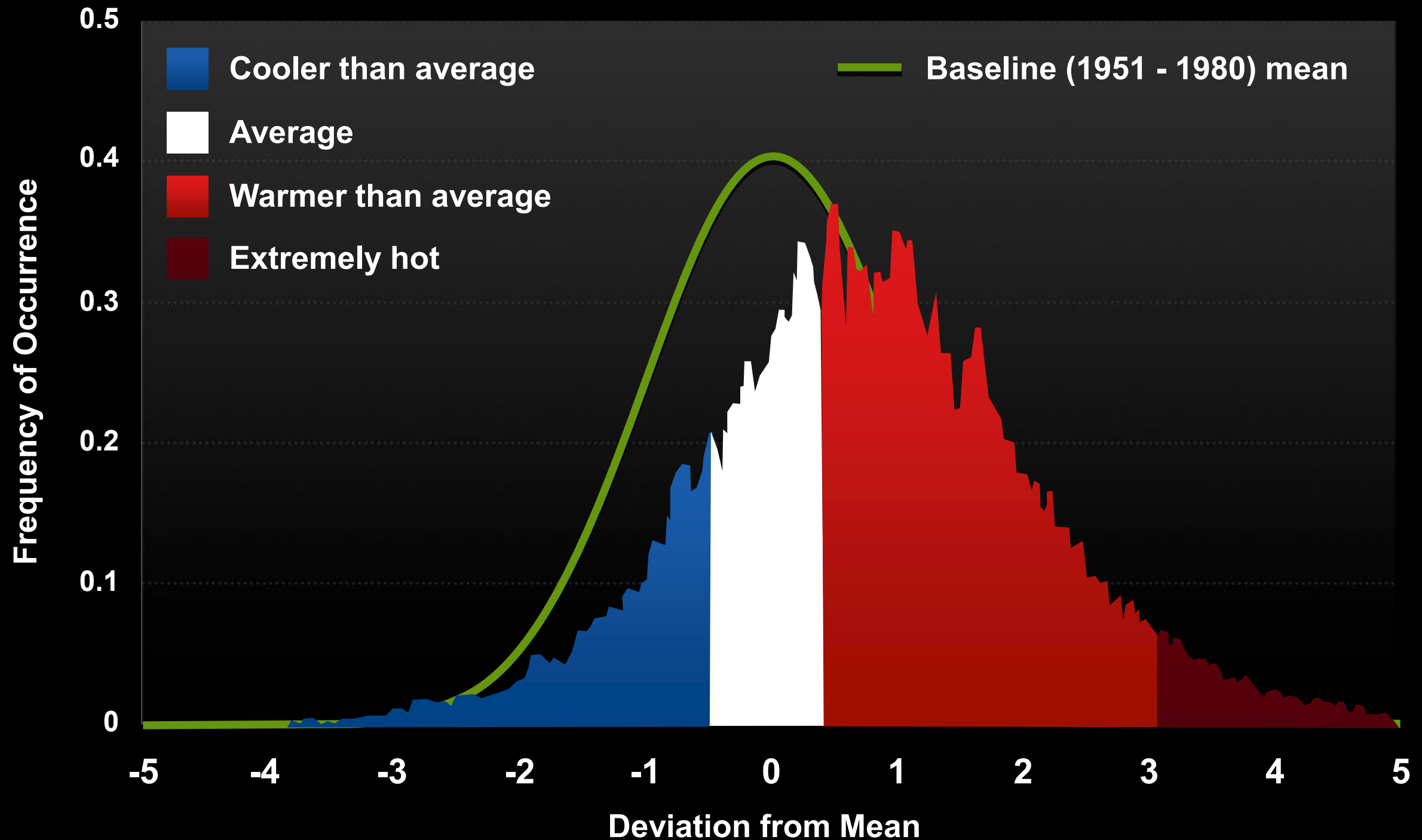
Summer Temperatures Have Shifted

1981 – 1991



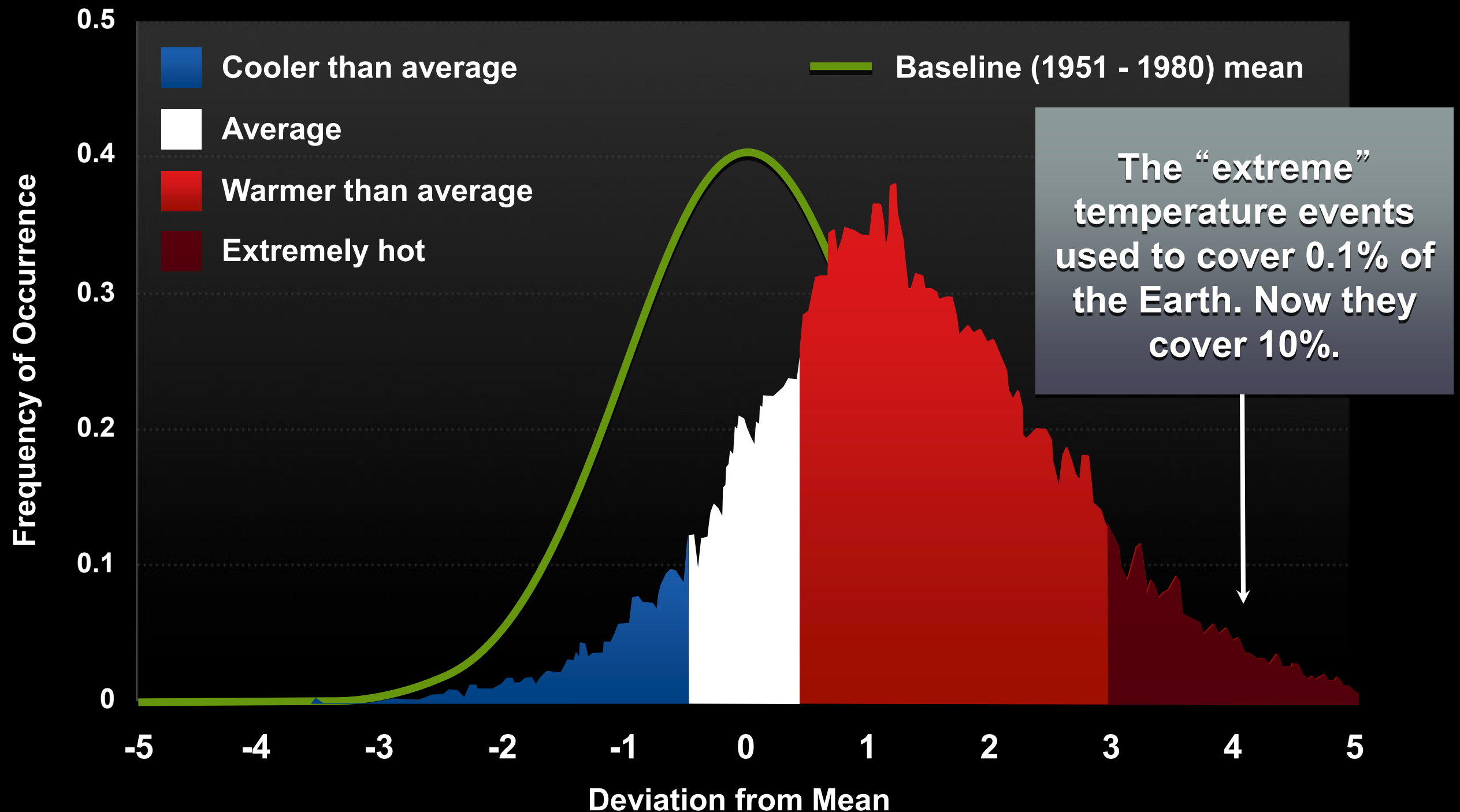
Summer Temperatures Have Shifted

1991 – 2001



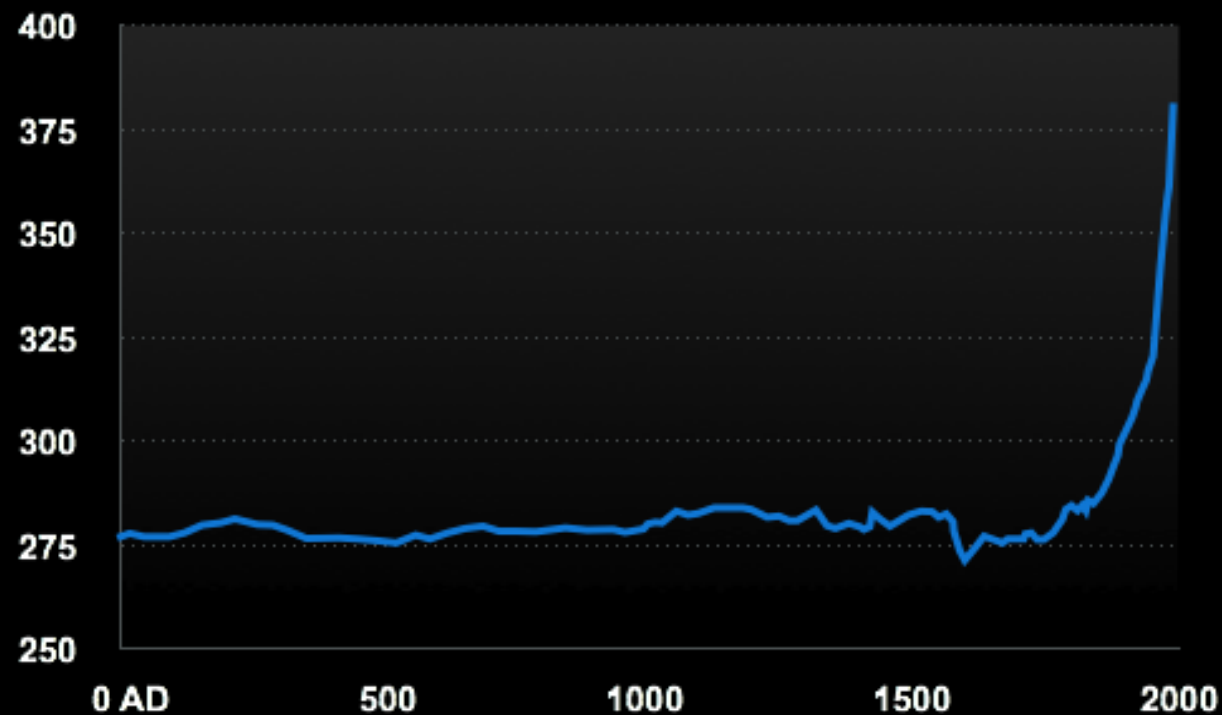
Summer Temperatures Have Shifted

2001 – 2011

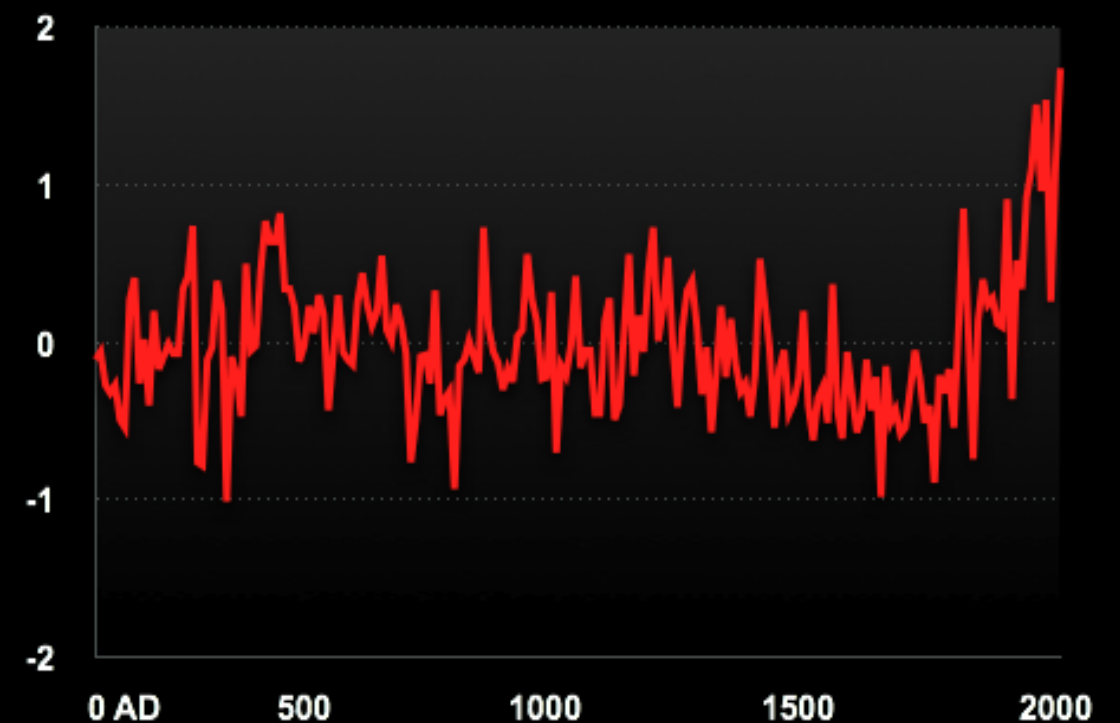


As CO₂ Increases, So Does the Temperature

CO₂ Concentration

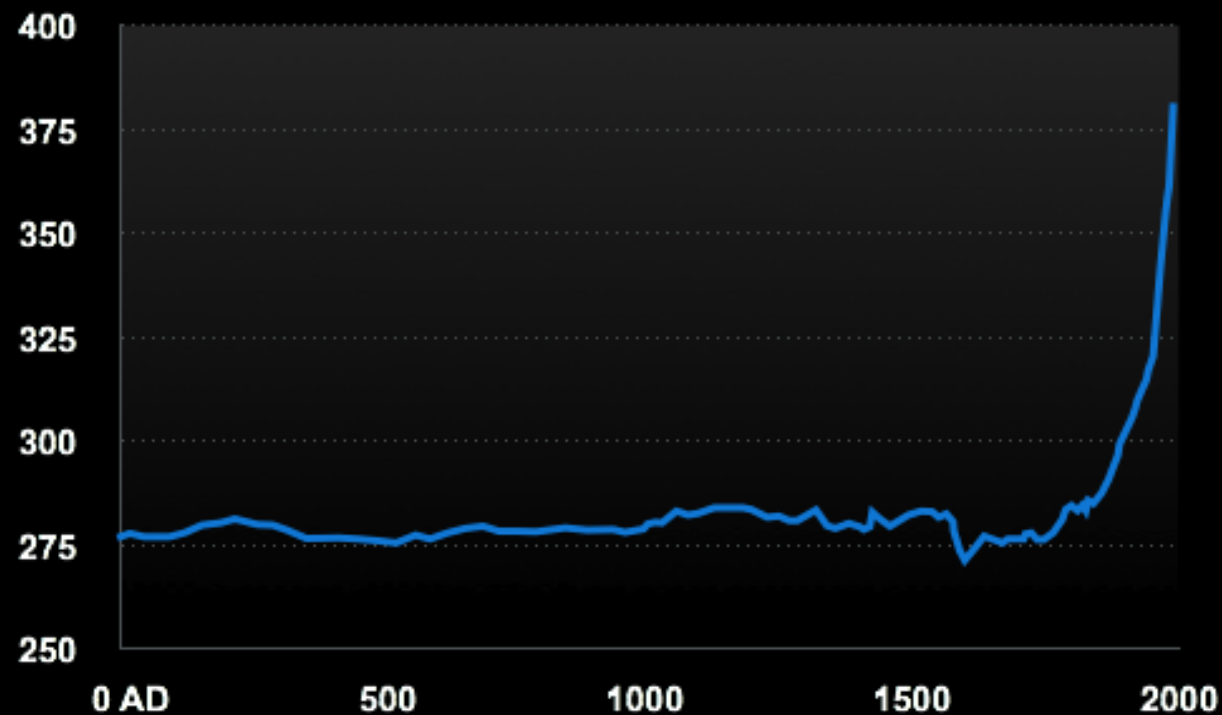


Temperature

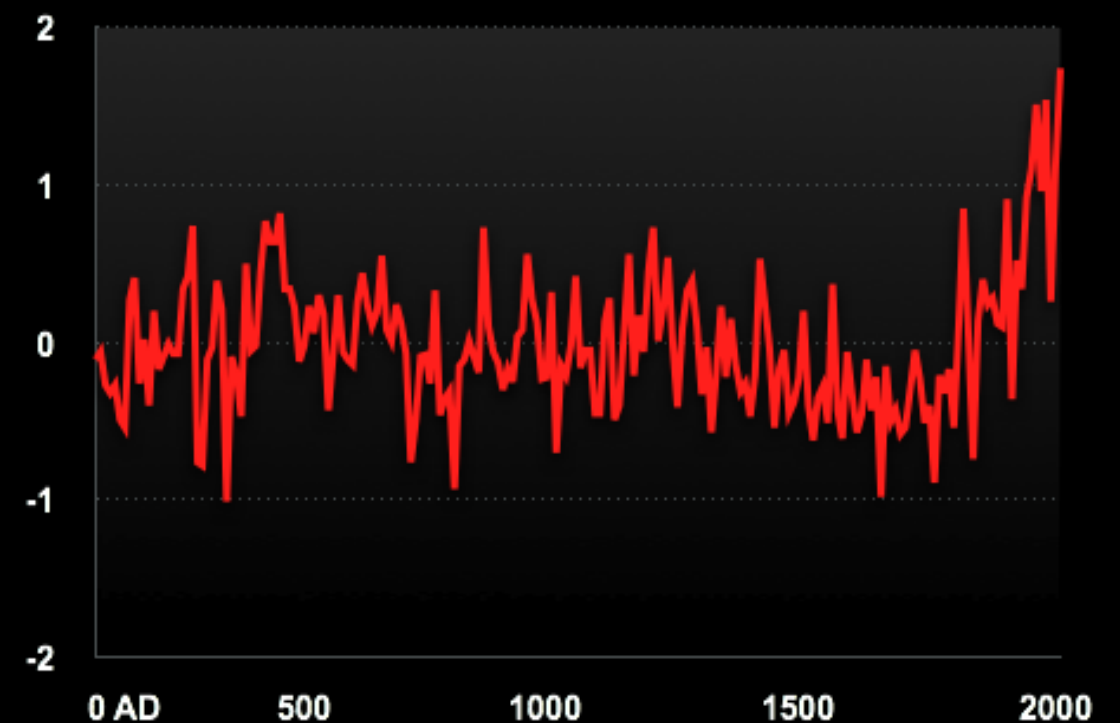


2000 Years of CO₂ and Global Temperature

CO₂ Concentration



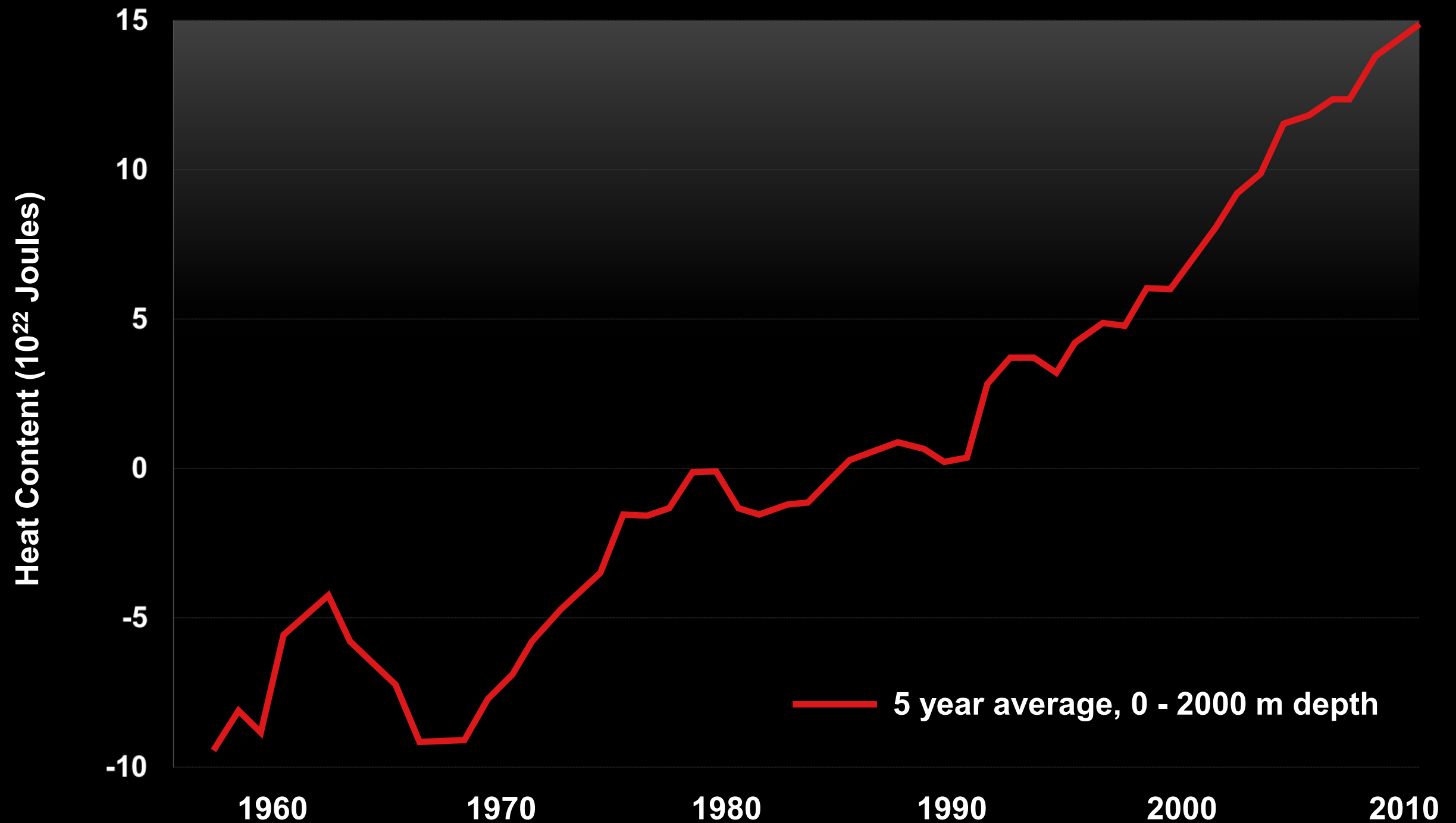
Temperature



Data: (Temperature) Thompson, et al., "Abrupt Tropical Climate Change: Past and Present," *Proc. Natl. Acad. Sci. USA*, vol. 103, no. 28 (CO₂) Australian Academy of Science; Etheridge, et al., "Law Dome CO₂, CH₄ and N₂O ice core records extended to 2000 years BP," *Geophys. Res. Lett.* 33, doi. 10.1029/2006GL026152, 2006. © 2006 American Geophysical Union. Reproduced/modified by permission of American Geophysical Union.

Global Ocean Heat Content

1955 – 2010

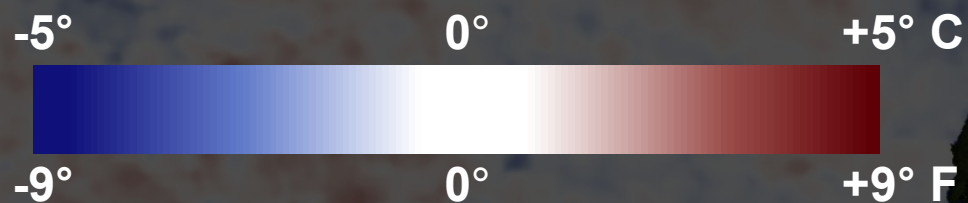


Data: NOAA/NESDIS/NODC Ocean Climate Laboratory, updated from Levitus, S., et al., "World ocean heat content and thermosteric sea level change (0-2000), 1955-2010," *Geophys. Res. Lett.* 39, doi:10.1029/2012GL051106, 2012.
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Sea Surface Temperature Anomaly

October 29, 2012

Temperatures Compared to
1981 – 2010 Average



Costliest Hurricanes to Hit the U.S.

Insured Losses in Billions

Hurricane	Year	Category	Deaths	Insured Losses	Total Losses
Katrina	2005	3	1,322	\$62.2 B	\$125.0 B
Ike	2008	2	170	18.5	38.3
Andrew	1992	5	62	17.0	26.5
Ivan	2004	3	125	13.8	23.0
Wilma	2005	3	42	12.5	22.0
Rita	2005	3	10	12.1	16.0
Charley	2004	4	36	8.0	18.0
Irene	2011	1	55	5.6	7.4
Frances	2004	2	50	5.5	12.0
Hugo	1989	4	116	5.1	9.6

Costliest Hurricanes to Hit the U.S.

Insured Losses in Billions

Hurricane	Year	Category	Deaths	Insured Losses	Total Losses
Katrina	2005	3	1,322	\$62.2 B	\$125.0 B
Sandy	2012	1	117 (in U.S.)	\$35.0	70.0
Andrew	1992	5	62	17.0	26.5
Ivan	2004	3	125	13.8	23.0
Wilma	2005	3	42	12.5	22.0
Rita	2005	3	10	12.1	16.0
Charley	2004	4	36	8.0	18.0
Irene	2011	1	55	5.6	7.4
Frances	2004	2	50	5.5	12.0
Hugo	1989	4	116	5.1	9.6

**As temperatures increase, the oceans
evaporate more moisture into the sky**

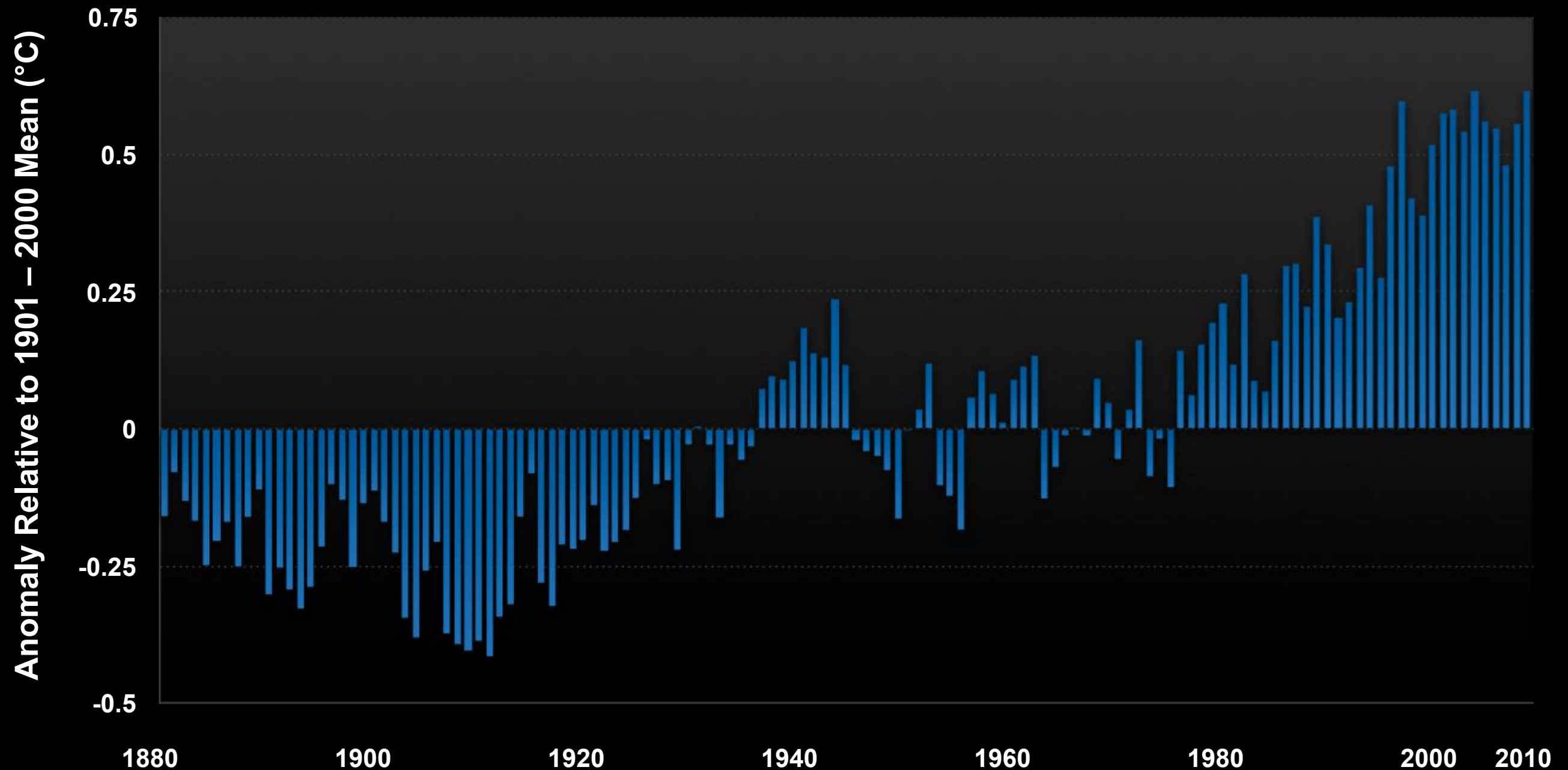
Warmer air can
hold
a lot more water vapor

**There is already 4% more water
vapor over the oceans than there
was only 30 years ago**

With each additional 1° (C) of temperature, the atmosphere's capacity to hold water vapor increases by 7%

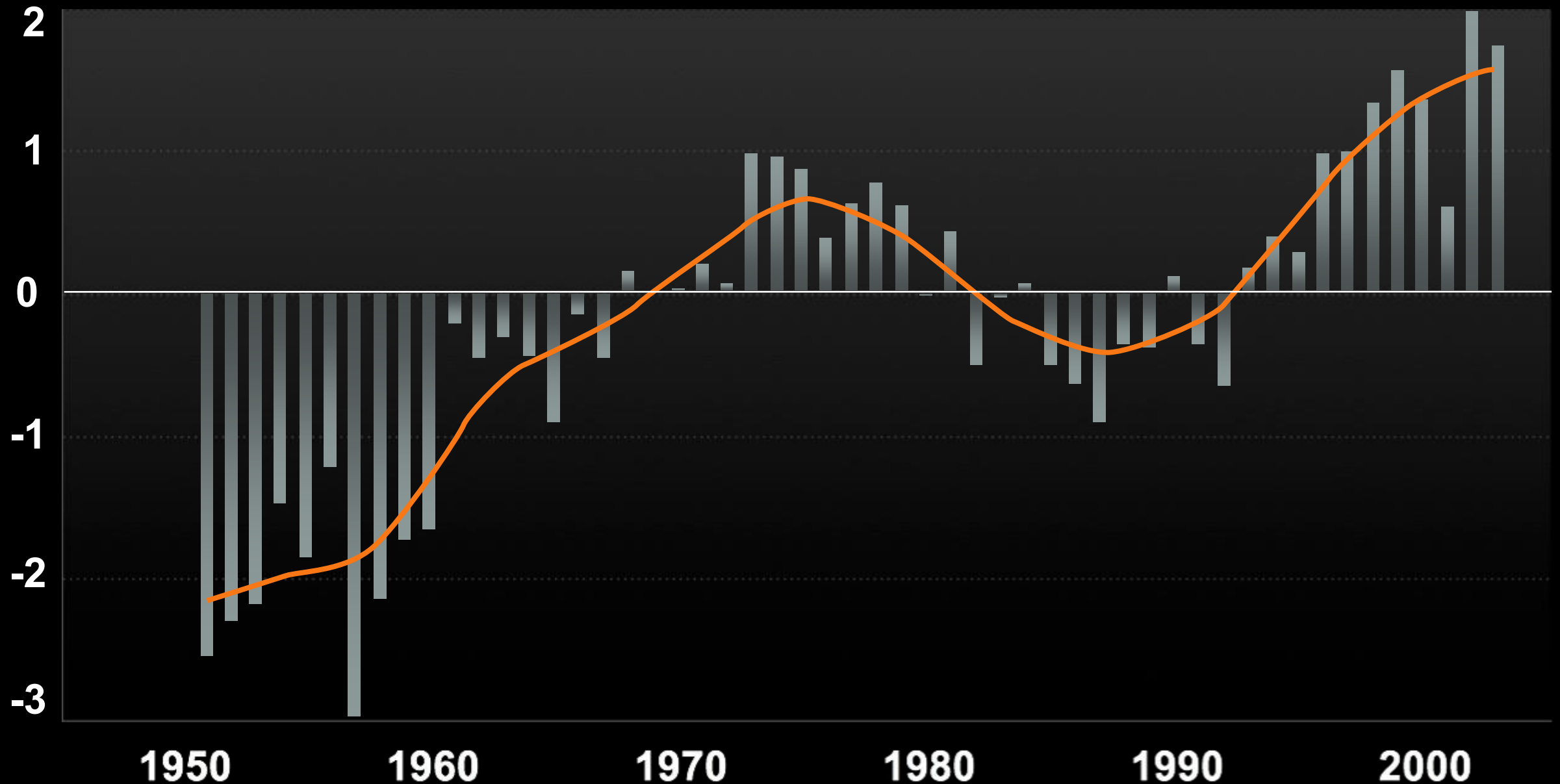
Change in Annual Global Temperature

1880 – 2010



Increase in Heavy Precipitation Days

Worldwide





**Causing bigger
and more frequent
FLOODS**

**So the rainstorms
(and snowstorms)
are getting
bigger
and
more intense**

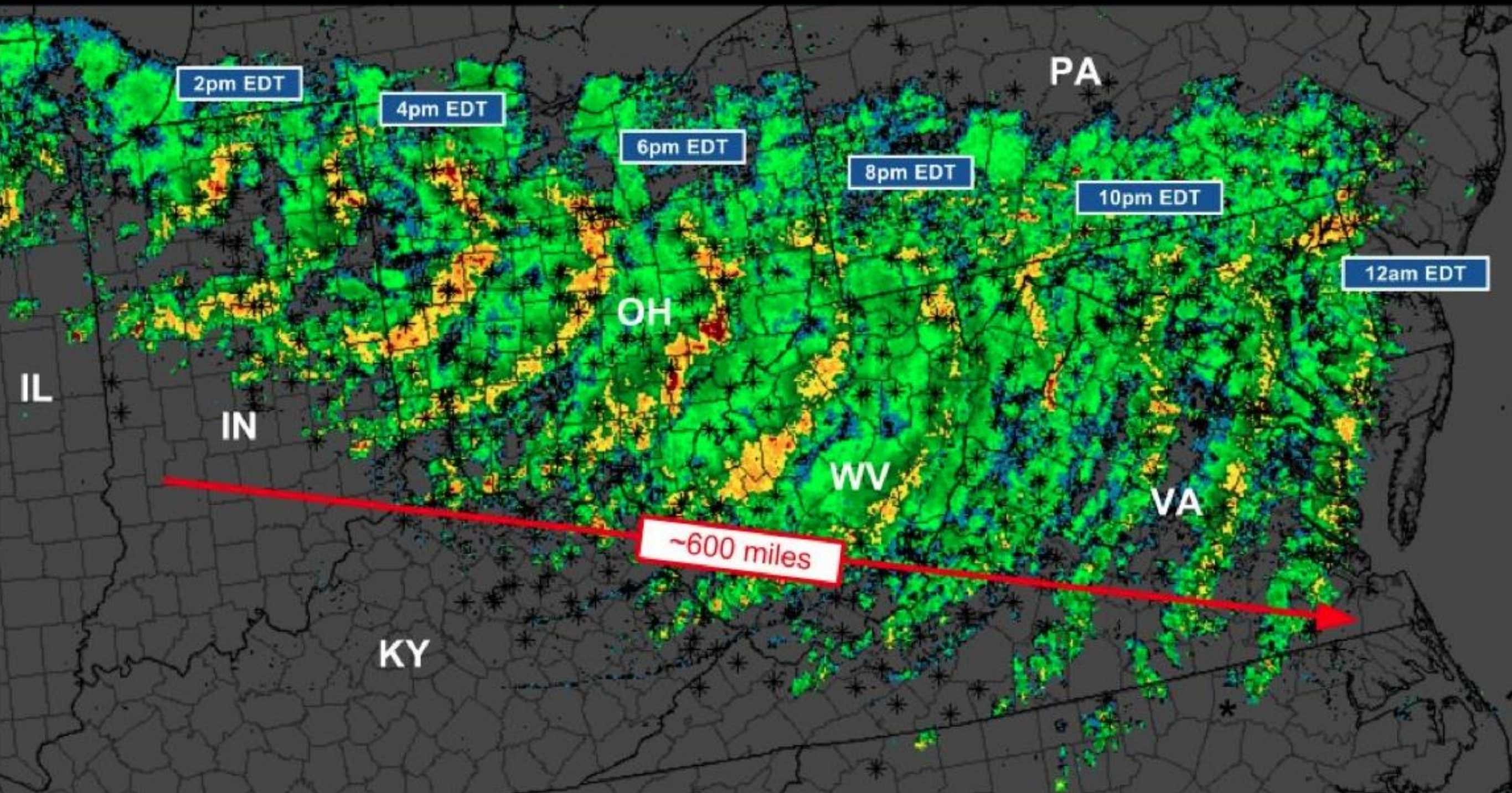
Chicago, Illinois

June 29, 2012



Midwest to East Coast Derecho

June 29, 2012



**As global temperatures
continue to increase,
the Earth's water cycle
intensifies even more**

Causing Bigger, Harder Downpours, and Simultaneously— Causing Longer and Deeper DROUGHTS

1

Evaporation from the ocean into the atmosphere increases even **MORE**

2

As the air gets even warmer, it can hold even **MORE** water vapor

3

Heavy downpours get even heavier, causing worse flooding

4

Snowpacks melt earlier in the year, leading to more spring flooding, but less water in the heat of summer

5

There are longer intervals in drought-stricken areas between downpours, making droughts **EVEN WORSE**

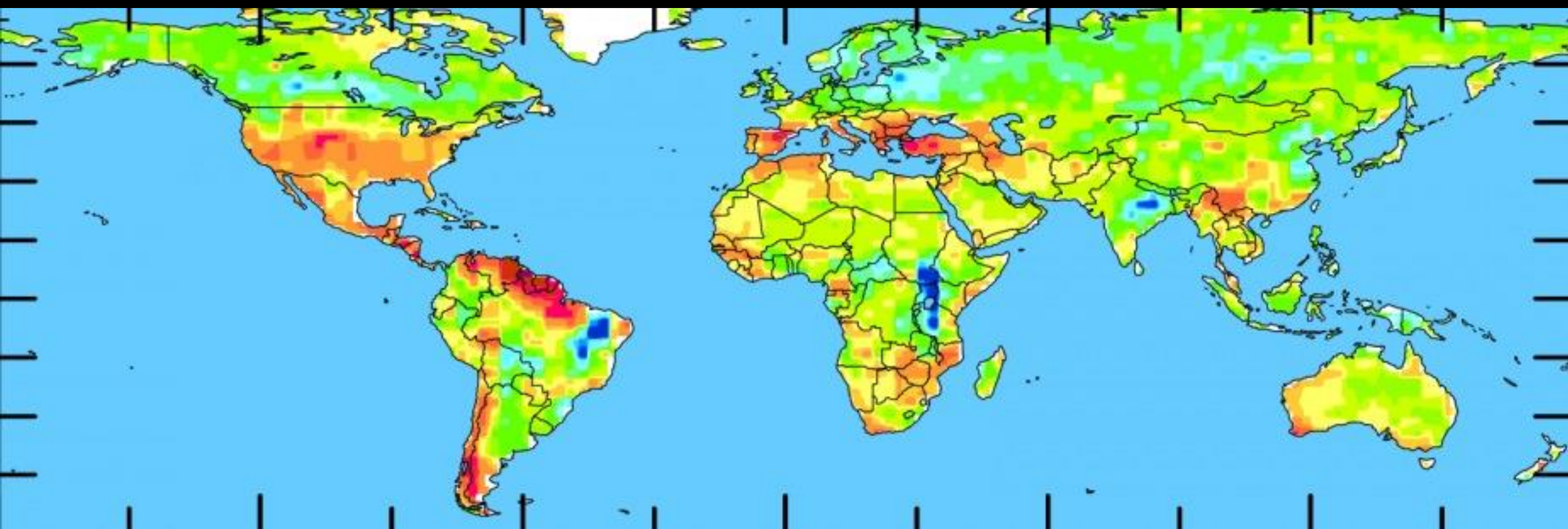
6

More water also evaporates **MORE QUICKLY** from the soil, making **DROUGHTS** deeper and longer still



Drought Conditions

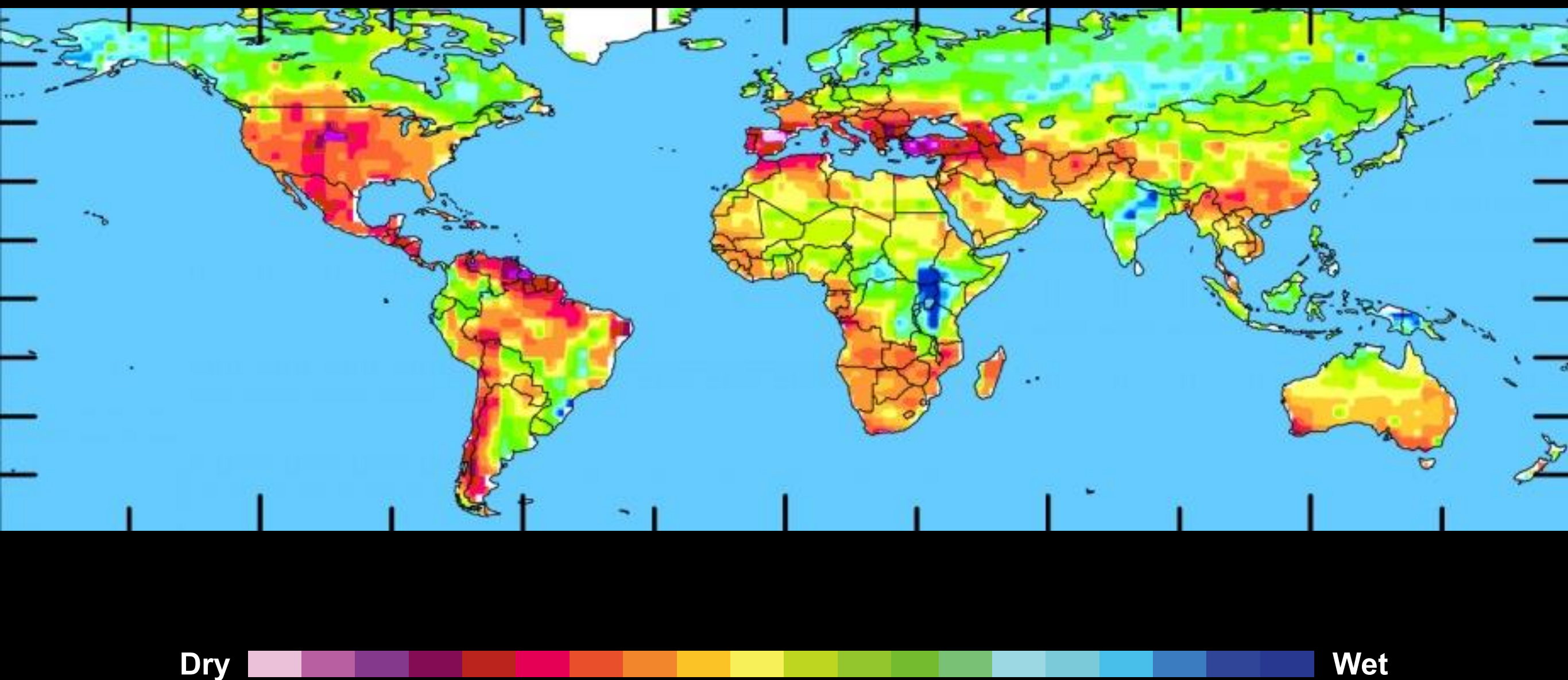
2000 – 2009



Dry  Wet

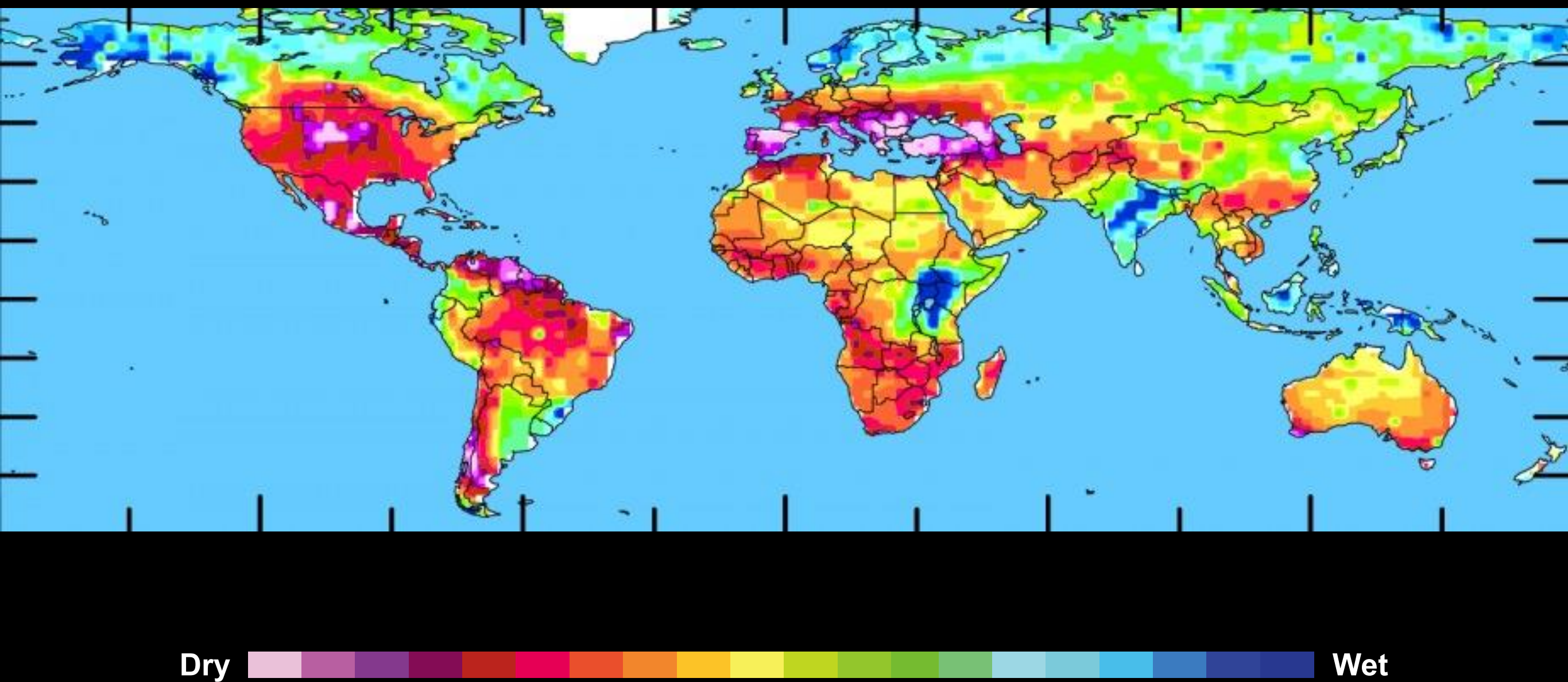
Drought Conditions

2030 – 2039



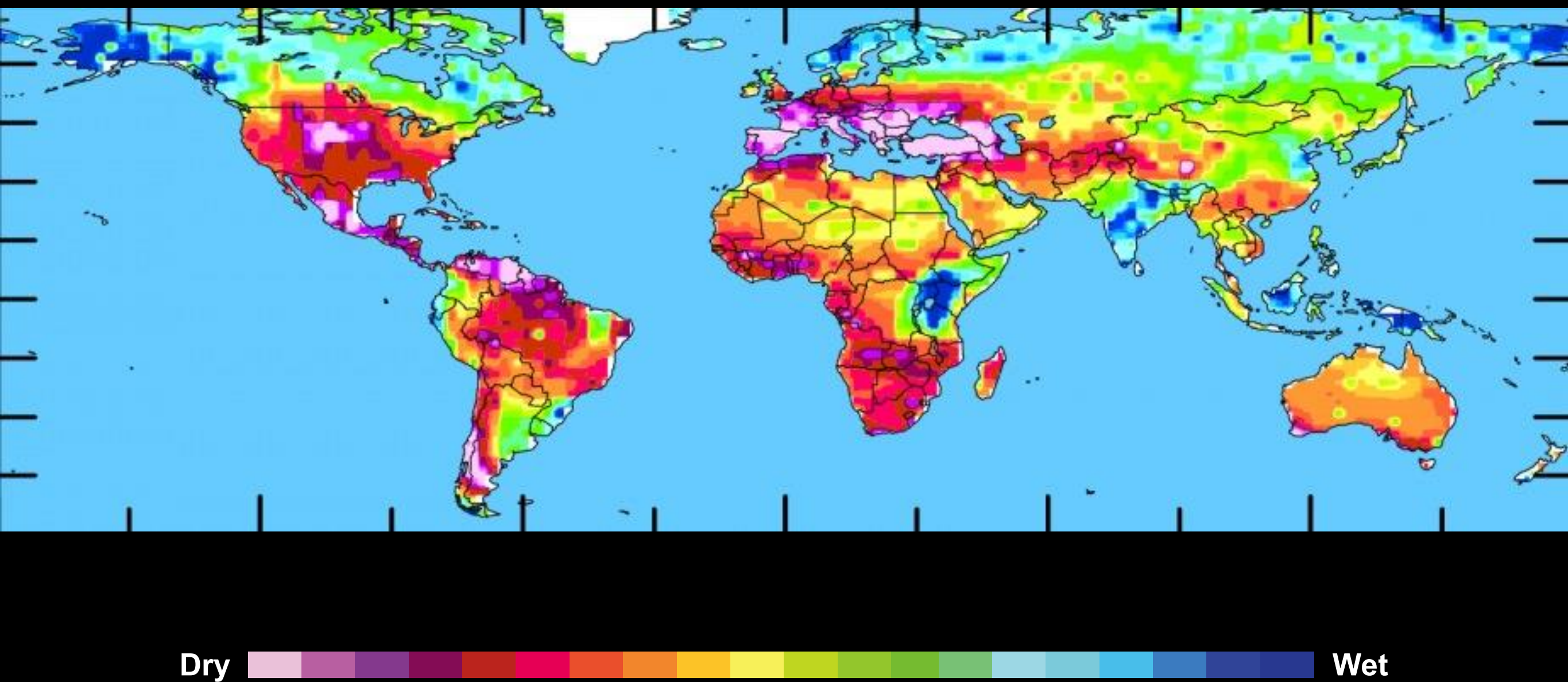
Drought Conditions

2060 – 2069



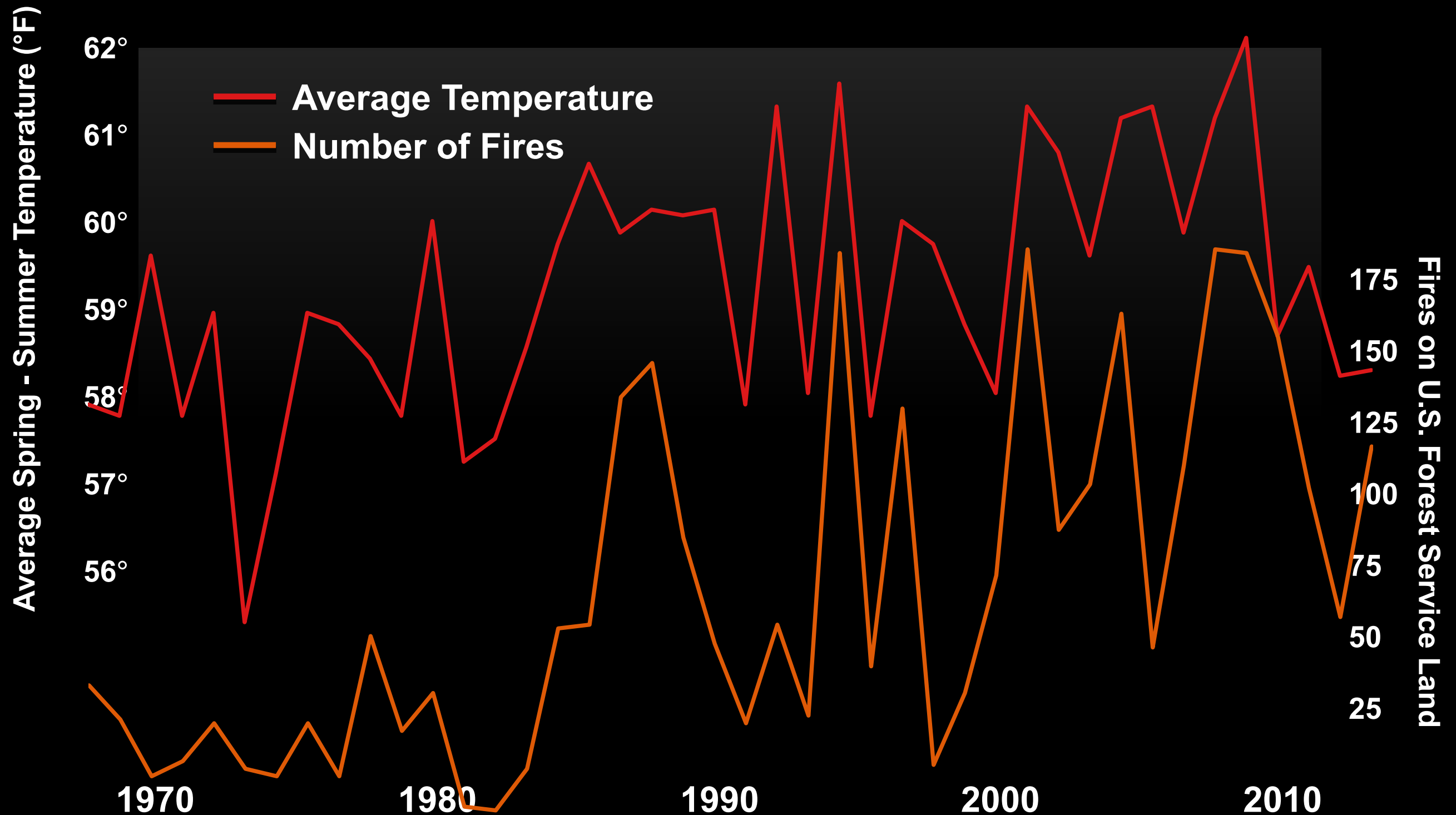
Drought Conditions

2090 – 2099



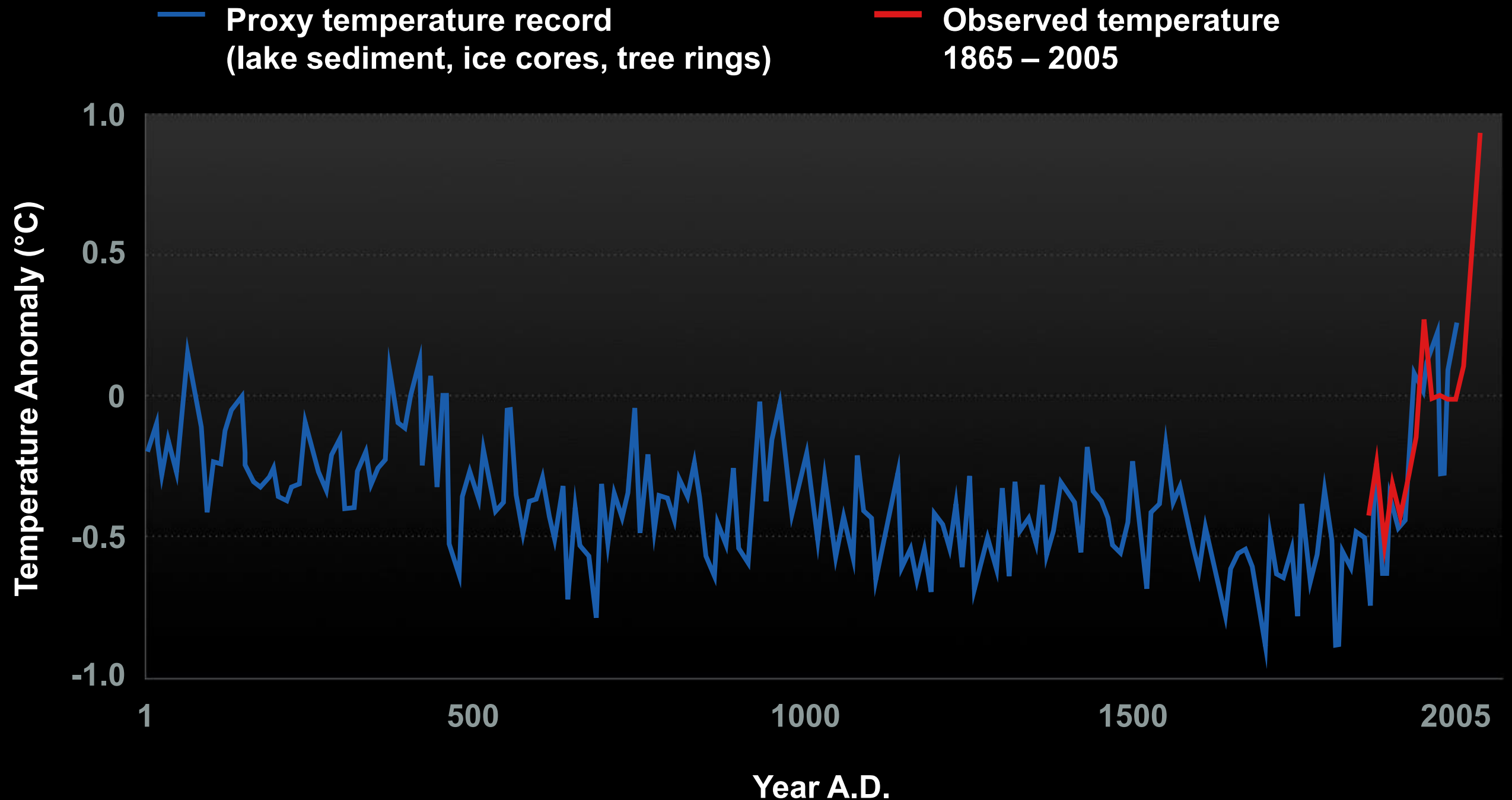
Hotter Years Typically Have More Fires

40 Years of Western U.S. Fire and Temperatures



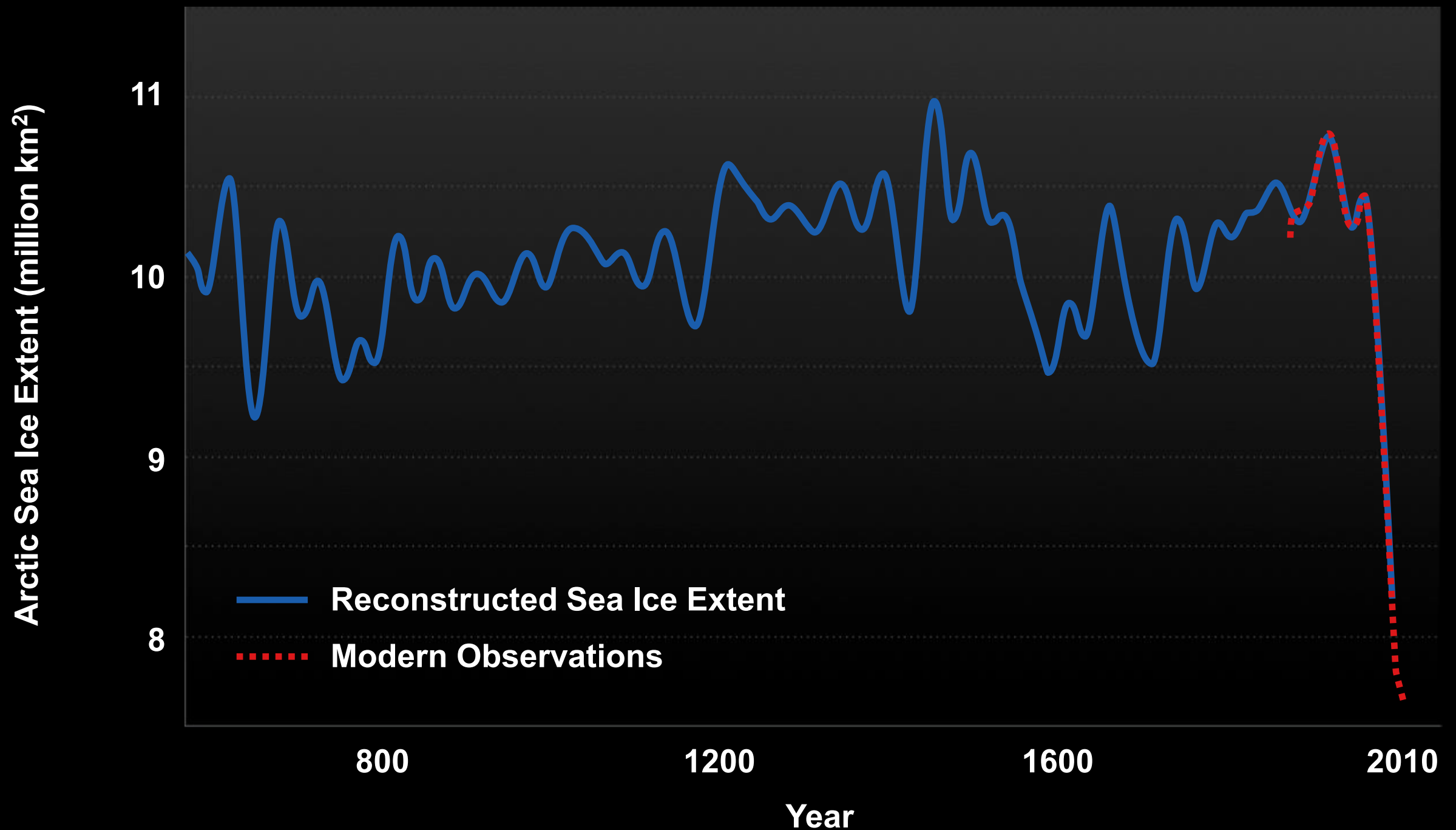
2000 Years of Arctic Temperatures

~ 1 A.D. – 2005 A.D.



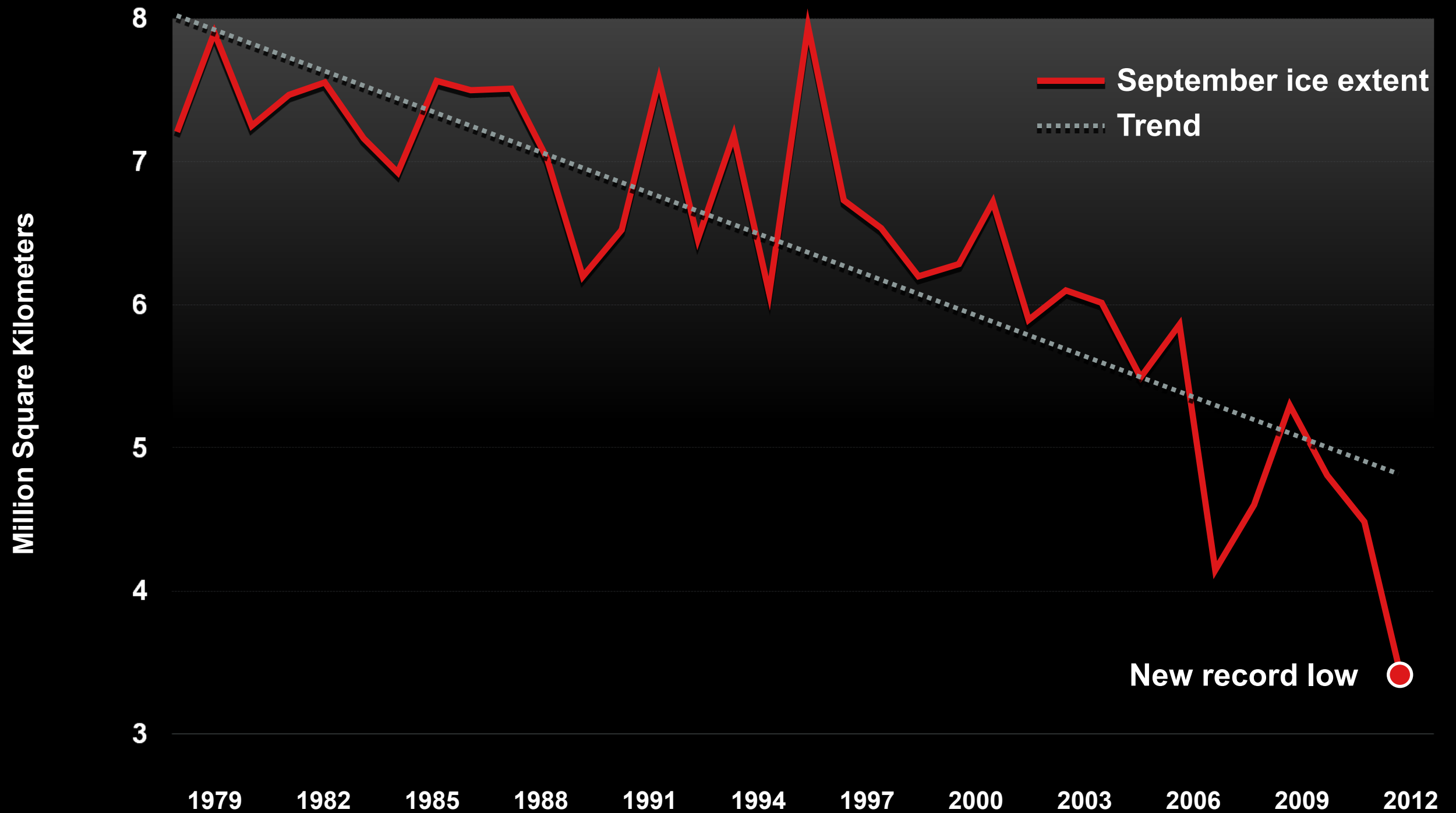
Arctic Sea Ice Extent

550 A.D. to Present



September Arctic Sea Ice Extent

1979 – 2012



Arctic Sea Ice Extent

September 1984

Russia

Greenland

Alaska
(U.S.A)

Canada

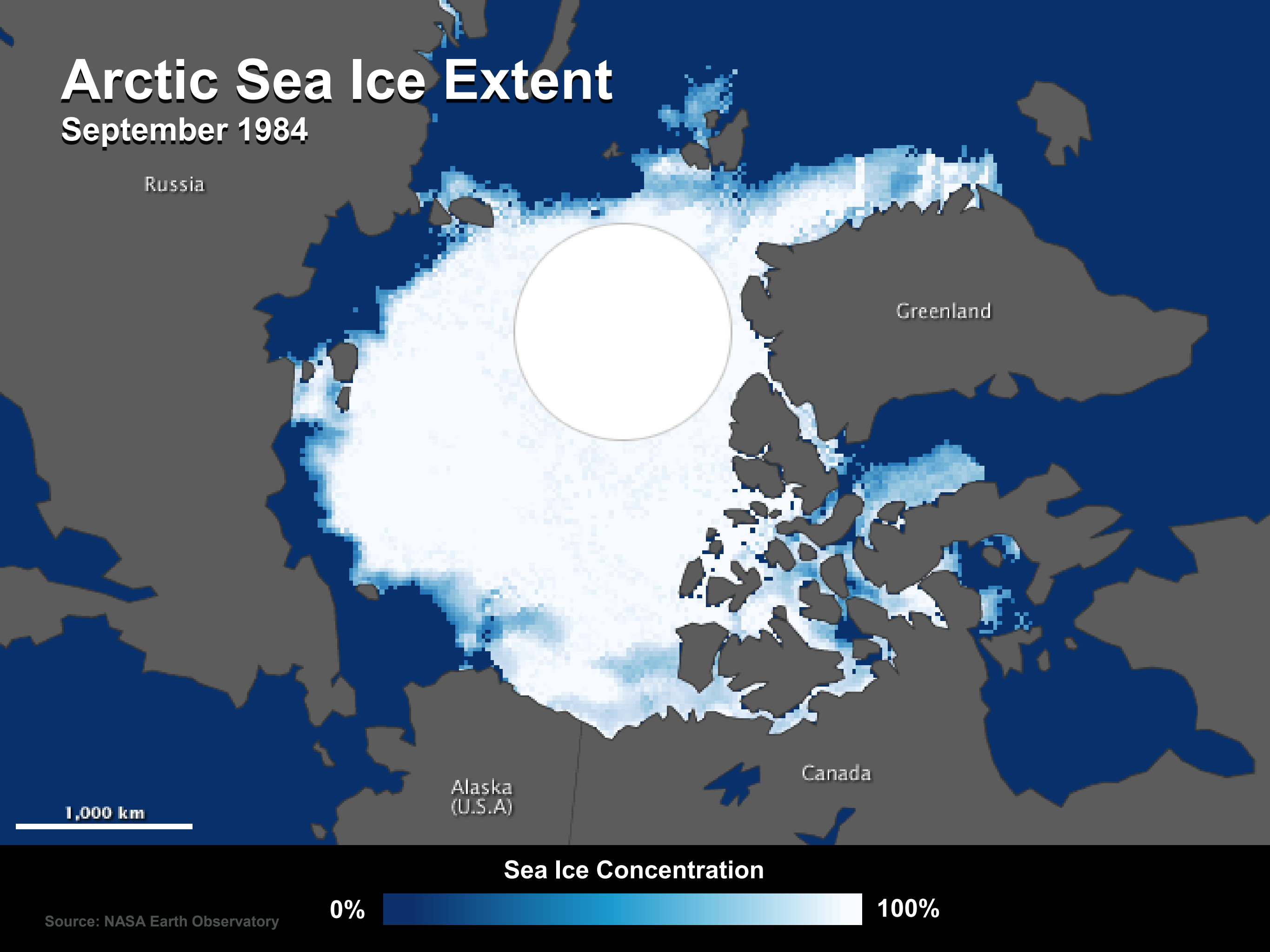
1,000 km

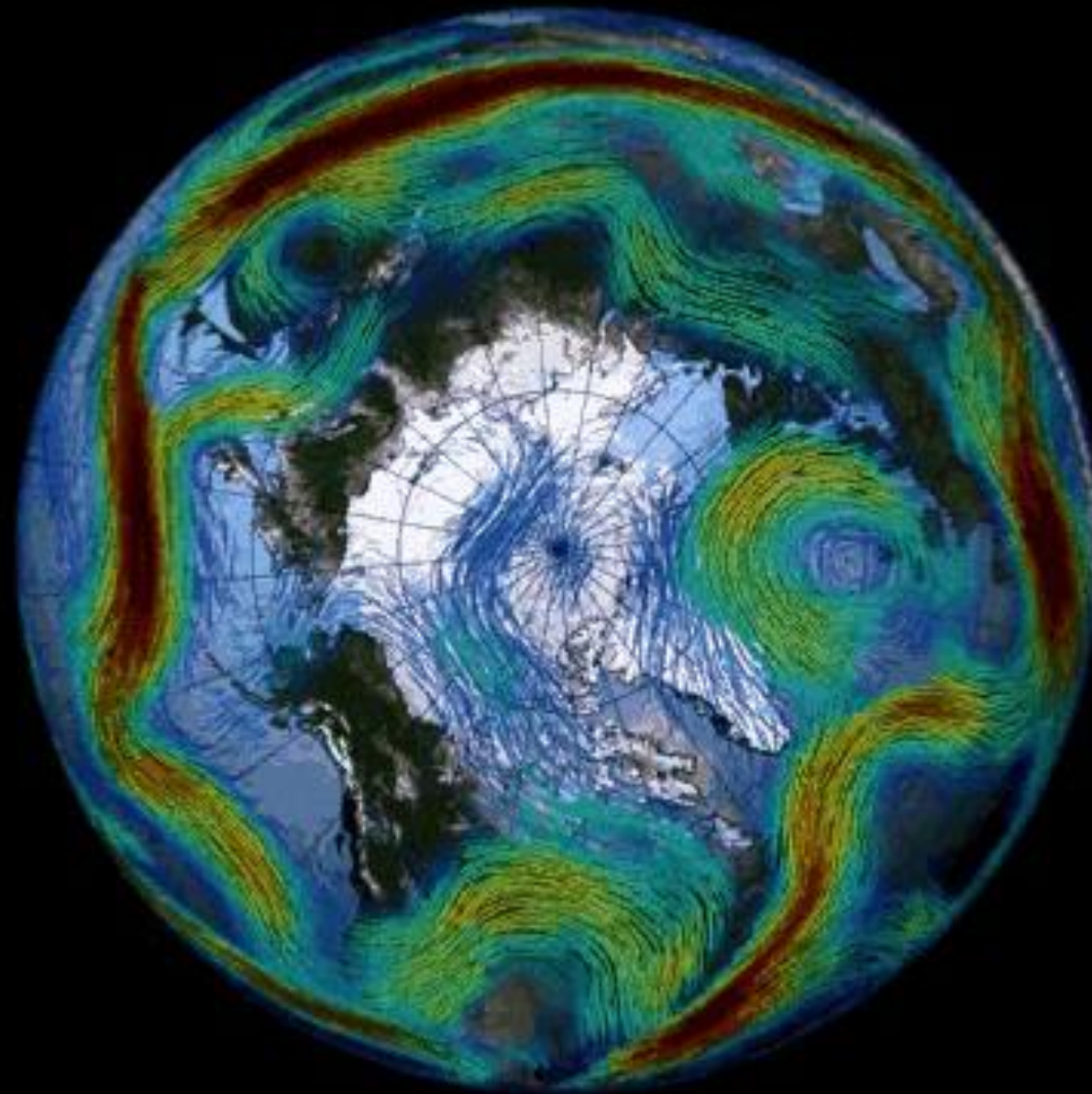
Sea Ice Concentration

0%

100%

Source: NASA Earth Observatory





The jet stream is becoming “wavier”

Steeper troughs and higher ridges mean weather systems progress more slowly, raising the chances for long-duration extreme events, like droughts, floods, and heat waves.