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# Climate Change in Illinois

Dr. Jim Angel, former State Climatologist for Illinois

facebook



Meteorologist Jacob Dickey

6m · 🌐



There's an Armadillo on the run in Catlin! David Harold messaged me and said state biologists came out last night and said he was healthy.

Armadillos are not common this far north, but occasional sightings have been in recent years have been in Southern Illinois and the Ozark.



# Introduction

- My background
- Logistics
  - Powerpoints will be uploaded to the Box folder and available for anyone
  - At around 30 minutes, there will be a pause for questions about material already covered
  - At the end of the lecture, there will be plenty of time for additional questions

# Overview of the course

- The focus will be on Illinois with limited discussion about national issues
- **Week 1: Overview of current trends and future projections for Illinois.**
- Week 2: Impacts on agriculture.
- Week 3: Impacts on water resources.
- Week 4: Impacts on health

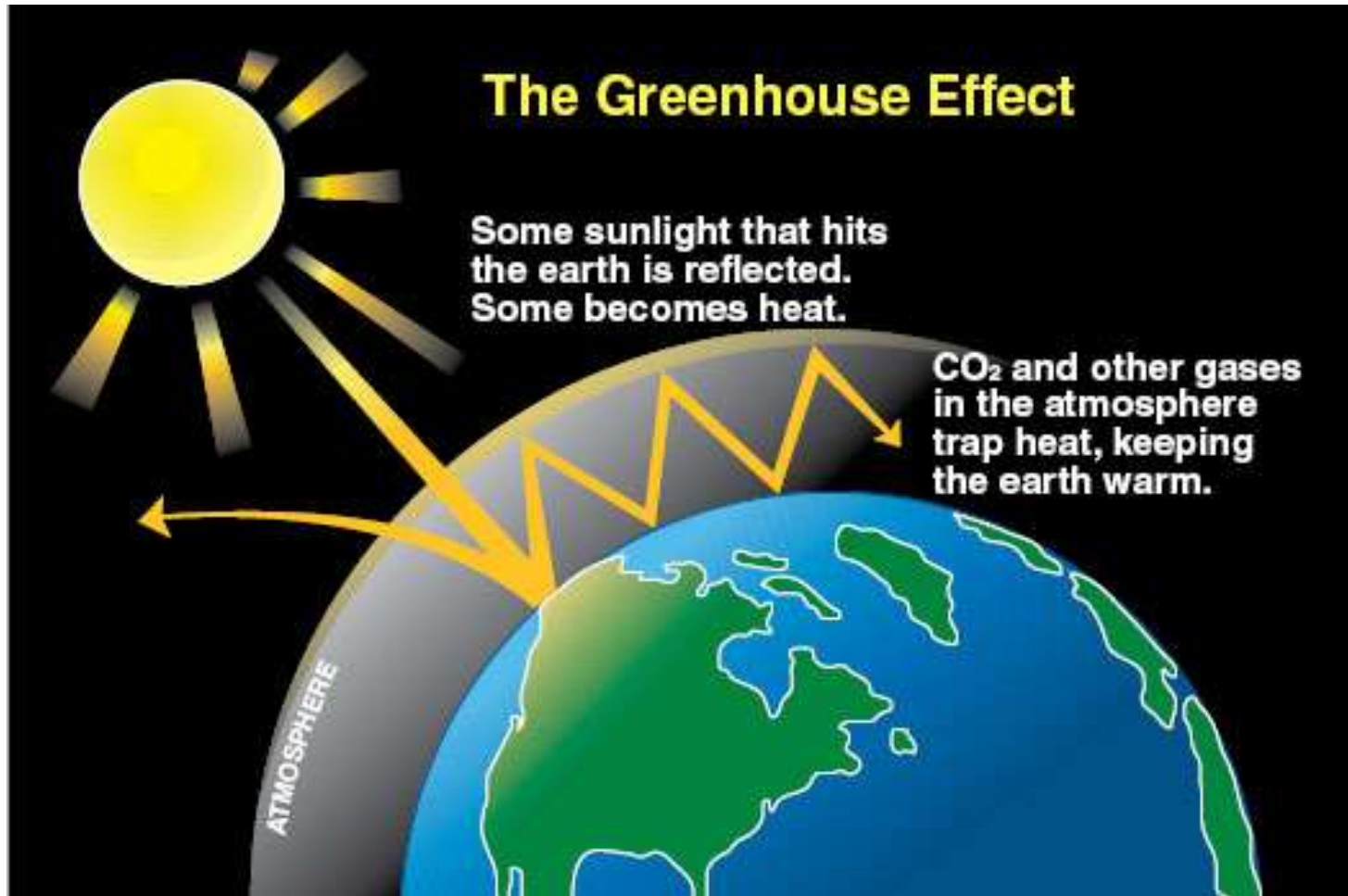
# Climate and Weather

- Weather is the conditions in the atmosphere over a short time
- Climate is how the atmosphere behaves over long periods of time
- “climate is what you expect, and weather is what you get”

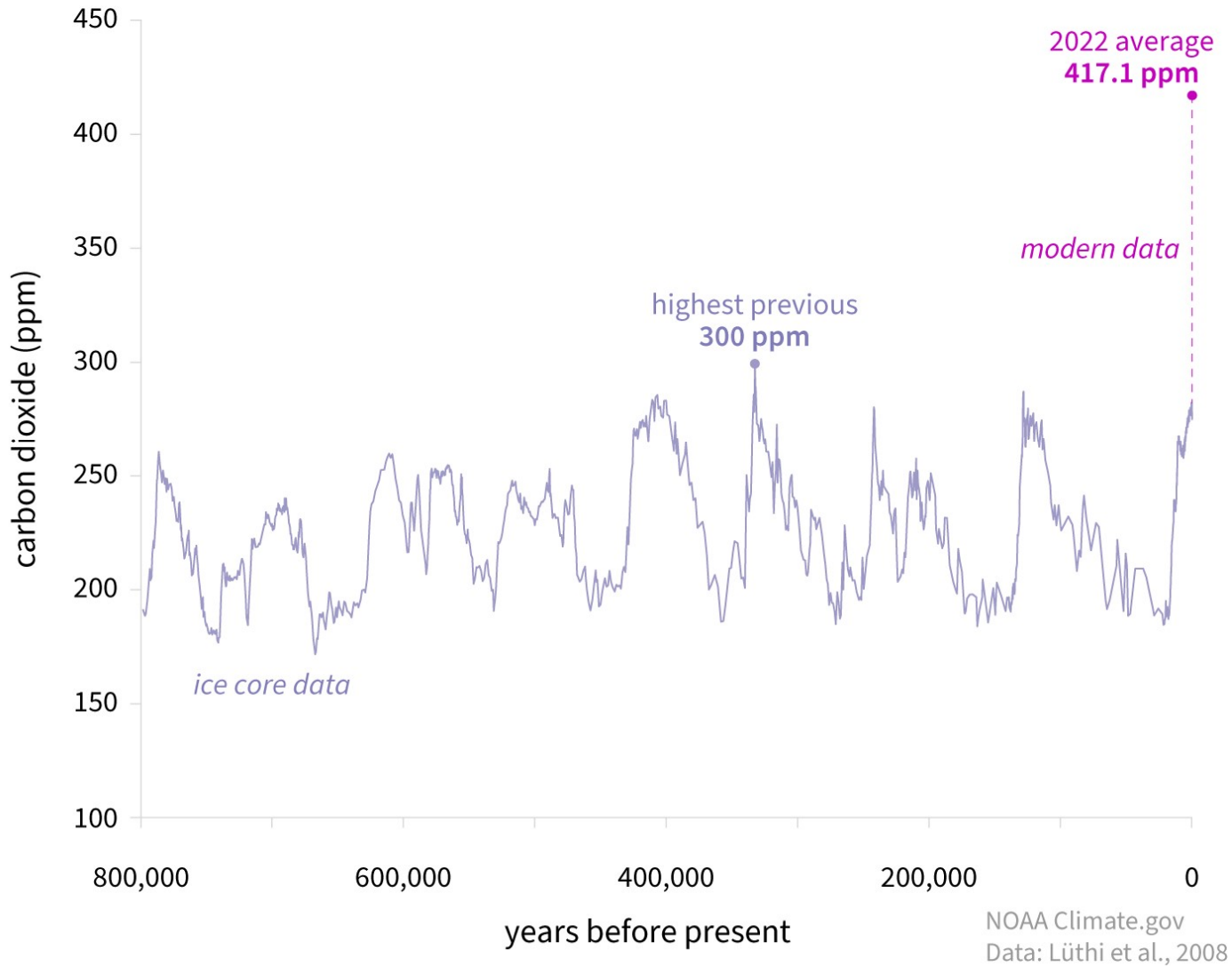
## The Greenhouse Effect

Some sunlight that hits the earth is reflected. Some becomes heat.

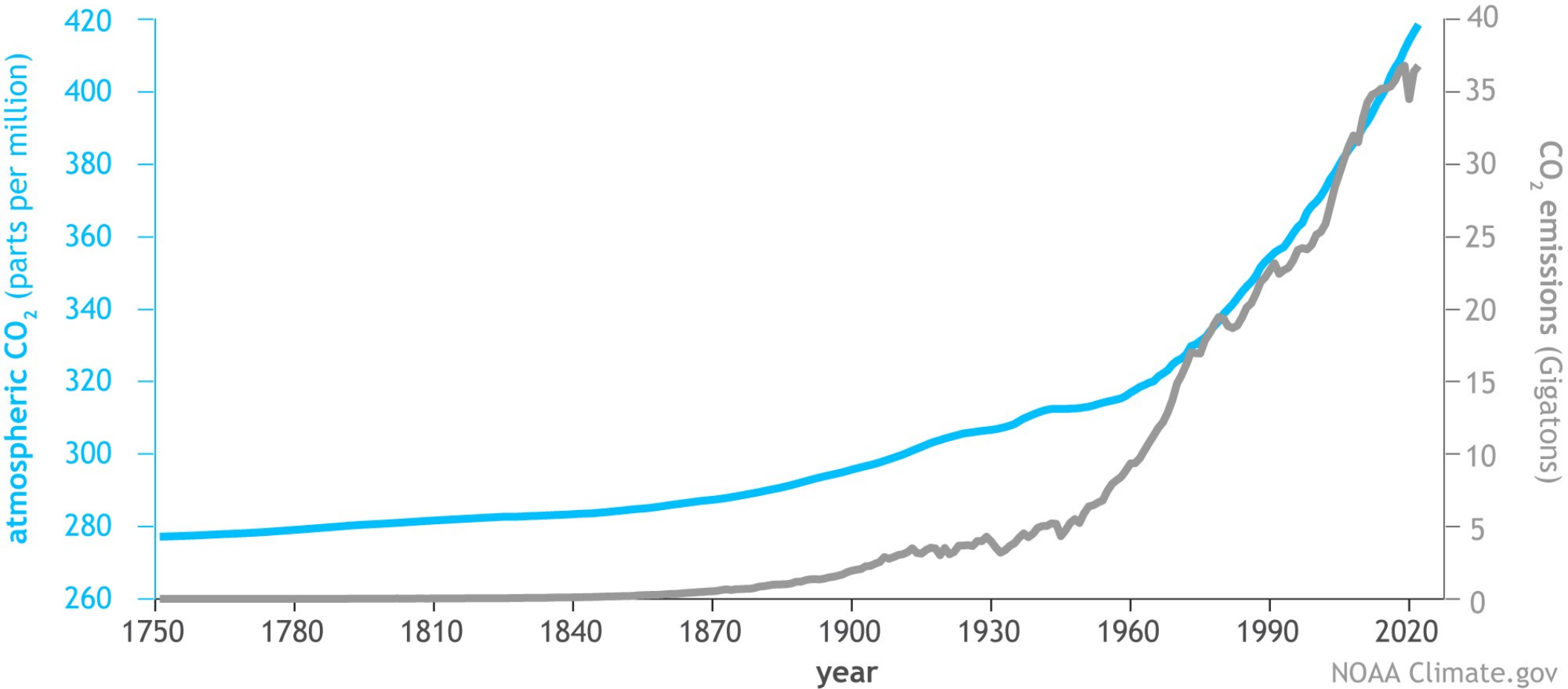
CO<sub>2</sub> and other gases in the atmosphere trap heat, keeping the earth warm.



# CARBON DIOXIDE OVER 800,000 YEARS



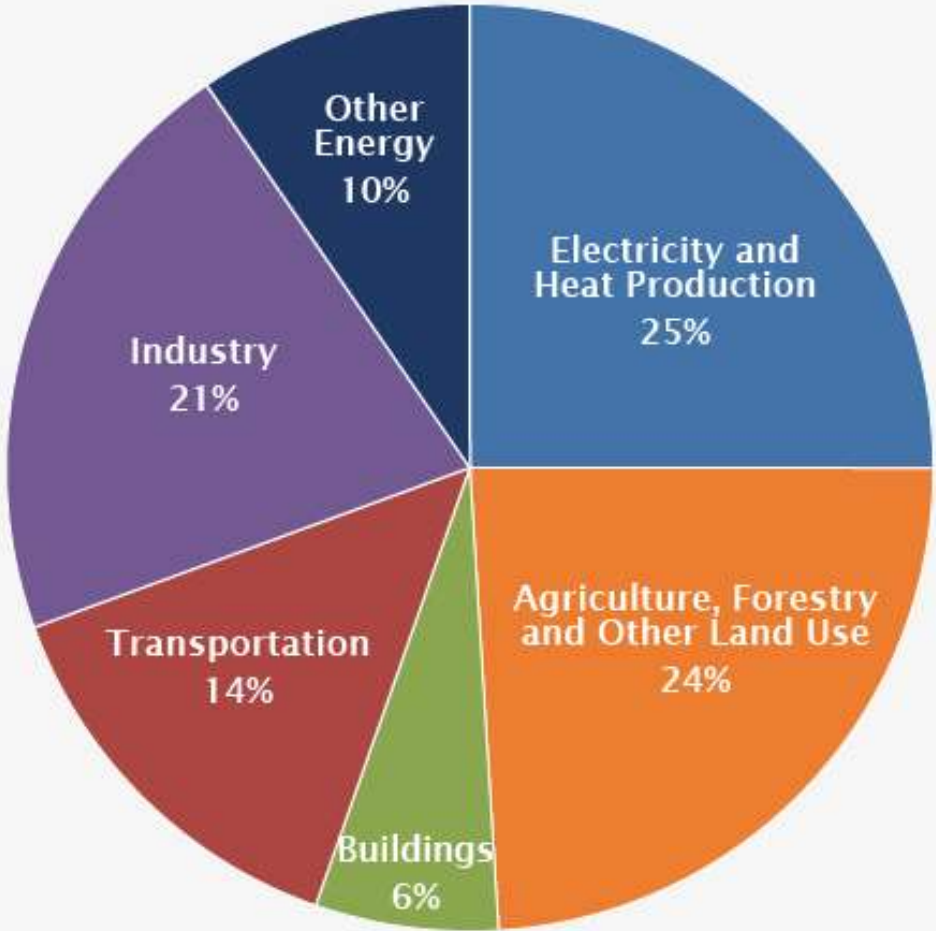
Global atmospheric carbon dioxide compared to annual emissions (1751-2022)



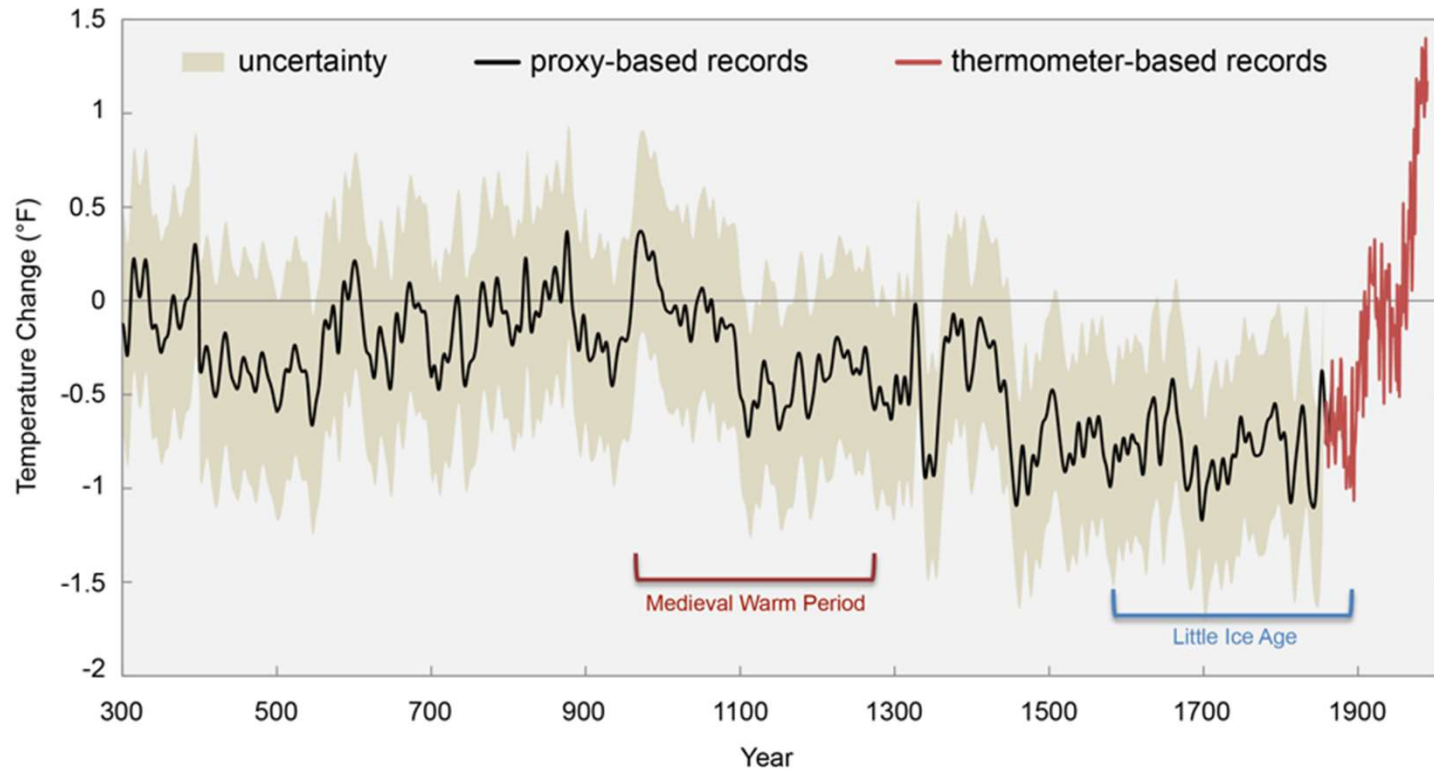
NOAA Climate.gov  
Data: NOAA, ETHZ, Our World in Data



# Global Greenhouse Gas Emissions by Economic Sector

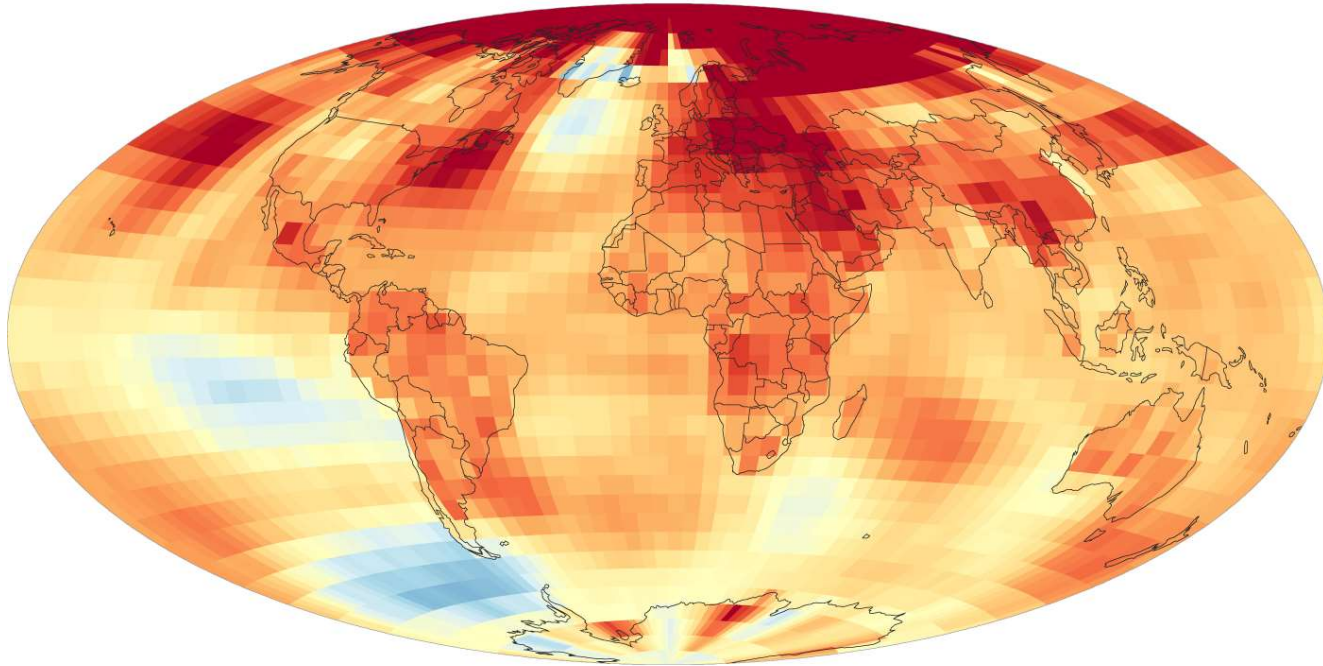


## 1700 Years of Global Temperature Change from Proxy Data




Studies of past climates suggest that current global temperatures were *likely* last observed during the Eemian period—the last interglacial—125,000 years ago.

1994-2023



Change in temperature ( $^{\circ}\text{F}/\text{decade}$ )

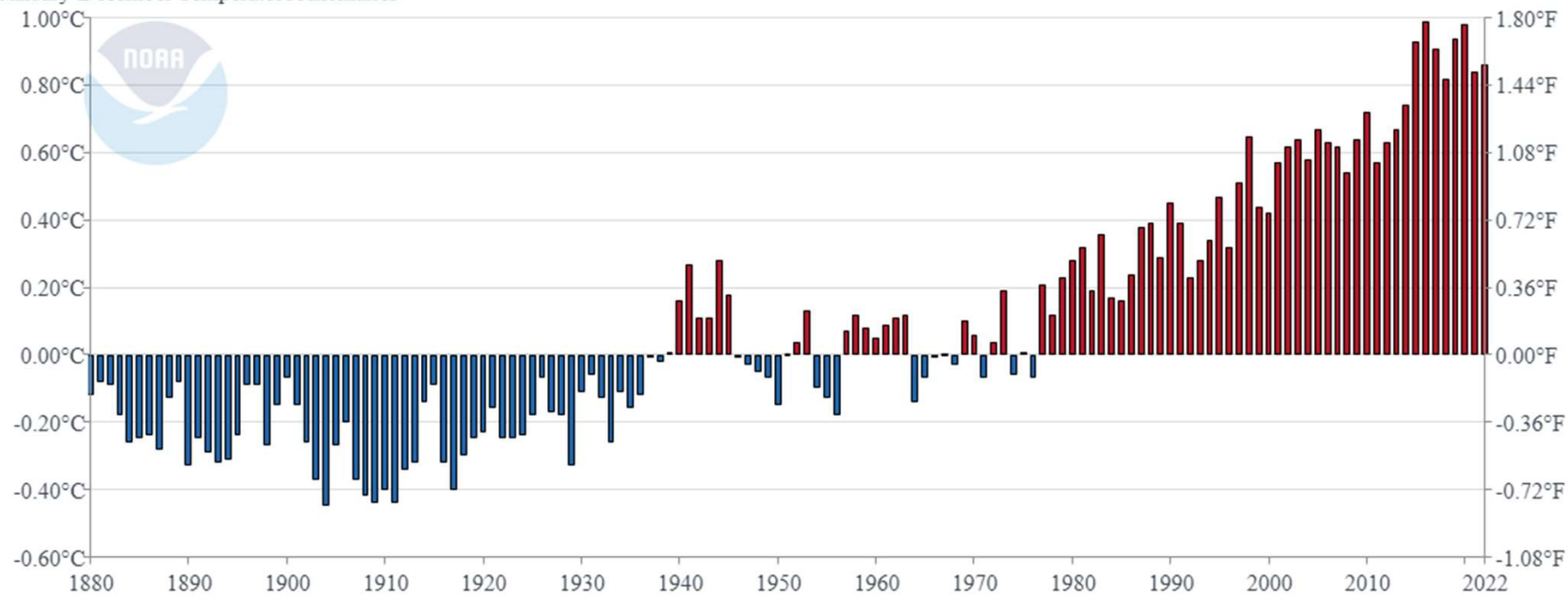


-1                      0                      1

NOAA Climate.gov  
Data: NCEI

## Global Land and Ocean

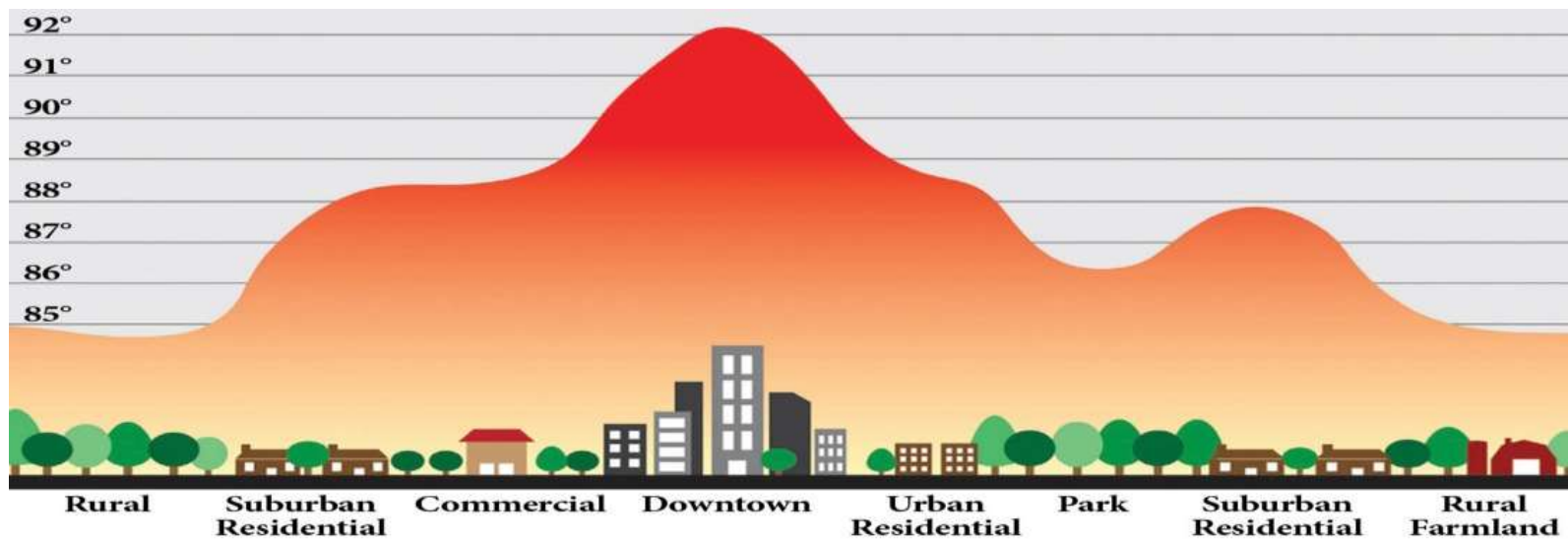
January-December Temperature Anomalies



# Changes in Land Use

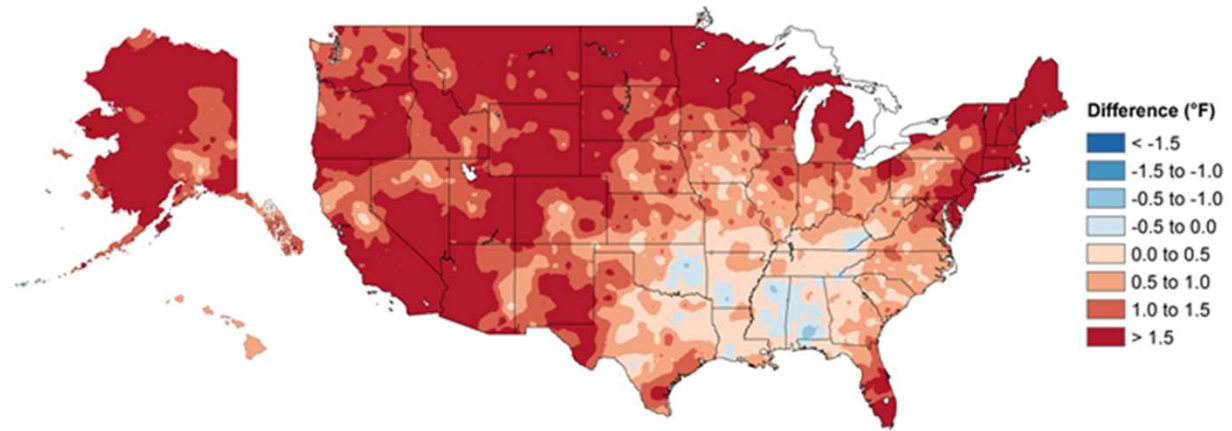


# Urban Heat & Flooding

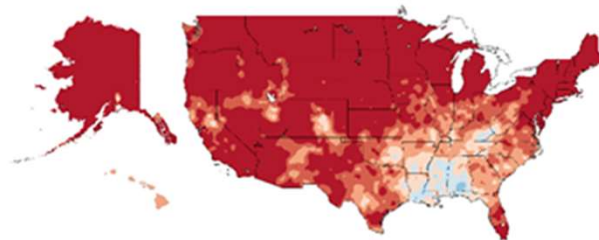


Observed  
changes in  
mean  
temperatures,  
1901-1960 vs  
1986-2016

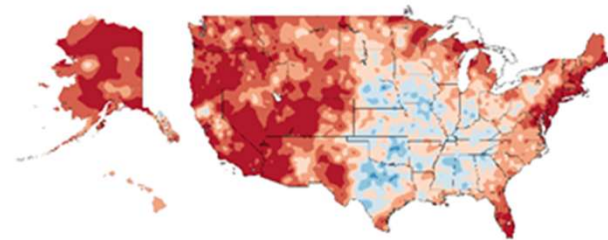
### Annual Temperature



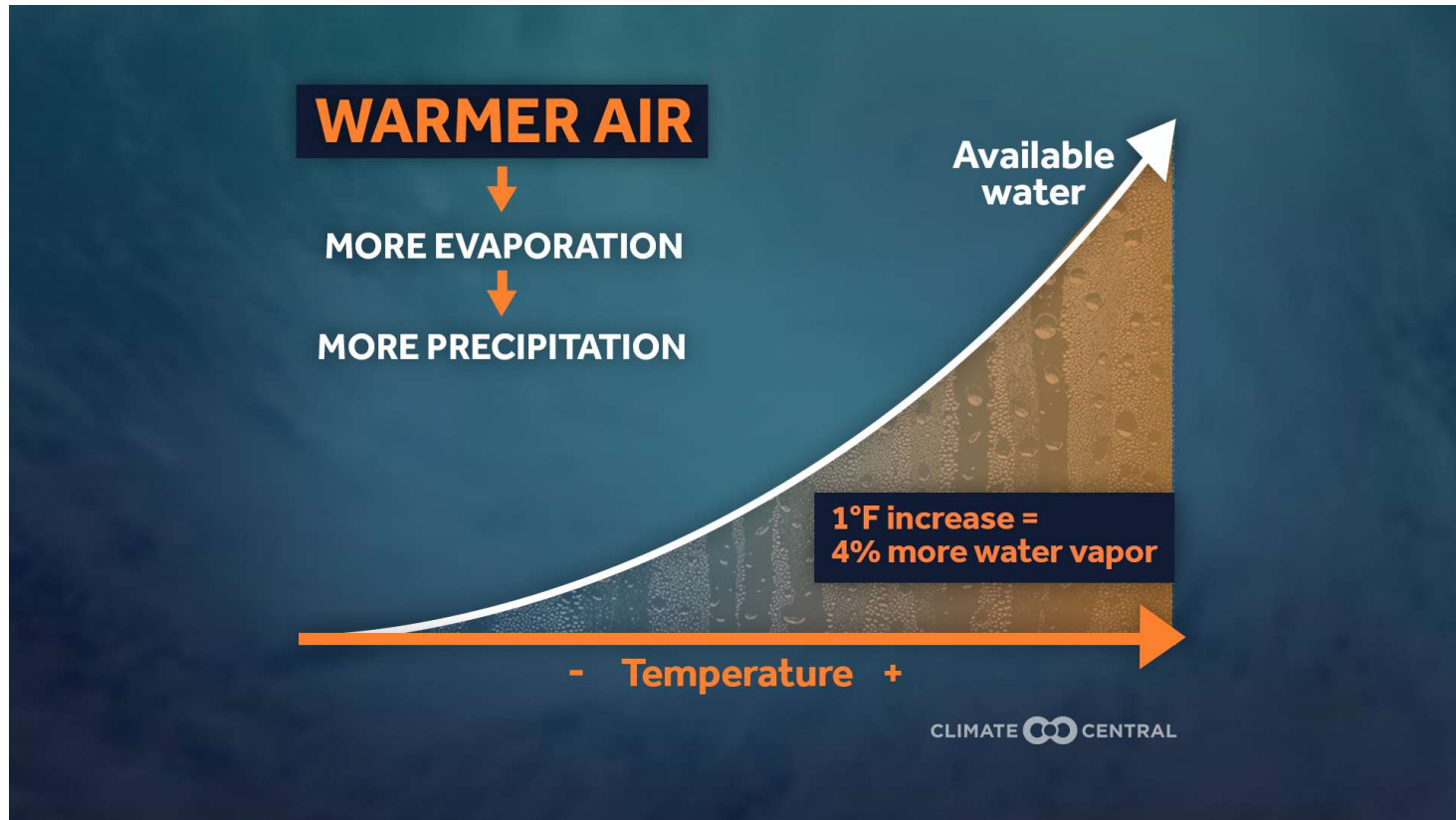
### Winter Temperature



### Summer Temperature



## Increased Humidity



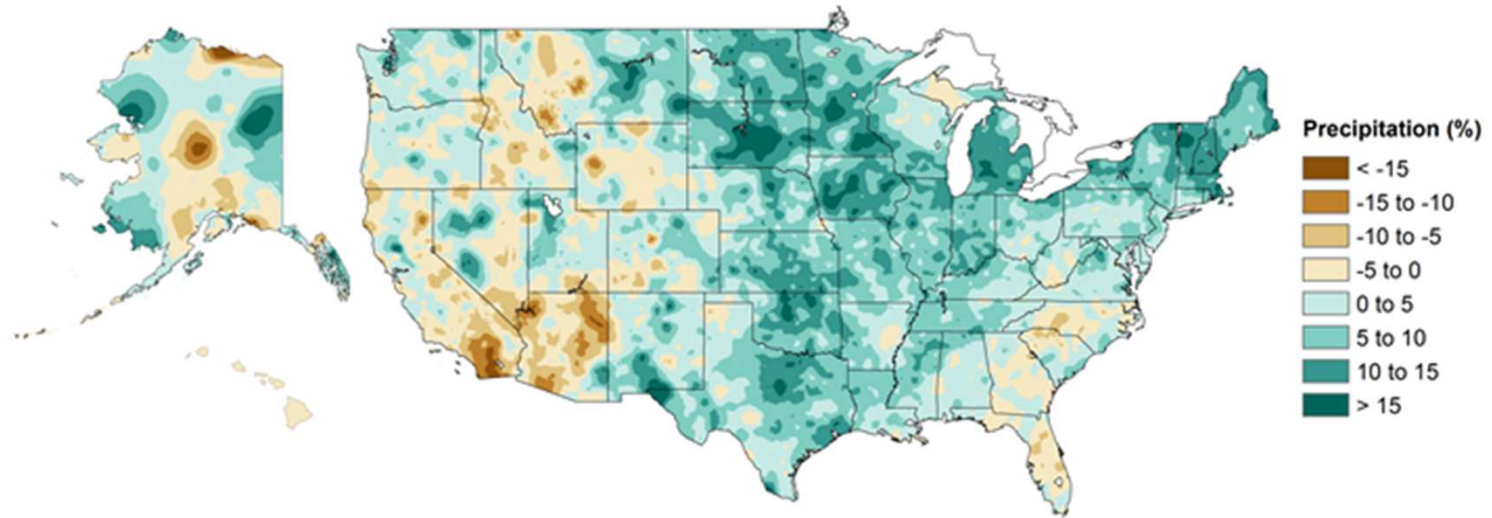


## Increased Humidity – Heavier Rains

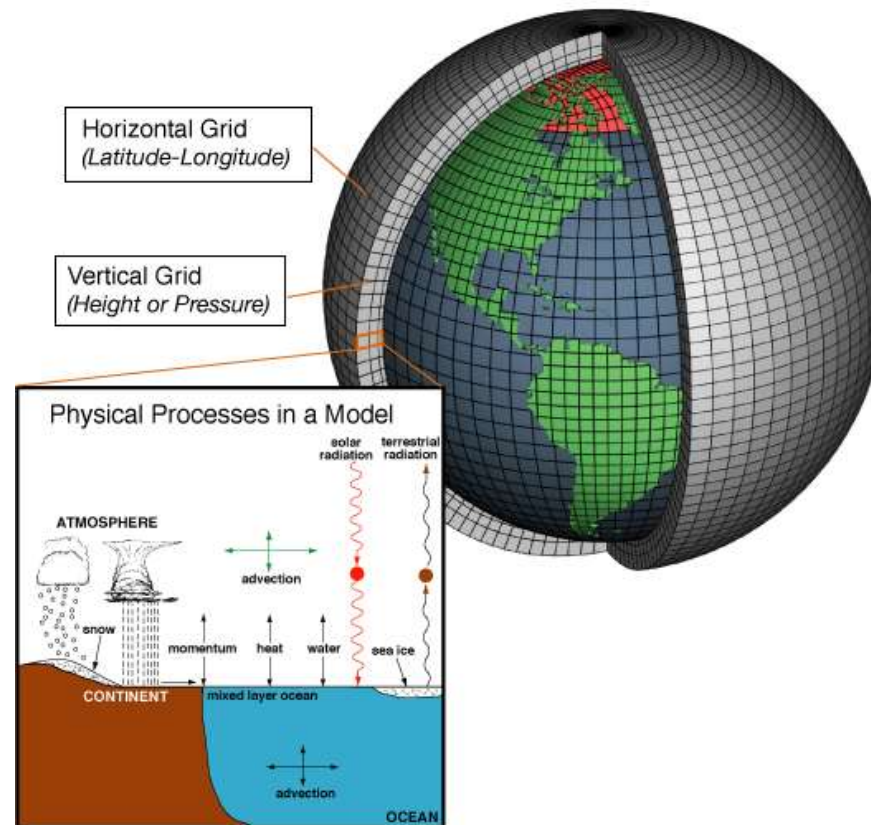


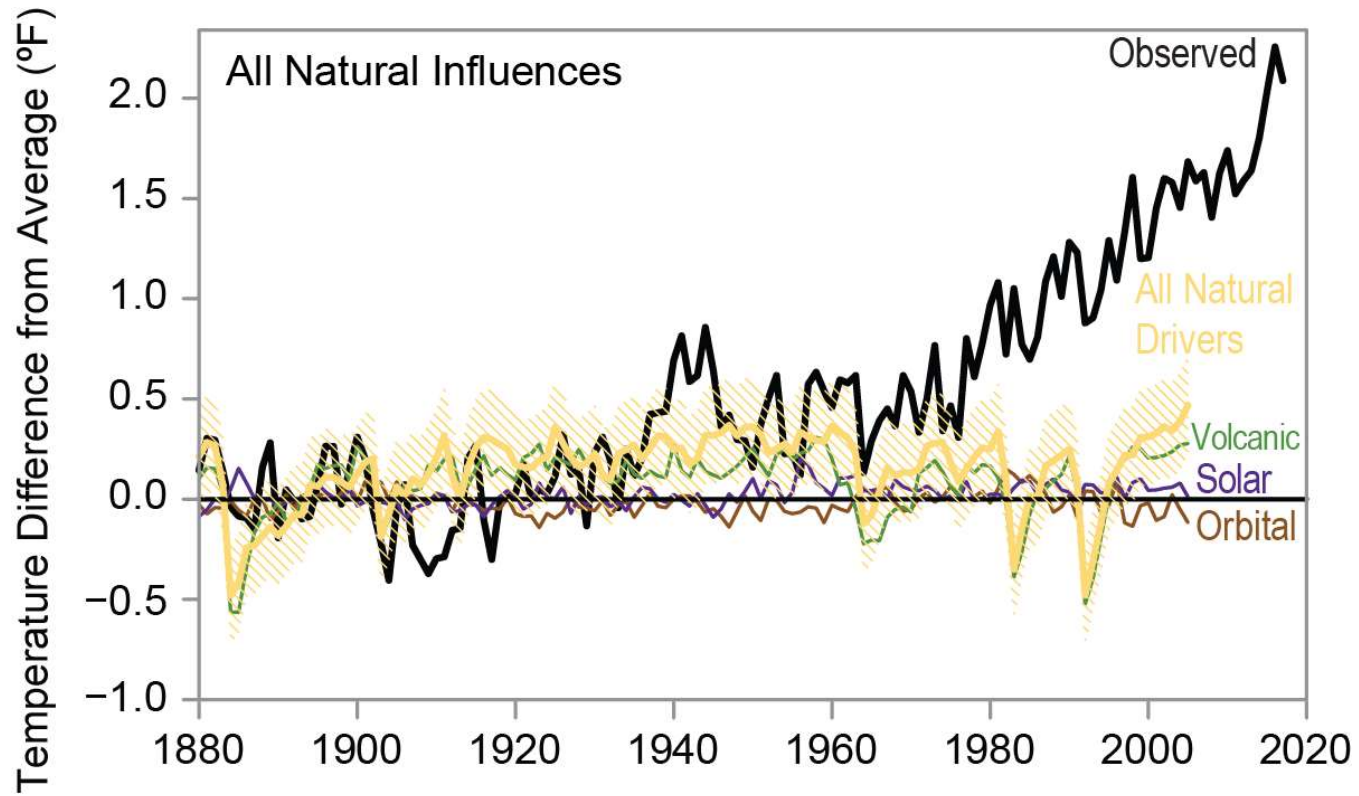
1986-2015 minus 1901-1960

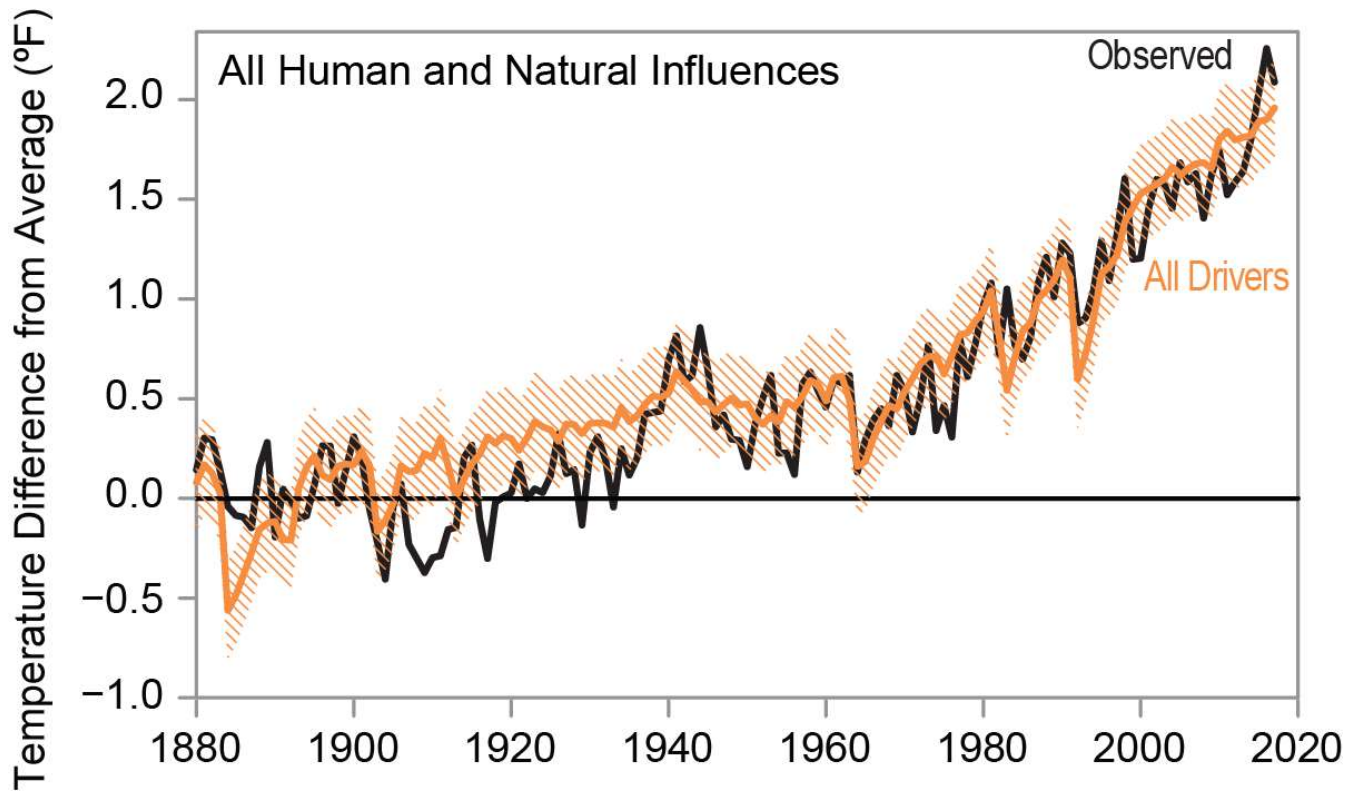
### Annual Precipitation

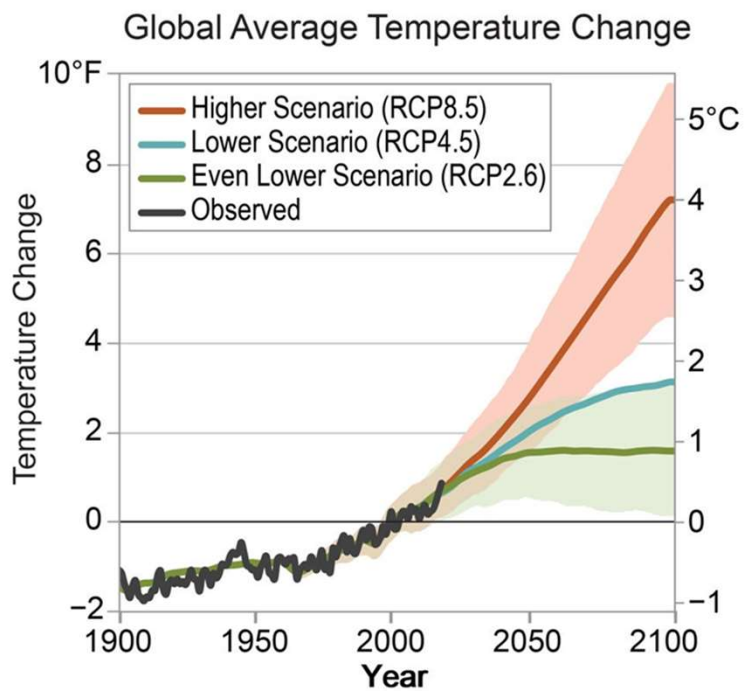
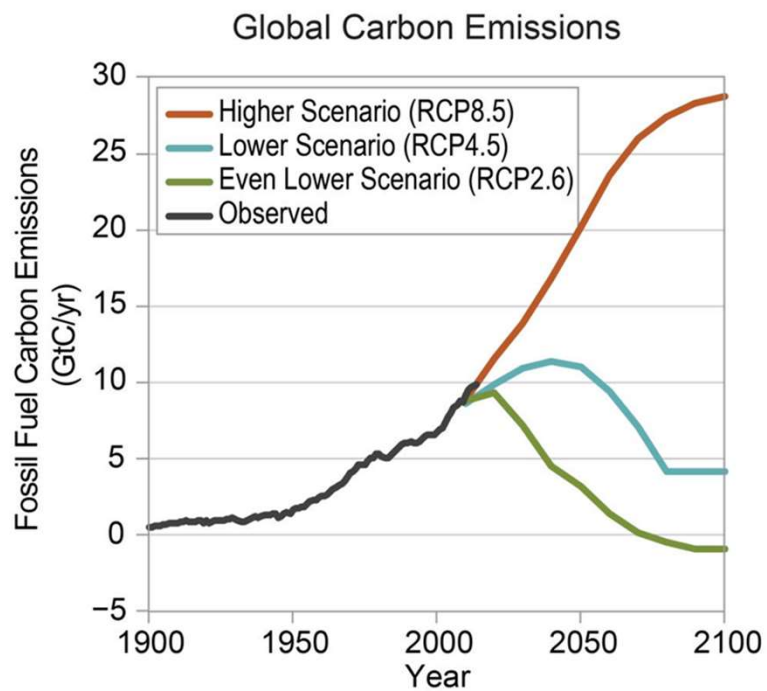


# Looking towards the future using climate models

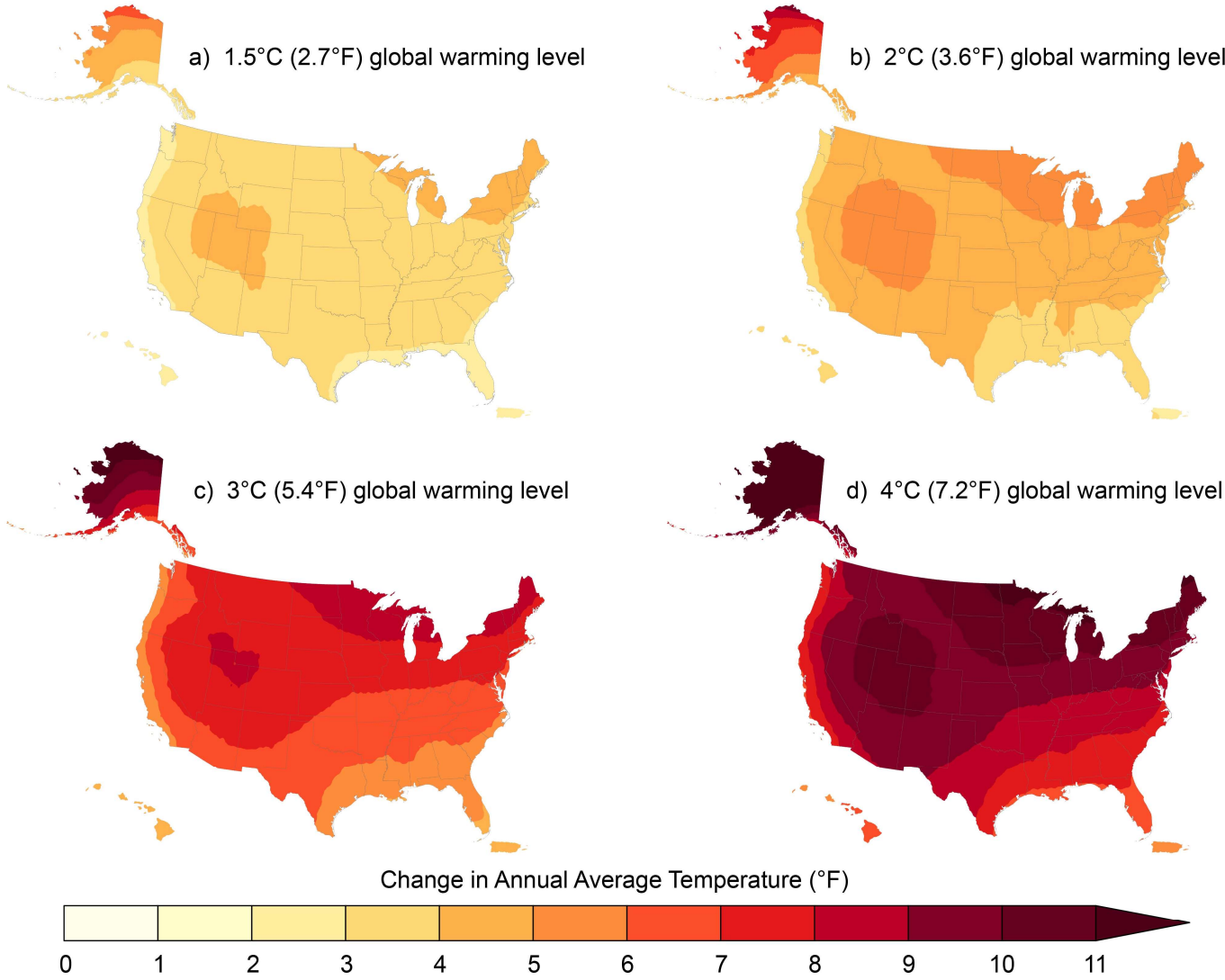




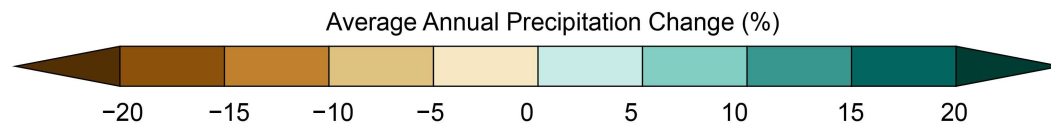
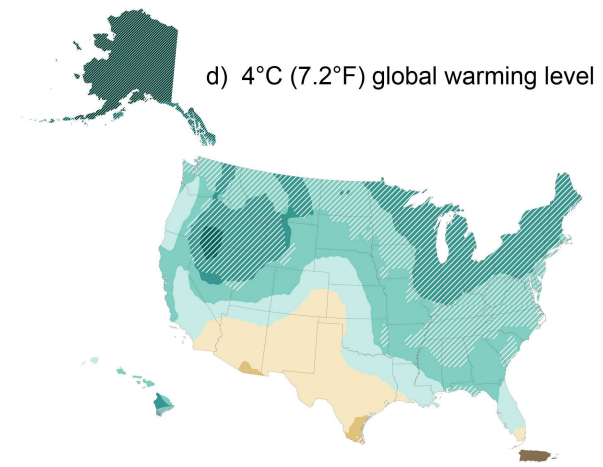
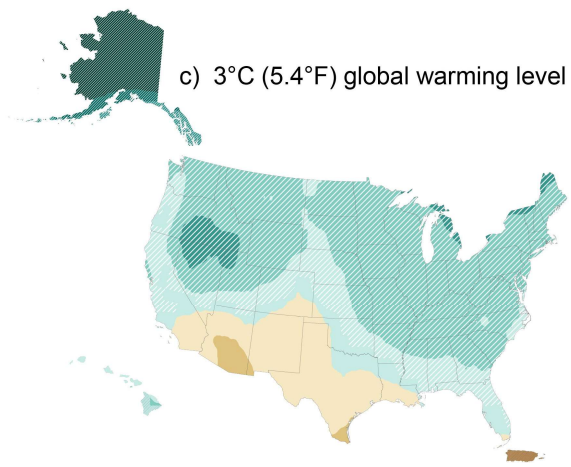
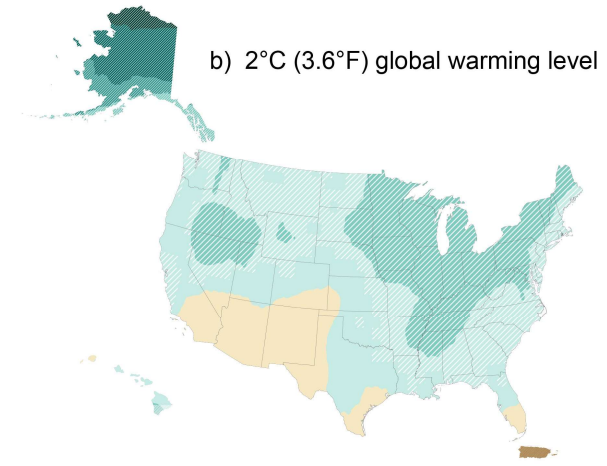
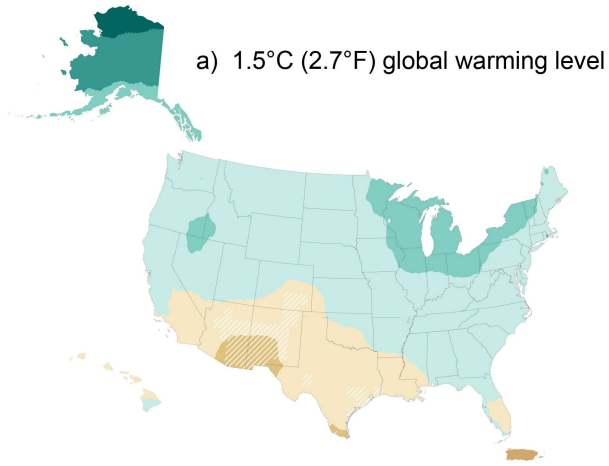




# Projected US Temperature Changes at 1.5°C, 2°C, 3°C, and 4°C of Global Warming



# Projected US Precipitation Changes at 1.5°C, 2°C, 3°C, and 4°C of Global Warming





<https://nca2023.globalchange.gov/>



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## The Fifth National Climate Assessment

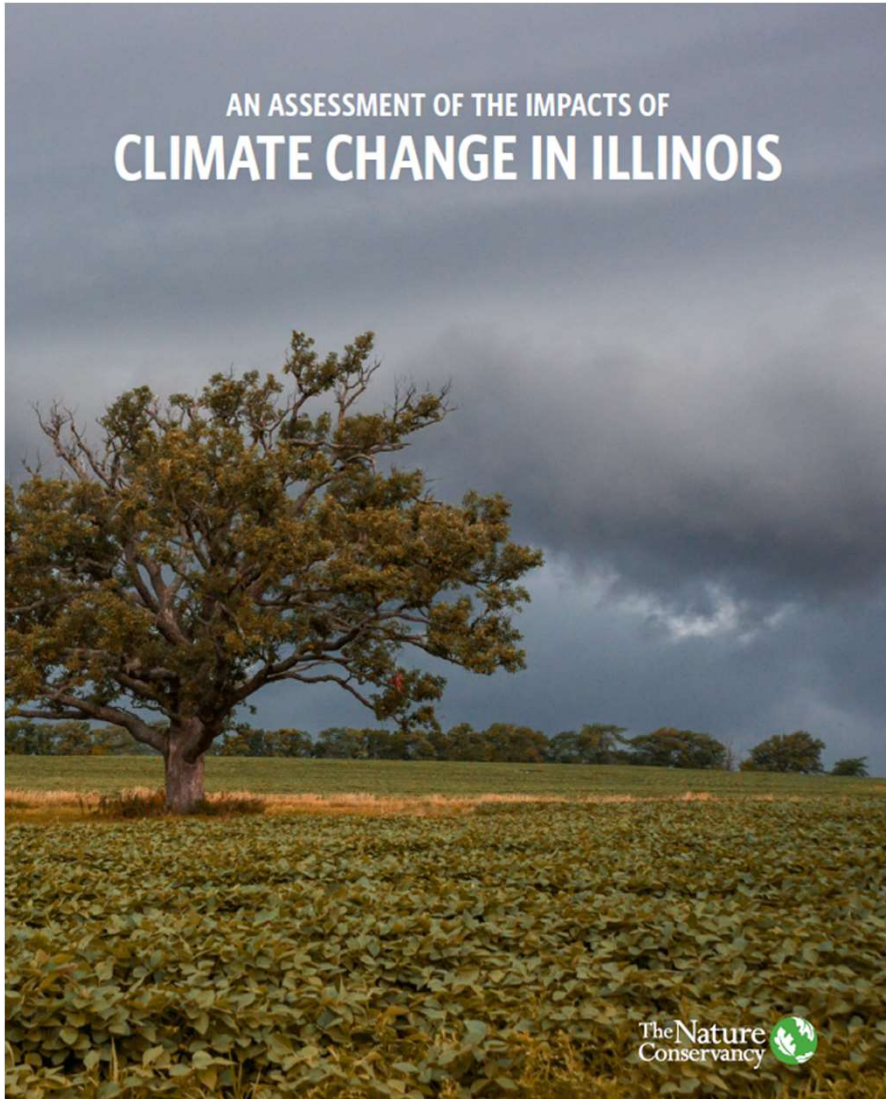
The Fifth National Climate Assessment is the US Government's preeminent report on climate change impacts, risks, and responses. It is a congressionally mandated interagency effort that provides the scientific foundation to support informed decision-making across the United States.



# So Far

- Widespread warming across the US already, more to follow
- More precipitation across the US, except for the Southwest
- Nearly all the warming can be explained by greenhouse gas emissions
- Questions on what was covered so far

AN ASSESSMENT OF THE IMPACTS OF  
**CLIMATE CHANGE IN ILLINOIS**



<https://www.nature.org/en-us/newsroom/illinois-climate-assessment/>

<https://databank.illinois.edu/datasets/IDB-1260194>

# AN ASSESSMENT OF THE IMPACTS OF CLIMATE CHANGE IN ILLINOIS

## The development of this report was co-led by

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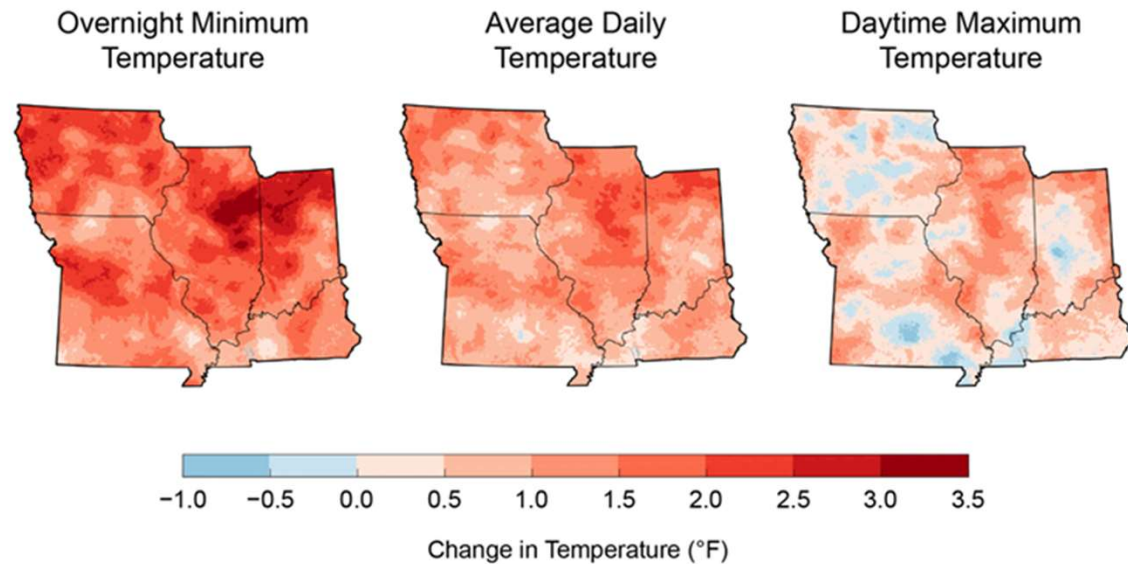
# Diary of the Weather, Fort Armstrong, Rock Island

July 1820

Date 1820	Thermometer			Course of the Winds	Weather	Remarks -
	7 A.M.	2 P.M.	9 P.M.			
July 1	80	96	80	S. E.	Fair R2	I arrived at Fort Armstrong on the 9 <sup>th</sup> of the Present Month; from the commencement still my arrival the Diary was kept by Maj. Mauston - Commanding Officer.
2	78	90	86	Do	Do 24.	
3	80	80	70	Do	Cloudy 5	
4	66	80	72	S. W.	Do	
5	70	82	78	Do	Fair	
6	71	84	76	Do	Do	
7	77	90	82	S. W.	Cloudy	
8	77	92	82	S. S. W. W.	Fair	
9	79	96	80	S. S. W. S. W.	Do	
10	78	96	84	S. W.	Do	
11	81	84	81	W. S. W.	Cloudy	
12	80	90	71	N. N. W. S. W.	Do	
13	58	78	67	N. W. S. W.	Fair	74.16 - 86.77 - 75.50
14	58	78	88	N. N. W.	Do	
15	68	90	70	E. + S. E.	Do	26.71 78.84
16	71	86	72	S. E.	Do	
17	76	90	82	S. E. + E.	Do	
18	78	90	73	S. E.	Do	
19	76	88	74	S. W.	Do	
20	72	90	78	N. W. S. W.	Rain, S. W.	A violent hurricane on the 21 <sup>st</sup> .
21	78	80	72	W. S. W.	Do	
22	70	88	66	S. E.	Fair	

# Observed Temperature Changes

Season	Overnight Minimum Temperature	Average Daily Temperature	Daytime Maximum Temperature
Winter	+ 3.0	+ 2.5	+ 2.2
Spring	+ 1.8	+ 1.6	+ 1.4
Summer	+ 1.7	+ 0.5	-0.7
Fall	+ 1.3	+ 0.8	+ 0.4

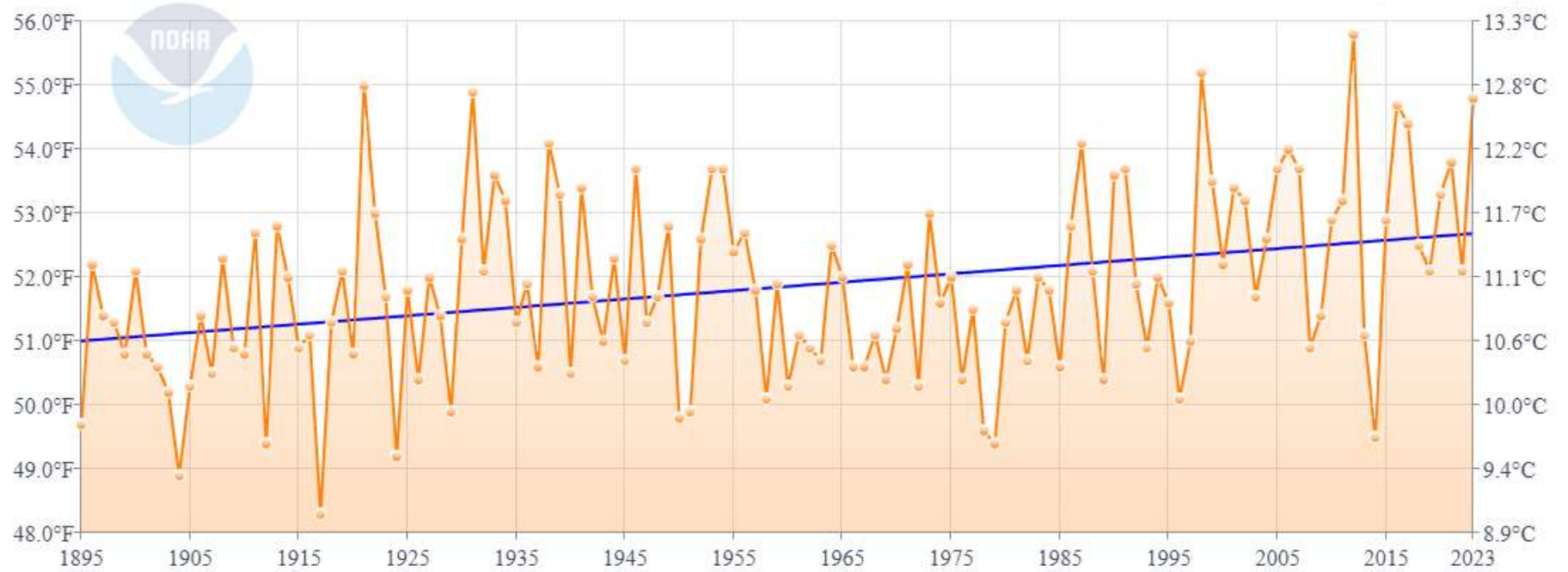


Changes between the early 20<sup>th</sup> century (1895-1924) and early 21<sup>st</sup> century (1990-2019)

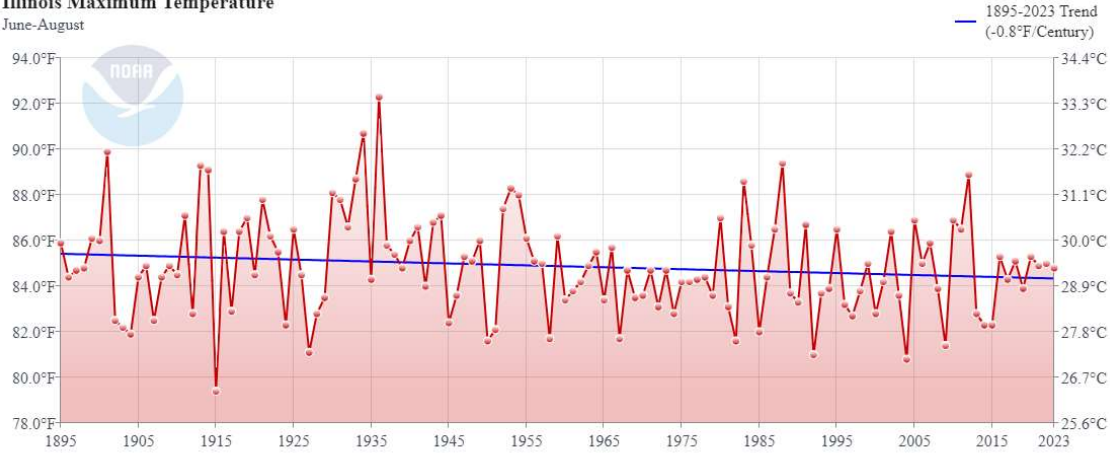
# Illinois Average Temperature

January-December

1895-2023 Trend  
(+1.3°F/Century)

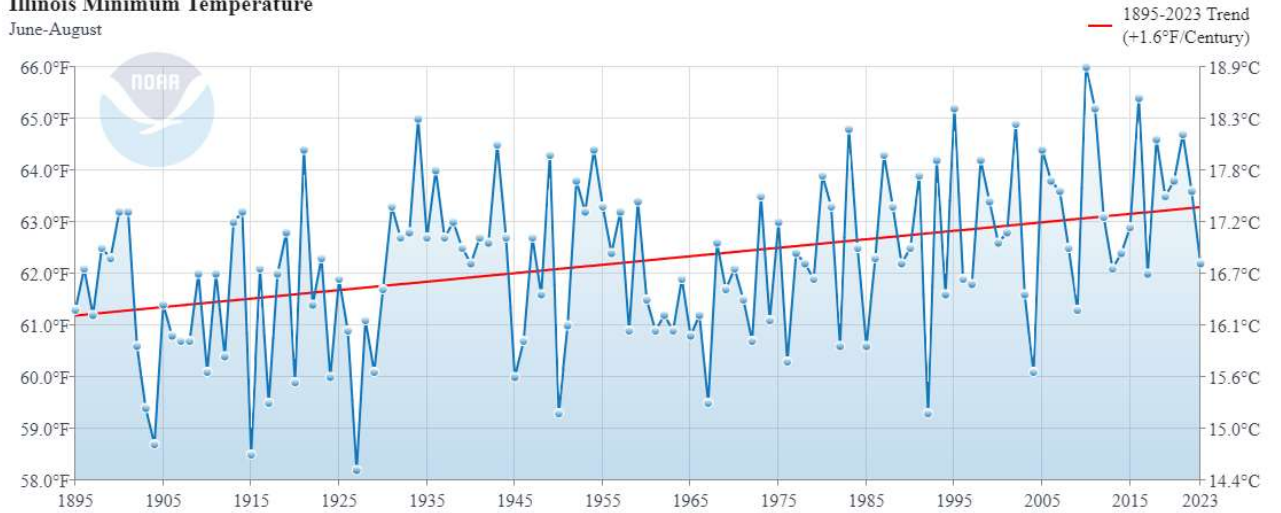


**Illinois Maximum Temperature**  
June-August



Summer Highs are cooling while Summer  
Lows are Warming

**Illinois Minimum Temperature**  
June-August

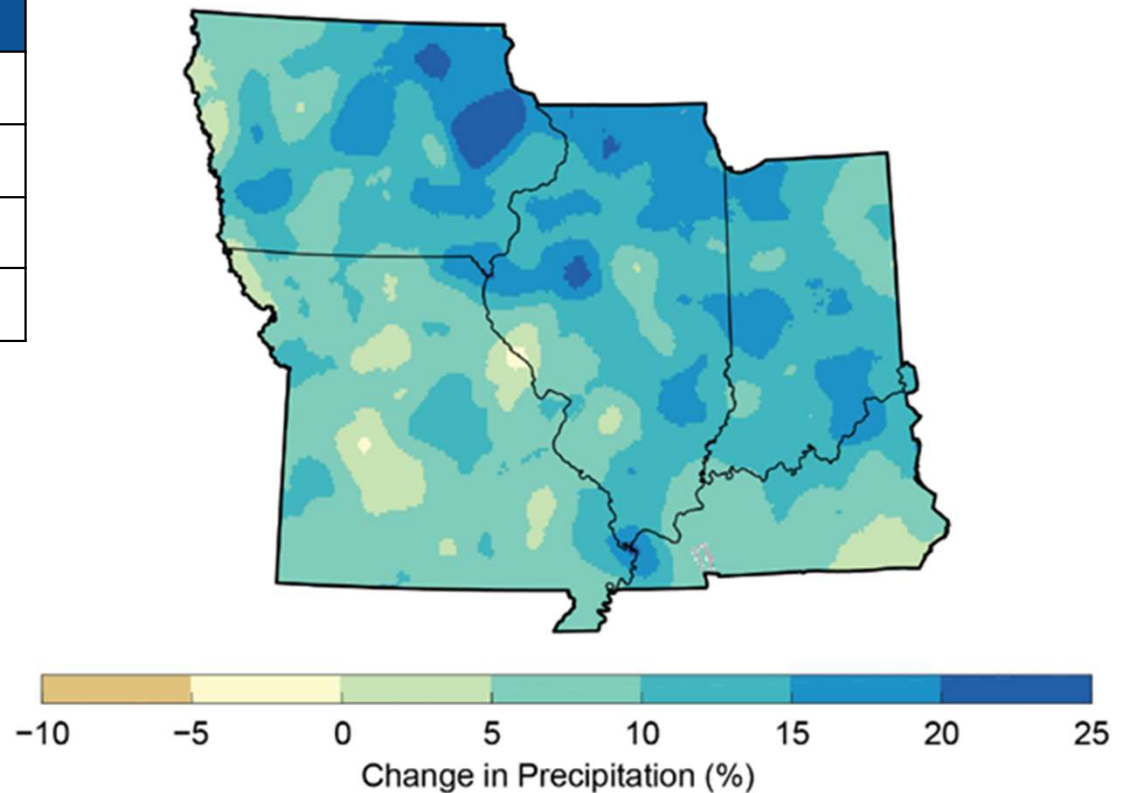




# Observed Precipitation Changes

Season	Precipitation (inches)	Precipitation Change (%)
Winter	+0.54	+8.5%
Spring	+1.33	+ 12.5%
Summer	+1.55	+ 14.3%
Fall	+1.33	+ 15.9%

Change in Annual Total Precipitation

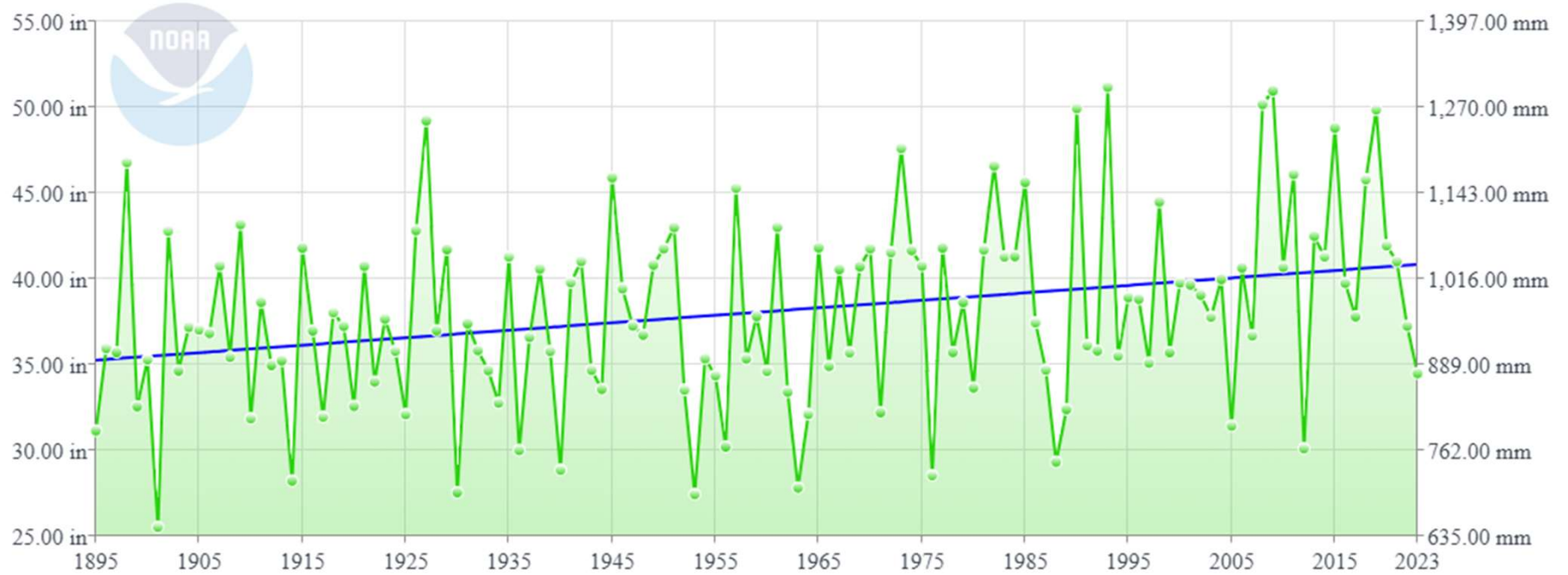


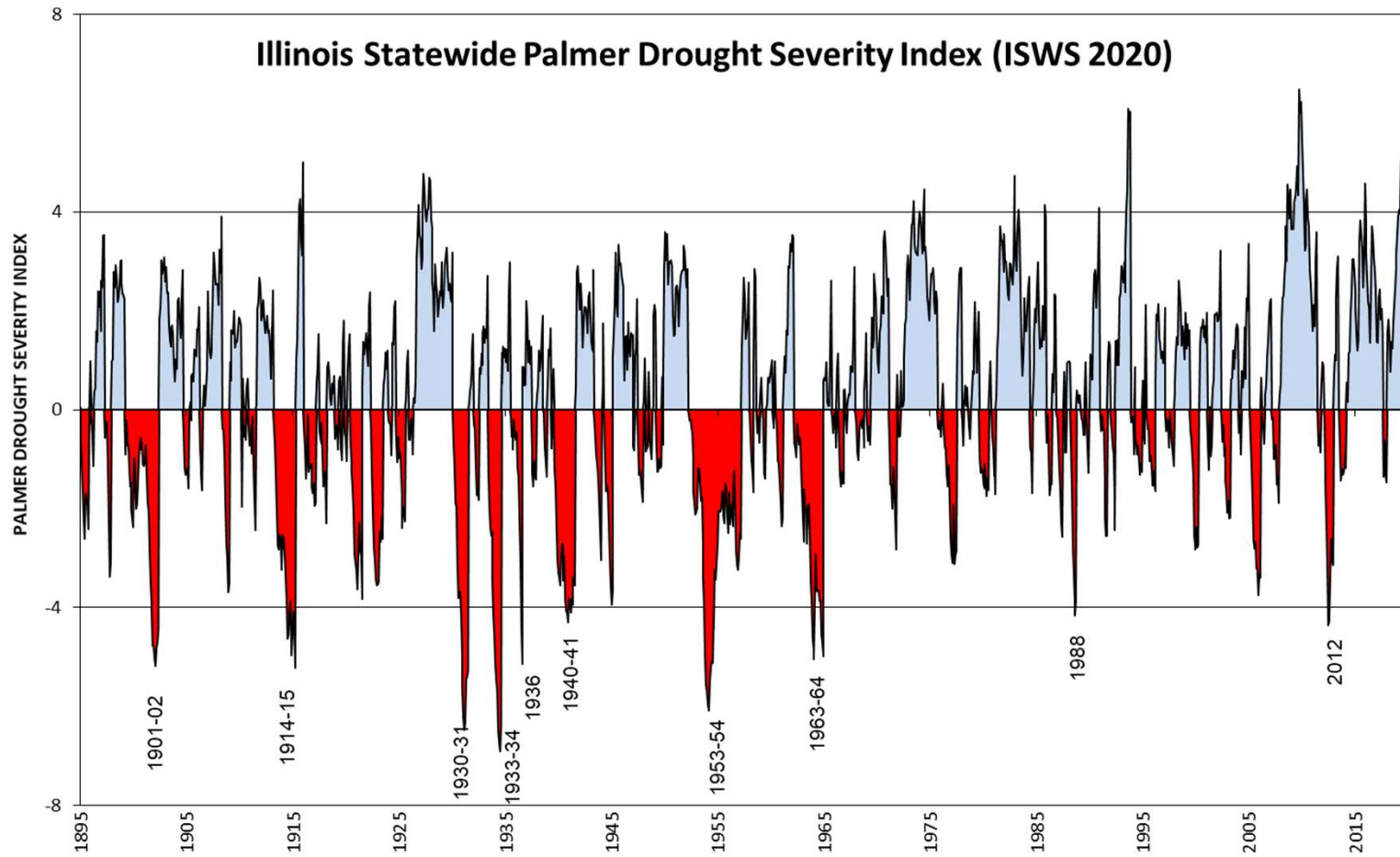
Changes between the early 20<sup>th</sup> century (1895-1924) and early 21<sup>st</sup> century (1990-2019)

# Illinois Precipitation

January-December

1895-2023 Trend  
(+4.36 in/Century)

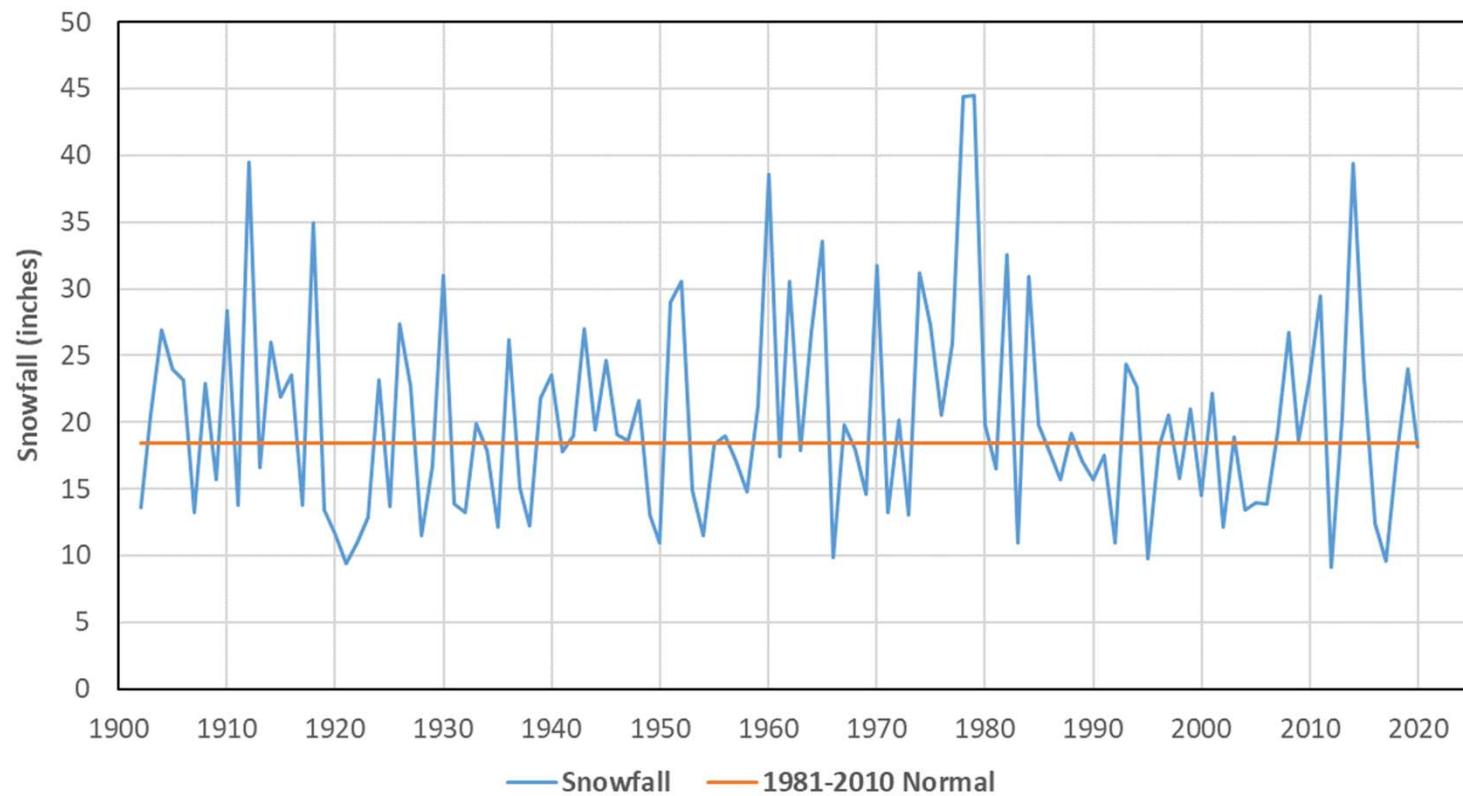




Blue means wet; red means dry; noteworthy droughts labeled

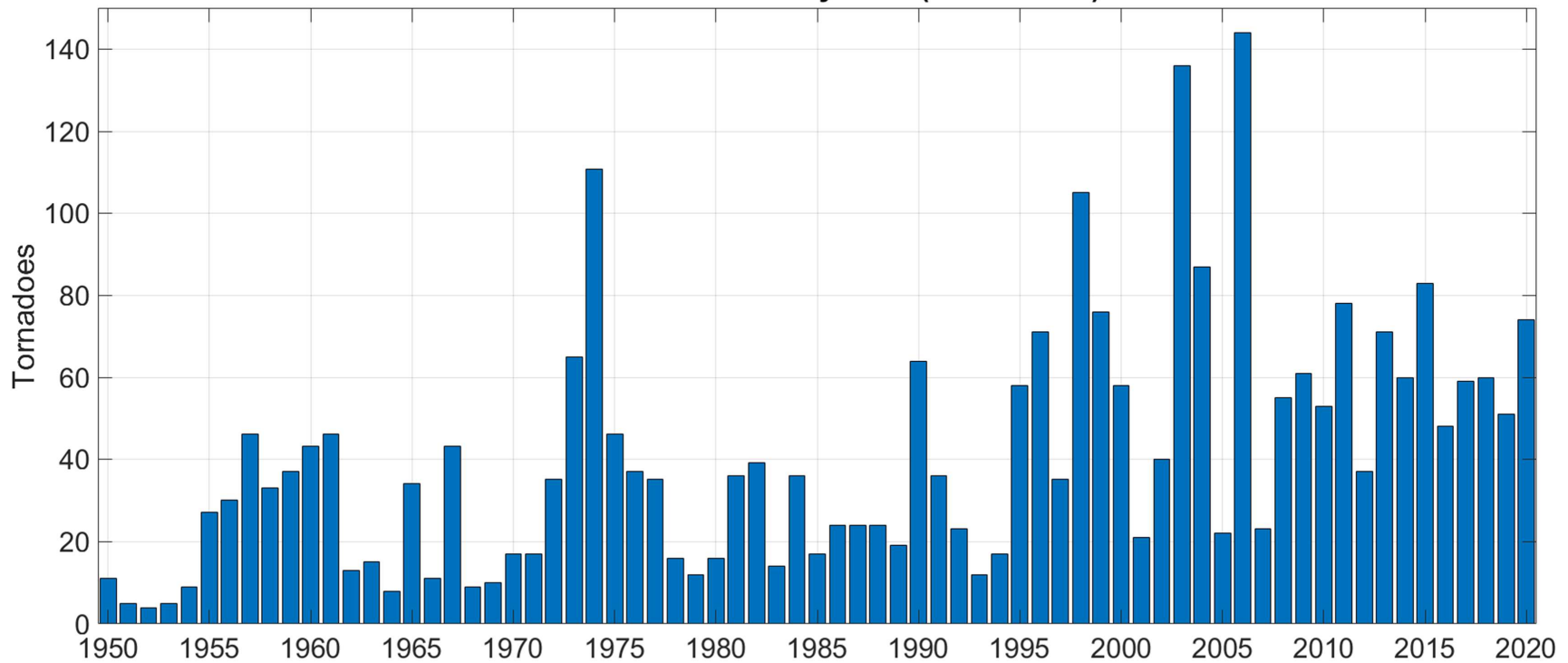
# Snowfall

Statewide average Snowfall for Illinois



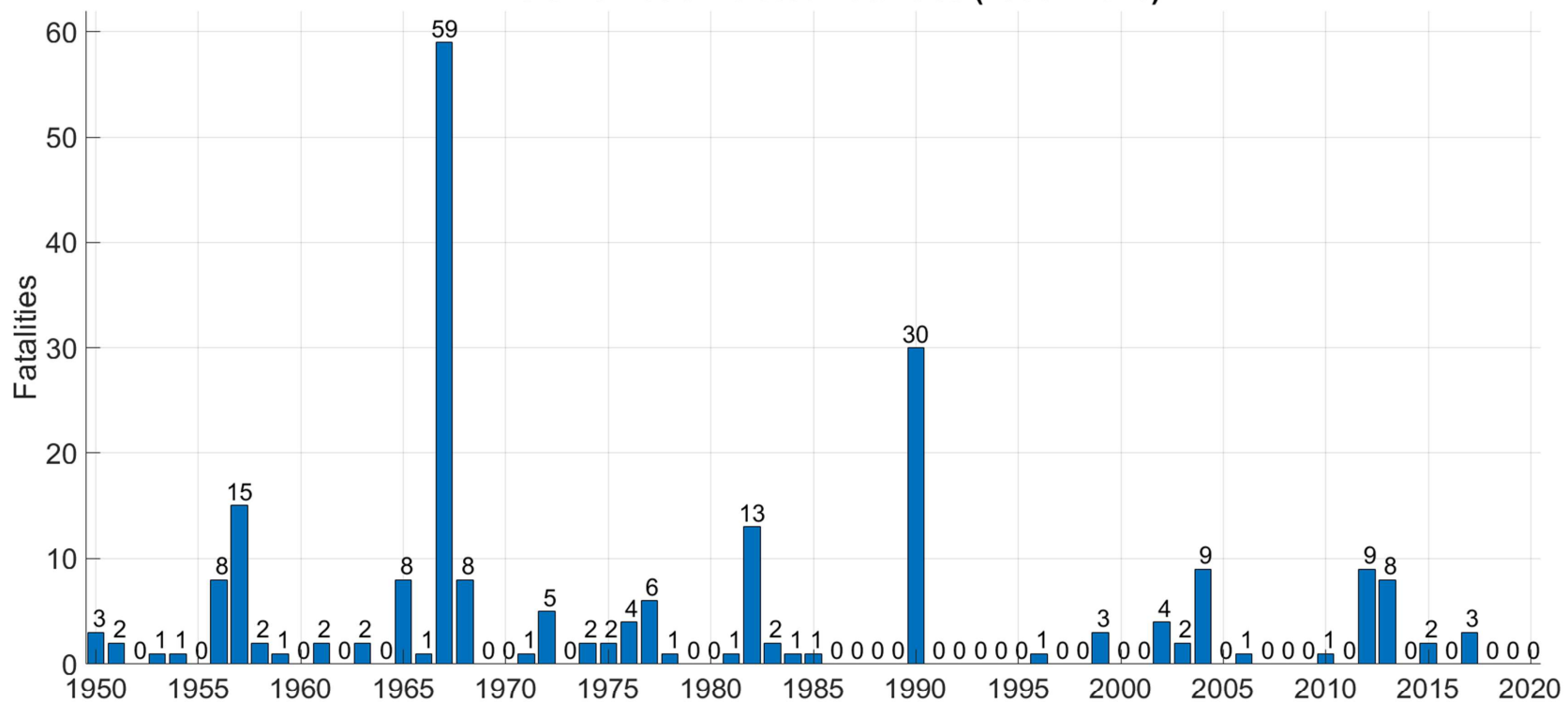
# Tornadoes

Illinois Tornadoes by Year (1950 - 2020)

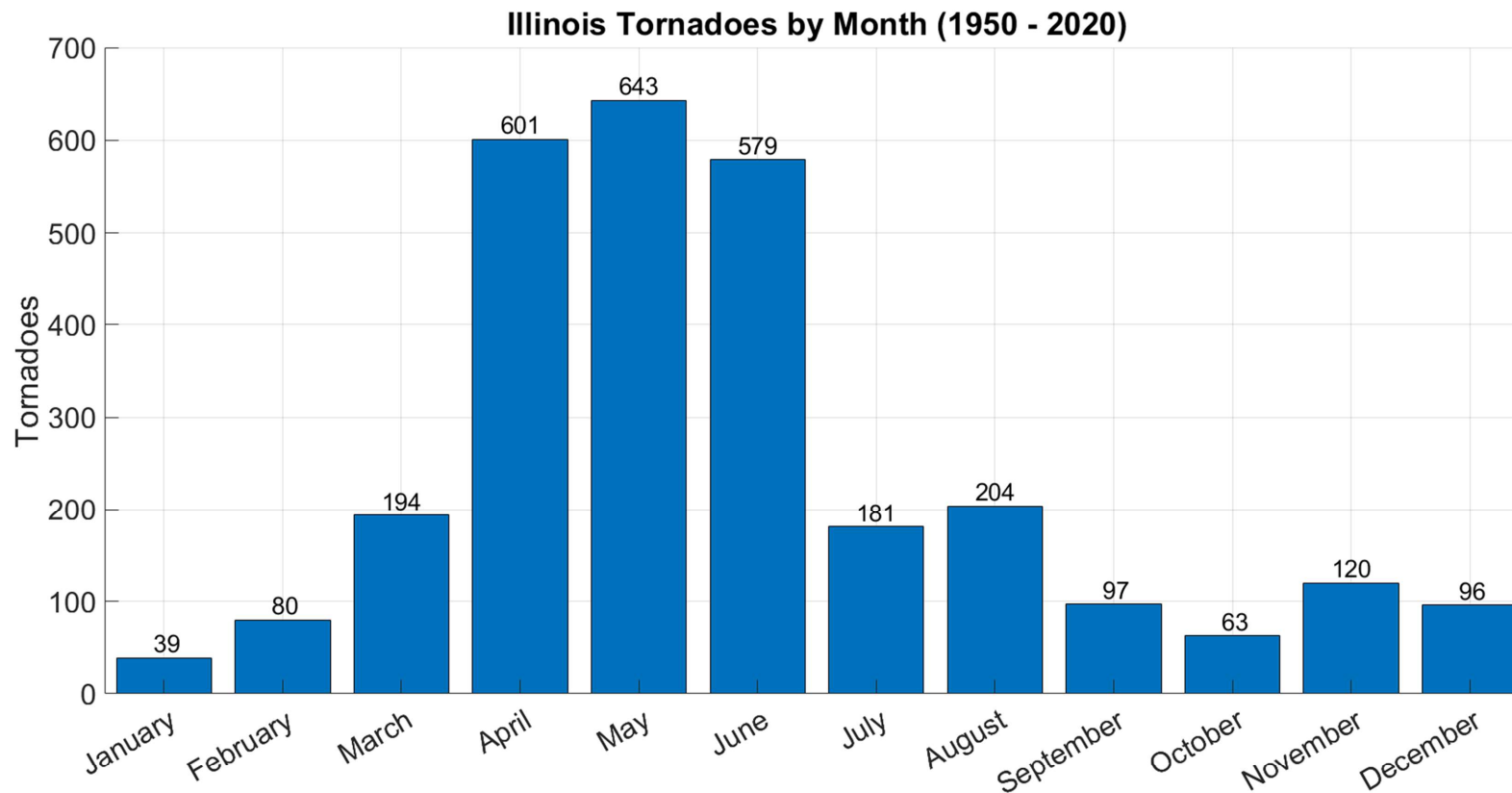


# Tornadoes

Illinois Tornado-Related Fatalities (1950 - 2020)

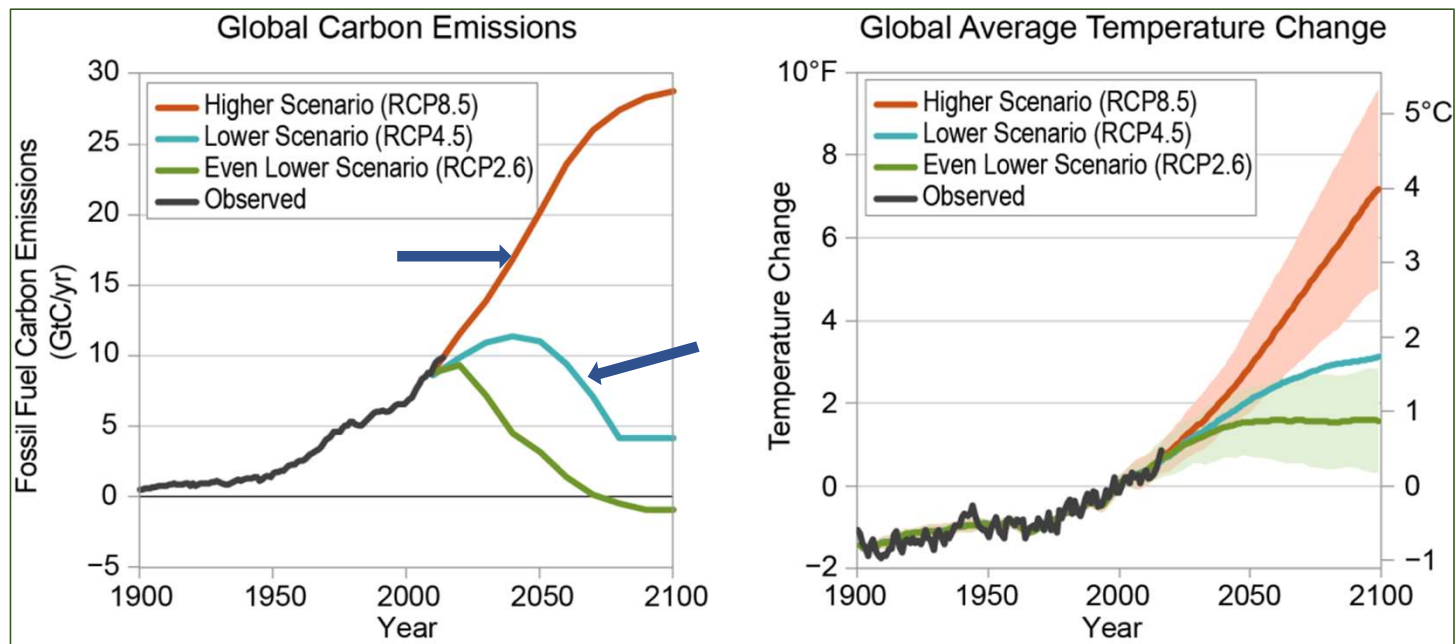


# Tornadoes



# Future Projections

➤ “higher” and “lower” scenarios of global carbon emissions



Source: Hayhoe, K. et al., 2018. Fourth National Climate Assessment.



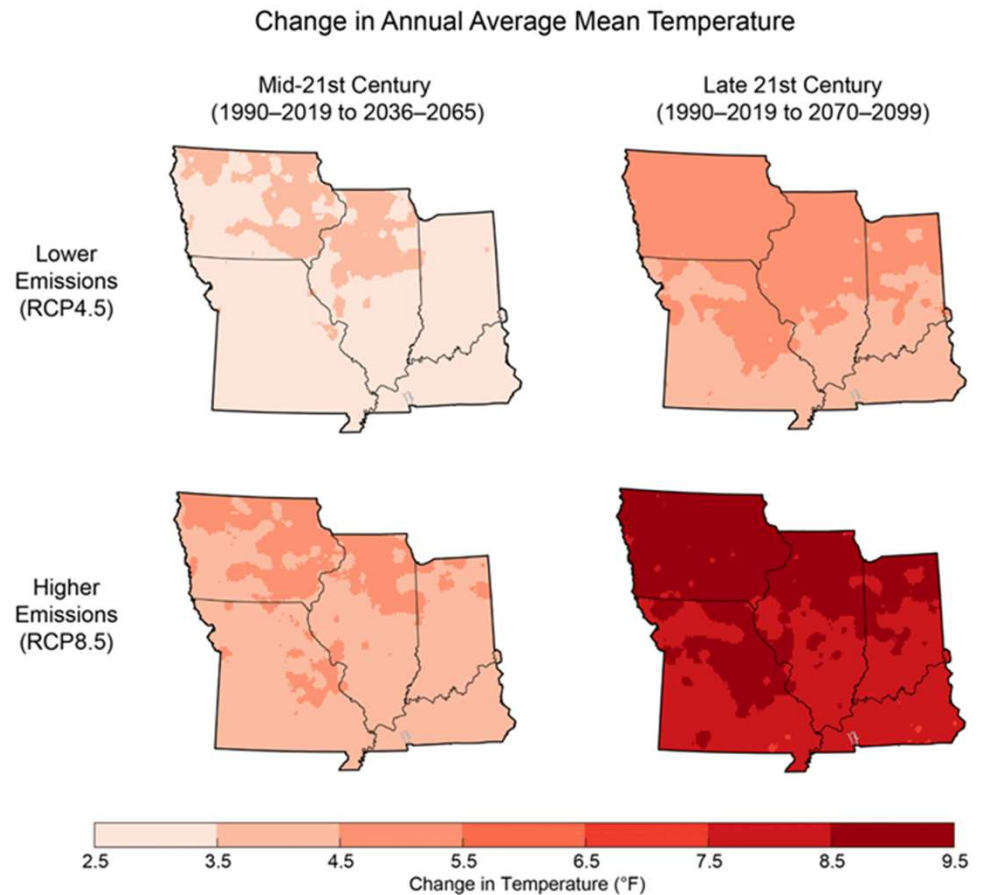
# Projected Temperatures

## Top panel – lower scenario, mid- to late-century

- 3-4°F warming by mid-century
- 4-5°F warming by late-century

## Bottom panel – higher scenario, mid- to late-century

- 4-5°F warming by mid-century
- 8-9°F warming by late-century



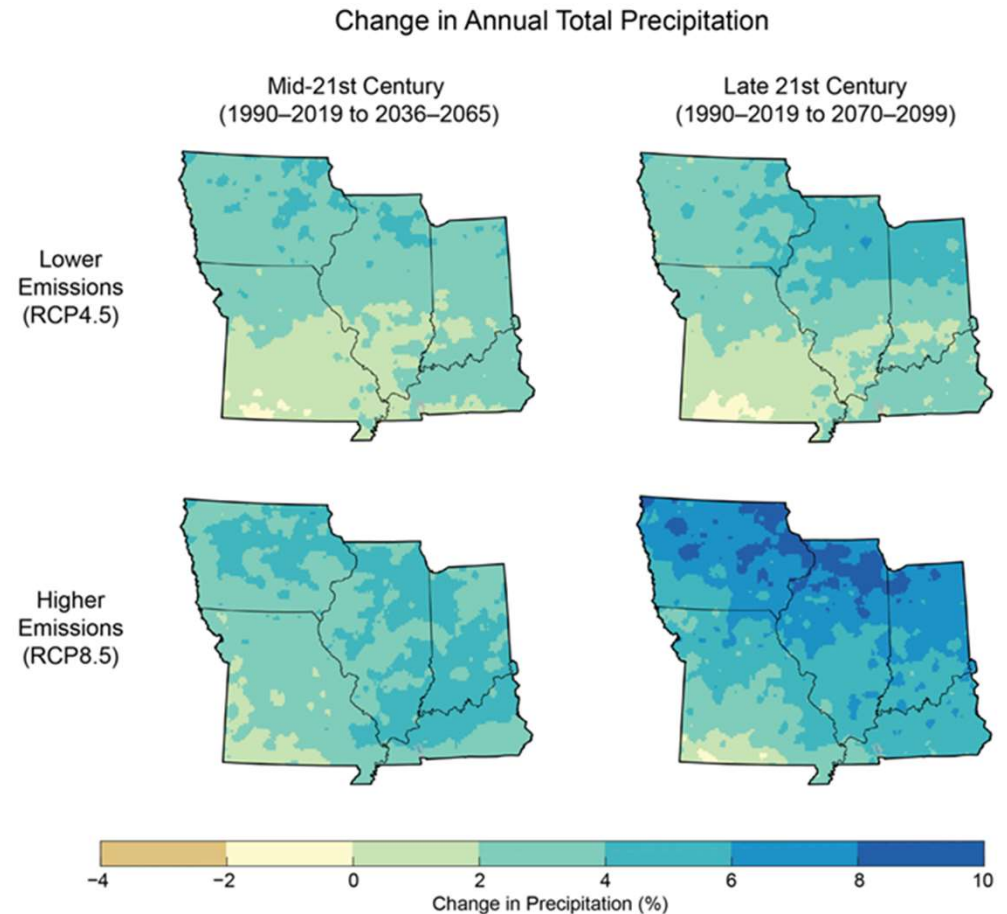
# Projected Precipitation

## Top panel – lower scenario, mid- to late-century

- 0-4% wetter by mid-century
- 2-6% wetter by late-century

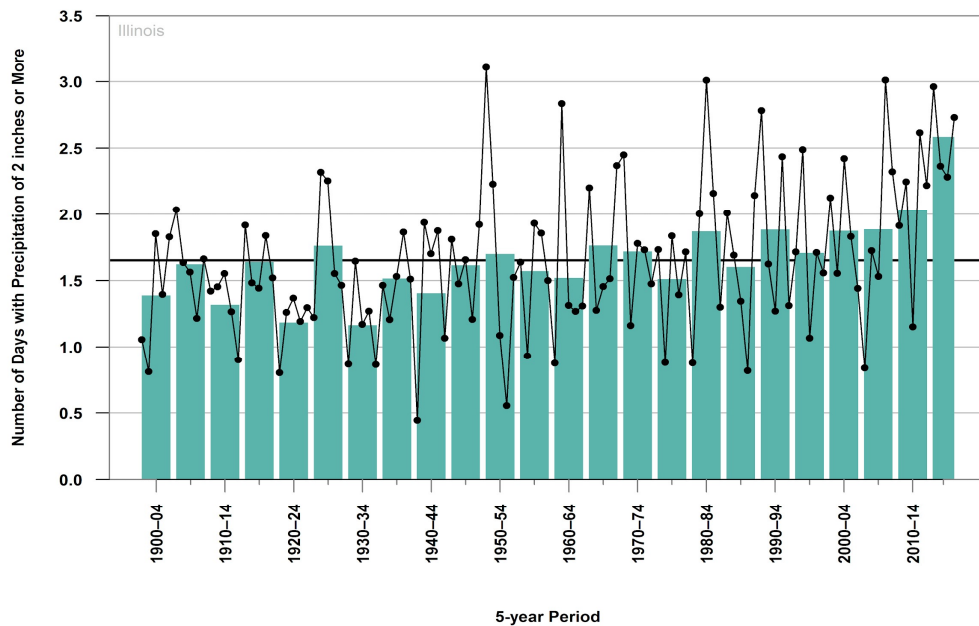
## Bottom panel – higher scenario, mid- to late-century

- 3-6% wetter by mid-century
- 4-10% wetter by late-century

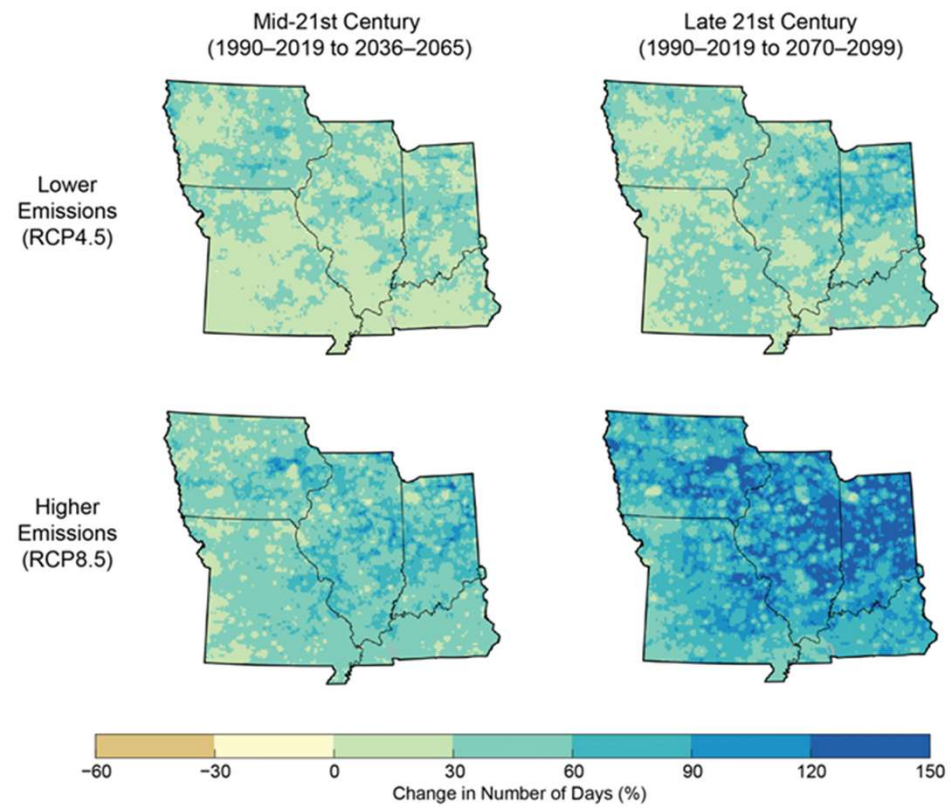


# Increasing Heavy Rains

Observed Number of Extreme Precipitation Events (1900-2018)



Change in Number of Days with Precipitation of 2 inches or greater



# Days of 100°F or Higher

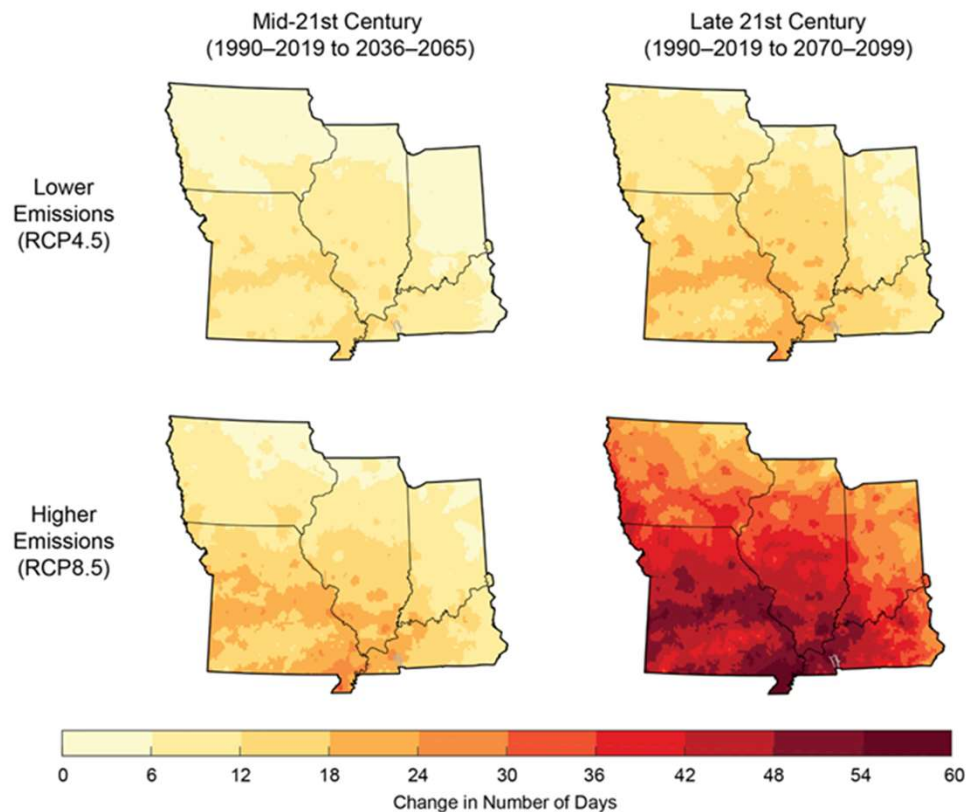
## Lower scenario

- 0-12 more days by mid-century
- 6-18 more days by late-century

## Higher scenario

- 6-18 more days by mid-century
- 18-48 more days by late-century

Change in Annual Number of Extremely Hot Days  
Daily Maximum Temperature of 100°F or Higher



# Nights of 70°F or Higher

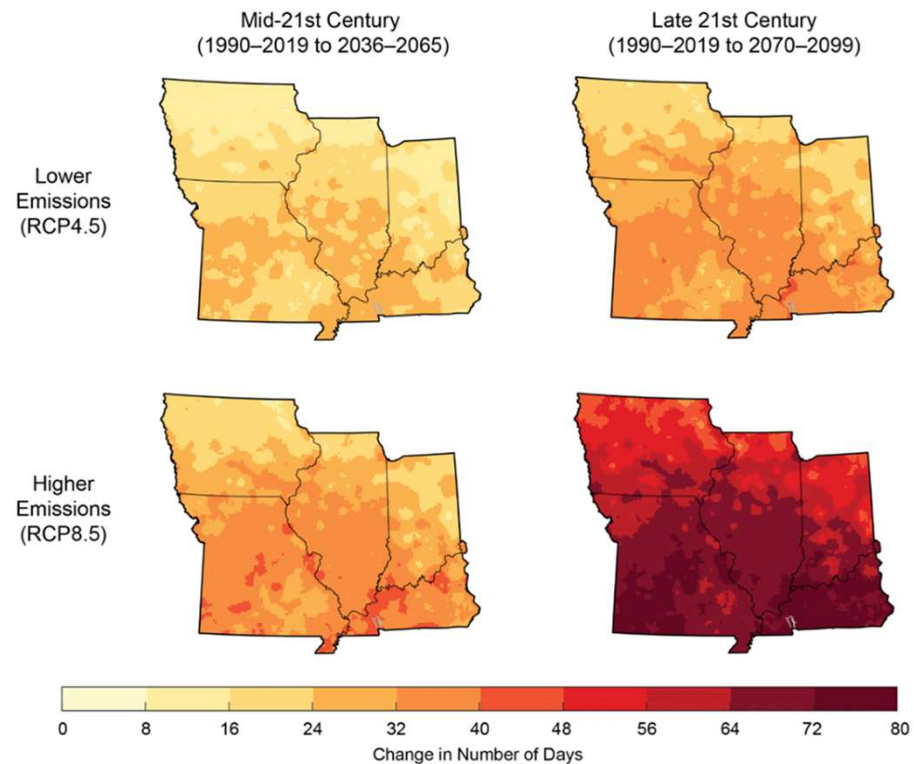
Change in Annual Number of Warm Nights  
Nighttime Minimum Temperature of 70°F or Higher

## Lower scenario

- 8-24 more days by mid-century
- 16-32 more days by late-century

## Higher scenario

- 24-40 more days by mid-century
- 48-80 more days by late-century



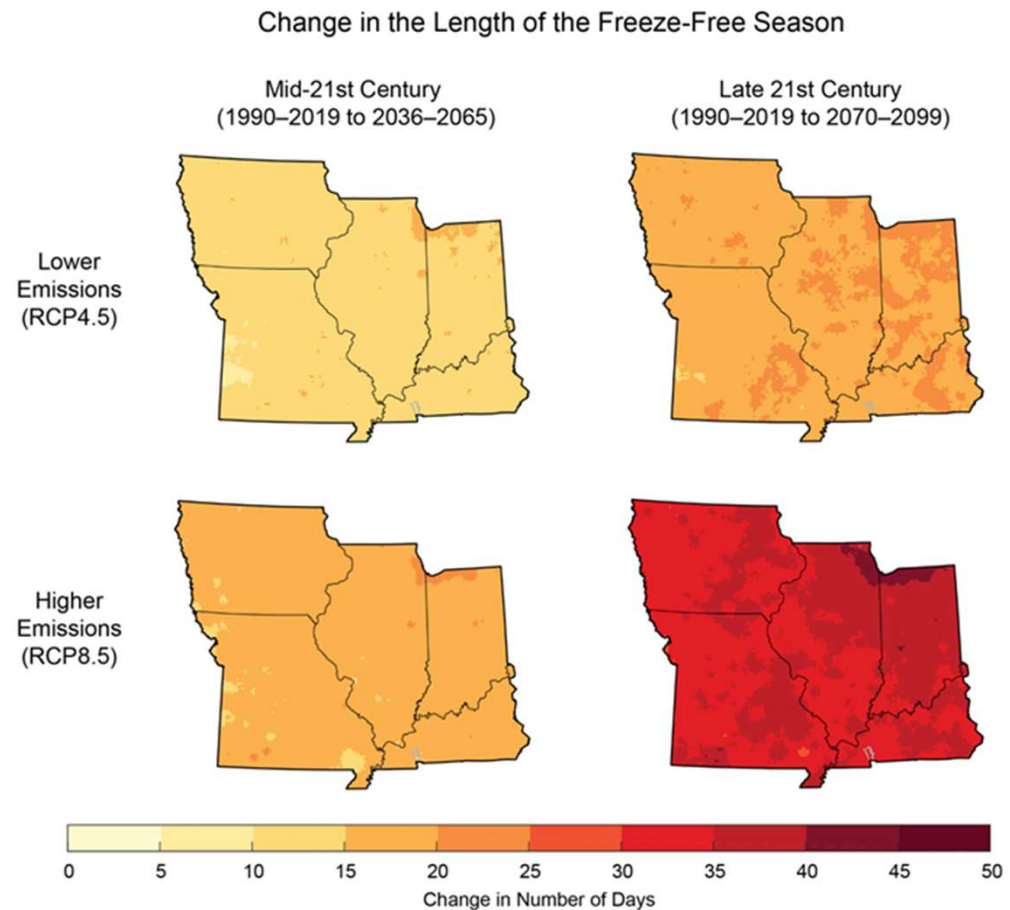
# Growing Season Length

## Lower scenario

- 10-15 days longer by mid-century
- 15-20 days longer by late-century

## Higher scenario

- 15-20 days longer by mid-century
- 30-45 days longer by late-century



# Future Winters

- Future winter will become milder with
  - overall warmer conditions
  - Fewer days below 0°F
  - Less snowfall
- Sound familiar? This winter is 5.3°F above normal with only 9.1 inches of snow and 7 days below 0°F

# Summary

- Human-induced climate change is happening in Illinois.
- Observed trends include warmer weather, more precipitation, and more heavy rains.
- Actions taken to reduce greenhouse gasses emissions can help us avoid the worst of the impacts.



# Thank You!

To access the report,  
please visit:

<https://databank.illinois.edu/datasets/IDB-1260194>

