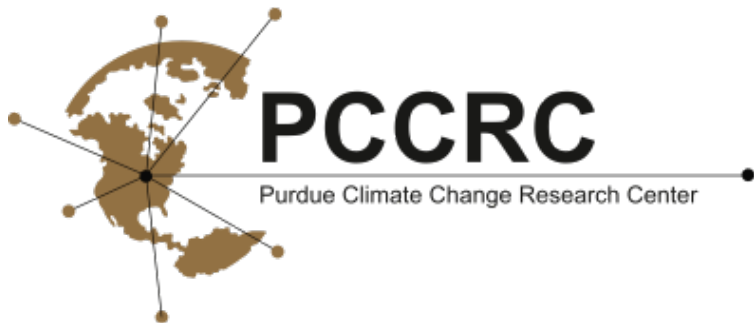


A photograph of a flooded campus area with trees and buildings in the background. The water is murky and reflects the trees.

# Managing Water in a Changing Climate

St. Joseph River Basin Commission Annual Symposium

May 11, 2018 | Niles, MI



**Melissa Widhalm**  
**Purdue Climate Change Research Center**

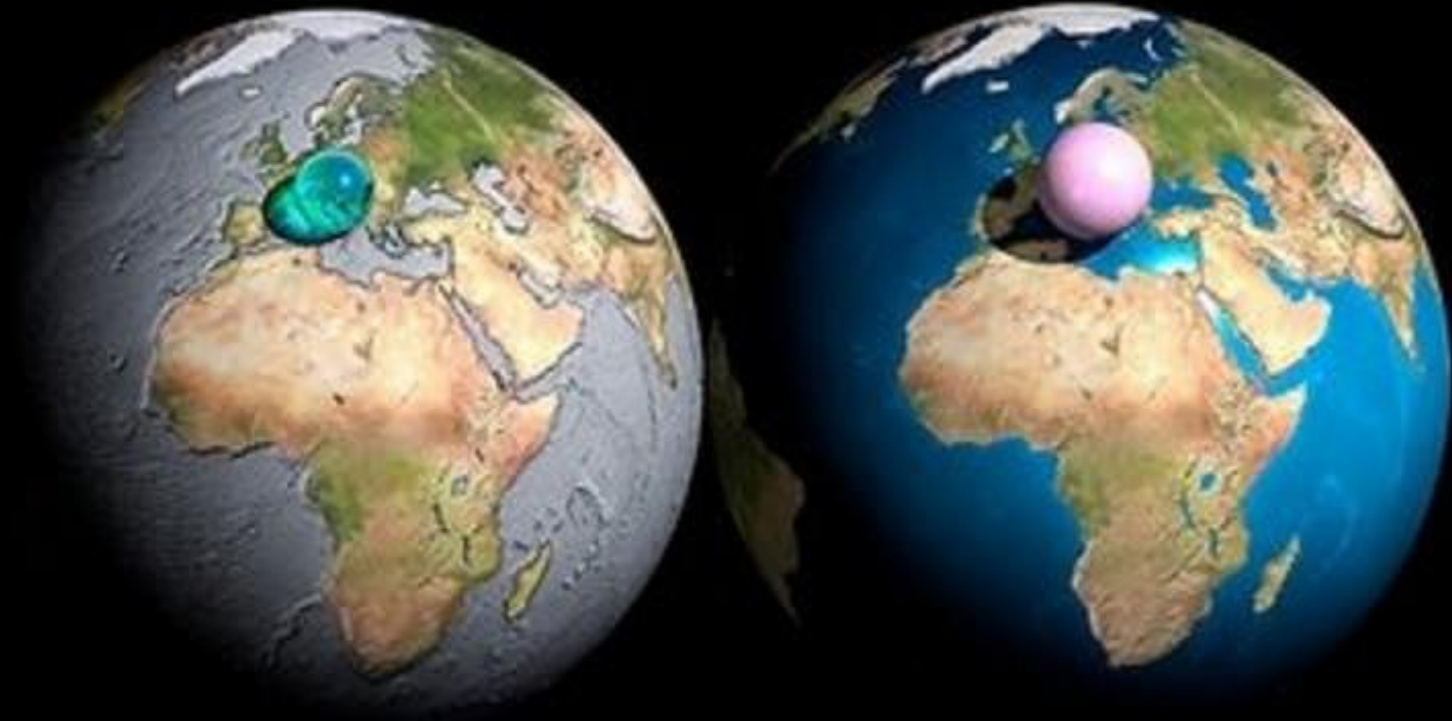
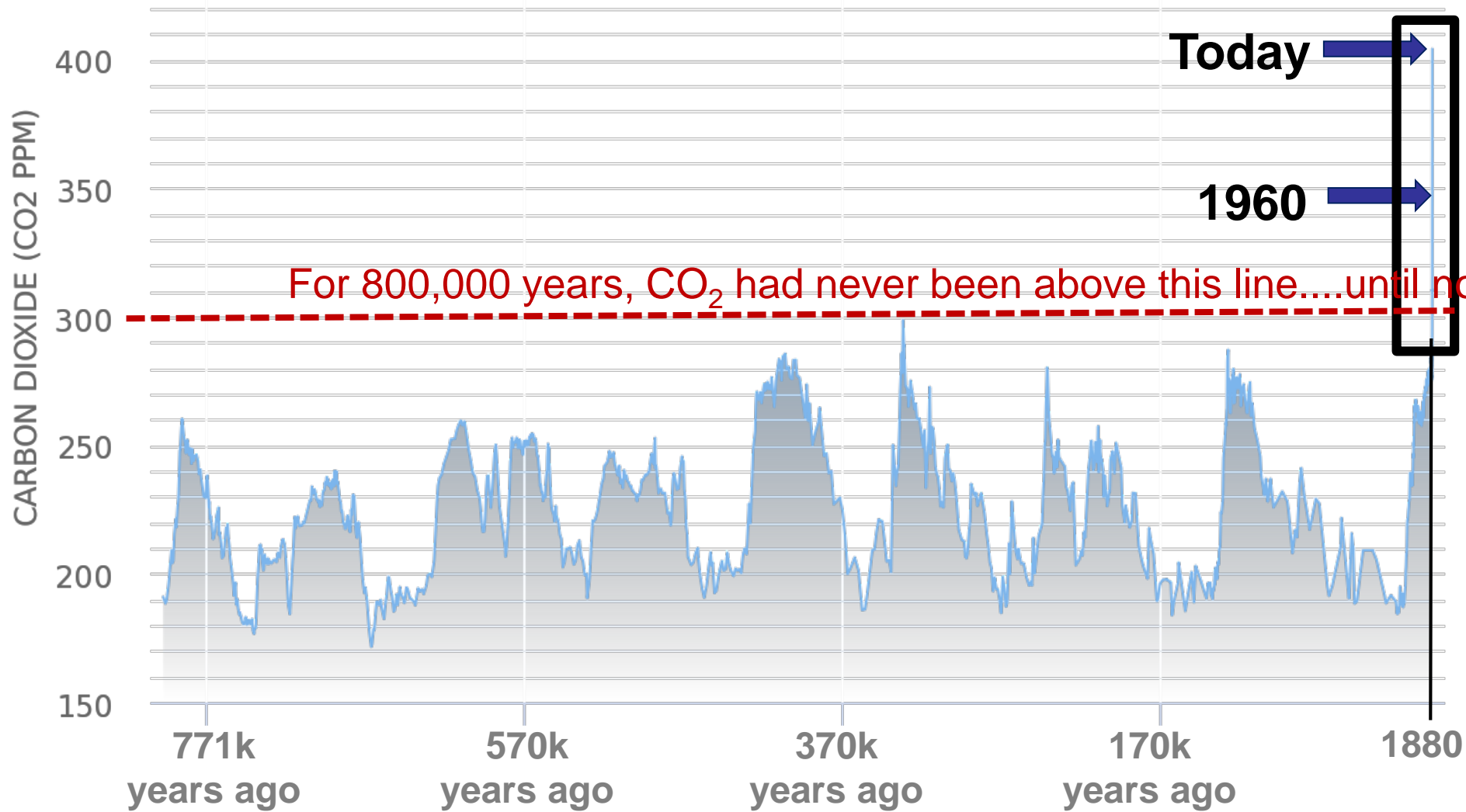


Image by Adam Nieman

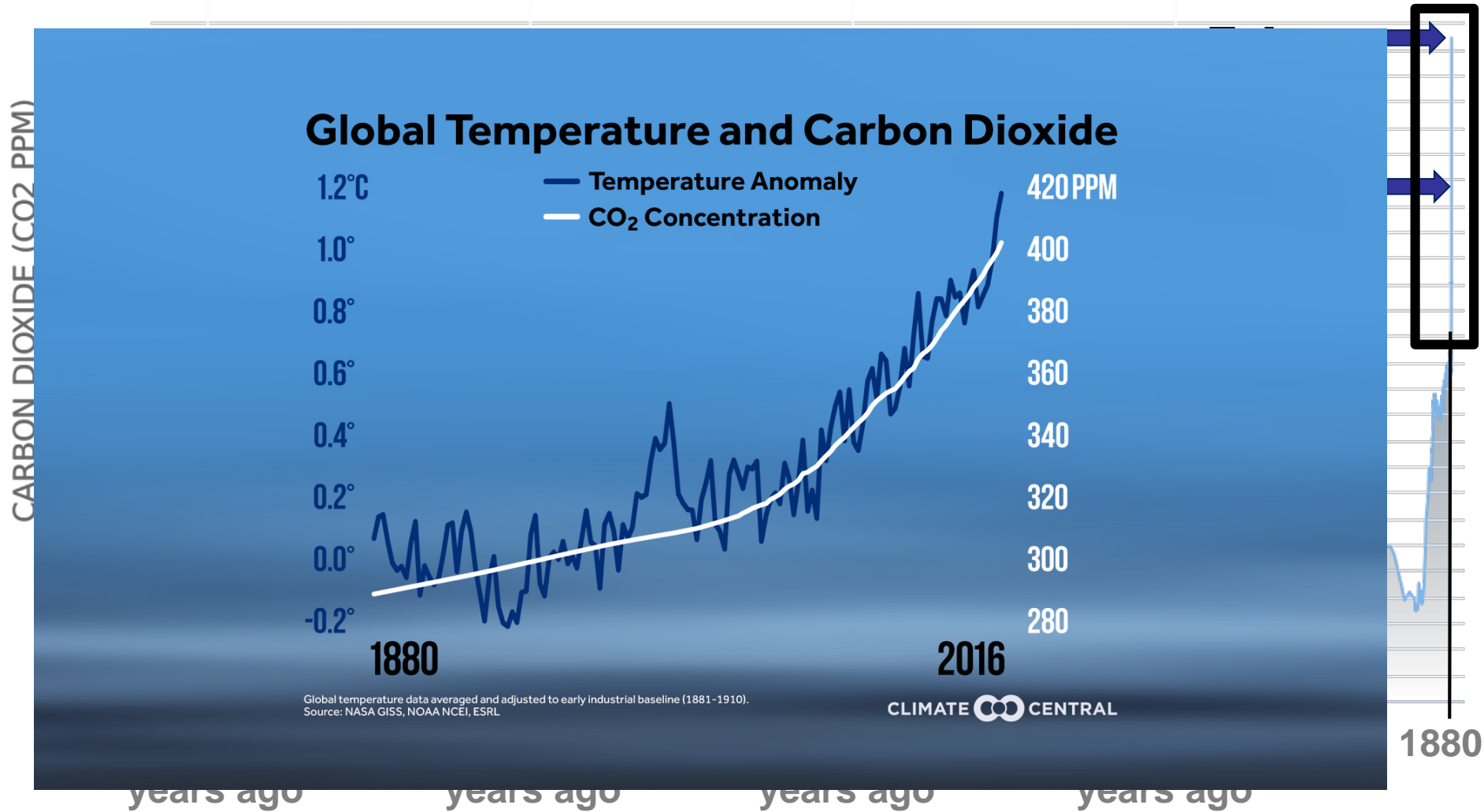


# Human activities are adding heat-trapping gases to the atmosphere





# Human activities are adding heat-trapping gases to the atmosphere



+ 1.5 °F  
+ 1 °F  
+ 0.5 °F  
20<sup>th</sup>  
Century  
Average  
- 0.5 °F  
- 1 °F

1884

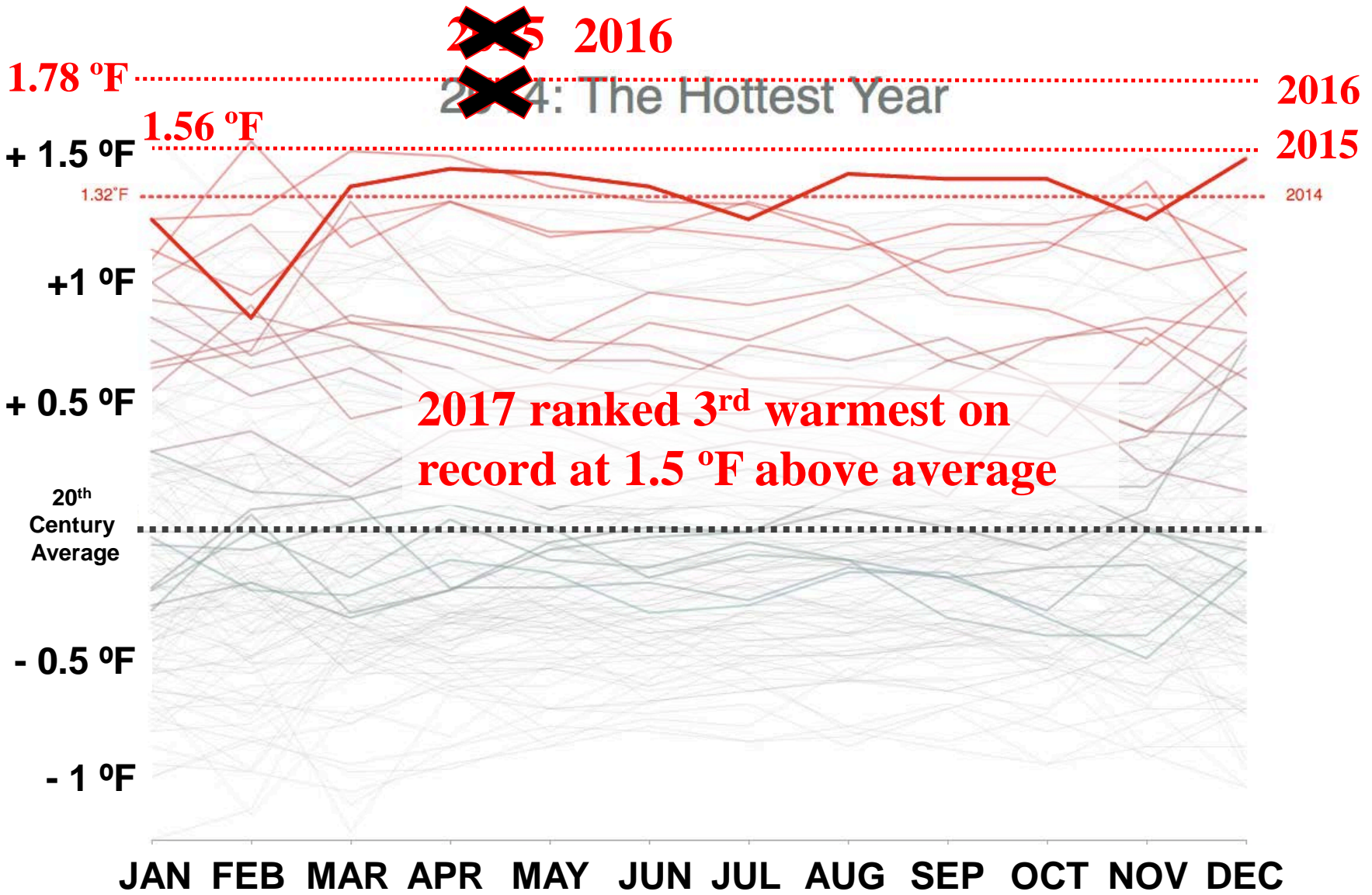
1881 **New Record**

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

# Global Average Temperature



SOURCE: GHCN-M & ICOADS Data Sets Provided by NOAA



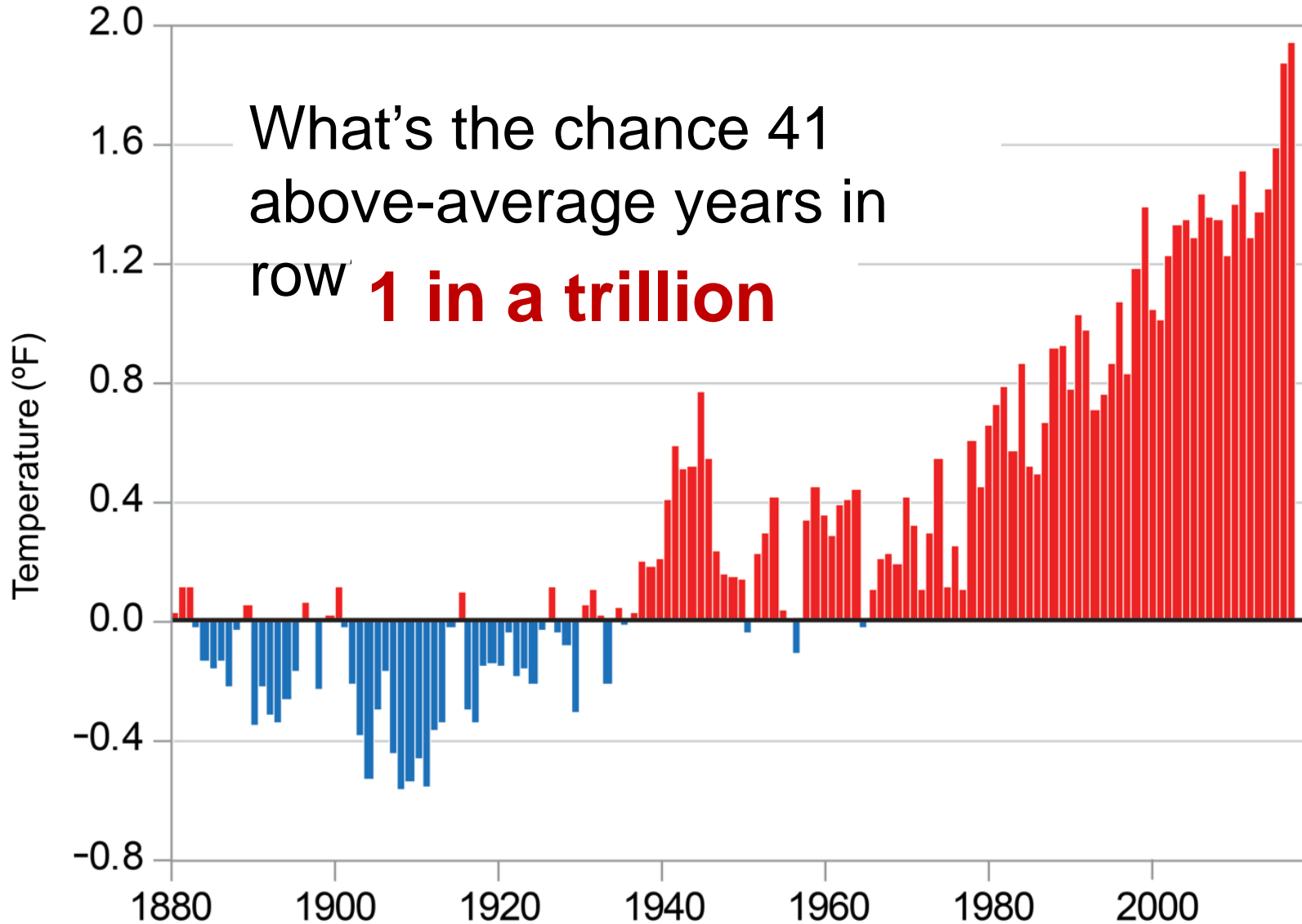
# Global Average Temperature



SOURCE: GHCN-M & ICOADS Data Sets Provided by NOAA

# Global Average Temperature

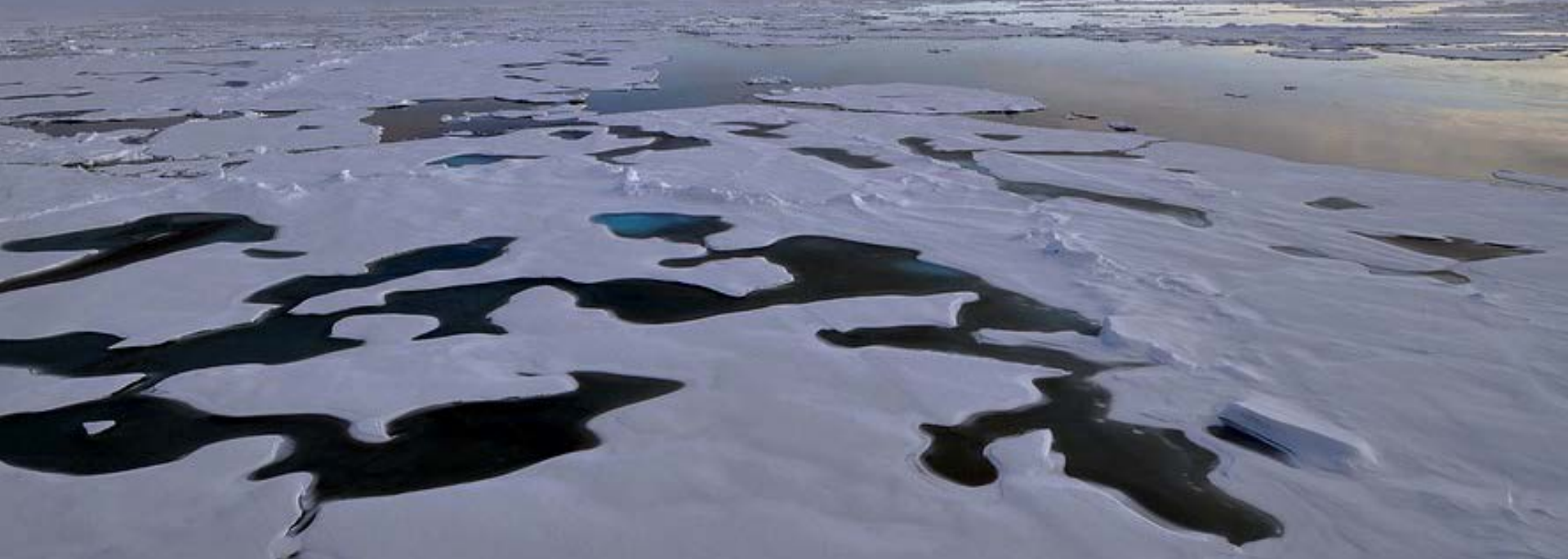
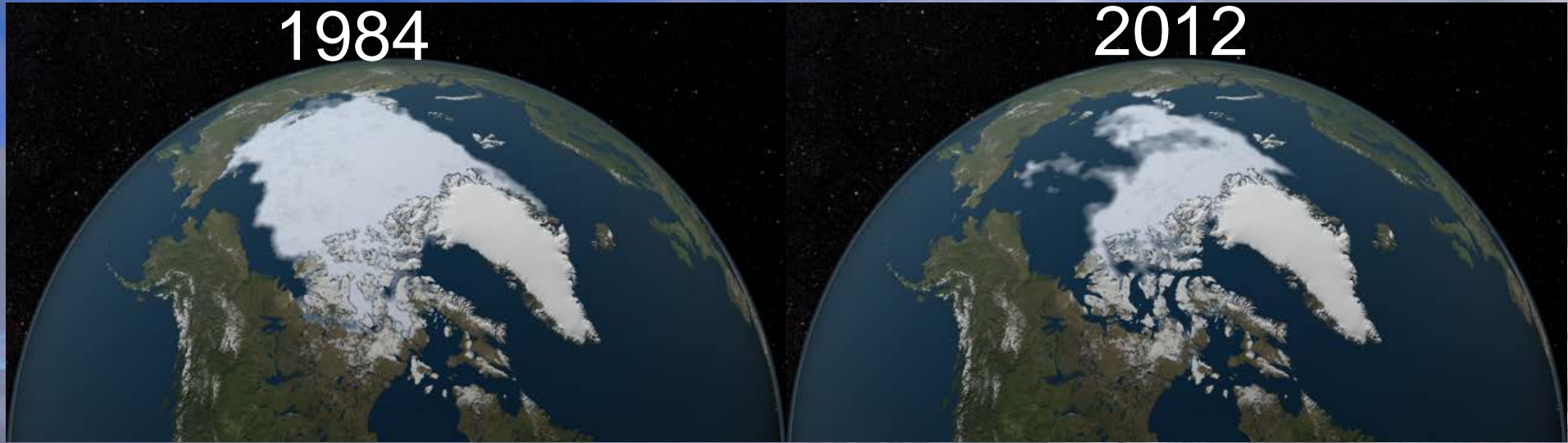
Difference from long-term average



# Arctic Sea Ice Extent

1984

2012







South Bend, IN – Feb

Photo Credit: Santiago Flores, South



A simple black outline map of the state of Indiana, centered on the page. The map shows the state's irregular borders, including the northern and southern edges.

What will climate change mean in  
**INDIANA?**

# PURDUE CLIMATE CHANGE RESEARCH CENTER

Exploring the causes and impacts of climate change, improving predictive models to project future climate conditions, and pursuing novel ideas for mitigation and adaptation.



## **ESTABLISHED IN 2004**

Broad-based support from academic and administrative units at Purdue

## **INTERDISCIPLINARY**

80+ faculty representing 22 departments

## **NON-PARTISAN**

Objective, science-based information

## **COLLABORATIVE**

Partnerships with schools, NGOs, businesses, government agencies, farmers



# IN CCIA

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## Indiana Climate Change Impacts Assessment

Prepared for: The Honorable Richard G. Lugar

Prepared by: The Purdue Climate Change Research Center

February 2008



# IN CCIA Reports

*Putting global change into local perspective*



Climate



Health



**May 15**

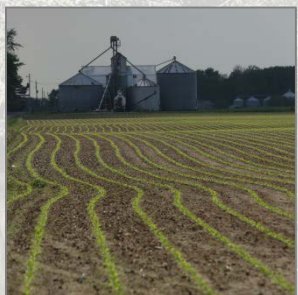
Forest Ecosystems



Urban Green Infrastructure



Aquatic Ecosystems



Agriculture



Tourism & Recreation



Water Resources



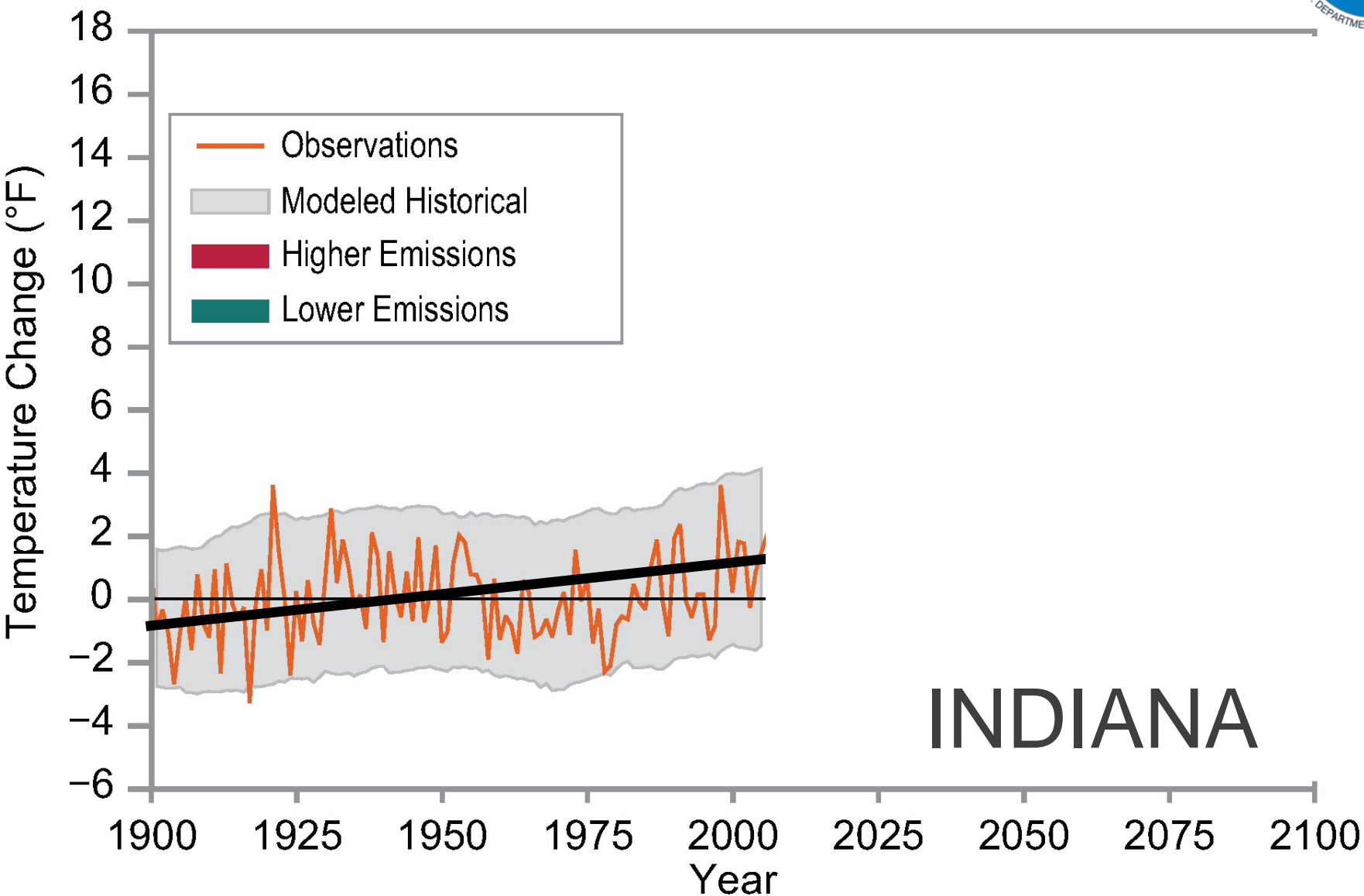
Energy



Infrastructure

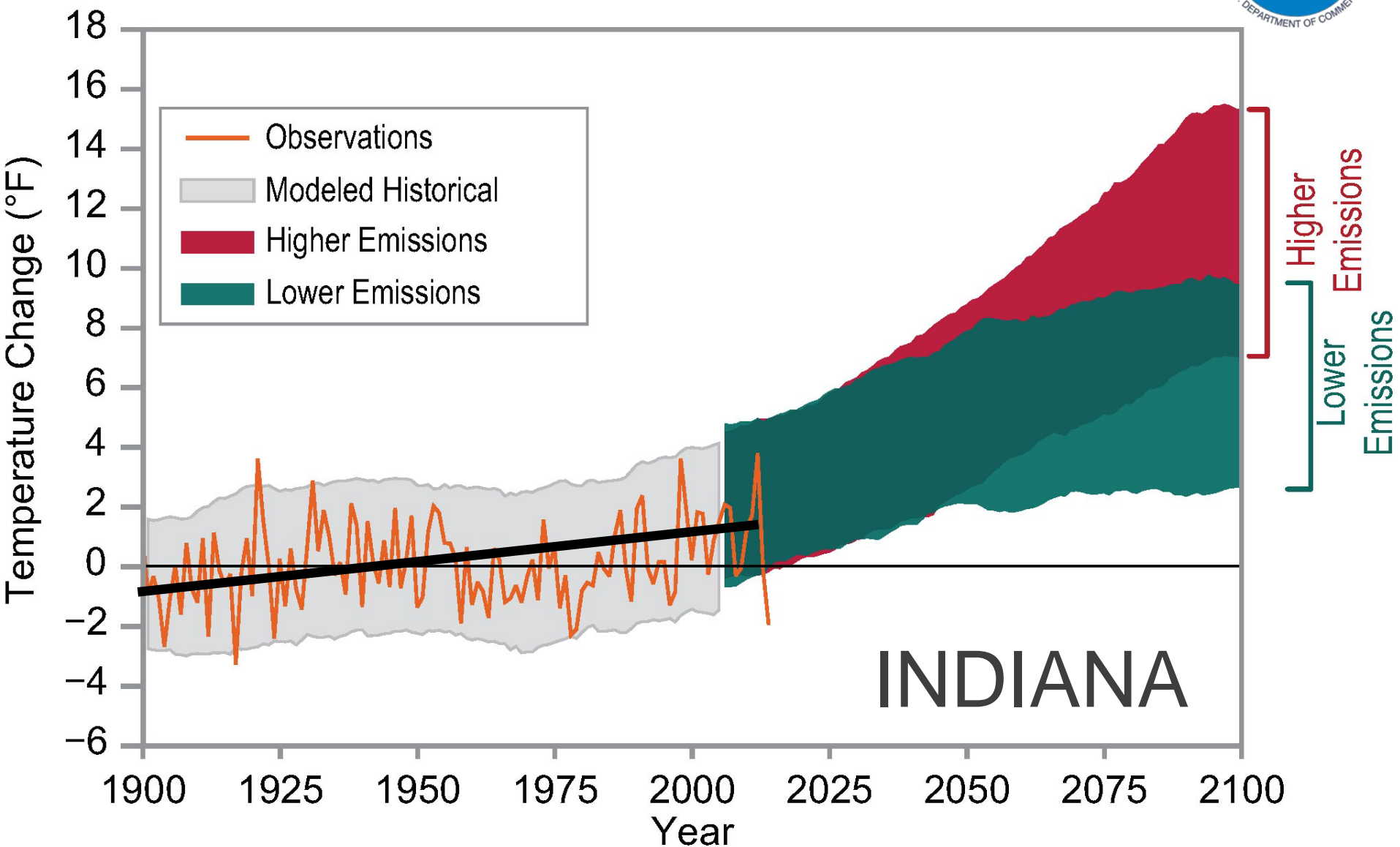


# Annual Statewide Average Temperature



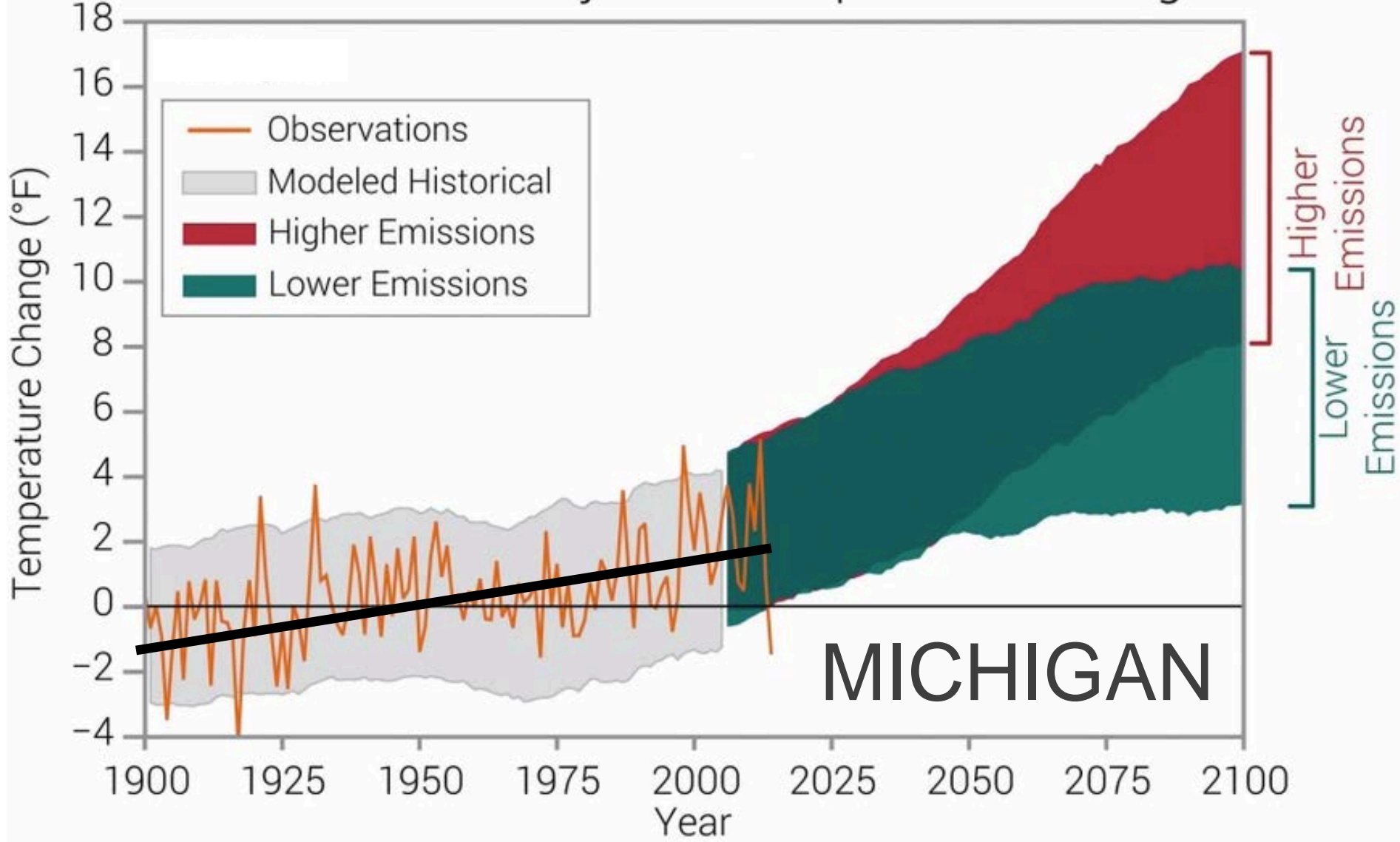
INDIANA

# Annual Statewide Average Temperature

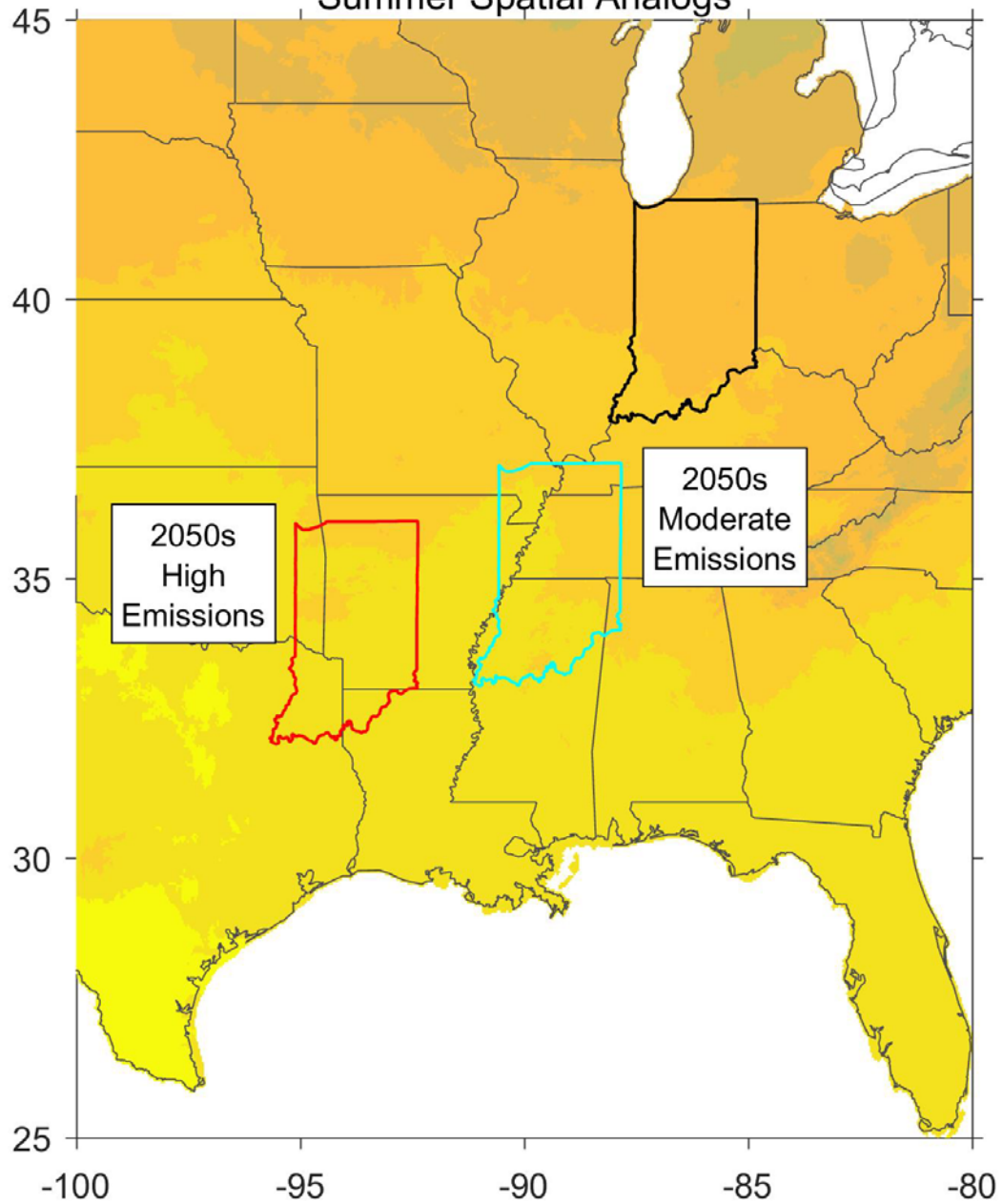




# Observed and Projected Temperature Change

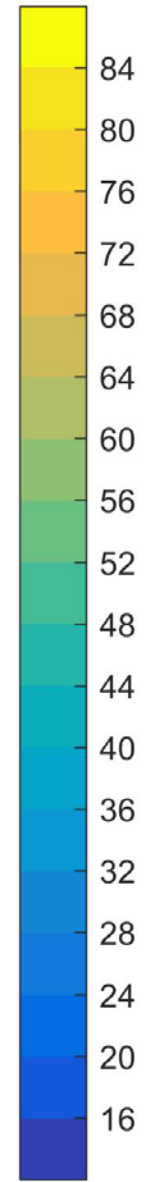


# Summer Spatial Analogs



# 2050s

(2041 to 2070)

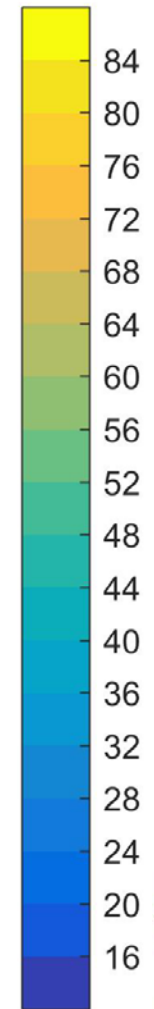
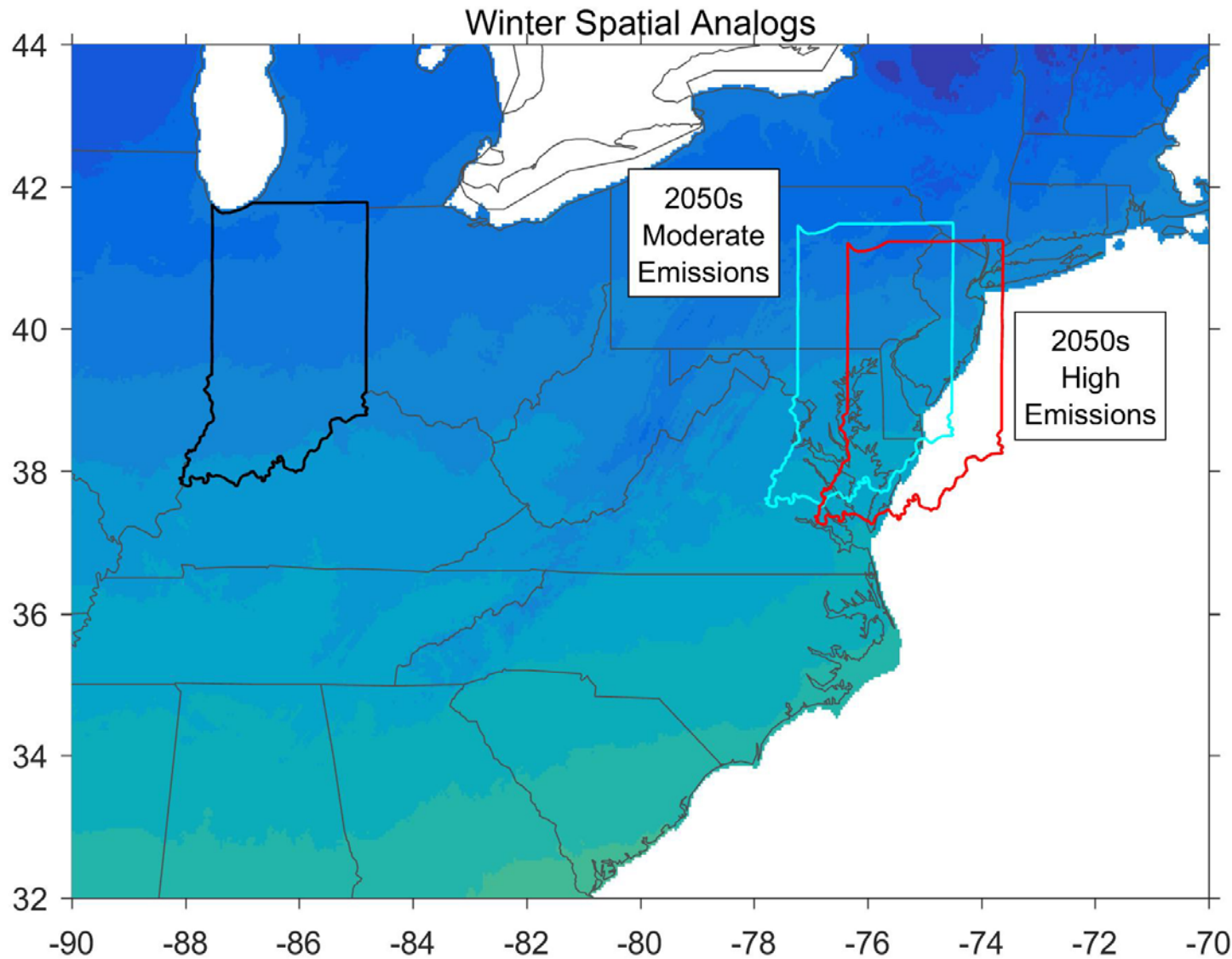


IN CCIA

Based on seasonal average temperature and precipitation

# 2050s

(2041 to 2070)



**IN CCIA**

Based on seasonal average temperature and precipitation



# Days Above 90 °F

Annual Count

14

PAST  
1915-2013

60

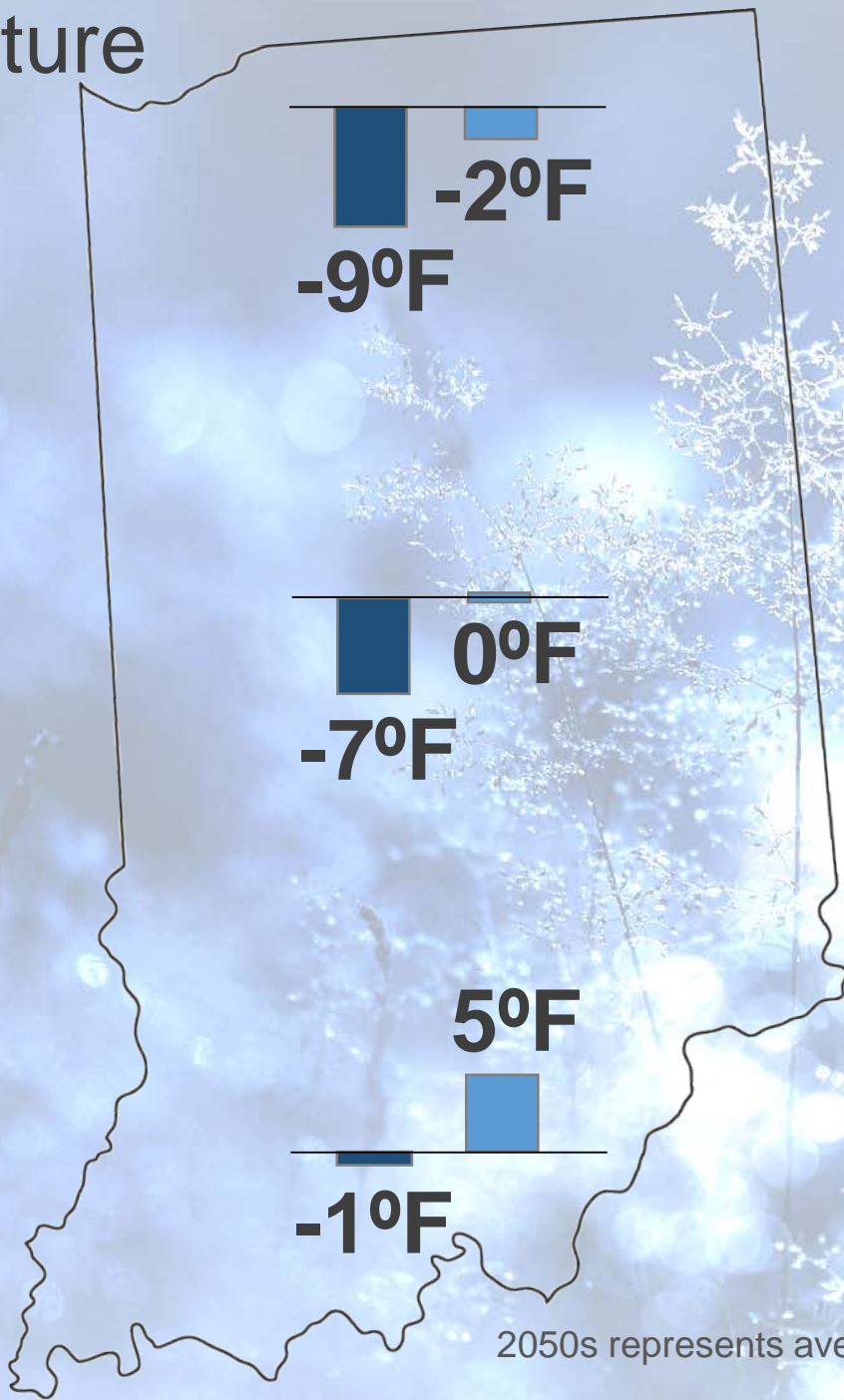
FUTURE  
2050s



Elkhart County, Indiana

Future data based on high emissions scenario  
2050s represents 30-year period 2041 to 2070

# Lowest Temperature of the Year



Future data for high emissions scenario for 2050s

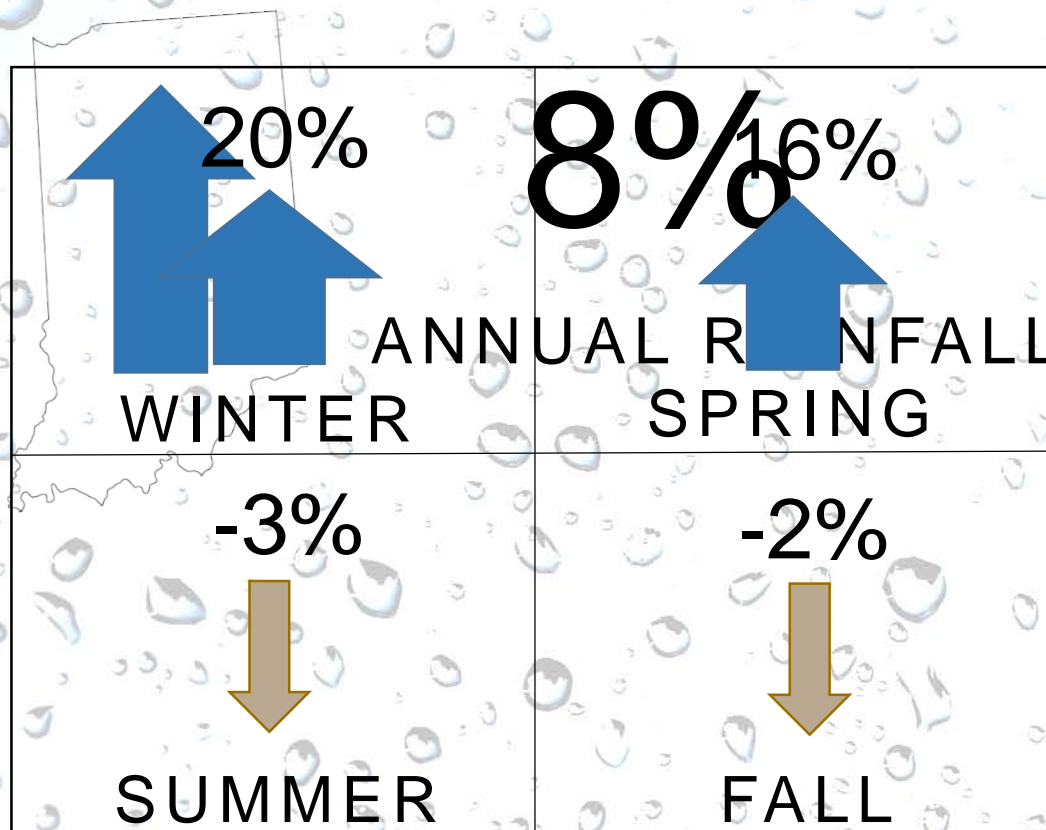
2050s represents average from 2041 to 2070

# 2050s

Relative to  
1971-2000 average



**IN CCIA**



**Statewide Average**

2050s represents average from 2041 to 2070

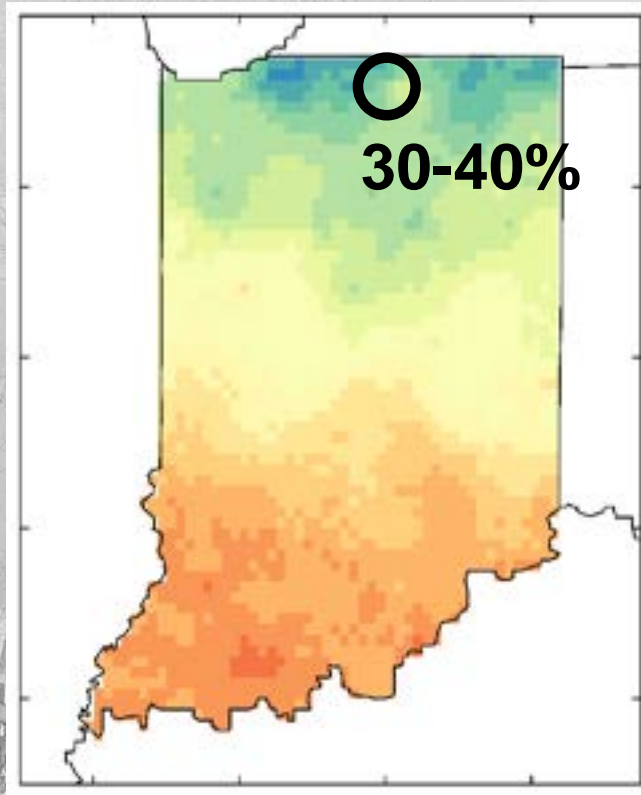
*Future data based on high  
emissions scenario*

# Rain or Snow?

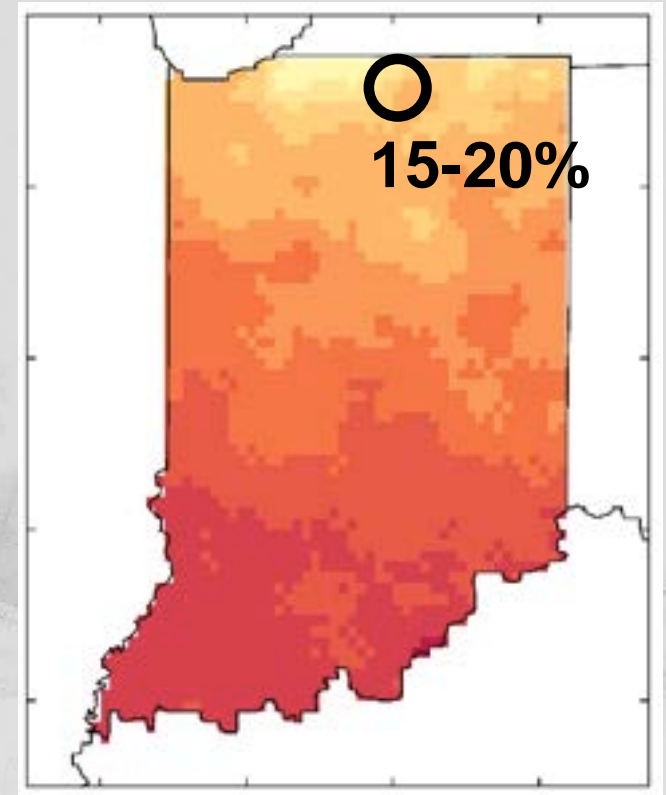
Fraction of Nov-Mar precipitation falling as snow



1915-2013



2050s



*Based on high emissions scenario for 2050s  
2050s represents average from 2041 to 2070*

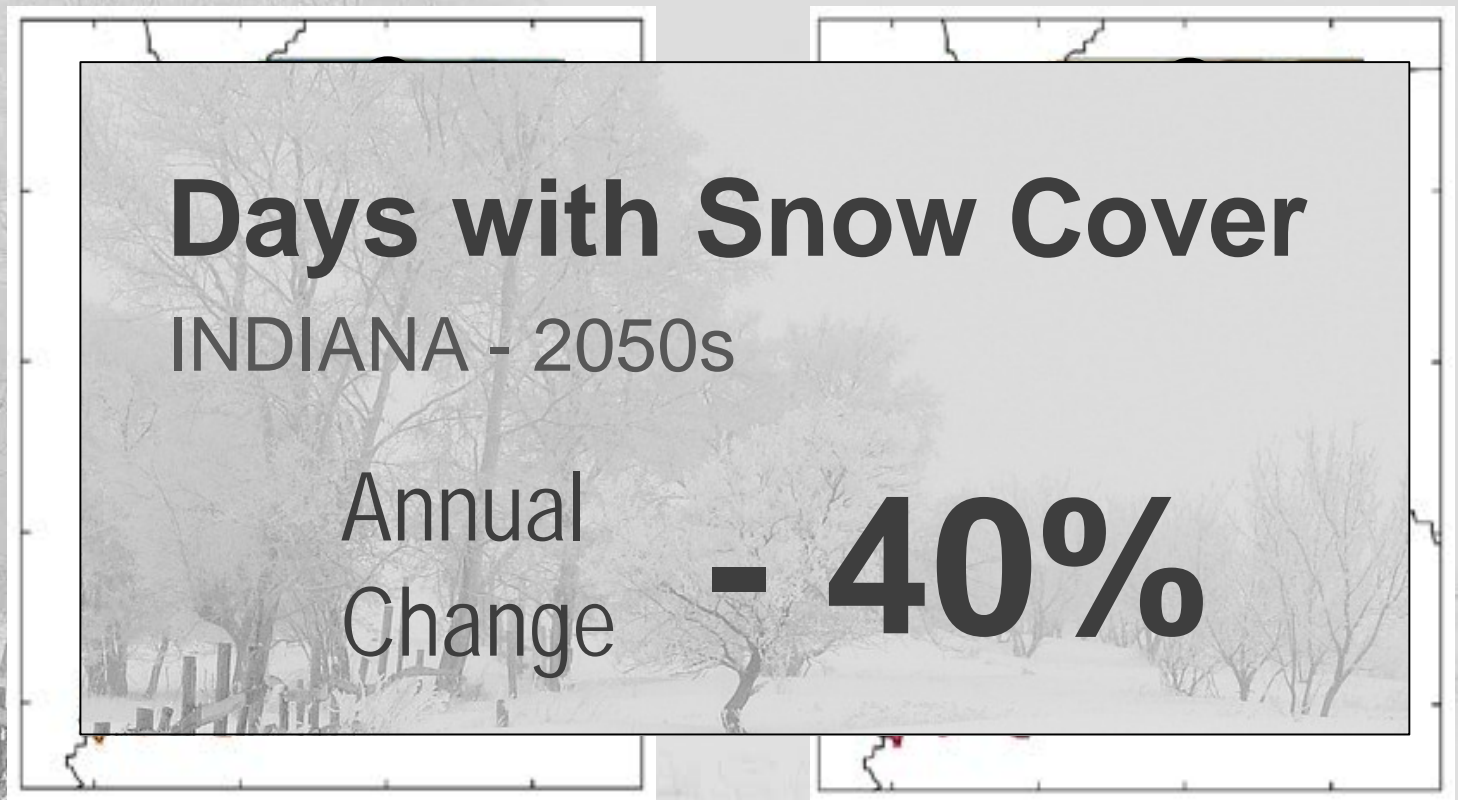
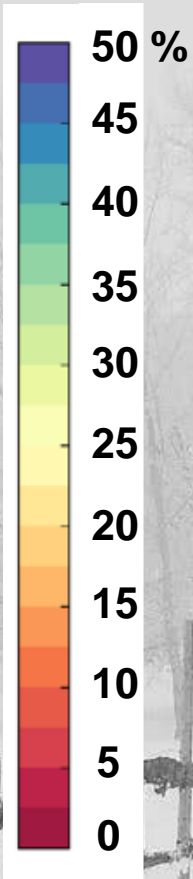
# Rain or Snow?

Fraction of Nov-Mar precipitation falling as snow



1915-2013

2050s



*Based on high emissions scenario for 2050s  
2050s represents average from 2041 to 2070*





# More Water Entering Our Rivers by Mid-Century

Project change in total runoff

Annual Change **+7%**

Annual change in tile drainflow **+34%**

*Future data based on high emissions scenario;  
2050s represents average from 2041 to 2070;  
Percent change is relative to 1984-2013 average*

**PRELIMINARY DATA**  
North Central Indiana



al



Change 9 / 0

Spring  
Change 25%



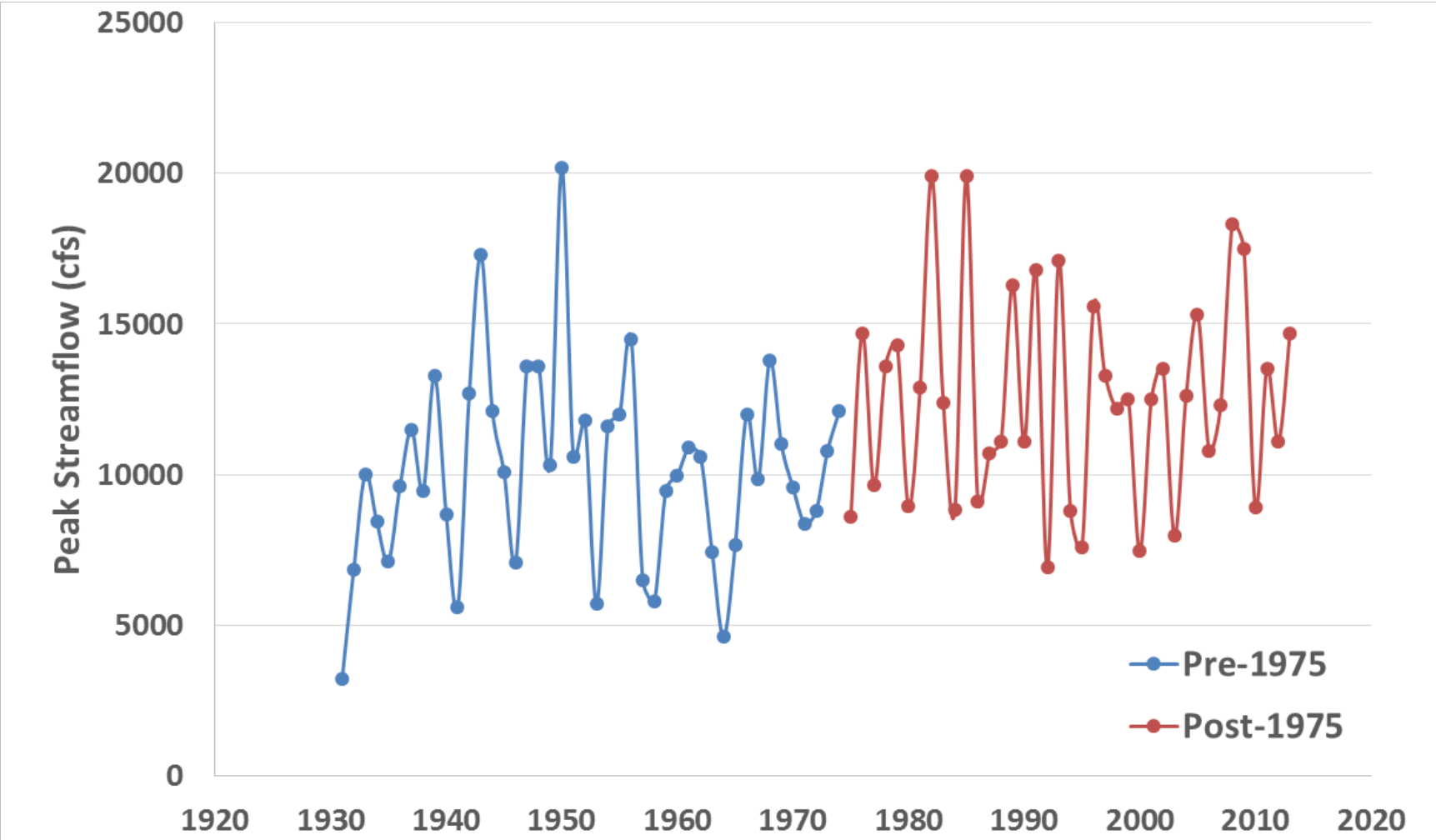
**PRELIMINARY DATA**

North Central Indiana

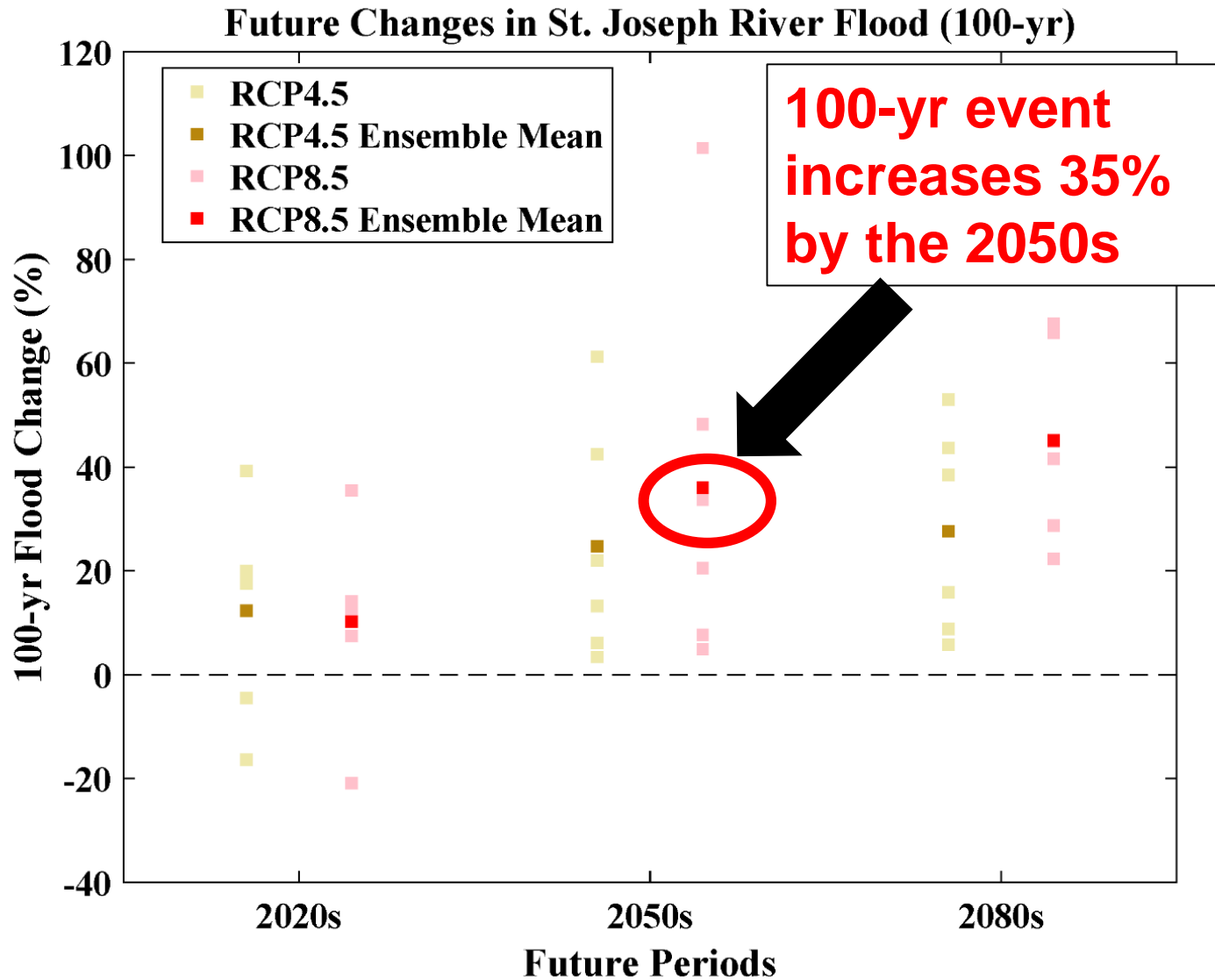
*Future data based on high emissions scenario;  
2050s represents average from 2041 to 2070;  
Percent change is relative to 1984-2013 average*

# Peak Annual Streamflow

Observations for St. Joseph River at Niles, MI




# Projected Changes in the Magnitude of the 100-yr Flood



# Water resource management will be critical

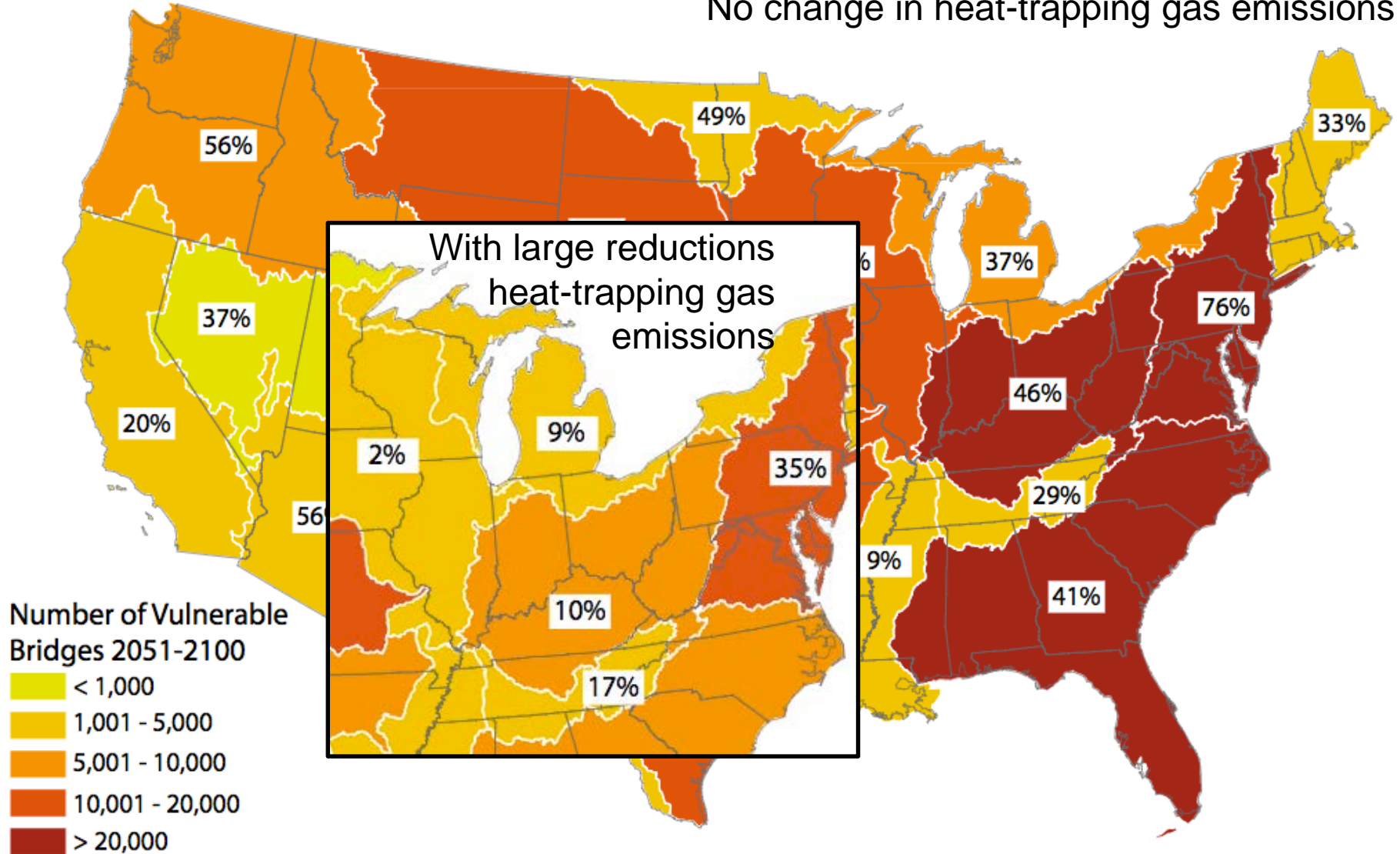
- Indiana is getting warmer and wetter
- Extreme heat & heavy rainfall will challenge us
- Seasonal changes are critical to managing risks



**Where we  
end up  
depends on  
the choices  
we make!**

# Vulnerable Bridges

No change in heat-trapping gas emissions



CIRA analysis identified bridges that may be vulnerable to increased peak river flows

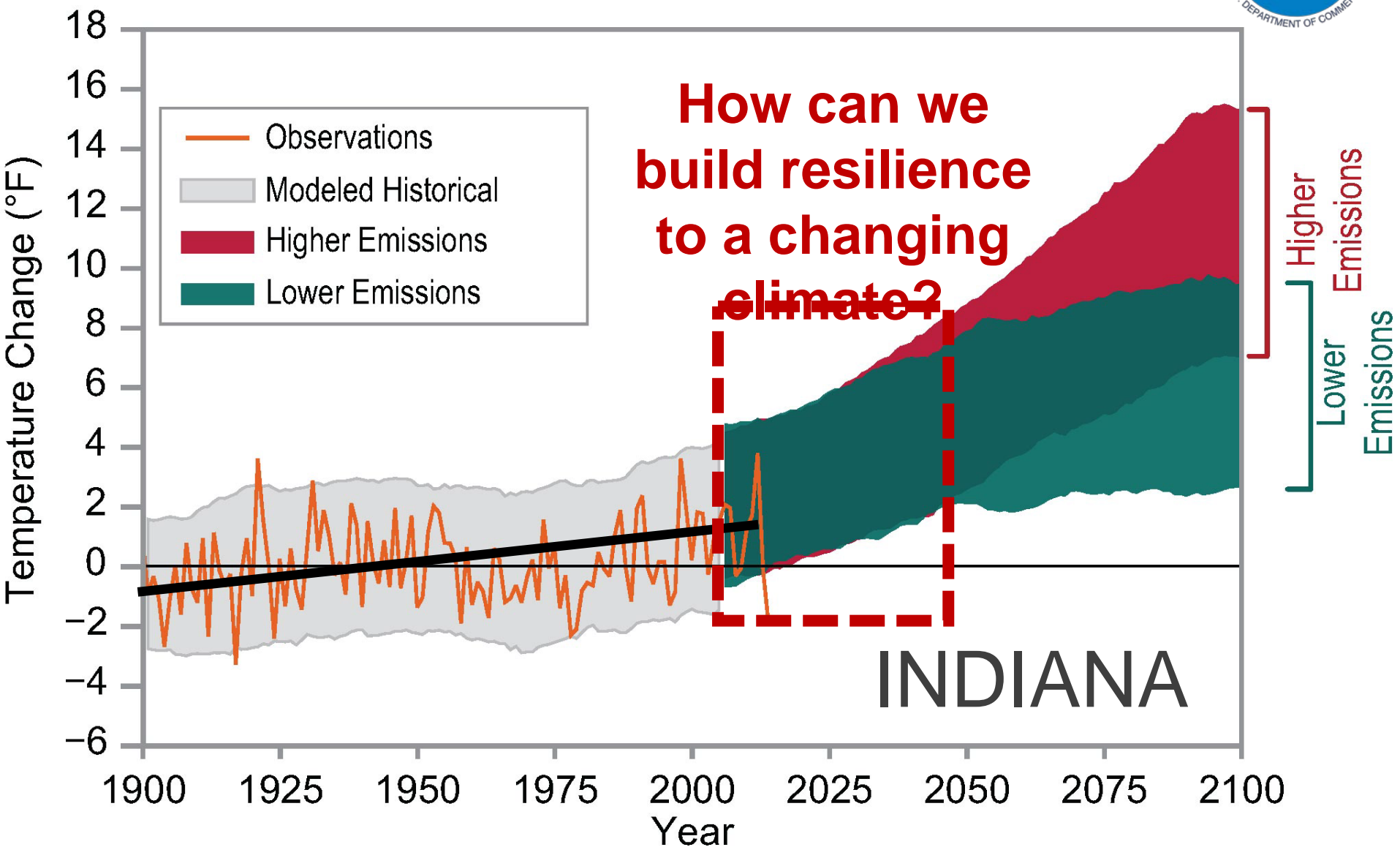
# Water Quality

**\$2.6 – 3 billion in avoided costs\***  
from poor water quality when  
emissions are reduced

EPA 2015

\*Estimate for contiguous US, compares costs  
of high and low emissions scenario in 2100

# Annual Statewide Average Temperature





# Stay informed, stay connected

<http://IndianaClimate.org>



@PurdueCCRC

**Jeffrey Dukes**

PCCRC Director

[jsdukes@purdue.edu](mailto:jsdukes@purdue.edu)

@DukesJeff

**Melissa Widhalm**

IN CCIA Coordinator

[mwidhalm@purdue.edu](mailto:mwidhalm@purdue.edu)