

# New England Climate, Forests and Farms

Dr. Elizabeth Burakowski  
UVAW Forum May 15, 2018





LEWIS S. BURWELL

Dealer in

...SPANISH...

Merino Sheep



Bridport, Vermont.

Addis n County.

Choice Stock for sale.

STOCK RAM FOR 1906





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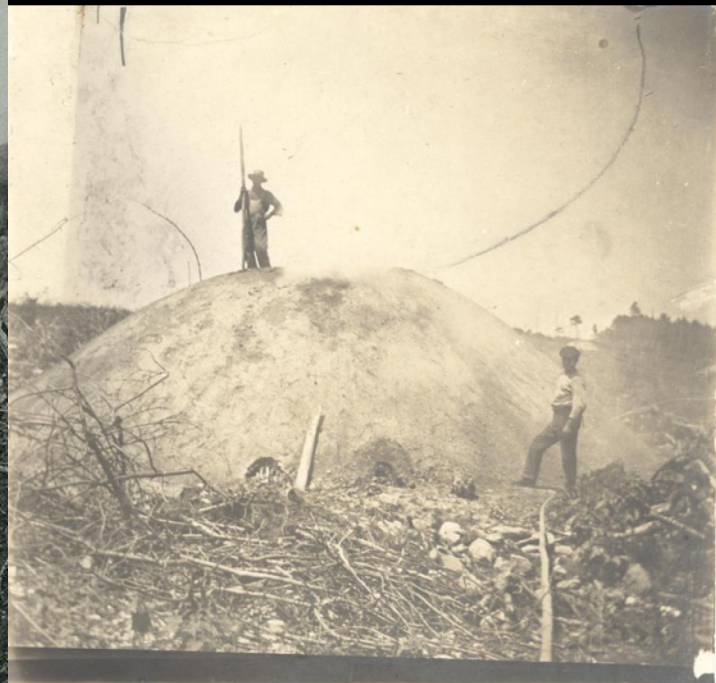
Merino Sheep

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STOCK RAM FOR 1906

Choice Stock for sale.







STOCK RAM FOR 1906

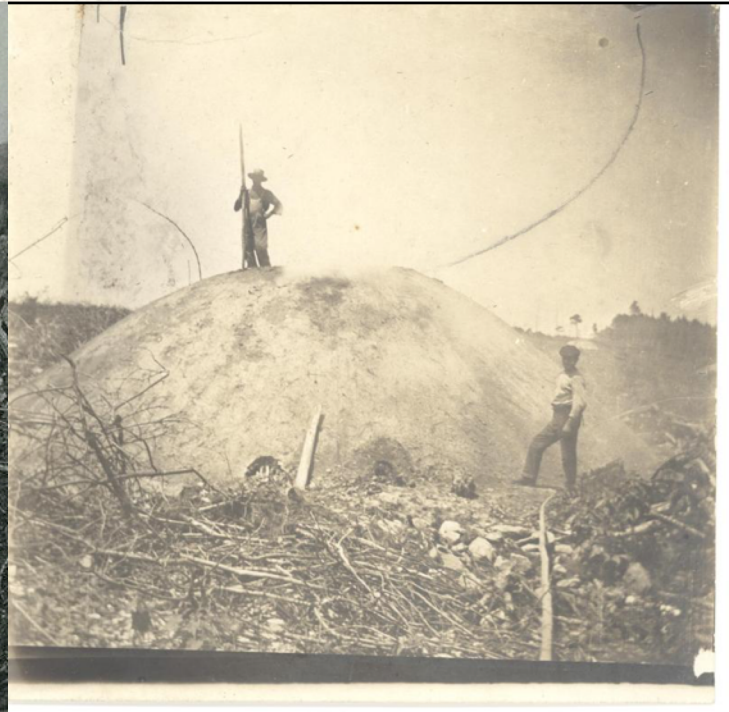
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Dealer in  
...SPANISH...

**Merino Sheep**

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Addison County.

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1880s



Harvard University

2010



David Foster



# Biophysical properties that affect surface temperature

Albedo



Canopy  
Roughness



Evaporative  
Cooling





# Albedo

An aerial photograph showing a dark, dense forest on the left side of a hill, transitioning into a lighter, textured field of crops or grass on the right side. The terrain is sloping downwards from the top left towards the bottom right.

“And when the snows are gone, the air moving over the earth is not so much chilled.”

Benjamin Franklin, 1763



# Albedo

Warmer

Cooler



# Biophysical properties that affect surface temperature

Albedo



Forests warmer during the day

Canopy Roughness





# Canopy Roughness

“The cultivated earth, as the sun advances above the horizon in the morning, acquires from it an intense heat, which is retained and increased throughout the day.” Thomas Jefferson, 1786.



# Canopy Roughness

Warmer

Cooler

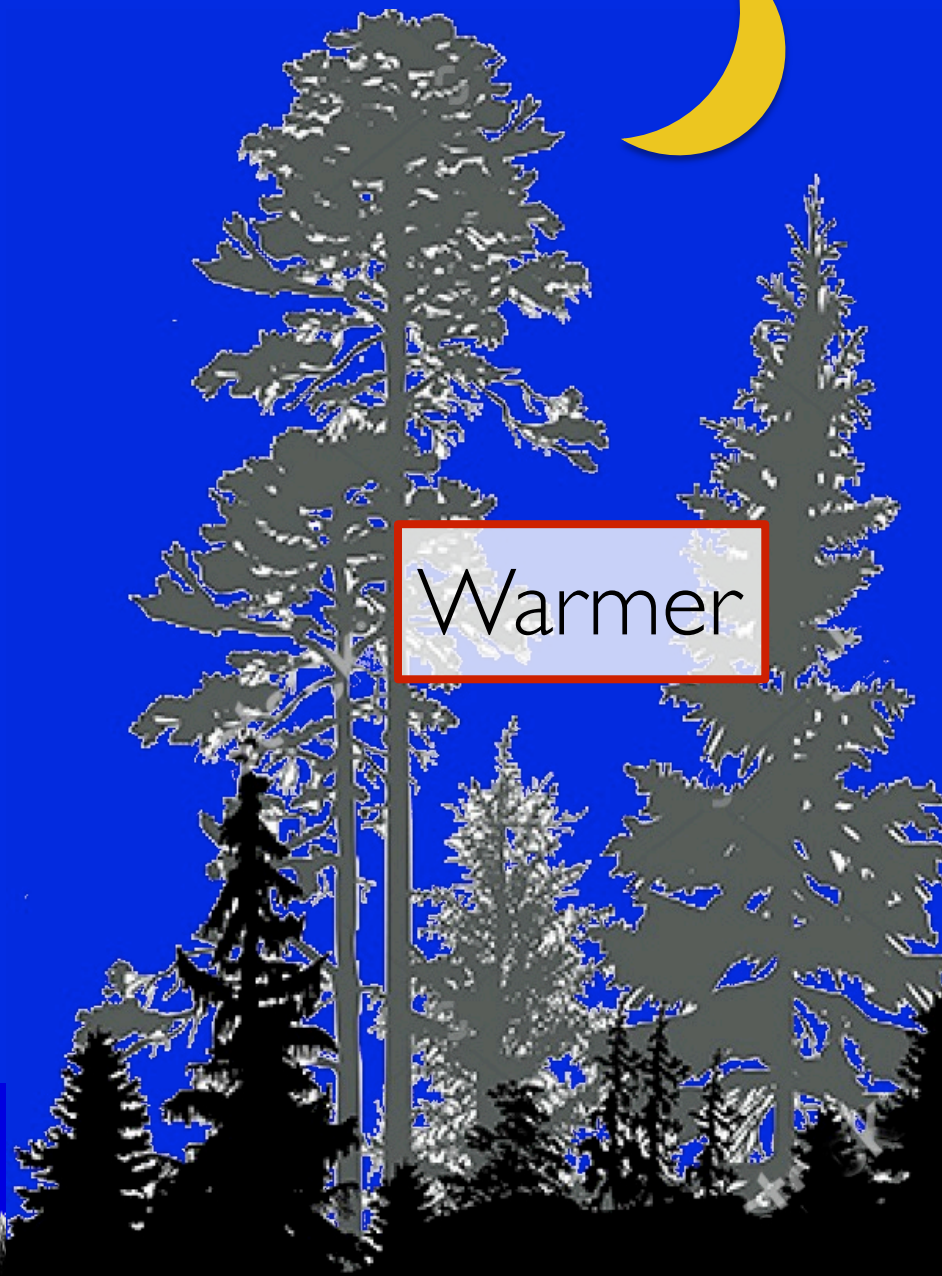
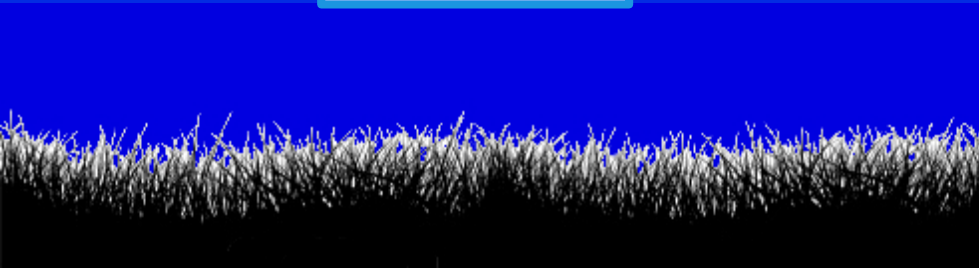


# Canopy Roughness



Warmer

Cooler





# Biophysical properties that affect surface temperature

Albedo



Forests warmer during the day

Canopy Roughness



Forests cooler during the day, warmer at night

Evaporative Cooling





# Evaporative Cooling

“The vapours that arise from forests, are soon converted into rain, and that rain becomes the subject of future evaporation, by which the earth is further cooled.” Hugh Williamson, 1811





# Evaporative Cooling

Generally  
Cooler

Generally  
Warmer



# Biophysical properties that affect surface temperature

Albedo



Forests warmer during the day

Canopy Roughness



Forests cooler during the day, warmer at night

Evaporative Cooling



Forests generally cooler





Large scale reforestation in New England has likely led to warmer winters & cooler summers.

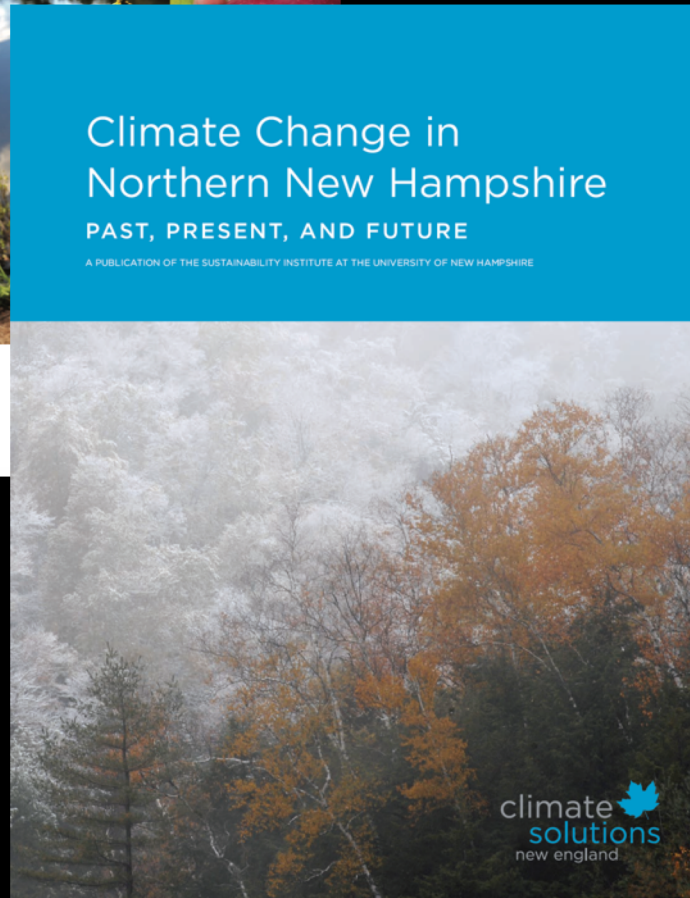
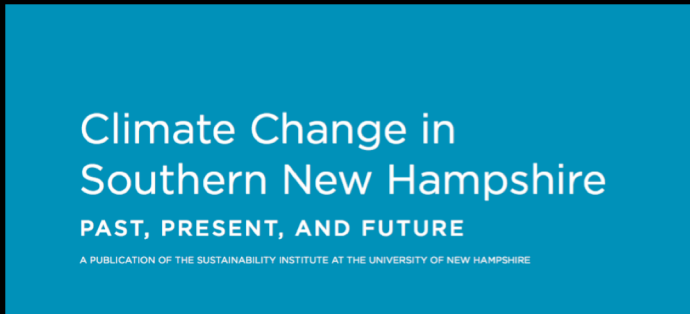


Harvard University

David Foster



# We know a lot about New England's past, what of the future?



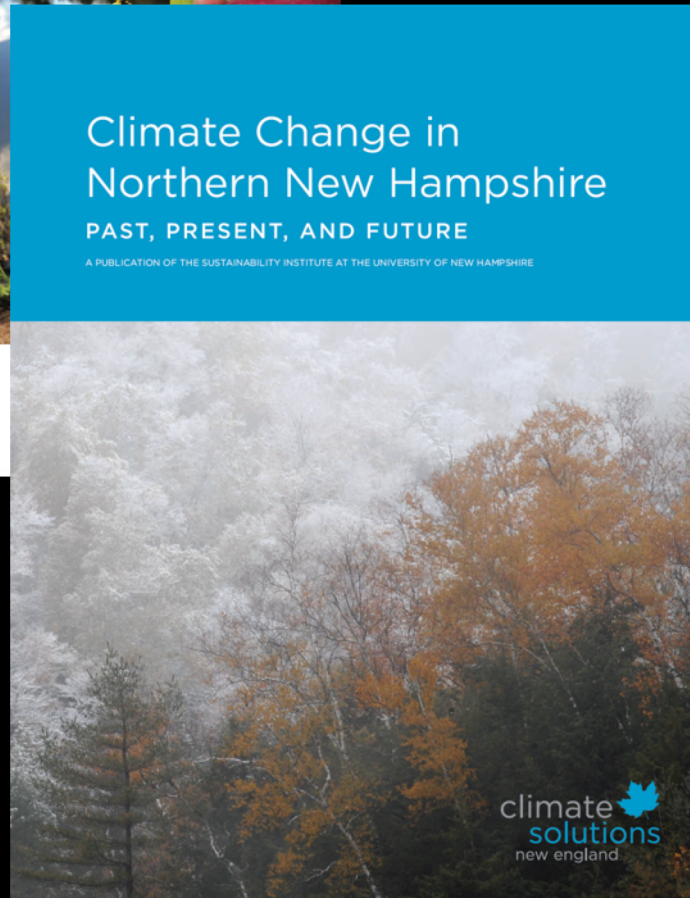
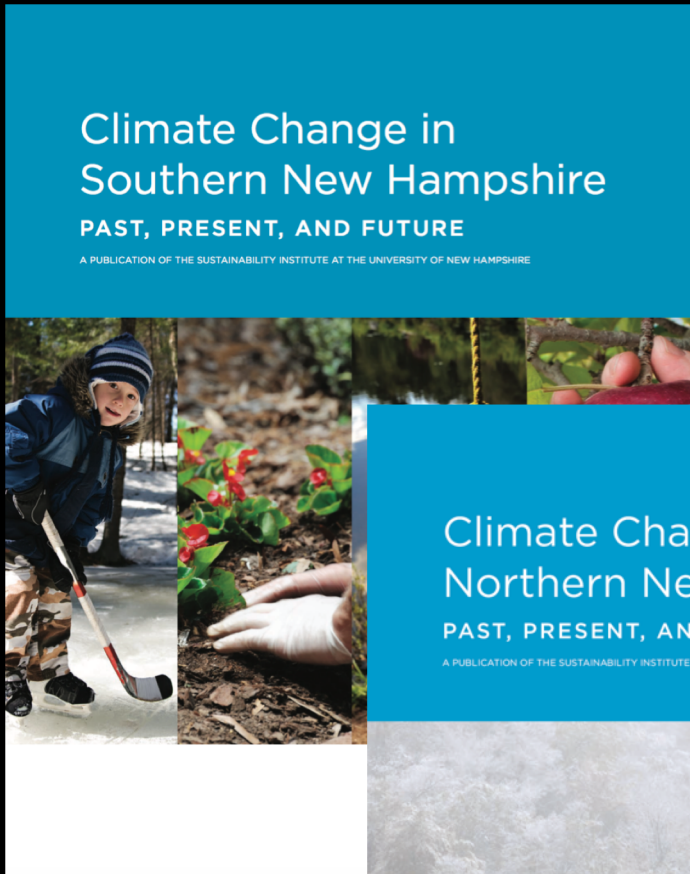
Include statistically downscaled climate projections for select cities and towns using four climate models, 1960-2100.

Wake et al.  
2014a, 2014b

<http://ddc-climate.sr.unh.edu/>



# We know a lot about New England's past, what of the future?

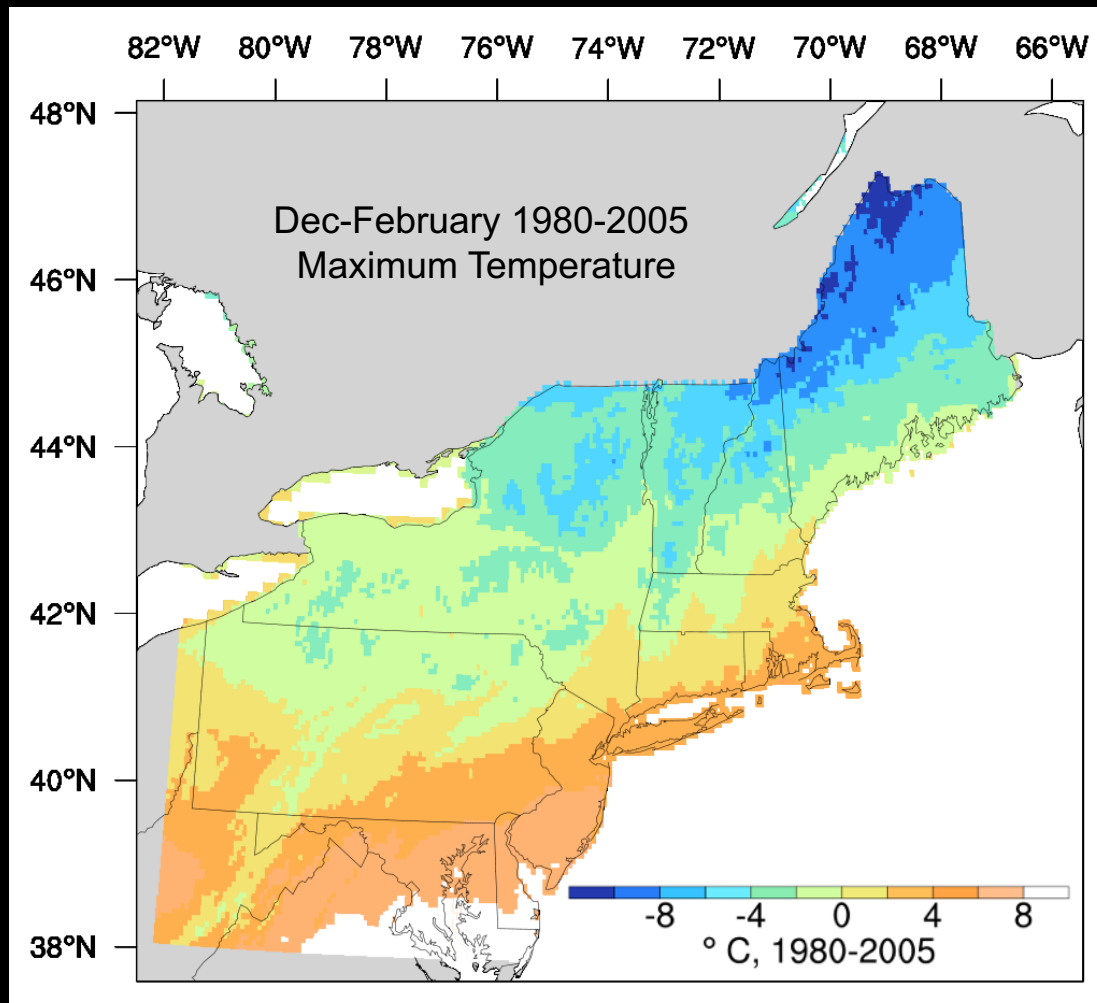


Summer 2018:  
Update to previous  
NH Climate  
Assessments.

Wake et al.  
2014a, 2014b



# LOCA Gridded Climate Projections:



- 1/16 degree (~4.5 miles)
- 1980-2099
- 29 climate models

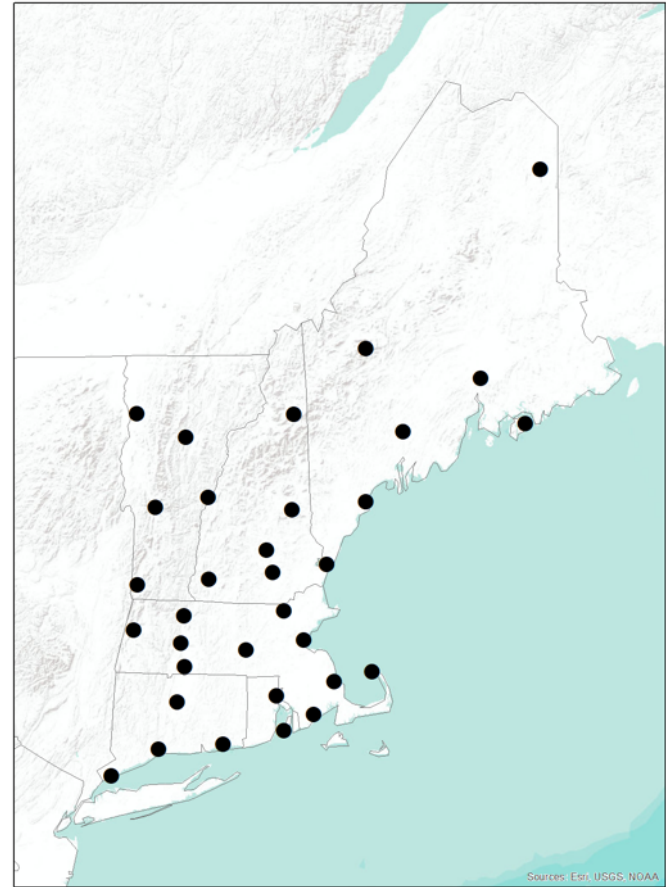
Pierce et al. 2014,  
*J. Hydromet*



# Spatial averaging

1. Select Cities\*
2. State
3. New England
4. Northeast domain

Email with your city's lat & lon  
[elizabeth.burakowski@unh.edu](mailto:elizabeth.burakowski@unh.edu)





# Climate Indicators

1. Annual and Seasonal Temperature and Precipitation



# Climate Indicators

1. Annual and Seasonal Temperature and Precipitation
2. Extreme temperature
  - Days  $> 90F, 95F$
  - Days  $< 32F, 0F$
  - Hottest day and night of year
  - Coldest day and night of year

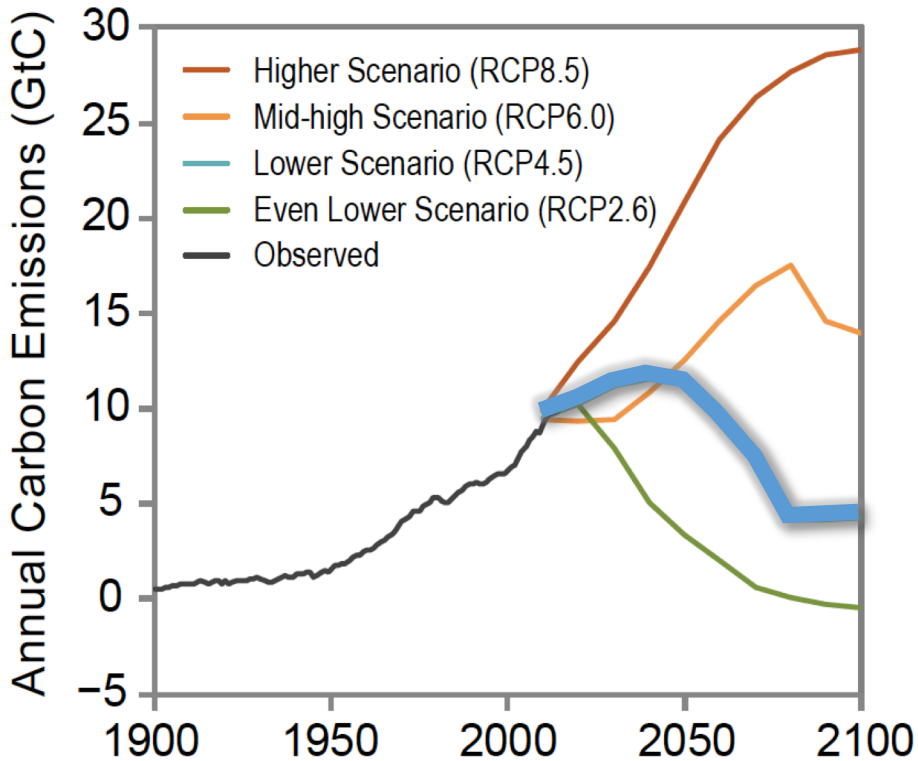
# Climate Indicators

1. Annual and Seasonal Temperature and Precipitation
2. Extreme temperature
  - Days  $> 90F$ ,  $95F$
  - Days  $< 32F$ ,  $0F$
  - Hottest day and night of year
  - Coldest day and night of year
3. Extreme precipitation
  - $> 1''$ ,  $2''$  in 1 day
  - $> 4''$  in 2 days
  - Wettest day of year

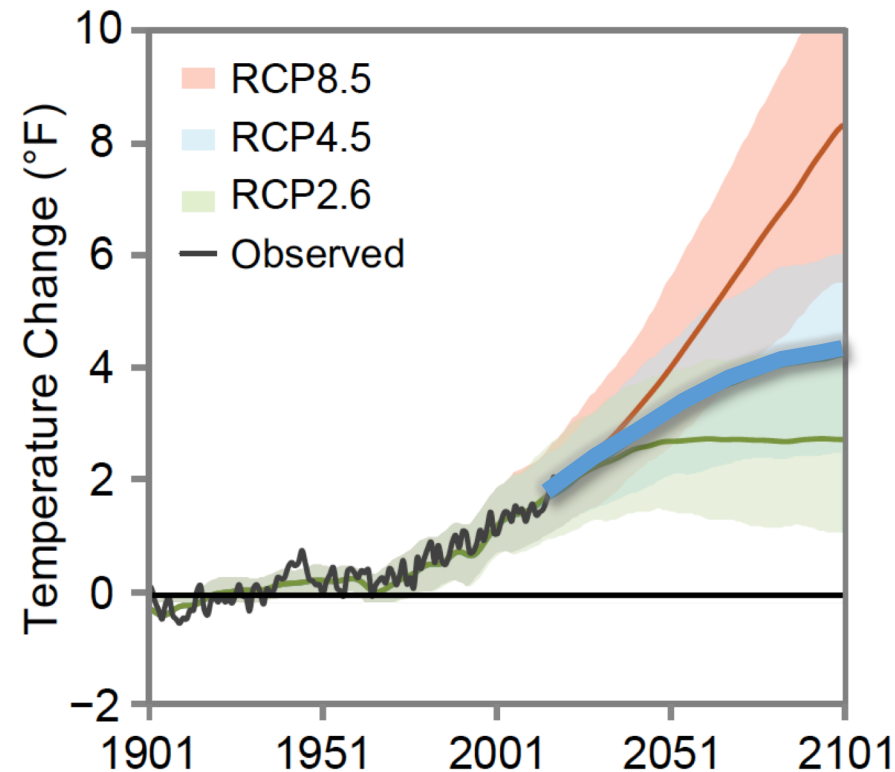


# Lower Emissions: RCP4.5

## Projected Annual Global Carbon Emissions

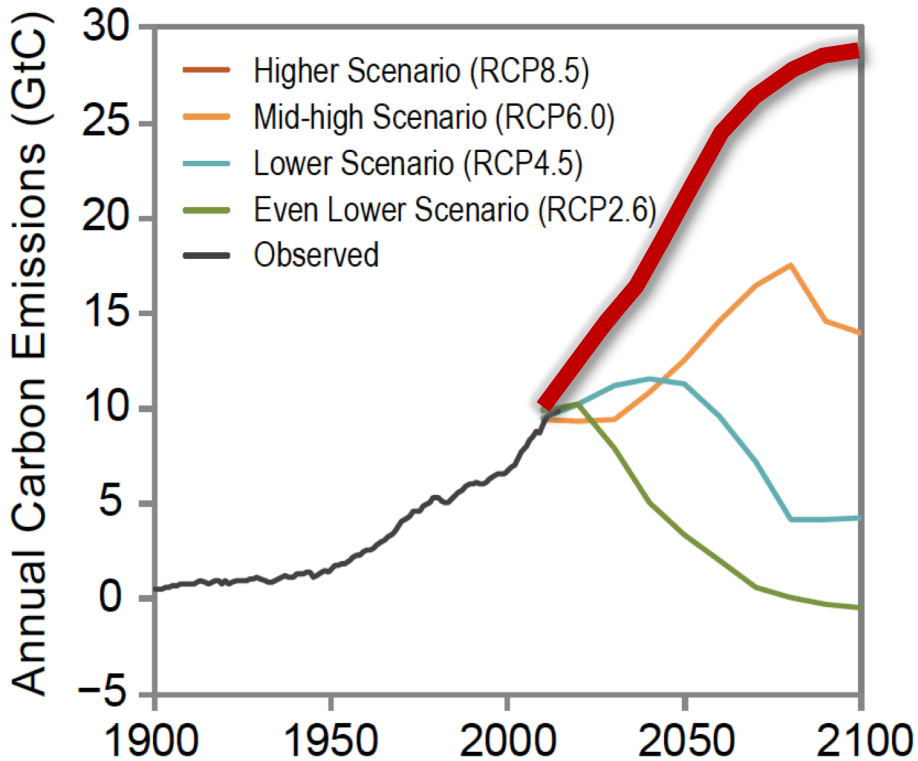


## Projected Global Temperatures

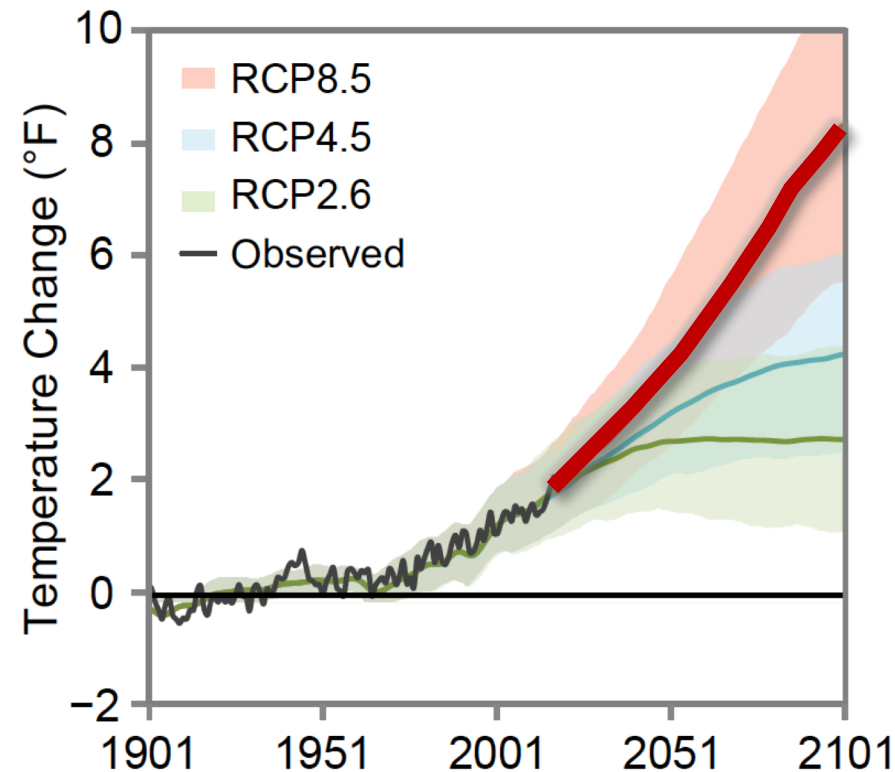


# Higher Emissions RCP8.5

## Projected Annual Global Carbon Emissions

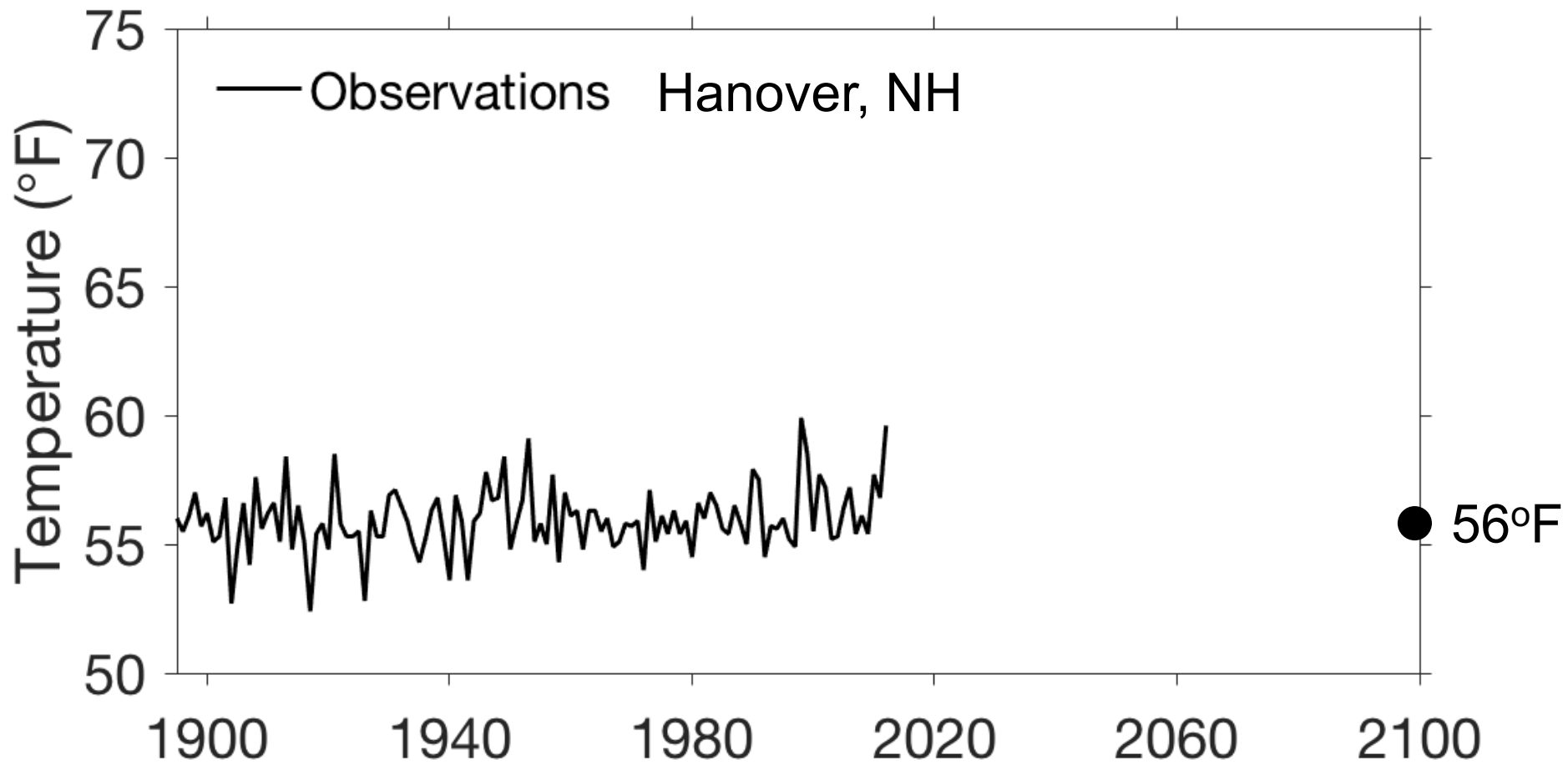


## Projected Global Temperatures

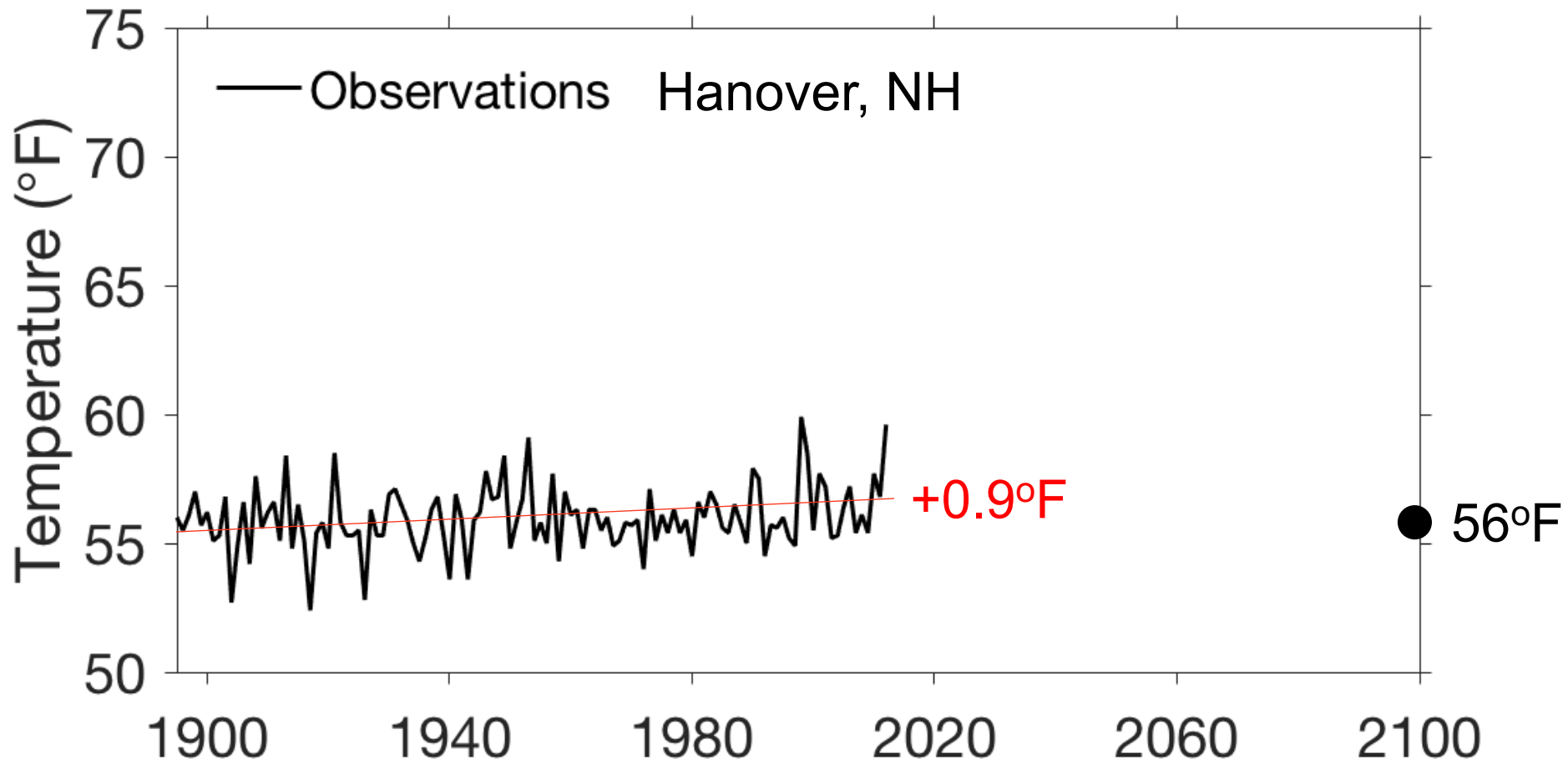




# Historical climatology: Annual Maximum Temperature

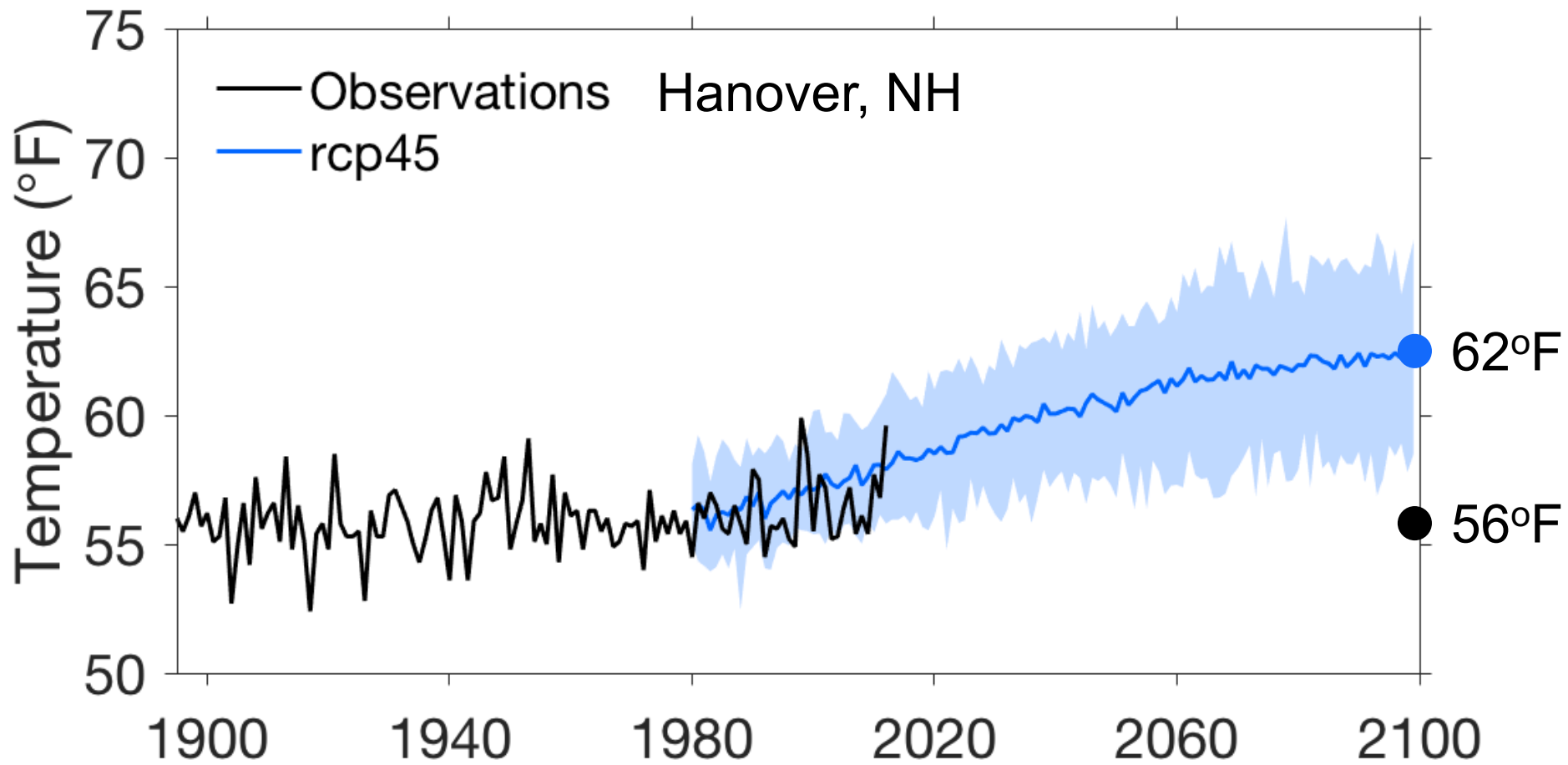


# Historical climatology: Annual Maximum Temperature

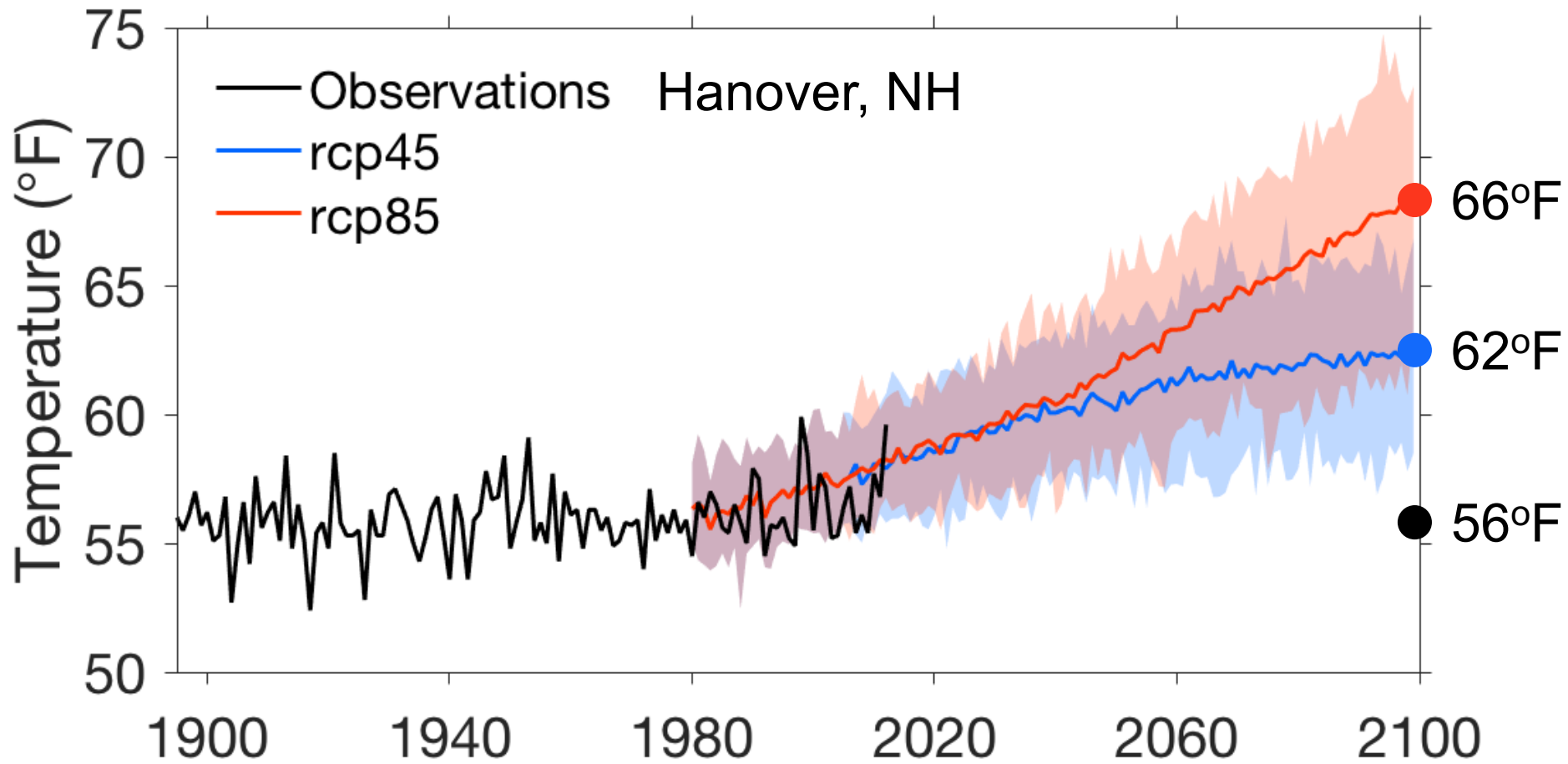




# Lower Emissions: Annual Maximum Temperature

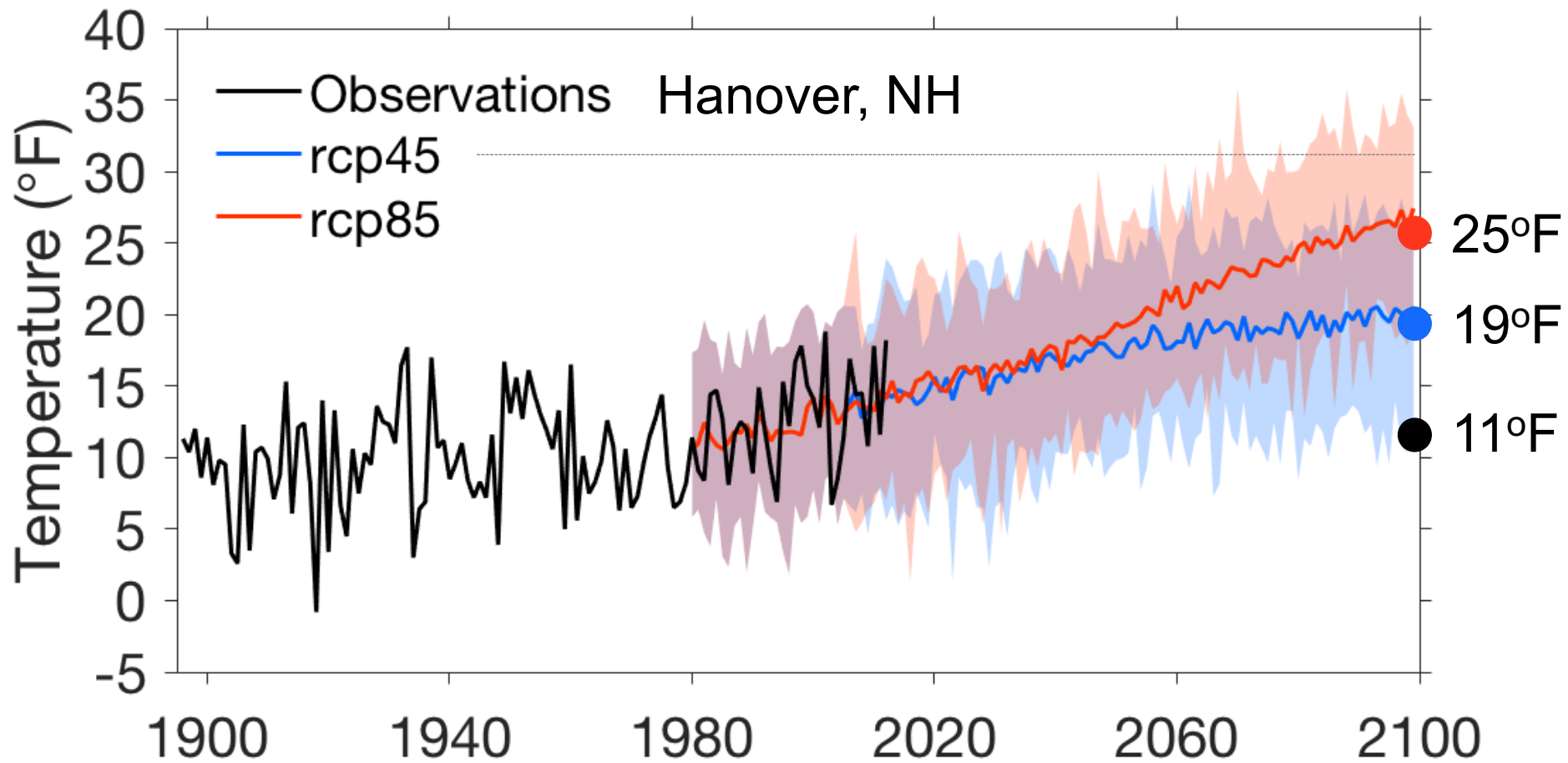


# Higher Emissions: Annual Maximum Temperature



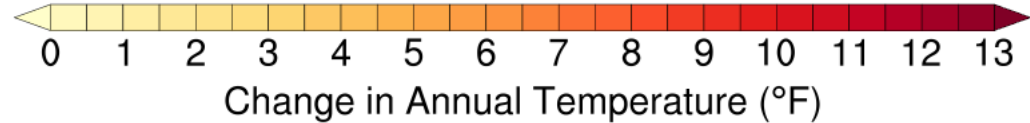
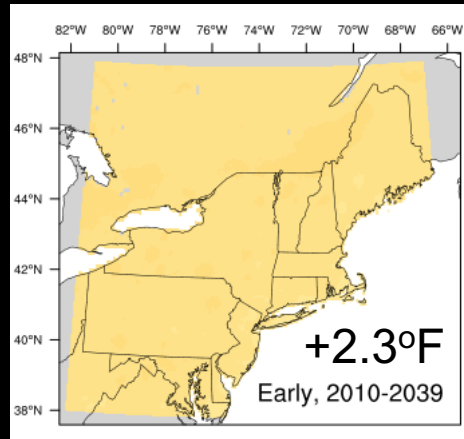


# Higher Emissions: Winter Minimum Temperature



# Future Projections: Annual Maximum Temperature

RCP4.5

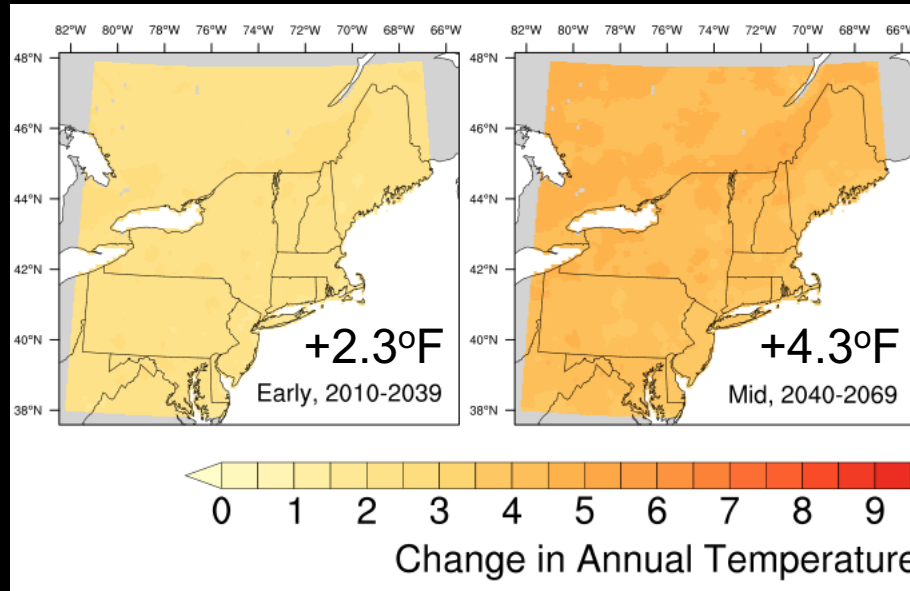


\*Relative to 1980-2005



# Future Projections: Annual Maximum Temperature

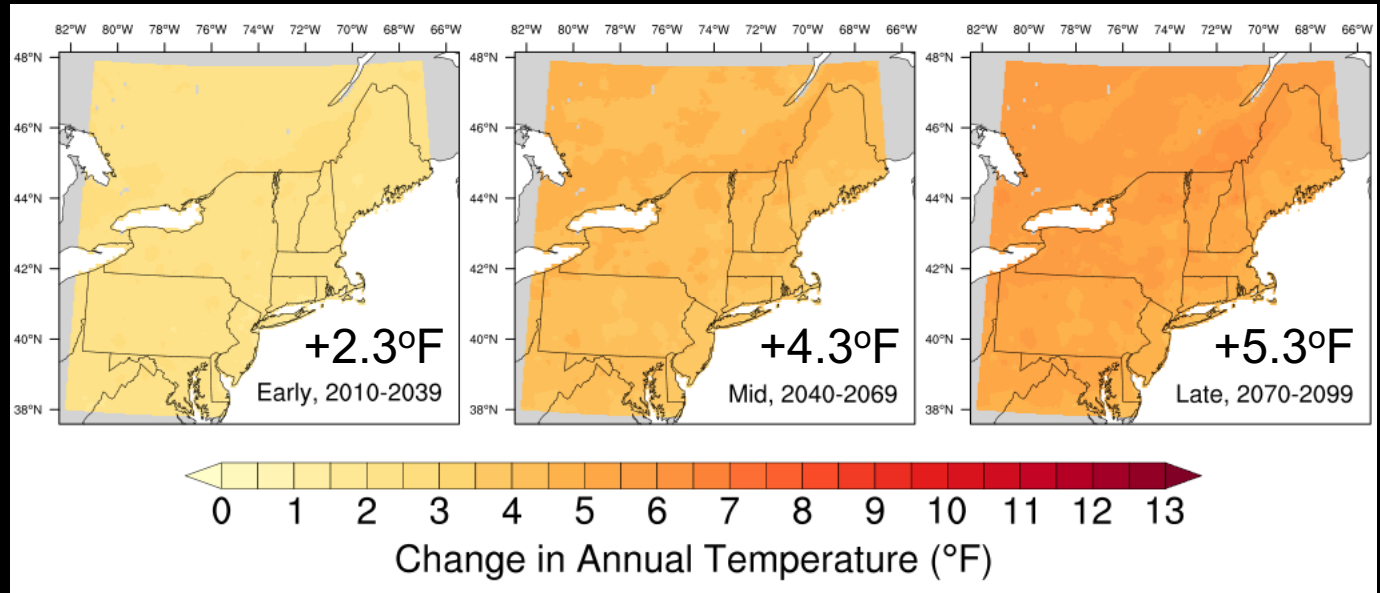
RCP4.5



\*Relative to 1980-2005

# Future Projections: Annual Maximum Temperature

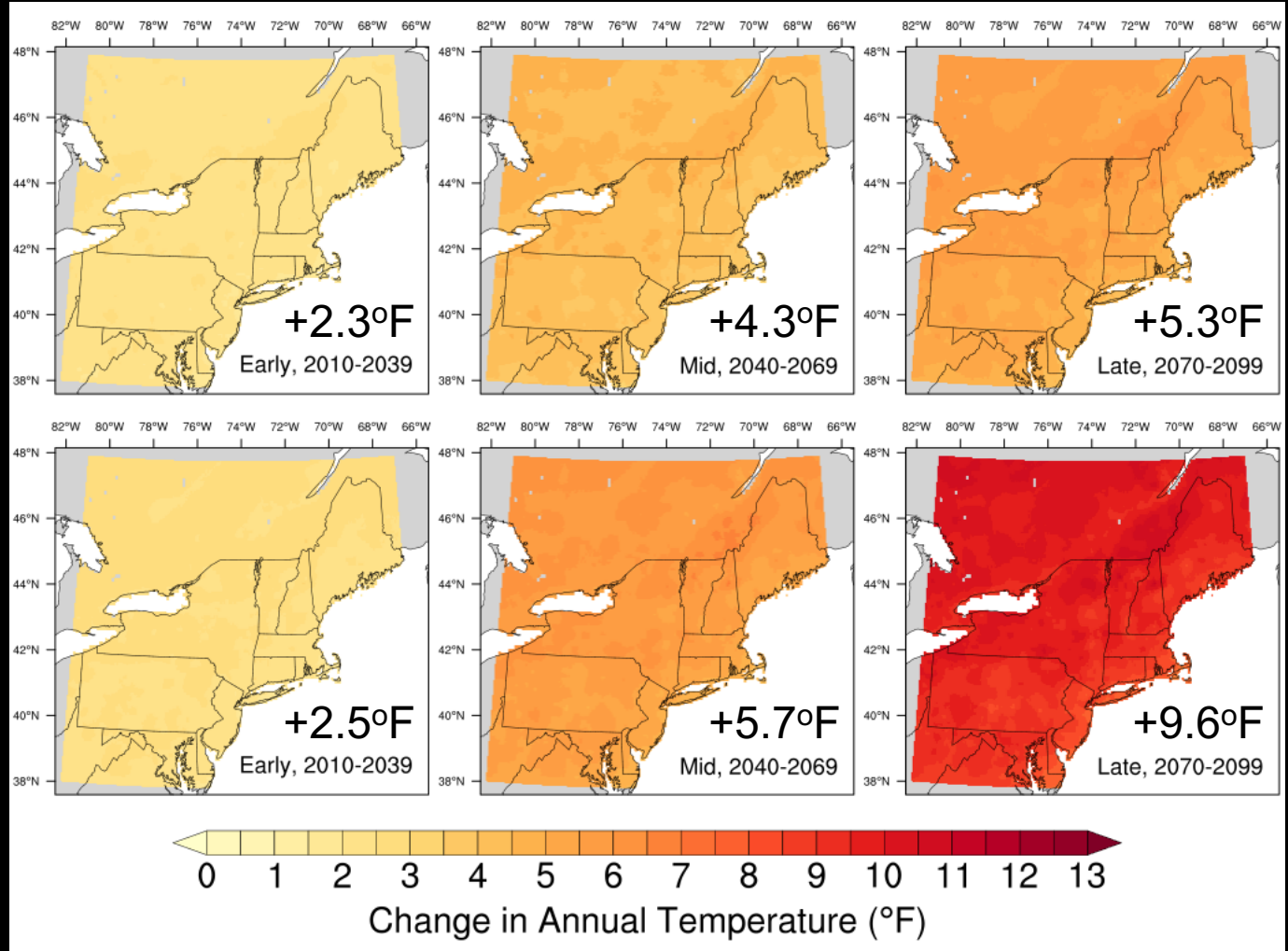
RCP4.5



\*Relative to 1980-2005

# Future Projections: Annual Maximum Temperature

RCP4.5

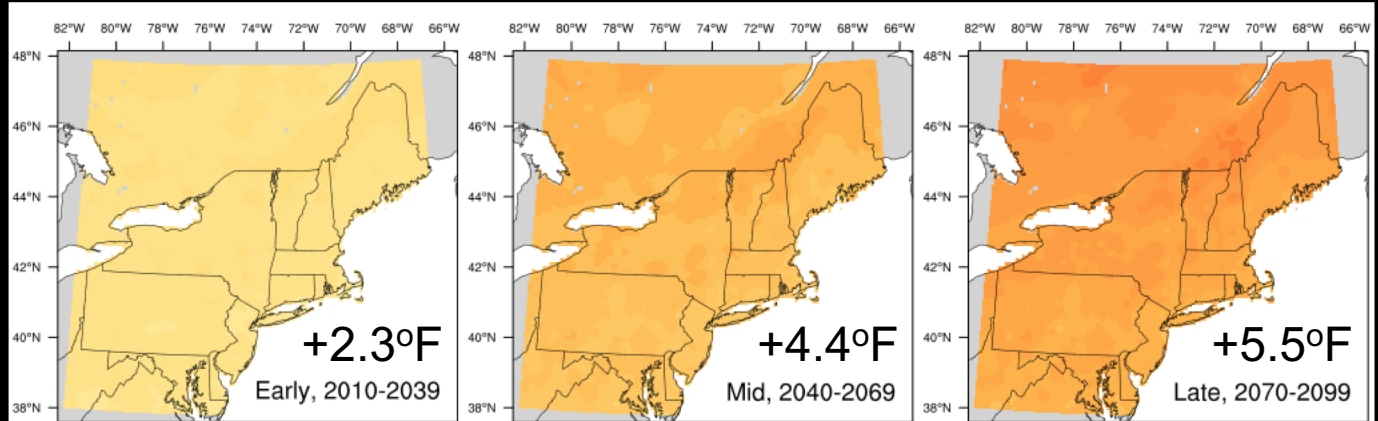


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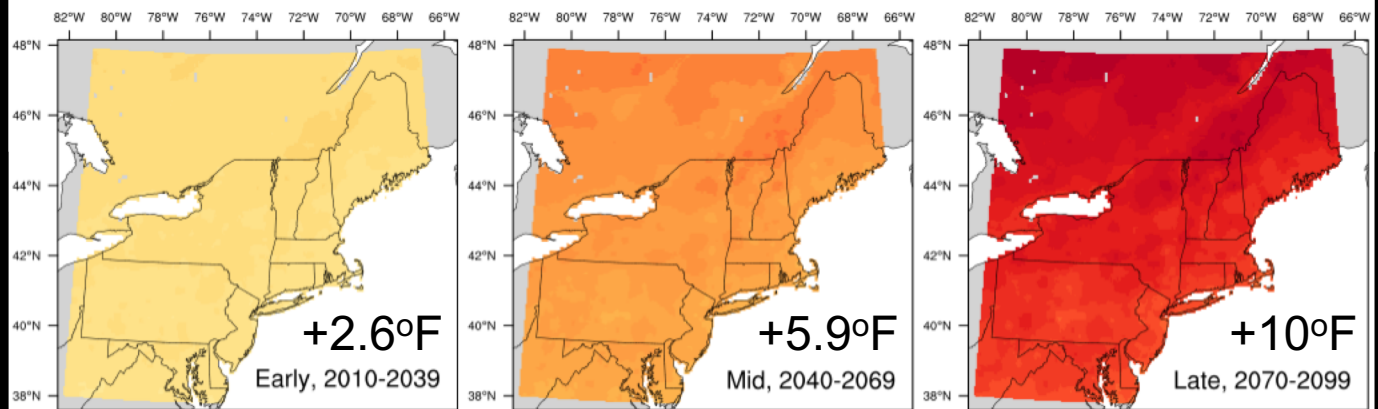


# Future Projections: Annual Minimum Temperature

RCP4.5



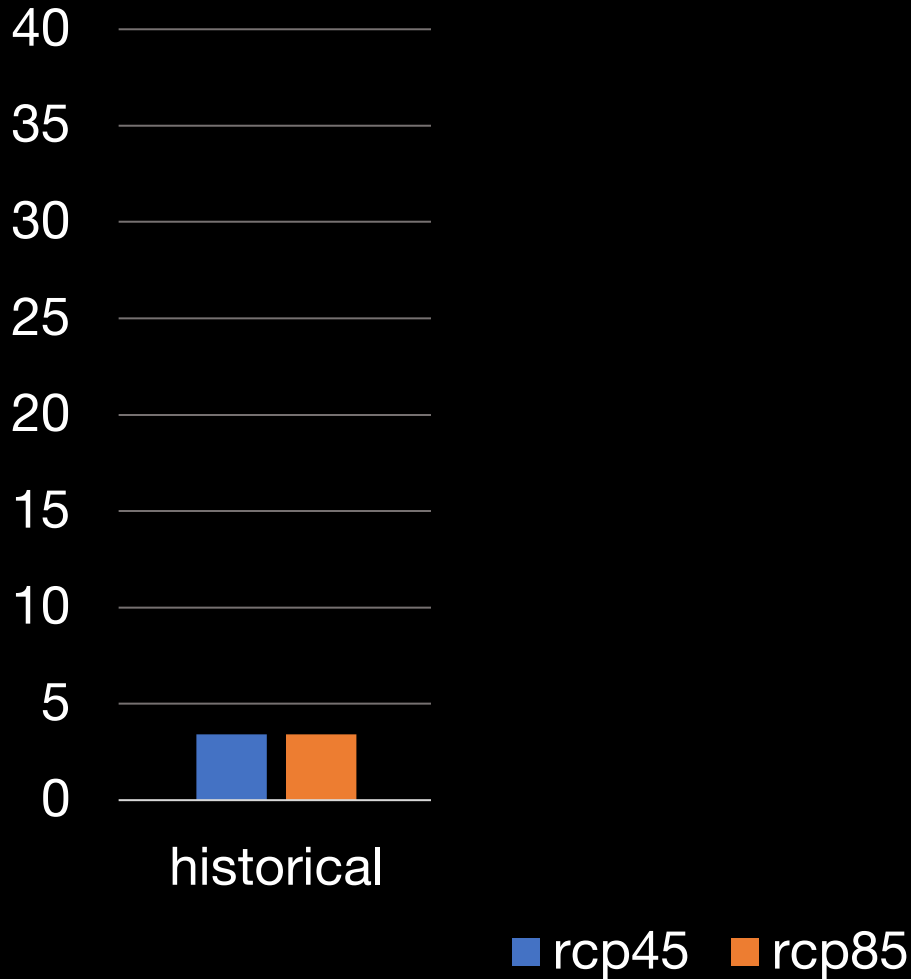
RCP8.5



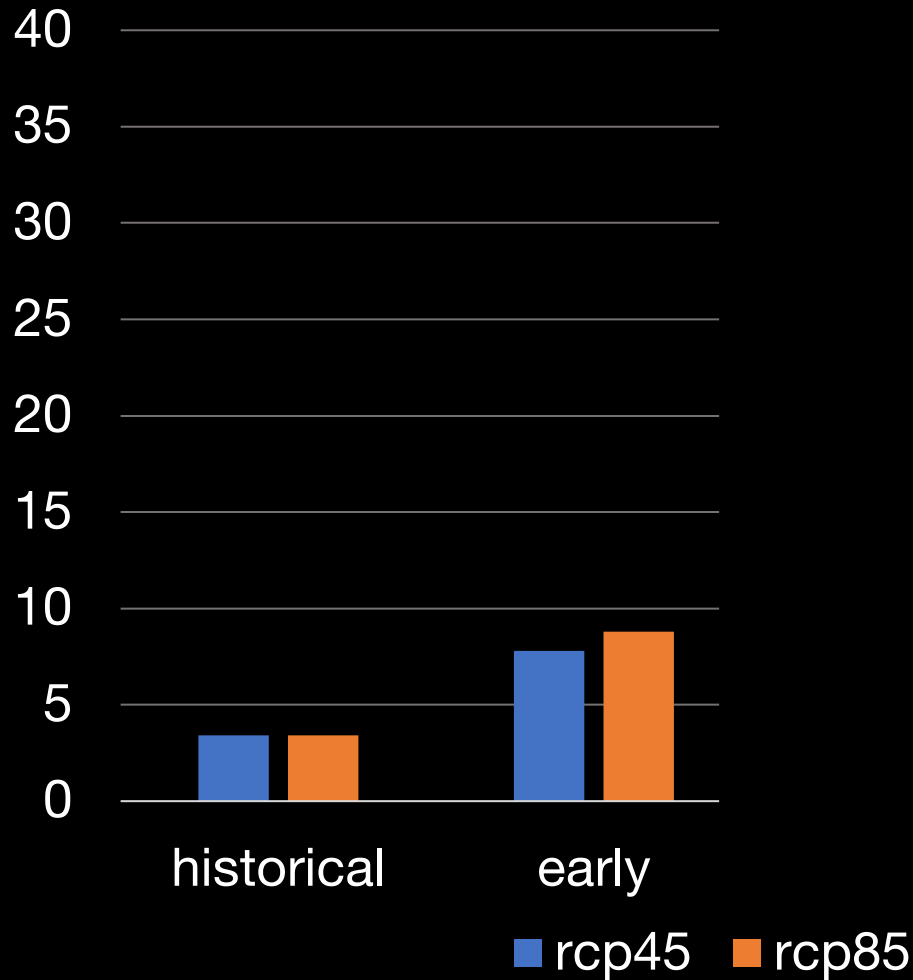
Change in Annual Temperature (°F)

\*Relative to 1980-2005

# Future Projections: Days > 90°F

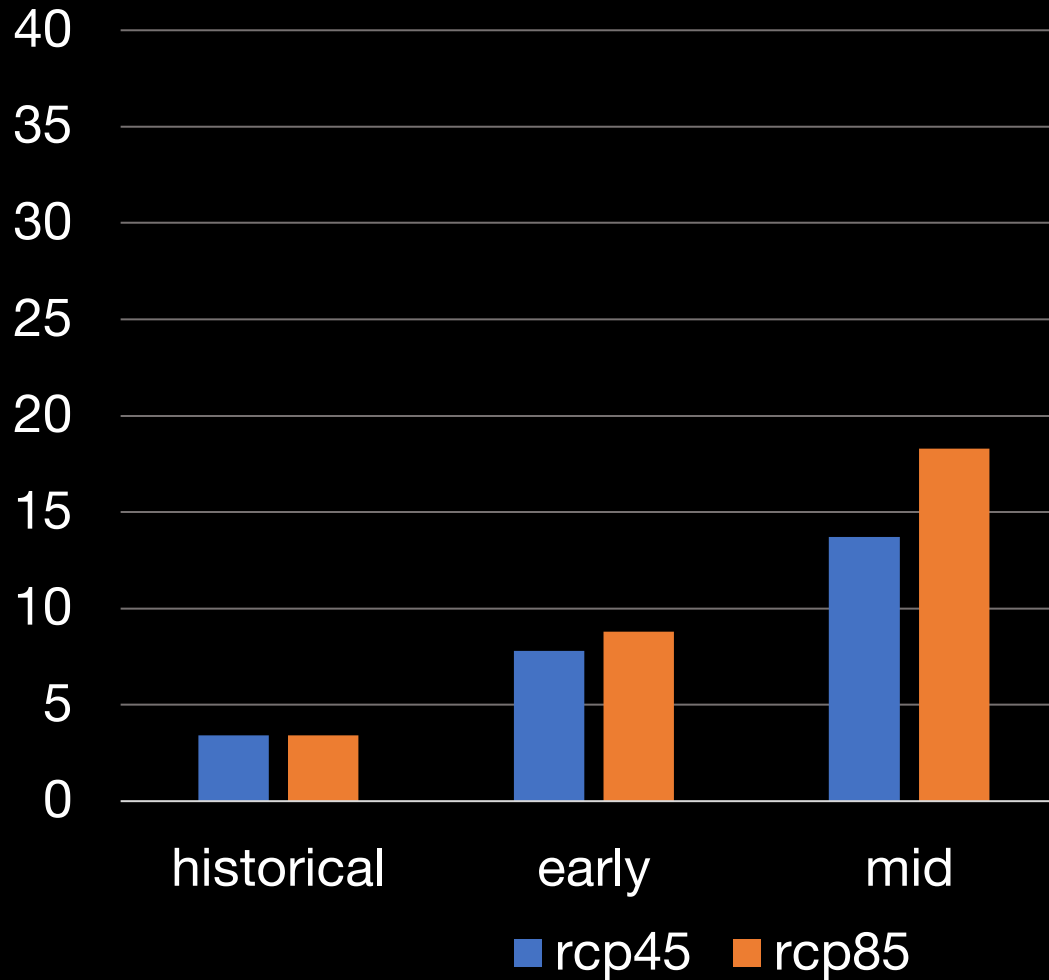


# Future Projections: Days > 90°F

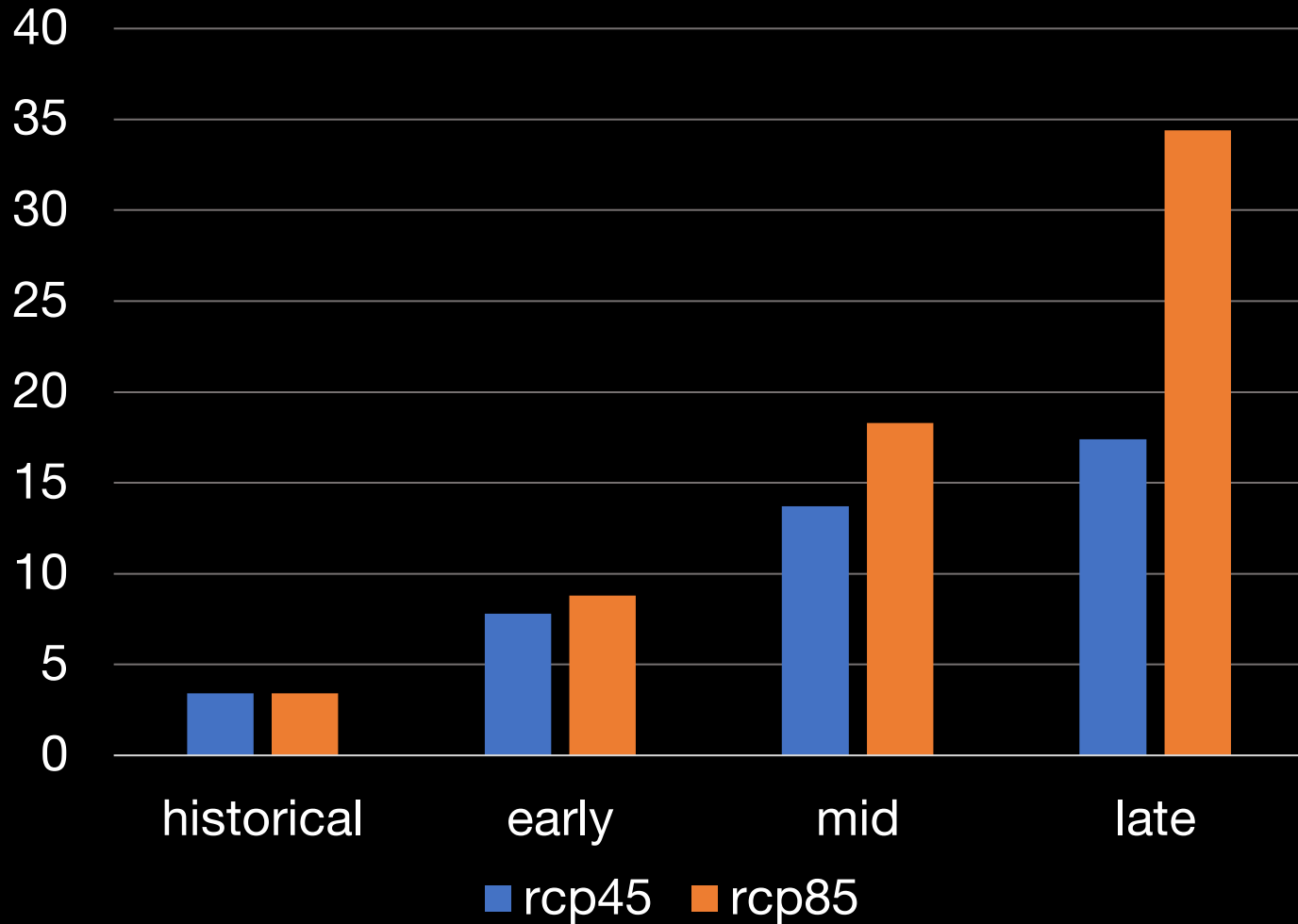




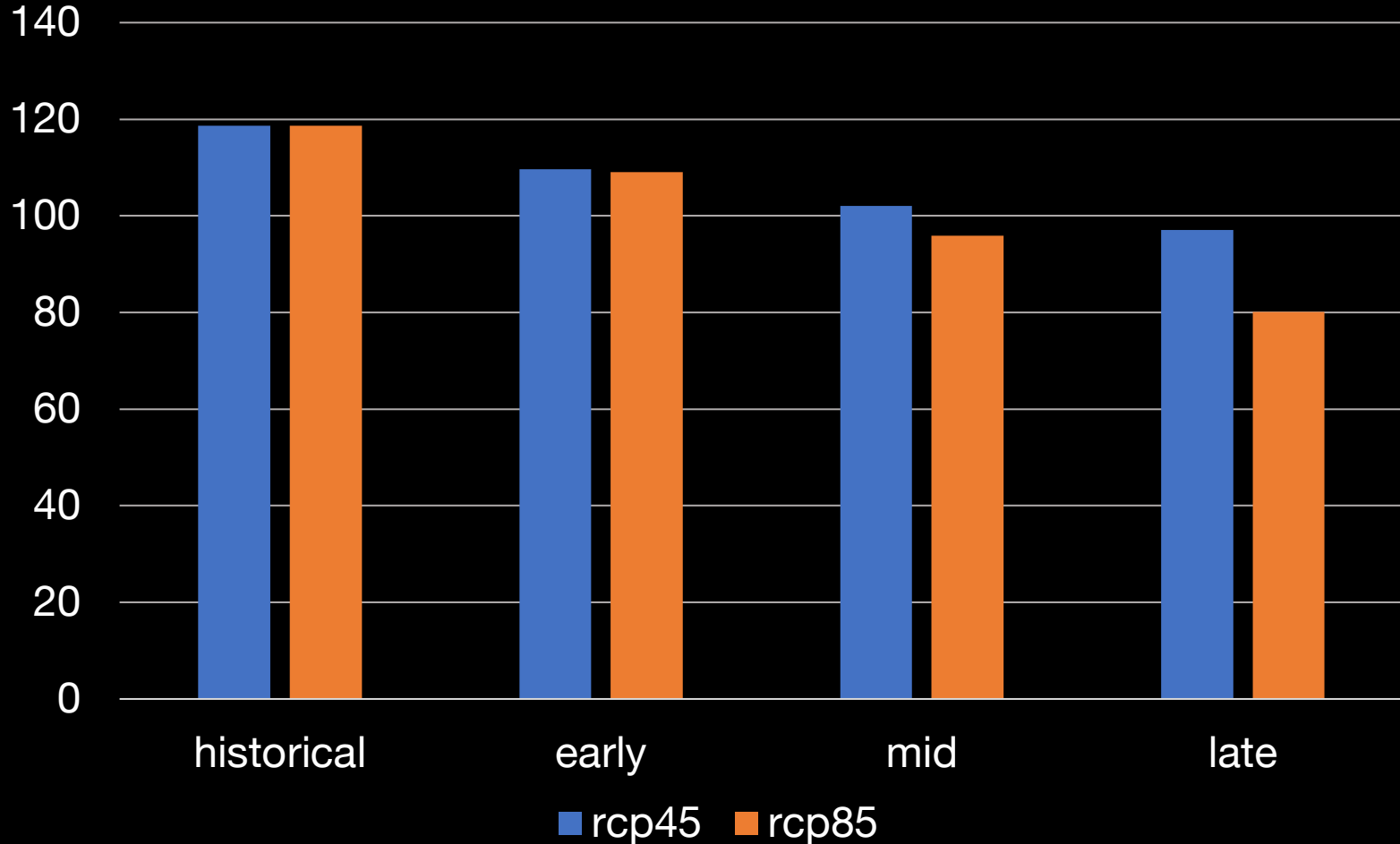
# Future Projections: Days > 90°F



# Future Projections: Days > 90°F



# Future Projections: Days below freezing





# Take-home Message

Climate Change

It's real.

It's us.

It's bad.

Scientists agree it's happening.

And there's hope.

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