

Changing Weather Patterns in PA: What can we expect?

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Western PA Region - Virtual Watershed Workshop: 1**

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PennState



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pennsylvania environmental council



Pennsylvania Organization
for Watersheds & Rivers

What weather patterns can we expect in Pennsylvania?



FOURTH NATIONAL CLIMATE ASSESSMENT

CHAPTER 18: NORTHEAST

What weather patterns can we expect in Pennsylvania?

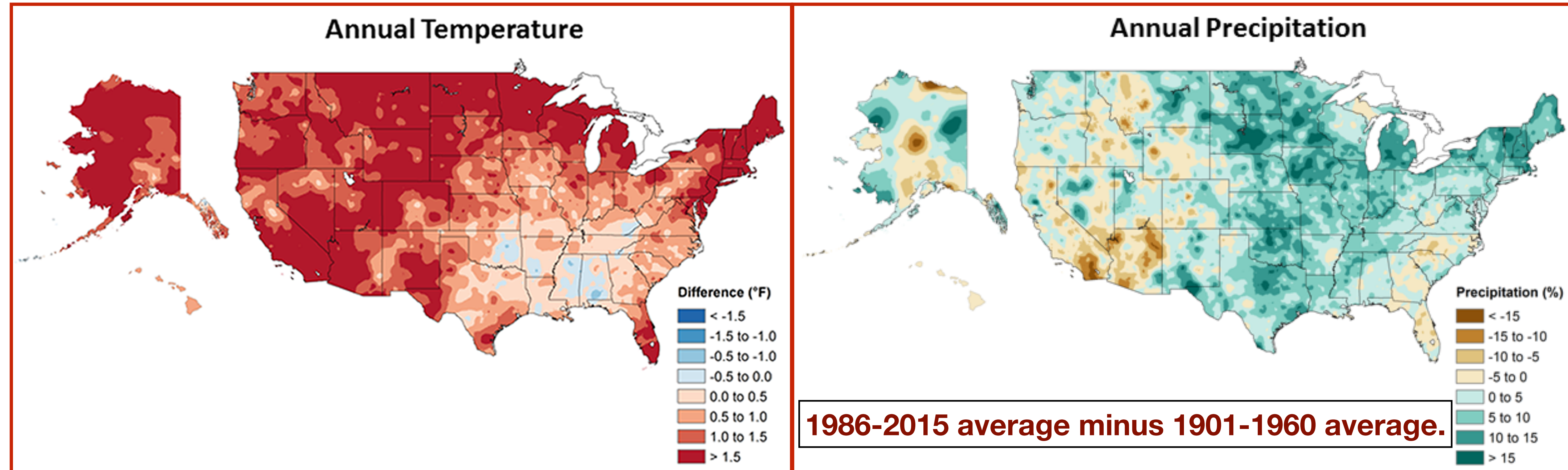
**Because Pennsylvania is a small region of the country,
we expect to see changes that reflect the patterns
in the larger scales across the North American continent.**

**The United States is mandated by congress
in the Global Change Research Act of 1990
to provide an assessment of the state of the climate
every five (5) years.**

Online access to the 4th National Climate Assessment, Volume I:

<https://science2017.globalchange.gov/>

How have Annual Temperatures and Precipitation Changed in the past 116 years?



NCA4: Figure 7.1

USGCRP, 2017:

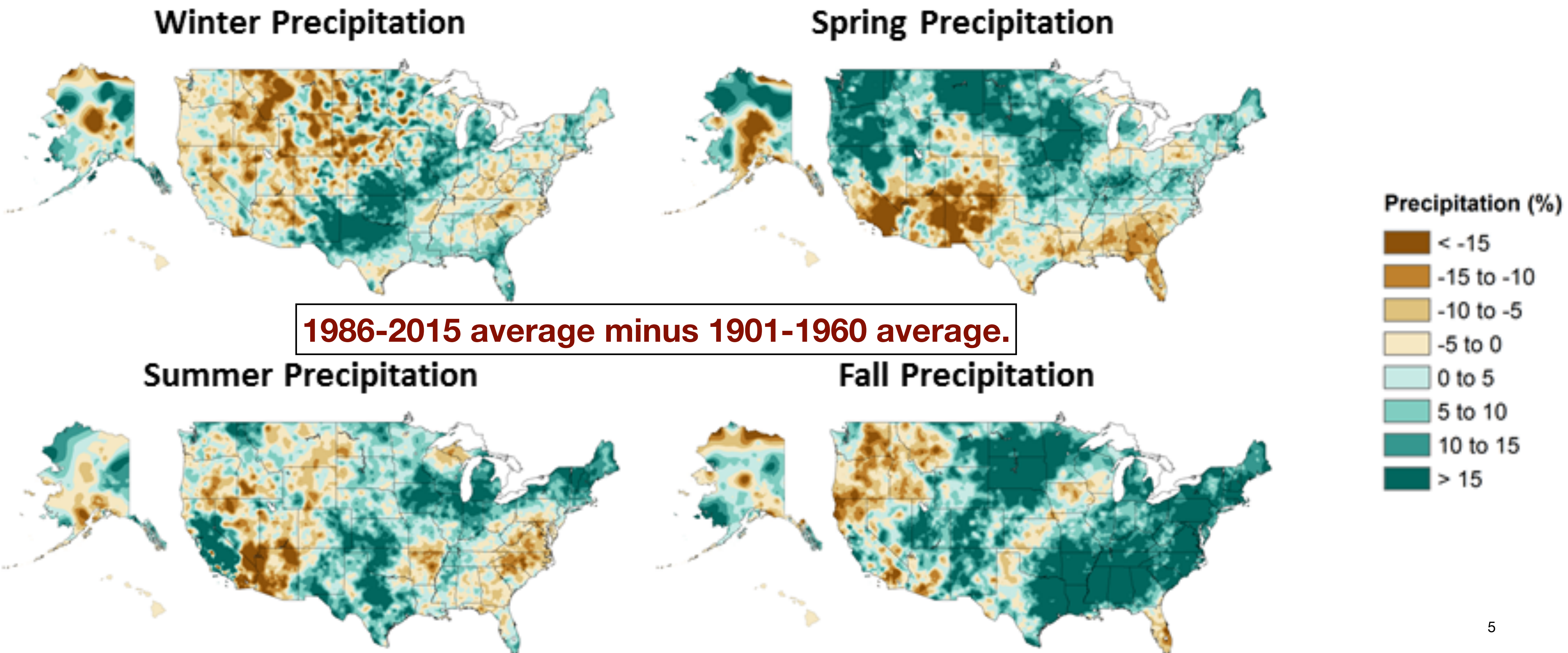
**Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6**

**We see the East Coast has experienced
the largest increases during the past
116 years.**

How have seasonal changes in precipitation changed over the past ?

USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6

Figure 7.1



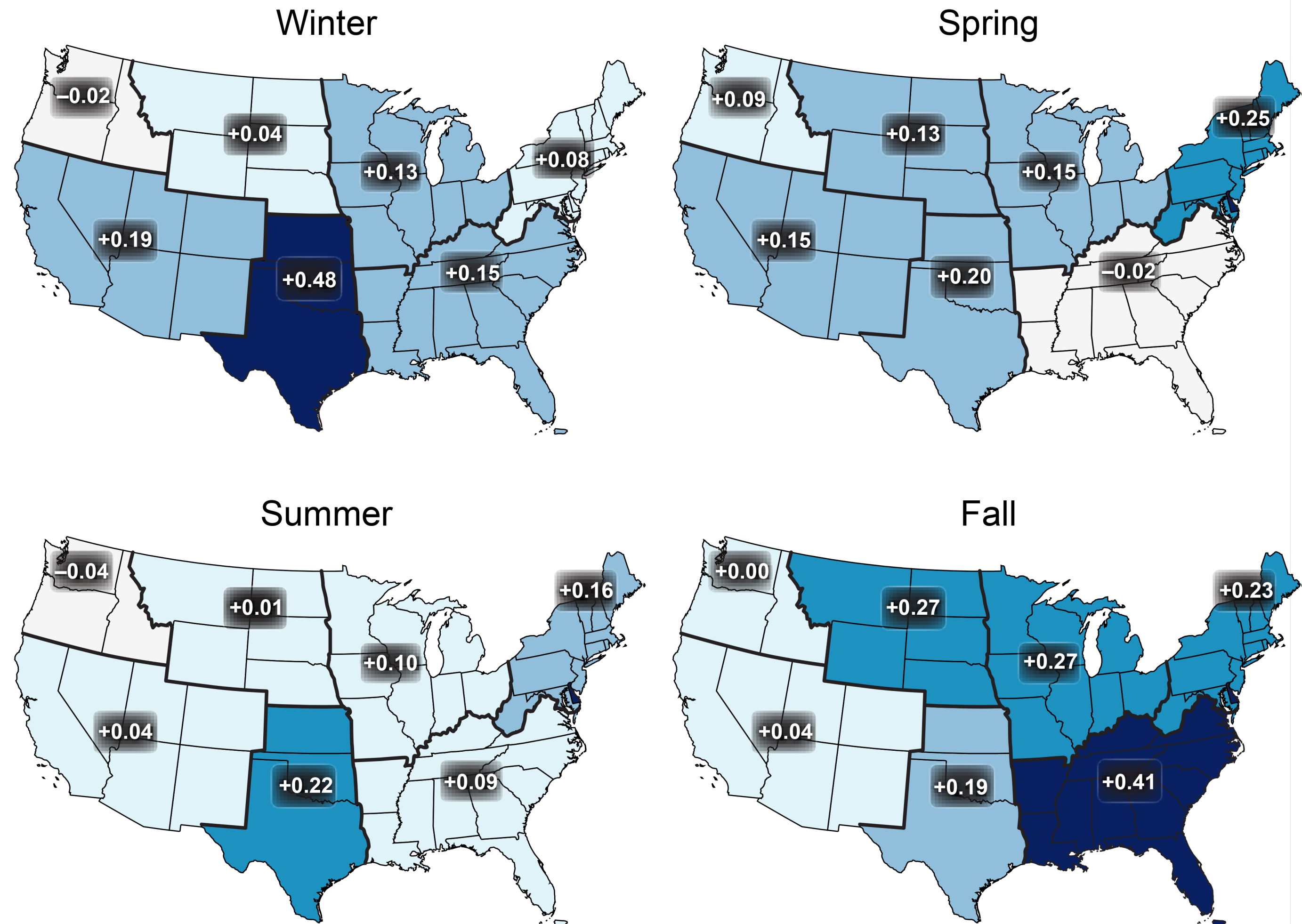
How have daily extremes changed in the past?

We see almost all regions have experienced increases during the 1948-2015 period.

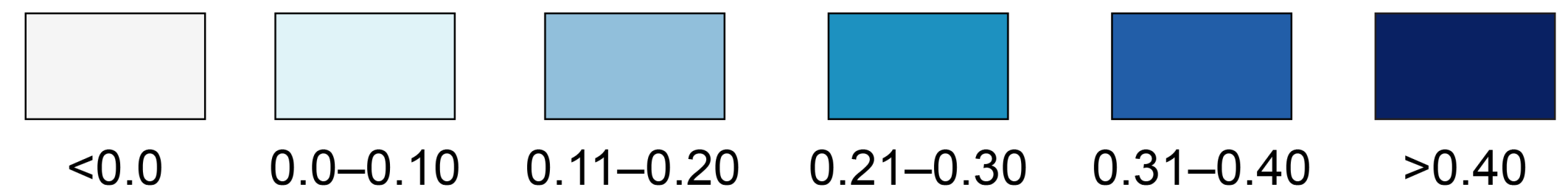
NCA4: Figure 7.2

USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6

Observed Change in Daily, 20-year Return Level Precipitation



Change (inches)



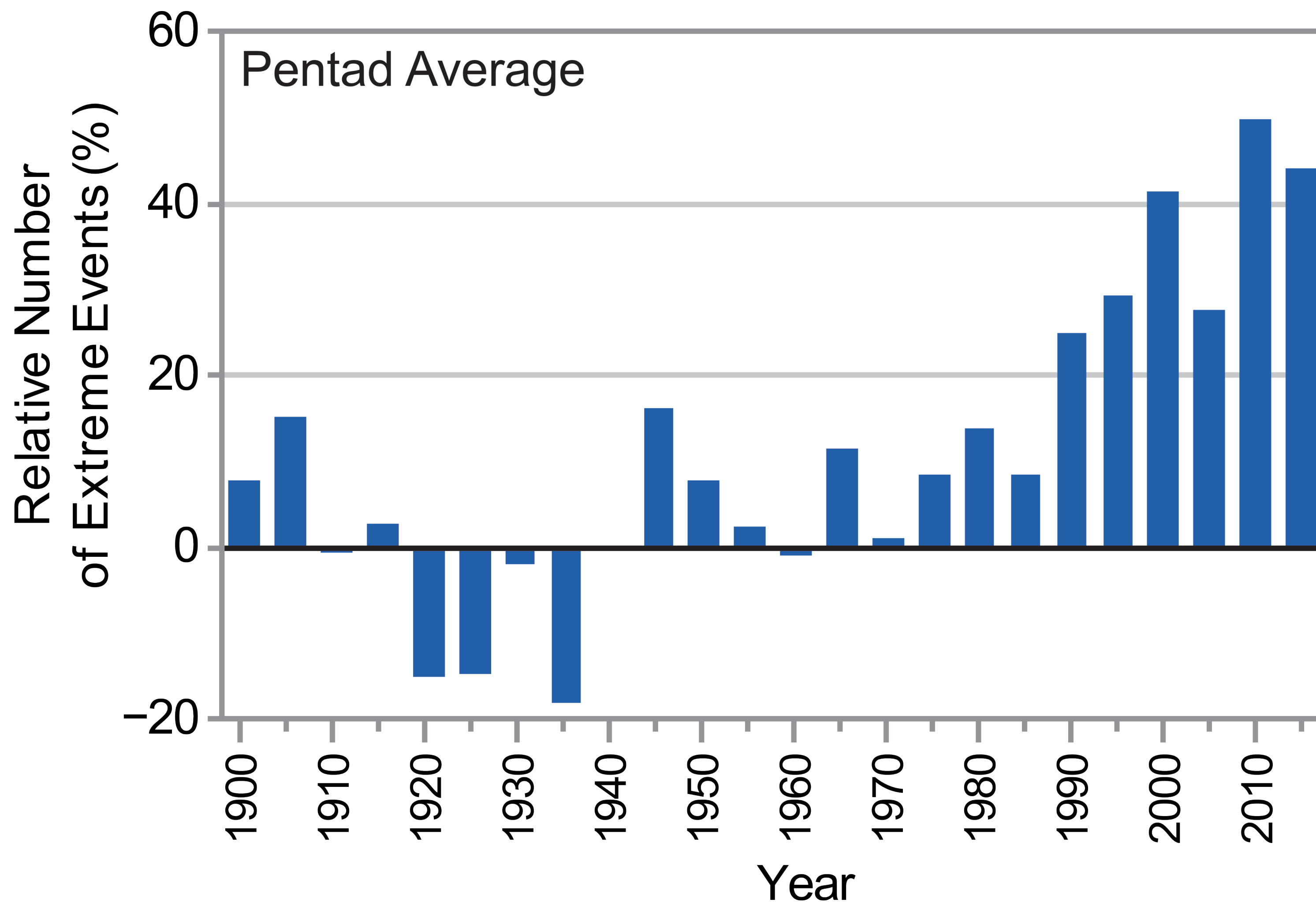
Have we seen changes in Extreme rainfall in the past century?

**Across the US, we have
seen steady increases
since the 1970s in the
number of extreme
events.**

NCA4: Figure 7.3

**USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6**

2-Day Precipitation Events Exceeding 5-Year Recurrence Interval



the number of 2-day precipitation events exceeding the threshold
for a 5-year recurrence based on the 1901-2016 period

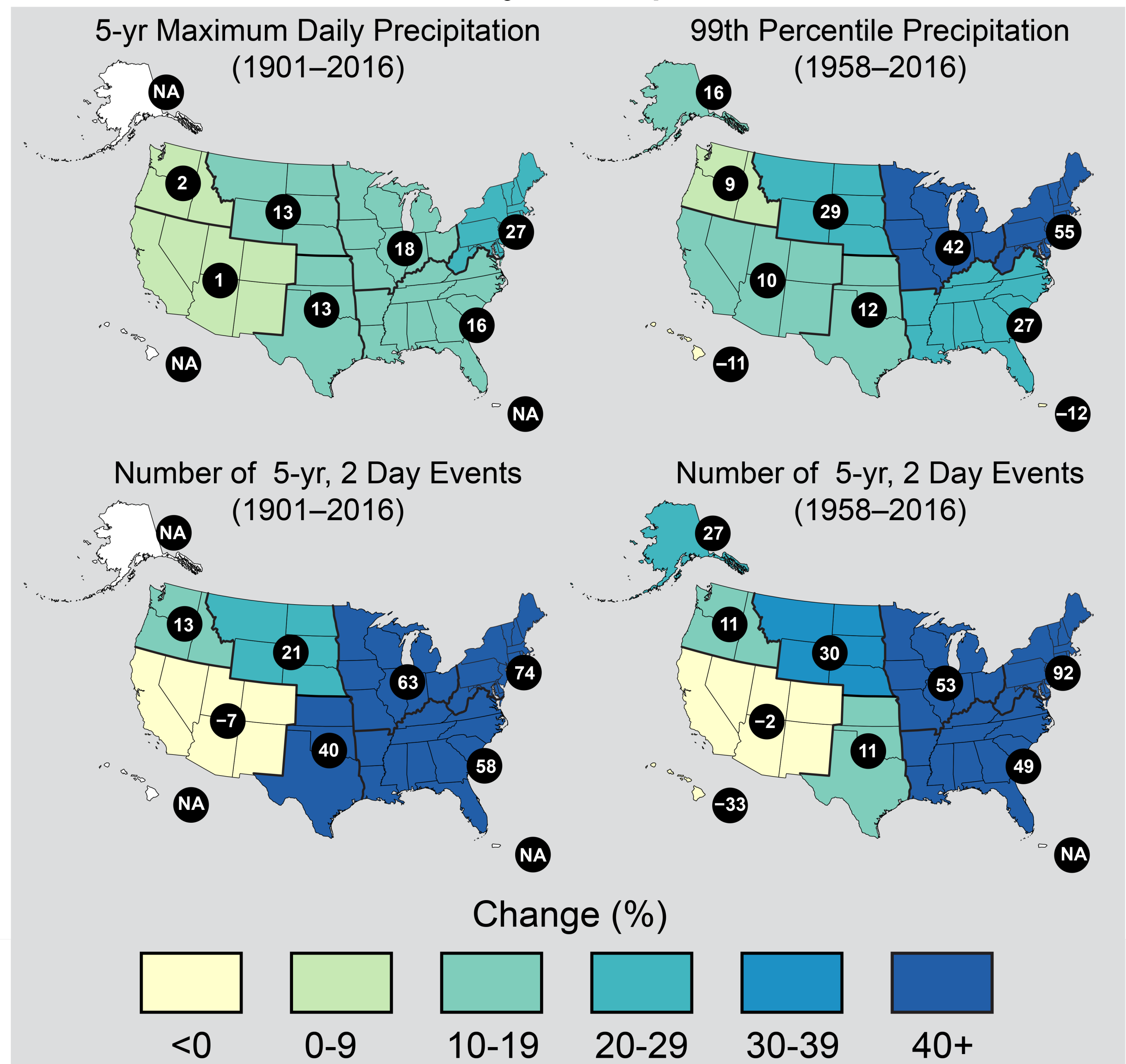
How have heavy rains increased in different regions?

We see the East Coast has experienced the largest increases during the past 116 years.

NCA4: Figure 7.4

USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6

Observed Change in Heavy Precipitation



How will Future rains vary across North America?

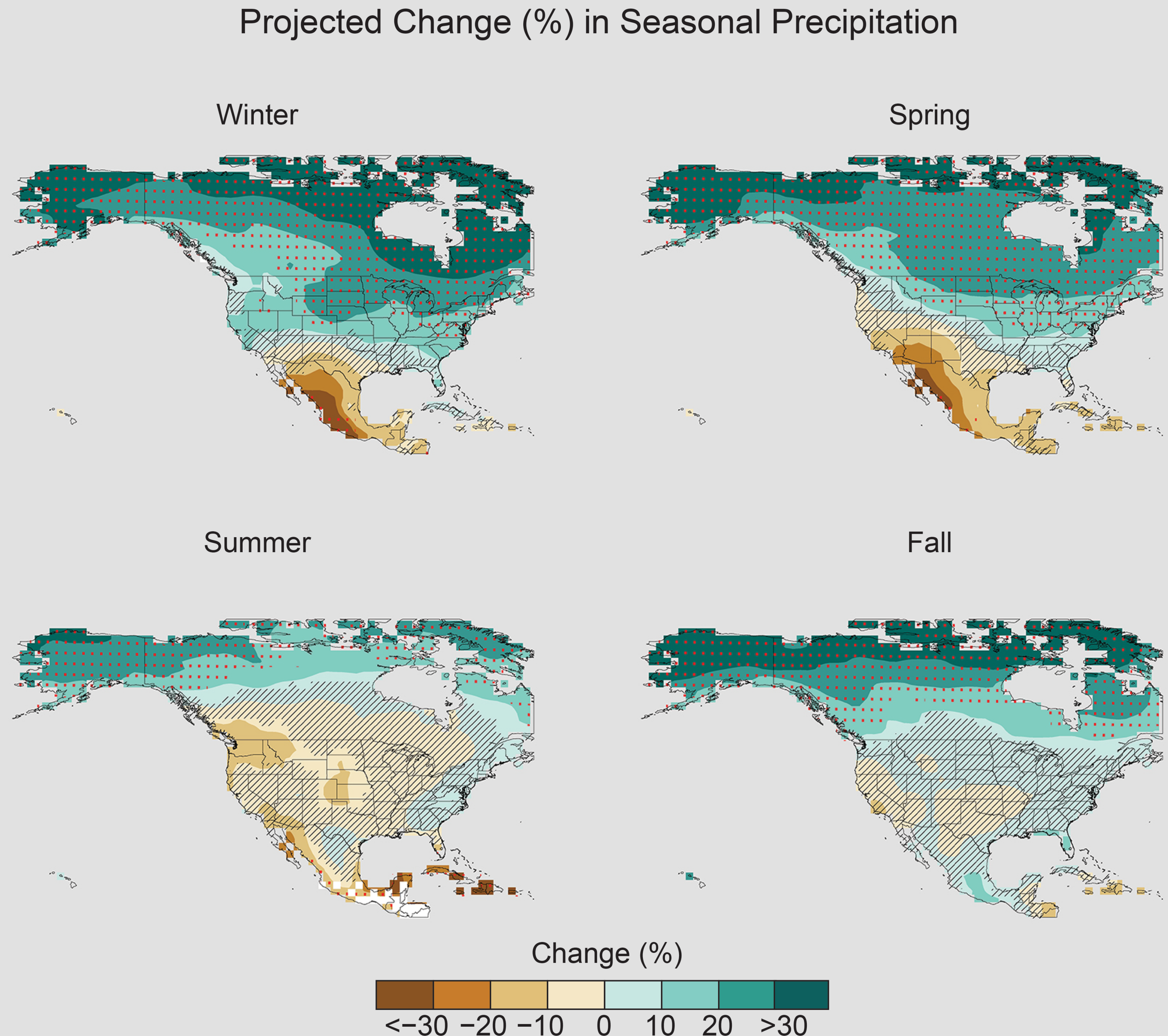
**The largest increases
will be across the
northern regions
primarily in the Winter
and Spring.**

**The largest decreases
will be in the southwest
and Mexico.**

NCA4: Figure 7.5

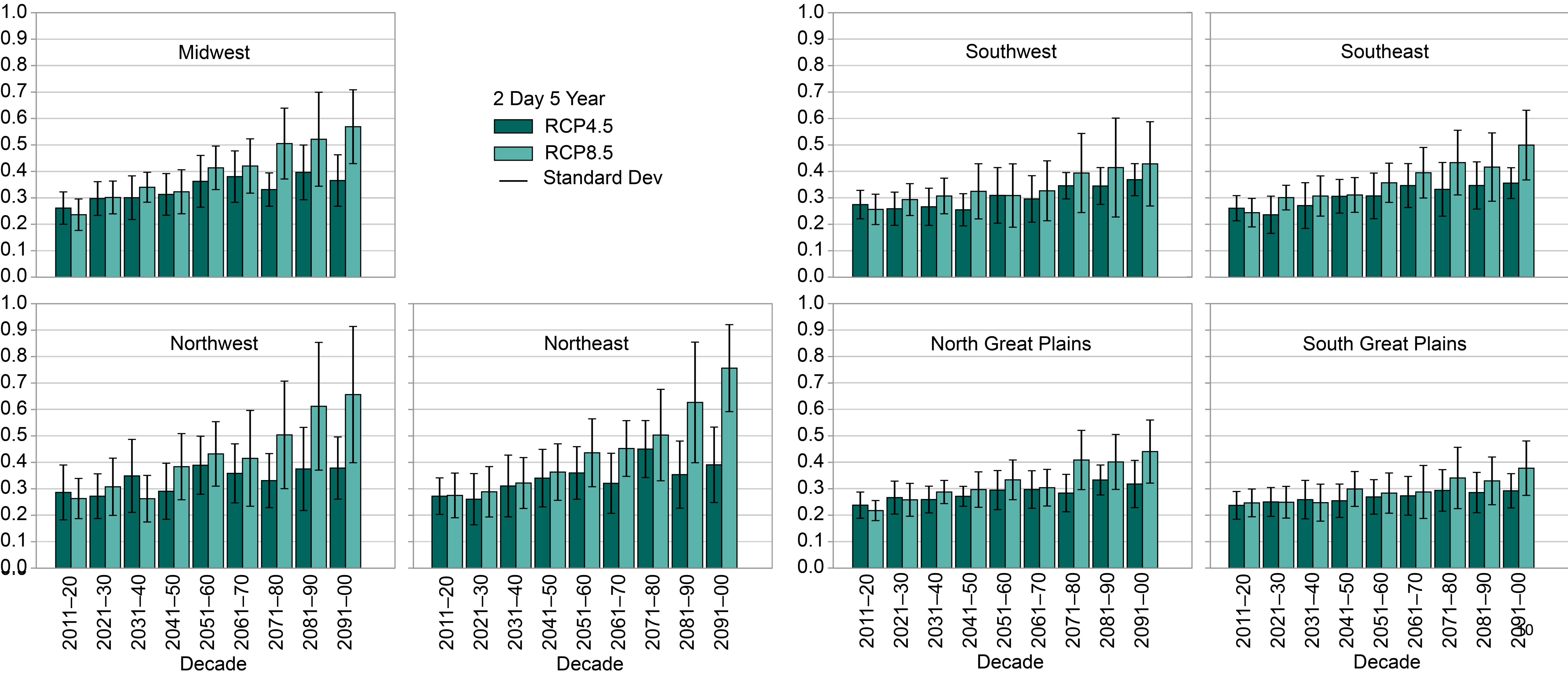
USGCRP, 2017:

**Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6**



Title Text

Figure 7.6

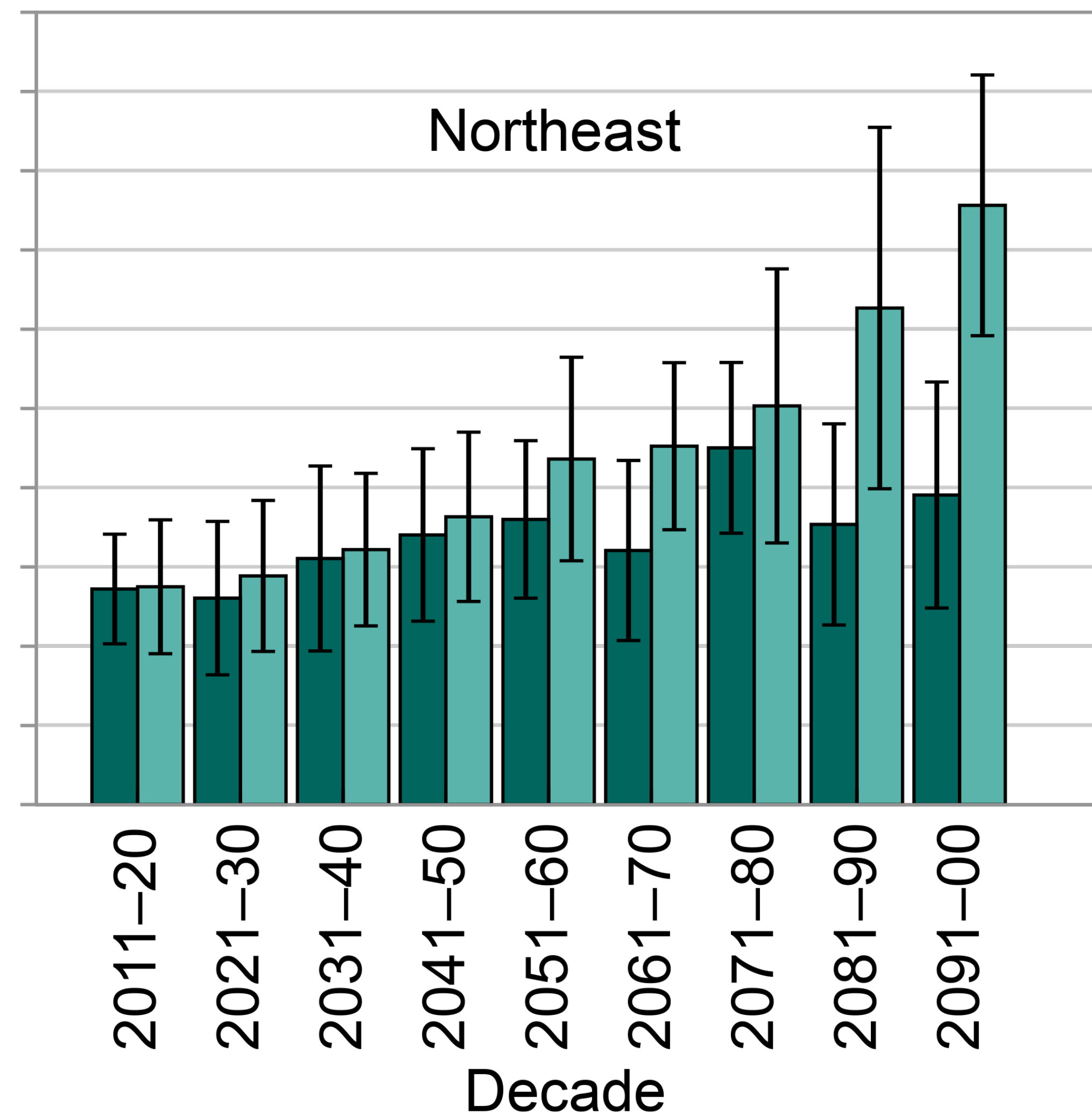


Have will extreme rainfall change in the future by region?

NCA4, Vol1: Figure 7.6

USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6

2 Day 5 Year
■ RCP4.5
■ RCP8.5
— Standard Dev



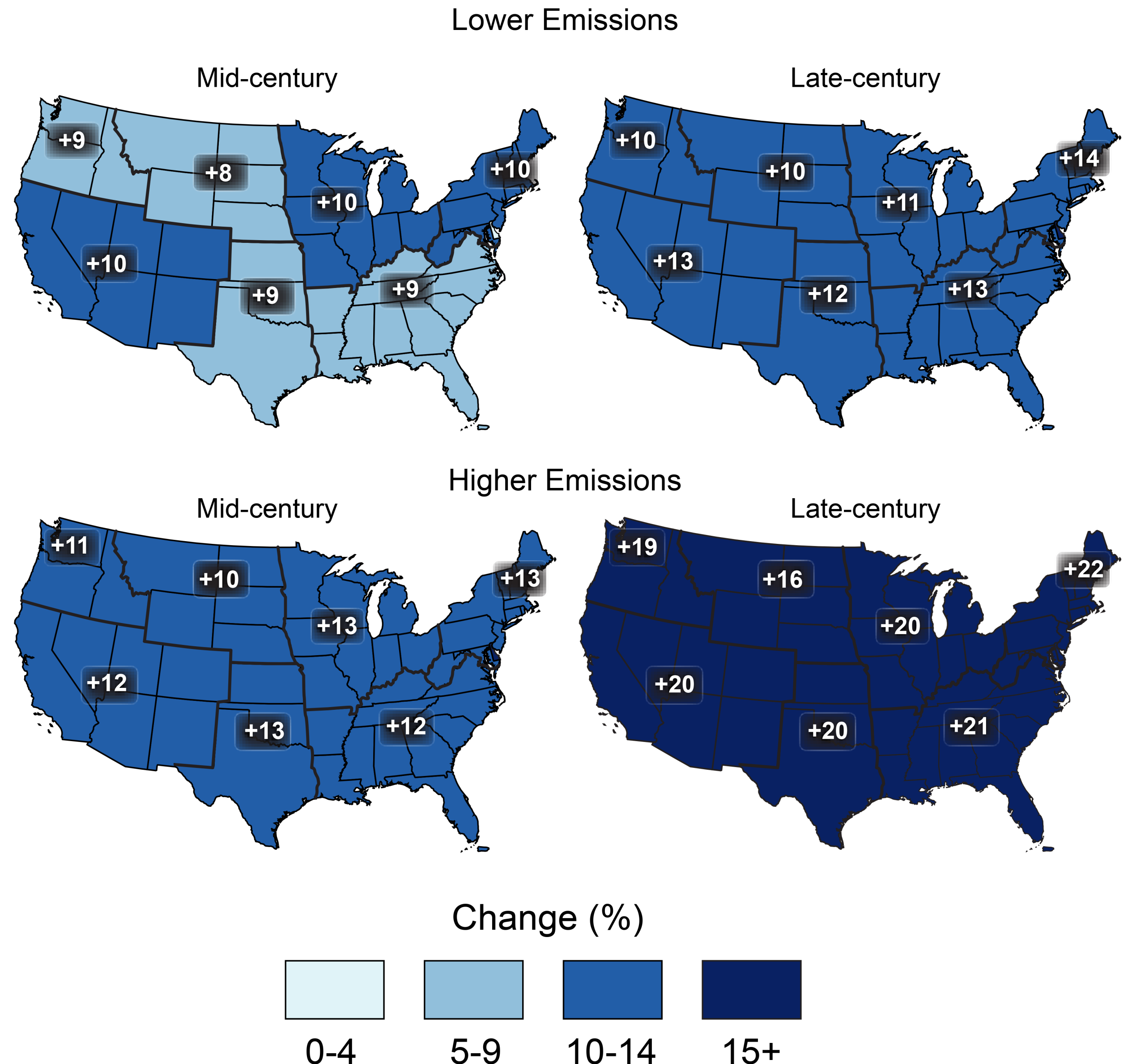
How will the Extremes change in the next 80 years?

**For two scenarios, the
extreme daily values are
increasing everywhere
and increase more in
later years.**

NCA4, Vol1: Figure 7.7

**USGCRP, 2017:
Climate Science Special Report: Fourth
National Climate Assessment,
doi: 10.7930/J0J964J6**

Projected Change in Daily, 20-year Extreme Precipitation



What are the take-home points?

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- **Consistent increases in both Temperature and Precipitation in the next 80 years.**

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 - **The largest rainfall events will be stronger.**

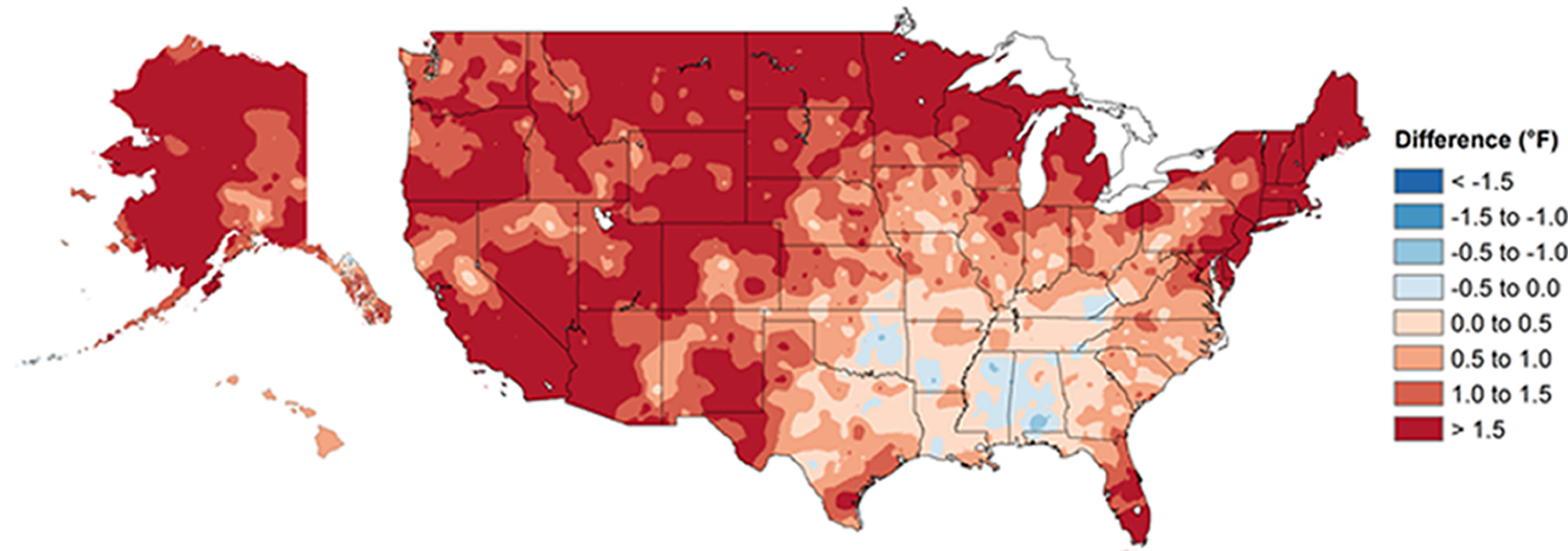
What are the take-home points?

- **Consistent increases in both Temperature and Precipitation in the next 80 years.**
- **Precipitation Extremes will be increasing:**
 - **The largest rainfall events will be stronger.**
- **The local patterns are tied to shifts in the large-scale changes in the circulations as well as the patterns of ocean sea surface temperatures.**

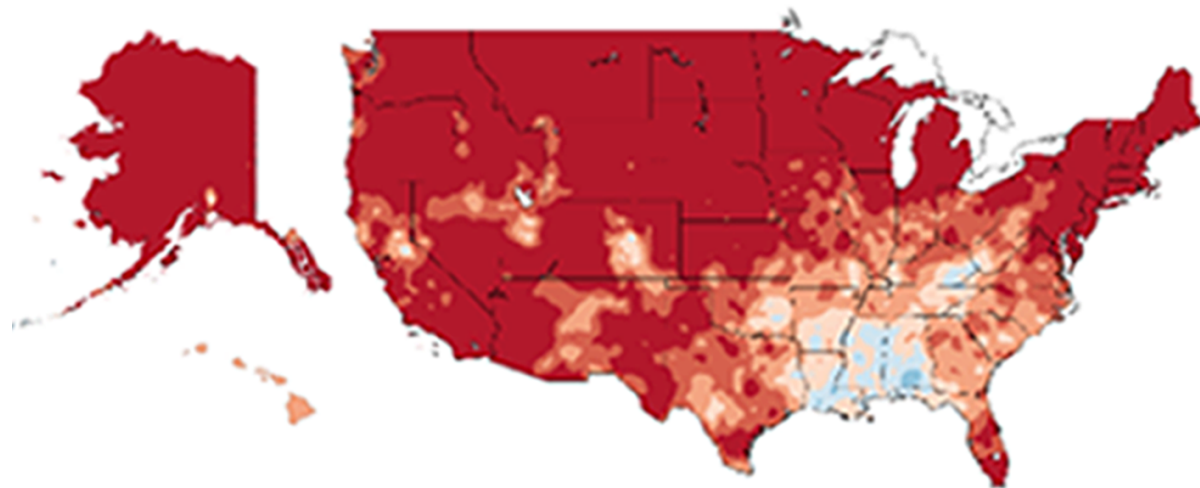
How have Temperatures and Precipitation Changed in the past 116 years?

NCA4, Vol1: Figures 6.1 and 7.1

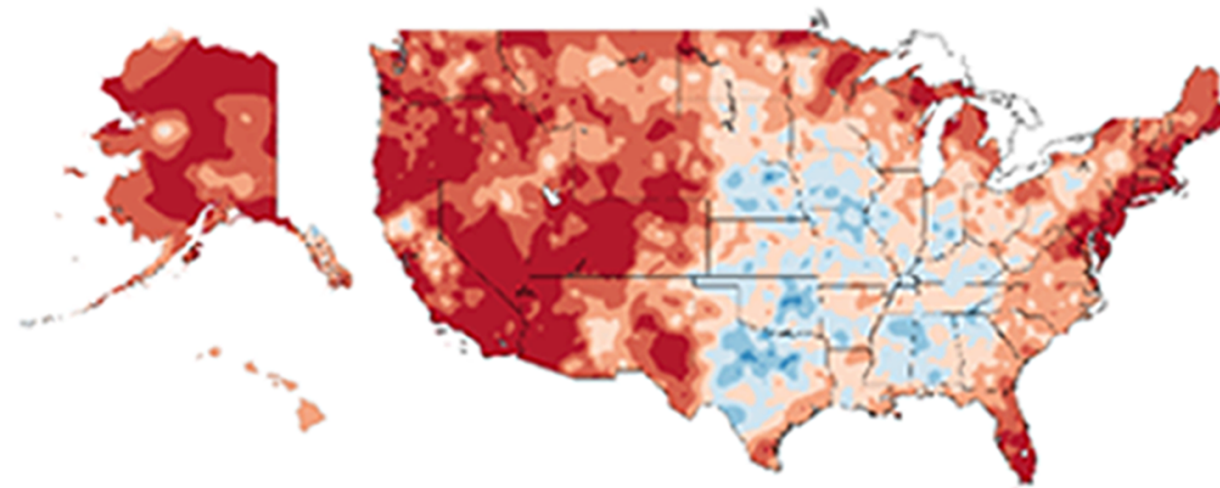
Annual Temperature



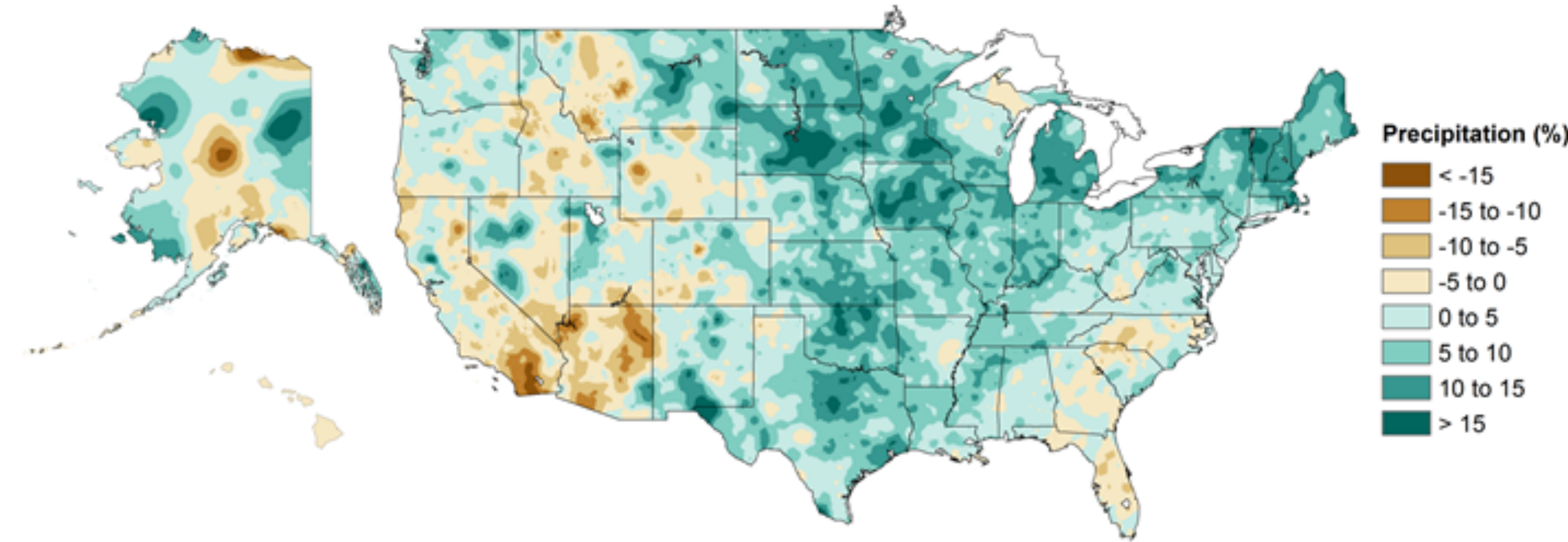
Winter Temperature



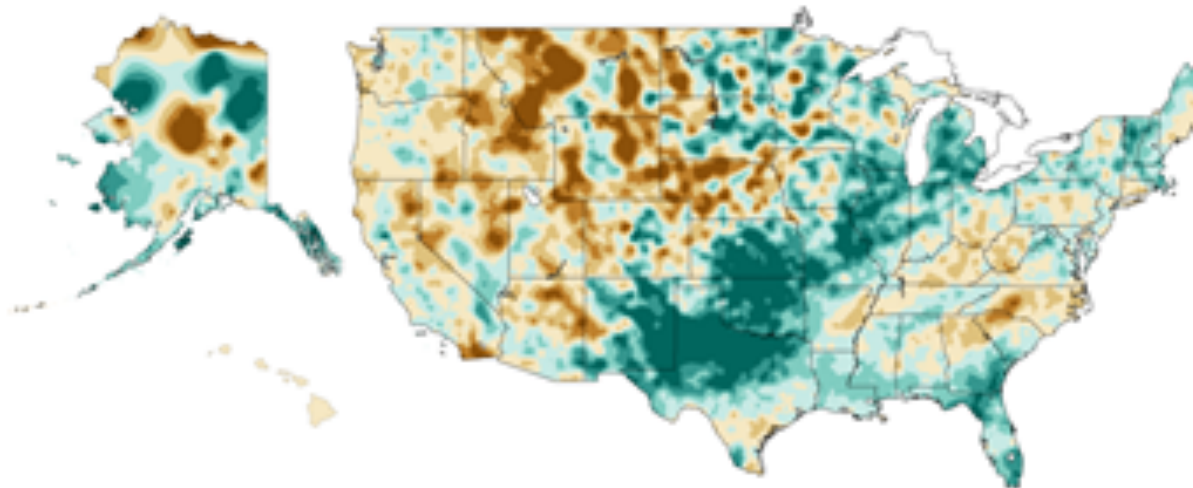
Summer Temperature



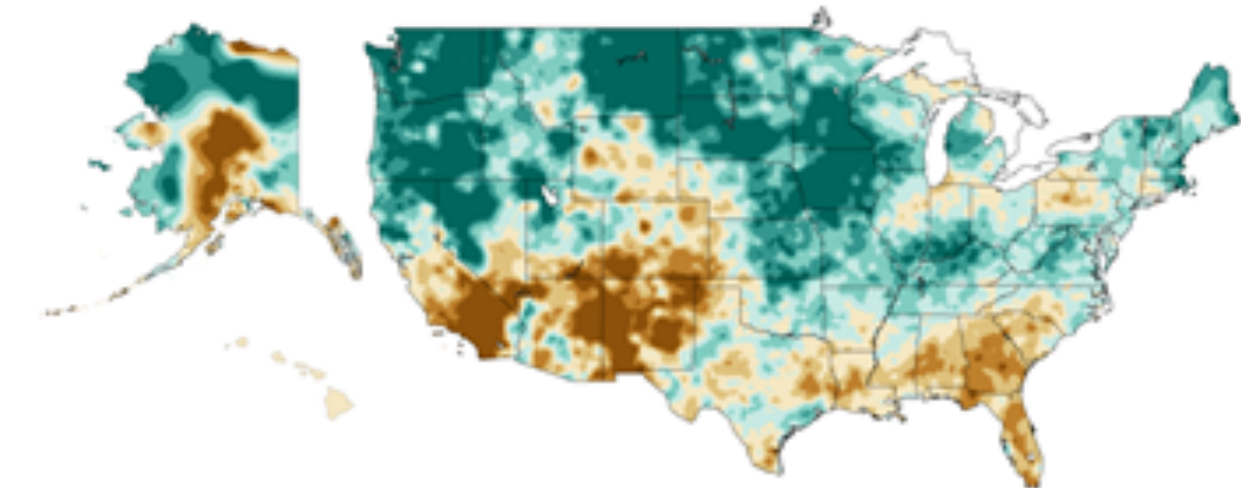
Annual Precipitation



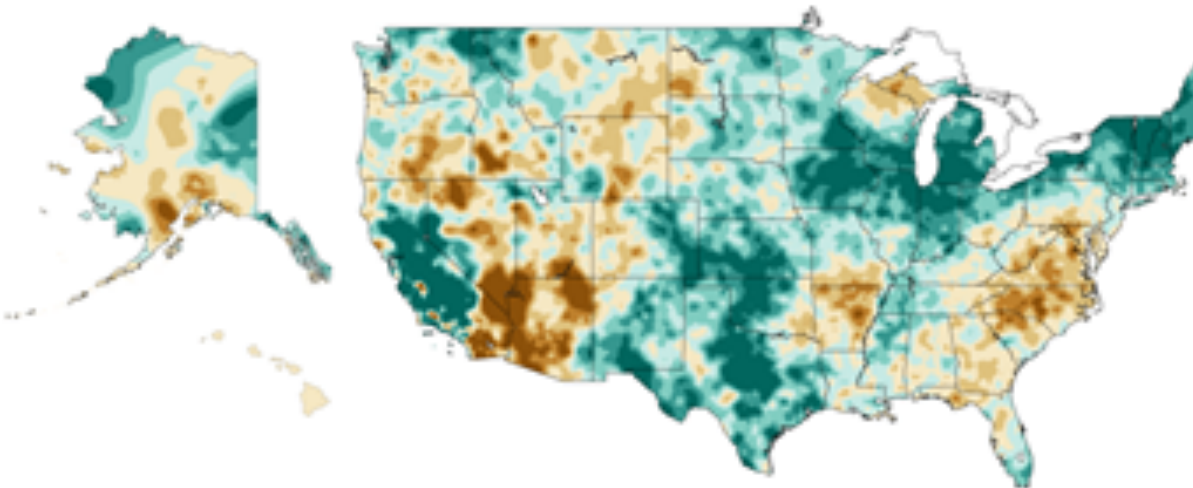
Winter Precipitation



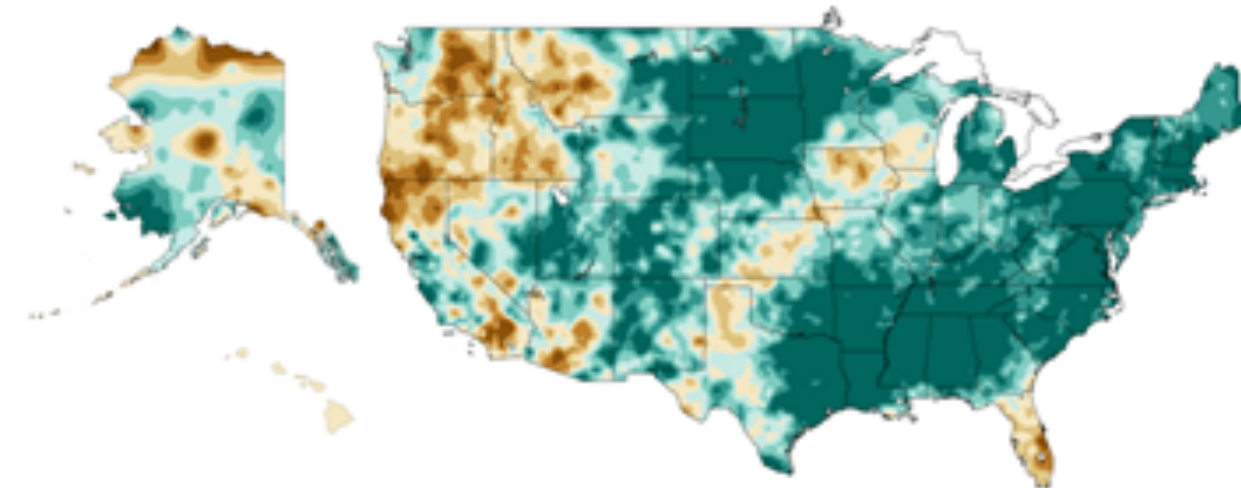
Spring Precipitation



Summer Precipitation



Fall Precipitation

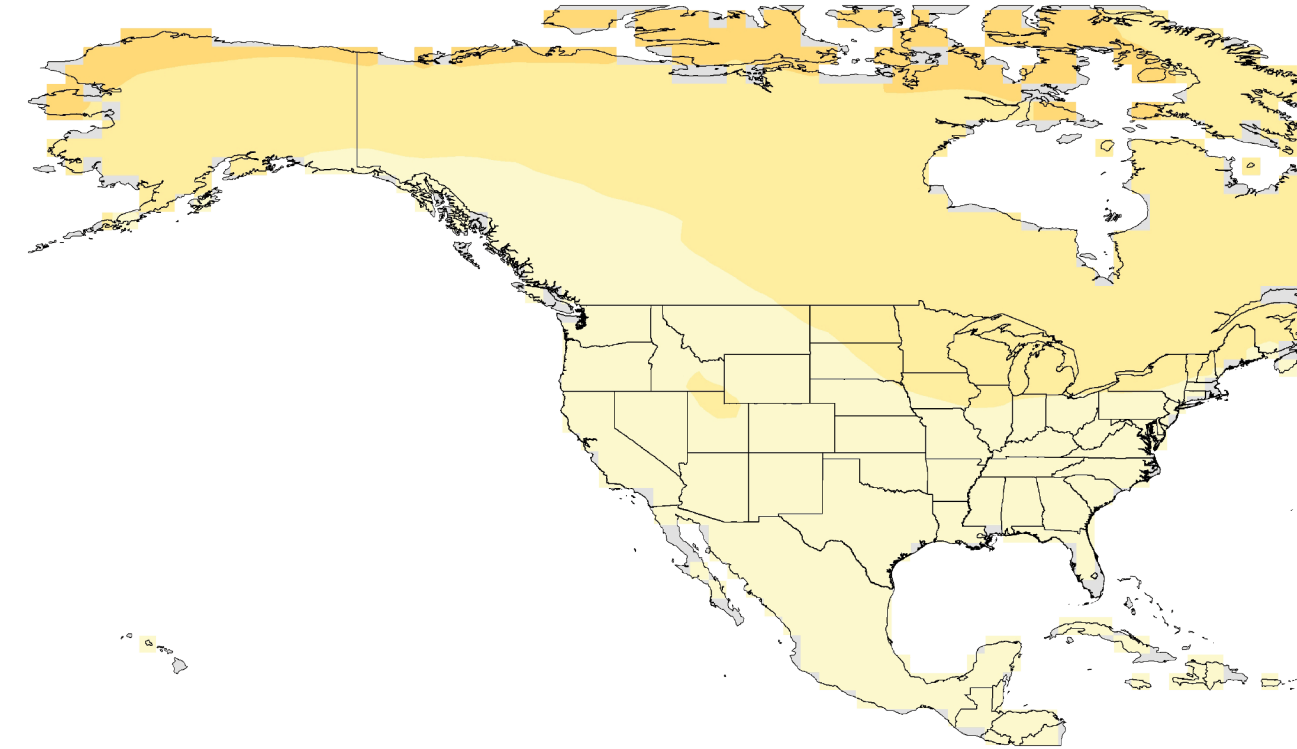


How will Temperatures change in the future scenarios?

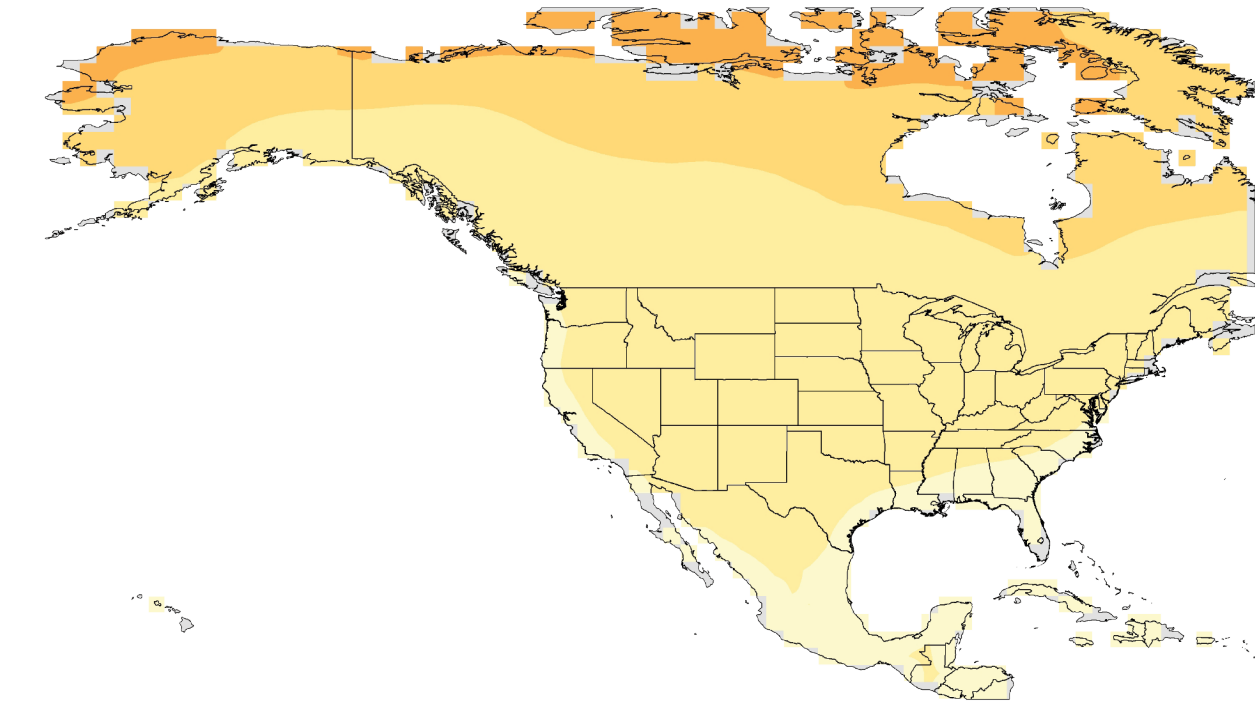
Projected Changes in Annual Average Temperature

Mid 21st Century

Lower Scenario (RCP4.5)

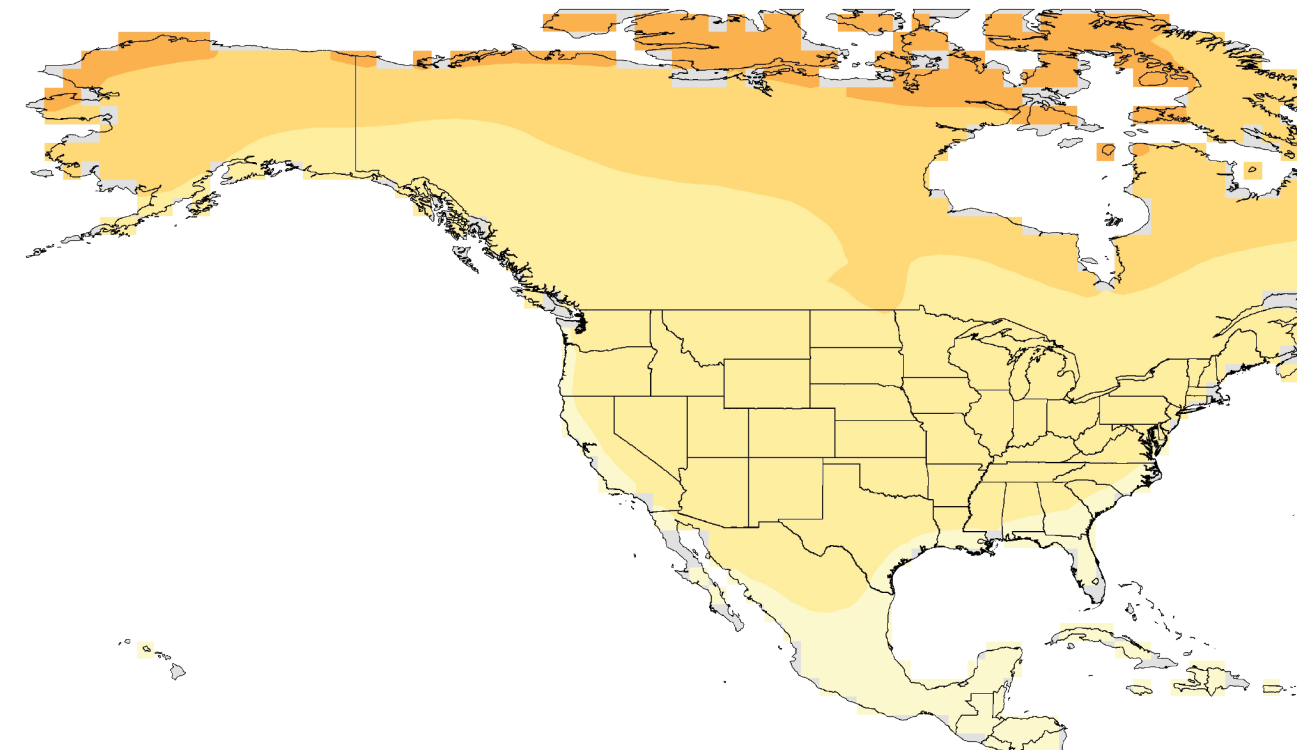


Higher Scenario (RCP8.5)

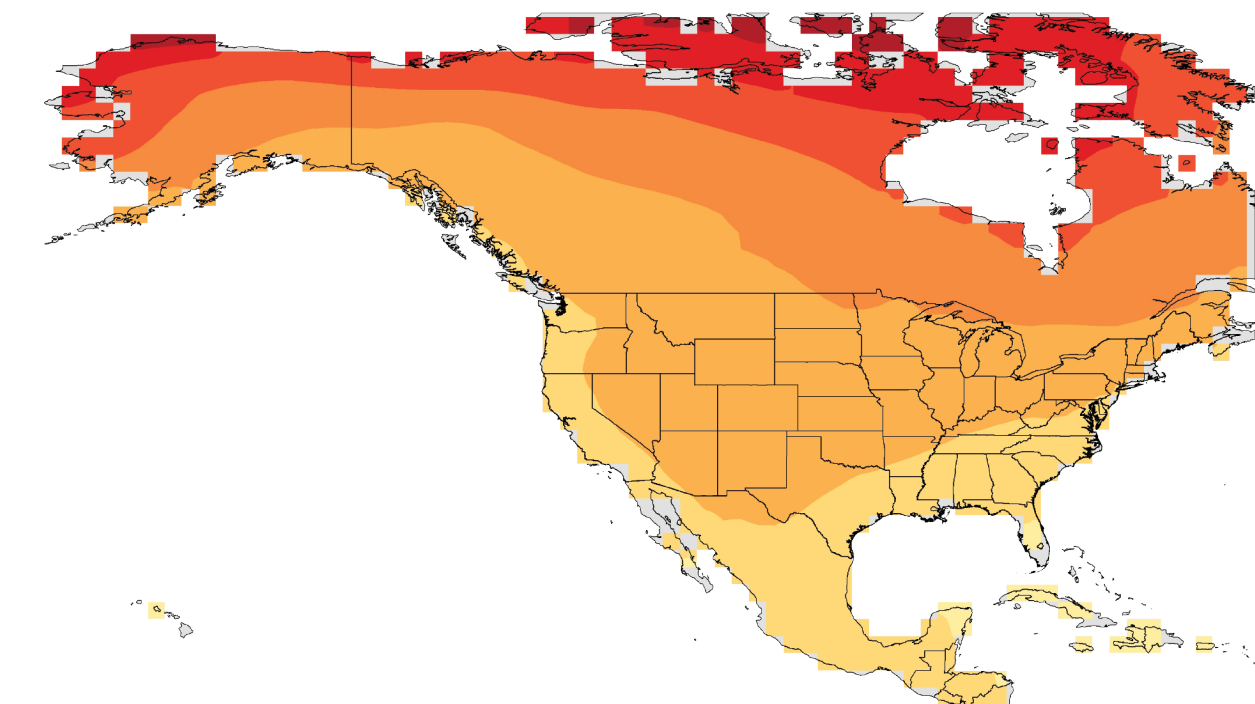


Late 21st Century

Lower Scenario (RCP4.5)



Higher Scenario (RCP8.5)



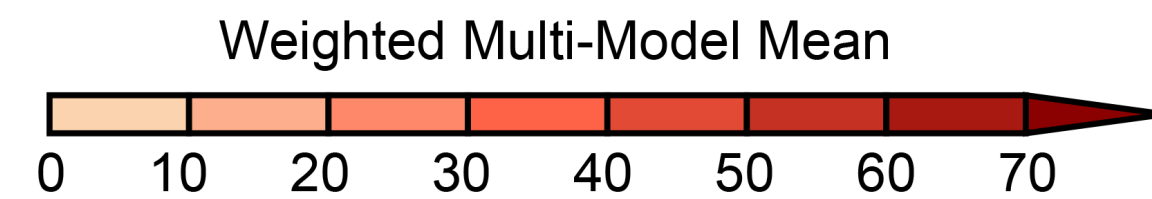
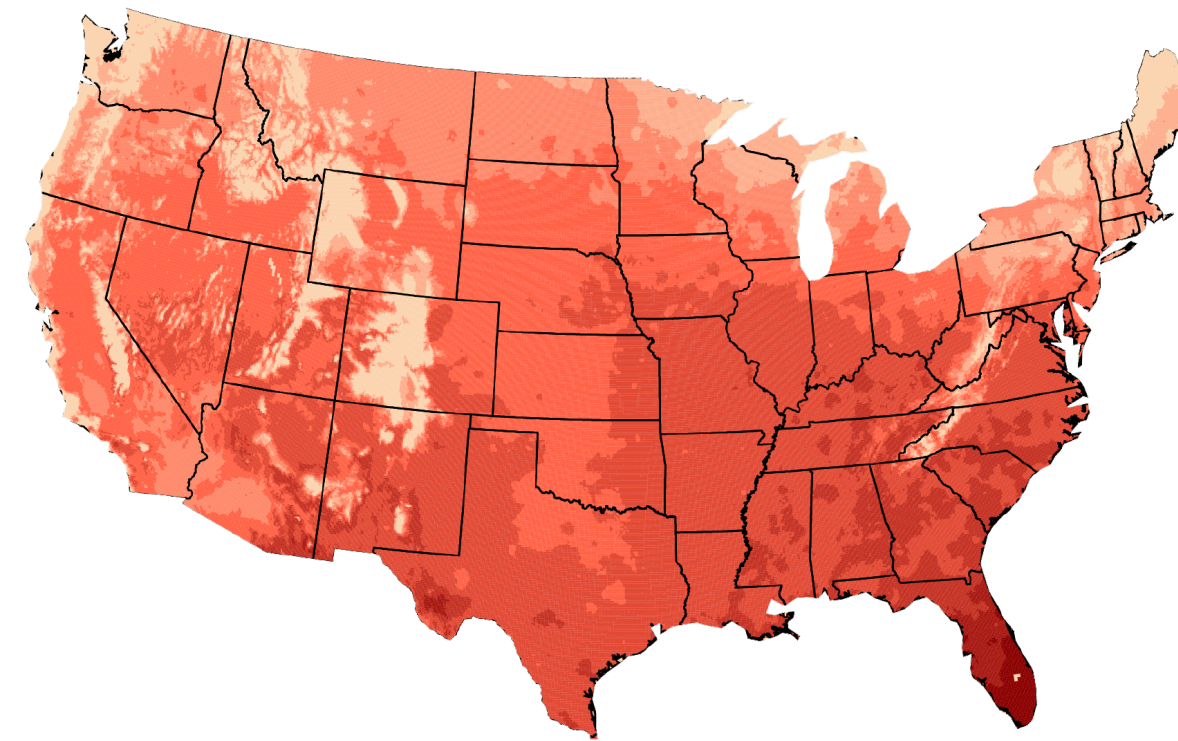
Change in Temperature (°F)



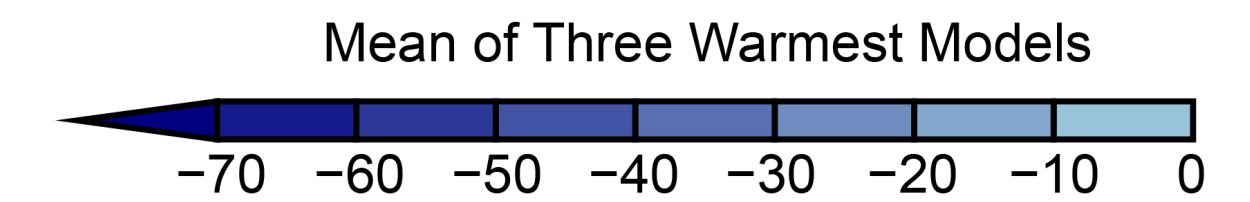
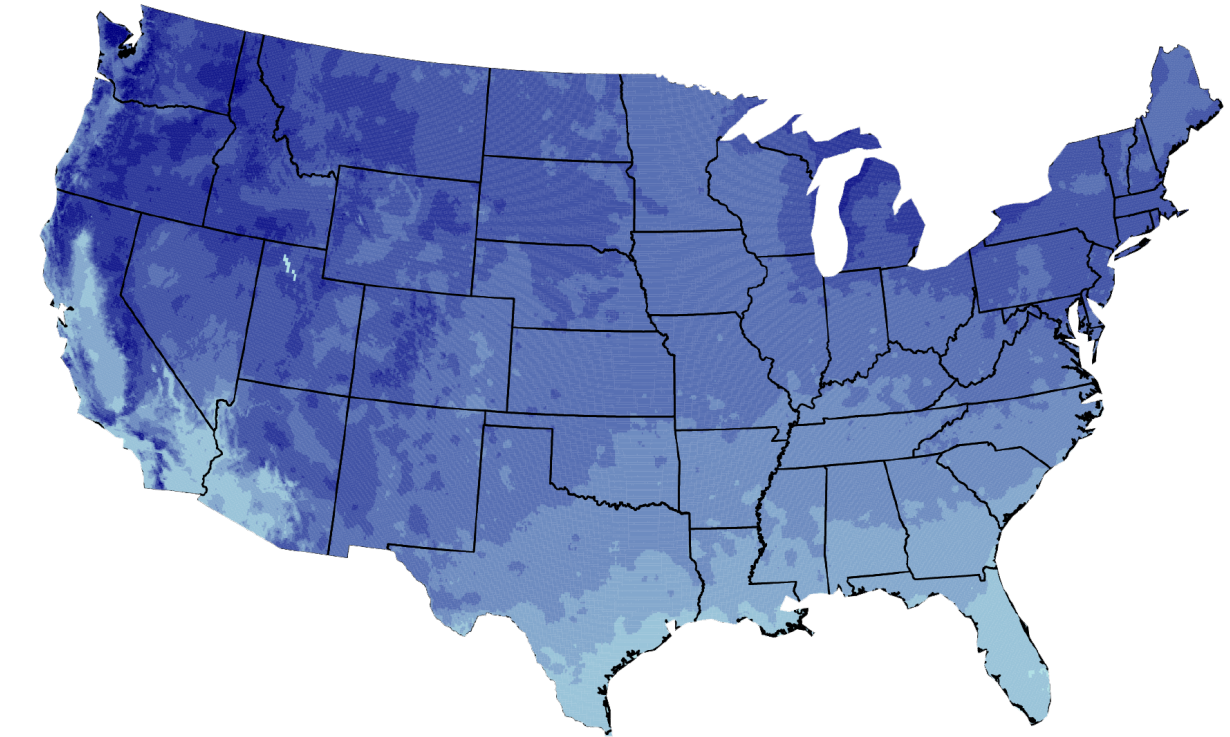
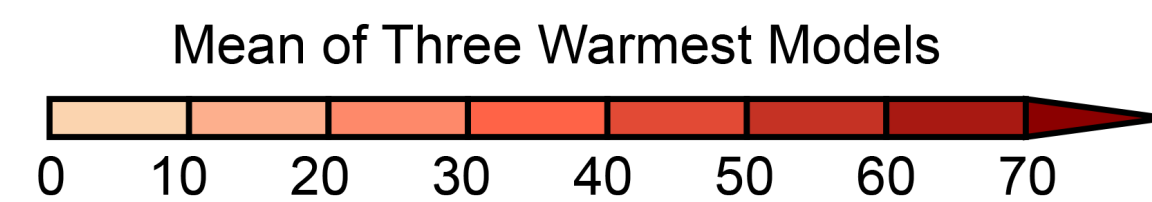
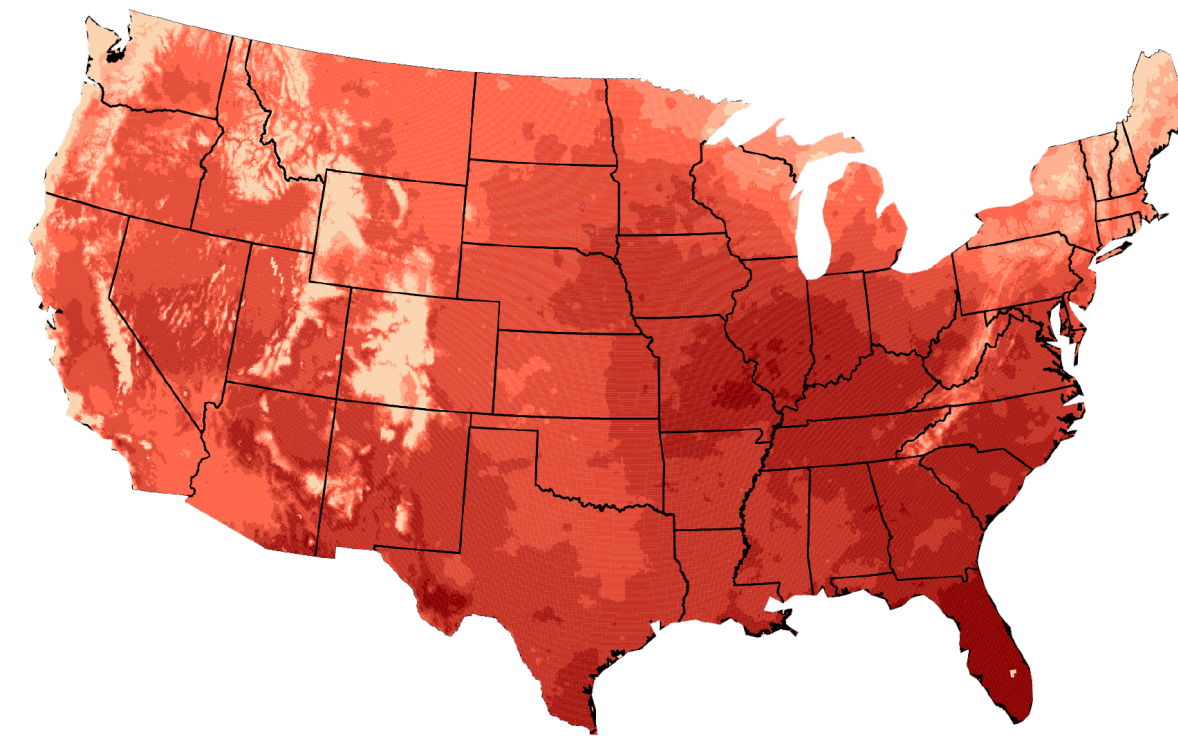
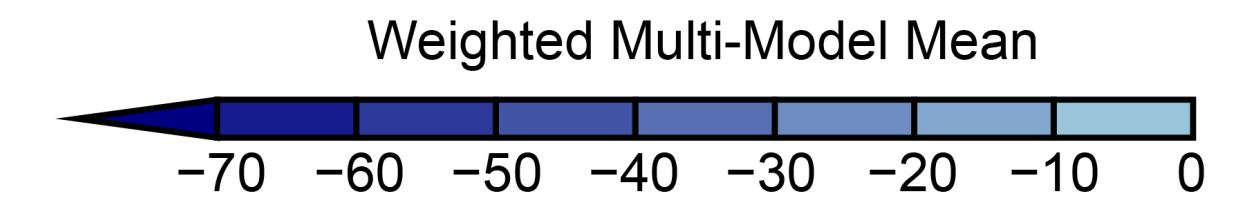
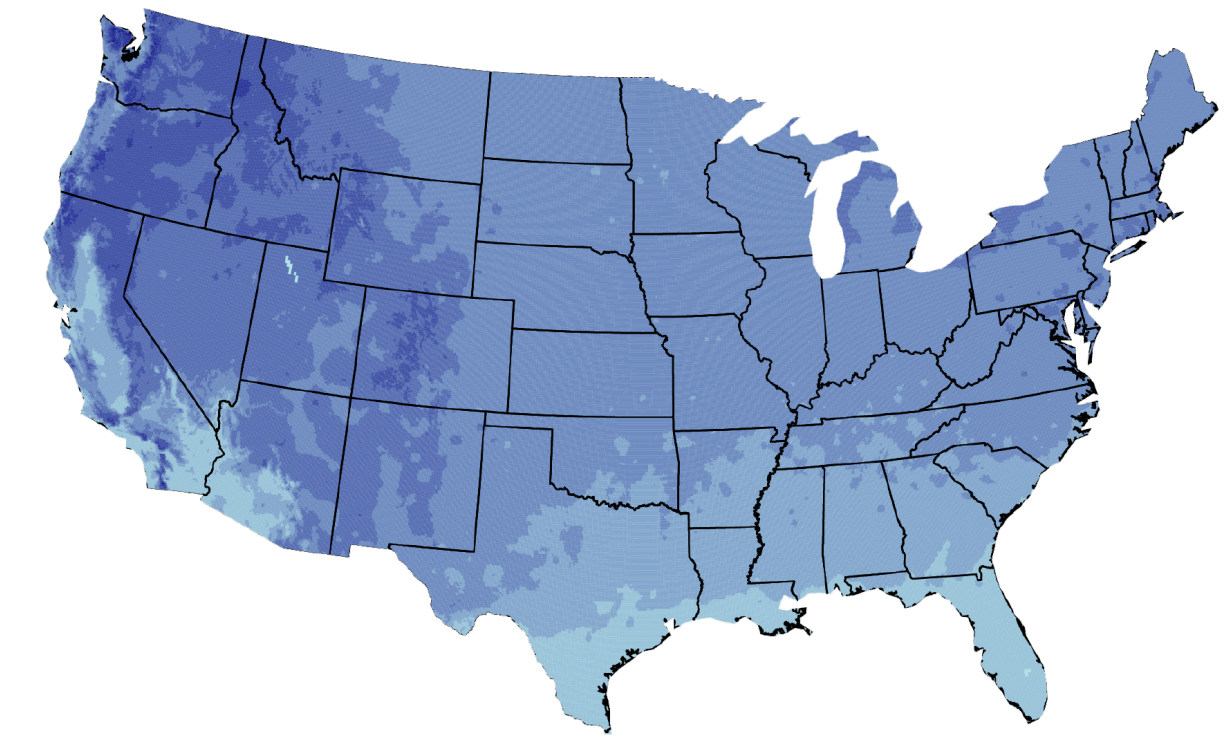
NCA4, Vol1: Figure 6.7

How will extreme Temperatures change in the future scenarios?

Projected Change in Number of Days Above 90°F
Mid 21st Century, Higher Scenario (RCP8.5)



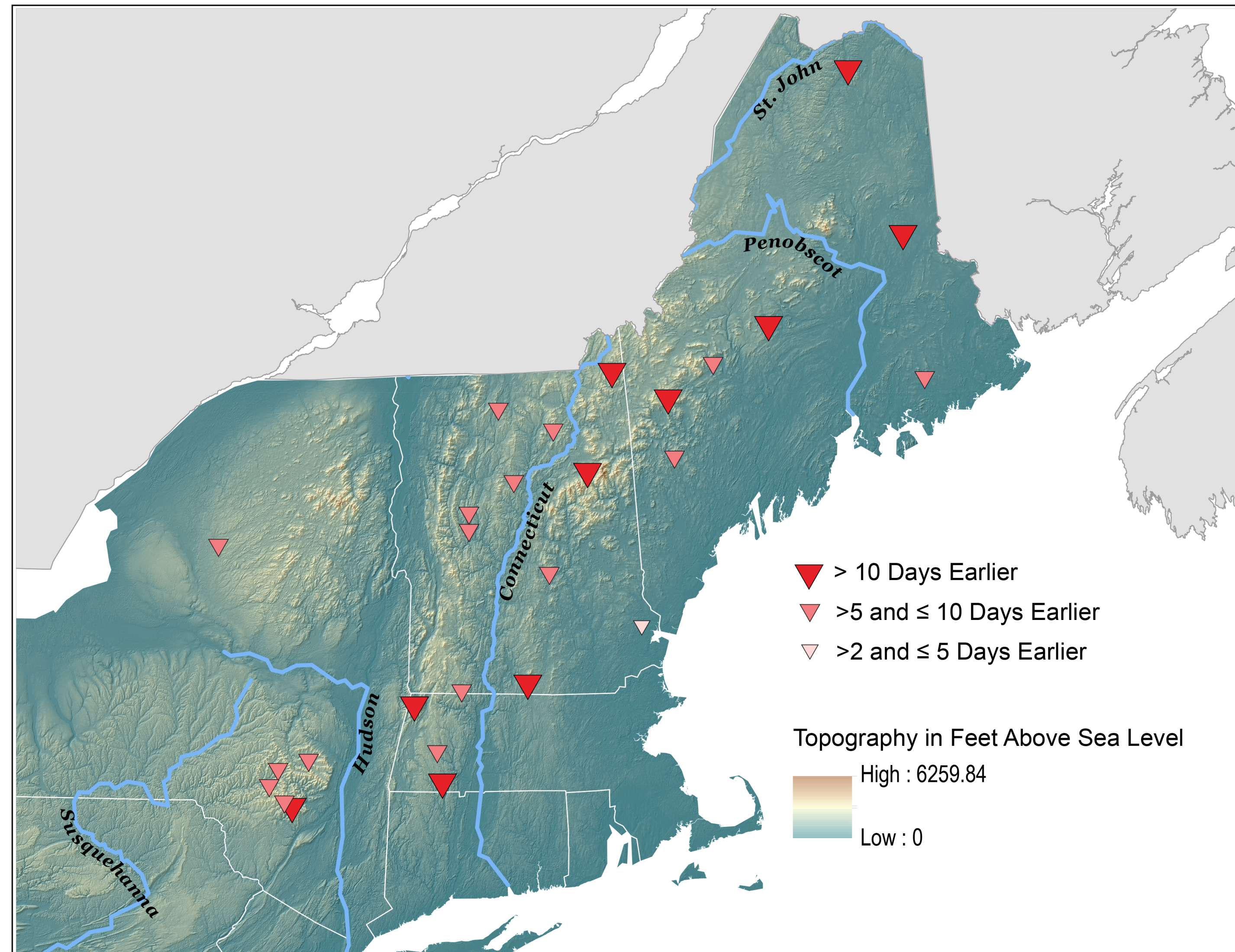
Projected Change in Number of Days Below 32°F
Mid 21st Century, Higher Scenario (RCP8.5)



NCA4, Vol1: Figure 6.8

How have snowmelt streamflows changed since 1960 to 2014?

NCA4, Vol2: Figure 18.2



Ocean Heat Wave in 2012

NCA4, Vol2: Figure 18.5

Figure 18.5: The map shows the difference between sea surface temperatures (SST) for June–August 2012 in the Northwest Atlantic and the average values for those months in 1982–2011.¹⁵⁵ While ocean temperatures during 2012 were exceptionally high compared to the current climate, they were within the range of end-of-century temperatures projected for the region under the higher scenario (RCP8.5). This heat wave affected the Northeast Continental Shelf ecosystem and fisheries, and similar extreme events are expected to become more common in the future ([Ch. 9: Oceans](#)). Source: adapted from Mills et al. 2013.¹⁵⁵ Reprinted with permission from Elsevier.

