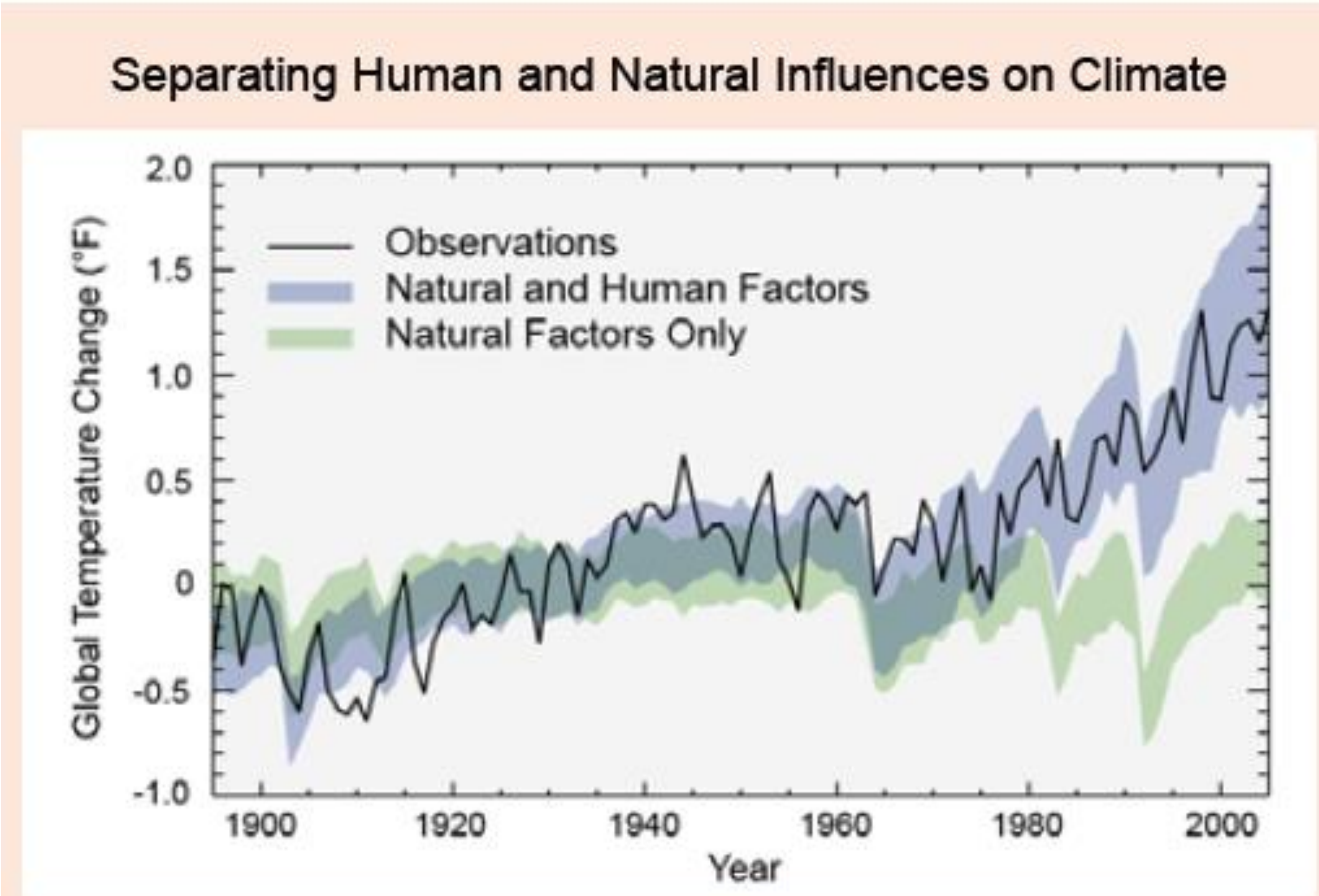
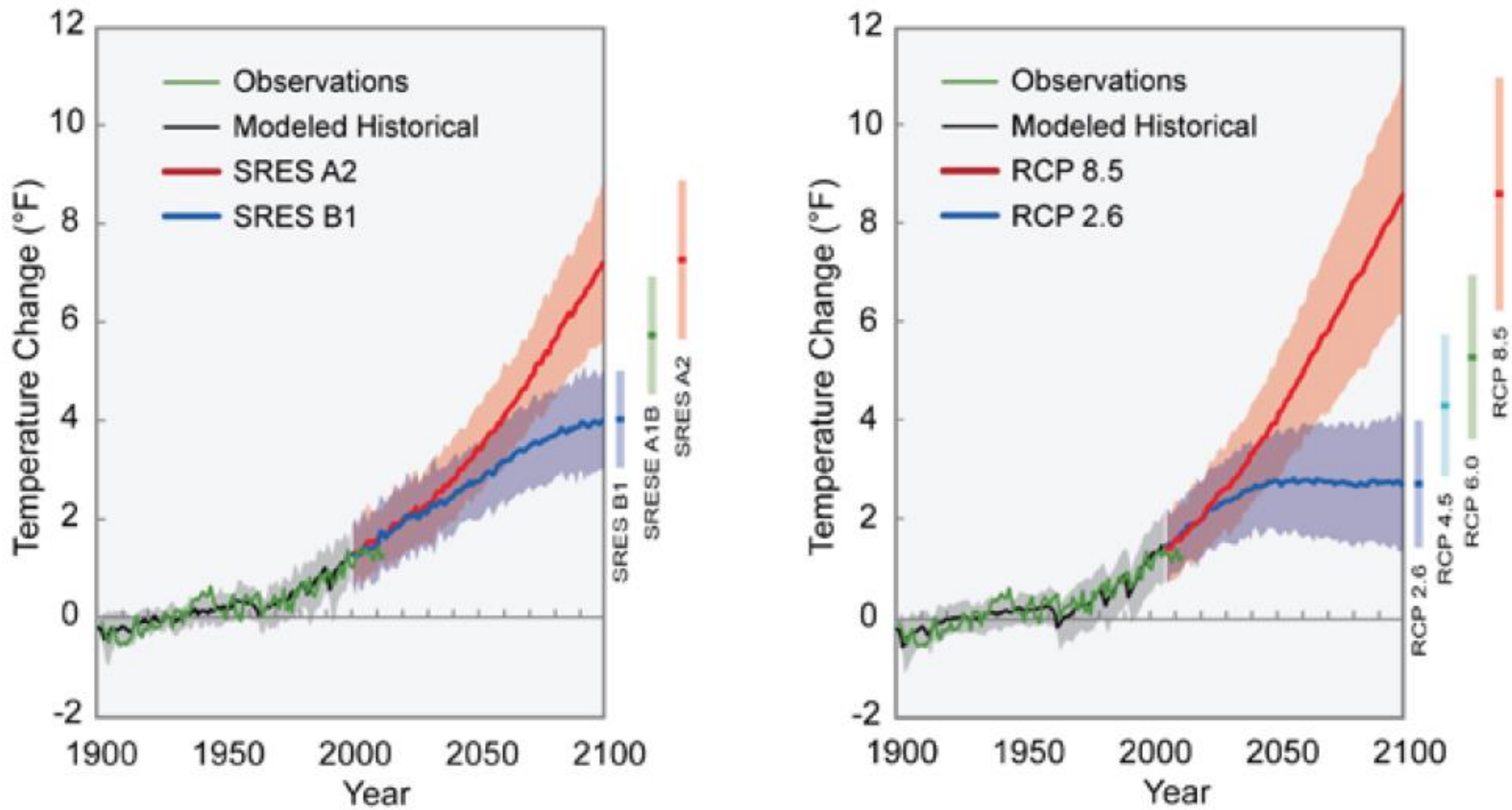
The Third U.S. National Climate Assessment, 2014

Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville, 2014: Ch. 2: Our Changing Climate. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67. doi:10.7930/J0KW5CXT.

On the Web: http://nca2014.globalchange.gov/report/our-changing-climate/introduction


Separating Human and Natural Influences on Climate
Observations
Natural and Human Factors
Natural Factors Only
Global Temperature Change (°F)
2.0
1.5
1.0
0.5
0
-0.5
-1.0
1900
1920
1940
1960
1980
2000
Year

Emissions Levels Determine Temperature Rises



Observed U.S. Temperature Change

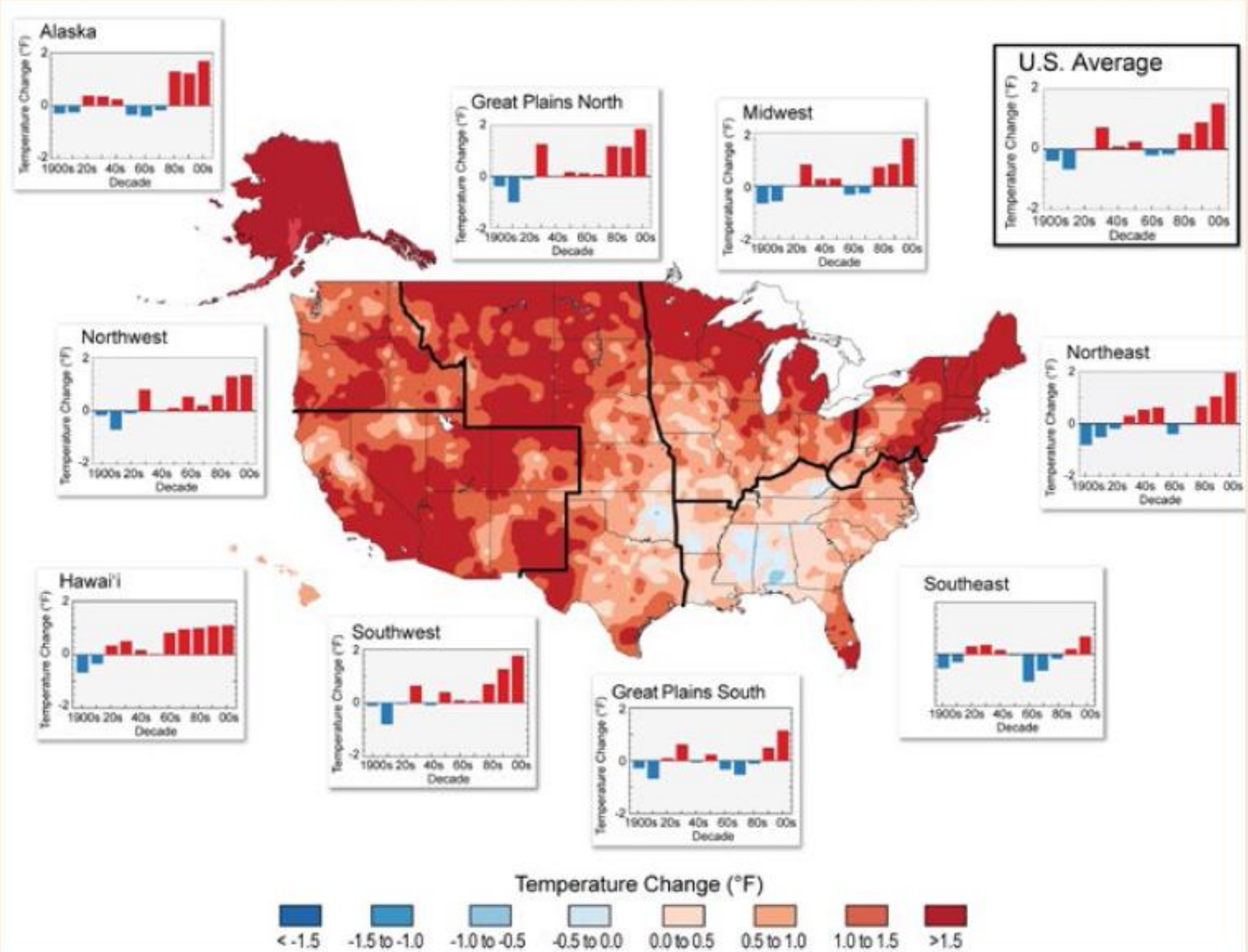
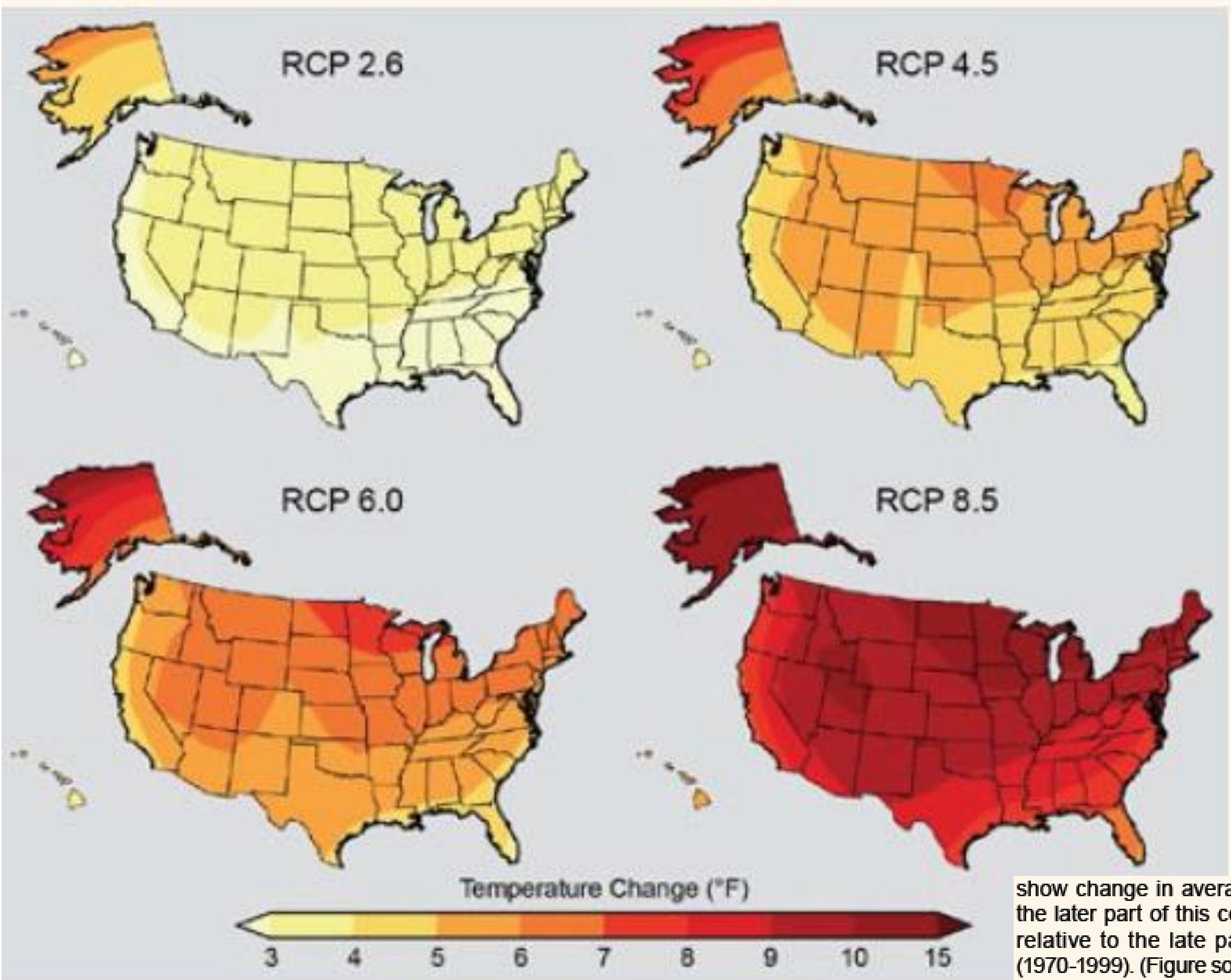


Figure 2.7. The colors on the map show temperature changes over the past 22 years (1991-2012) compared to the 1901-1960 average, and compared to the 1951-1980 average for Alaska and Hawai'i. The bars on the graphs show the average temperature changes by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph (2000s decade) includes 2011 and 2012. The period from 2001 to 2012 was warmer than any previous decade in every region. (Figure source: NOAA NCDC / CICS-NC).

Projected average temperature increase



show change in average temperature in the later part of this century (2071-2099) relative to the late part of last century (1970-1999). (Figure source: NOAA NCDC / CICS-NC).

Projected Temperature Change of Hottest and Coldest Days

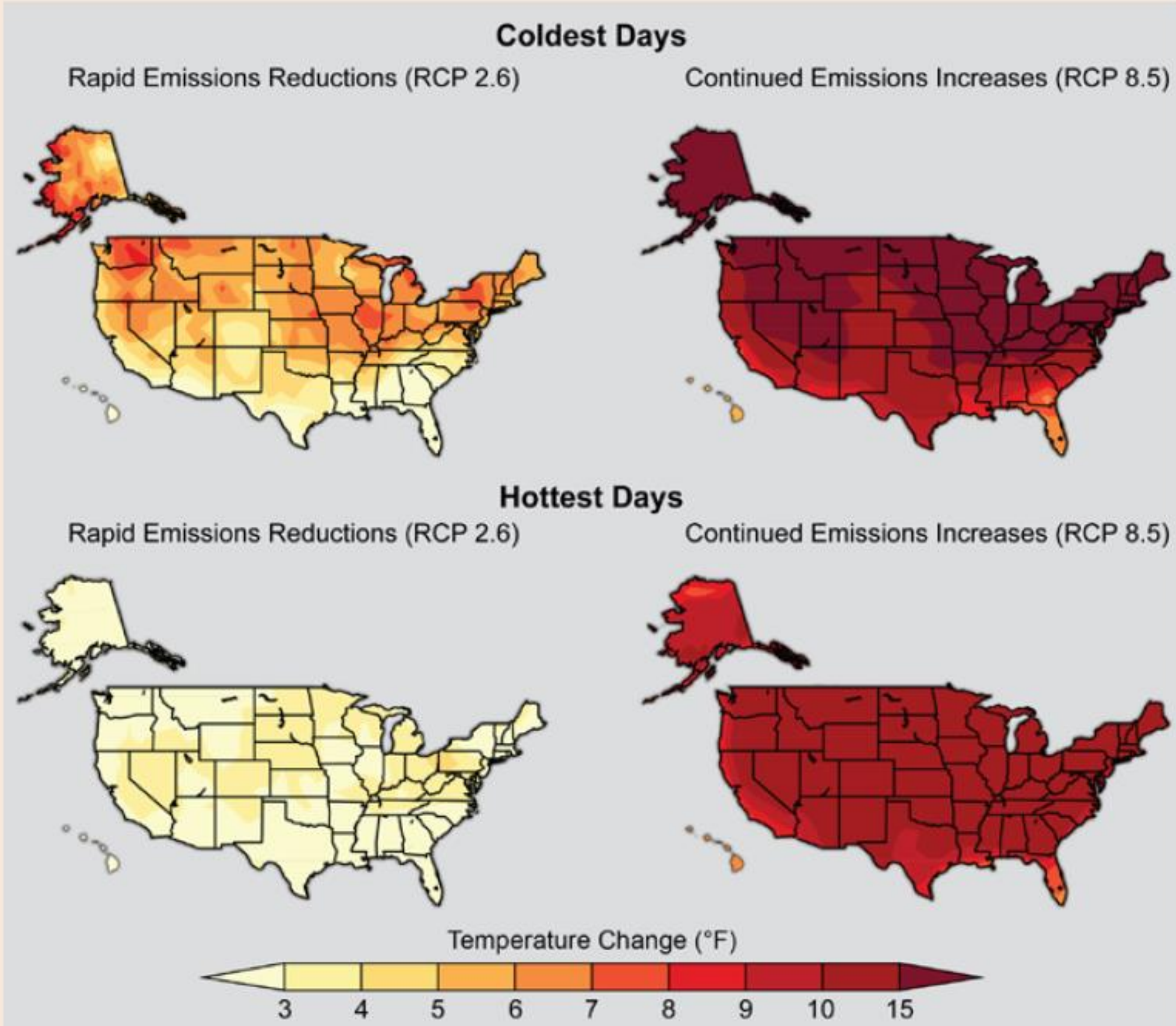
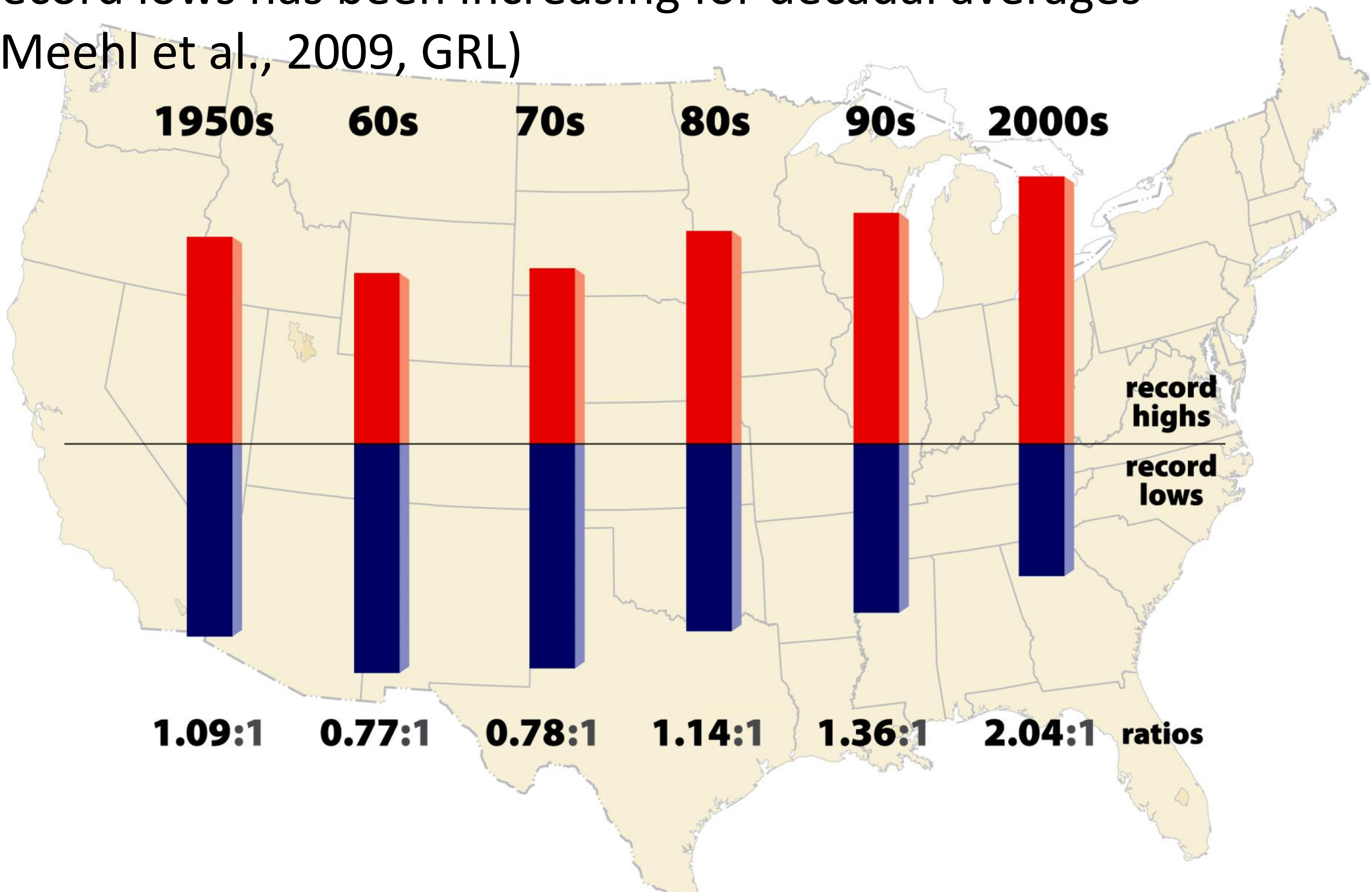


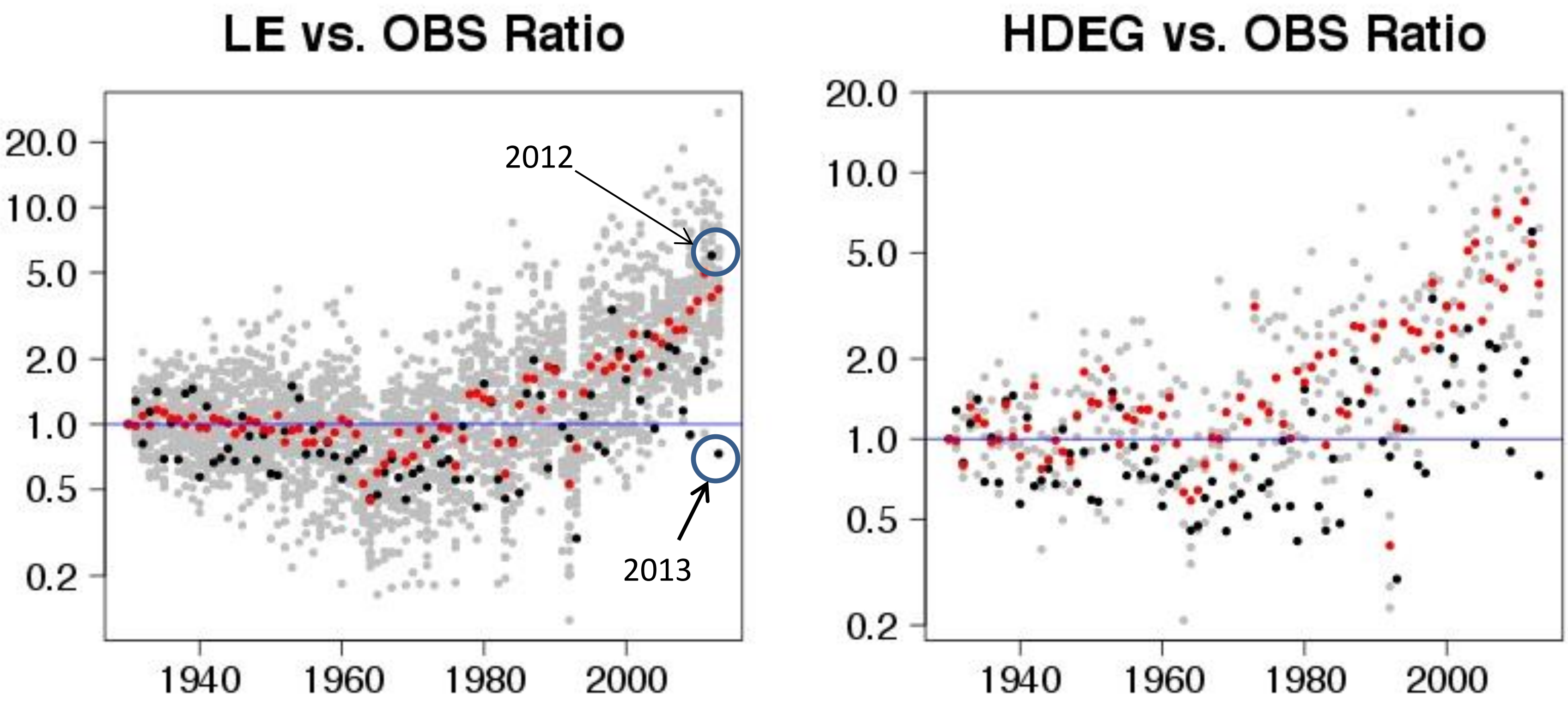
Figure 2.20. Change in surface air temperature at the end of this century (2081-2100) relative to the turn of the last century (1986-2005) on the coldest and hottest days under a scenario that assumes a rapid reduction in heat trapping gases (RCP 2.6) and a scenario that assumes continued increases in these gases (RCP 8.5). This figure shows estimated changes in the average temperature of the hottest and coldest days in each 20-year period. In other words, the hottest days will get even hotter, and the coldest days will be less cold. (Figure source: NOAA NCDC / CICS-NC).

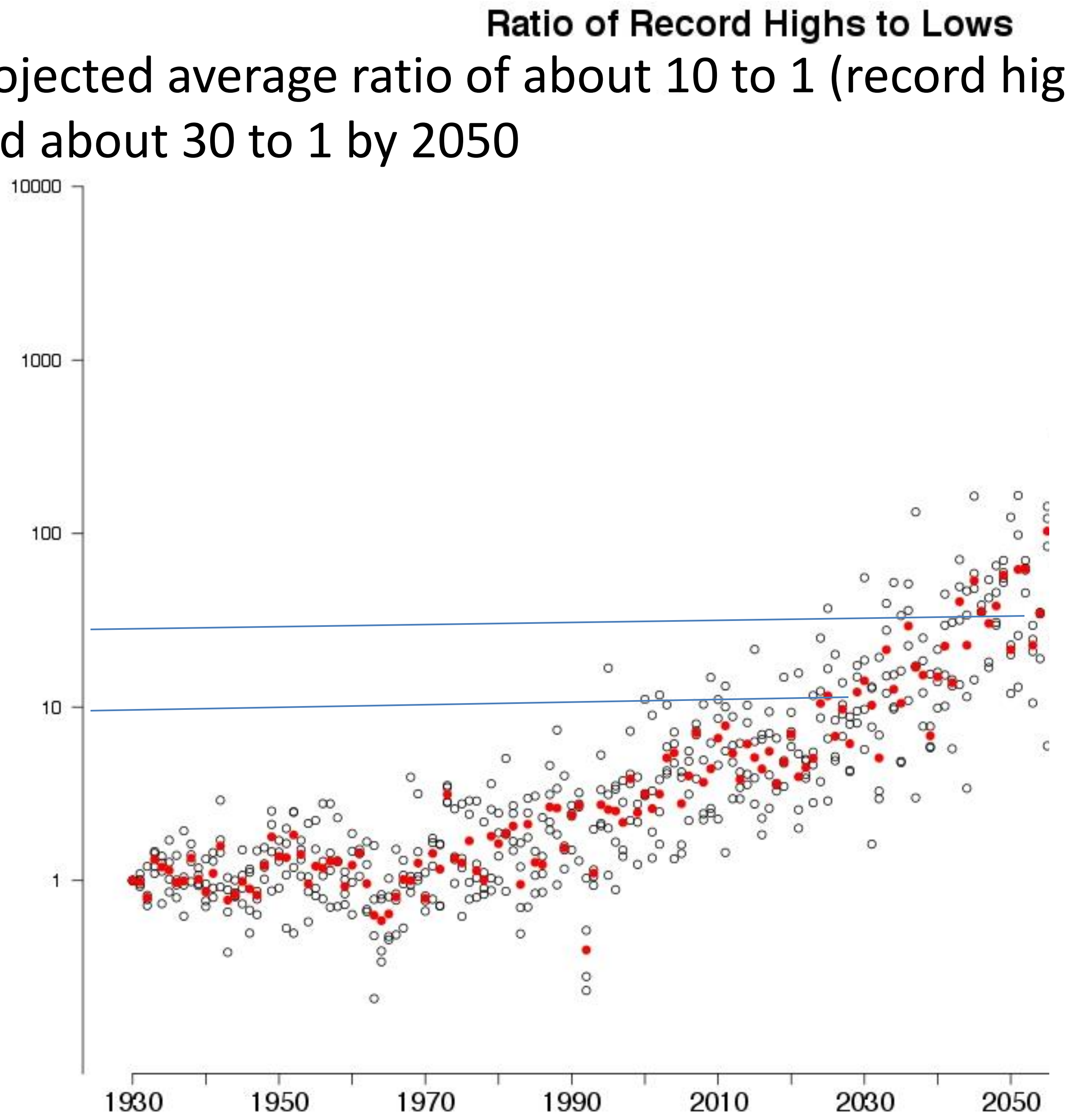
Global warming shifts the odds towards a better chance for more record highs compared to record lows

Using station data starting in 1950, the ratio of record highs to record lows has been increasing for decadal averages (Meehl et al., 2009, GRL)



Using station data starting in 1930, the increase in the ratio of record highs to record lows has large amplitude interannual variability in models and observations, but both show increases in the ratio



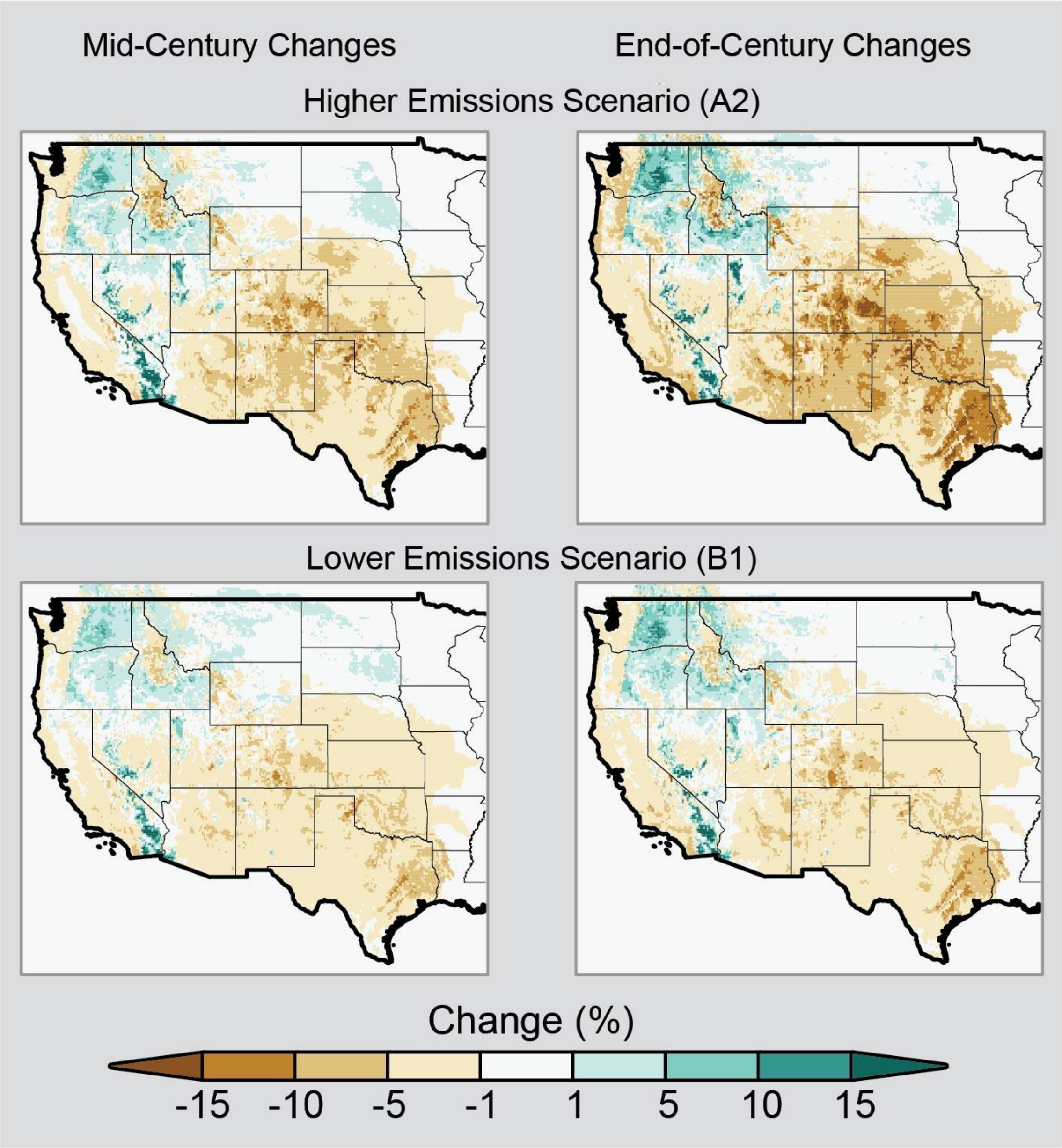


Projected average ratio of about 10 to 1 (record highs to lows) by 2030 and about 30 to 1 by 2050

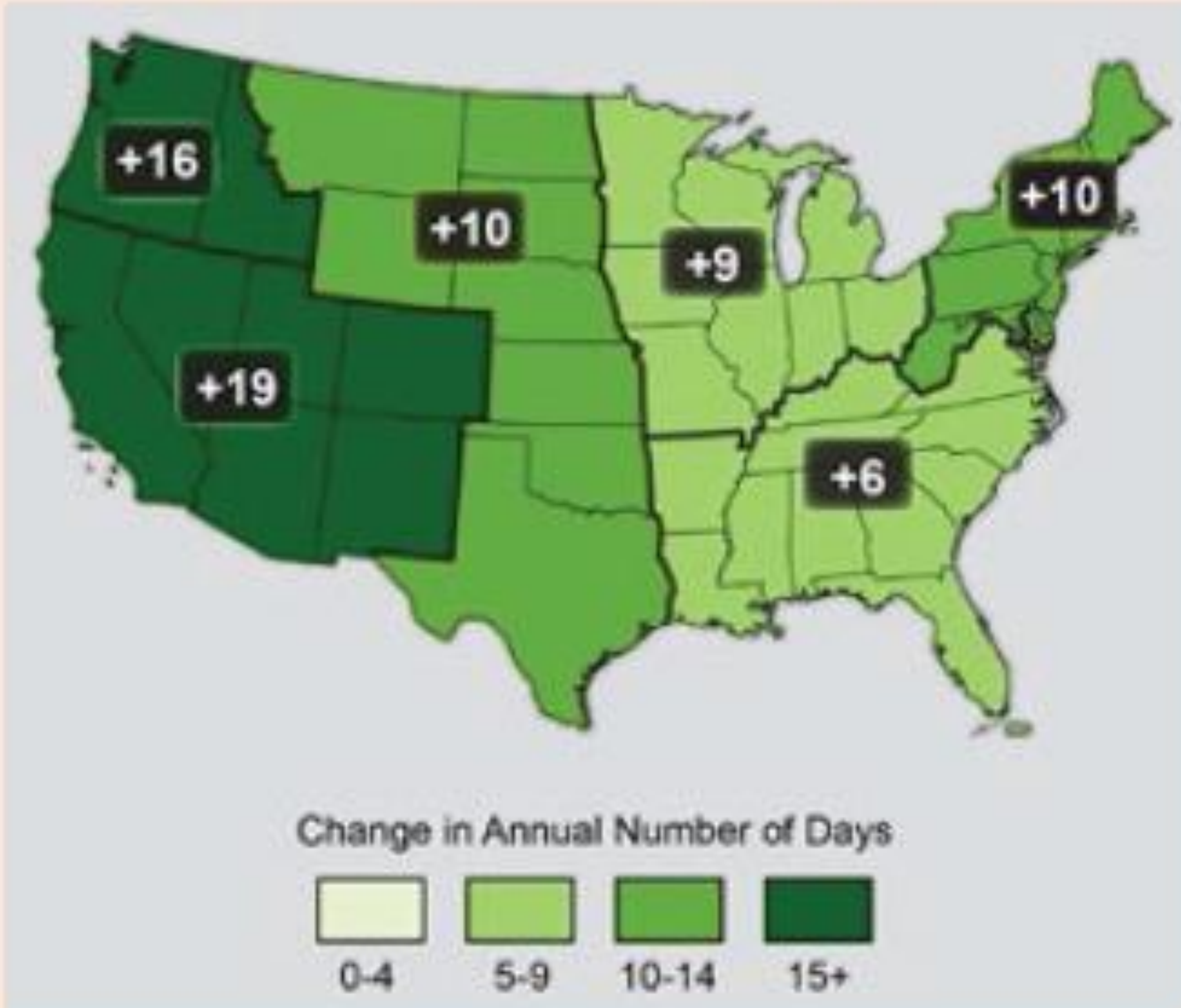
Video: Steroids, baseball and climate change

FINAL_Steroids_and_Climate_Change.wmv

Projected Changes in Soil Moisture for the Western U.S.



Observed Increase in Frost-Free Season Length



1991-2012 relative to 1901-1960.

Projected Changes in Frost-Free Season Length

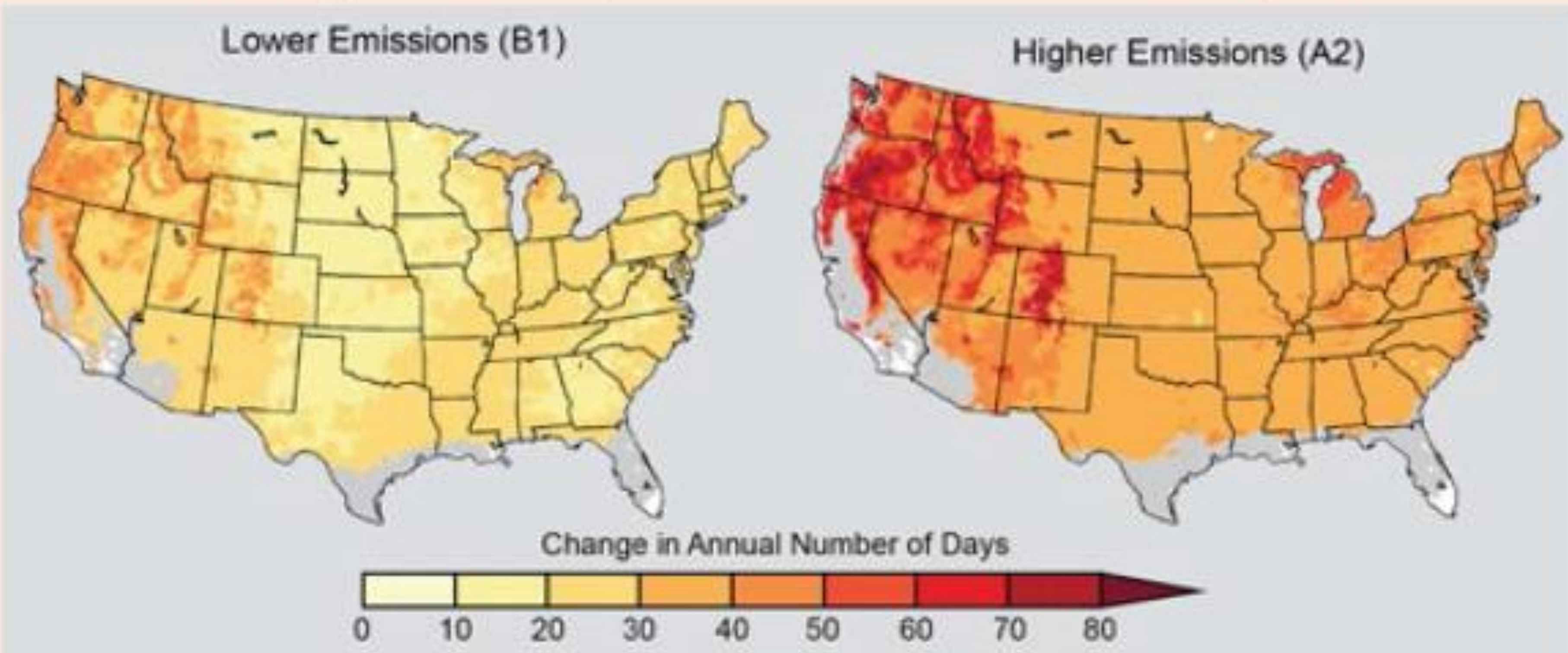


Figure 2.11. The maps show projected increases in frost-free season length for the last three decades of this century (2070-2099 as compared to 1971-2000) under two emissions scenarios,

Observed U.S. Precipitation Change

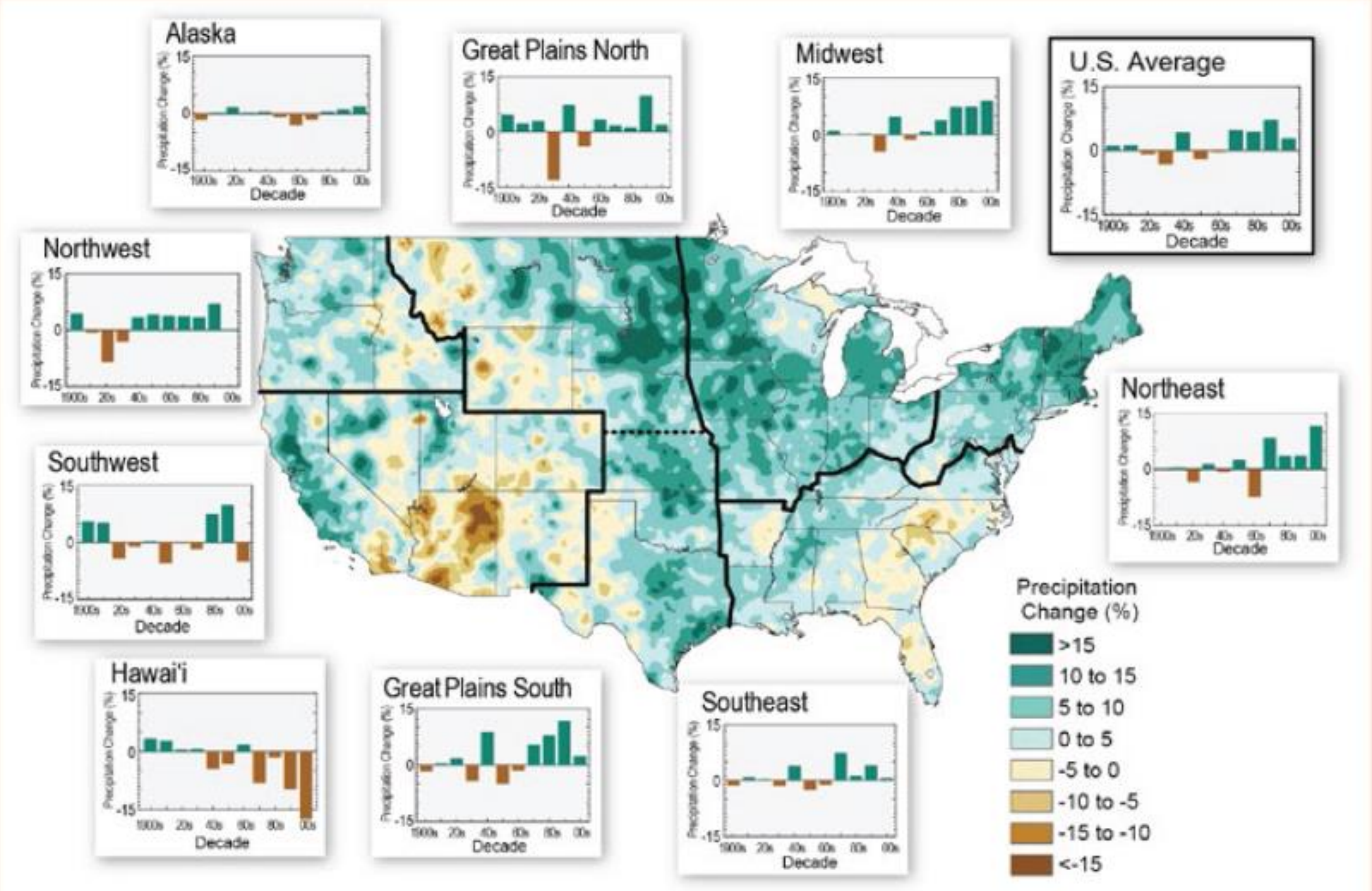


Figure 2.12. The colors on the map show annual total precipitation changes for 1991-2012 compared to the 1901-1960 average,

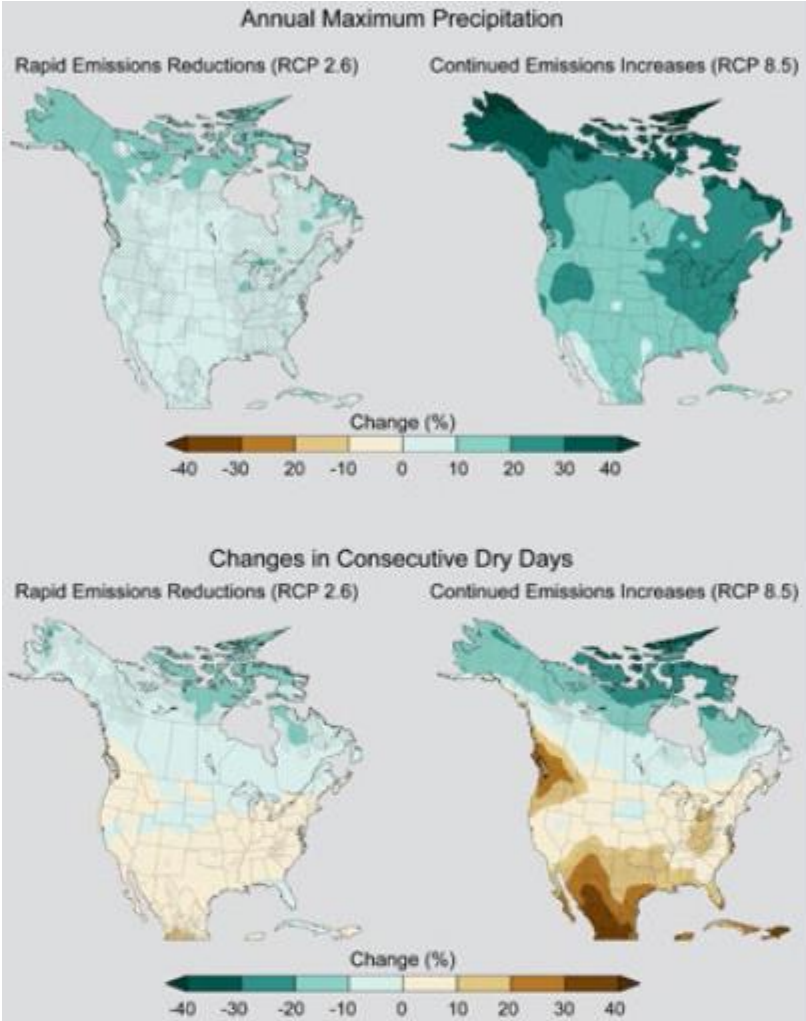
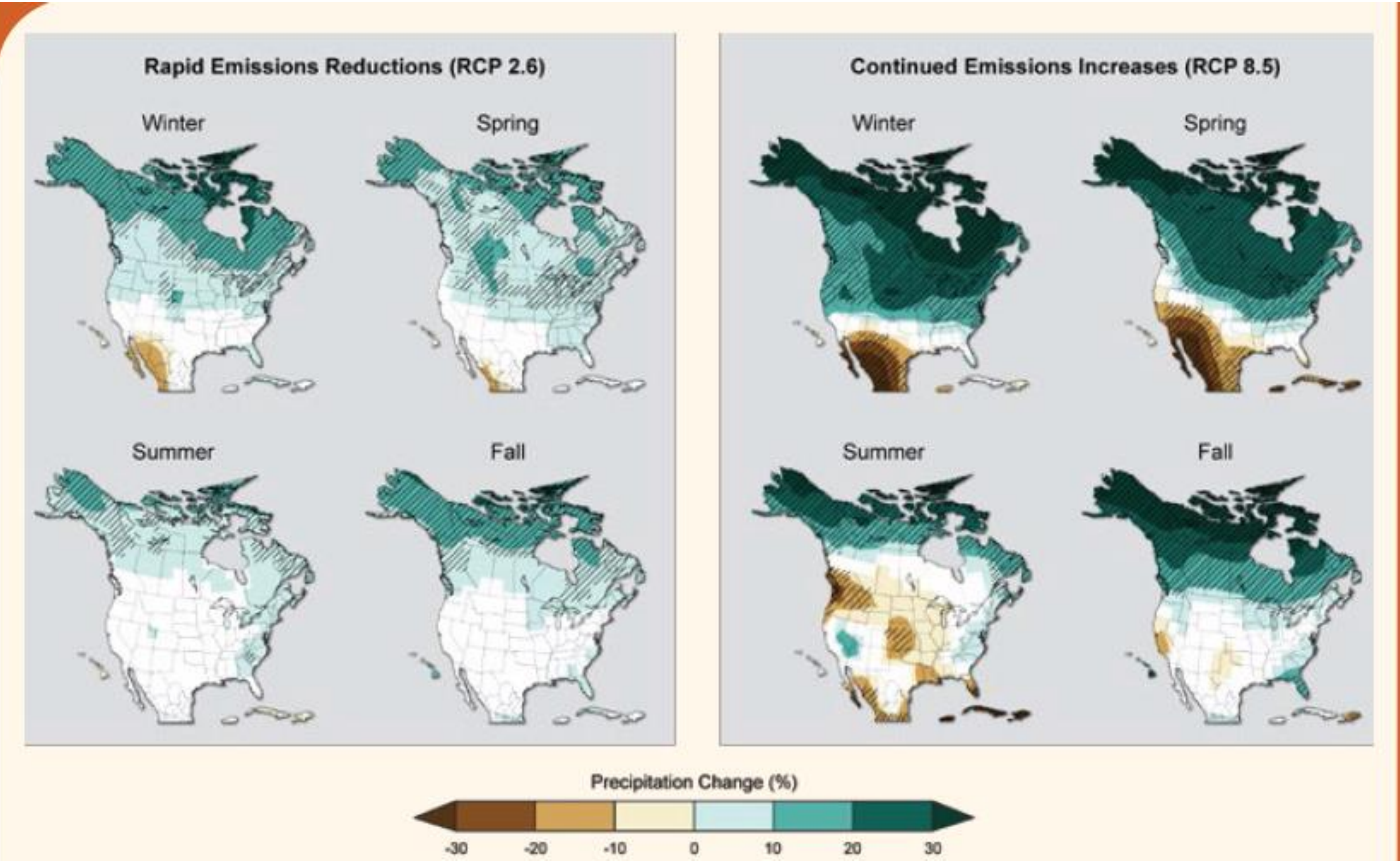


Figure 2.13. Top panels show simulated changes in the average amount of precipitation falling on the wettest day of the year for the period 2070-2099 as compared to 1971-2000 under a scenario that assumes rapid reductions in emissions (RCP 2.6) and one that assumes continued emissions increases (RCP 8.5). Bottom panels show simulated changes in the annual maximum number of consecutive dry days (days receiving less than 0.04 inches (1 mm) of precipitation) under the same two scenarios. Simulations are from CMIP5 models. Stippling indicates areas where changes are consistent among at least 80% of the models used in this analysis. (Figure source: NOAA NCDC / CICS-NC).

Precipitation projected to become more intense but with more time between storms

Projected changes in average precipitation



Observed U.S. Trend in Heavy Precipitation

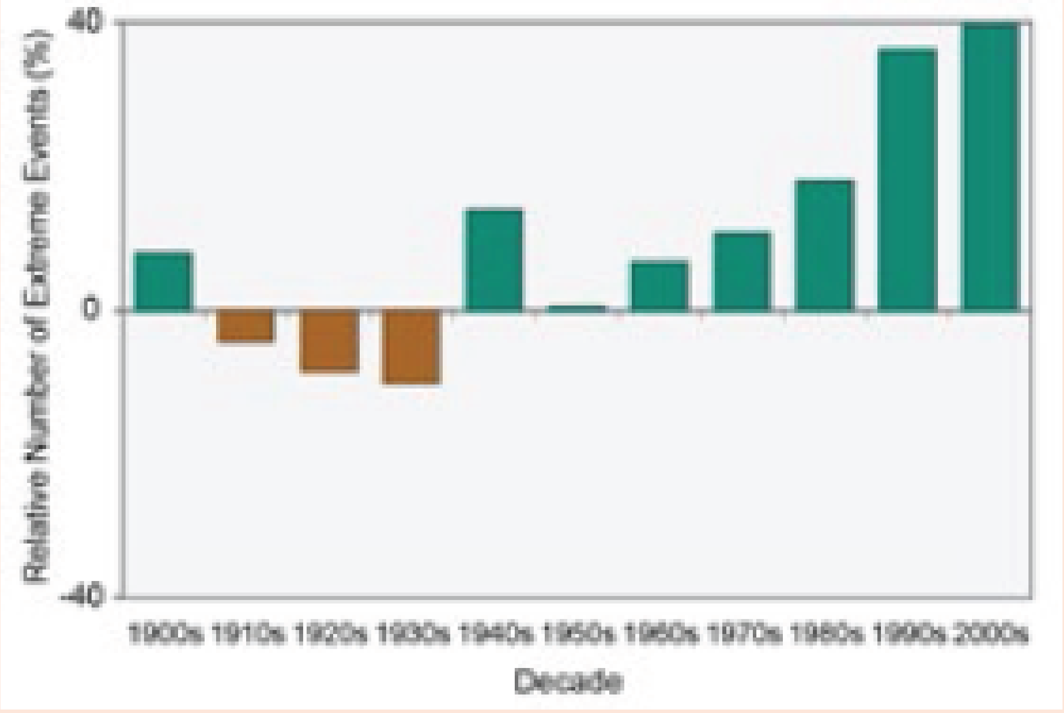


Figure 2.16: One measure of a heavy precipitation event is a 2-day precipitation total that is exceeded on average only once in a five-year period, also known as a once-in-five-year event. As this extreme precipitation index for 1901-2012 shows, the occurrence of such events has become much more common in recent decades. Changes are compared to the period 1901-1960, and do not include Alaska or Hawai'i. The 2000s decade (far right bar) includes 2001-2012. (Figure source: adapted from Kunkel et al. 2013[52]).

Observed Change in Very Heavy Precipitation

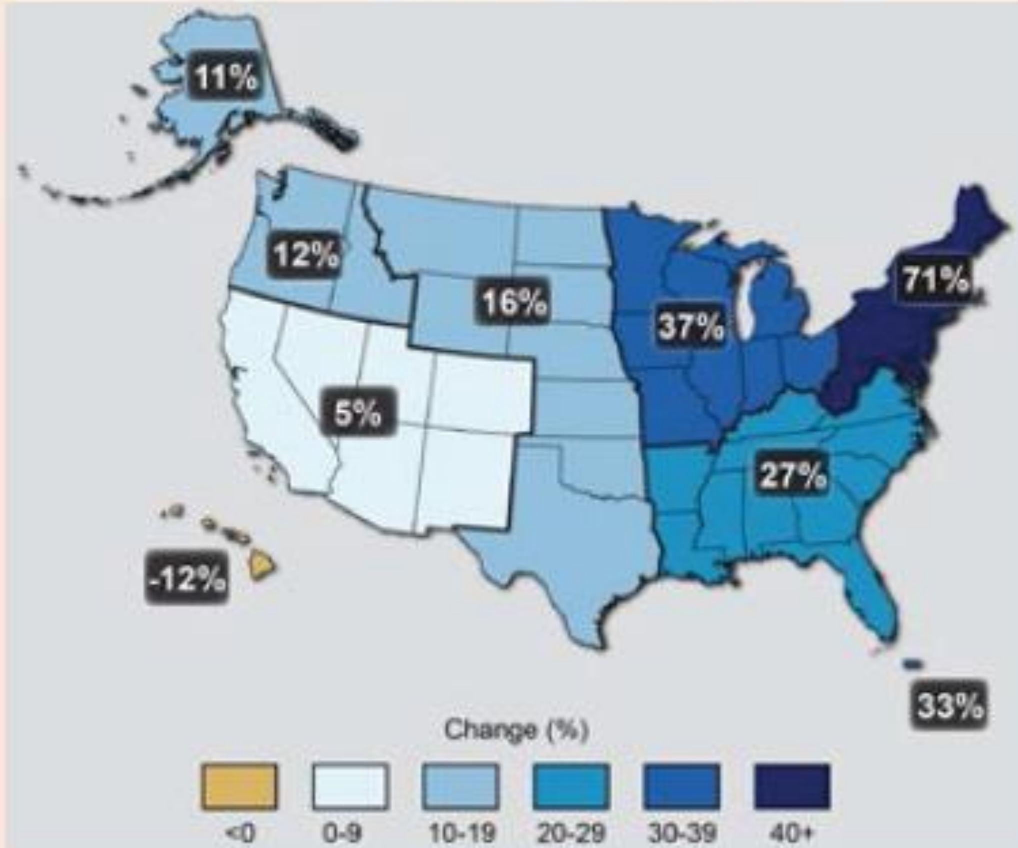


Figure 2.18. The map shows percent increases in the amount of precipitation falling in very heavy events (defined as the heaviest 1% of all daily events) from 1958 to 2012 for each region of the continental United States. These trends are larger than natural variations for the Northeast, Midwest, Puerto Rico, Southeast, Great Plains, and Alaska. The trends are not larger than natural variations for the Southwest, Hawai'i, and the Northwest. The changes shown in this figure are calculated from the beginning and end points of the trends for 1958 to 2012. (Figure source: updated from Karl et al. 2009[1]).

Observed changes in precipitation intensity

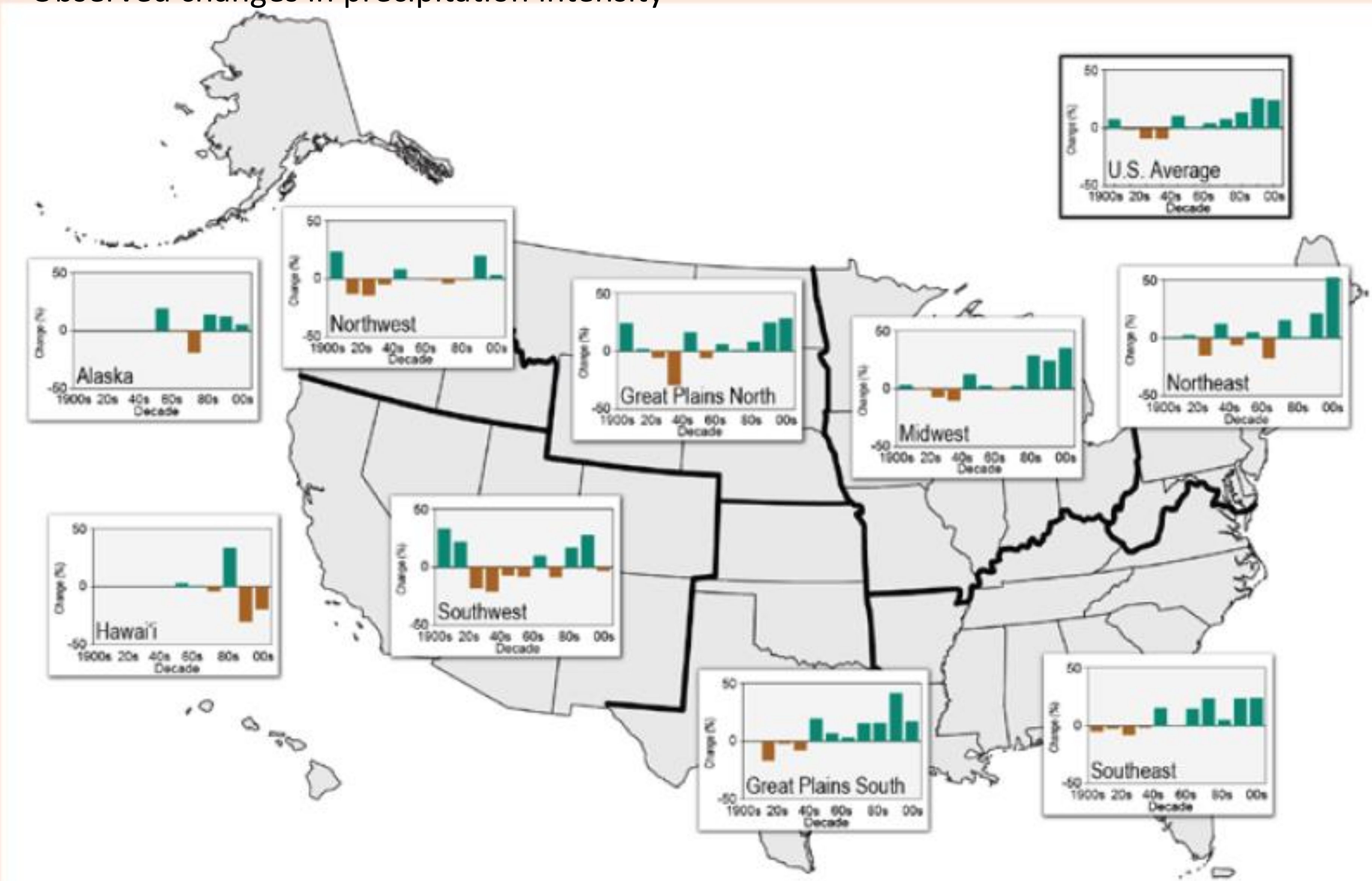


Figure 2.17. Percent changes in the annual amount of precipitation falling in very heavy events, defined as the heaviest 1% of all daily events from 1901 to 2012 for each region. The far right bar is for 2001-2012. In recent decades there have been increases nationally, with the largest increases in the Northeast, Great Plains, Midwest, and Southeast. Changes are compared to the 1901-1960 average for all regions except Alaska and Hawai'i, which are relative to the 1951-1980 average. (Figure source: NOAA NCDC / CICS-NC).

Projected Change in Heavy Precipitation Events

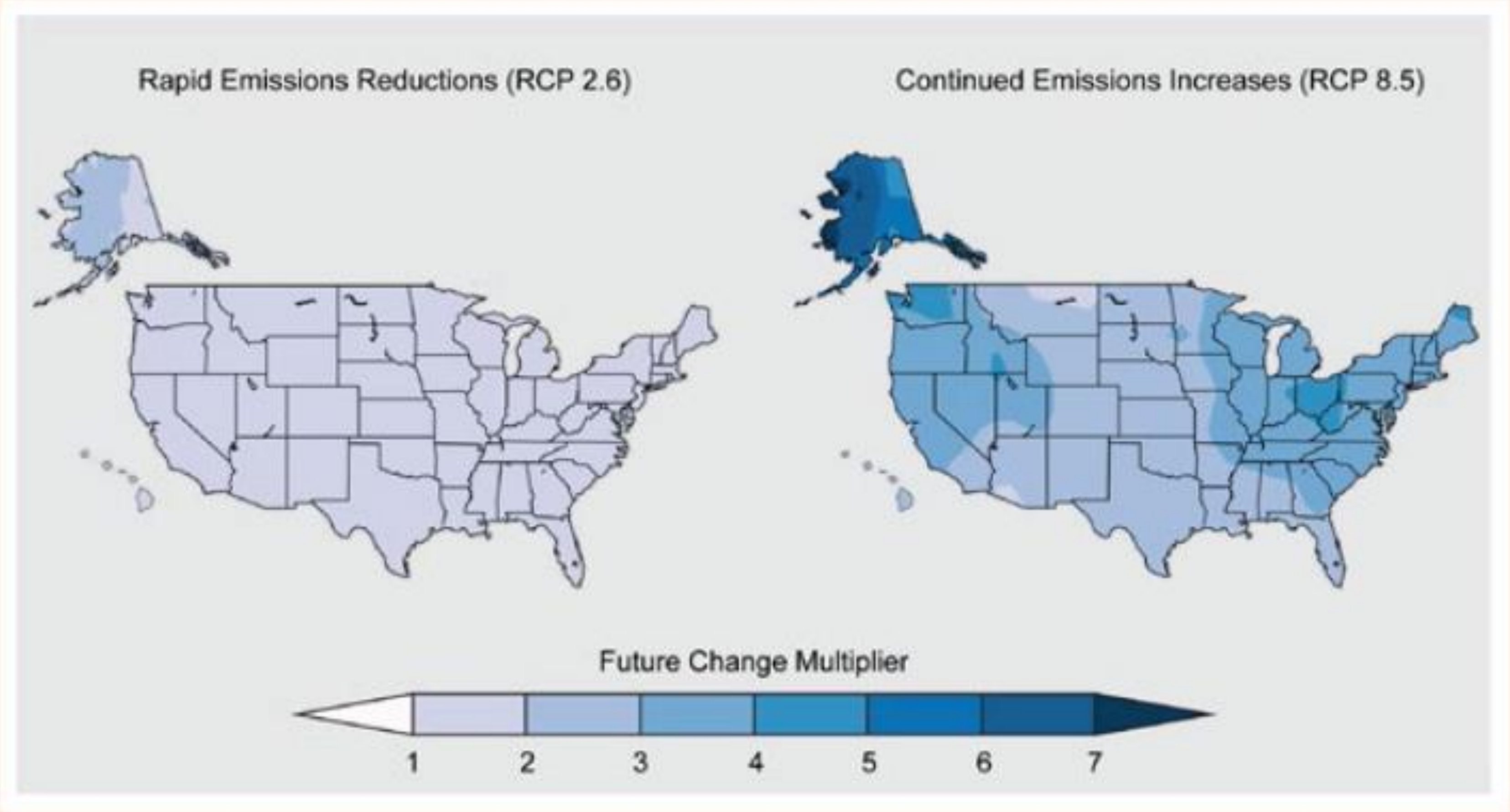


Figure 2.19. Maps show the increase in frequency of extreme daily precipitation events (a daily amount that now occurs once in 20 years) by the later part of this century (2081-2100) compared to the later part of last century (1981-2000). Such extreme events are projected to occur more frequently everywhere in the United States. Under the rapid emissions reduction scenario (RCP 2.6), these events would occur nearly twice as often. For the scenario assuming continued increases in emissions (RCP 8.5), these events would occur up to five times as often. (Figure source: NOAA NCDC / CICS-NC).

Trends in Flood Magnitude

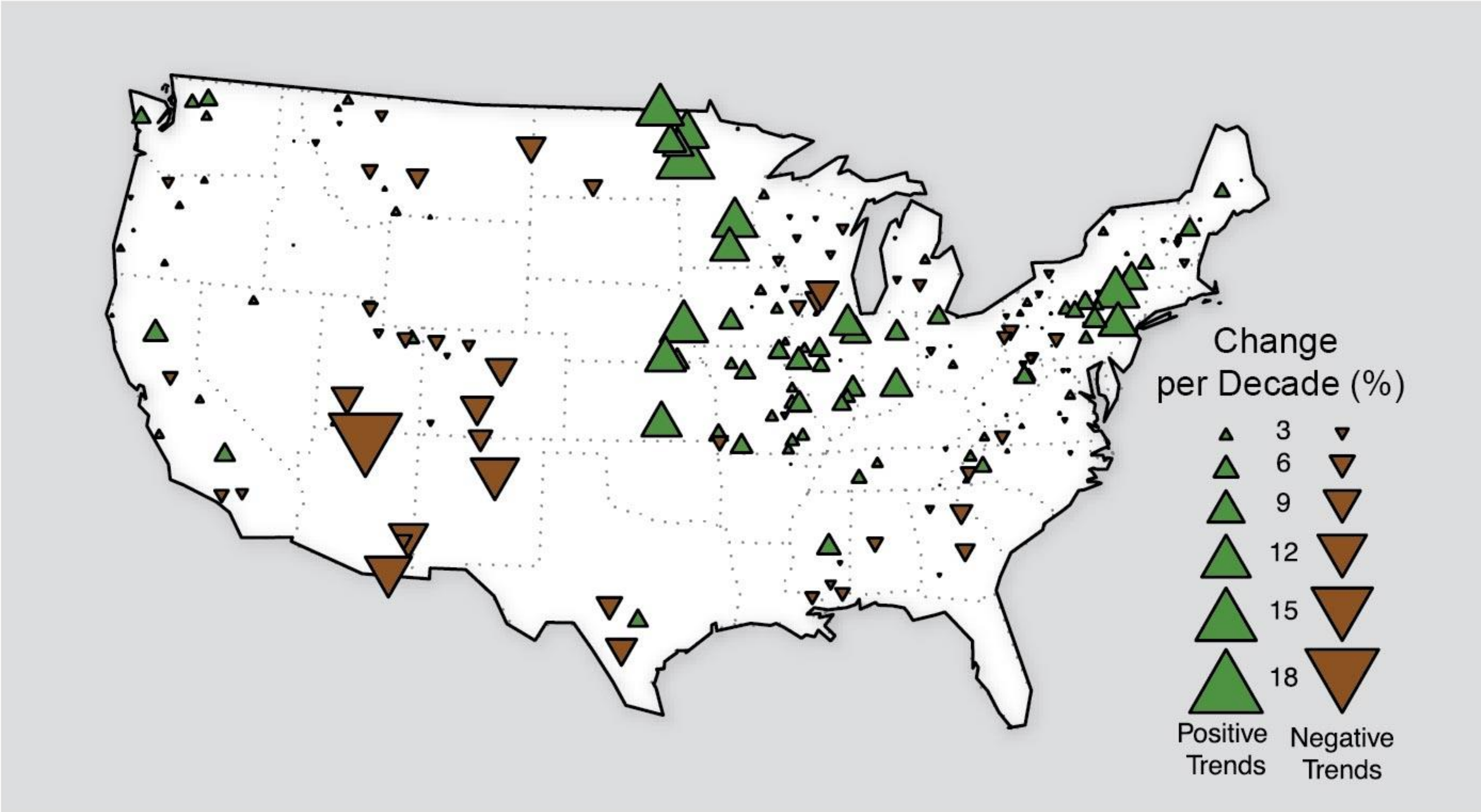


Figure 2.21. Trend magnitude (triangle size) and direction (green = increasing trend, brown = decreasing trend) of annual flood magnitude from the 1920s through 2008. Local areas can be affected by land-use change (such as dams). Most significant are the increasing trend for floods in the Midwest and Northeast and the decreasing trend in the Southwest. (Figure source: Peterson et al. 2013[48]).