Agronomy 406
World Climates

April 19, 2018

Climate change and its impact in Iowa and its surrounding region. (Includes materials from Eugene Takle, Christopher Anderson, and the Climate Science Special Report of the U.S. National Climate Assessment. http://nca2014.globalchange.gov)

Poster session next week, during regular class time:

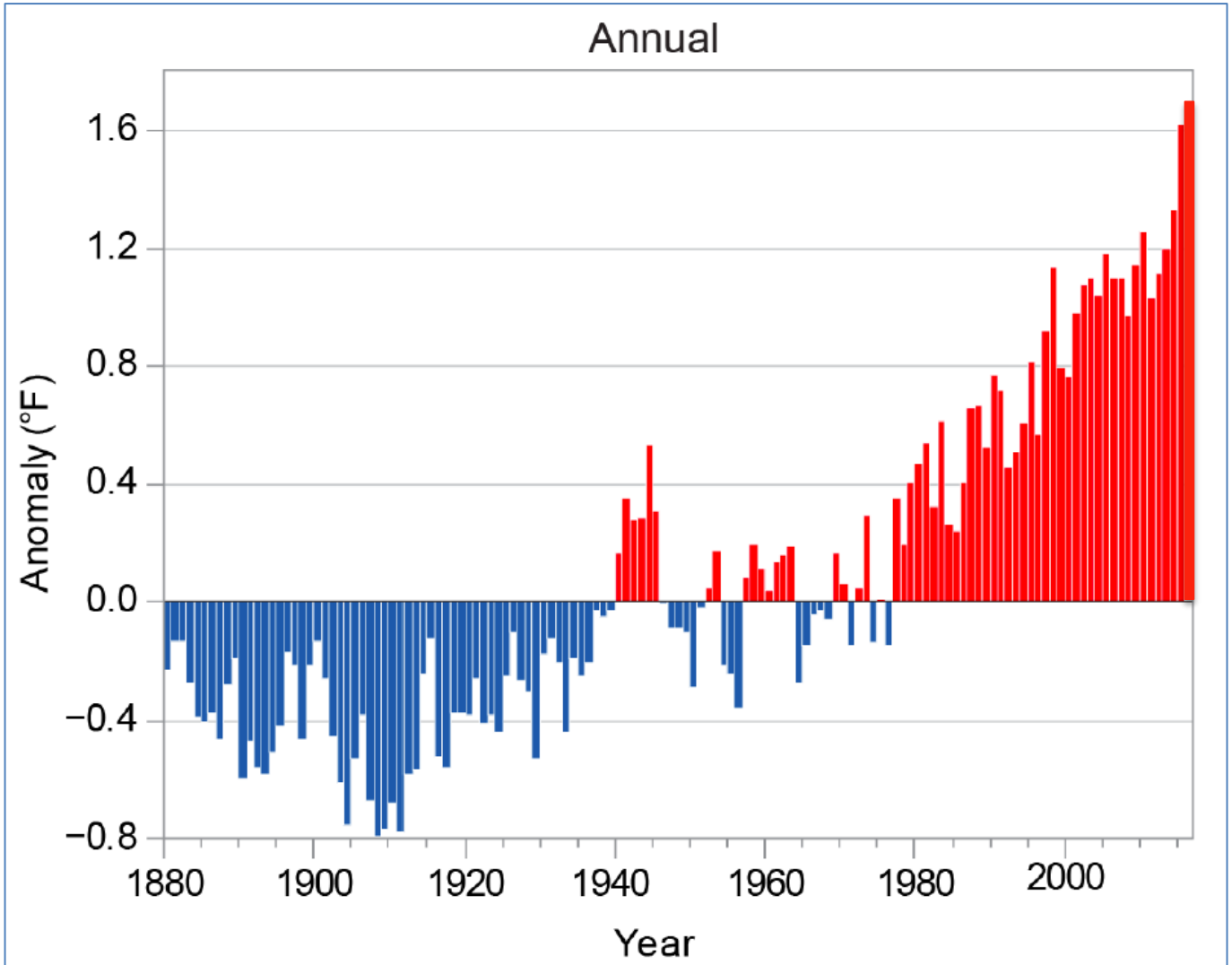
Agronomy Commons (2nd floor of Agronomy Hall).

Arrive a few minutes early to set up your poster.

See schedule in Pages section on Canvas.

Review assignments will be distributed at the poster session.

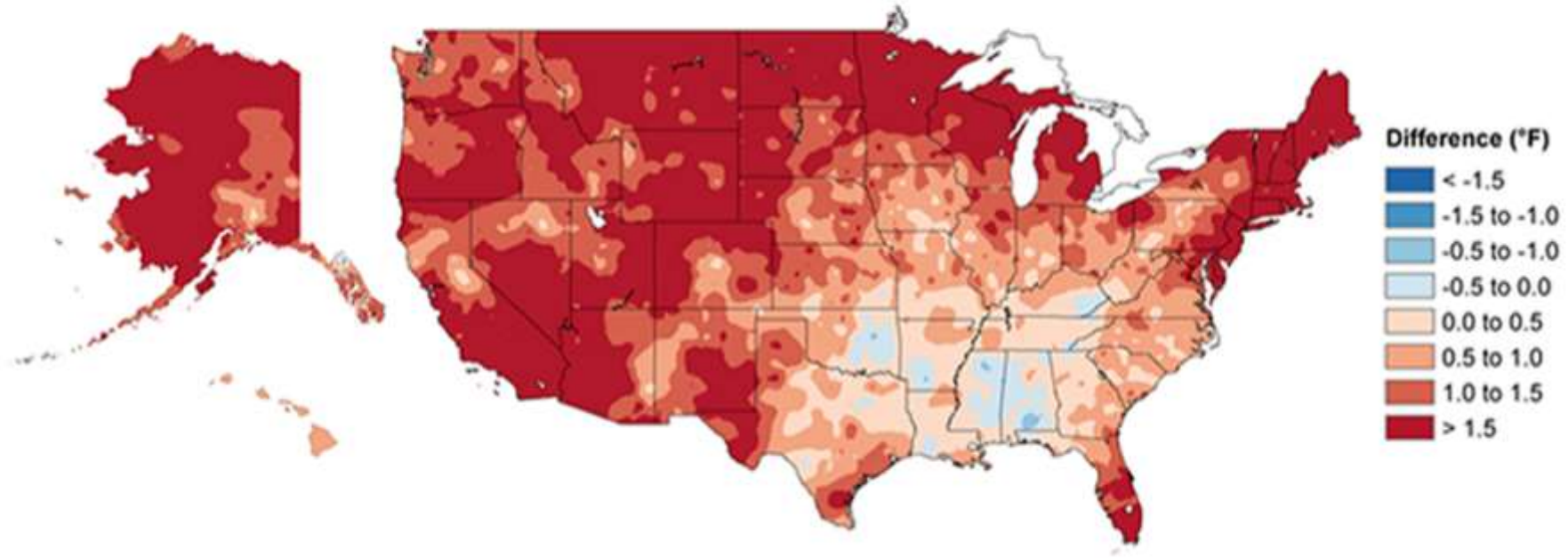
The larger context: Observed change in global mean temperature



NOAA

Warming in the central and southern U.S. has been modest

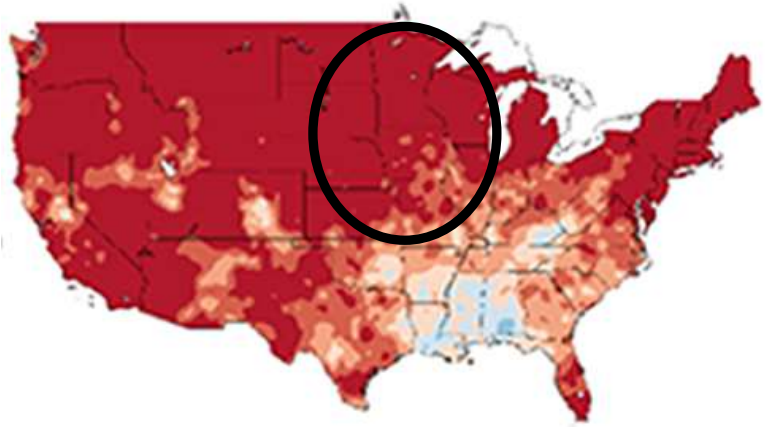
Annual mean temperature change,
1986-2016 versus 1901-1960



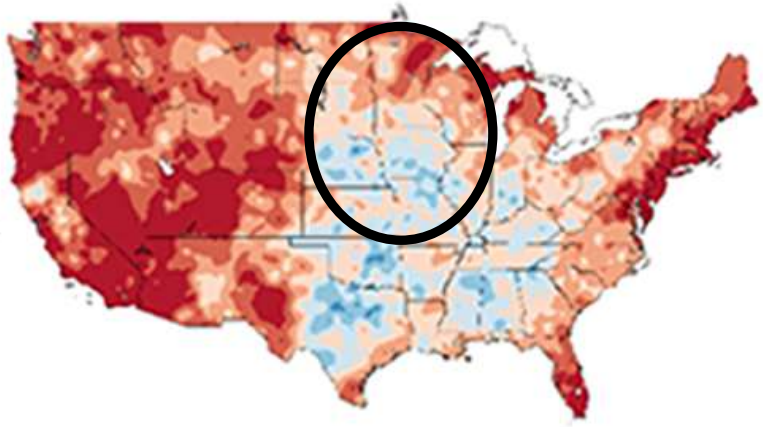
CSSR fig. 6.1

Most of the warming in the north-central U.S. has occurred in winter

Winter temperature change, 1986-2016 versus 1901-1960



Summer temperature change, 1986-2016 versus 1901-1960



Difference (°F)

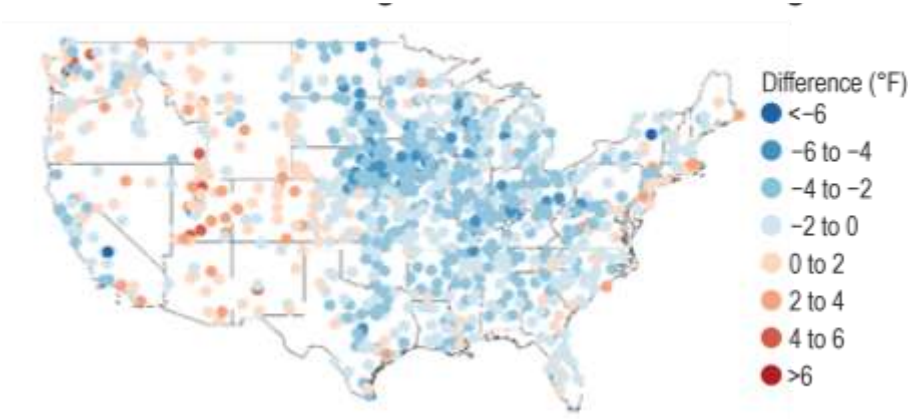
- < -1.5
- -1.5 to -1.0
- -0.5 to -1.0
- -0.5 to 0.0
- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- > 1.5

CSSR fig. 6.1

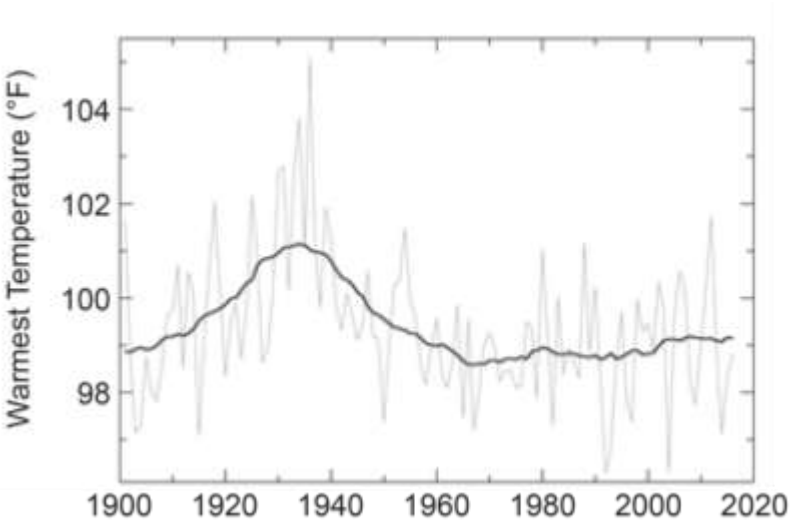
Warmest temperatures of the year have shown little trend (except Dust Bowl period)

Change in warmest temperature of the year

1986-2016 average minus 1901-1960 average



Trend in warmest temperature of the year

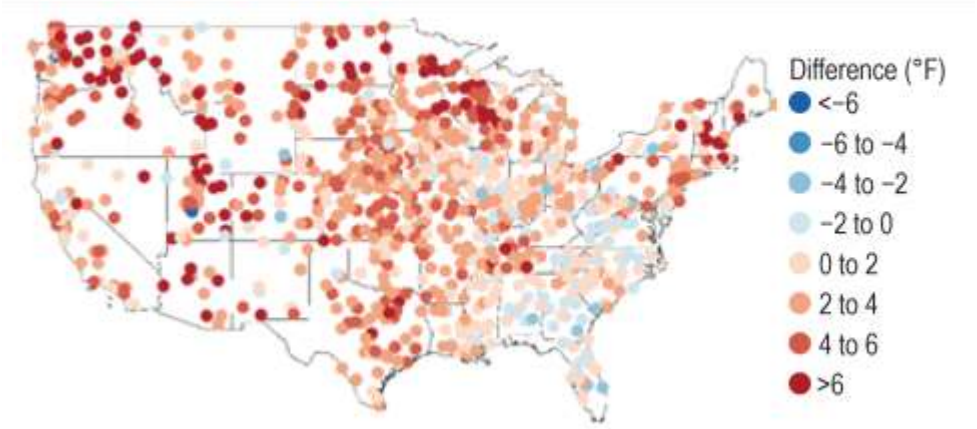


CSSR fig. 6.3

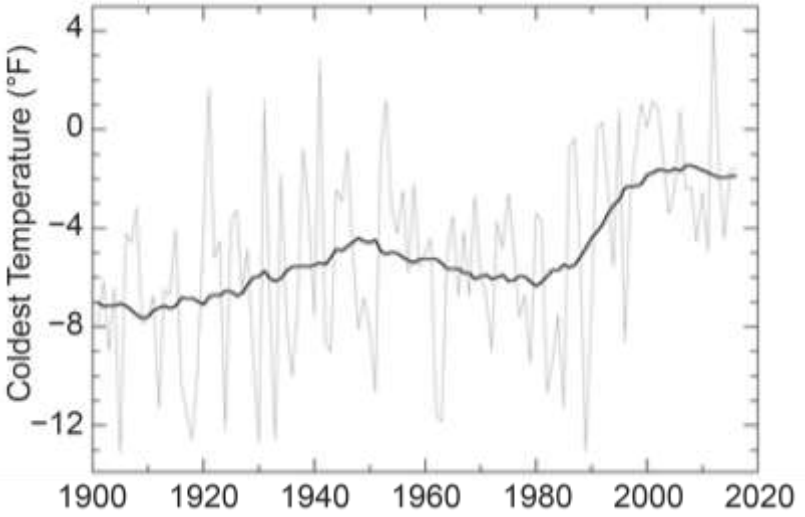
Coldest temperatures of the year have become less cold

Change in coldest temperature of the year

1986-2016 average minus 1901-1960 average

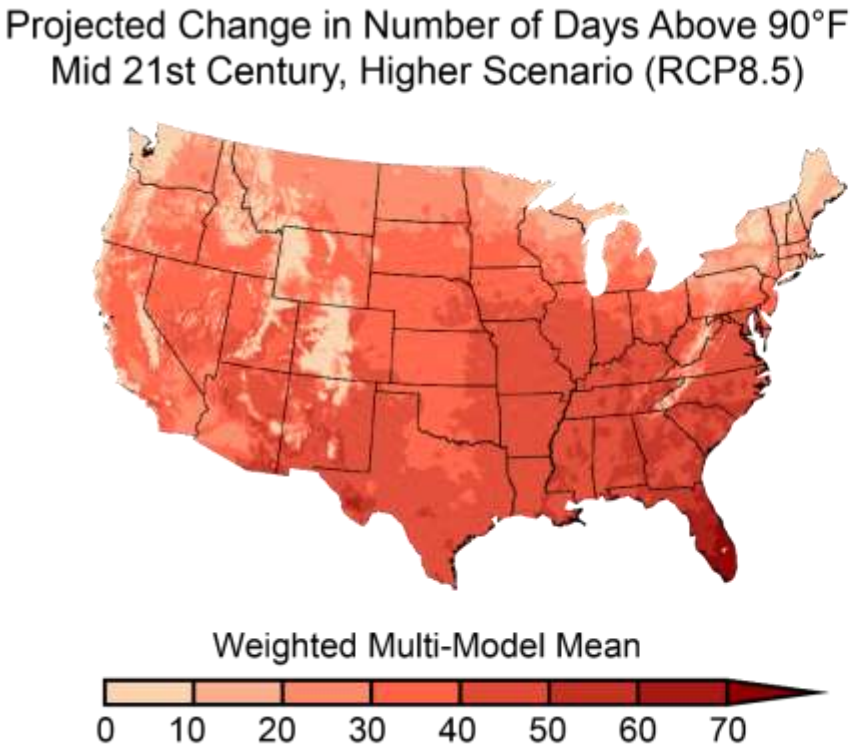


Trend in coldest temperature of the year

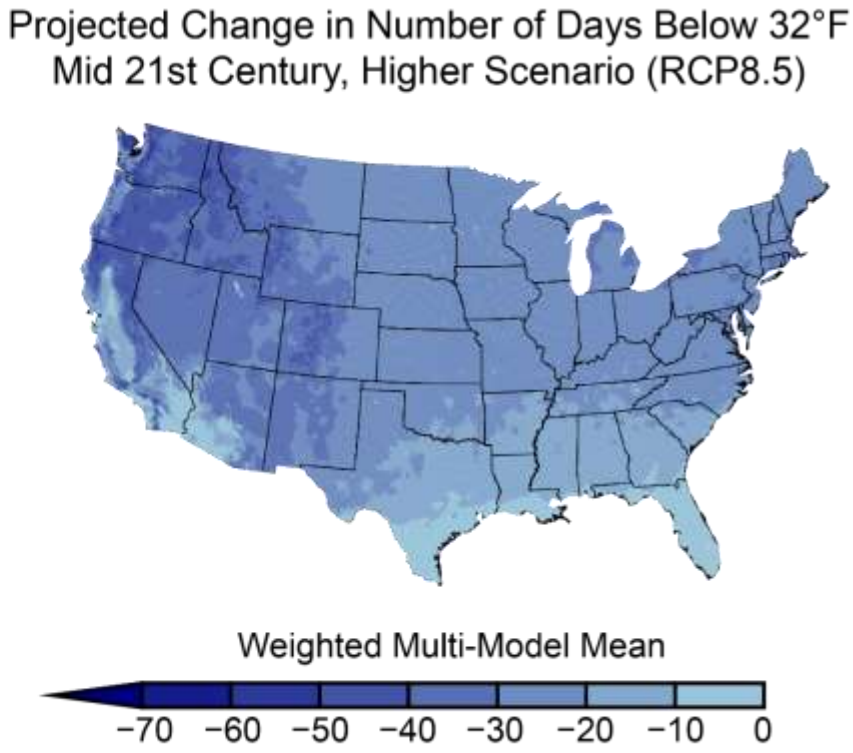


CSSR fig. 6.3

Hot temperatures (>90ºF) are predicted to become more common



Below freezing temperatures will become less common



CSSR fig. 6.9

Discussion

Most of the warming has occurred in winter, and below-freezing temperatures have become less common.

> What effects do you think would result from **milder winters?**

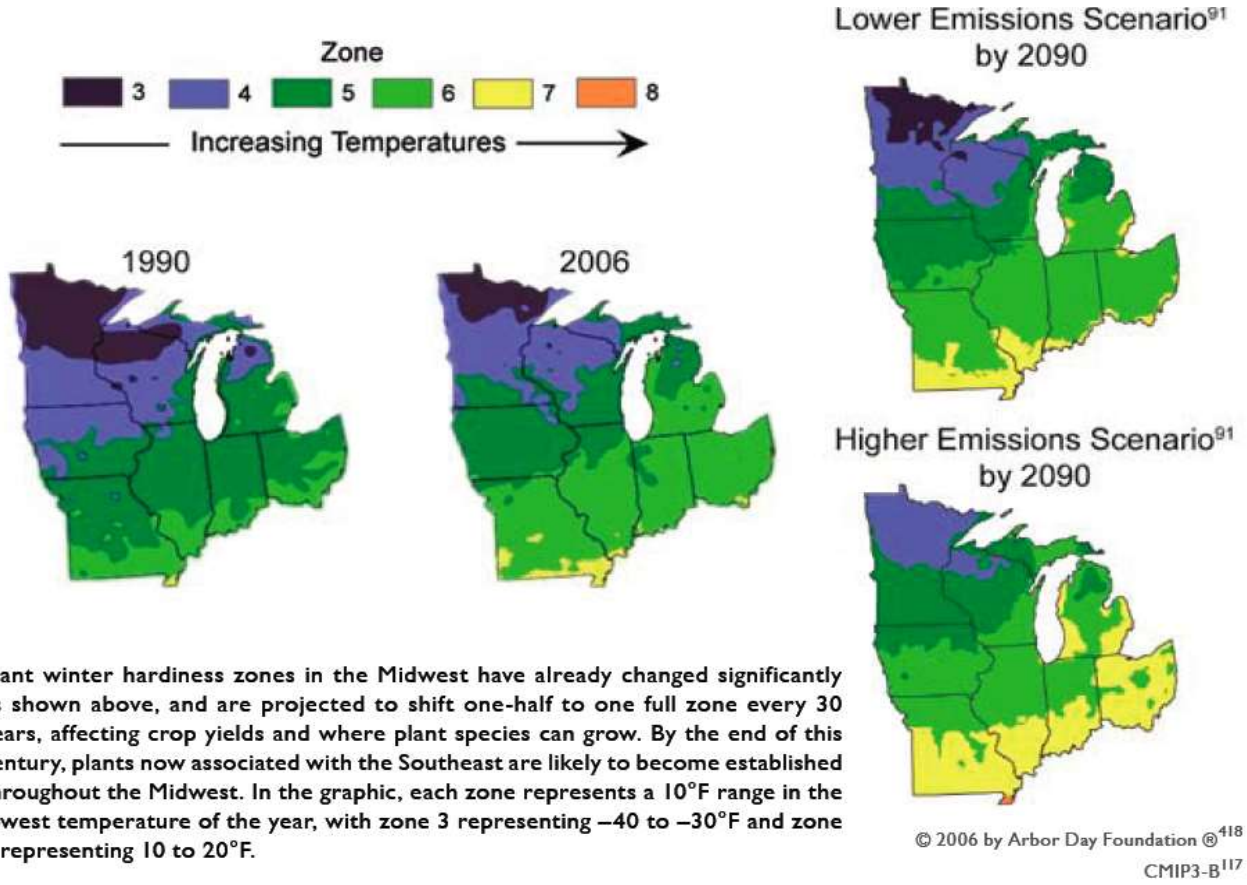
Think of different activities – agriculture, human health, etc.

Consider both **positive** and **negative** effects.

Plant hardiness zones are moving north

Plant hardiness zones are based on the **annual average extreme minimum temperature.**

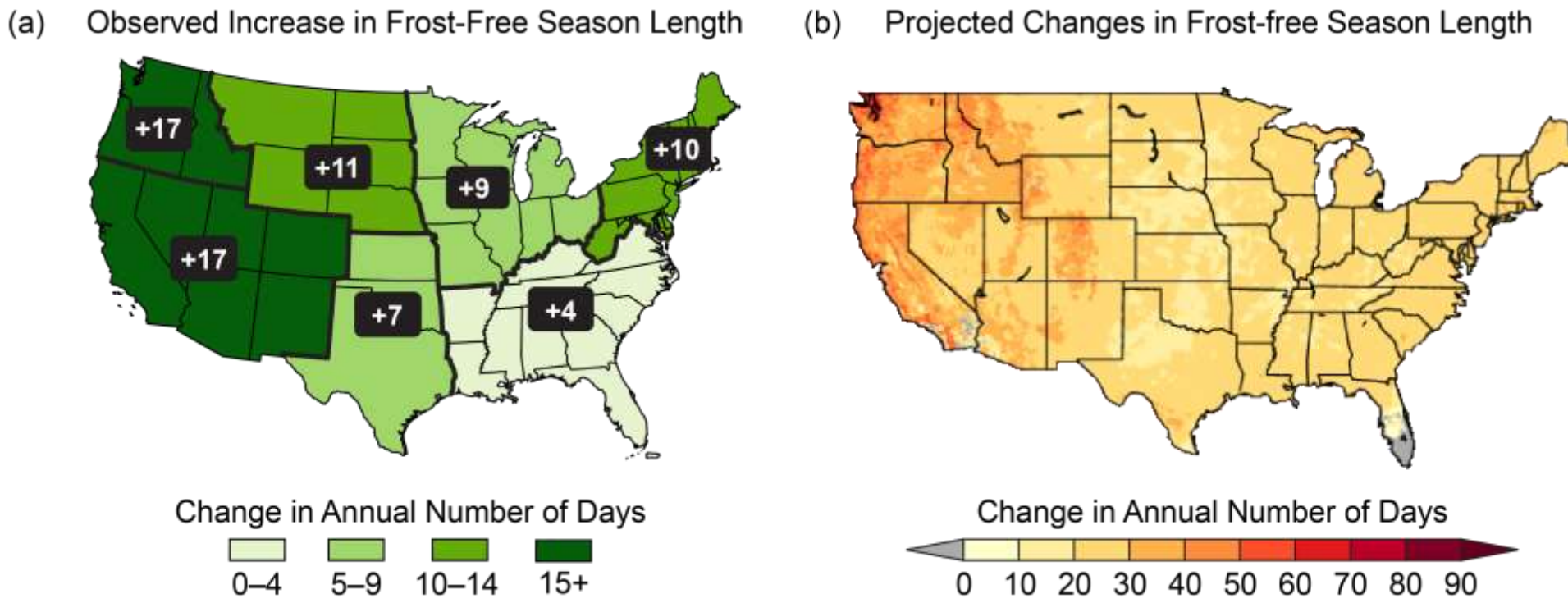
Zone	Tmin (°F)
3	-40 to -30
4	-30 to -20
5	-20 to -10
6	-10 to 0
7	0 to +10



Plant winter hardiness zones in the Midwest have already changed significantly as shown above, and are projected to shift one-half to one full zone every 30 years, affecting crop yields and where plant species can grow. By the end of this century, plants now associated with the Southeast are likely to become established throughout the Midwest. In the graphic, each zone represents a 10°F range in the lowest temperature of the year, with zone 3 representing –40 to –30°F and zone 8 representing 10 to 20°F.

Karl, T. R., J. M. Melillo, and T. C. Peterson, (eds.), 2009: Global Climate Change Impacts in the United States. Cambridge University Press, 2009, 196pp.

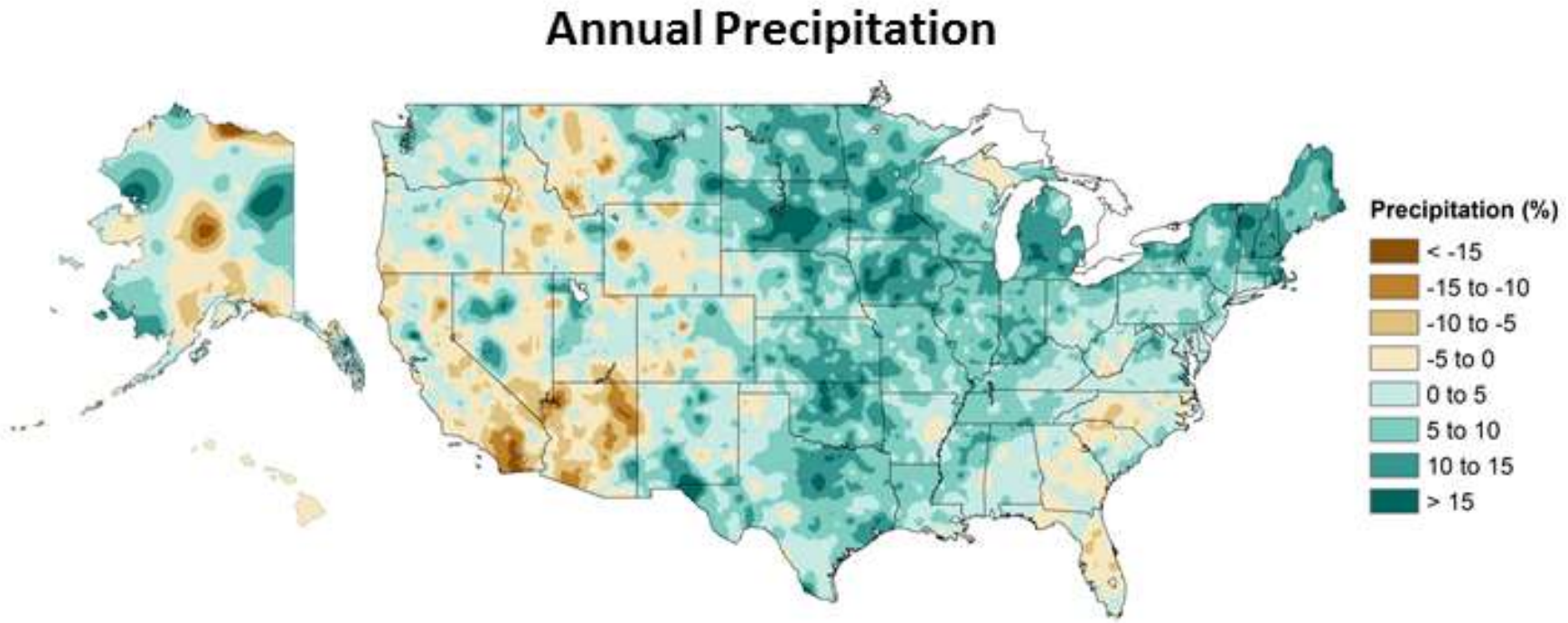
Growing season has become longer and is predicted to lengthen more



CSSR fig. 10.3

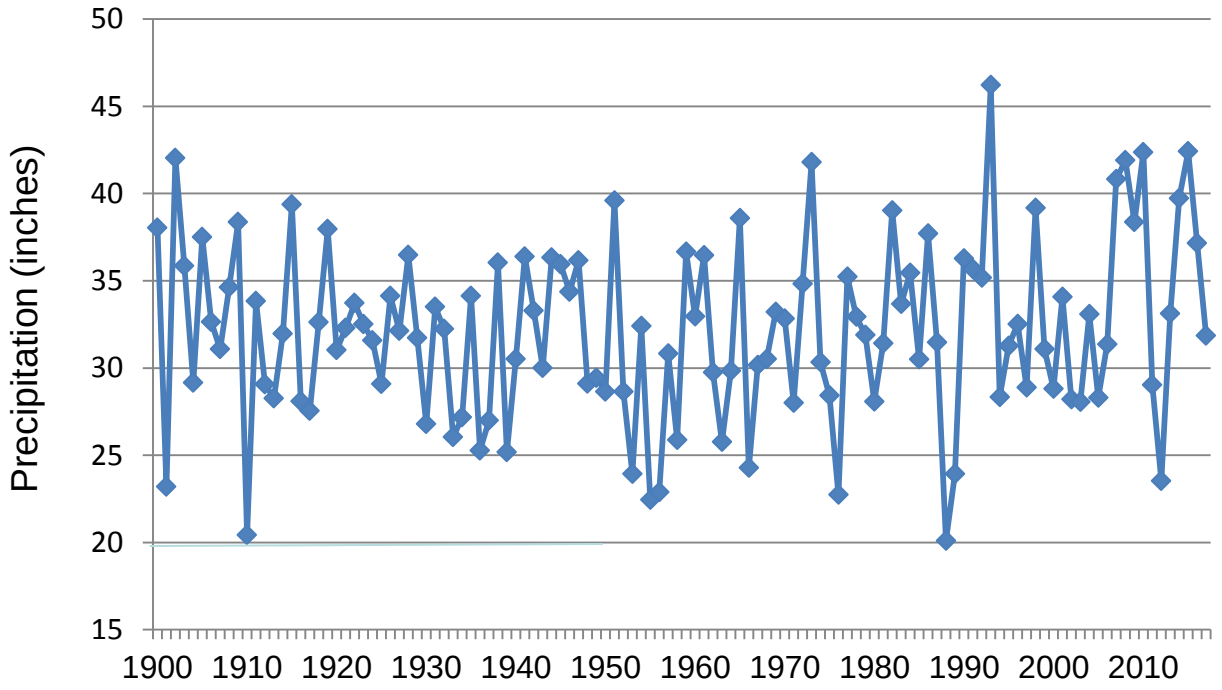
Annual precipitation in north-central U.S. has increased by about 5-10%

Average for 1986-2005 versus 1901-1960

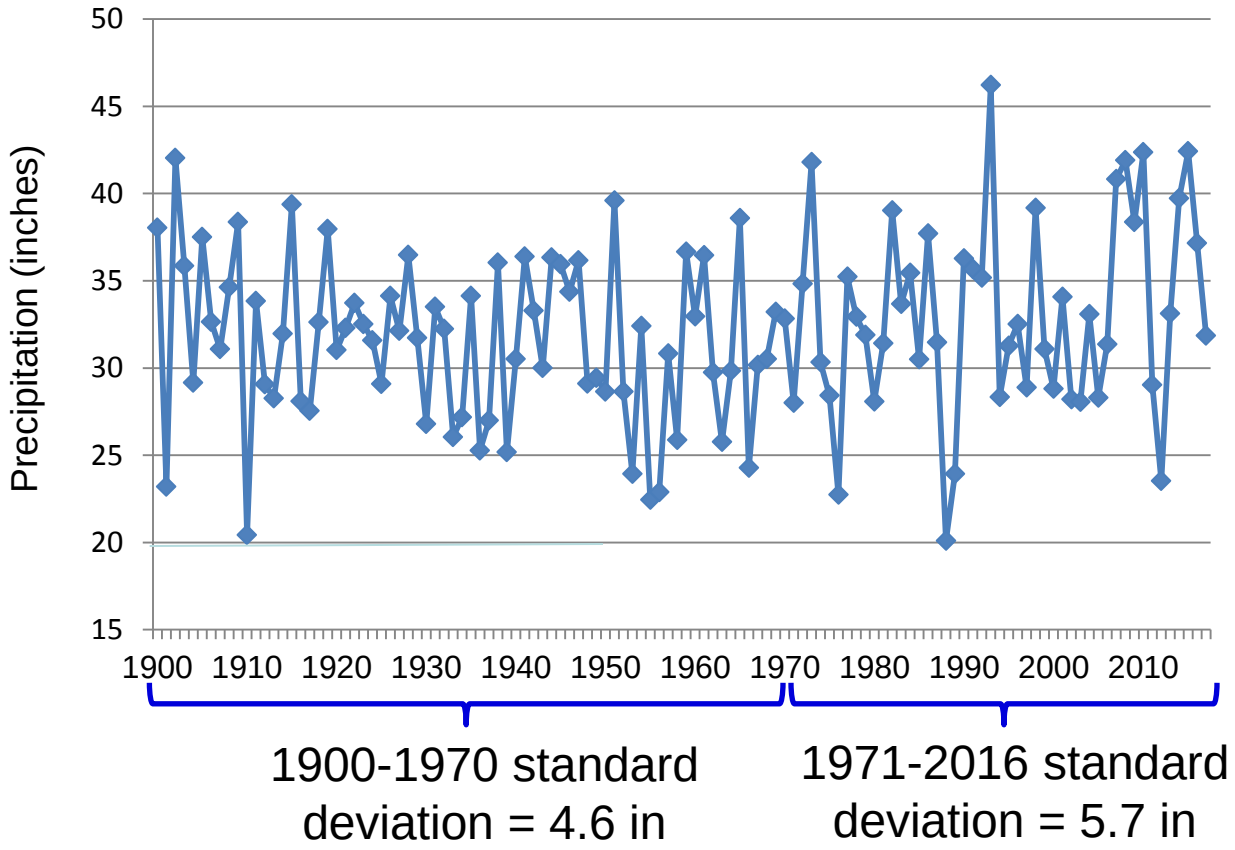


CSSR fig. 7.1

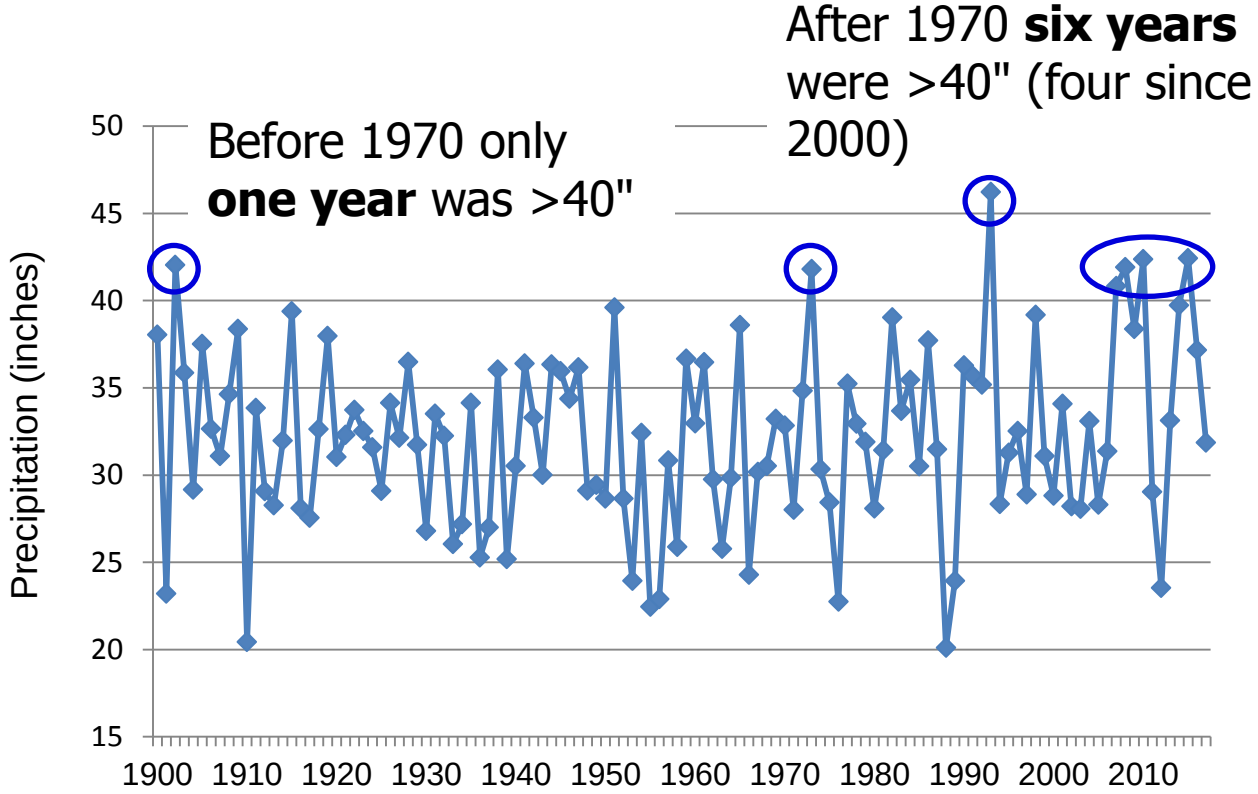
Iowa annual precipitation has changed only modestly



But precipitation has become more variable from year to year…

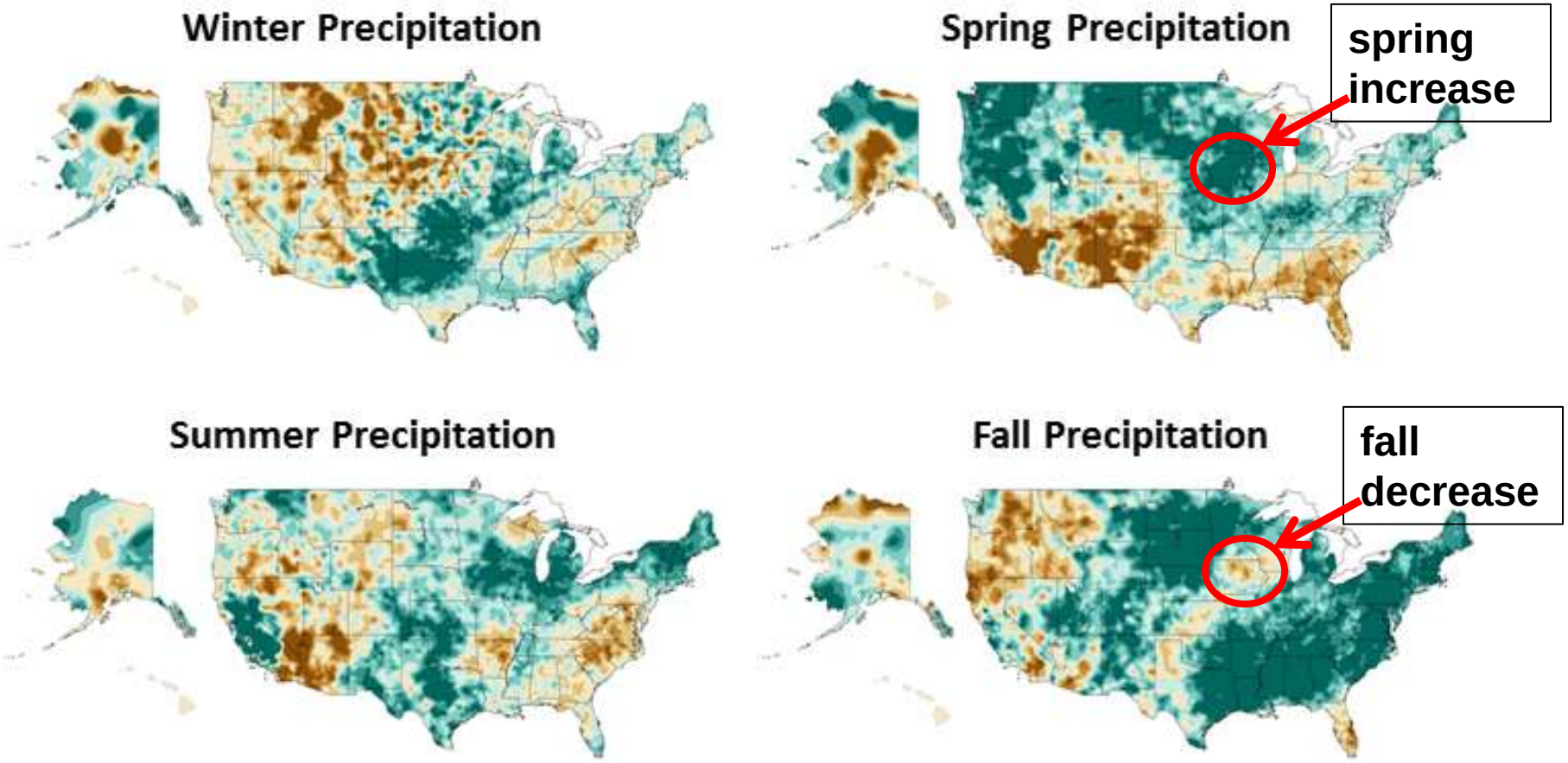


…and years with high rainfall have become more common



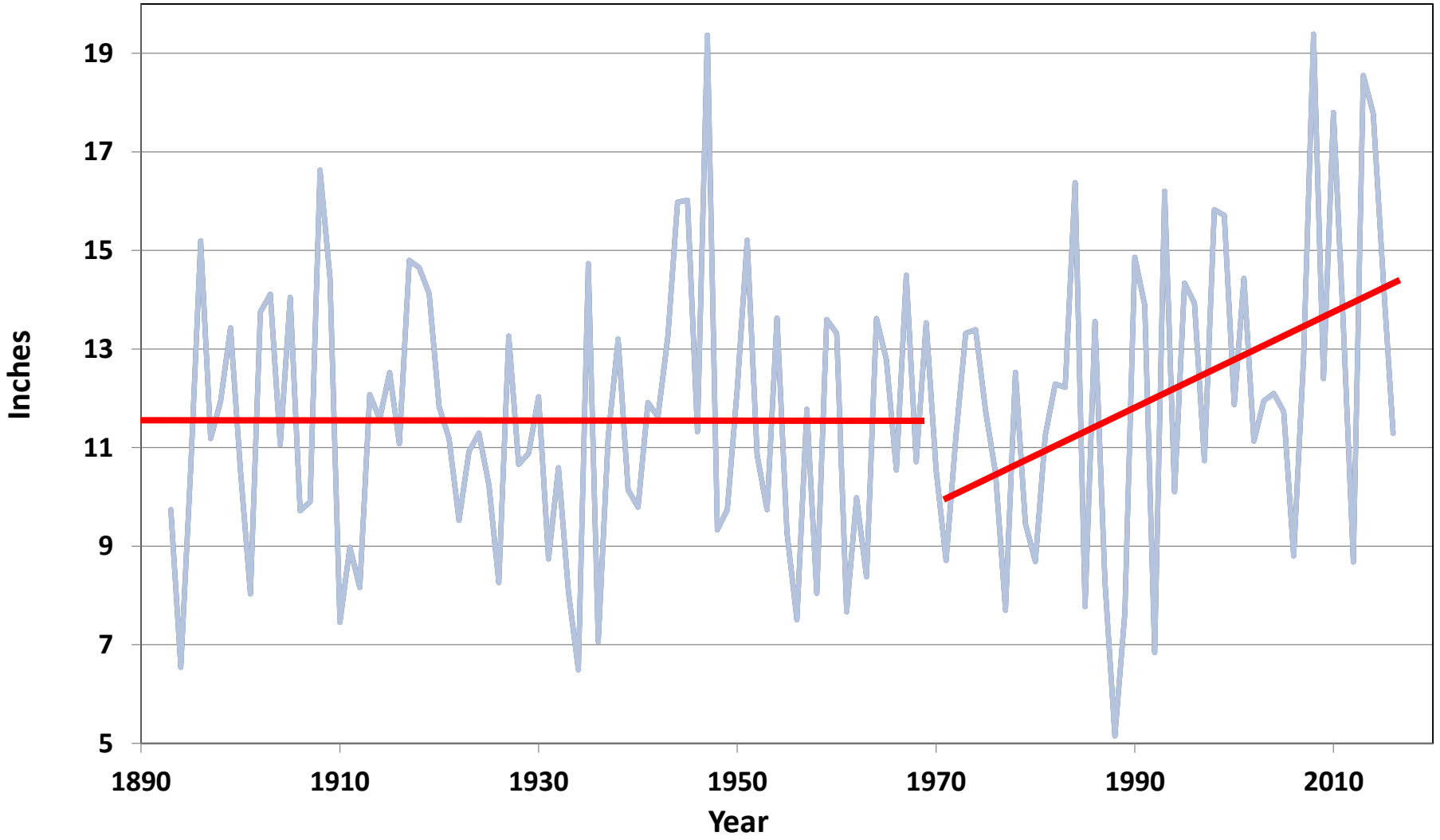
Precipitation changes differ by season

Average for 1986-2005
versus 1901-1960

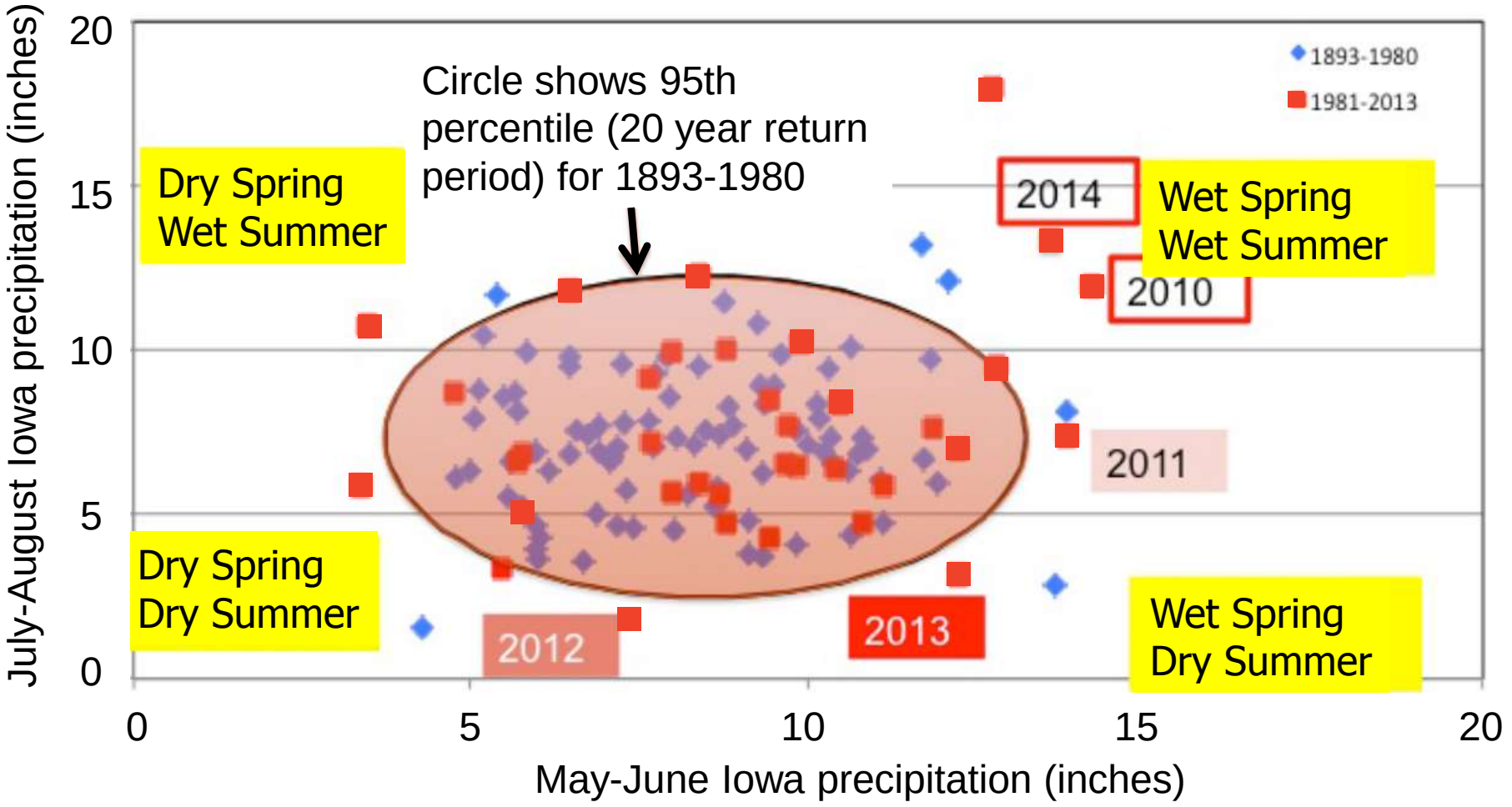


CSSR fig. 7.1

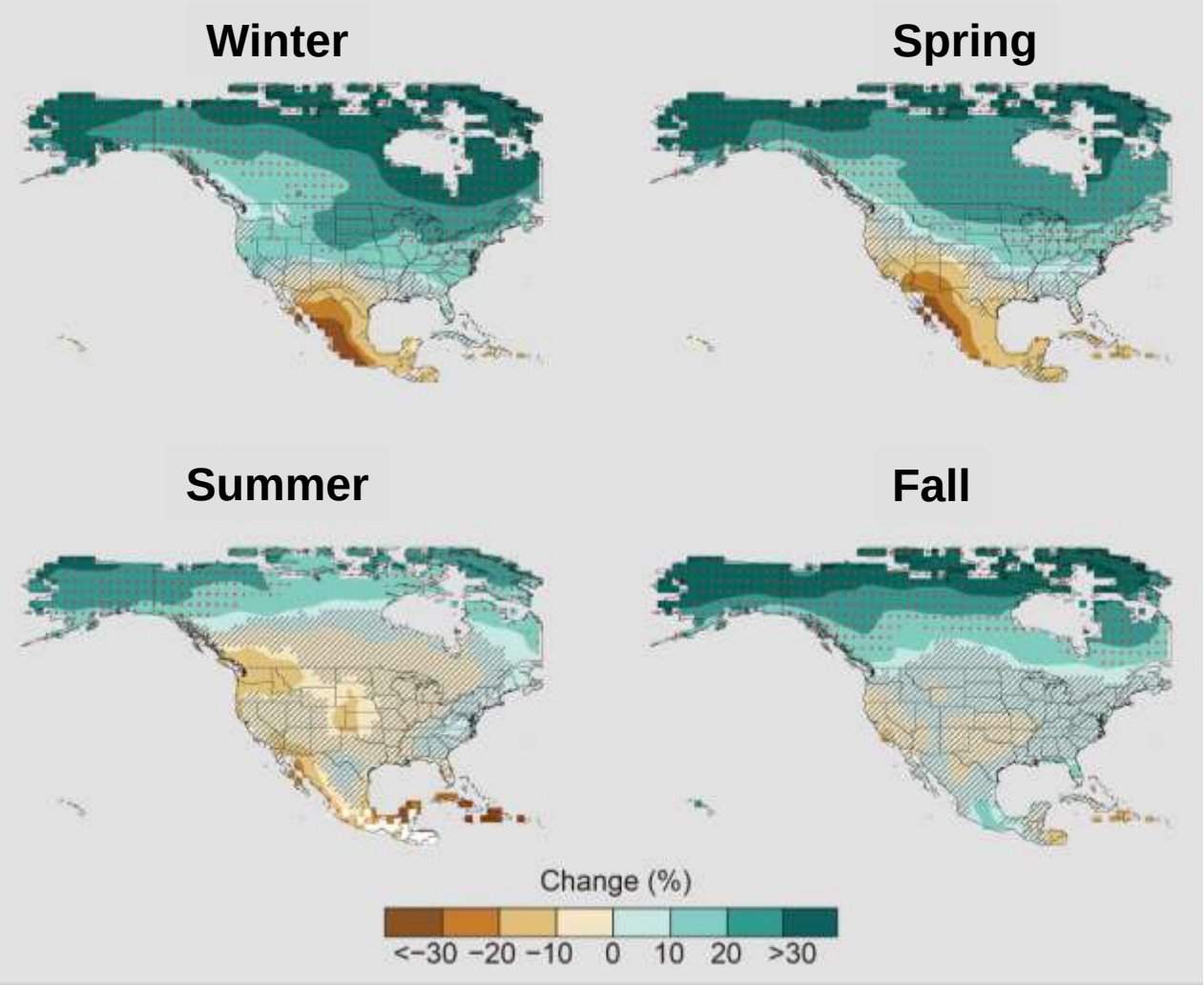
Iowa Statewide Spring Precipitation (April-May-June)



Unusual combinations of spring and summer rainfall are occurring more often



The increase in spring precipitation is projected to continue



Projected change in seasonal precipitation (percent).

CSSR fig. 7.5

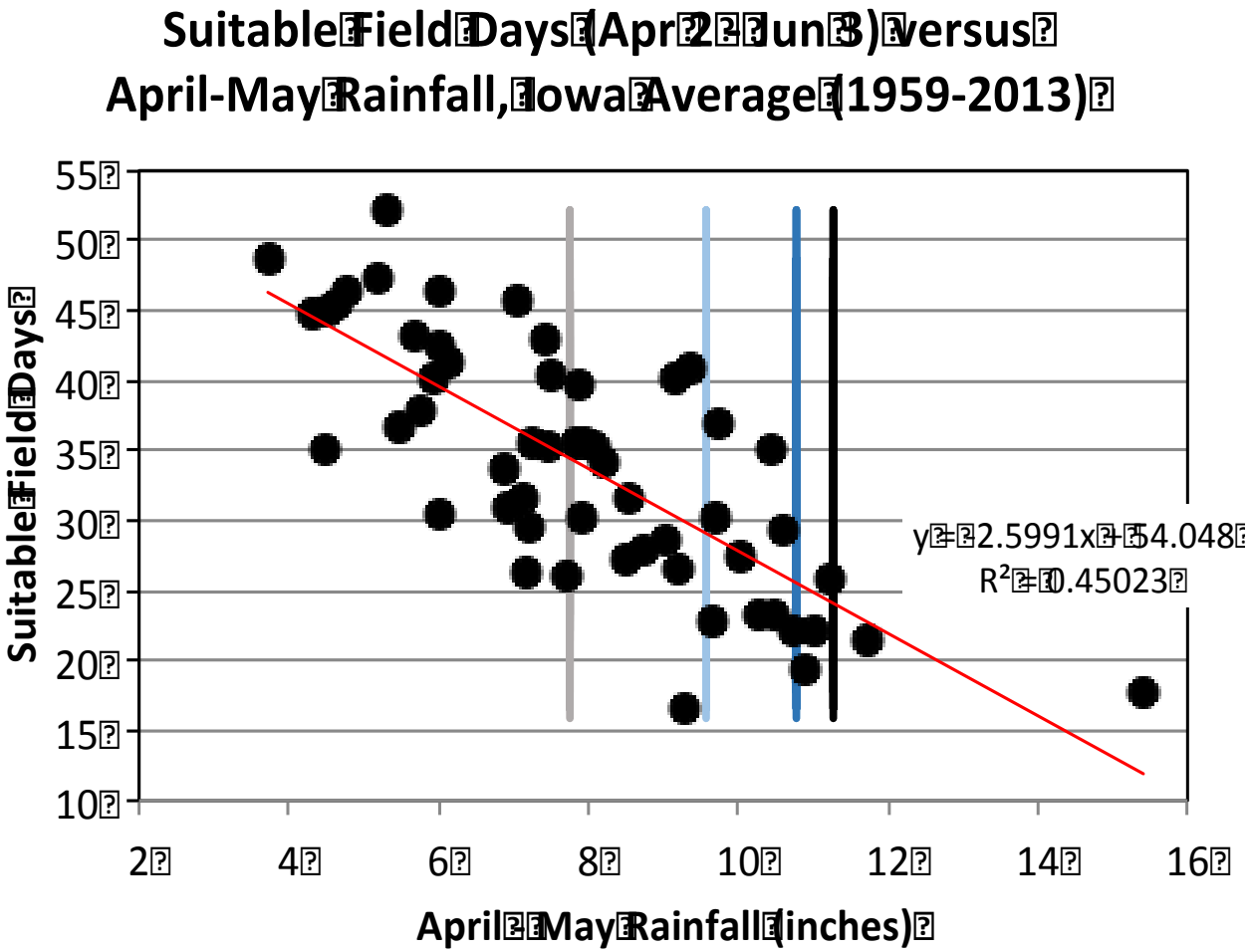
Effects of increased spring rainfall

Spring rain has been increasing while fall rain has been declining.

Is more spring rain and less fall rain good, or bad? Or some combination?

Explain why you think so.

Every 1" increase of April-May rainfall reduces suitable field days by 2.6 days



Source: Chris Anderson

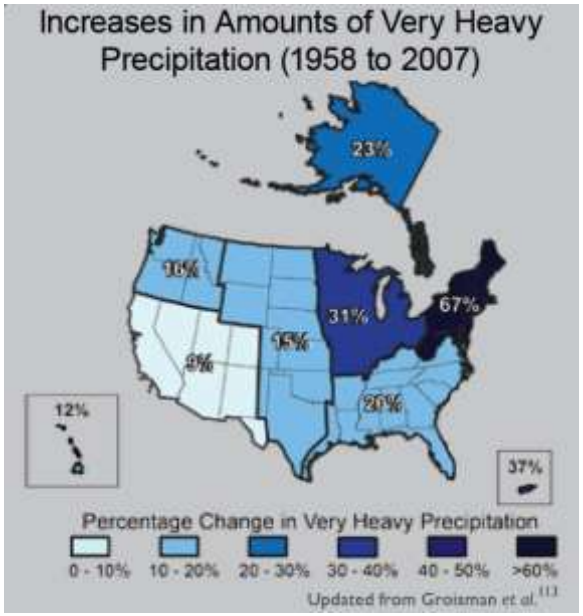
"100 year" floods now occur much more often than 100 years

Ames, 1993

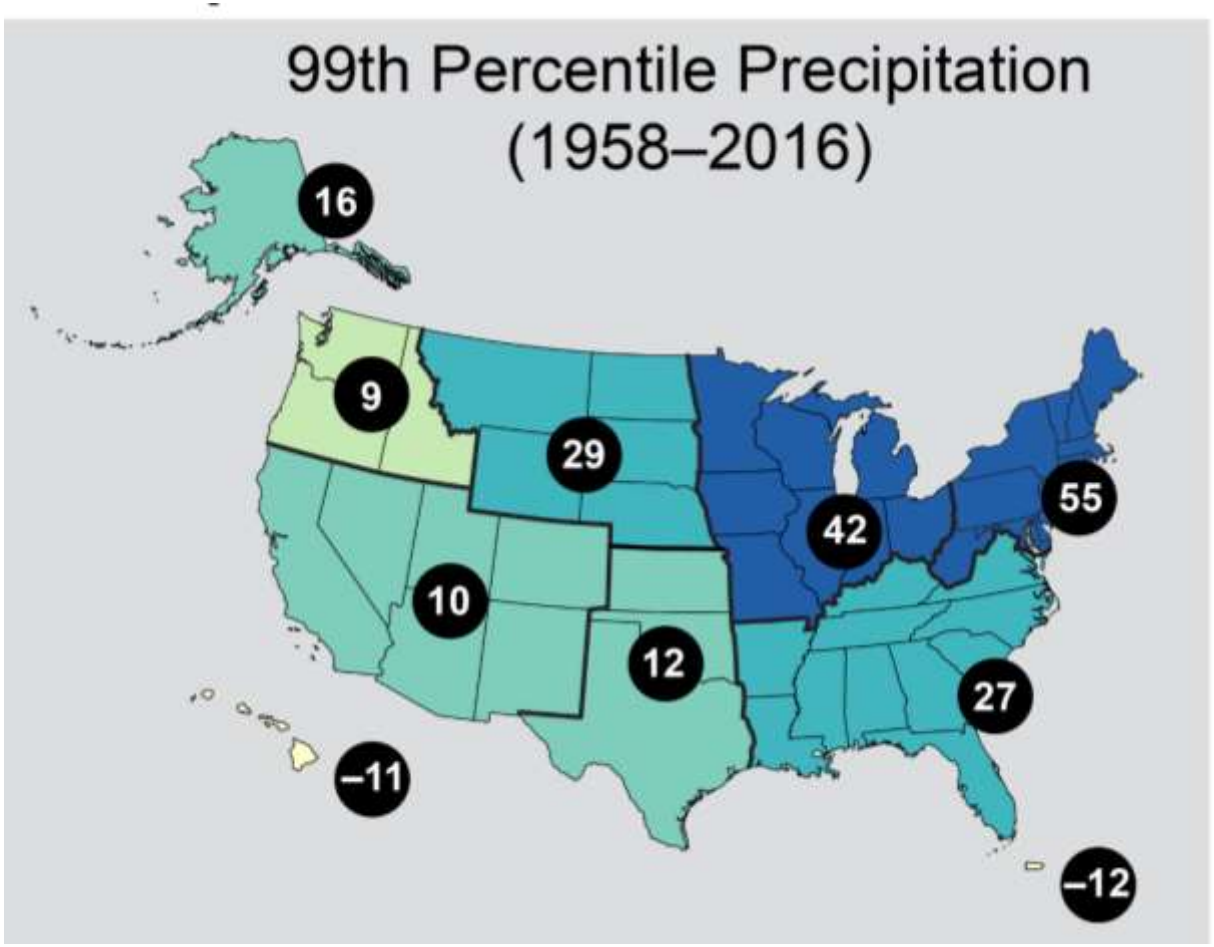
"**One of the clearest trends** in the United States observational record is an **increasing frequency and intensity of heavy precipitation events**… "

Karl et al. 2009, *Global Climate Change Impacts in the United States*

Ames, 2010



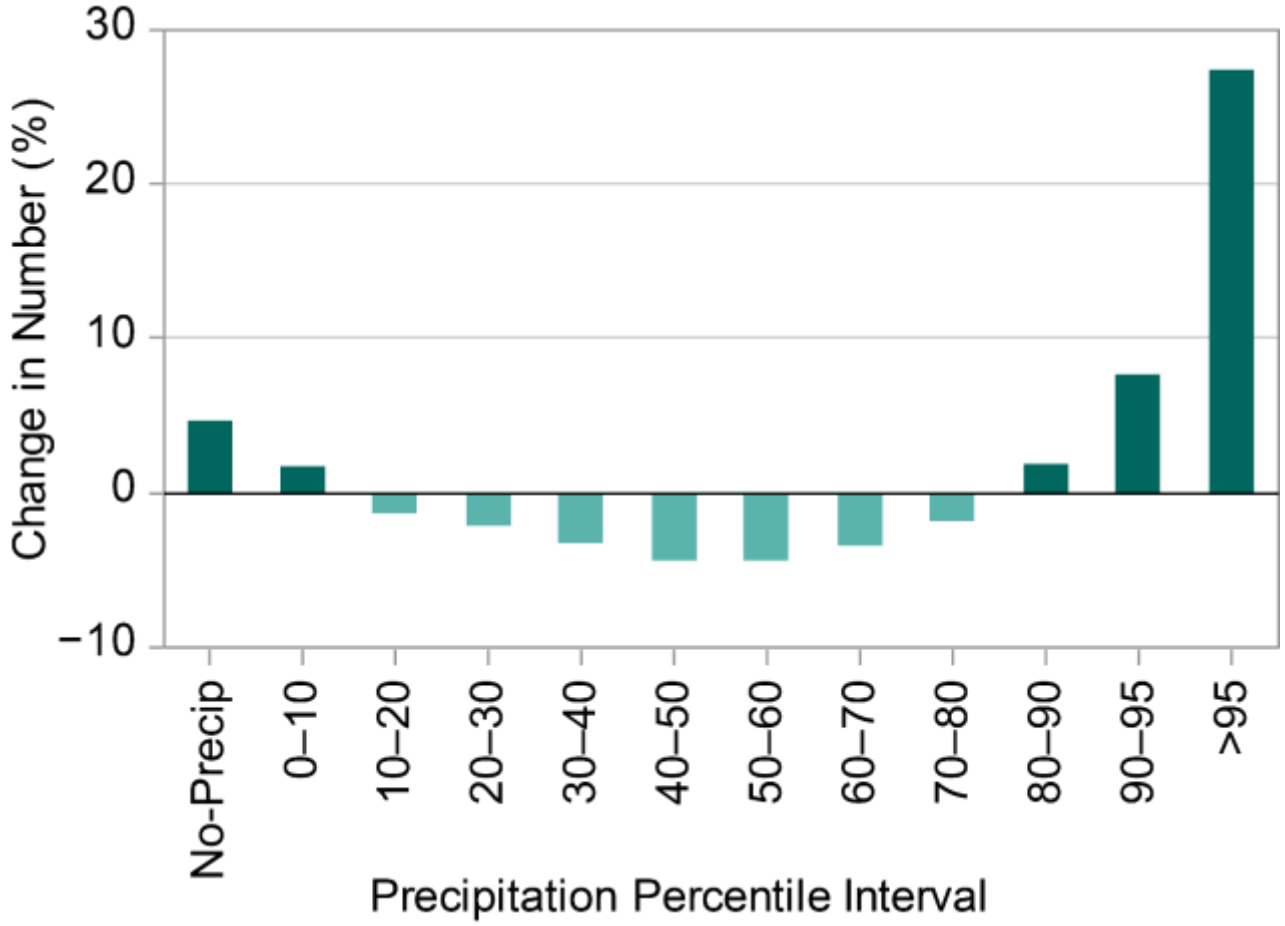
Extreme rainfall has become more intense



Percentage change in intensity of the top 1 percent of rainfall days.

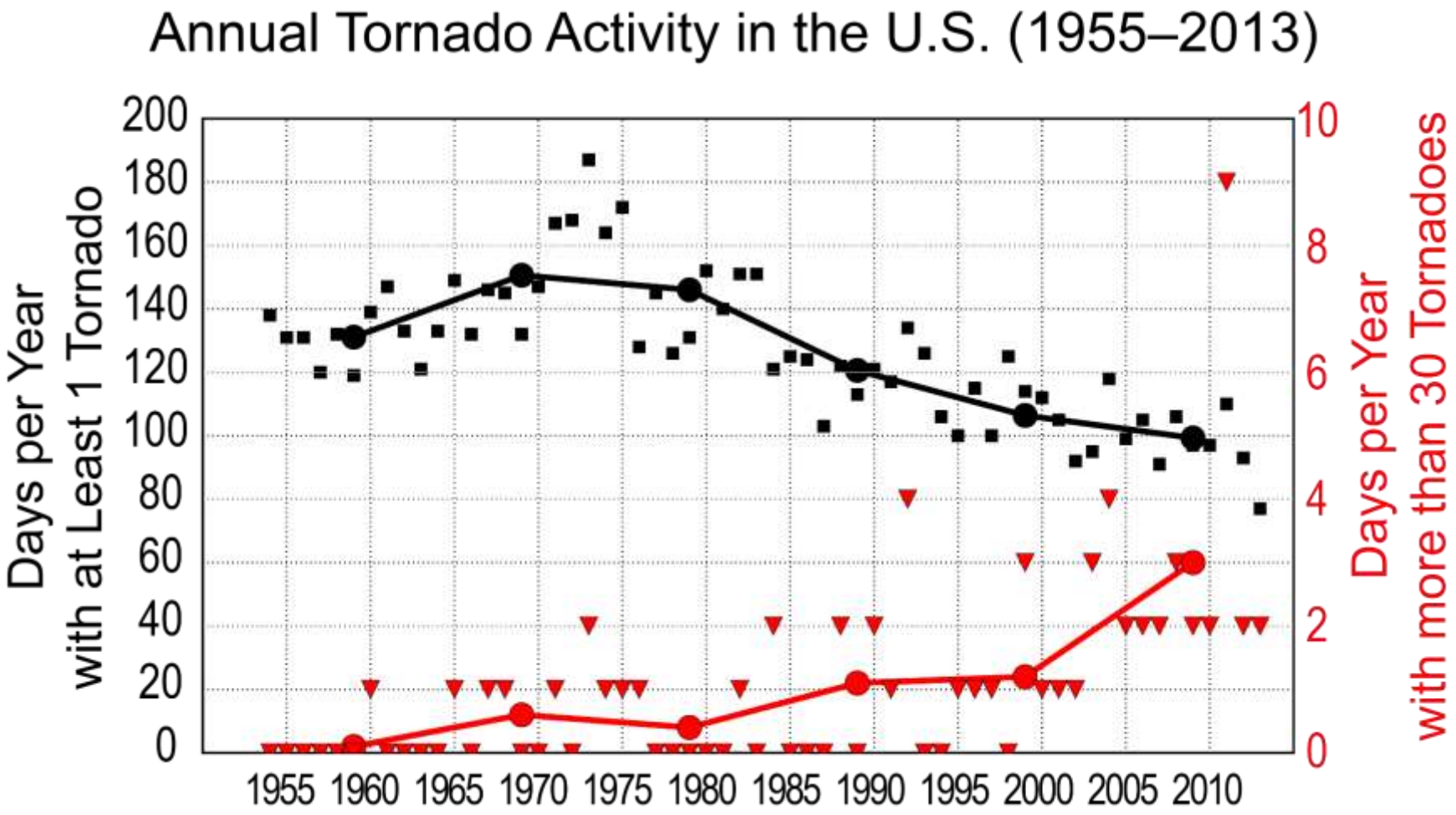
CSSR fig. ES-6

Moderate rain days are projected to decrease slightly while heavy rain days are projected to increase strongly



CSSR fig. 7.8

Number of tornado days has declined, but number of highly active days has increased



Adaptation and mitigation

Adaptation involves actions to deal with the **effects** of climate change.

> Given that climate change is occurring, how do we change what we do to adjust?

Mitigation involves actions to address the **causes** of climate change.

> What steps can we take to limit future changes of the climate?

Adaptation and mitigation

In your teams, think of

- two actions that could be taken to **adapt** to climate change, and
- two actions that could be taken to **mitigate** climate change.

Think of **specific actions** rather than broad measures such as "reduce greenhouse gas emissions." You might consider putting yourself in the place of a specific individual, group, or business such as a farmer, manufacturer, etc.

Producer adaptation

Agricultural producers are very familiar with the concept of adaptation.

Producers continually adapt to conditions that affect profitability.

Situations requiring adaptation include:

- Weed populations
- Costs of fuel and fertilizer
- Fluctuating market prices
- Adverse weather conditions

Photos courtesy of USDA-NRCS

Producer adaptation

Weather and climate conditions can either increase or reduce profitability. In some cases, producers may adapt in order to benefit from climate changes:

- Higher summer rainfall that allows for higher plant densities.
- A longer growing season allows longer-season hybrid corn.
- Drier autumn conditions that enable natural dry-down.

Photos courtesy of USDA-NRCS

Levels of Adaptation

Different levels of climate change may result in different levels of impacts and therefore require different responses.

Adaptation can be of three levels:

- **Resistance**
- **Resilience**
- **Transformation**

Adaptation to climate change: Resistance

Resistance allows current practices to continue with minimal change.

An example is using varieties that are more drought-tolerant or heat-tolerant.

Adaptation to climate change: Resilience

Building **resilience** to climate change consists of taking action to protect yields as well as soil resources or agricultural infrastructure.

Examples include planting cover crops or contour planting on slopes to reduce soil erosion.

Photos courtesy of USDA-NRCS

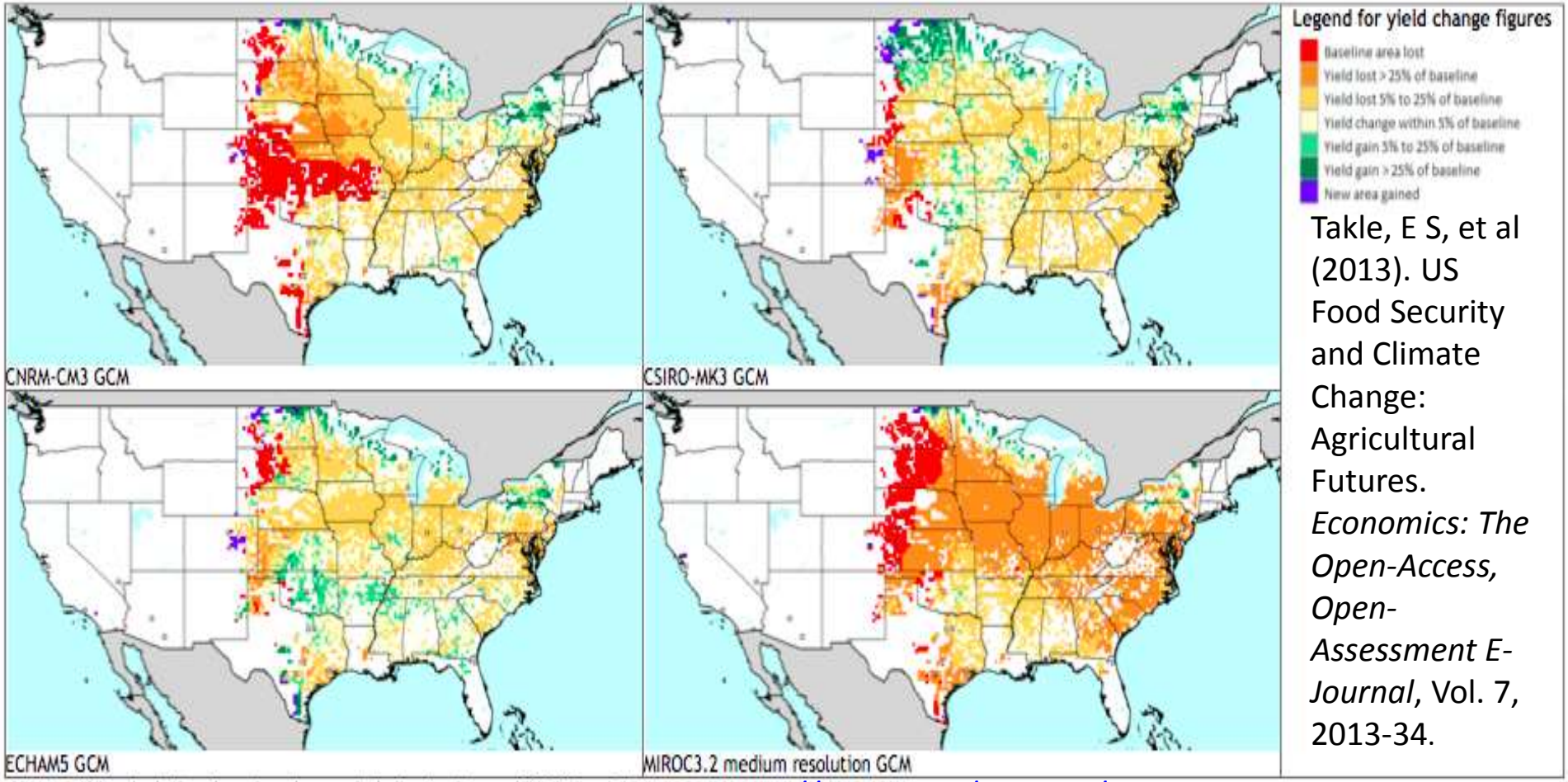
Adaptation to climate change: Transformation

Transformation recognizes that past practices are no longer profitable or sustainable. A major shift is required.

An example would be changing from irrigated row crop agriculture to rangeland agriculture.

Photos courtesy of USDA-NRCS

Maize yields are projected to decline across much of the Corn Belt and growing regions will shift



Source: IFPRI calculations based on downscaled climate data and DSSAT model runs

Takle, E S, et al (2013). US Food Security and Climate Change: Agricultural Futures. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 7, 2013-34.

http://dx.doi.org/10.5018/economics-ejournal.ja.2013-34

Example of Iowa agricultural producers' adaptations to climate change

- **Longer growing season:** plant earlier, plant longer season hybrids, harvest later
- **Wetter springs:** larger machinery enables planting in smaller weather windows
- **More summer precipitation:** higher planting densities for higher yields
- **Wetter springs and summers:** more drainage tile is being installed, closer spacing
- **Drier autumns:** delay harvest to take advantage of natural dry-down conditions

Summary

Climate change is happening now in Iowa and the surrounding regions.

Climate change is more complicated than just "global warming":

changes in seasonality, rainfall, extremes, etc.

We need strategies for both mitigation (reducing climate change) and adaptation (dealing with its effects).

We know that Iowa farmers believe that climate is changing and will continue to change because **they already are spending money to adapt to climate change.**