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Responses to Climate Change in Nebraska: Challenges and Opportunities for Agriculture

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University of Nebraska – Lincoln
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Outline

- ❖ Brief review of US National Climate Assessment
- ❖ A closer look at the impact of changes in precipitation
- ❖ Matching the scales and variables of climate change to agricultural decisions
- ❖ Producing *actionable science* that has credibility, salience, and legitimacy
- ❖ Visioning changes to the Nebraska landscape



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Overall Message of the 2014 National Climate Assessment

- ❖ Climate change is happening now
- ❖ All Americans are feeling the effects of climate change
- ❖ The 2014 National Climate Assessment is the most comprehensive review of the US climate and impacts of climate change
- ❖ Americans have opportunities to reduce emissions of heat trapping gases and prepare for the effects of climate change



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US Climate Change in a Nutshell

Dry areas will become drier and
hotter

Wet areas will become wetter and
more humid



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US Climate Change in a Nutshell (for my location)

Dry *periods* will become drier and
hotter

Wet *periods* will become wetter
and more humid



U.S. Global Change Research Program
**National Climate
Assessment**

The National Climate Assessment

US Global Change Research Program

National Coordination Office

<http://nca2014.globalchange.gov>



Six Key Messages

- **Climate disruptions to agricultural production have increased in the recent past and are projected to increase further over the next 25 years. By mid-century and beyond, these impacts will be increasingly negative on most crops and livestock.**
- **Many agricultural regions will experience declines in crop and livestock production from increased stress due to weeds, diseases, insect pests, and other climate change- induced stresses.**

Six Key Messages (cont'd, 1)

- **Current loss and degradation of critical agricultural soil and water assets by increasing extremes in precipitation will continue to challenge both rain-fed and irrigated agriculture unless innovative conservation methods are implemented.**
- **The rising incidence of weather extremes will have increasingly negative impacts on crop and livestock productivity because critical thresholds are already being exceeded.**

Six Key Messages (cont'd, 2)

- Agriculture has been able to adapt to recent changes in climate; however, increased innovation will be needed to ensure the rate of adaptation of agriculture and the associated socioeconomic system can keep pace with future climate change.
- Climate change effects on agriculture will have consequences for food security both in the U.S. and globally, not only through changes in crop yields, but also changes in the ways climate affects food processing, storage, transportation, and retailing.



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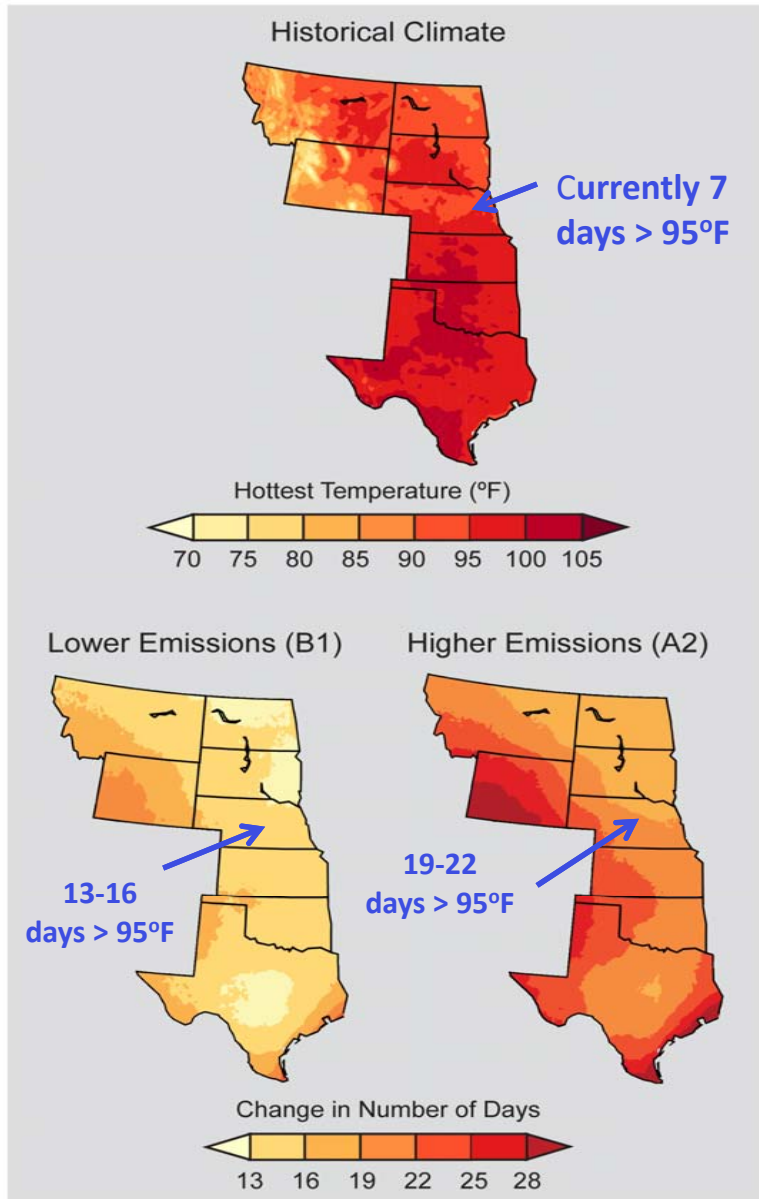
Great Plains Region

Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water. New agricultural practices will be needed to cope with changing conditions.

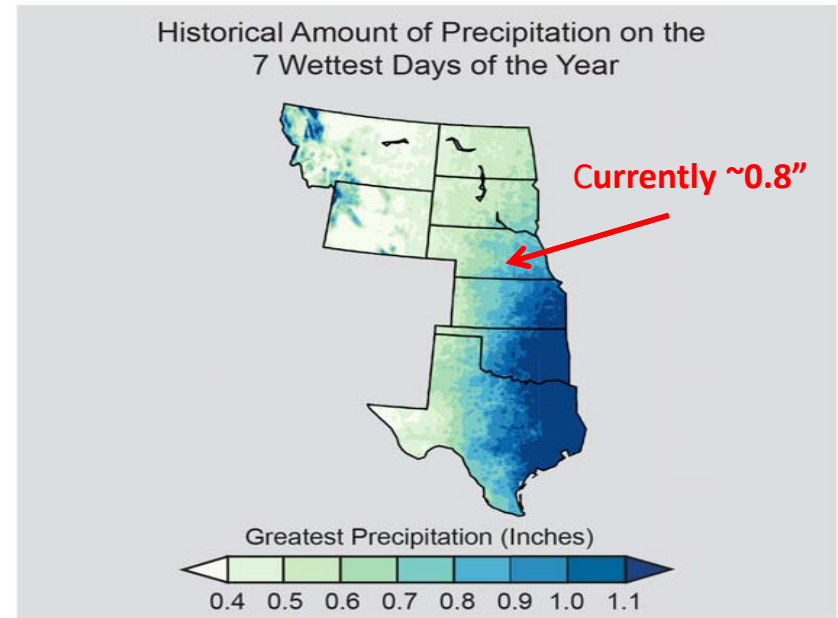
<http://nca2014.globalchange.gov/report/regions/great-plains>

Changes in Number of Hot Days and Heavy Precipitation

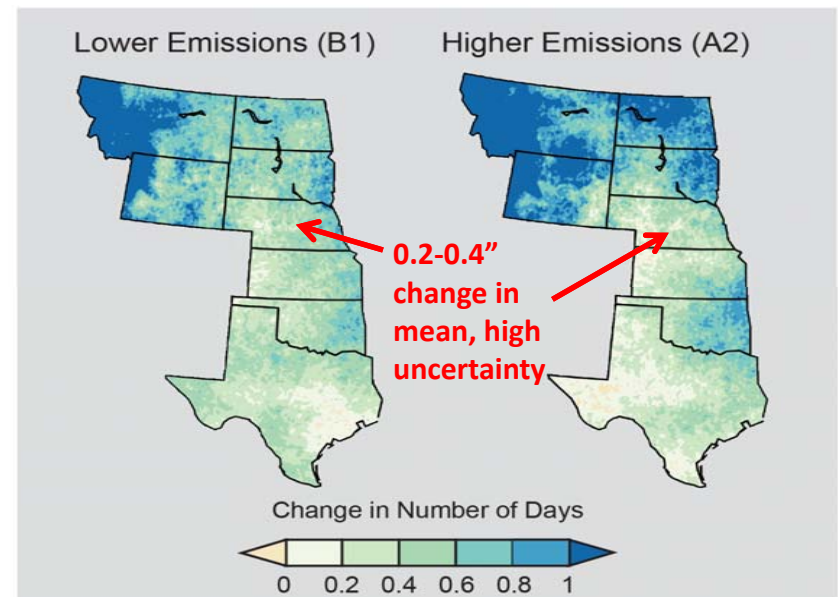
Projected Change in Number of Hot Days



Historical Amount of Precipitation on the 7 Wettest Days of the Year



Projected Change in Precipitation on the 7 Wettest Days of the Year





GREAT PLAINS

KEY MESSAGES

Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.

Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall events have already been observed; as these trends continue, they will require new agriculture and livestock management practices.

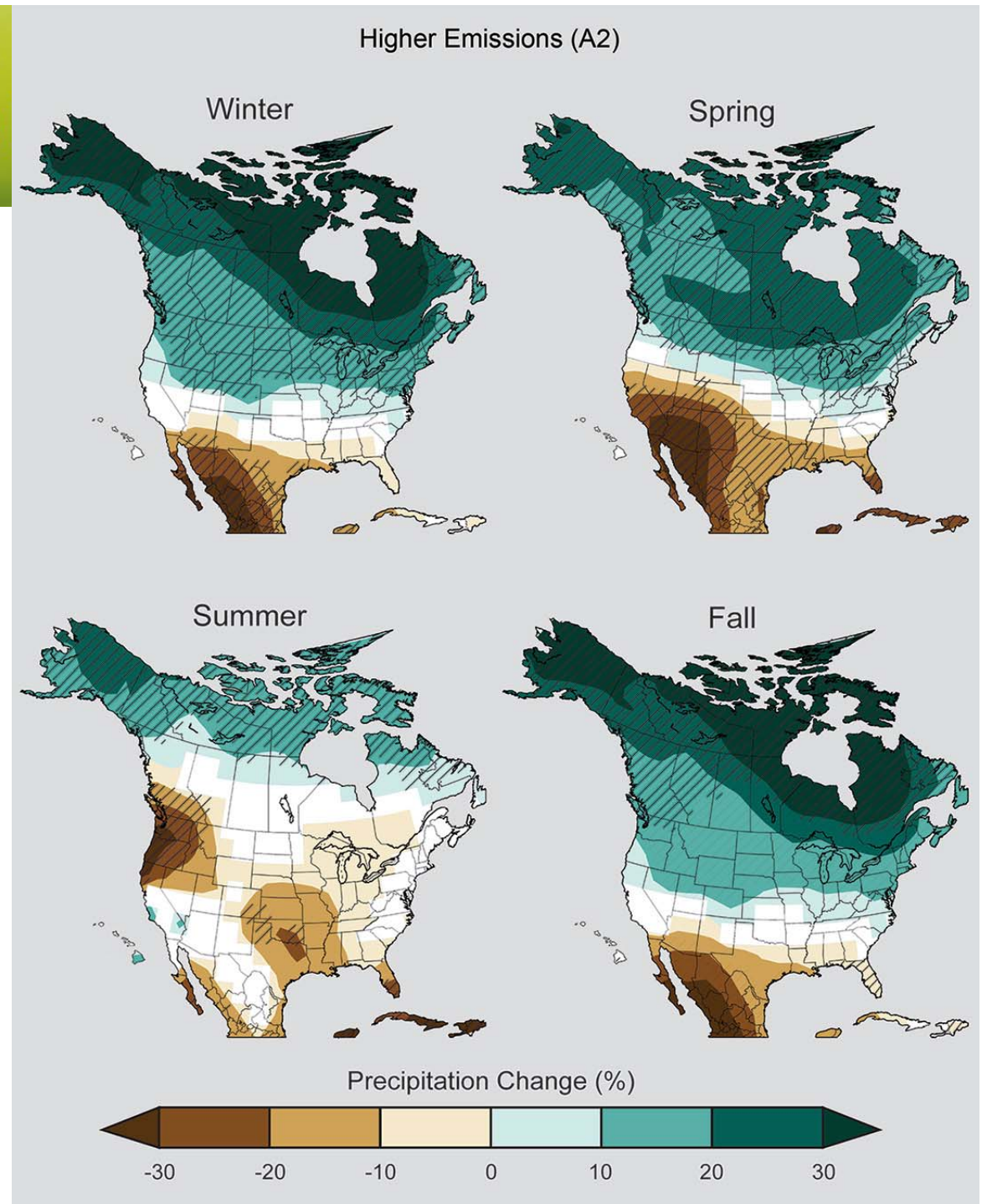
Landscape fragmentation is increasing, for example, in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.

Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system.

The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts.

Projected Precipitation Change by Season

2071-2099 scenario
compared to the
period 1970-1999





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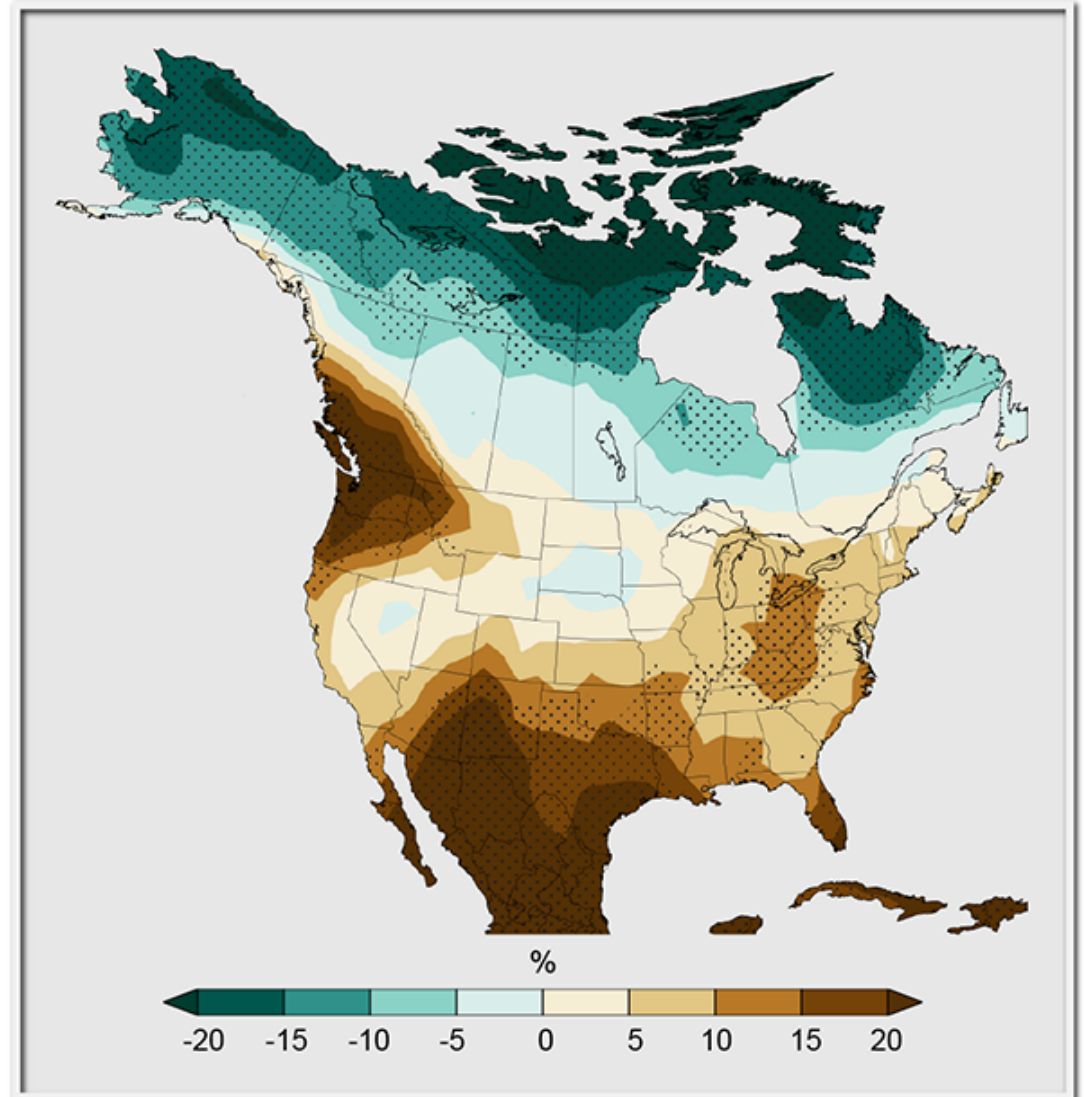
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Number of Consecutive Dry Days Likely to Increase

2081-2100 relative to
1980-1999 under the
higher scenario,
RCP8.5

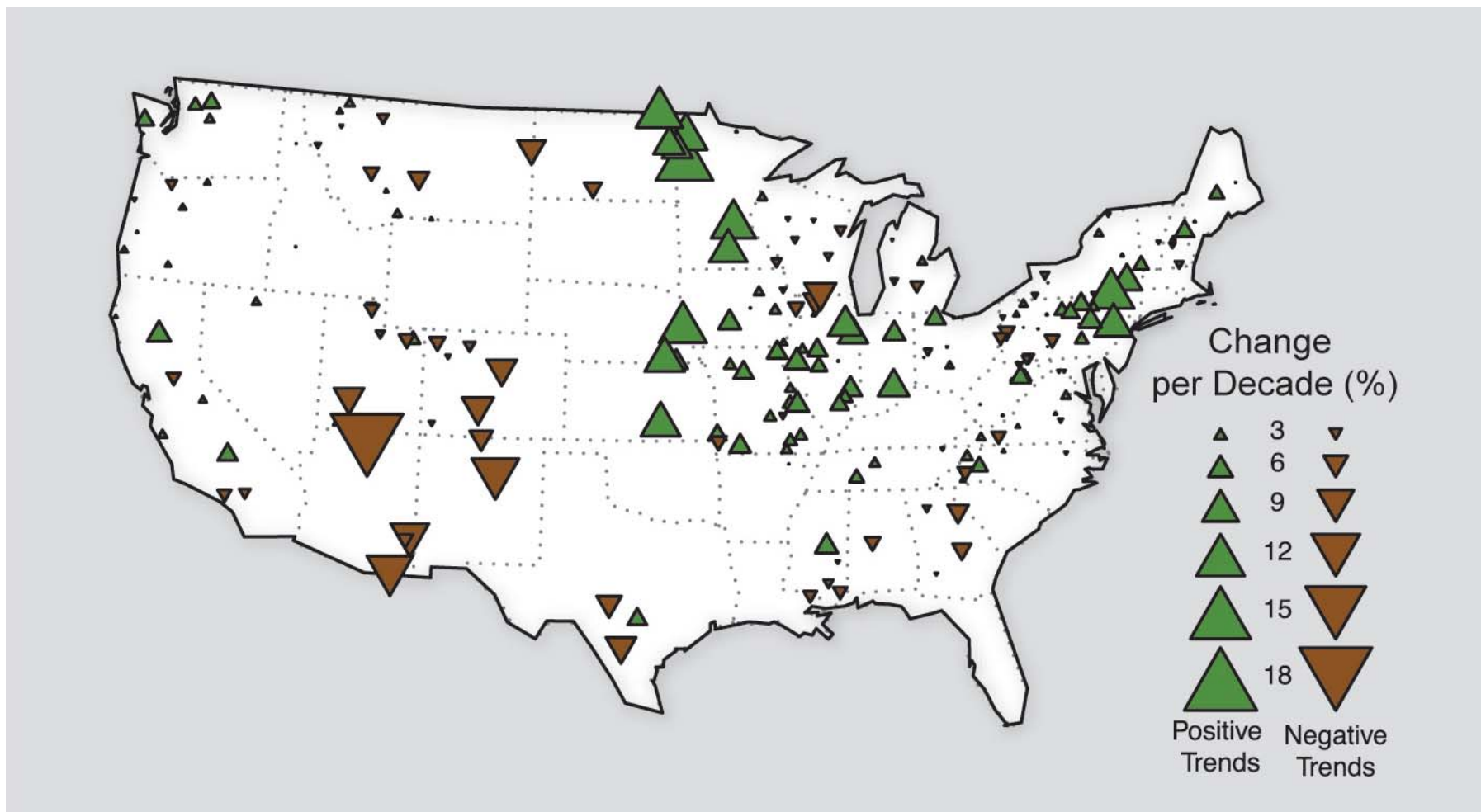
National Climate Assessment

Change in Maximum Number of Consecutive Dry Days





Trends in Flood Magnitude





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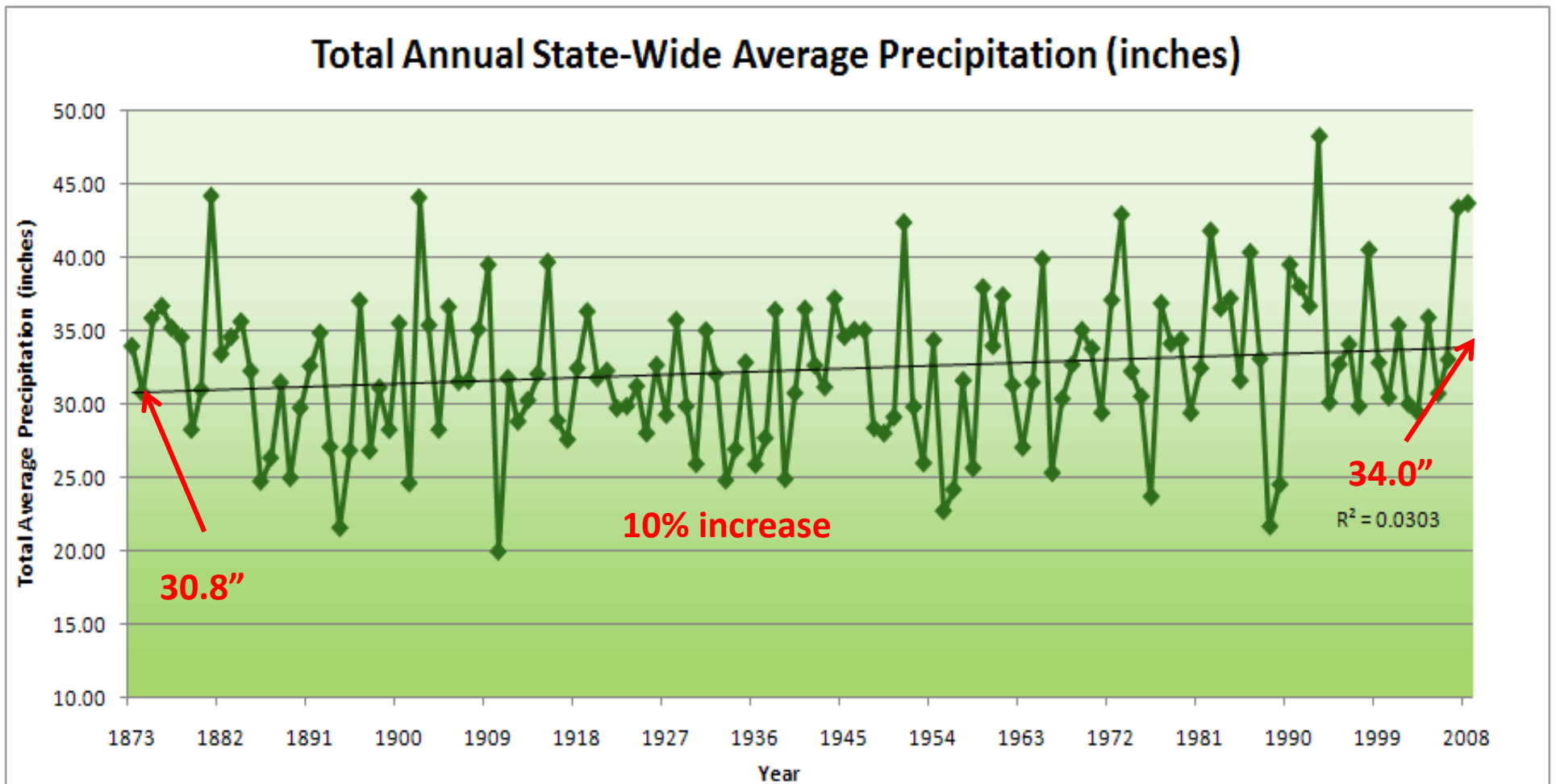
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A Closer Look at the Impact of Changes in Precipitation:

Examples from Iowa

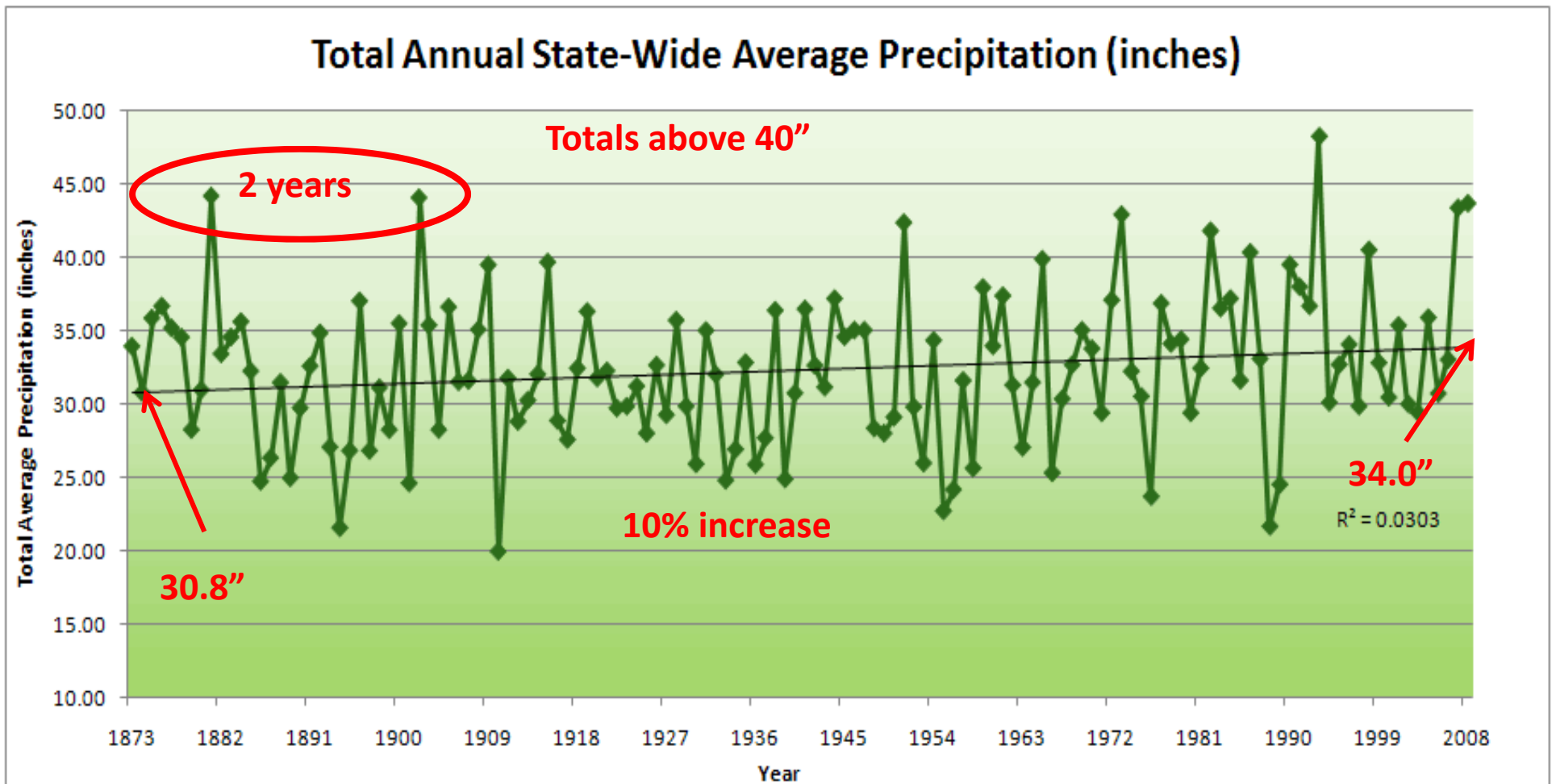


Iowa State-Wide Average Data



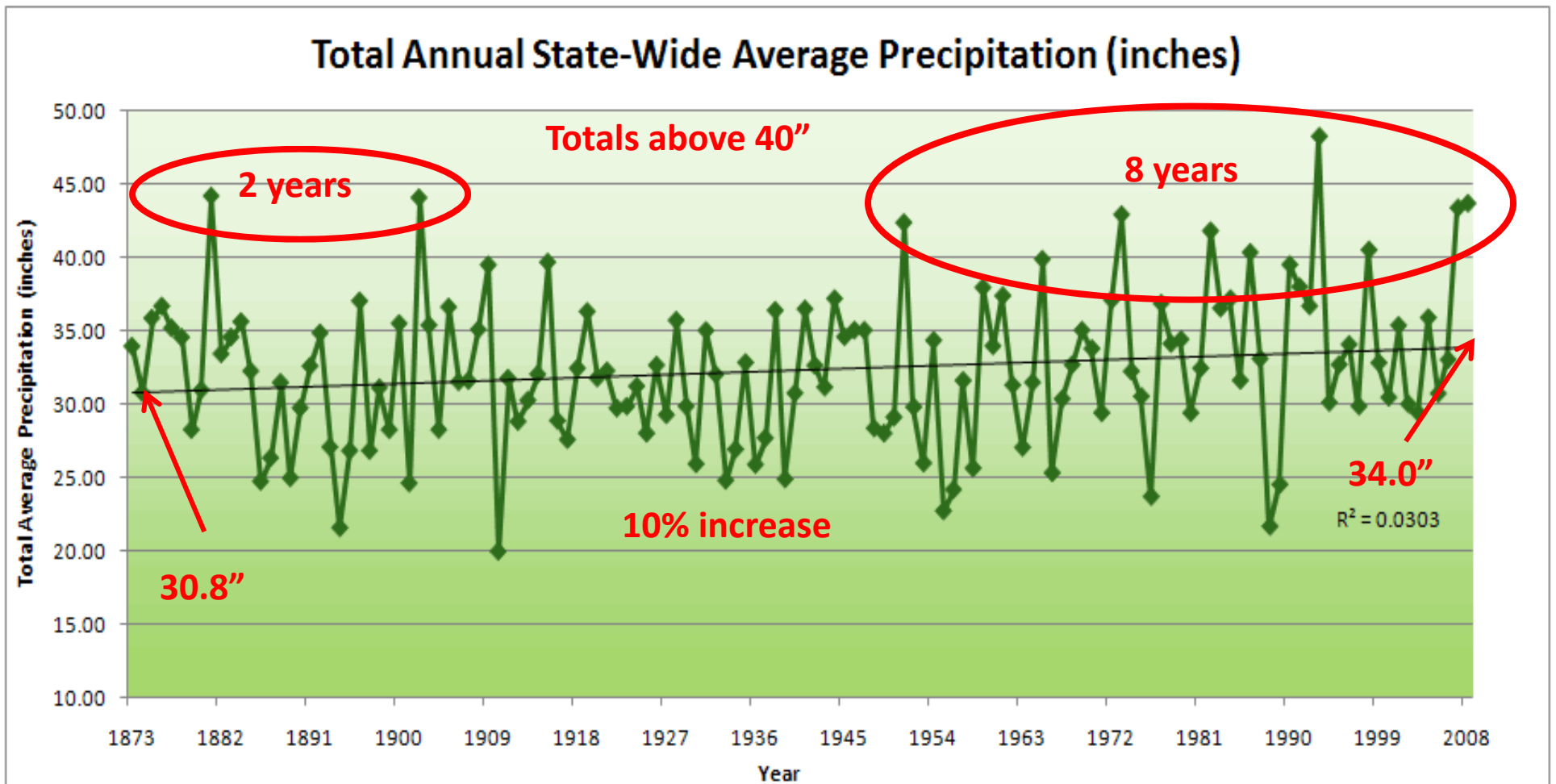


Iowa State-Wide Average Data



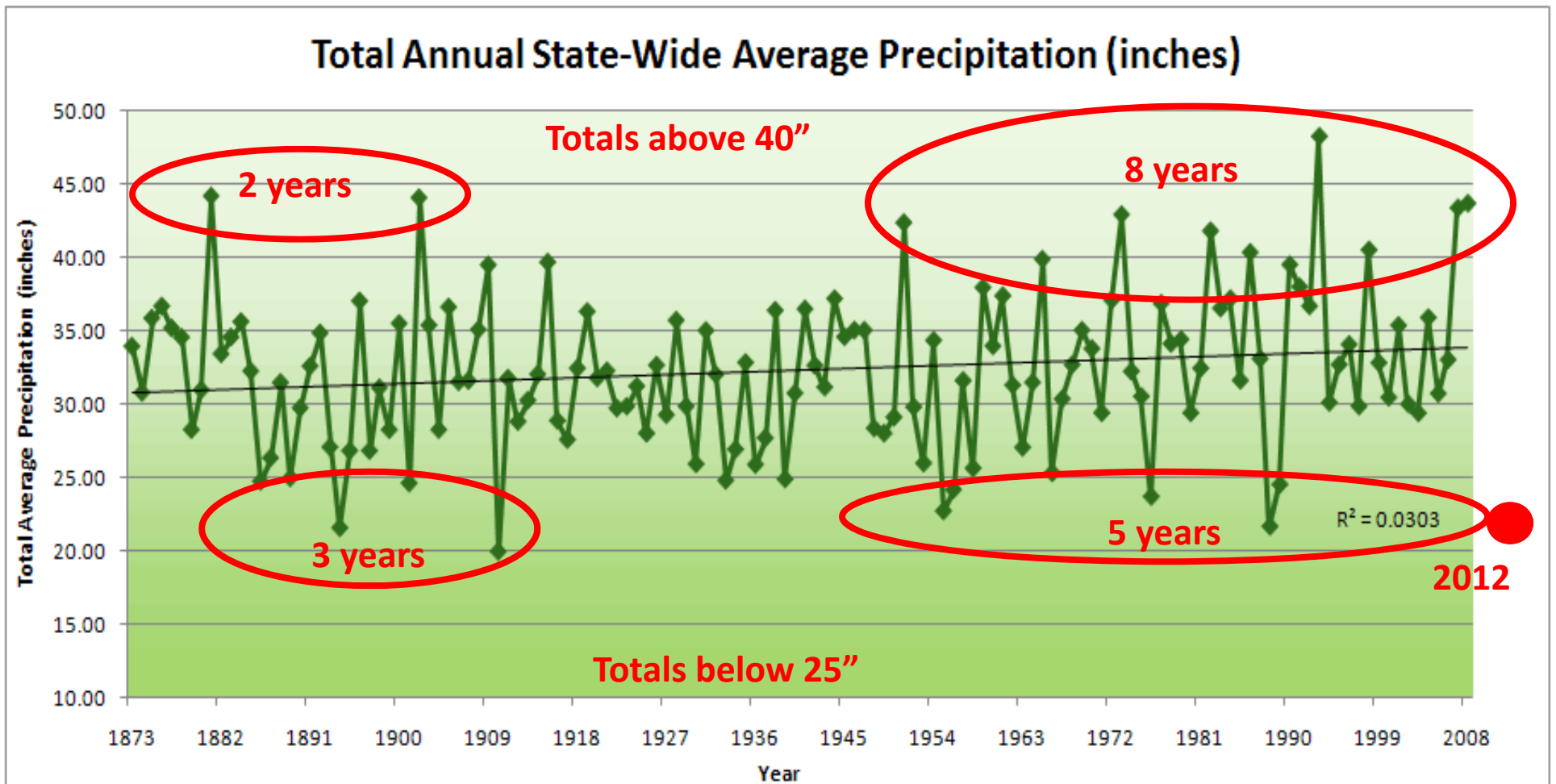


Iowa State-Wide Average Data



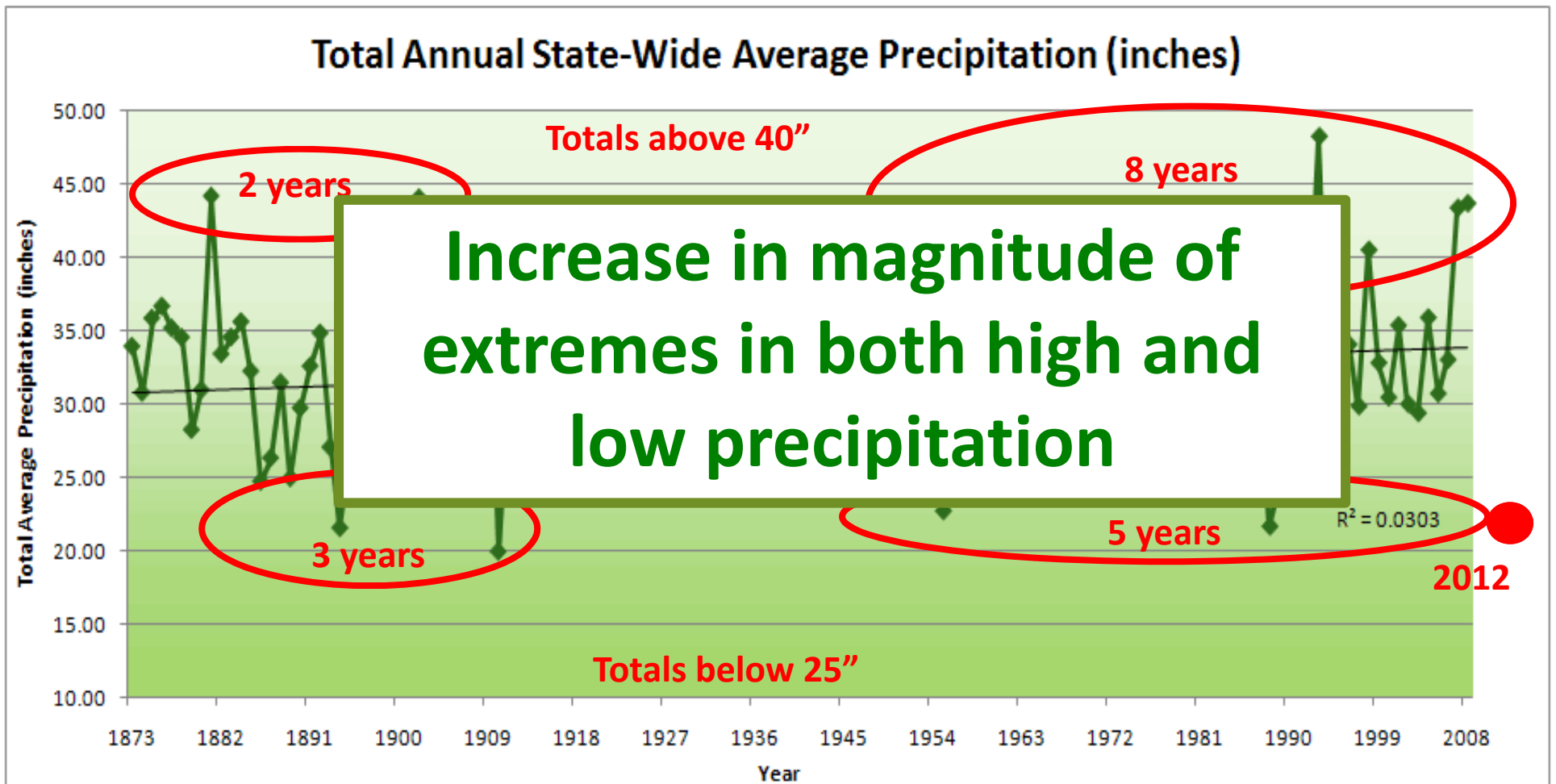


Iowa State-Wide Average Data



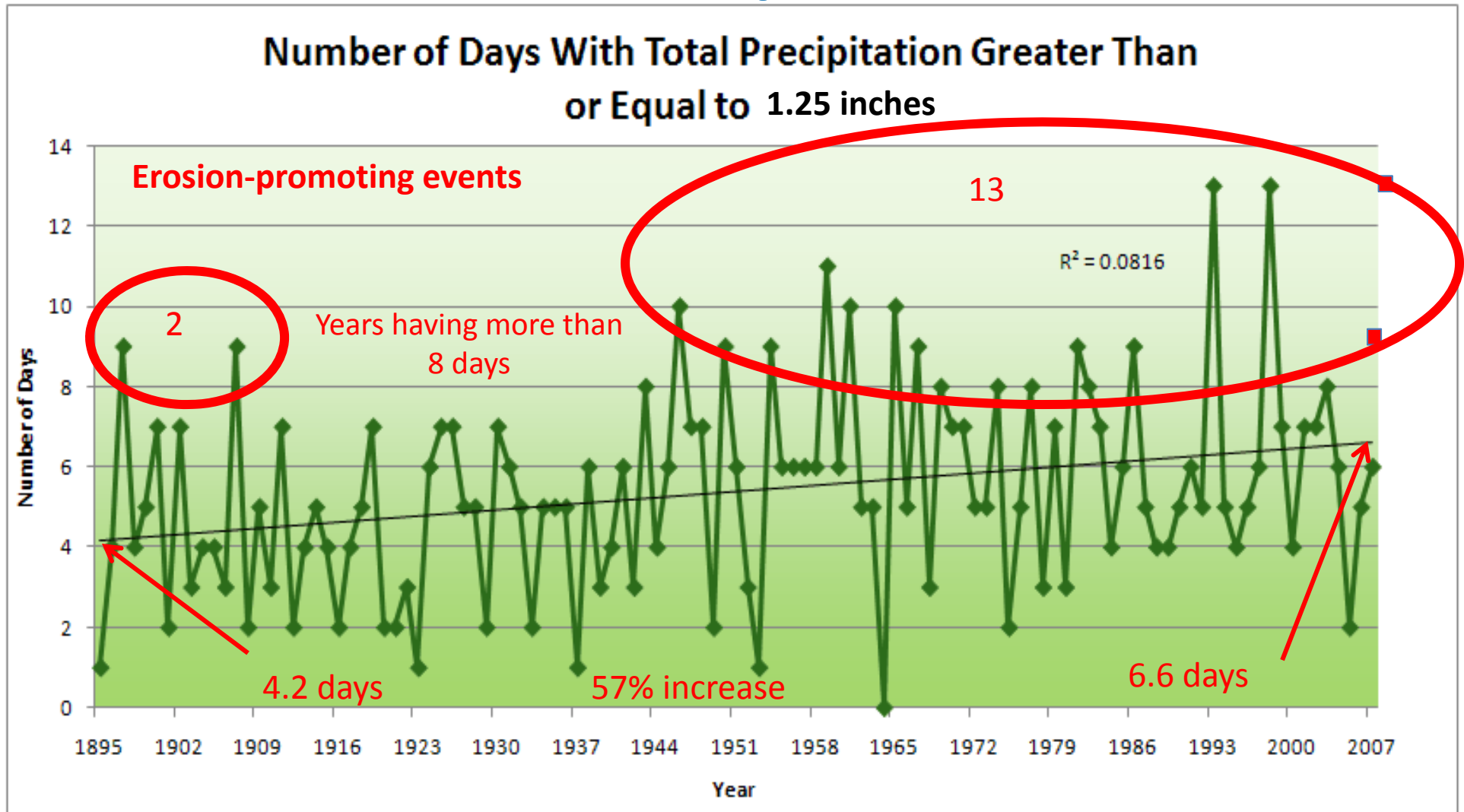


Iowa State-Wide Average Data





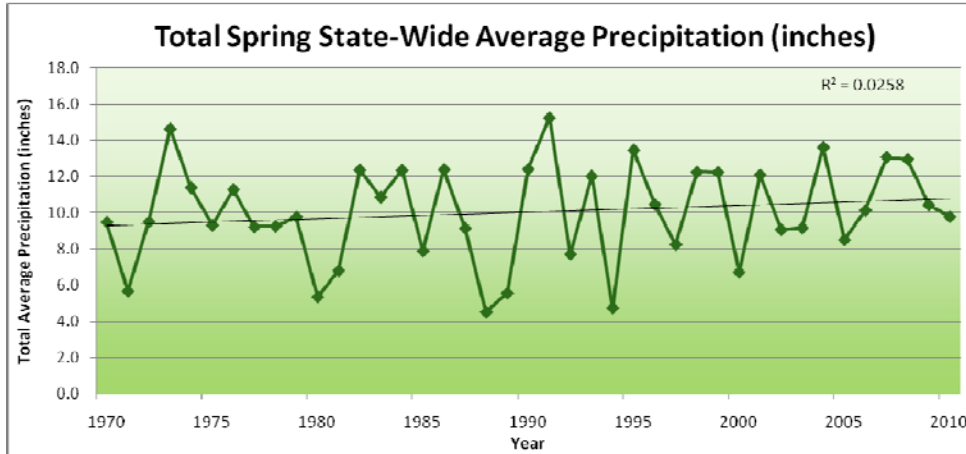
Cedar Rapids Data



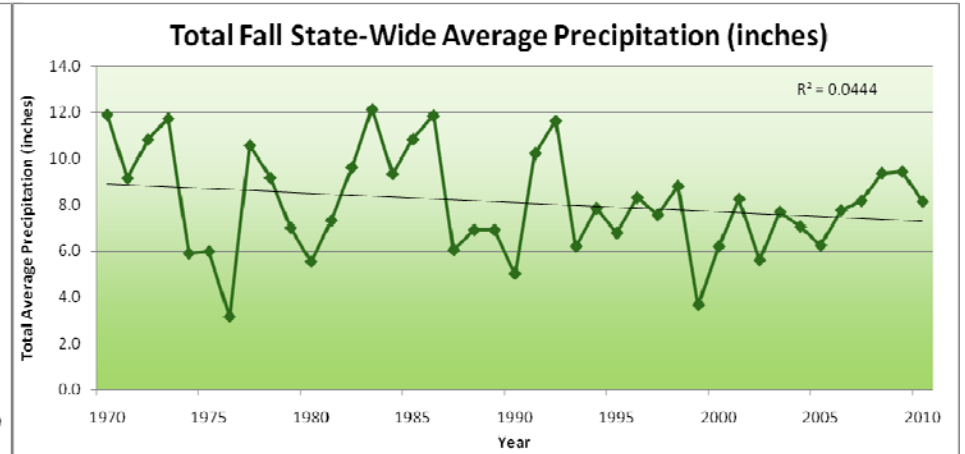


Amplification of the Seasonality of Precipitation

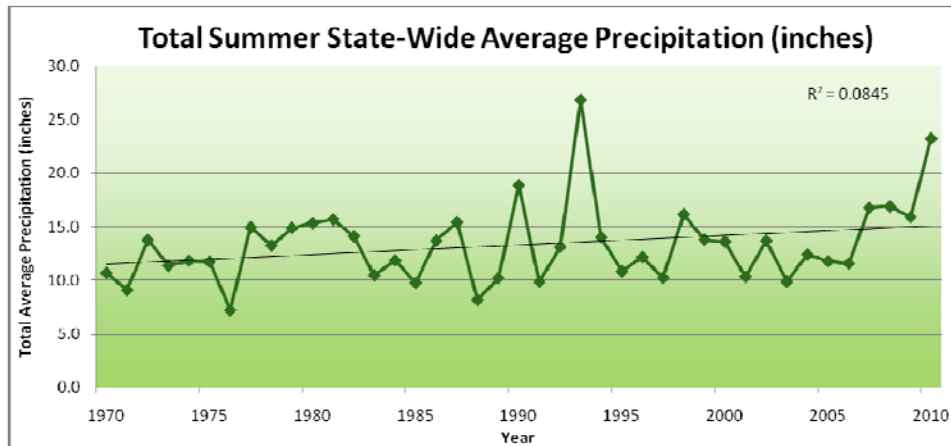
Spring



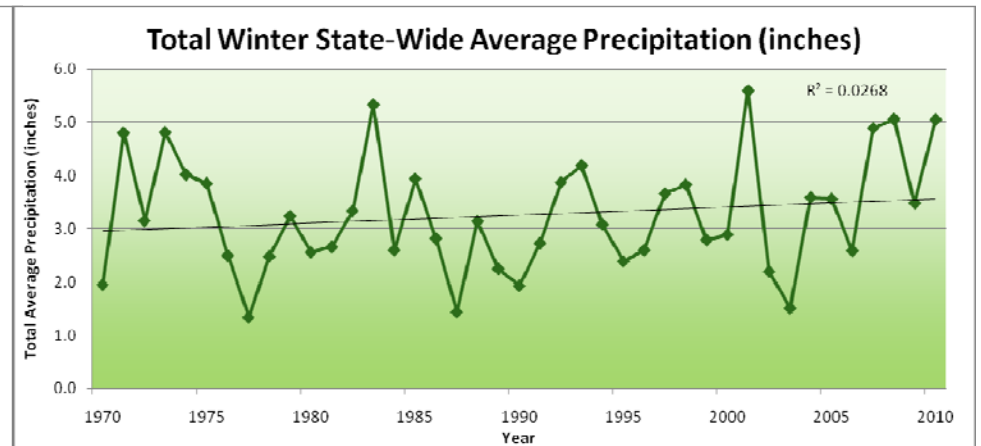
Fall



Summer



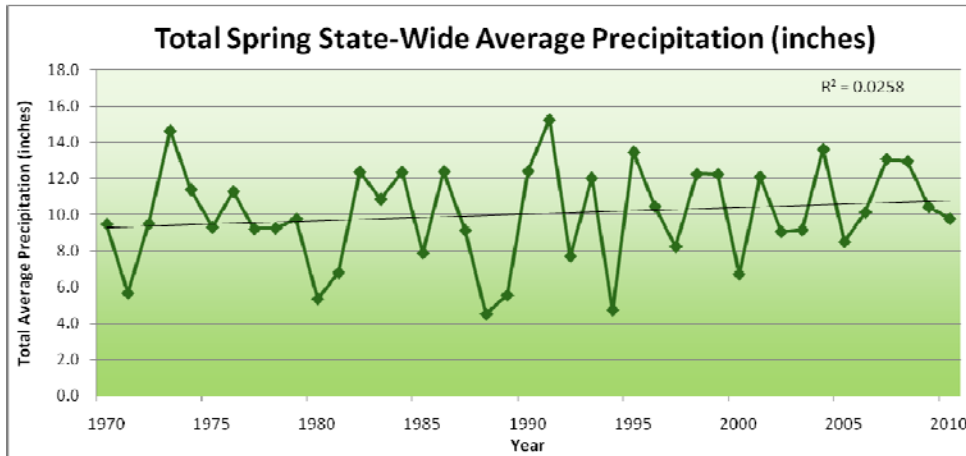
Winter



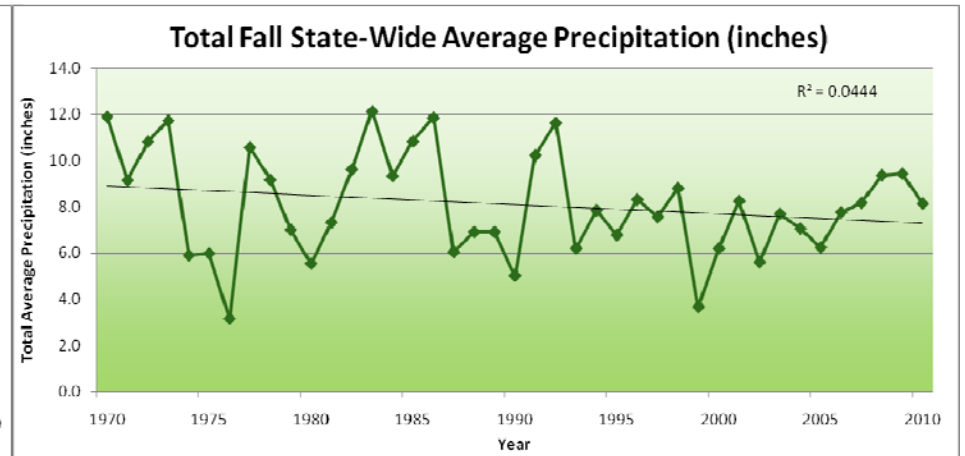


Amplification of the Seasonality of Precipitation

Spring



Fall



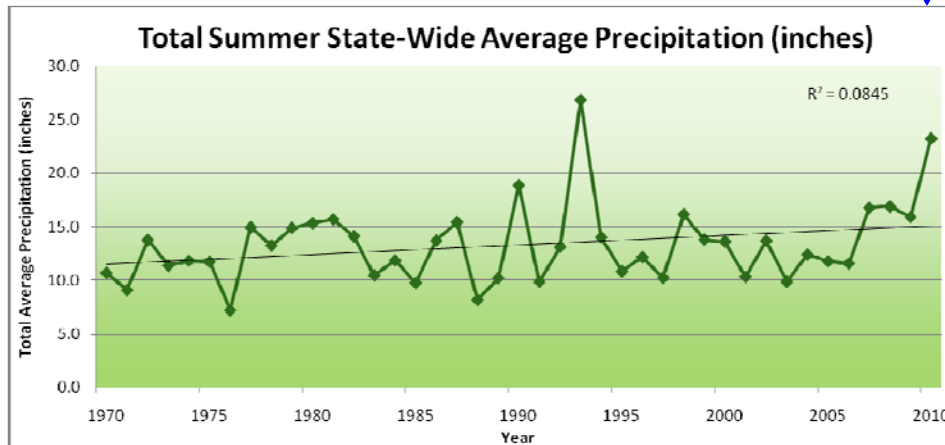
21.2 => 25.3 inches (22% increase)



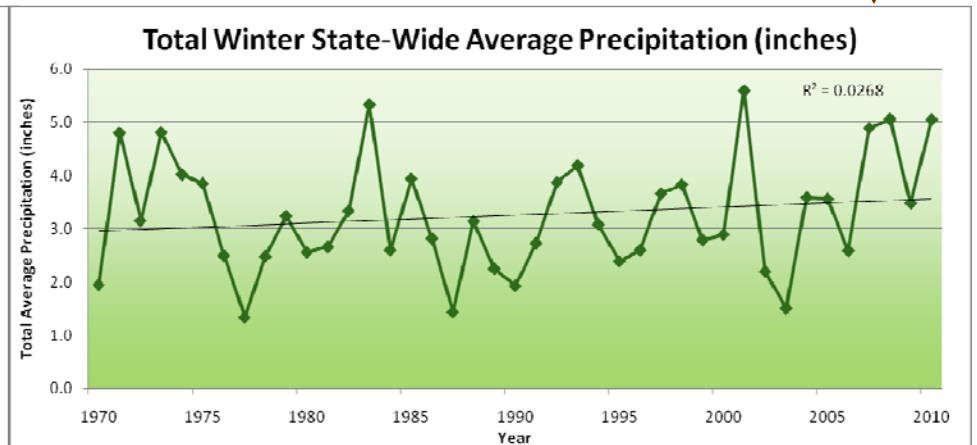
12.1 => 10.5 inches (13% decrease)



Summer



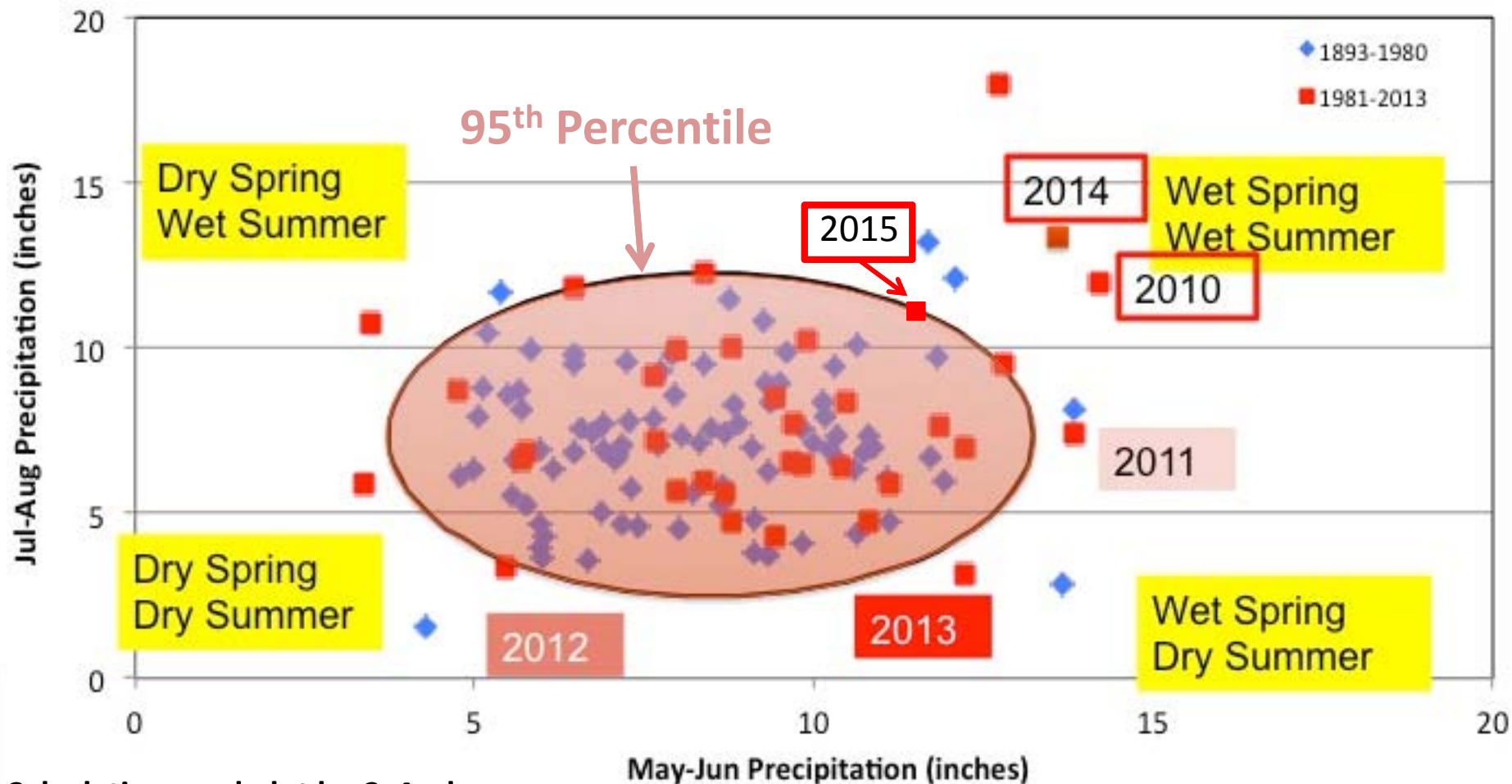
Winter



Weather Trend: Unusual combinations of spring and summer rainfall are occurring more often

Spring and Summer Rainfall In Iowa (1893-2013)

1-in-20-yr return in 1893-1980 has 1-in-4-yr return in 1981-2013



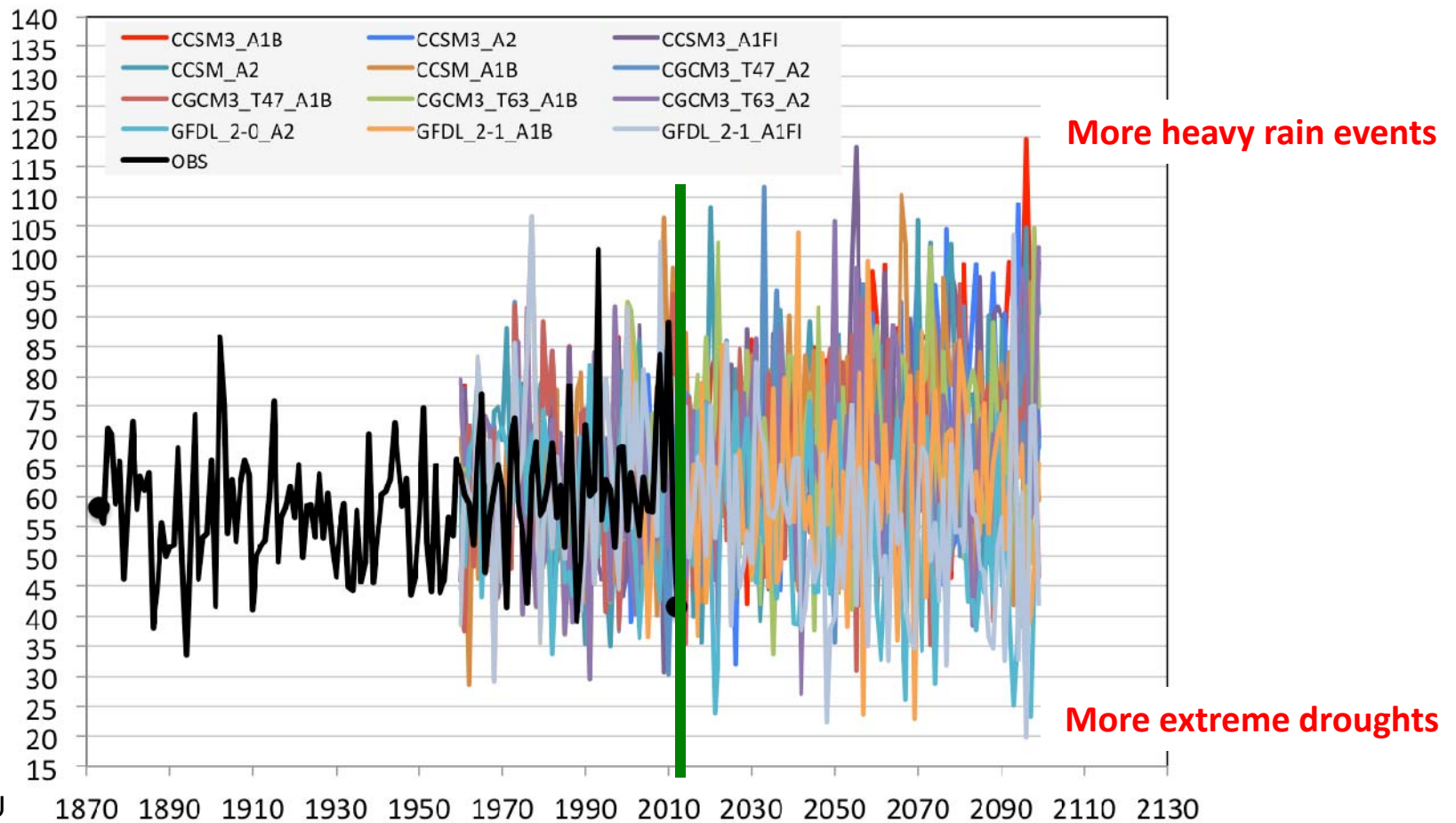
Calculations and plot by C. Anderson

Data Source: State of Iowa Climatologist



Future Variability in Growing Season Precipitation for Iowa

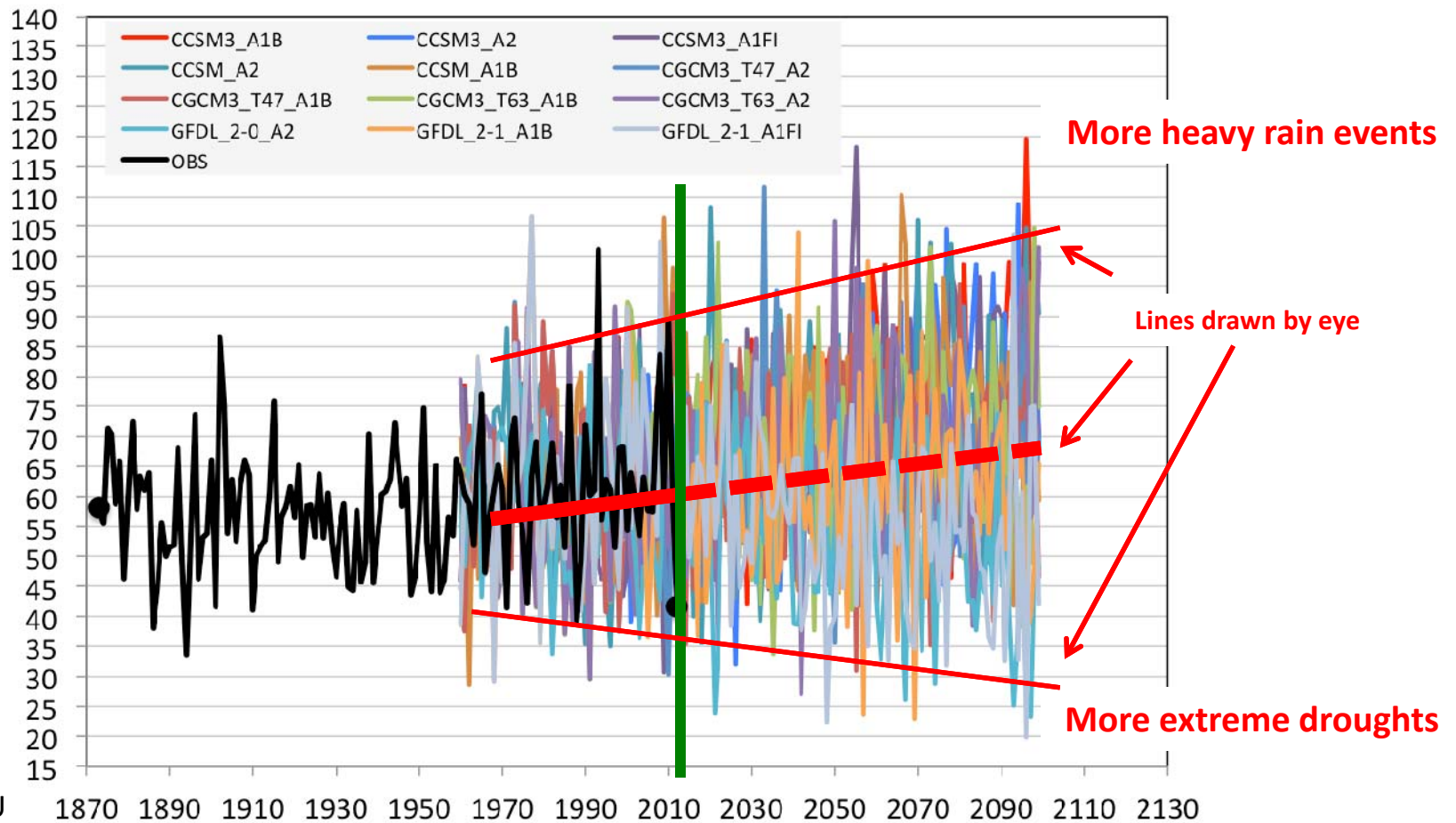
Annual Apr-Sep Rainfall (cm)





Future Variability in Growing Season Precipitation for Iowa

Annual Apr-Sep Rainfall (cm)



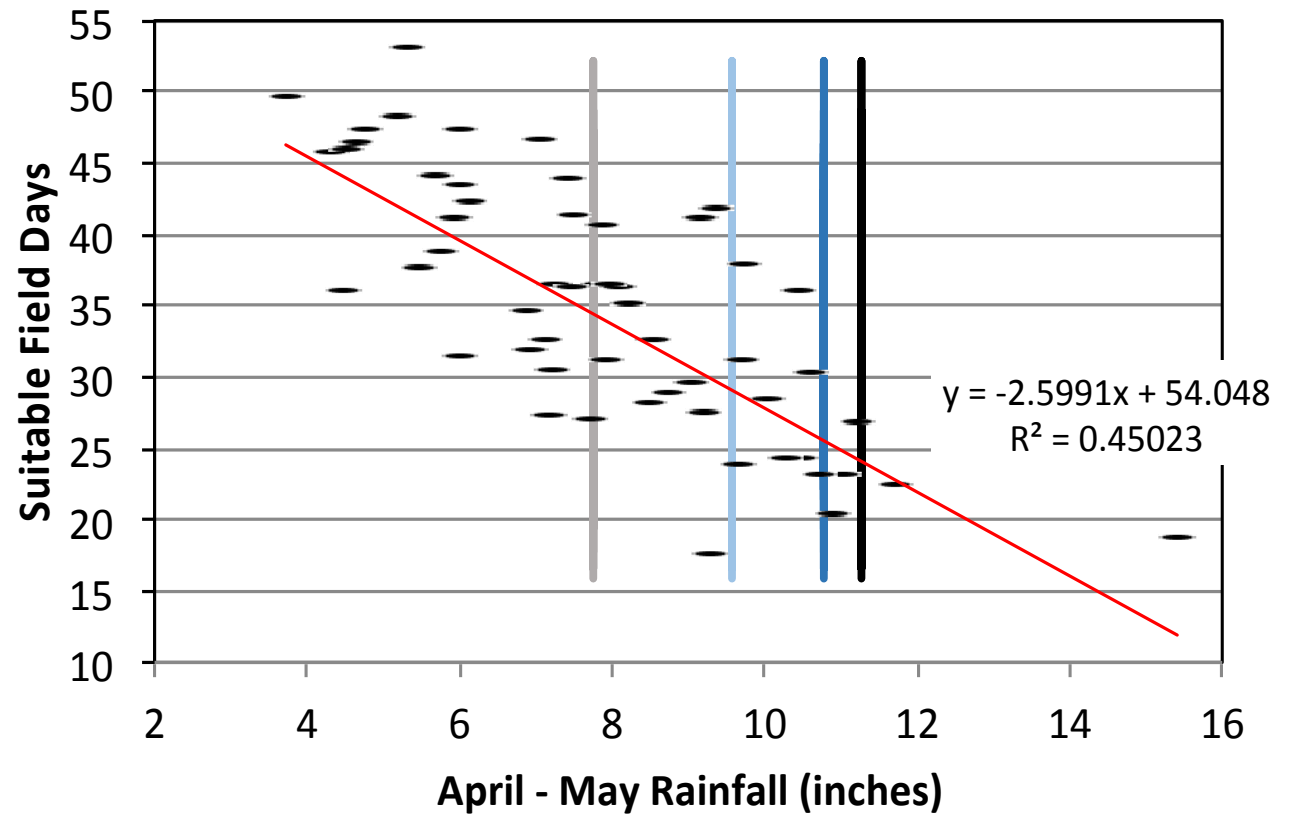


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Every 1”
Increase of
April-May
Rainfall
Reduces
Suitable Field
Days by 2.6
days

Suitable Field Days (Apr 2 - Jun 3) versus
April-May Rainfall, Iowa Average (1959-2013)



Source: Chris Anderson



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Matching the scales and variables of climate change to agricultural decisions

