United States Department of Agriculture
Midwest Climate Hub

Climate Changes Impacting Midwest Crops

…not just temperature and precipitation

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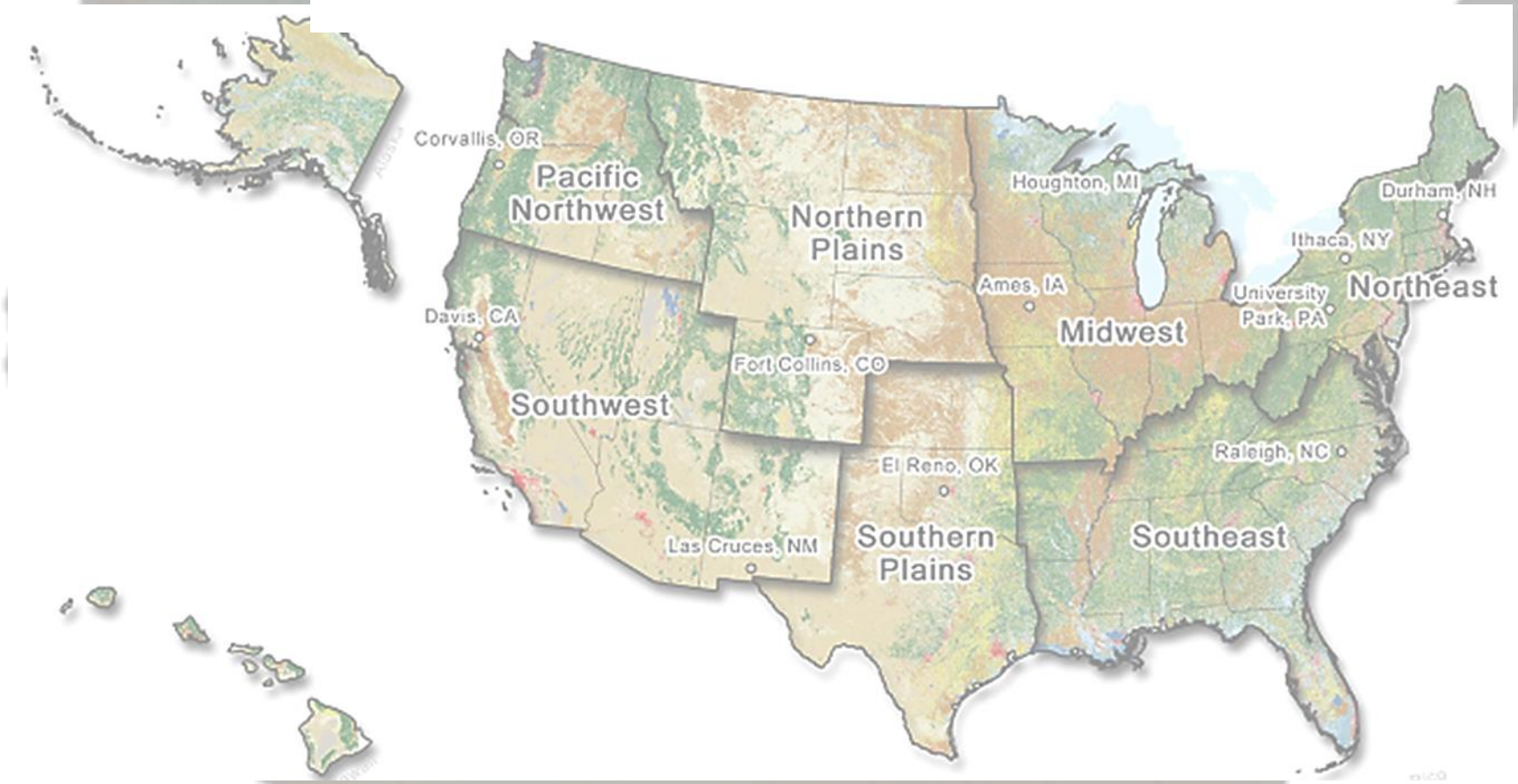
Agenda

- A bit about the USDA Climate Hubs
- Various Climate Issues
- Feedback on some needs
- Outlook 17 (time permitting)

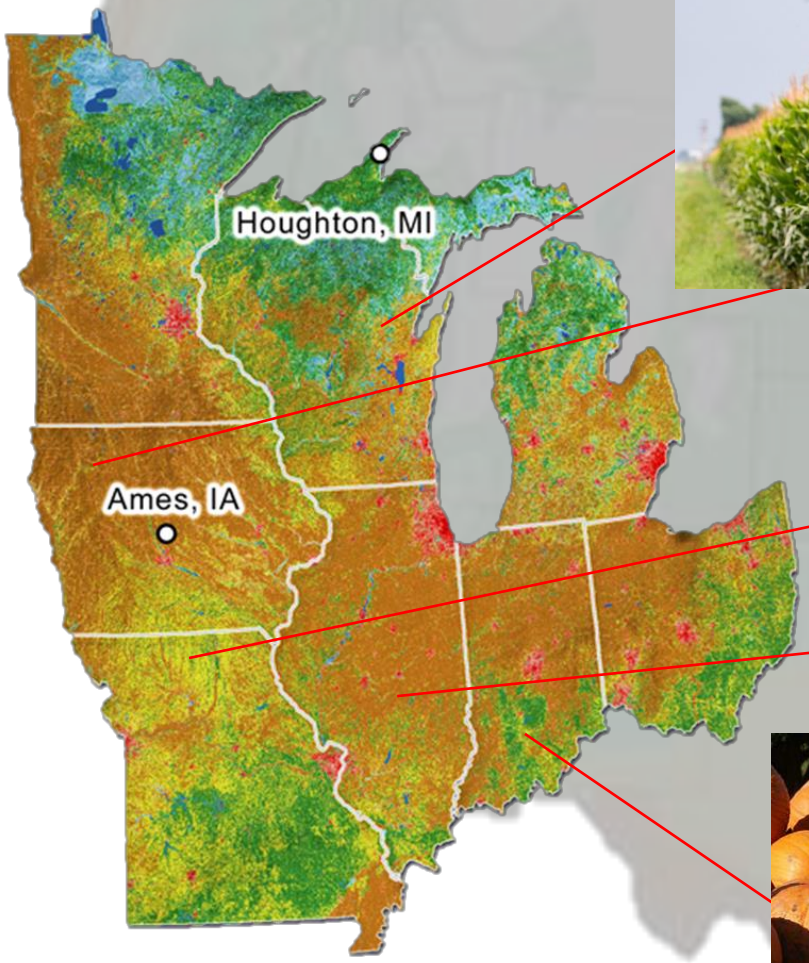
The Climate Hubs



Regional Climate Hubs are providing **Information and Tools** to **Decision Makers** to **Build Resilience** to climate variability.

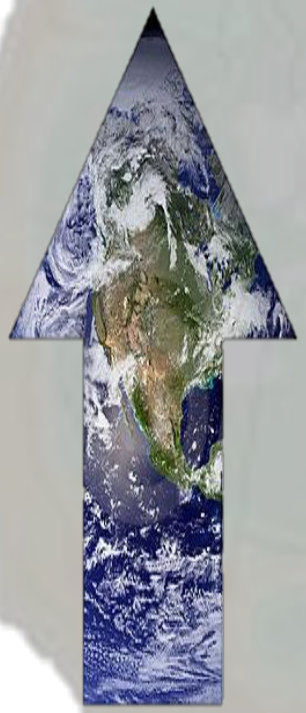
USDA

Midwest Climate Hub



Agricultural Research Service

The Need for Climate Hubs



- Increasing climate variability
- An increase in number and intensity of extreme events
- Changing trends in climate and weather
- Added stress that to agriculture and the natural resources

The More you Know…
Information Leads to Action

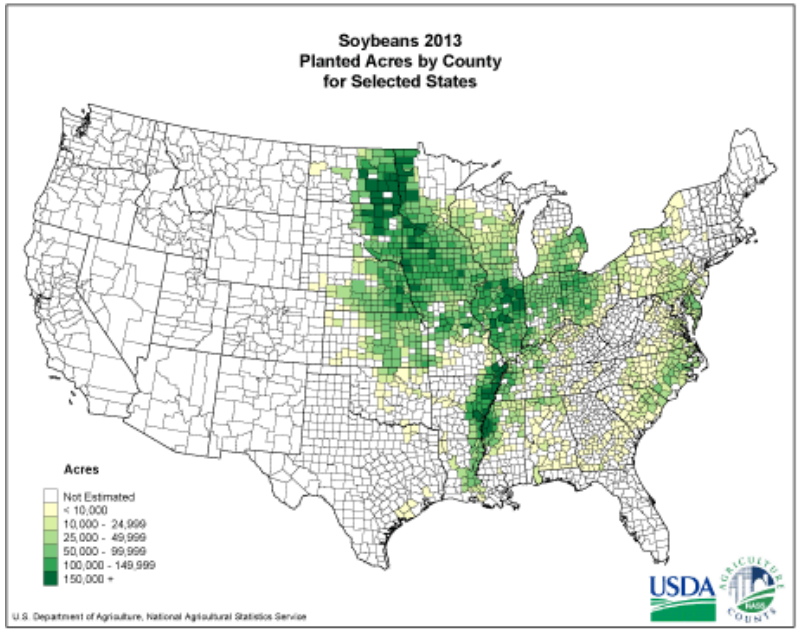
USDA

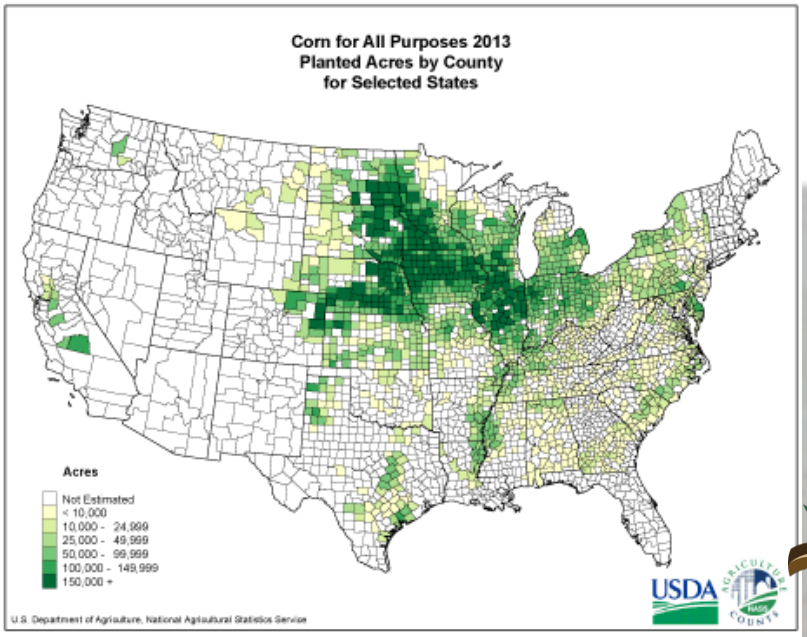
Midwest Climate Hub: Vulnerabilities in the Midwest

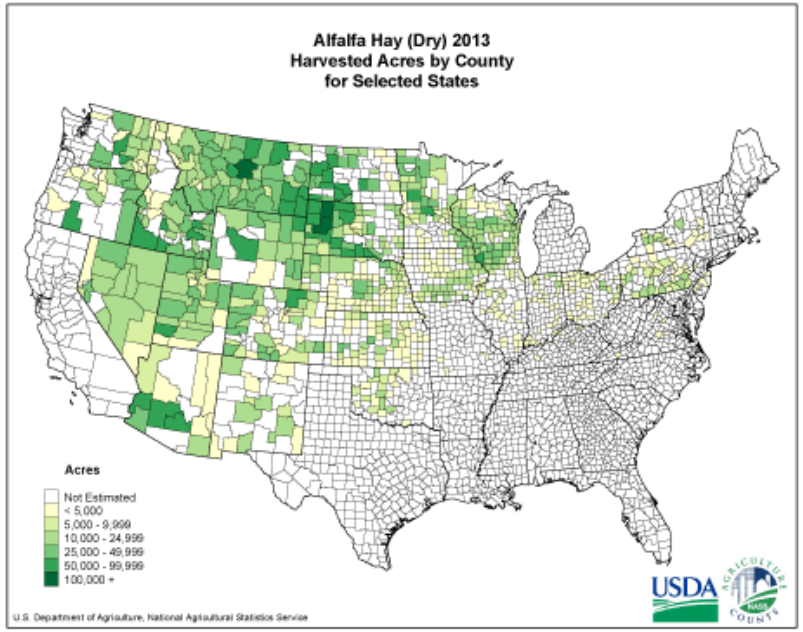
Link actionable information and users together to protect and enhance the natural resources of soil, water, and air.

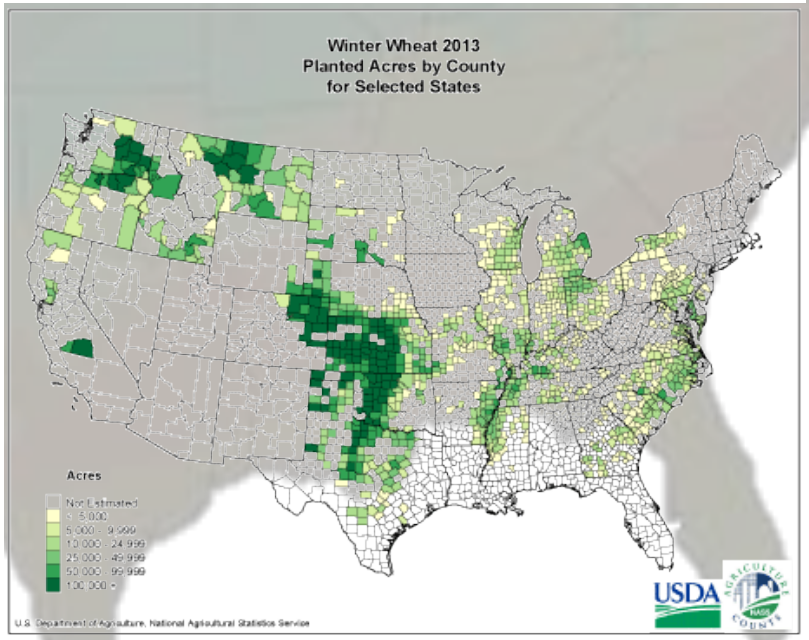
→ Integrate information to deliver solutions to producers through a variety of outlets

Crop Production







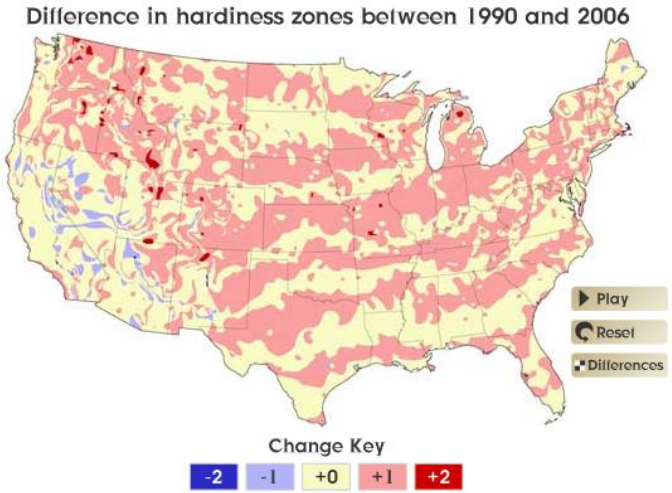


NLAE
National
Laboratory
for Agriculture
and the Environment

Hardiness Zone Changes

Zone Changes

This animation illustrates the general warming that has occurred from 1990 to 2006. Click the play button to see how the hardiness zones have changed.



Details

Play will change the map from the 1990 USDA hardiness zones to the 2006 Arborday.org hardiness zones.

Reset will change the map to show the 1990 USDA hardiness zones.

Differences shows colors that represent how much each zone has changed since 1990. For example, the pink areas of the map have warmed up enough to change one hardiness zone (e.g. the top half of Nebraska has increased by one zone).

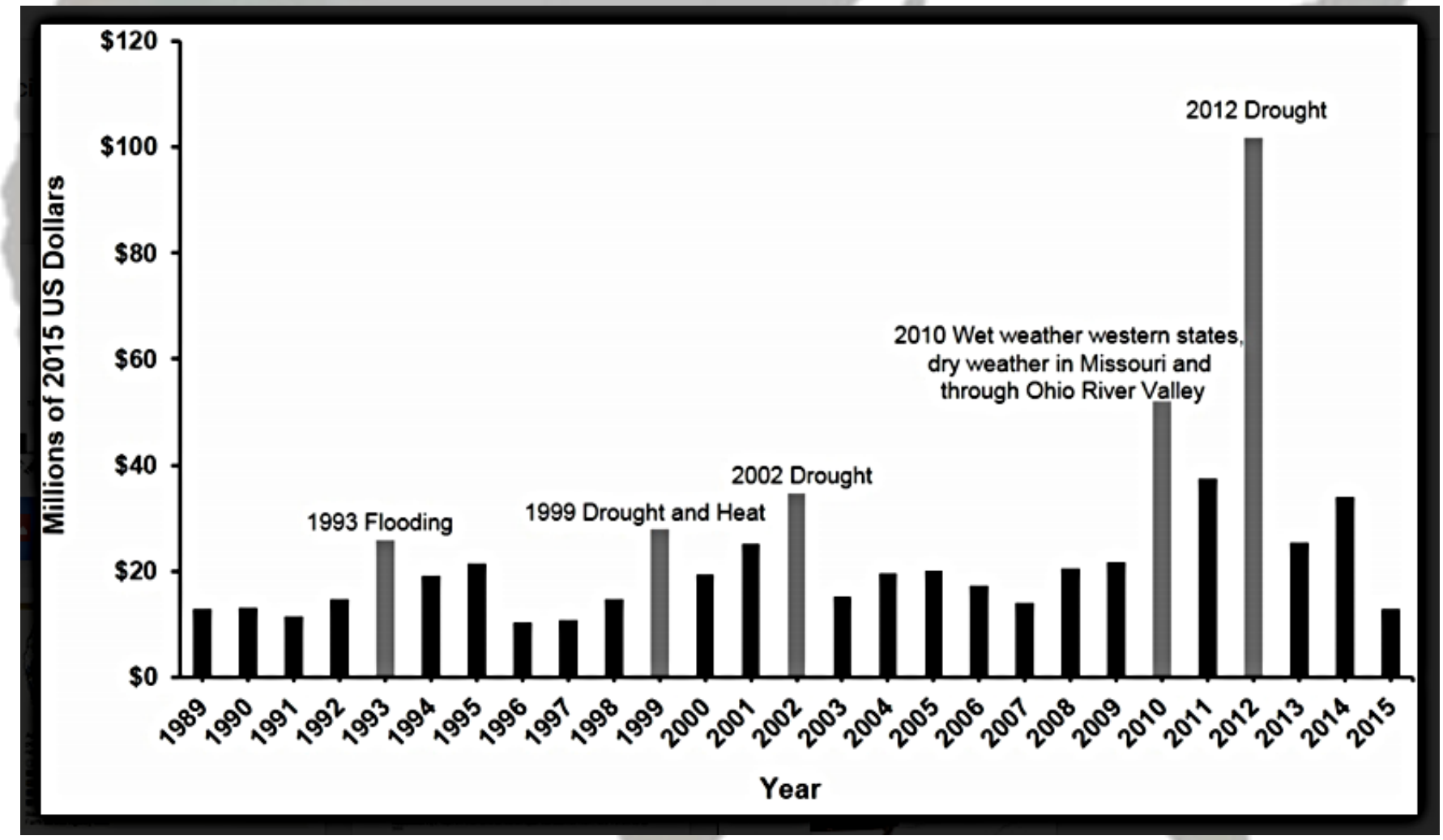
https://www.arborday.org/media/mapchanges.cfm

Implications

- Expanding the “corn belt” north and west and replacing wheat, sunflower, and canola
- Expanding corn and soybean into areas with potentially more risk of crop failure

- Harder to get widespread crop losses
- Changing typical growing zones
- Increasing risk at individual locations

USDA Crop Loss Data

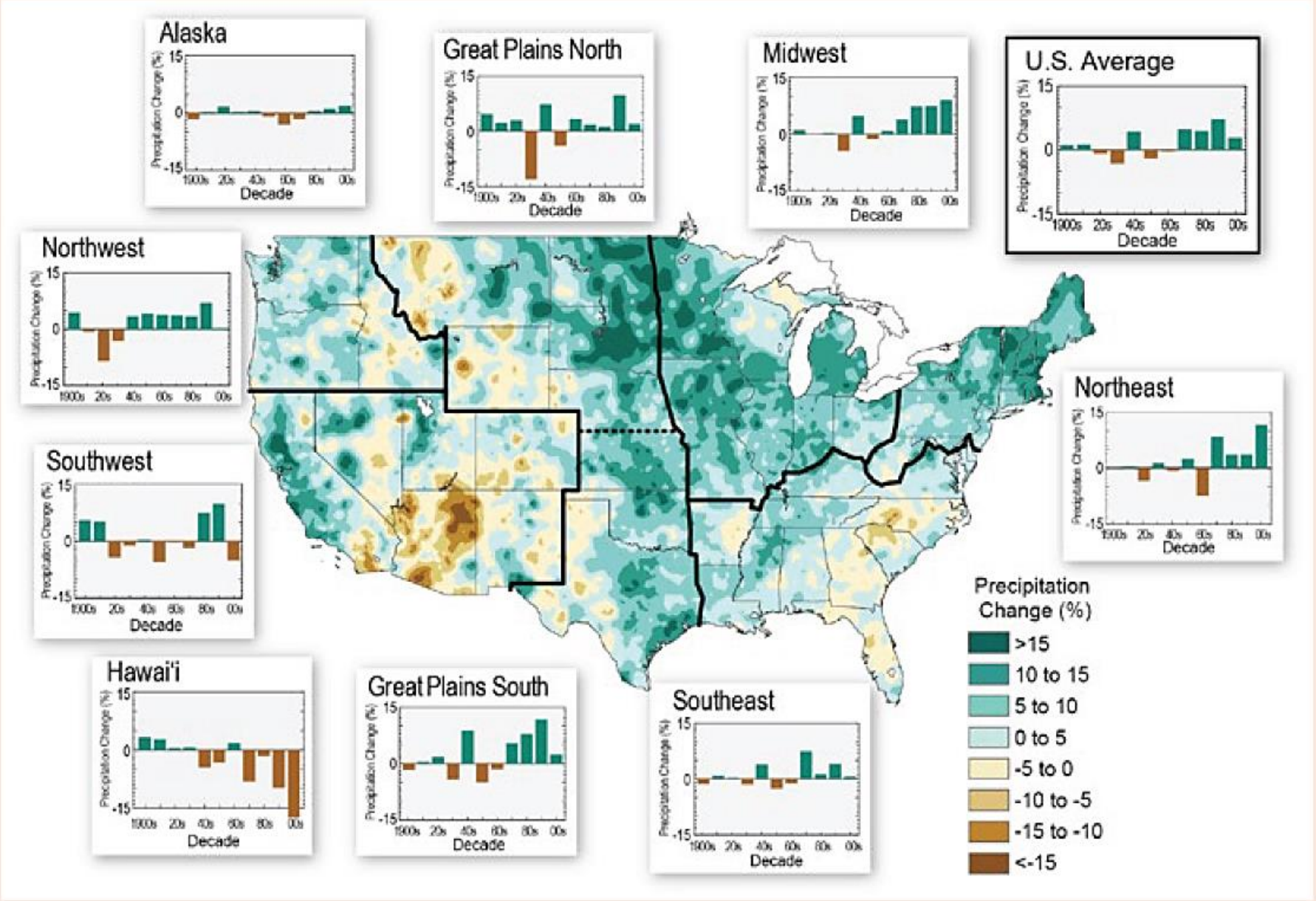


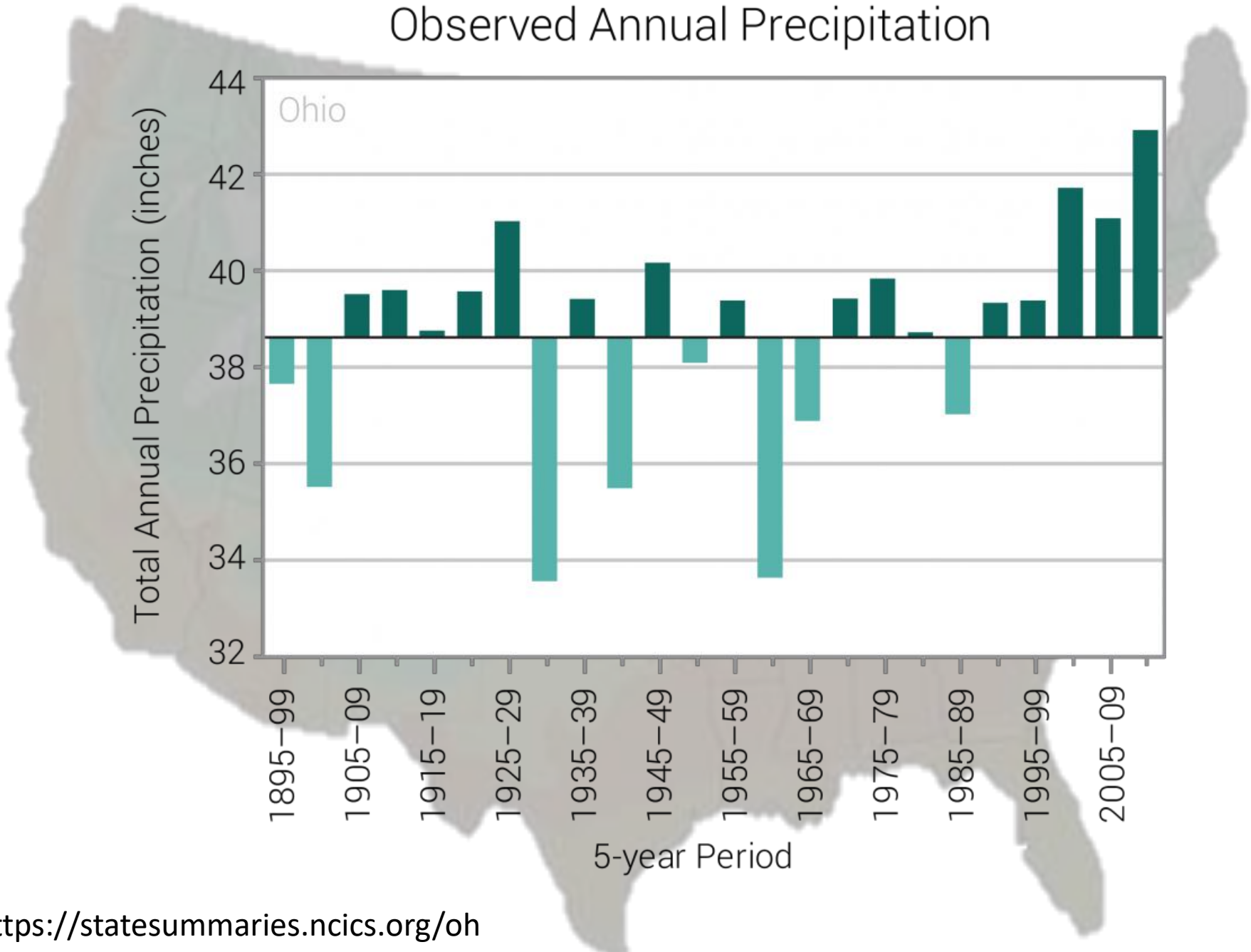
CLIMATE CHANGES IMPACTING AGRICULTURE

Getting Wetter

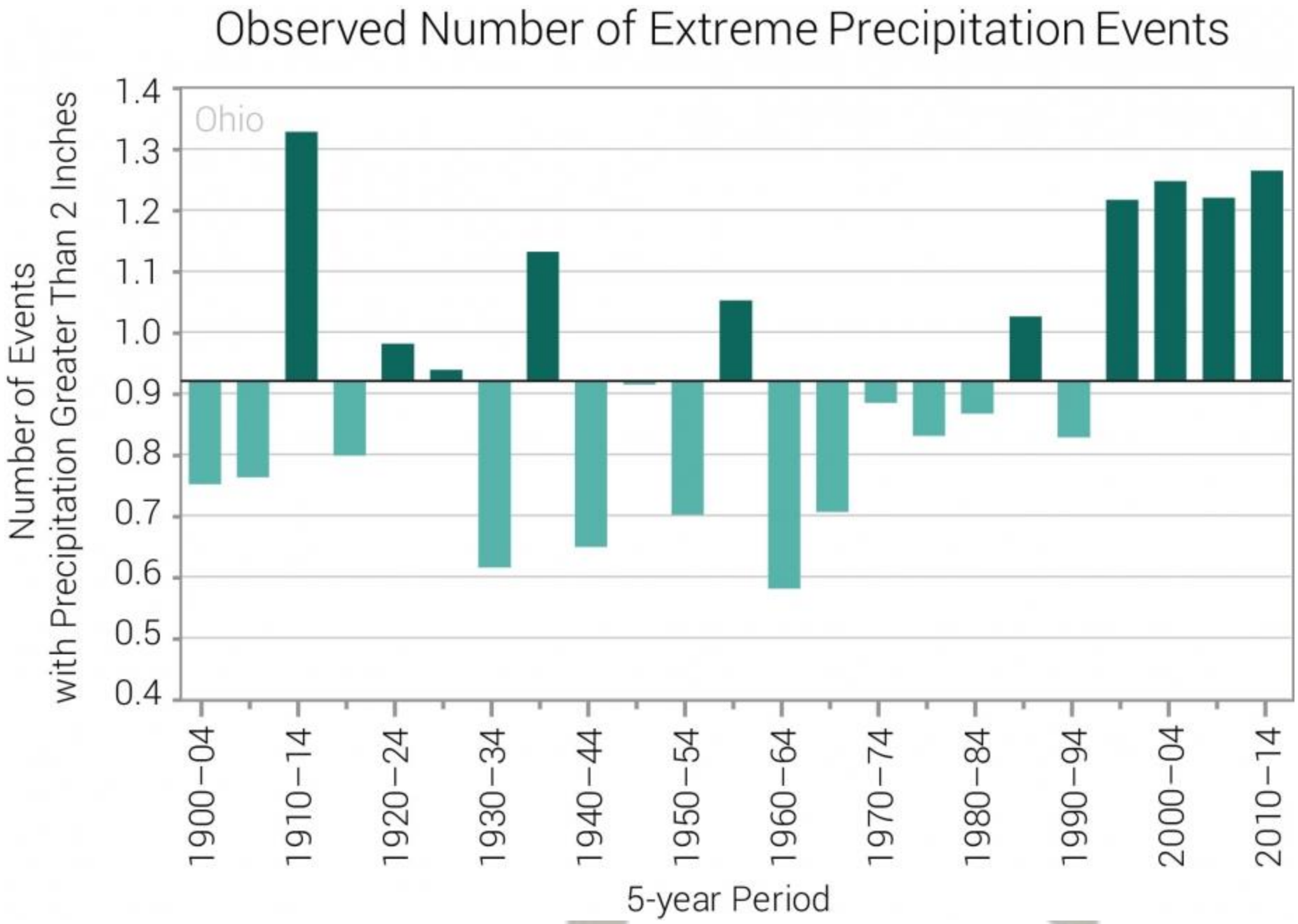
- The whole corn belt has seen increased precipitation in the last century.
  - Good
  - Bad
  - Both

Observed U.S. Precipitation Change





https://statesummaries.ncics.org/oh



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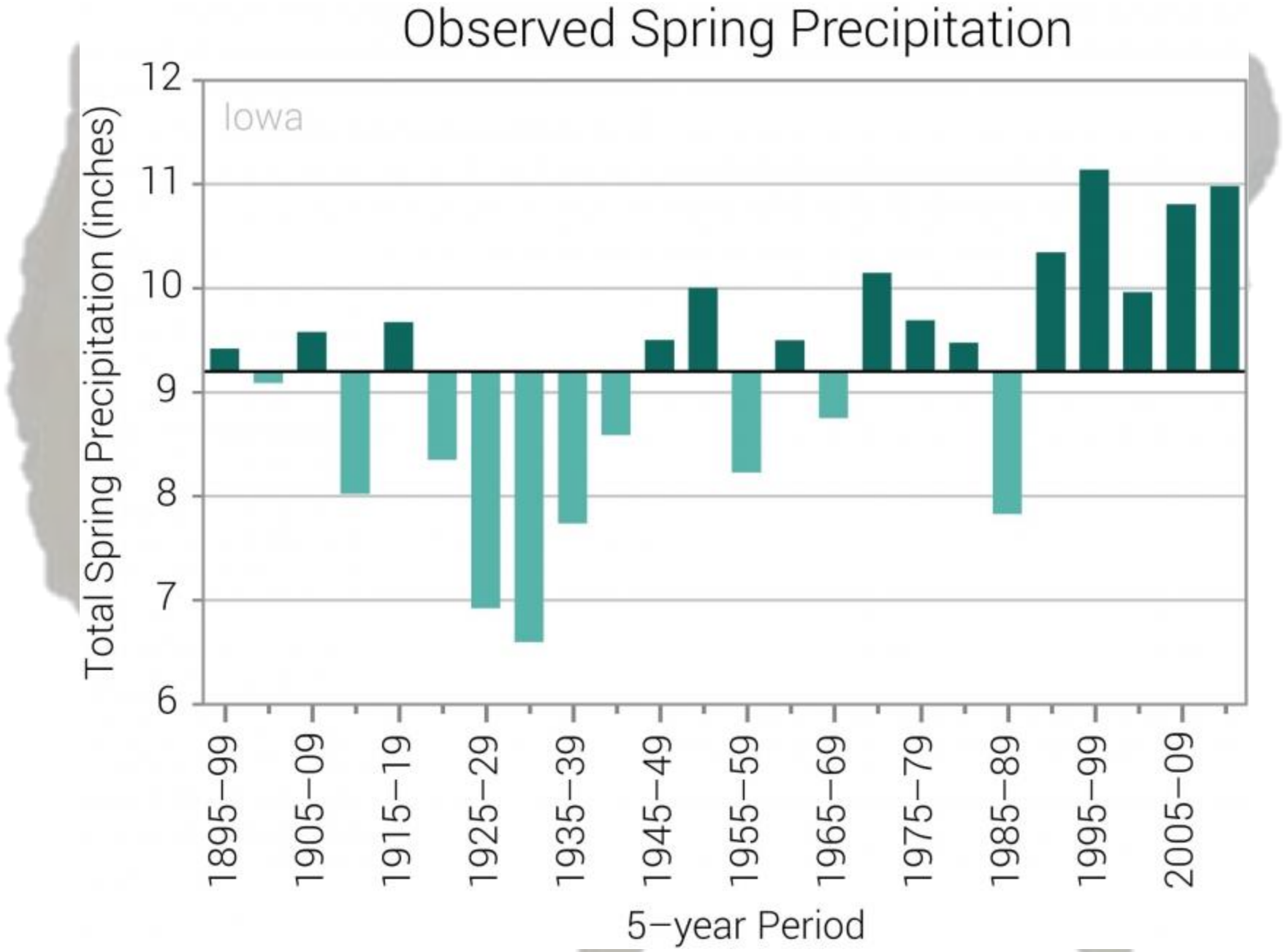


https://statesummaries.ncics.org/ia

CSCAP/U2U Survey Results

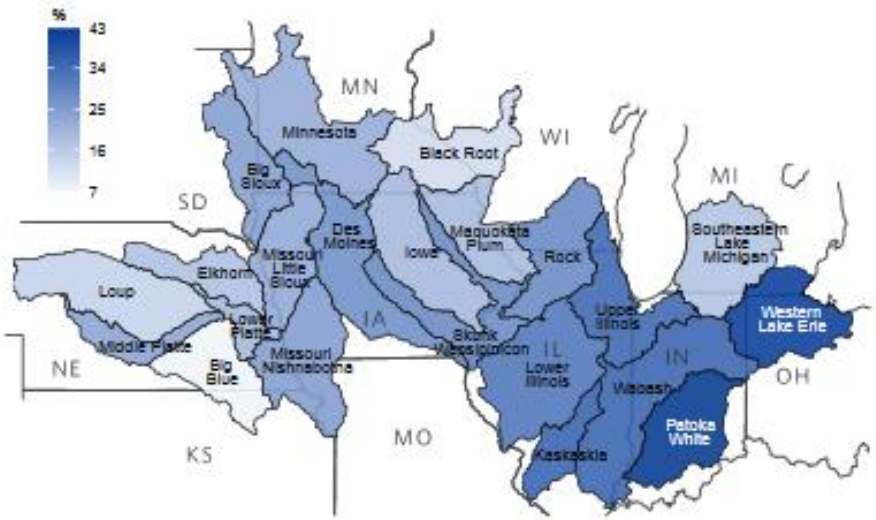


FIGURE 1 | Increased flooding, percent concerned or very concerned.

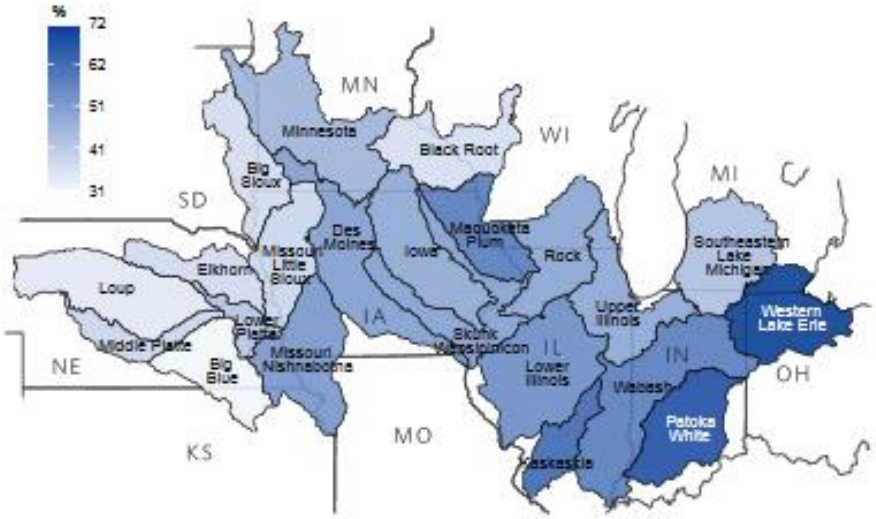
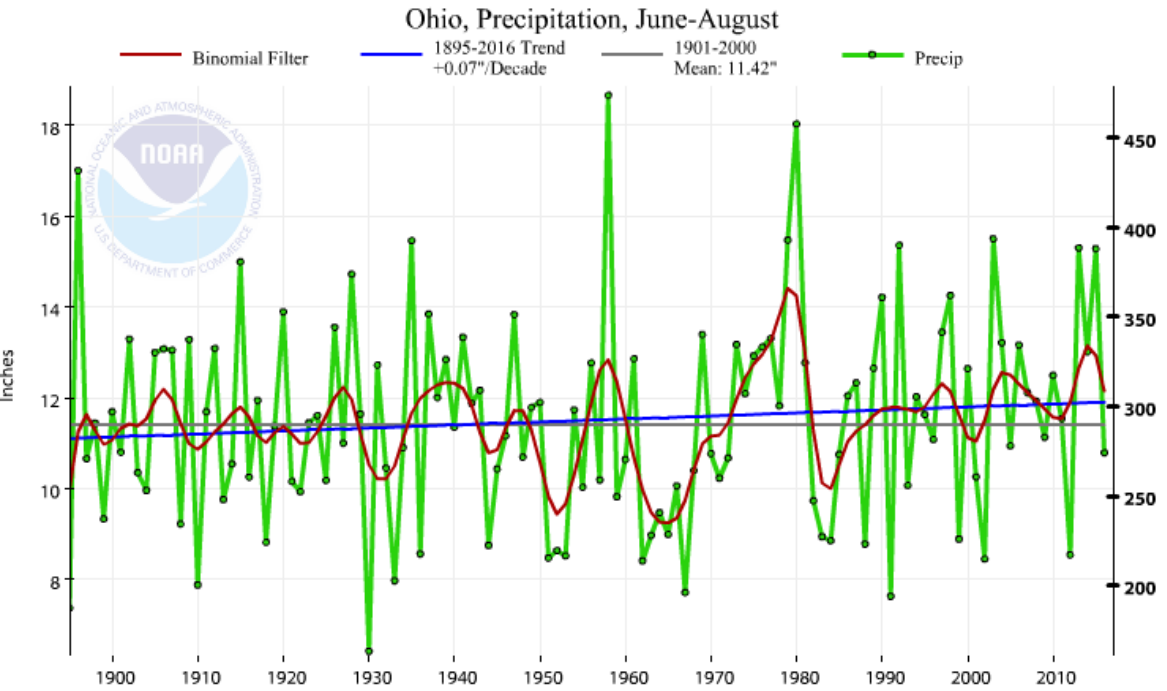


FIGURE 2 | More frequent extreme rains, percent concerned or very concerned.

https://sustainablecorn.org/What_Farmers_are_Saying/Farmer_Survey.html

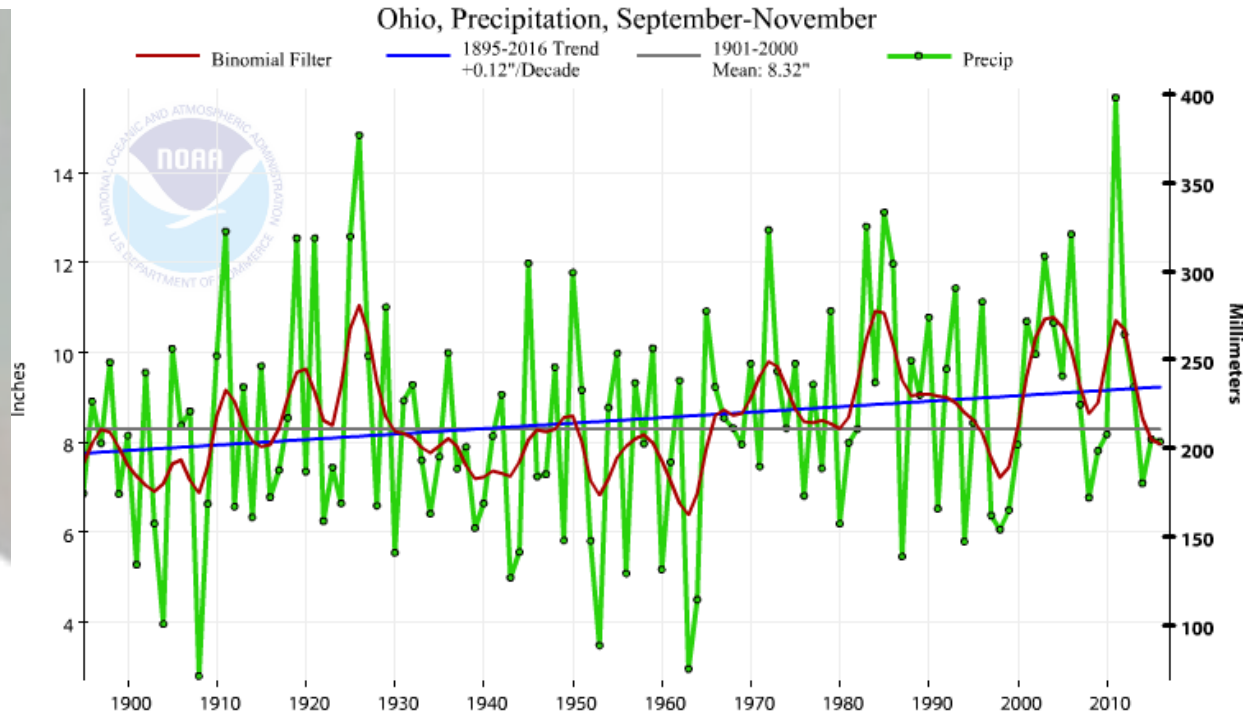
Time of Year

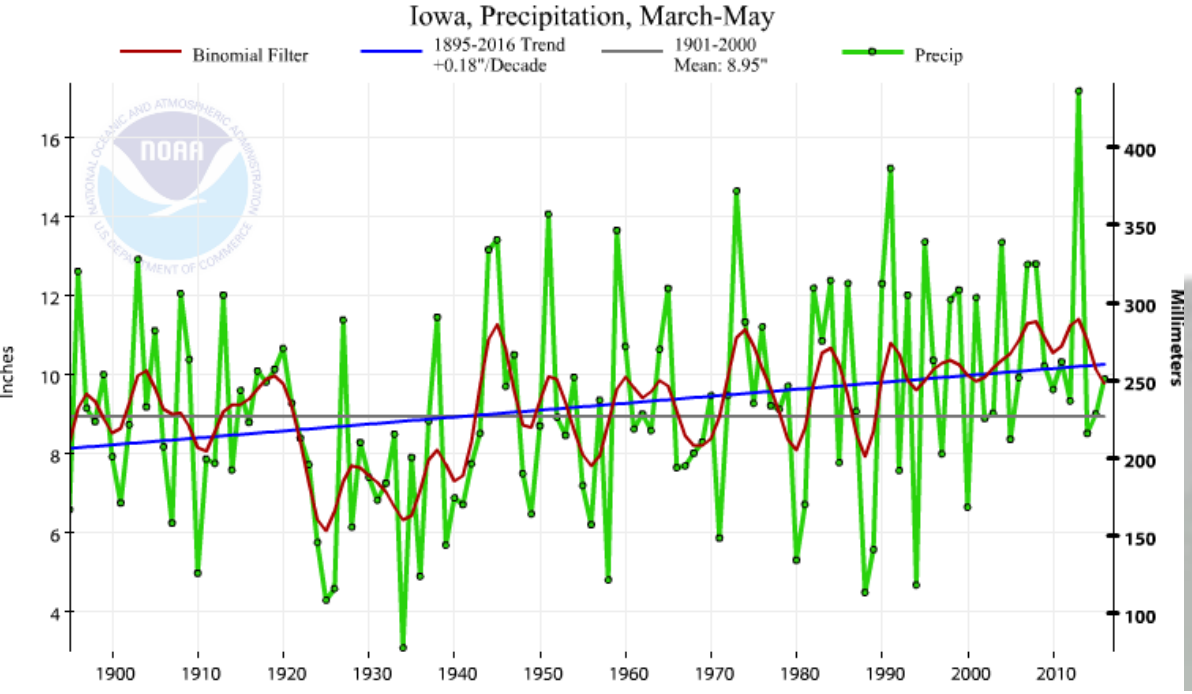
- Greatly variable across the corn belt
- Large impact on soils
- Along with precipitation intensity



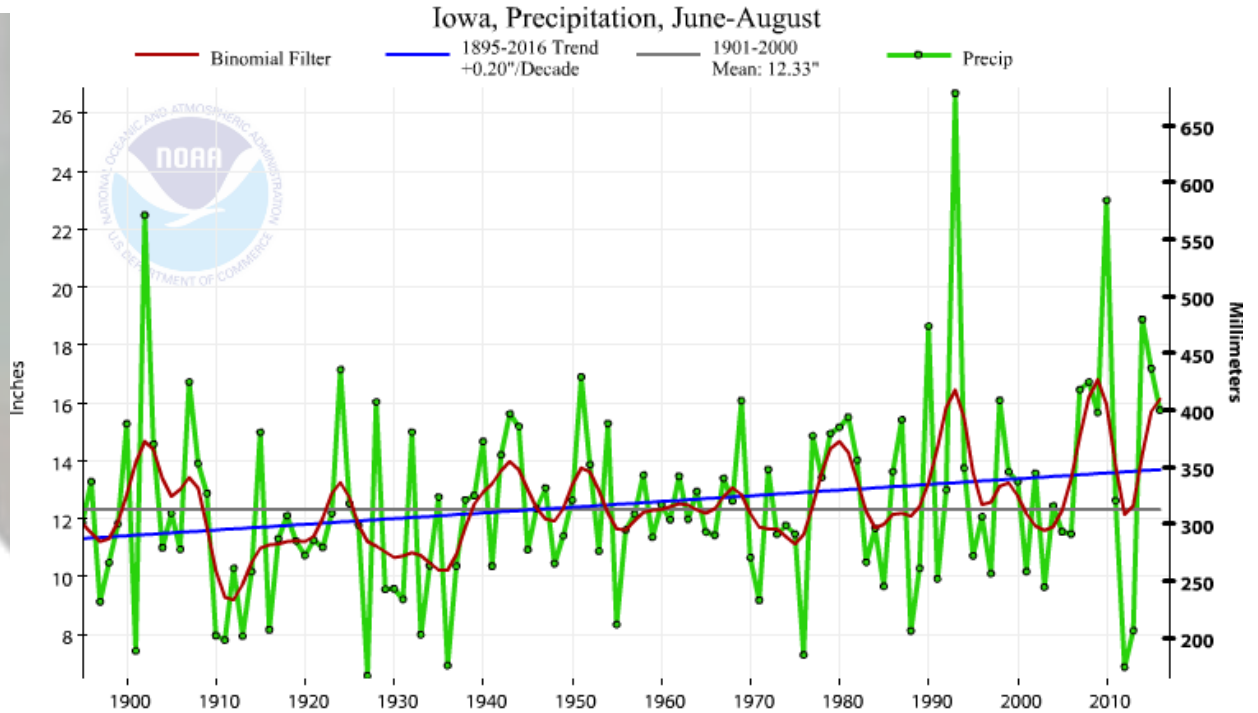
Summer and Fall biggest increases in Ohio

Other seasons less overall change





Summer and Summer biggest increases in IA



https://www.ncdc.noaa.gov/cag

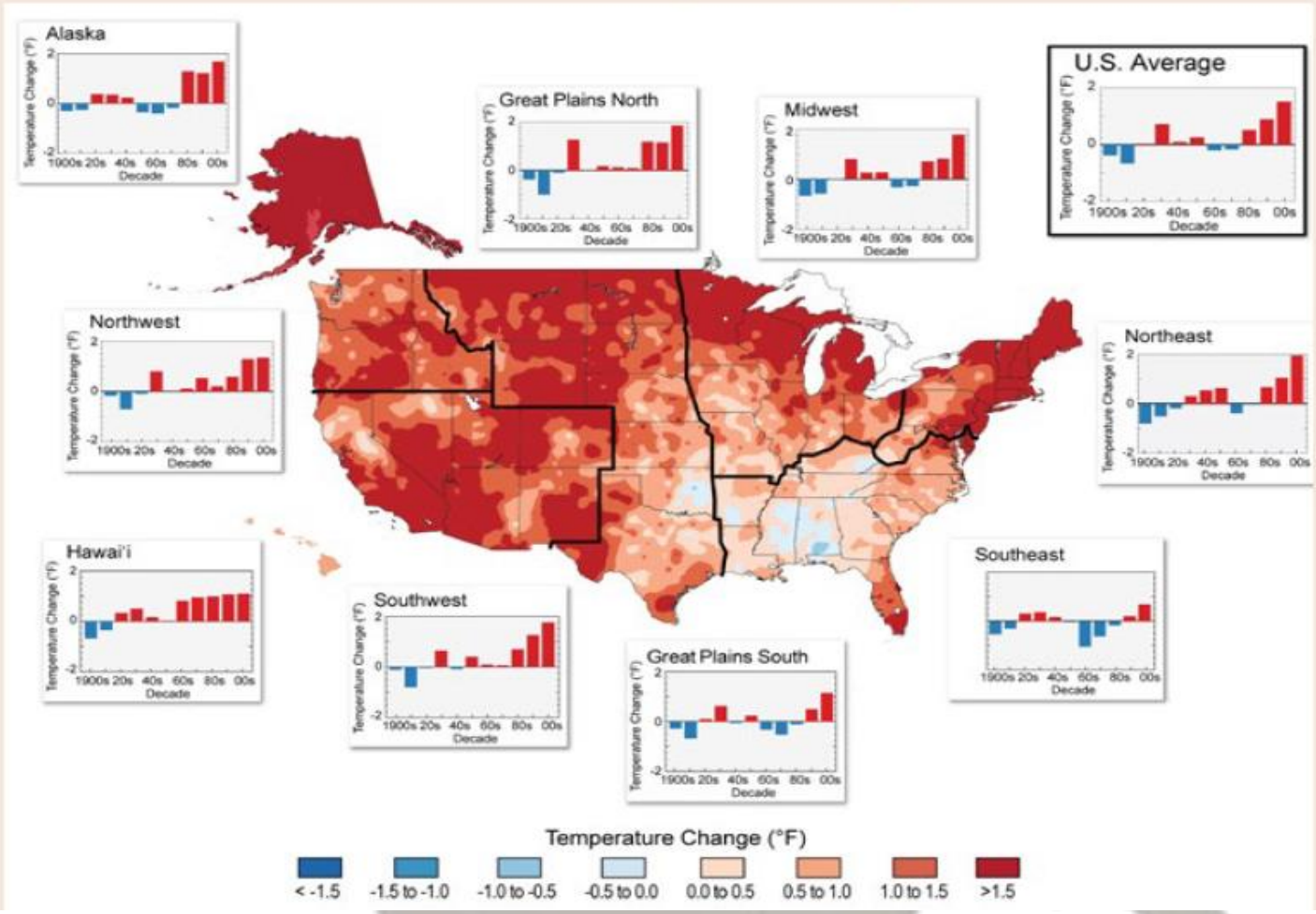
Issues from Precipitation

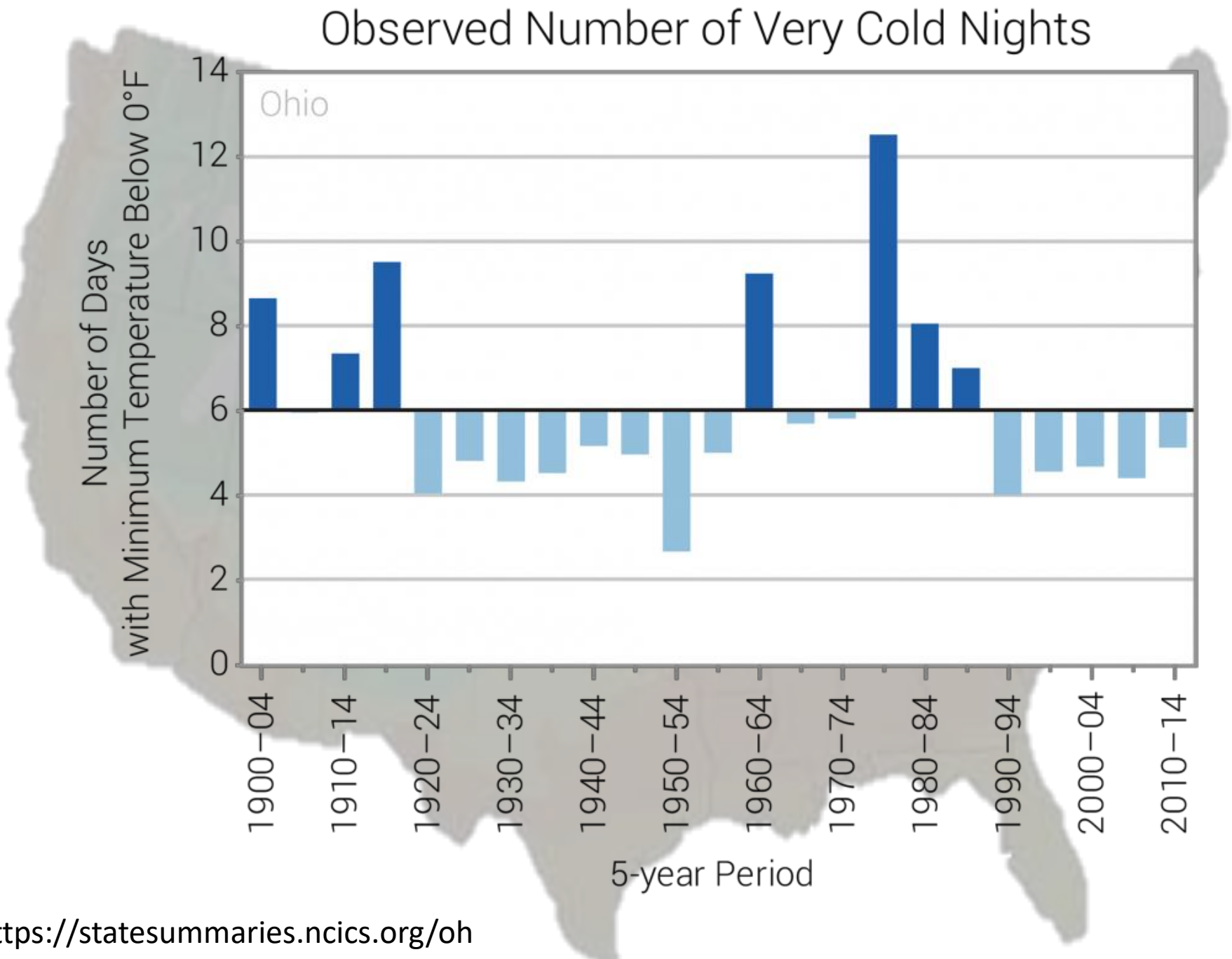
- Soil movement/loss
  - Reducing tillage
  - Cover crops
- Nutrient loss – Water quality issues
  - 4Rs
- Fall – additional precipitation limiting field work/harvest

Getting Warmer

- The whole corn belt is getting warmer. But occurring in different ways
- Highly seasonal

Observed U.S. Temperature Change





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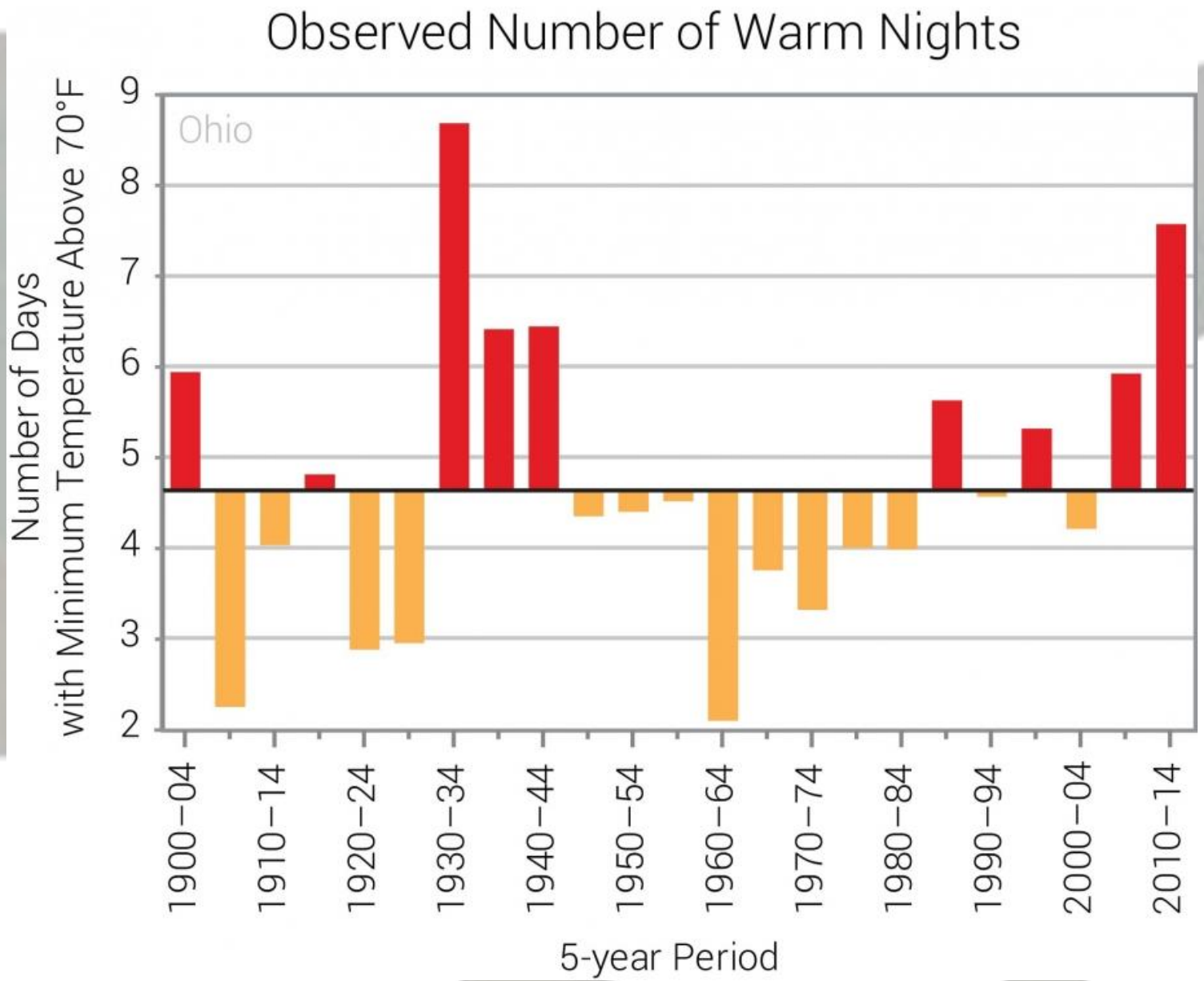
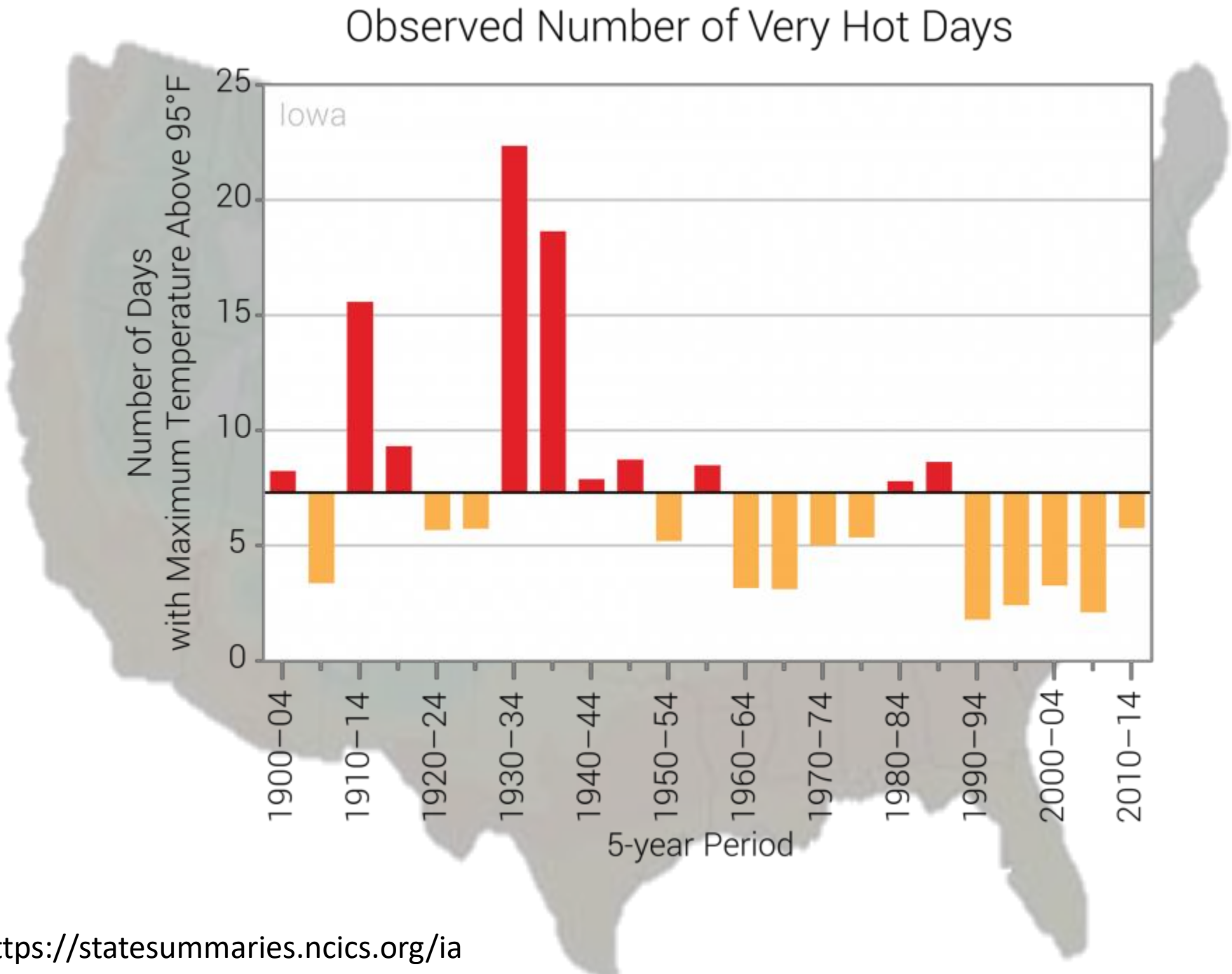


https://statesummaries.ncics.org/oh

Warm Nights

- Added livestock/human stress
- Additional cooling needed
- Push GDD accumulation/phenological state more quickly (yield loss)

- Does help increase frost free season period



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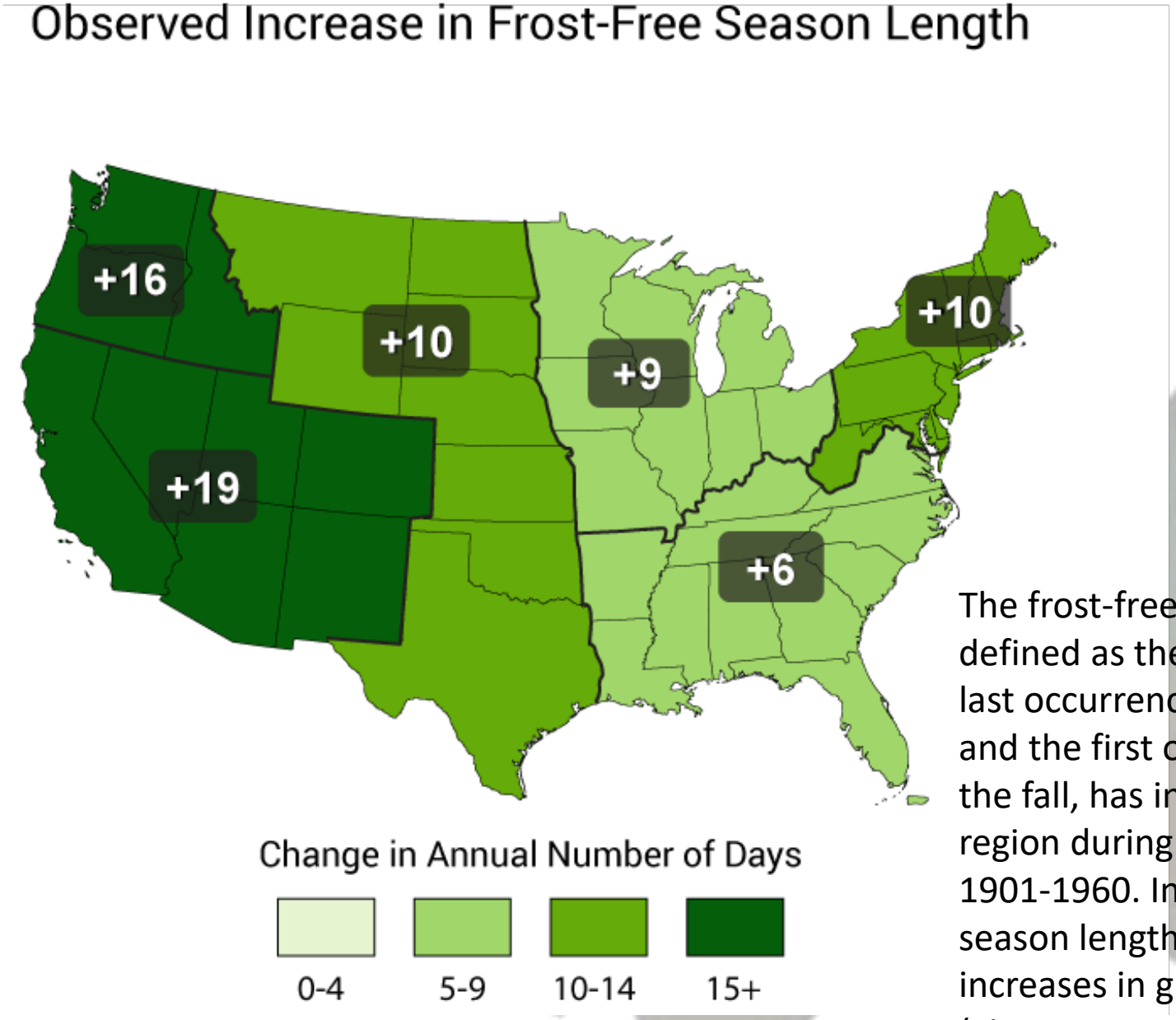


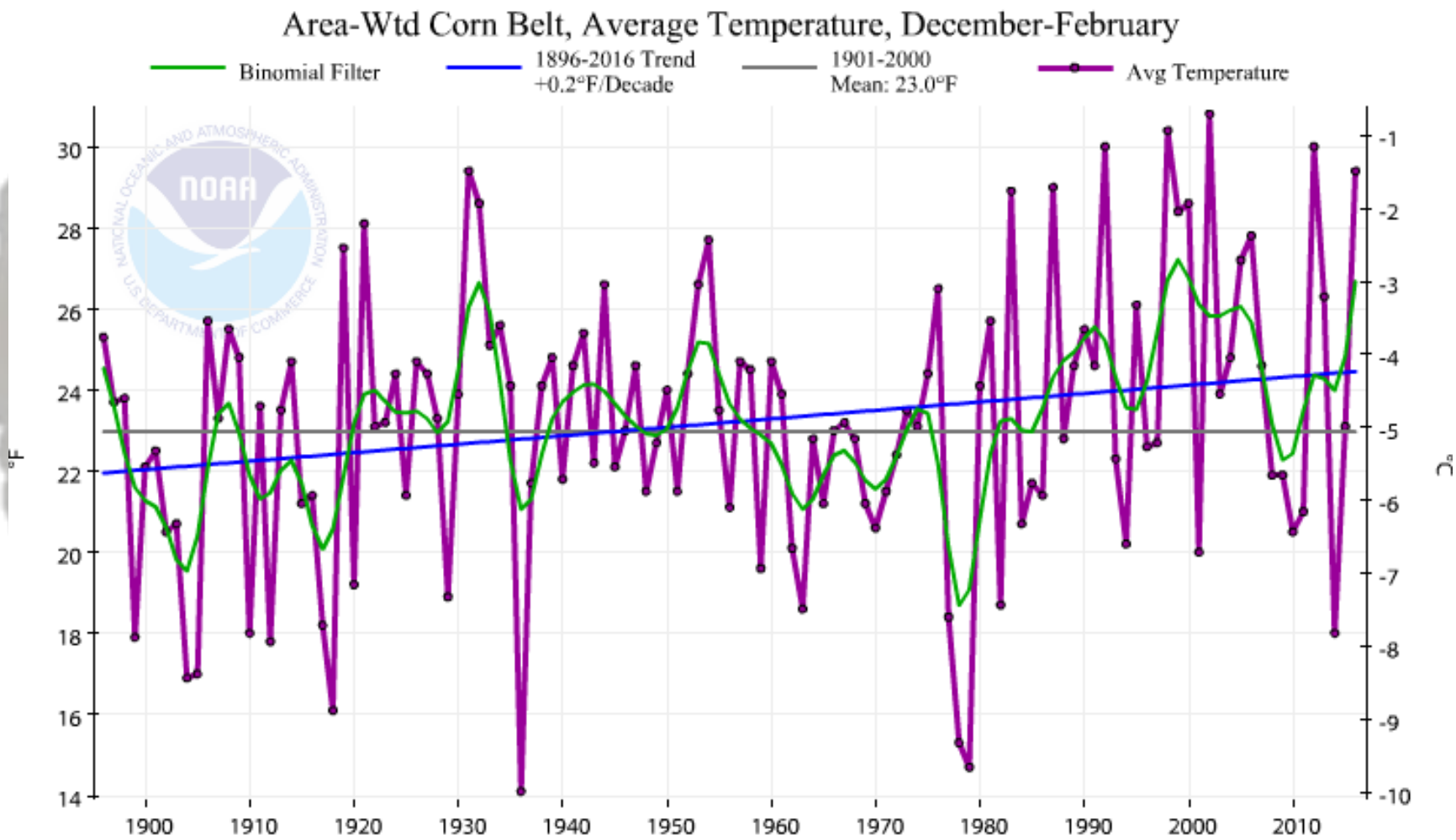
The frost-free season length, defined as the period between the last occurrence of 32°F in the spring and the first occurrence of 32°F in the fall, has increased in each U.S. region during 1991-2012 relative to 1901-1960. Increases in frost-free season length correspond to similar increases in growing season length. (Figure source: NOAA NCDC / CICS-NC).

http://nca2014.globalchange.gov/

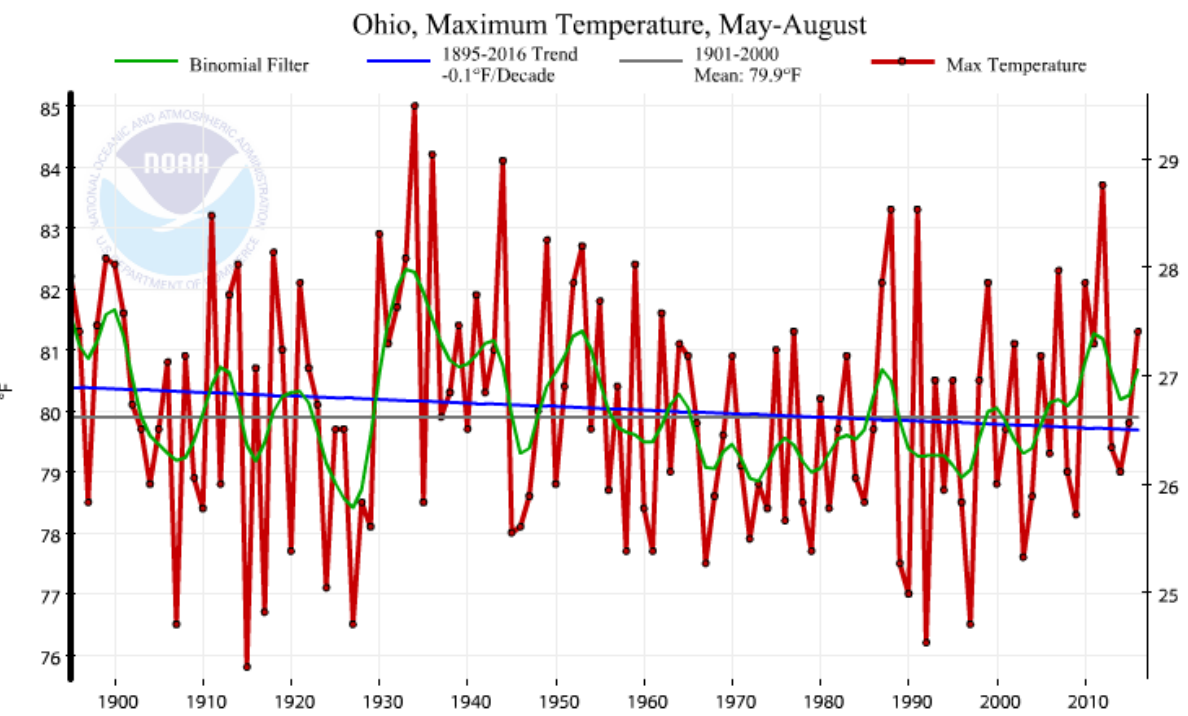
Frost-Free Season Change

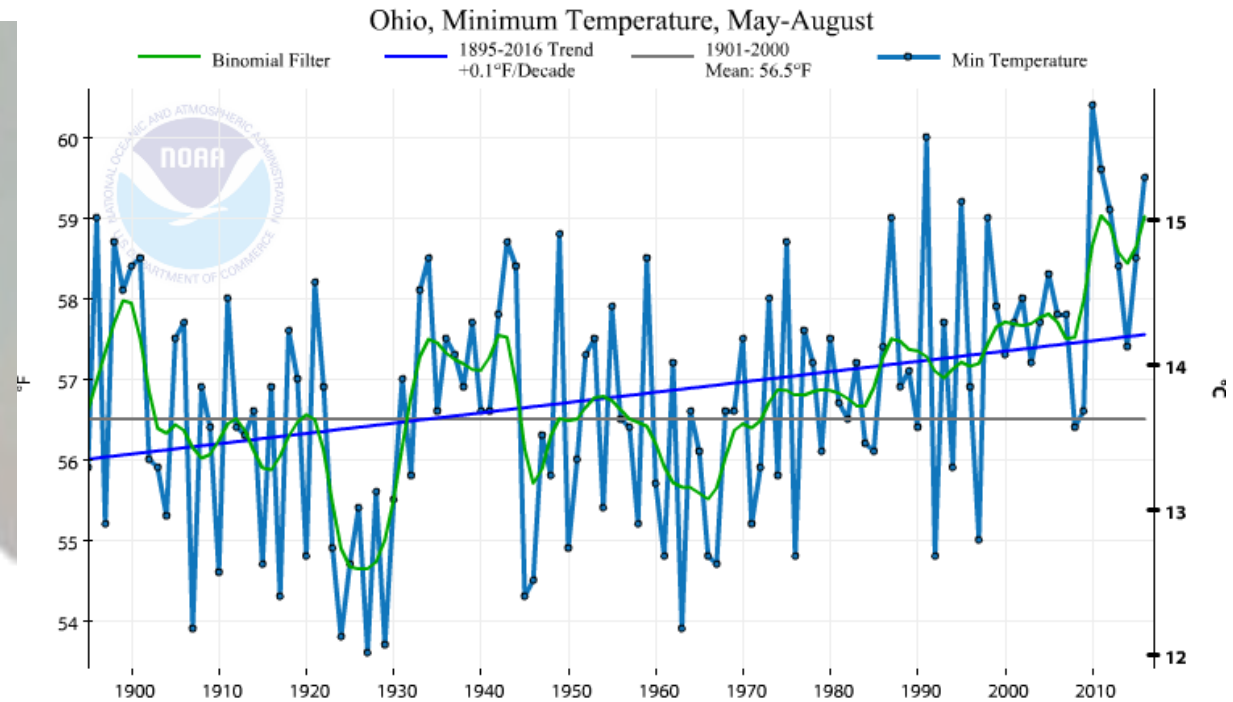
- Longer hybrid
- Earlier spring (confounded)
- Earlier planting not always possible/soil conditions

Corn Belt Winter Avg. Temp.



- Warmer
- Highly variable





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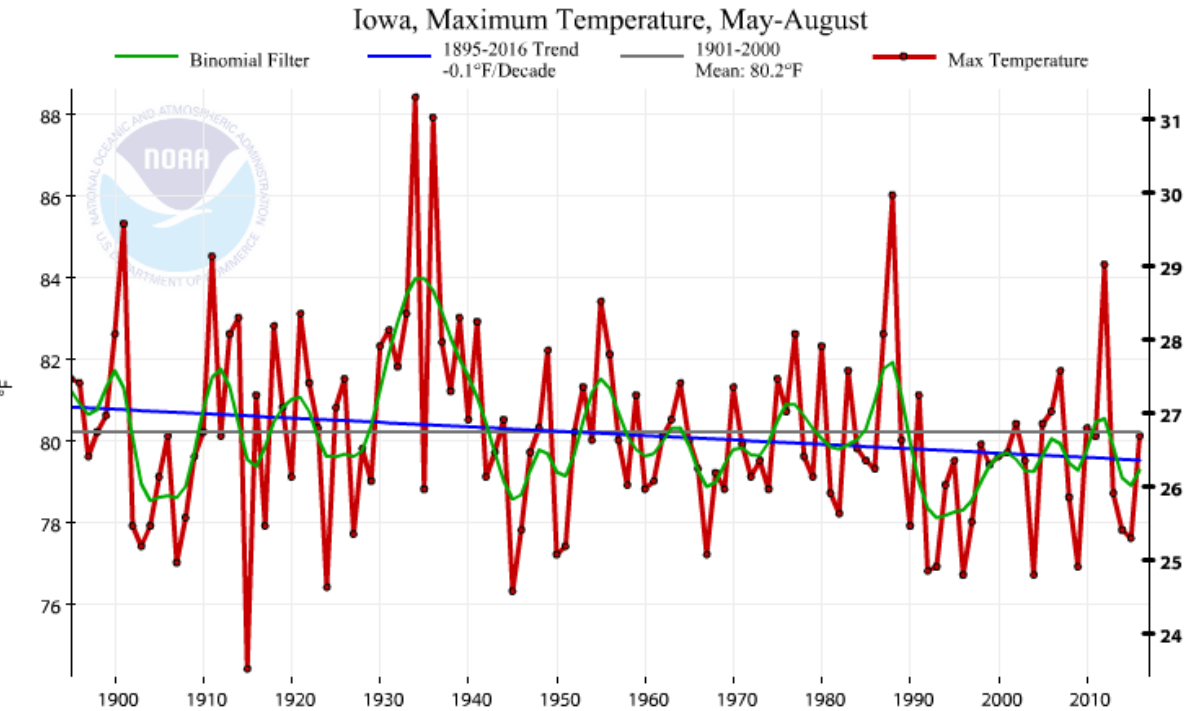
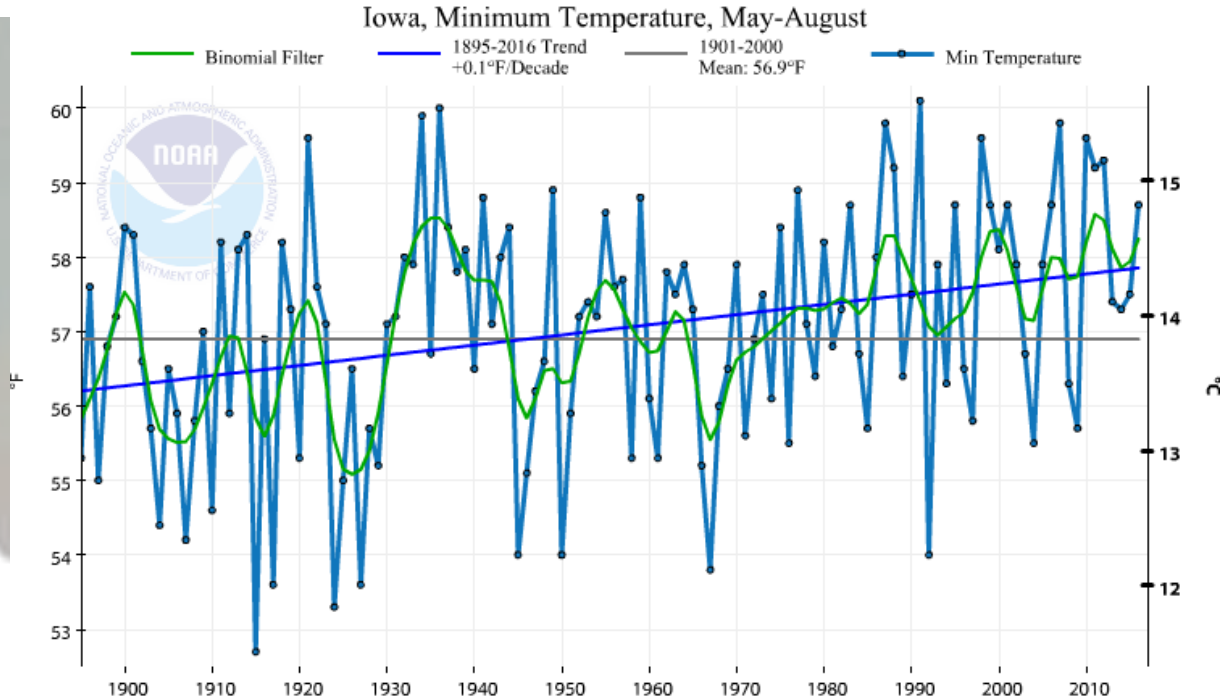
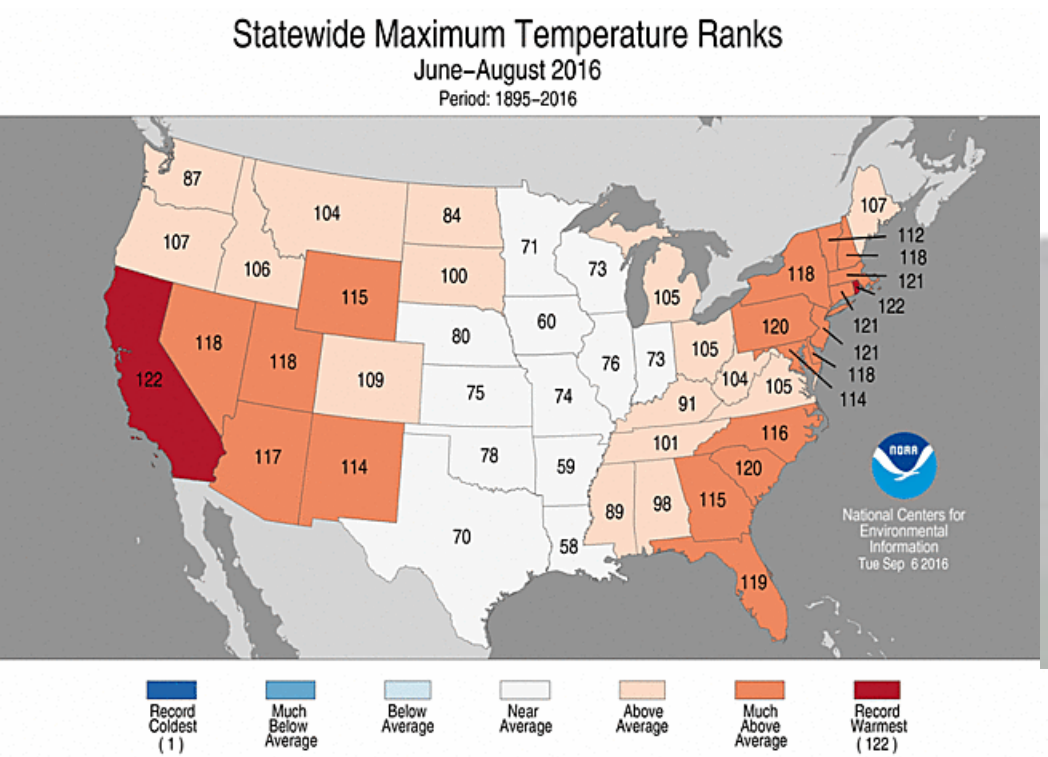
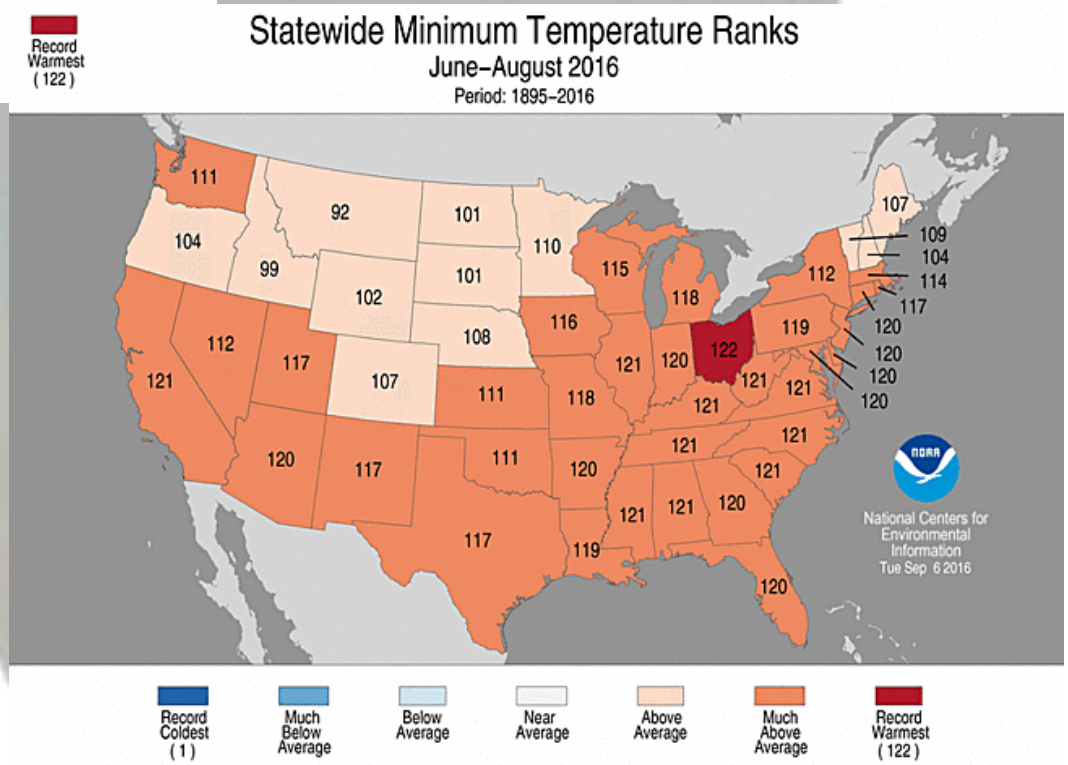




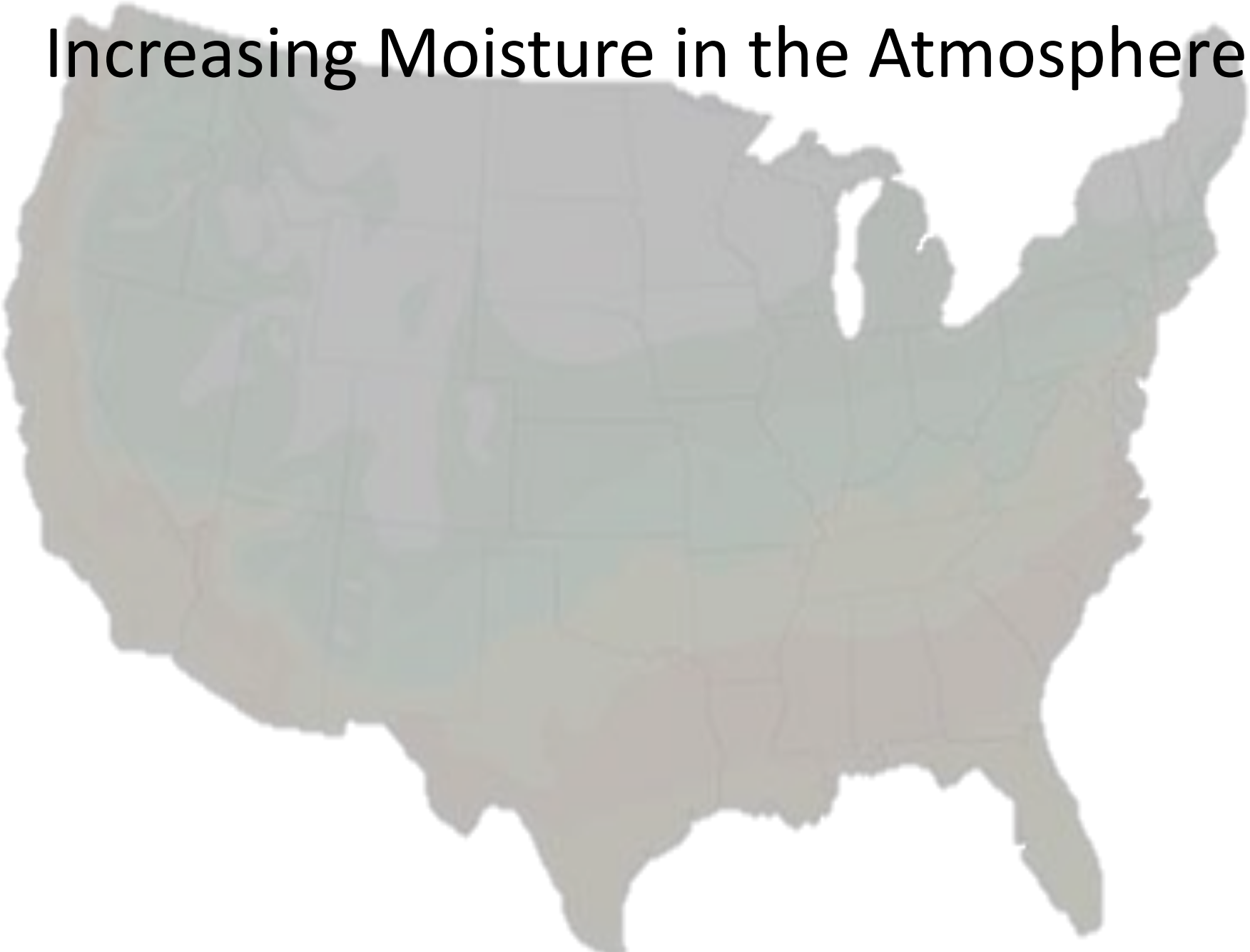
https://www.ncdc.noaa.gov/cag

June – August Temperature Ranks 2016





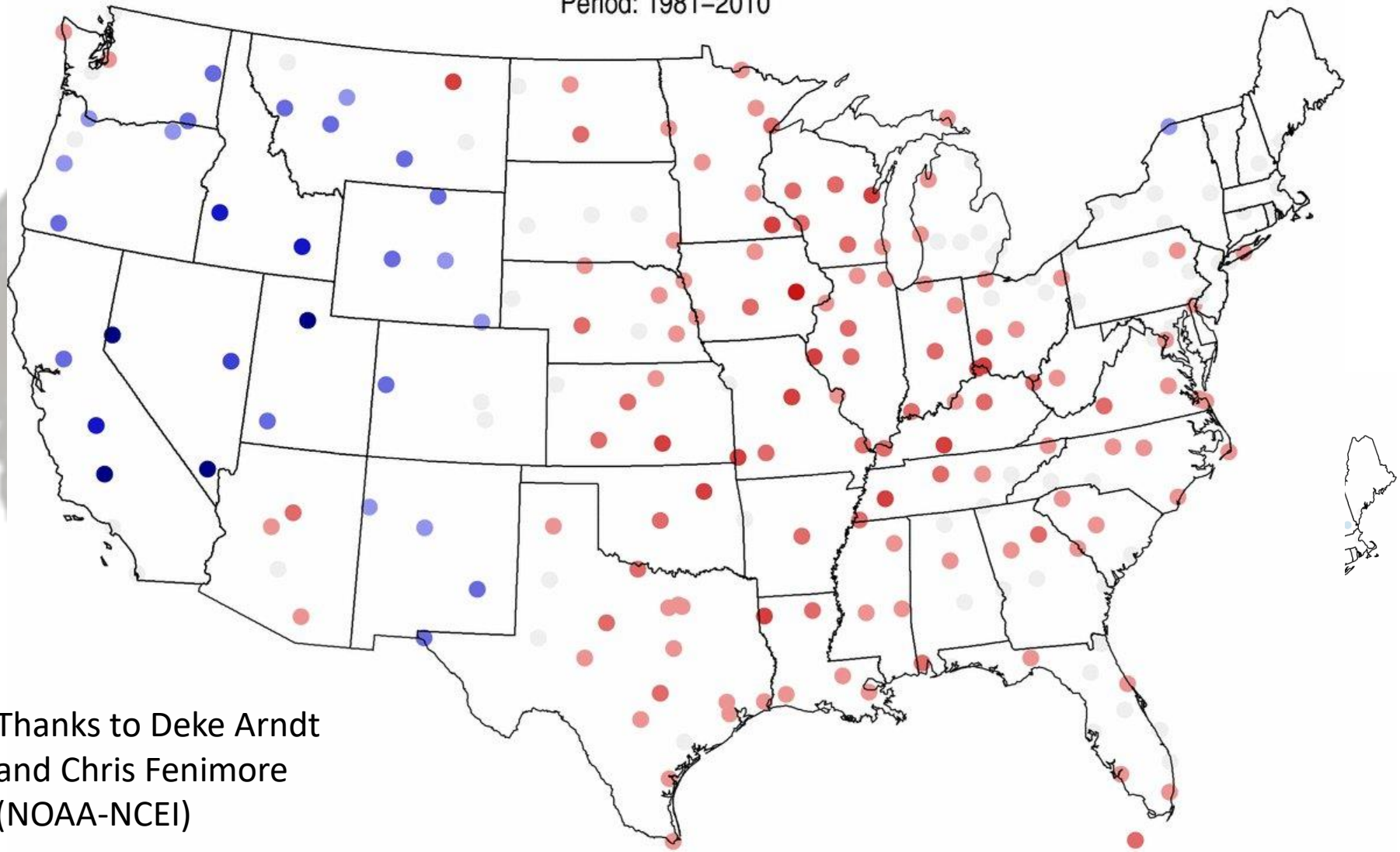
Increasing Moisture in the Atmosphere



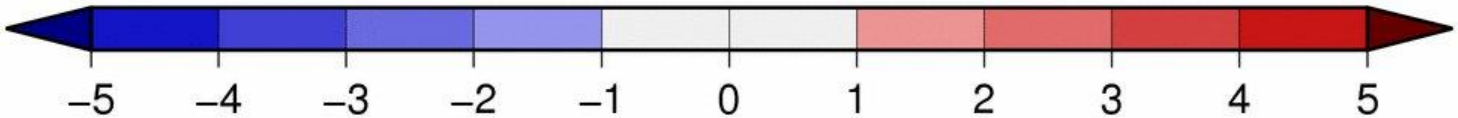
Average Dew Point Temperature Departures from Average

June–August 2016

Period: 1981–2010



Thanks to Deke Arndt and Chris Fenimore (NOAA-NCEI)



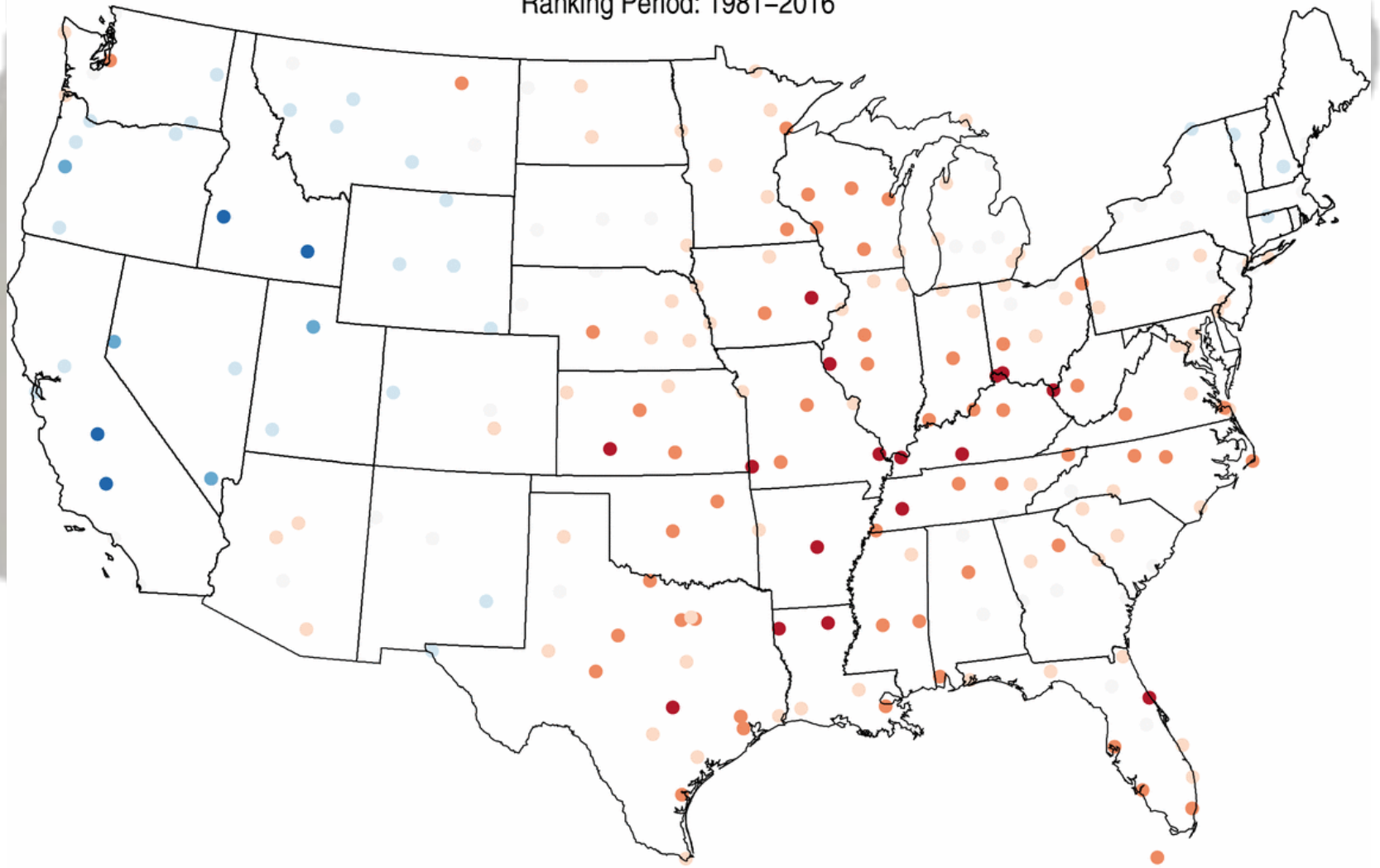
Data Source: Integrated Surface Daily (ISD)

National Centers for Environmental Information

Average Dew Point Temperature Percentiles

June–August 2016

Ranking Period: 1981–2016



Record Low* | Much Below Normal | Below Normal | Near Normal | Above Normal | Much Above Normal | Record High*

*Includes Ties

Data Source: Integrated Surface Daily (ISD)

National Centers for Environmental Information

Increasing Moisture in the Atmosphere

- Complicated issues
  - Warmer nights/not as warm days
  - Still high heat index and stressful conditions-little evening relief
  - Changing disease potential
  - Adds to livestock stresses

But can CO_2 affect herbicide efficacy?

Ambient CO2 | Future CO2

As carbon dioxide increases, glyphosate efficacy is reduced

Ziska et al. 1999. Weed Science. 47:608-615, inter alia

Summary: Weed Management Implications

Rising CO2 may reduce herbicide efficacy ; the basis of the reduction is likely species specific.

Little known regarding the impact of climate and/or CO2 on other means of weed or pest control.

CO2/climate is likely to alter basic aspects of pest biology, including gene transfer, fitness and distribution.

CSCAP/U2U Survey

Weeds

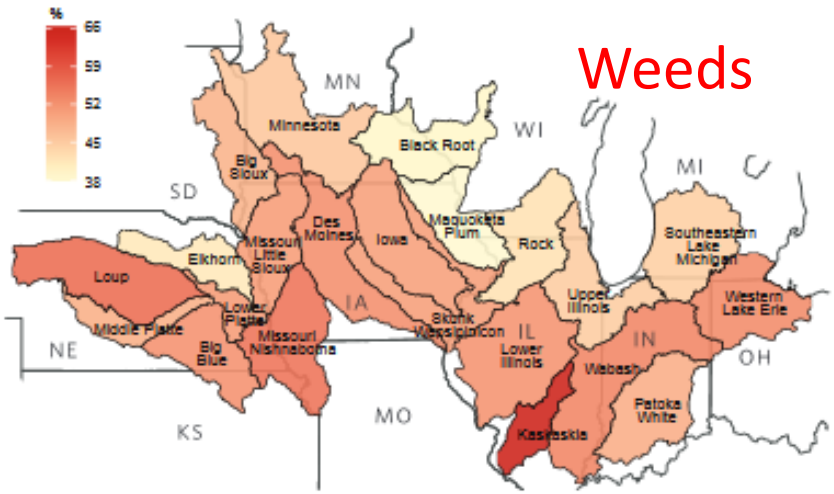


FIGURE 1 | Increased weed pressure, percent concerned or very concerned.

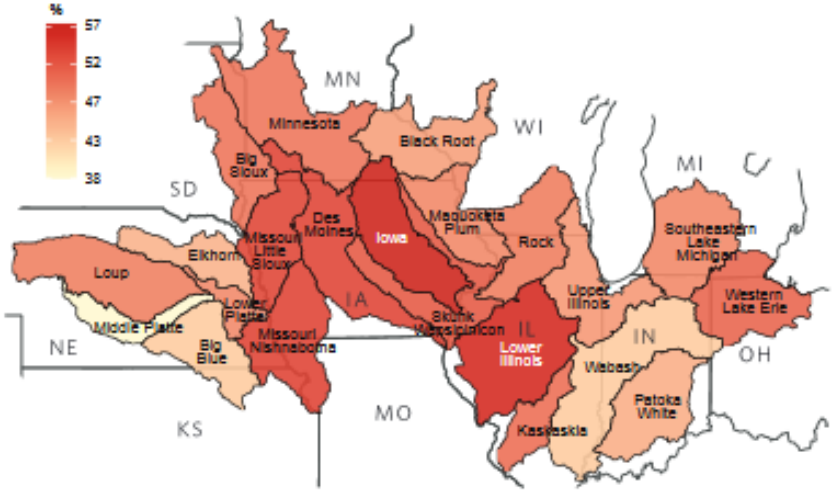


FIGURE 2 | Increased insect pressure, percent concerned or very concerned.

Insects

very concerned.

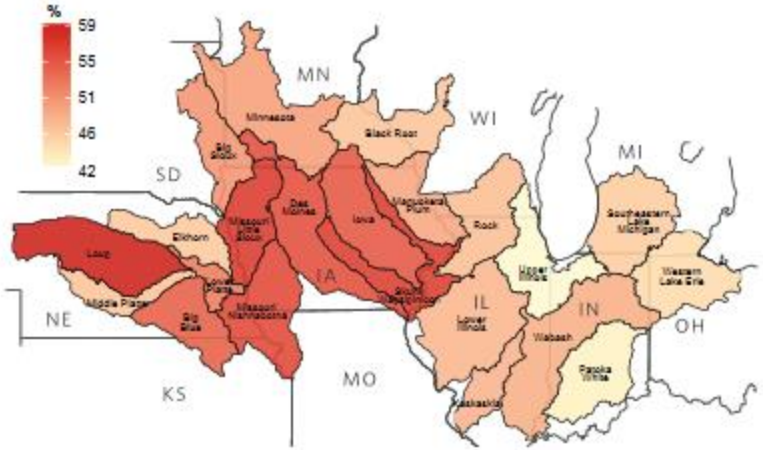
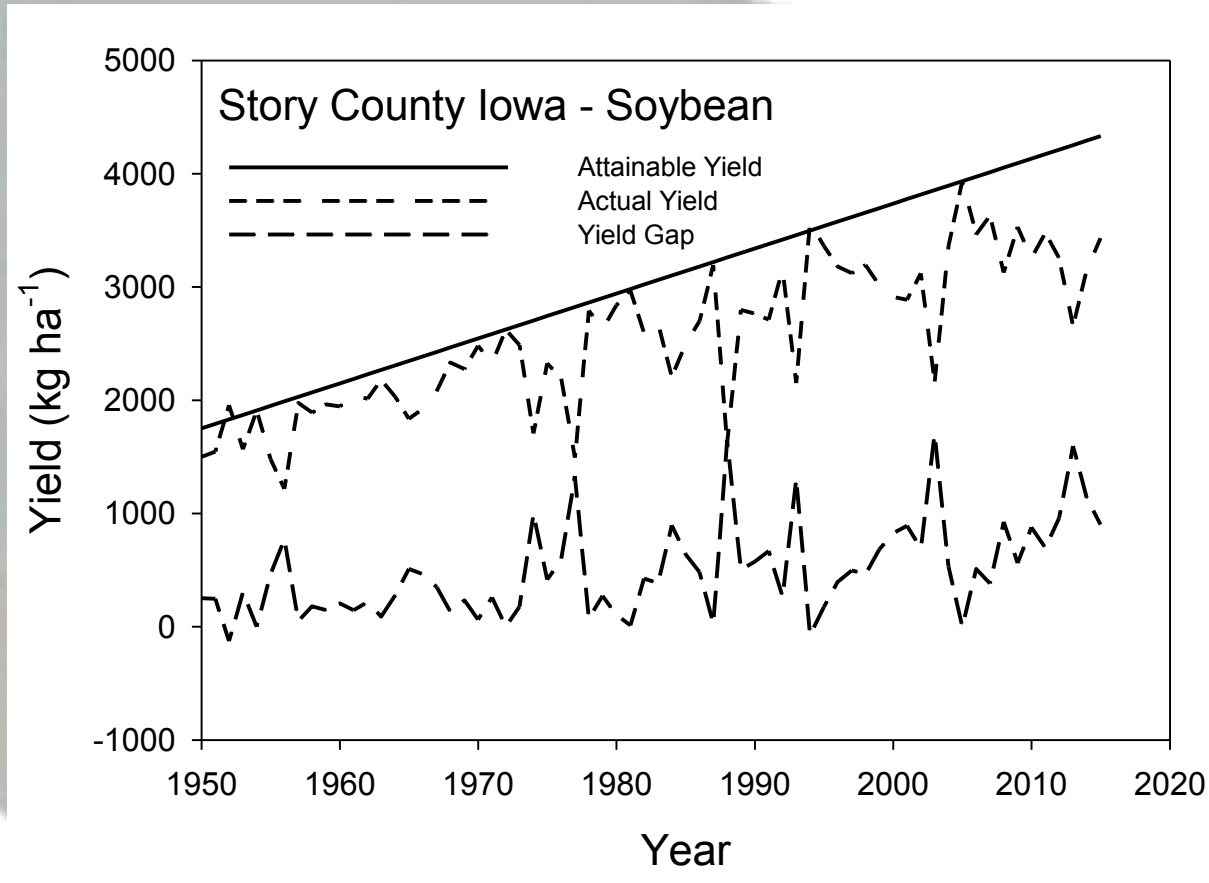
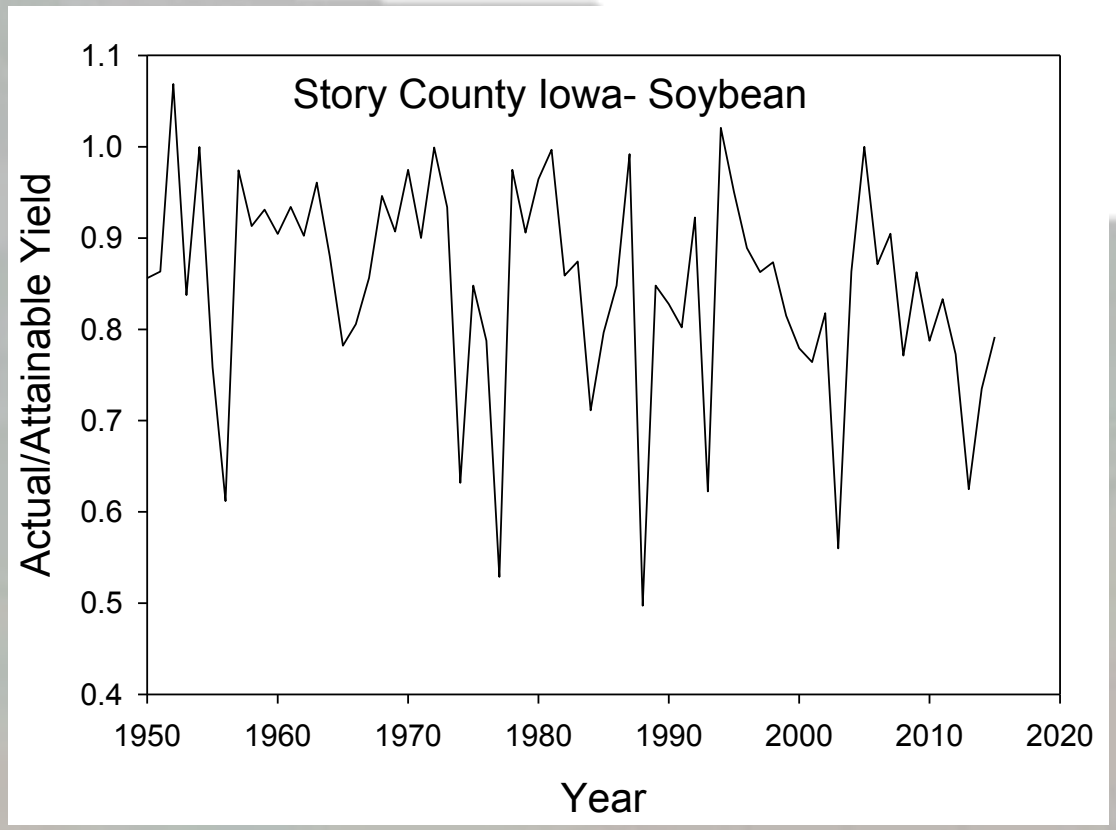


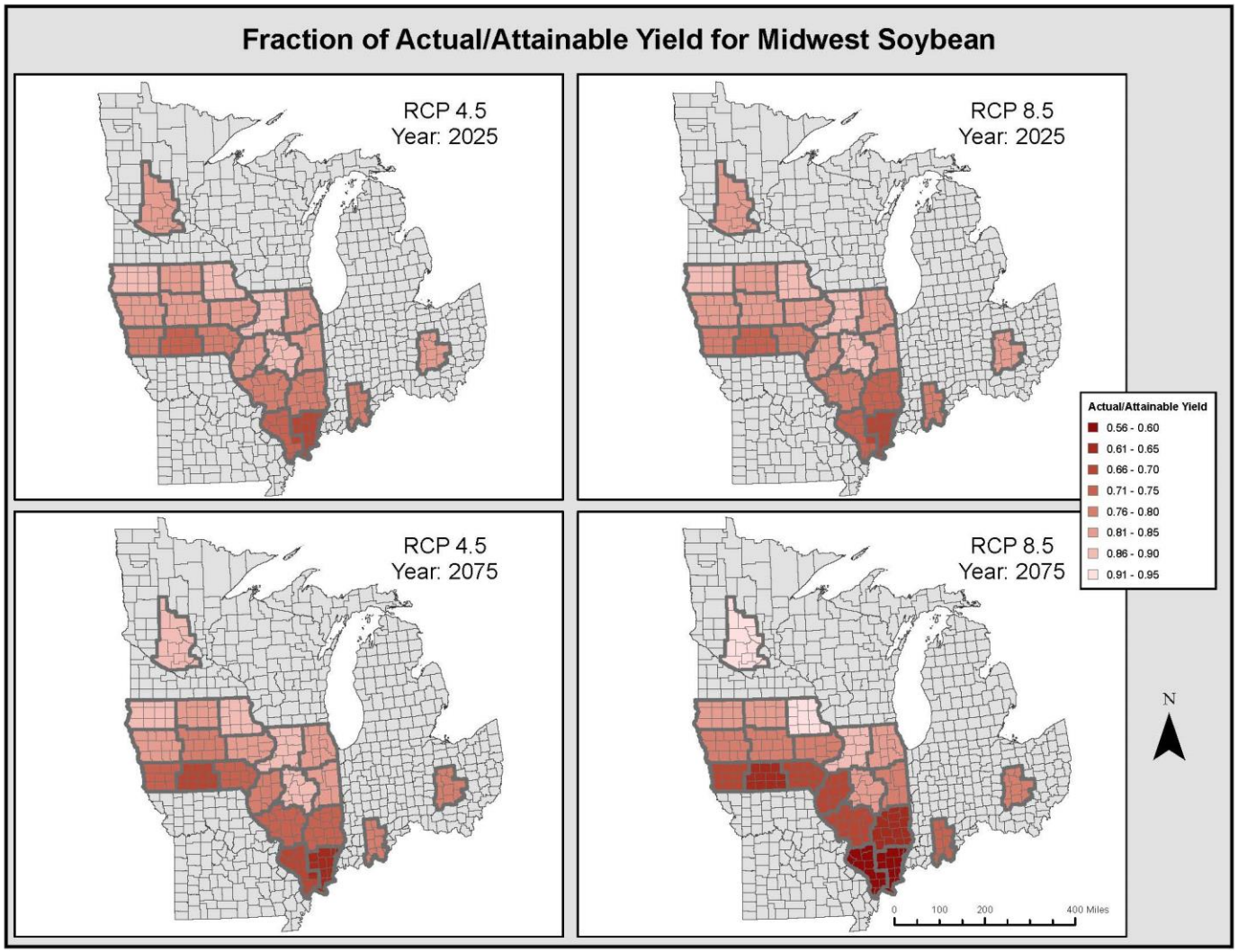
FIGURE 3 | Higher incidence of crop disease, percent concerned or very concerned.

Diseases

2


Story County Iowa - Soybean
Attainable Yield
Actual Yield
Yield Gap
Yield (kg ha-1)
5000
4000
3000
2000
1000
0
-1000
1950
1960
1970
1980
1990
2000
2010
2020
Year


Story County Iowa- Soybean
Actual/Attainable Yield
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
1950
1960
1970
1980
1990
2000
2010
2020
Year


Fraction of Actual/Attainable Yield for Midwest Soybean
RCP 4.5
Year: 2025
RCP 8.5
Year: 2025
RCP 4.5
Year: 2075
RCP 8.5
Year: 2075
Actual/Attainable Yield
0.56 - 0.60
0.61 - 0.65
0.66 - 0.70
0.71 - 0.75
0.76 - 0.80
0.81 - 0.85
0.86 - 0.90
0.91 - 0.95
N
0
100
200
400 Miles

Climate Resilience/Adaptation/Mitigation

**It will all start with protecting and enhancing the soil

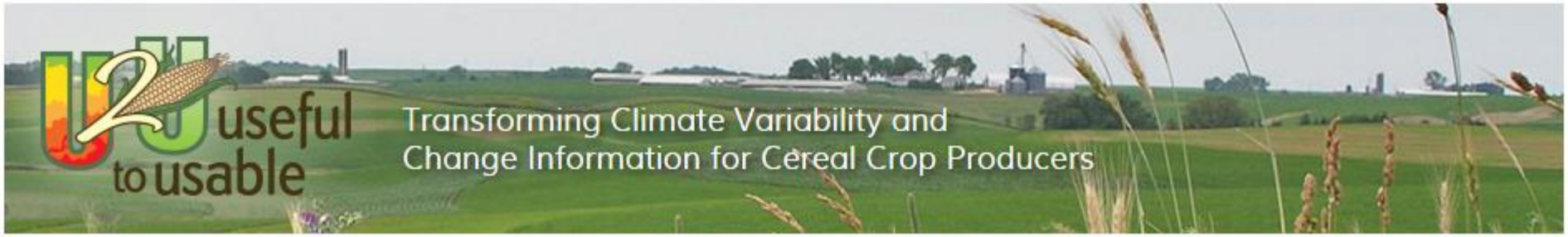
30 July 2012 (*Drought Year*)

Re

TOOLS


LEARN MORE
useful
to usable
**Helping producers make better long-term plans

Decision Dashboard



DECISION DASHBOARD | MEDIA CENTER | NEWSLETTER | ABOUT US

Decision Dashboard

U2U$_{DST}$ Suite | Other Decision Resources | Agro-Climate Reports | Weather/Climate Maps | Drought Info | Climate Outlooks | Helpful Links

U2U$_{DST}$ SUITE

AgClimate View$_{DST}$

A convenient way to access customized historical climate and crop yield data for the U.S. Corn Belt. View graphs of monthly temperature and precipitation,

Corn GDD$_{DST}$

Track real-time and historical GDD accumulations, assess spring and fall frost risk, and guide decisions related to planting, harvest, and seed selection.

www.AgClimate4U.org

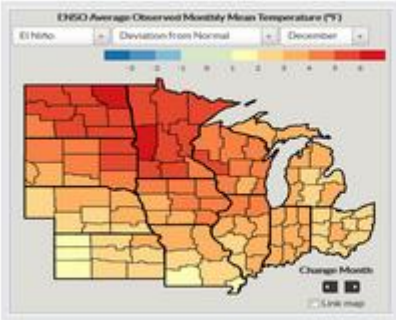
Decision Support Tools

U2U useful to usable

U2U$_{DST}$ SUITE

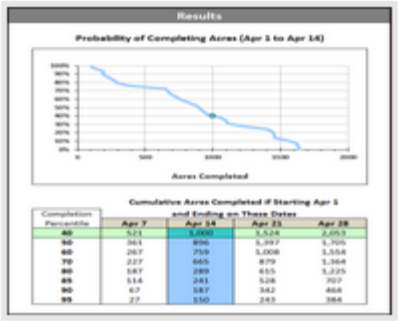
AgClimate View$_{DST}$

A convenient way to access customized historical climate and crop yield data for the U.S. Corn Belt. View graphs of monthly temperature and precipitation, plot corn and soybean yield trends, and compare climate and yields over the past 30 years.



Climate Patterns Viewer$_{DST}$

Discover how global climate patterns like the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) have historically affected local climate conditions and crop yields across the U.S. Corn Belt.



Probable Fieldwork Days$_{DST}$

This spreadsheet-based tool uses USDA data on Days Suitable for Fieldwork to determine the probability of completing in-field activities during a user-specified time period. This product is currently available for Illinois, Iowa, Kansas, and Missouri. (Hosted by the University of Missouri)

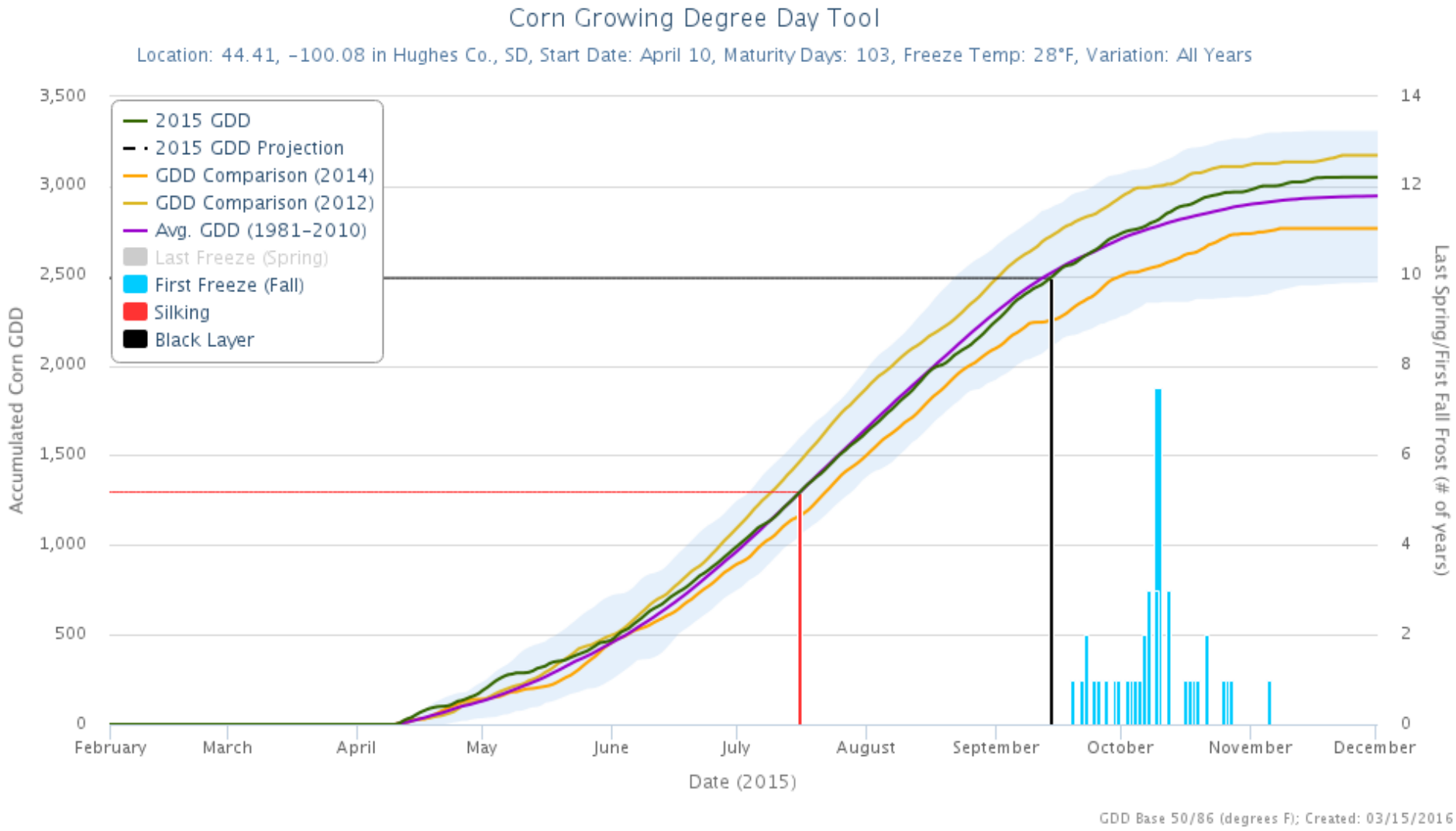
Corn GDD$_{DST}$

Track real-time and historical GDD accumulations, assess spring and fall frost risk, and guide decisions related to planting, harvest, and seed selection. This innovative tool integrates corn development stages with weather and climate data for location-specific decision support tailored specifically to agricultural production.

Corn Split N$_{DST}$ (NEW!)

Determine the feasibility and profitability of using post-planting nitrogen application for corn production. This product combines historical data on crop growth and fieldwork conditions with economic considerations to determine best/worst /average scenarios of successfully completing nitrogen applications within a user-specified time period.

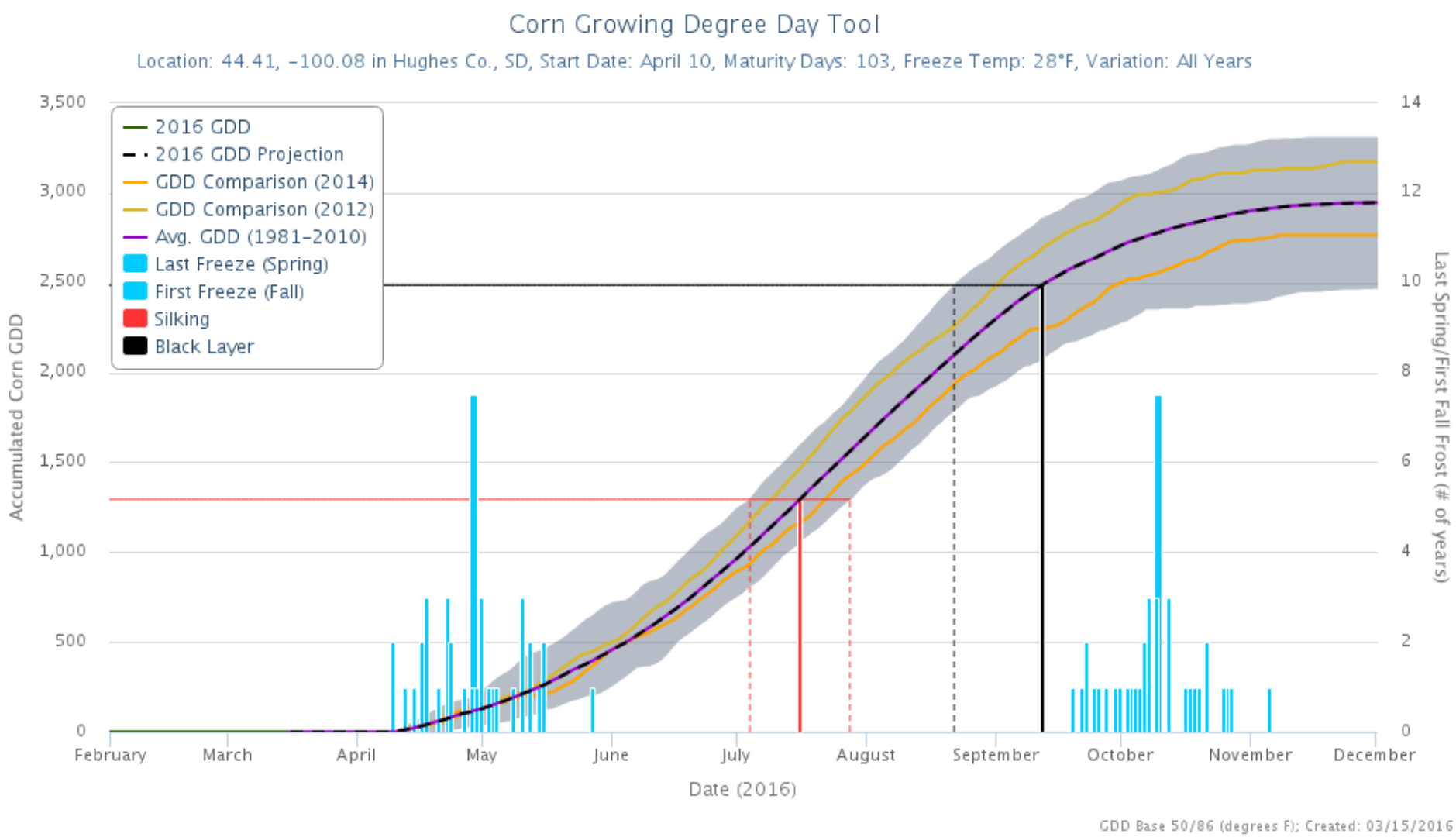
www.AgClimate4U.org


Corn Growing Degree Day Tool
Location: 44.41, -100.08 in Hughes Co., SD, Start Date: April 10, Maturity Days: 103, Freeze Temp: 28°F, Variation: All Years
2015 GDD
2015 GDD Projection
GDD Comparison (2014)
GDD Comparison (2012)
Avg. GDD (1981-2010)
Last Freeze (Spring)
First Freeze (Fall)
Silking
Black Layer
Accumulated Corn GDD
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Last Spring/First Fall Frost (# of years)
14
12
10
8
6
4
2
0
February
March
April
May
June
July
August
September
October
November
December
Date (2015)
GDD Base 50/86 (degrees F); Created: 03/15/2016

Corn Growing Degree Days

This tool puts current conditions into a 30-year historical perspective and offers trend projections through the end of the calendar year. Growing Degree Day (GDD) projections, combined with analysis of historical analog data, can help you make decisions about:

- Climate Risks – Identify the likelihood of reaching maturity before frosts/freezes.
- Activity Planning – Consider corn hybrid estimated physiological maturity requirements, along with GDD projections when making seed purchasing and other growing season decisions.
- Marketing – Look at historical and projected GDD when considering forward pricing and crop insurance purchases.


Corn Growing Degree Day Tool
Location: 44.41, -100.08 in Hughes Co., SD, Start Date: April 10, Maturity Days: 103, Freeze Temp: 28°F, Variation: All Years
2016 GDD
2016 GDD Projection
GDD Comparison (2014)
GDD Comparison (2012)
Avg. GDD (1981-2010)
Last Freeze (Spring)
First Freeze (Fall)
Silking
Black Layer
Accumulated Corn GDD
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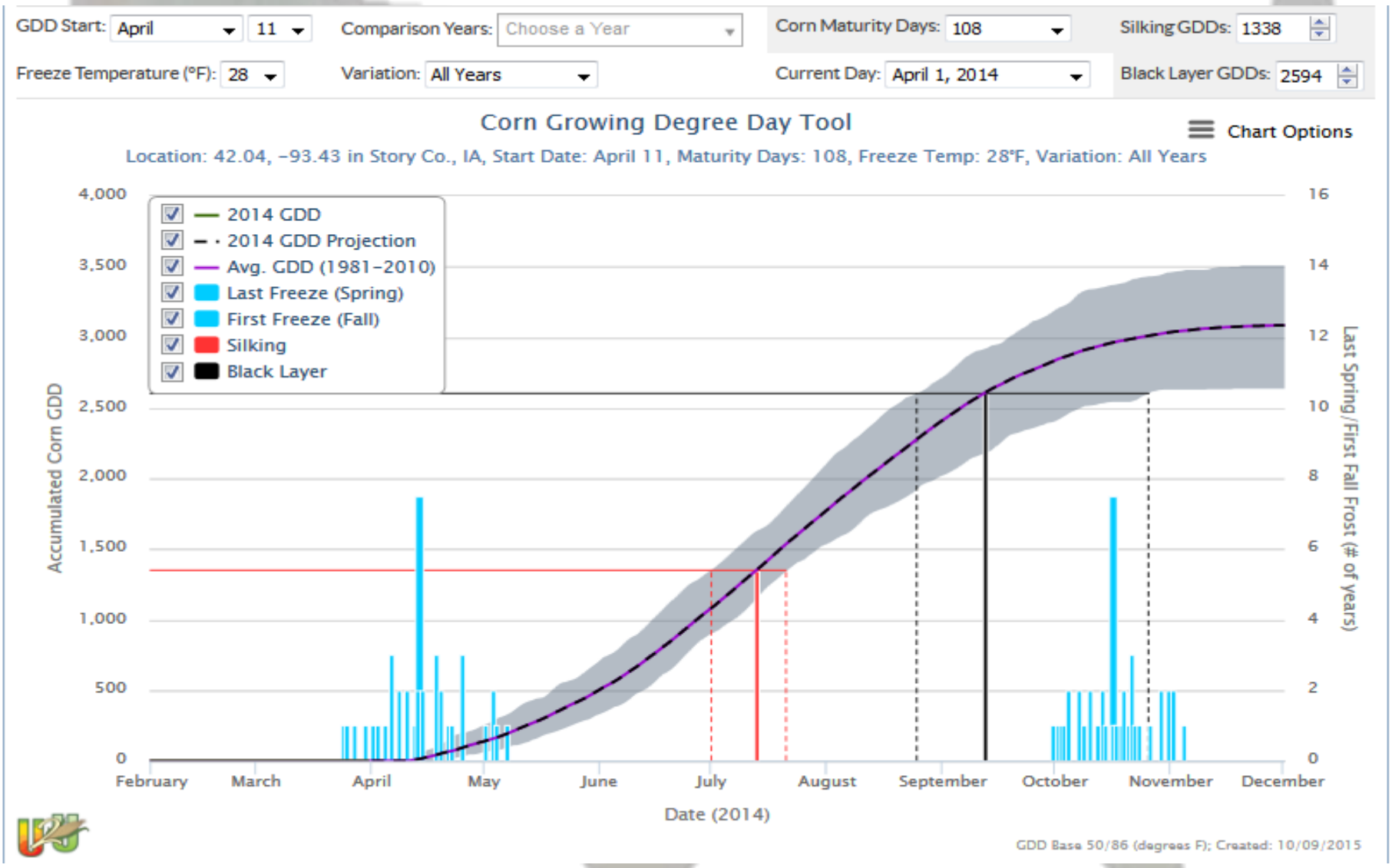
May
June
July
August
September
October
November
December
Date (2016)
GDD Base 50/86 (degrees F); Created: 03/15/2016

GDD Graph



www.AgClimate4U.org

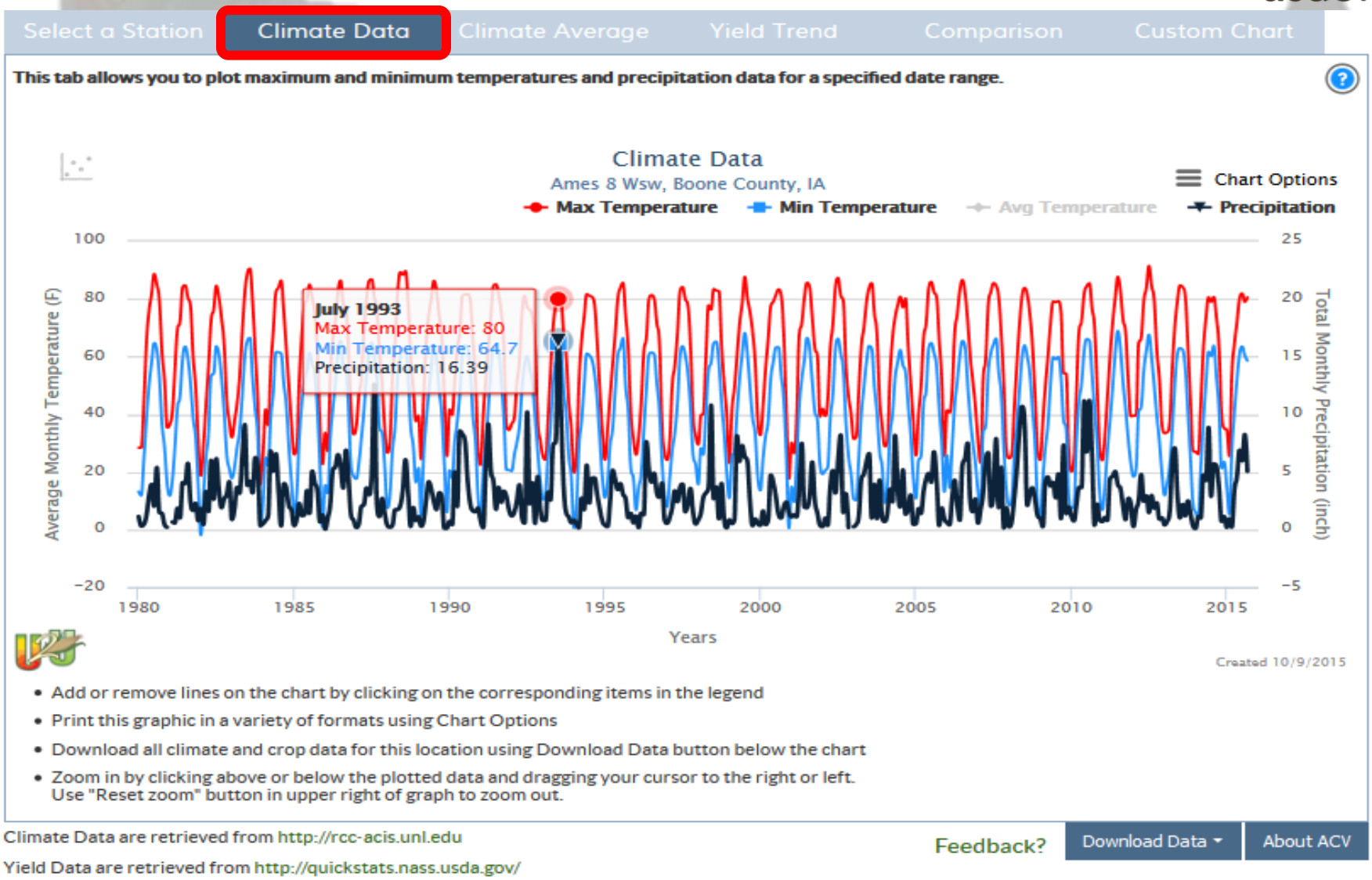
AgClimate View

- Plot local temperature and precipitation variation as far back as 1980,
- Track county crop yields and trends, and
- Consider crop yields in the context of temperature, precipitation, and growing degree day data

Used in tandem with other decision resources, AgClimate View can help you find long-term correlations between climate trends and yields, while helping you put your recent crop experience into historical context.

www.AgClimate4U.org

Historical Weather Data



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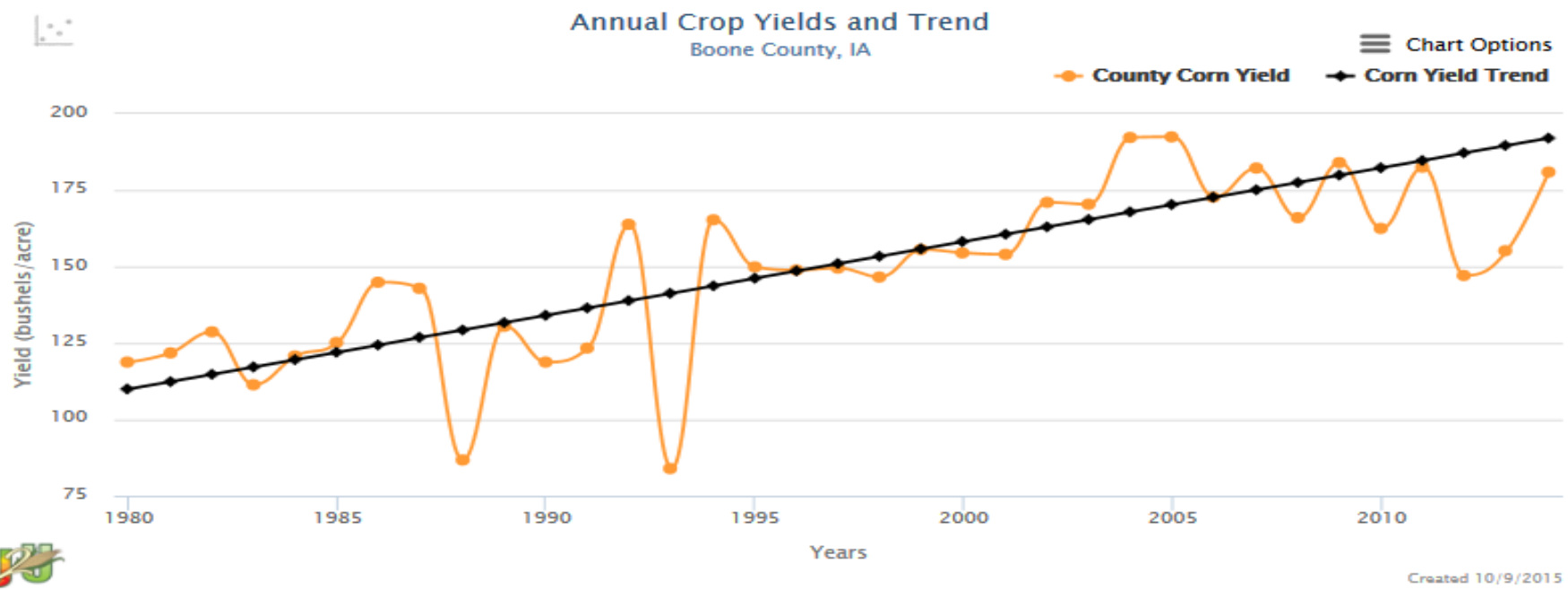
Crop Yields and Trends

Select a Station | Climate Data | Climate Average | **Yield Trend** | Comparison | Custom Chart

This tab allows you to view annual county yields for a selected time period and the corresponding linear yield trend.

Corn Trend Soybean Trend



- Add or remove lines on the chart by clicking on the corresponding items in the legend
- Print this graphic in a variety of formats using Chart Options
- Download all climate and crop data for this location using Download Data button below the chart
- Zoom in by clicking above or below the plotted data and dragging your cursor to the right or left. Use "Reset zoom" button in upper right of graph to zoom out.

Climate Data are retrieved from http://rcc-acis.unl.edu

Yield Data are retrieved from http://quickstats.nass.usda.gov/

Feedback? | Download Data | About ACV

www.AgClimate4U.org

Climate Patterns Viewer

This tool provides an historical (1981-2010) look at how the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) have affected local climate conditions across the Corn Belt. You can explore the influence on:

- average monthly total precipitation,
- average monthly temperature,
- deviations of these variables from 1981-2000 normals, and
- deviations of these variables from neutral phases.

The maps can help you make decisions about:

- Climate Risks – Identify periods of more extreme weather.
- Activity Planning – Consider crop choice and irrigation needs.
- Marketing – Explore forward pricing alternatives.

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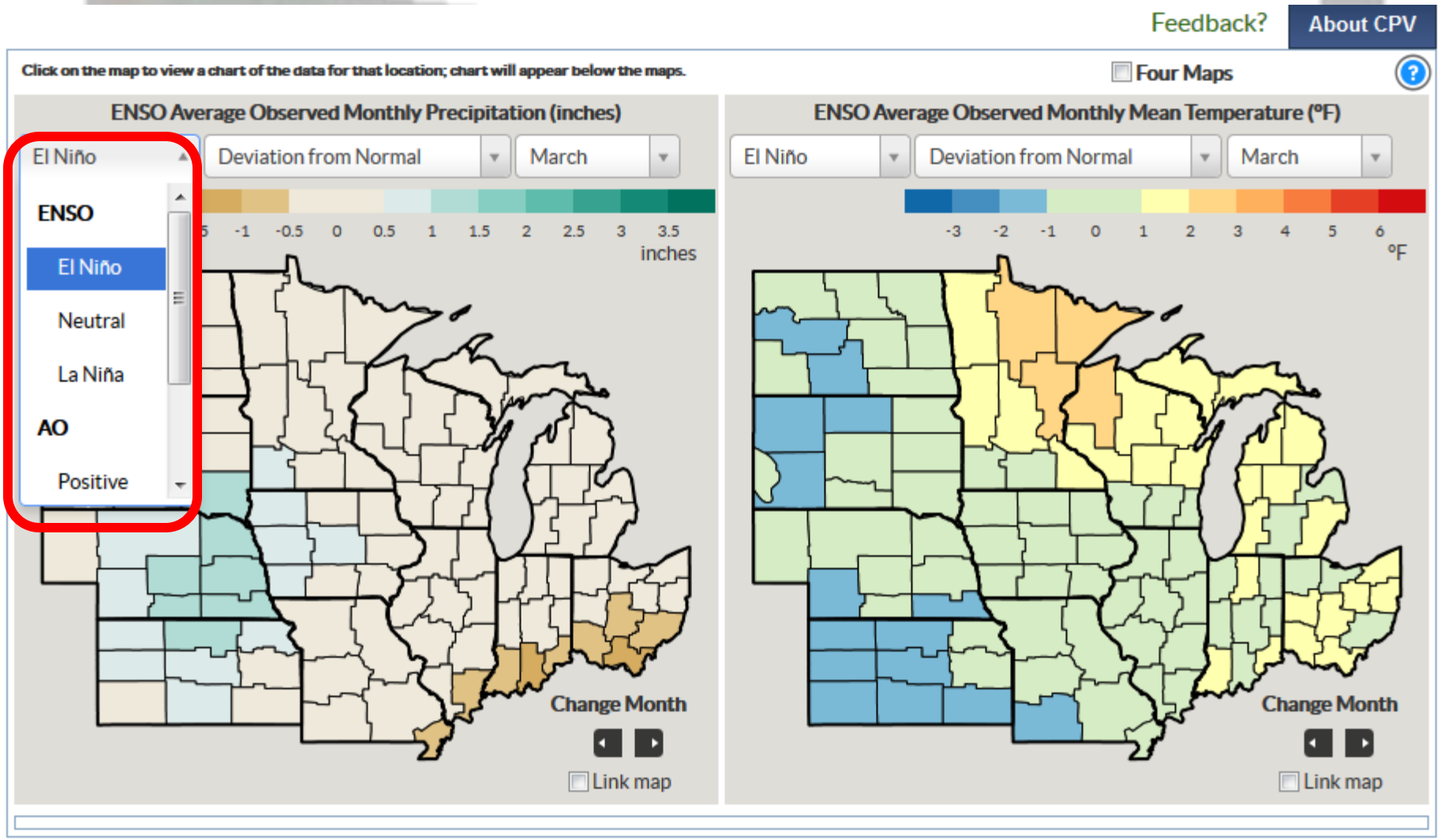
Choice of Cycle



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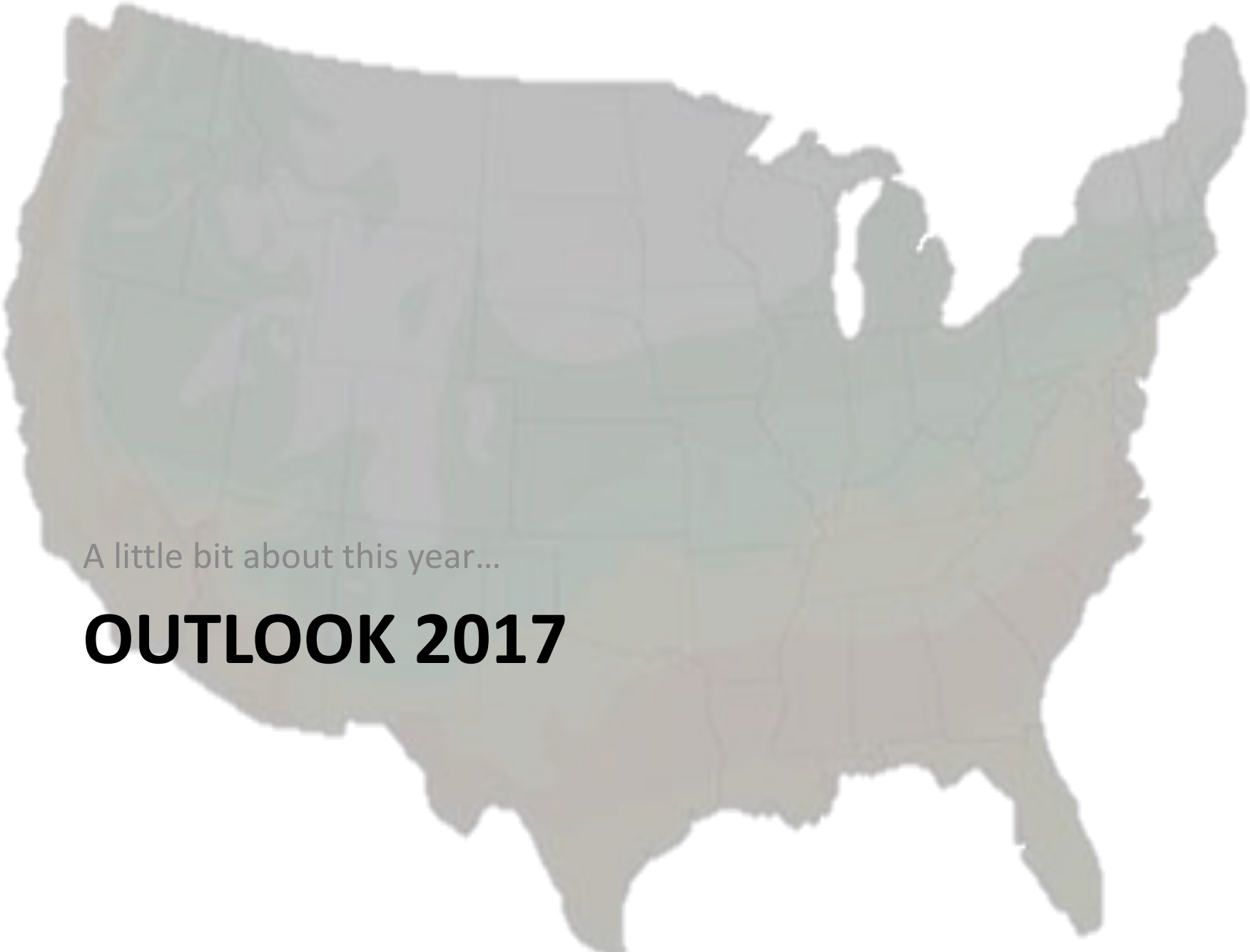
What data/information/tools needs do you have?

CLIMATE NEEDS

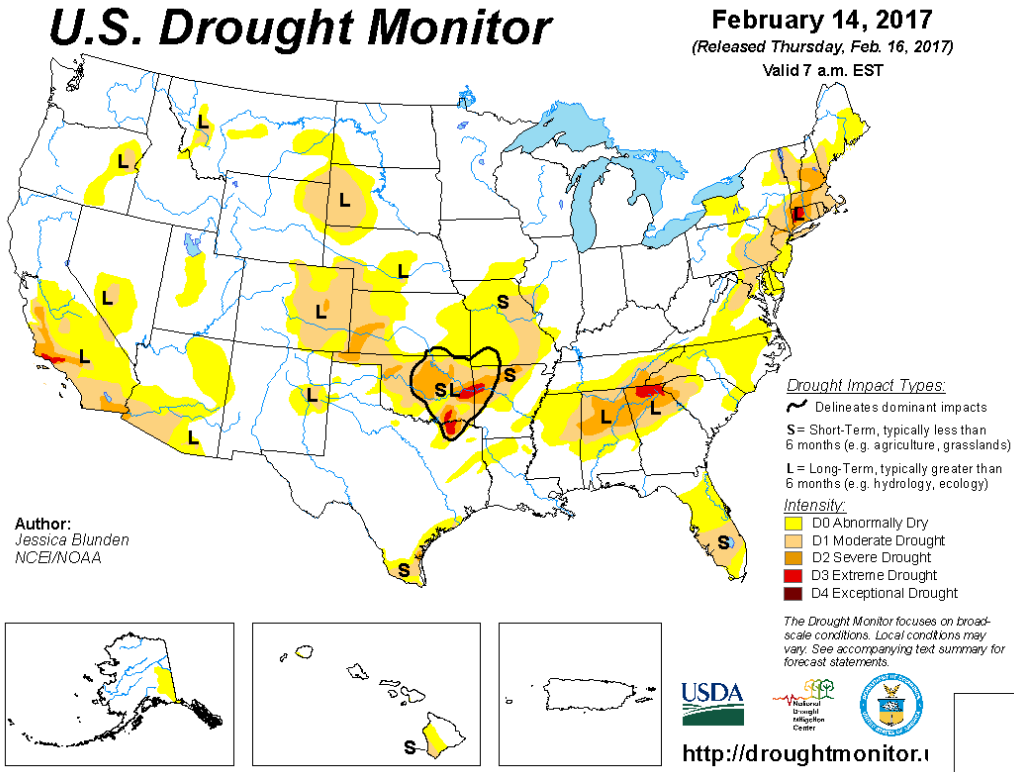
Survey-partnership

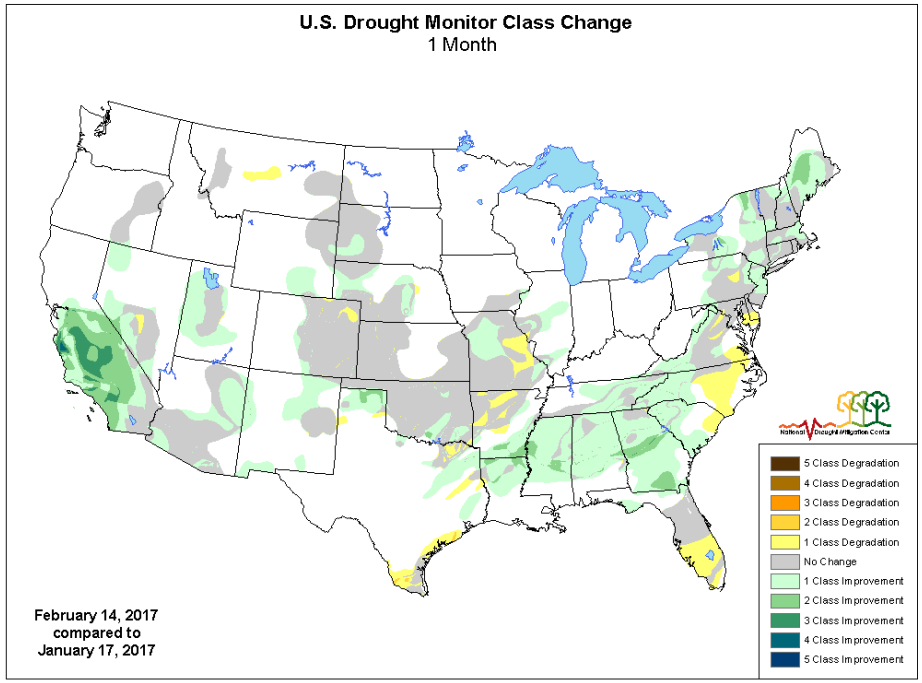
- Partnering with
  - National Drought Mitigation Center
  - Midwest Regional Climate Center
- More information
  - Data/tool needs
  - Drought information



A little bit about this year…

OUTLOOK 2017



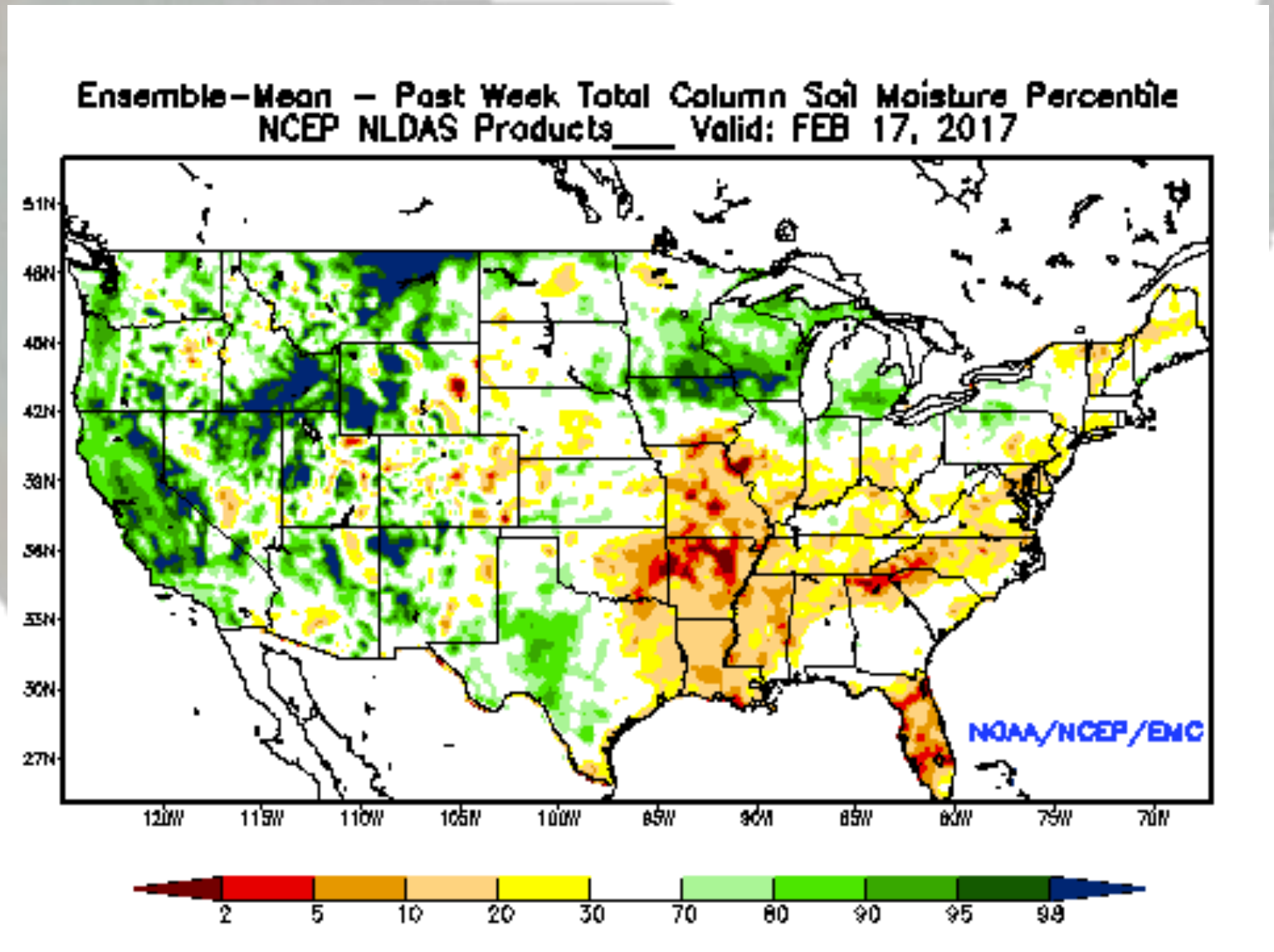


- Drought conditions have eased in CA and southeast– increasing some Midwest
- Watch southeast IA – dryness on par with 1988 there.

www.cpc.ncep.noaa.gov/products/Drought/

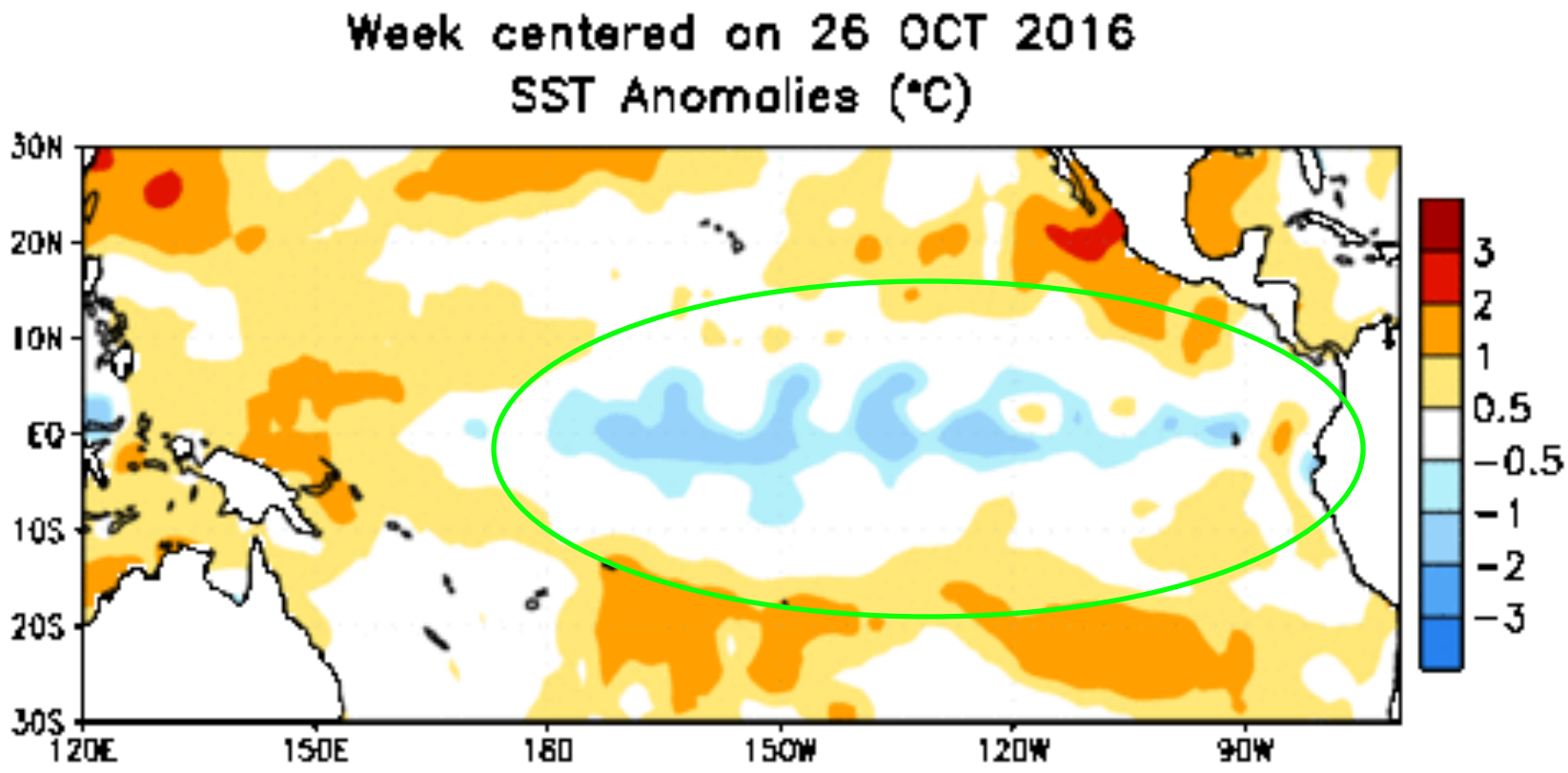
Modeled Soil Moisture

National Land Data Assimilation System



www.emc.ncep.noaa.gov/mmb/nldas/drought/

Pacific SST Anomalies



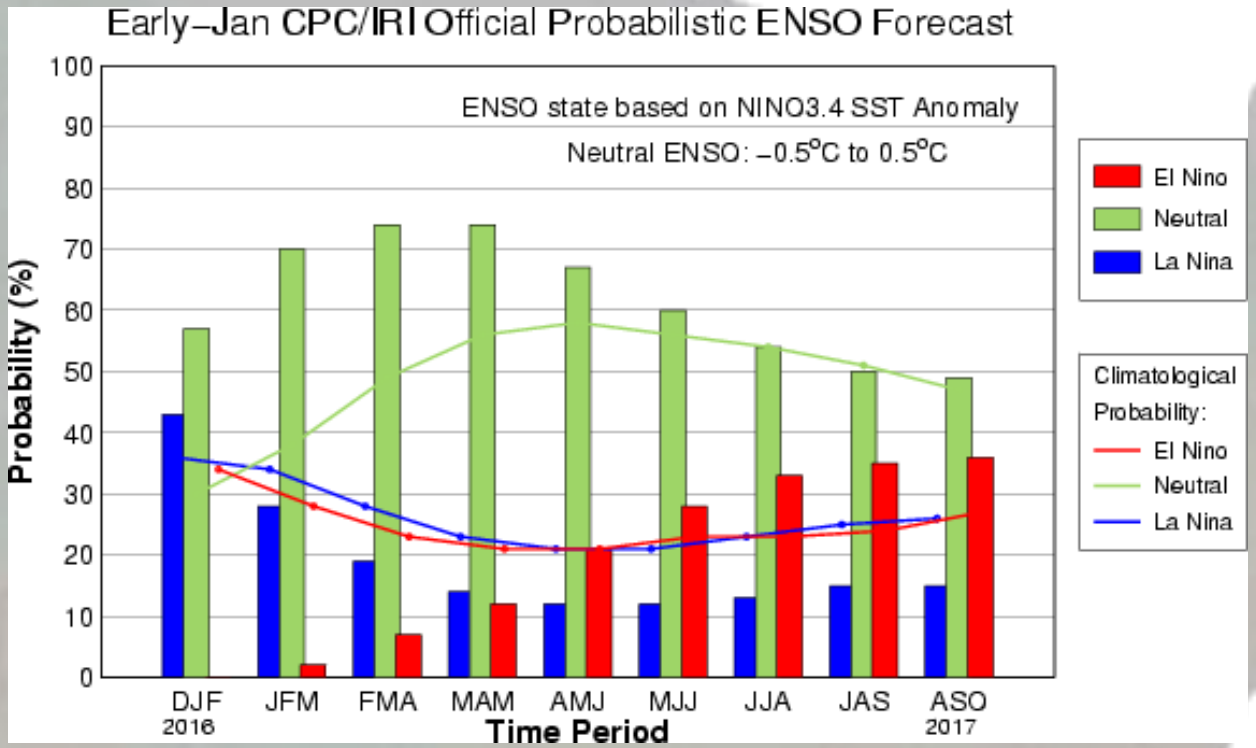
Cold SSTs disappearing – end of La Niña in sight

Outlooks – What can you use?

- El Niño/La Niña – SSTs in general
- Computer models
- Trends

- Current conditions – for potential impacts

ENSO Probabilistic Forecast

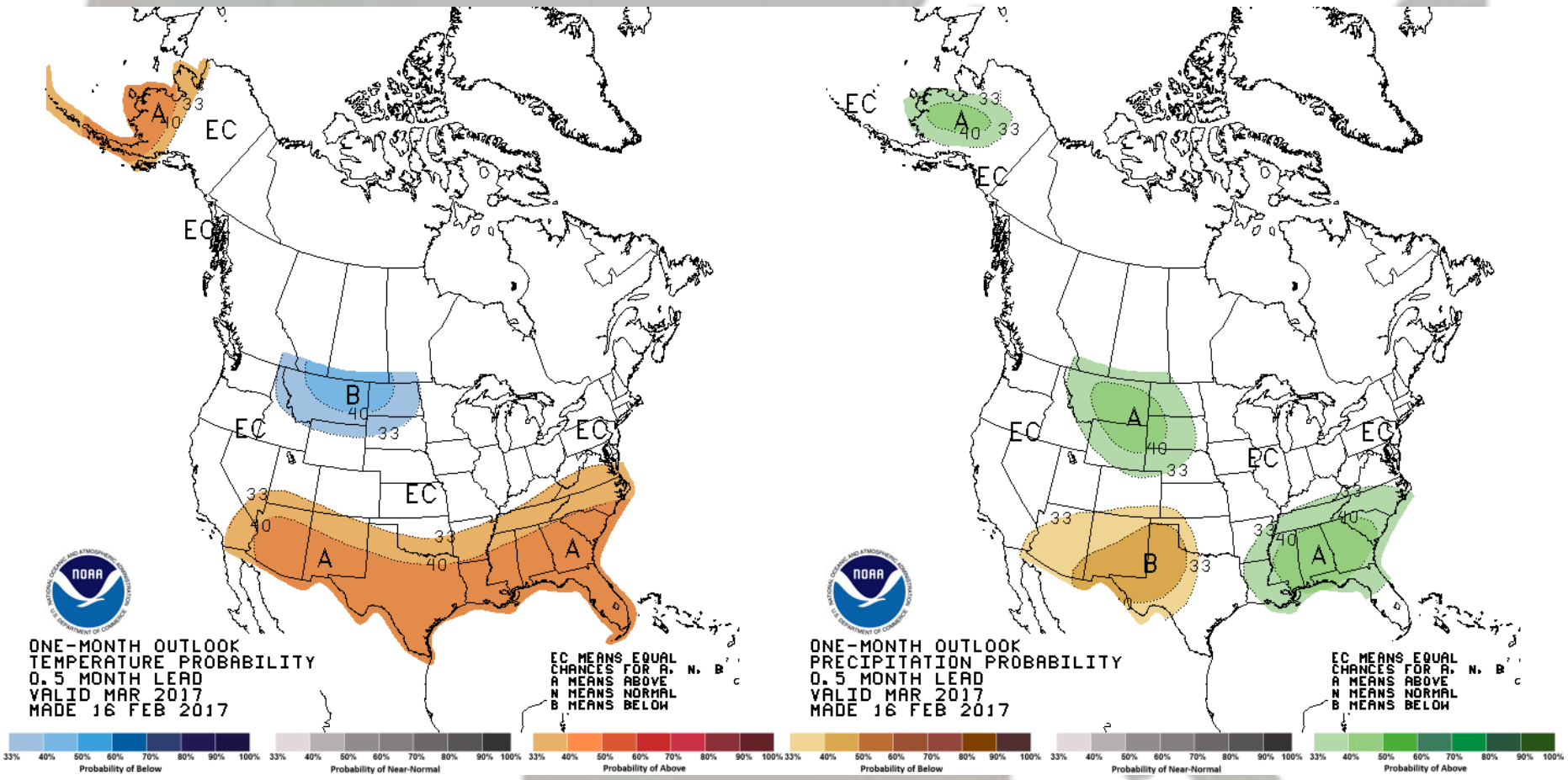


- Weak La Niña continues
- Expected to transition to ENSO neutral by February

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

Monthly Outlook for March

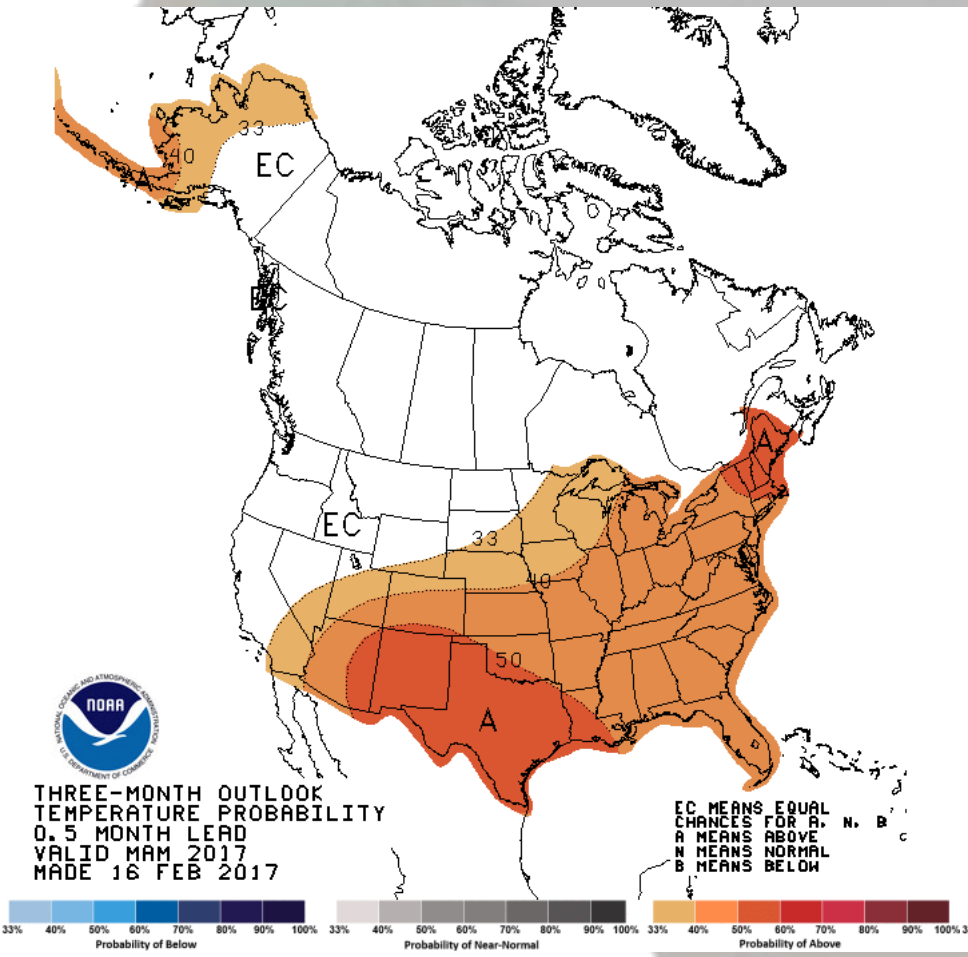
NWS Climate Predication Center

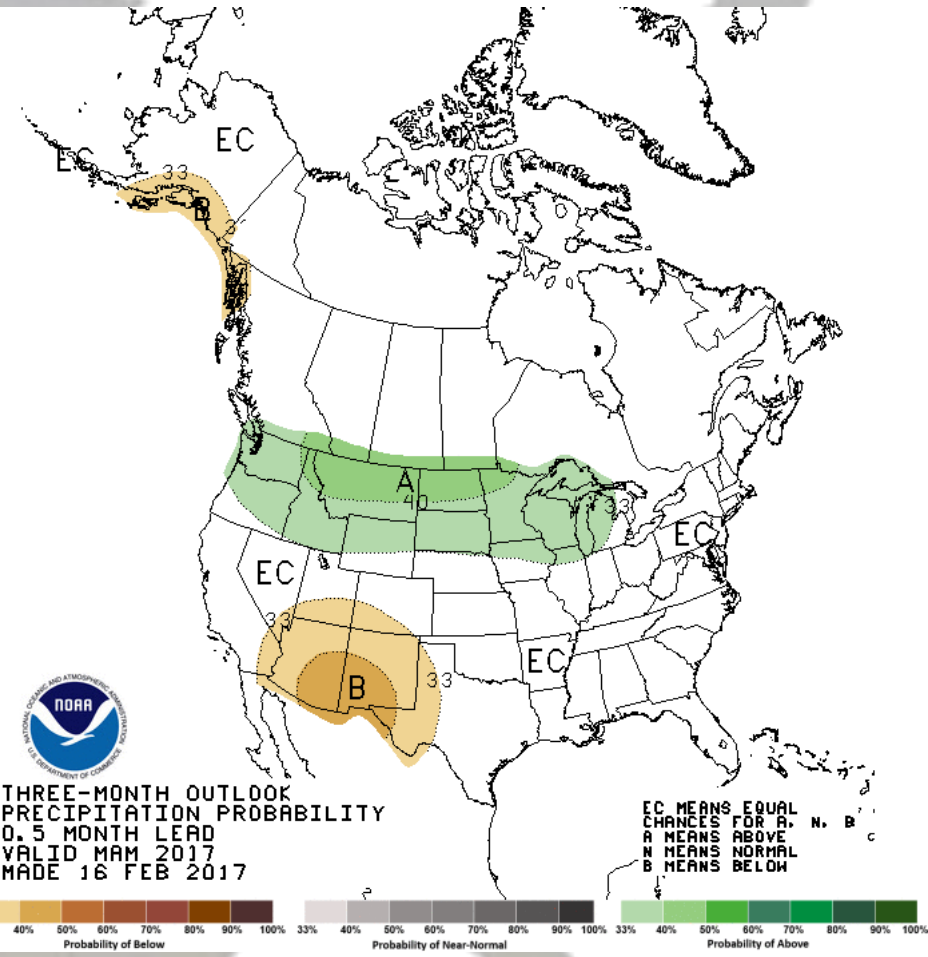


http://www.cpc.ncep.noaa.gov/products/predictions/long_range/lead14/

Seasonal Outlook for Mar-April-May

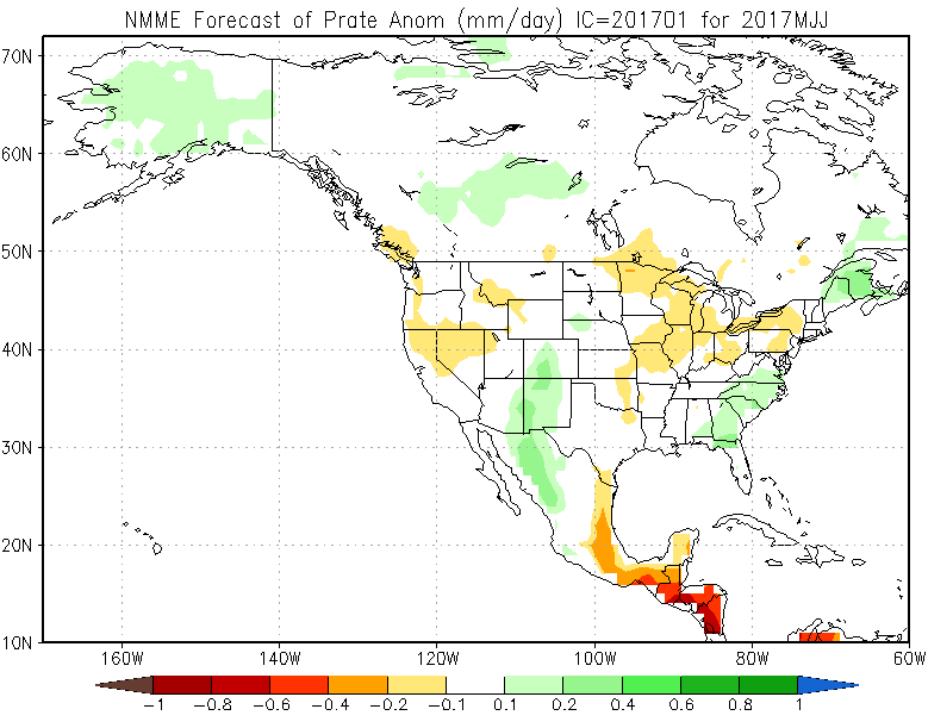
NWS Climate Predication Center

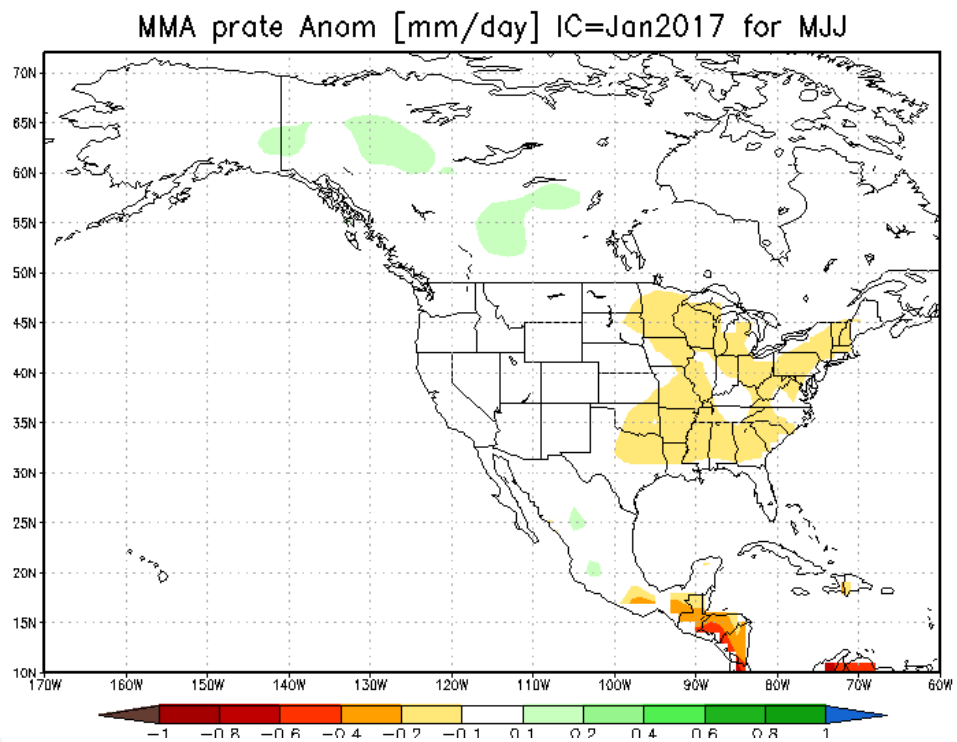




http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1

Computer models





Two computer model summaries

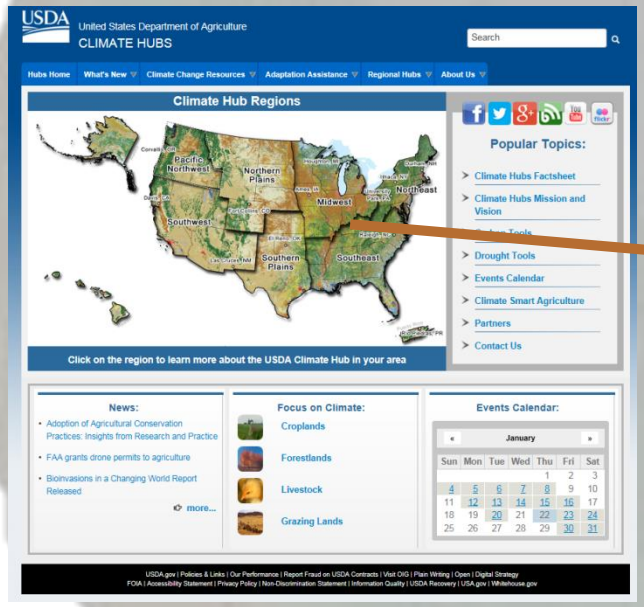
- Both lean slightly dry into summer (MJJ)
- Not a great amount of skill
- Something we should continue to watch

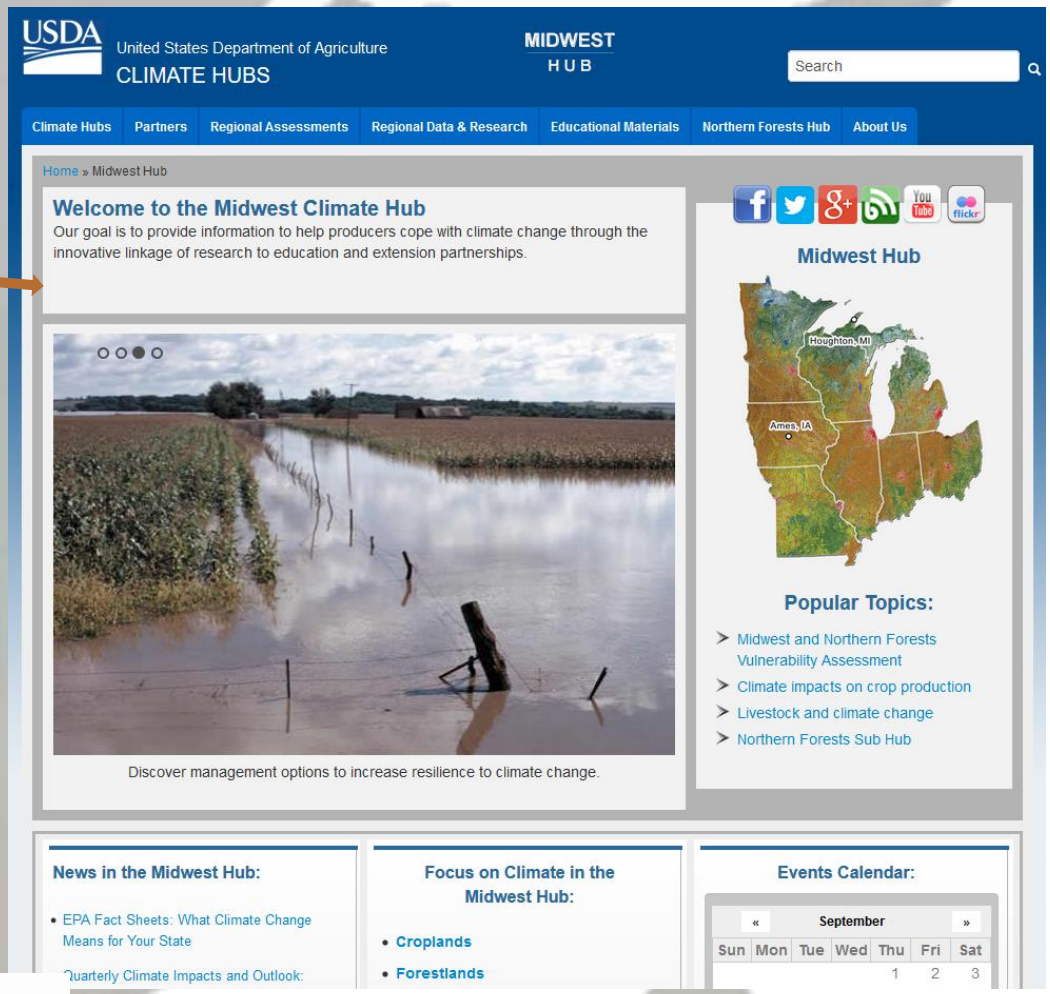
Summary

- La Niña is disappearing – little impact on growing season with small chance El Niño
- Summer likely leans a little warm, Overall trend – low temperatures
- Will have to watch computer model development on dryness
- No other major issues appearing in Corn Belt

Where to go for information?

Keeping Up-to-Date with the Midwest Climate Hub





Visit the Climate Hubs Website
www.usda.gov/climatehubs

**Get on the Midwest Climate Hub Email list

USDA
United States Department of Agriculture
Midwest Climate Hub

Midwest and Great Plains Climate-Drought Outlook
15 September 2016

Virga near Huron SD – Author Photo

Photo tak

United States Department of Agriculture
Midwest Climate Hub

For more Information on the Midwest Climate Hub

Midwest Climate Hub

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