How to deal with a variable/changing climate – mitigating risk and capitalizing on advantages

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AASC
AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

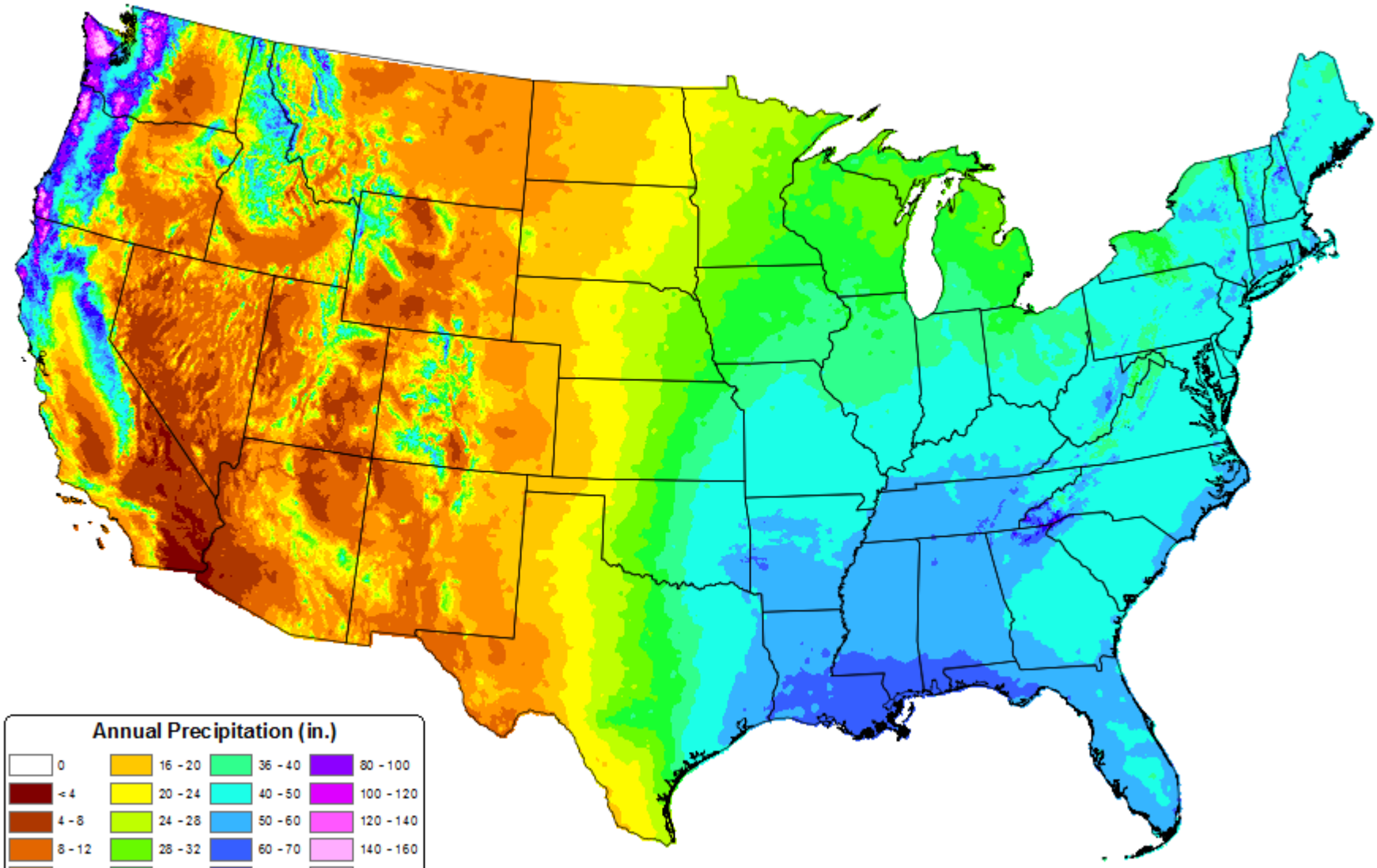
South Dakota State University
College of Agriculture and Biological Sciences

South Dakota Climate and Weather

Livin’ at the extremes

30-yr Normal Precipitation: Annual

Period: 1981-2010



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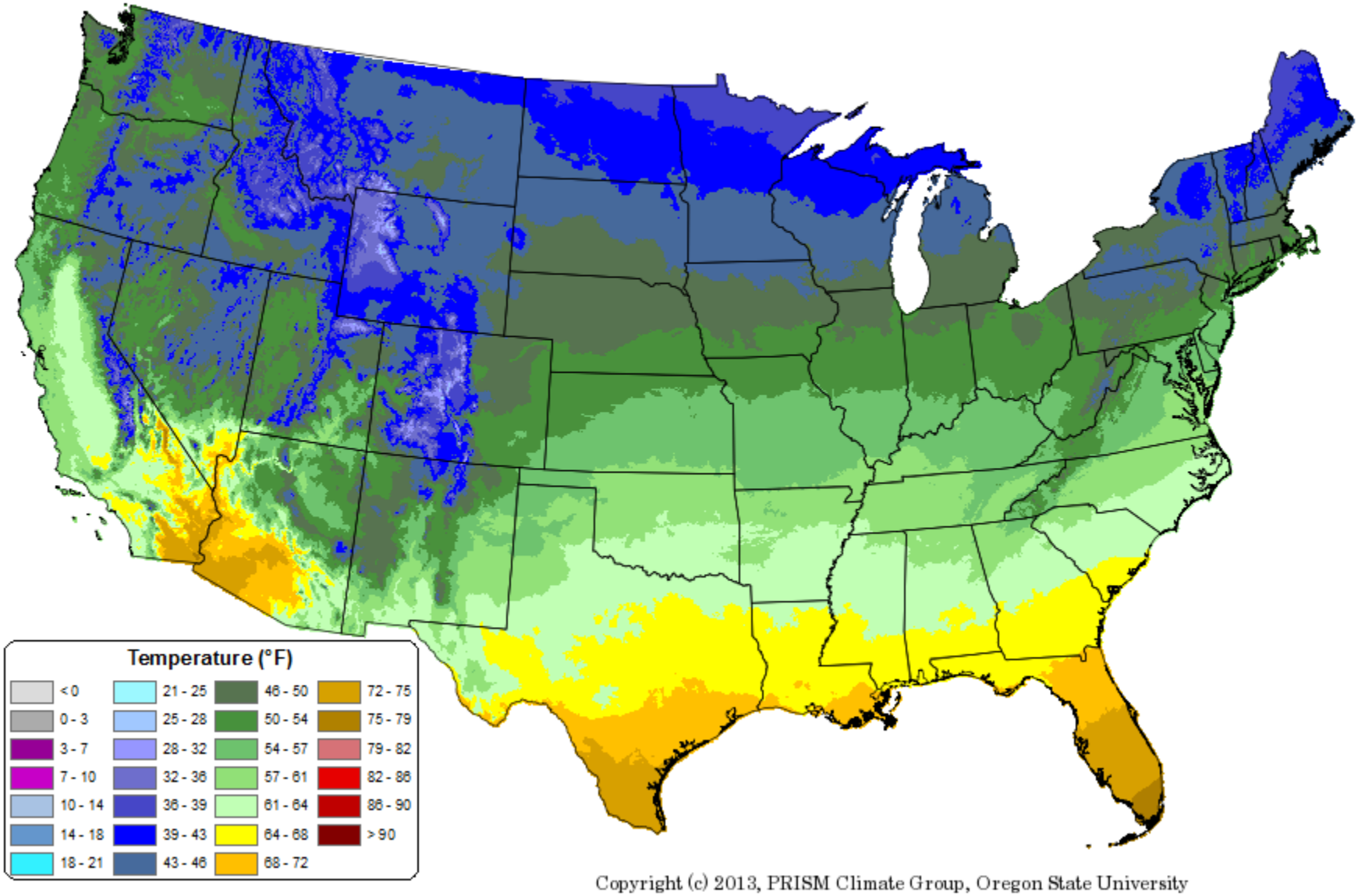
30-yr Normal Mean Temperature: Annual

Period: 1981-2010



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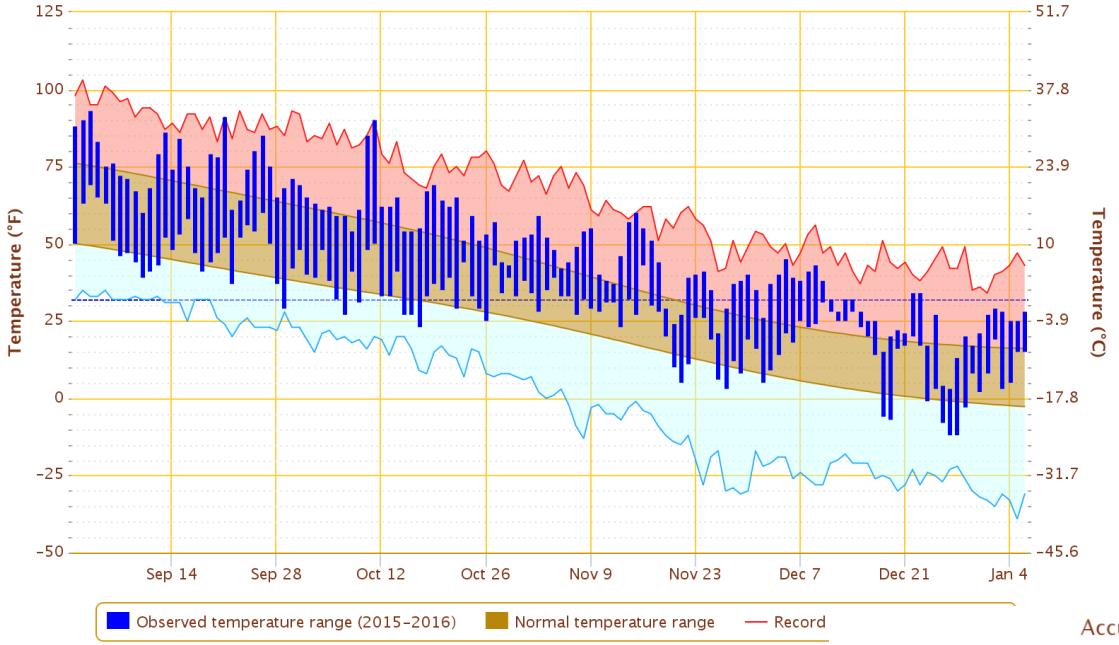
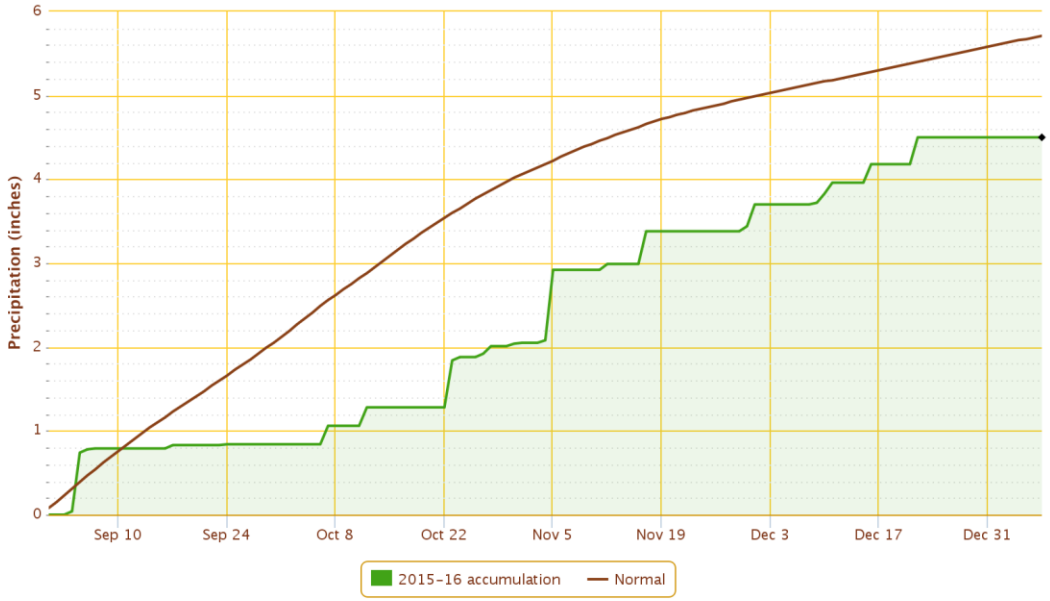
Daily Temperature Data – GRAND FORKS INTL AP, ND

Period of Record – 1965-03-31 to 2016-01-06. Normals period: 1981-2010. Click and drag to zoom chart.



Accumulated Precipitation – GRAND FORKS INTL AP, ND

Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



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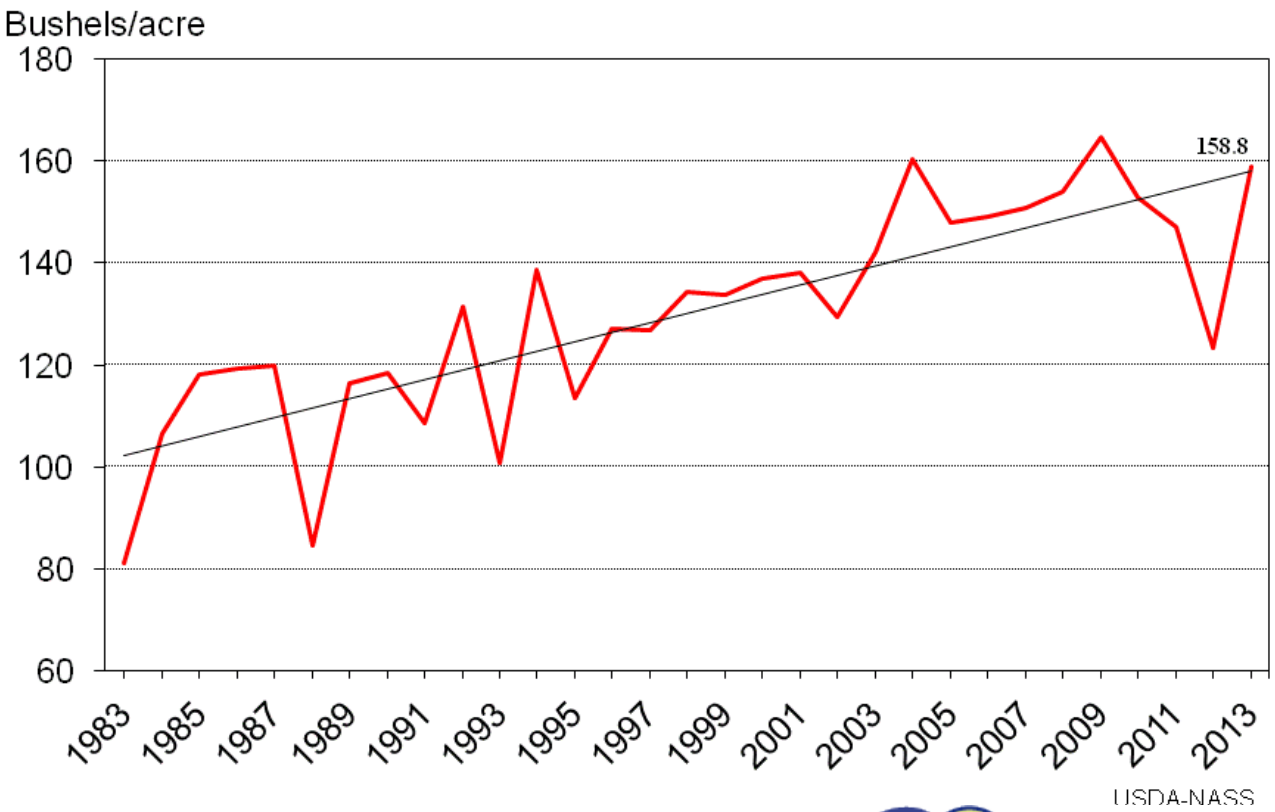
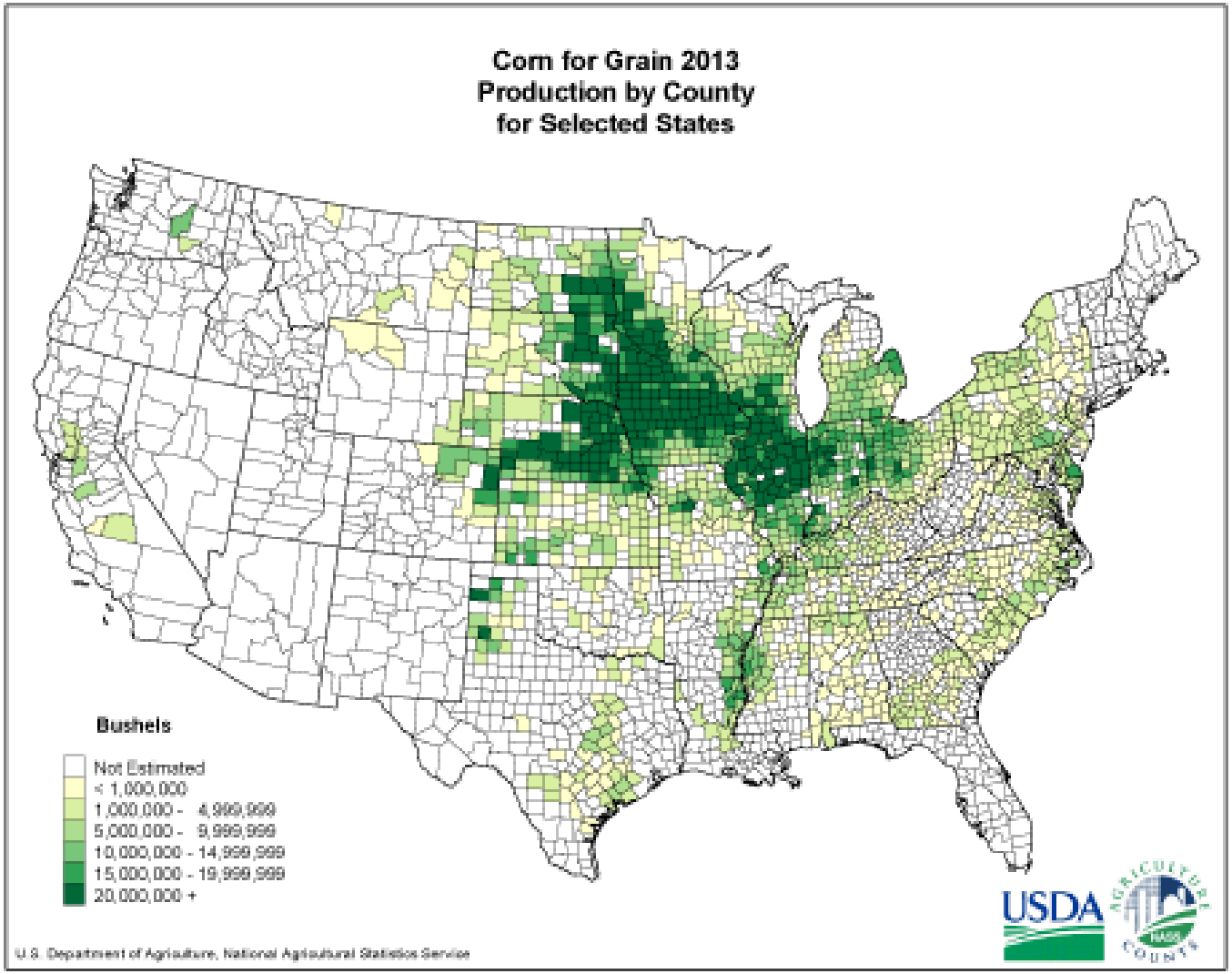
Climate Impacts Yields



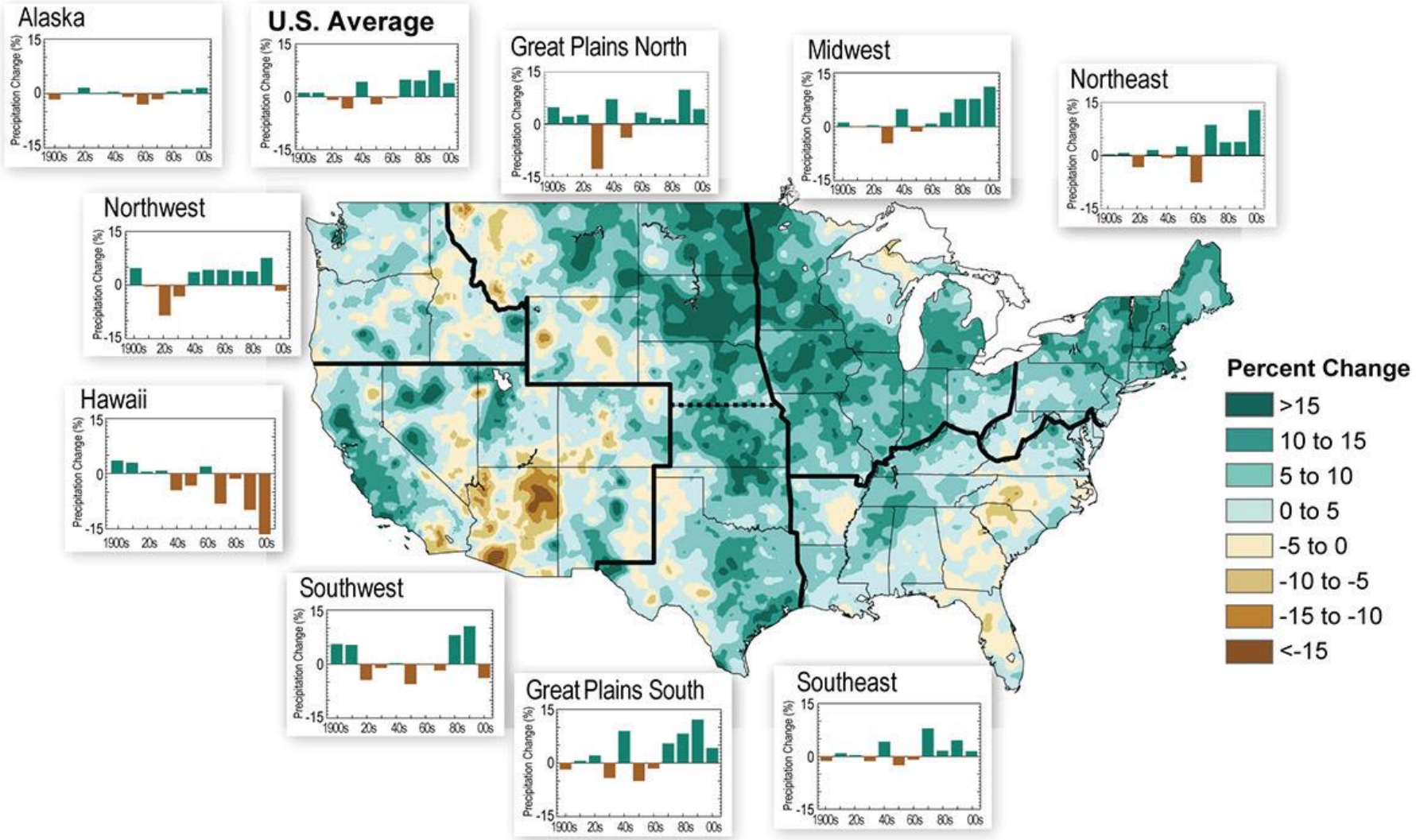
CLIMATE CHANGES

Derived from

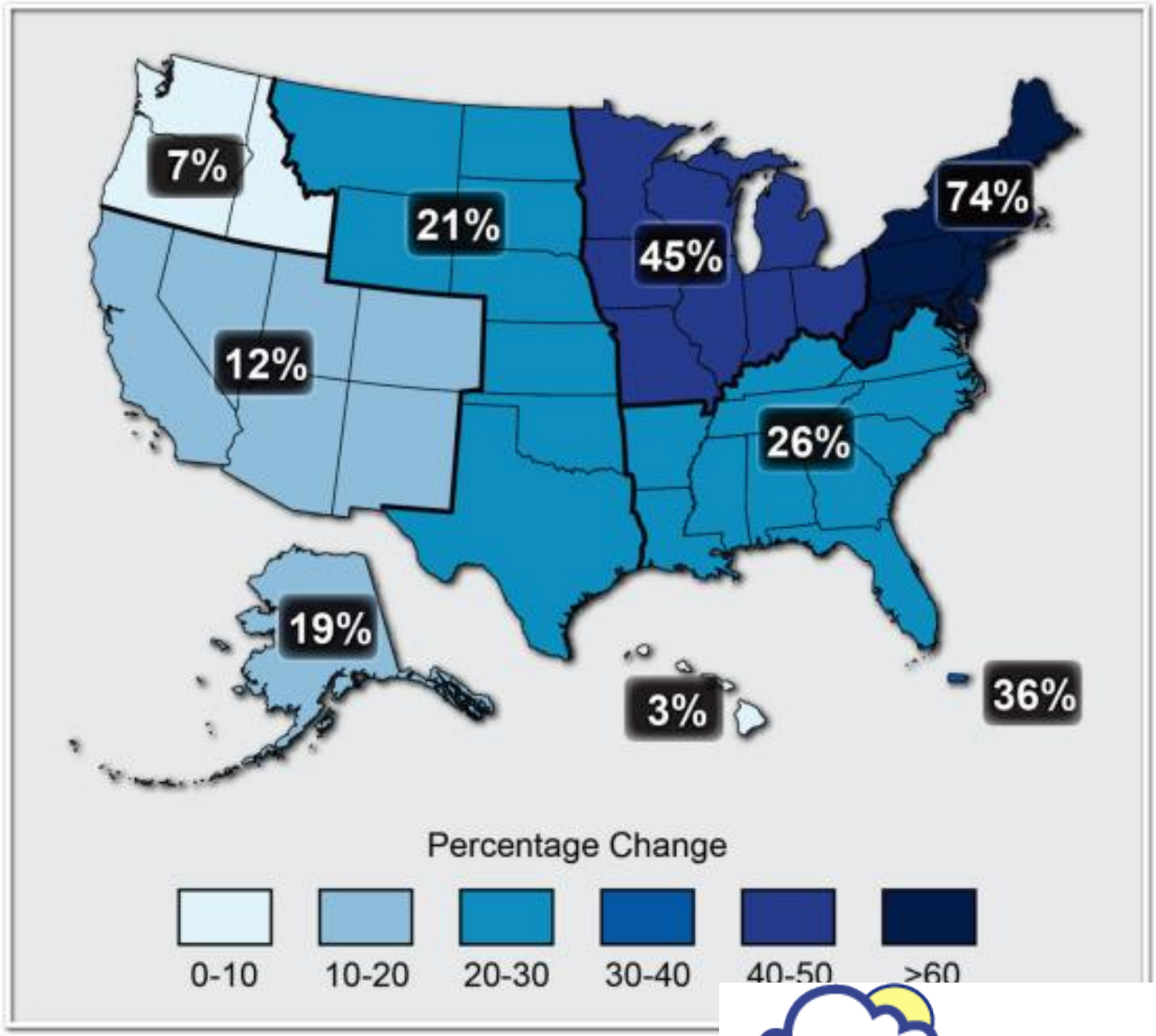
- http://nca2014.globalchange.gov/


Corn for Grain 2013
Production by County
for Selected States
Bushels
Not Estimated
< 1,000,000
1,000,000 - 4,999,999
5,000,000 - 9,999,999
10,000,000 - 14,999,999
15,000,000 - 19,999,999
20,000,000 +
U.S. Department of Agriculture, National Agricultural Statistics Service
USDA

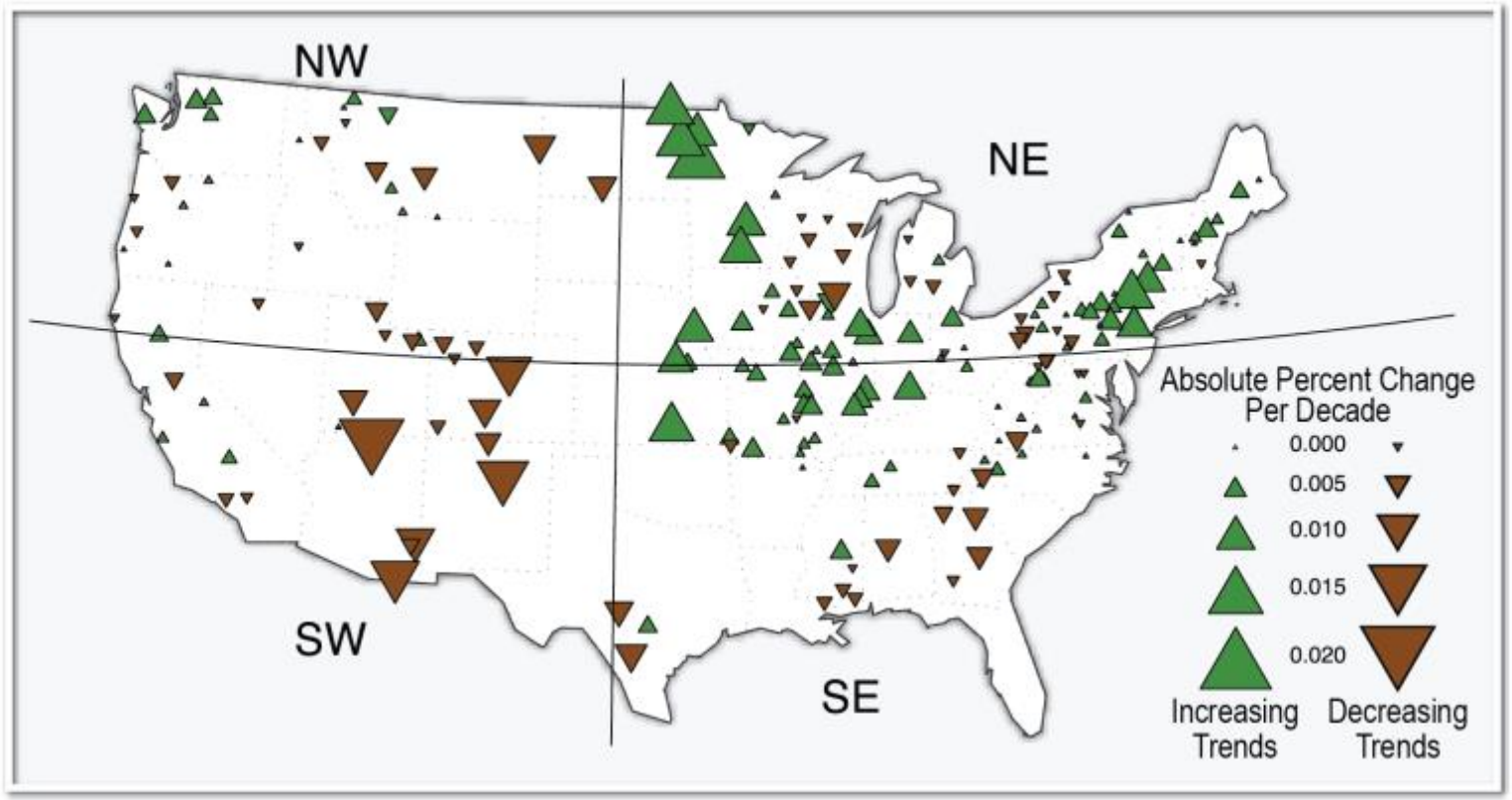
Observed U.S. Precipitation Change

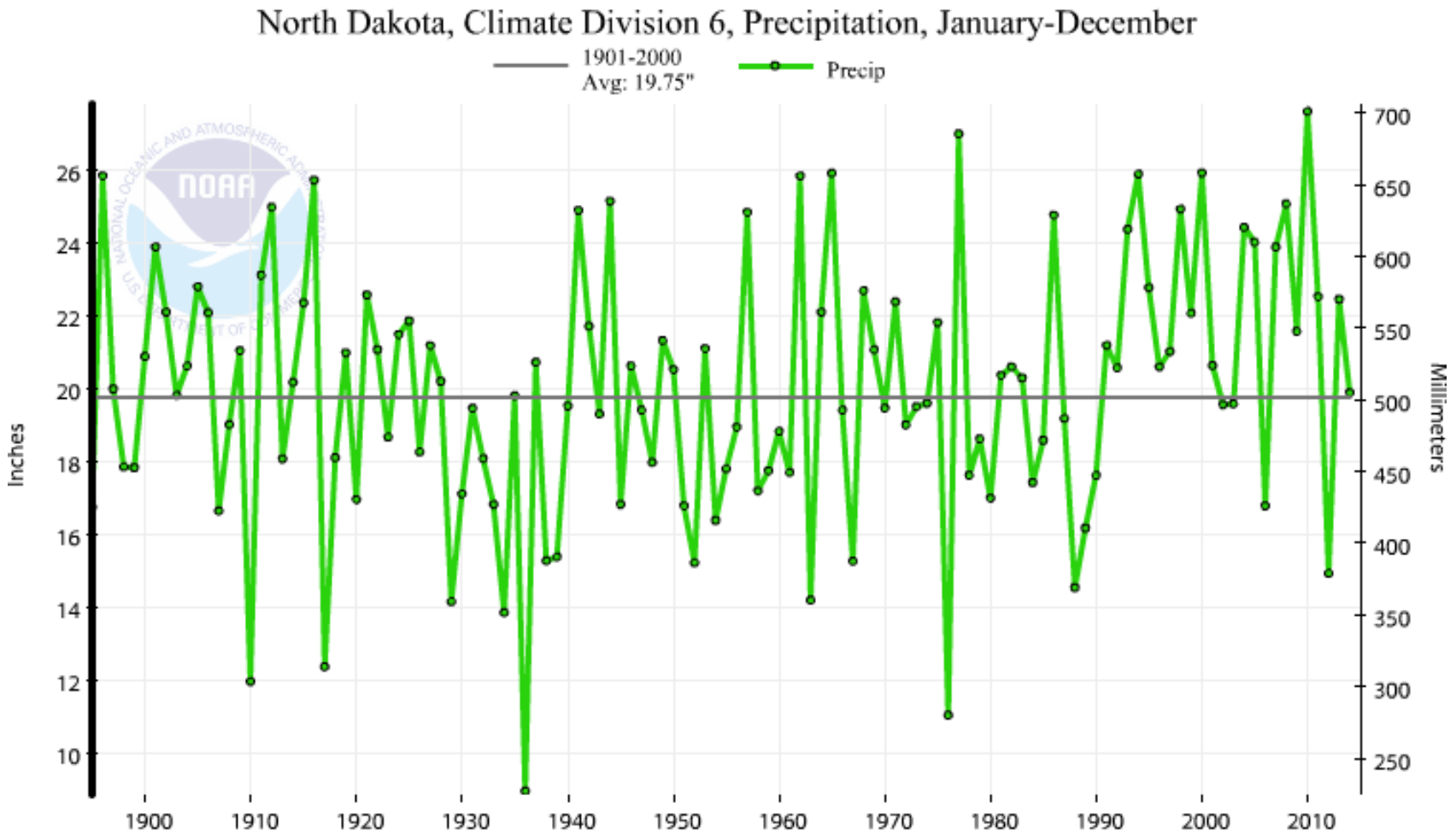


Percentage Change in Very Heavy Precipitation

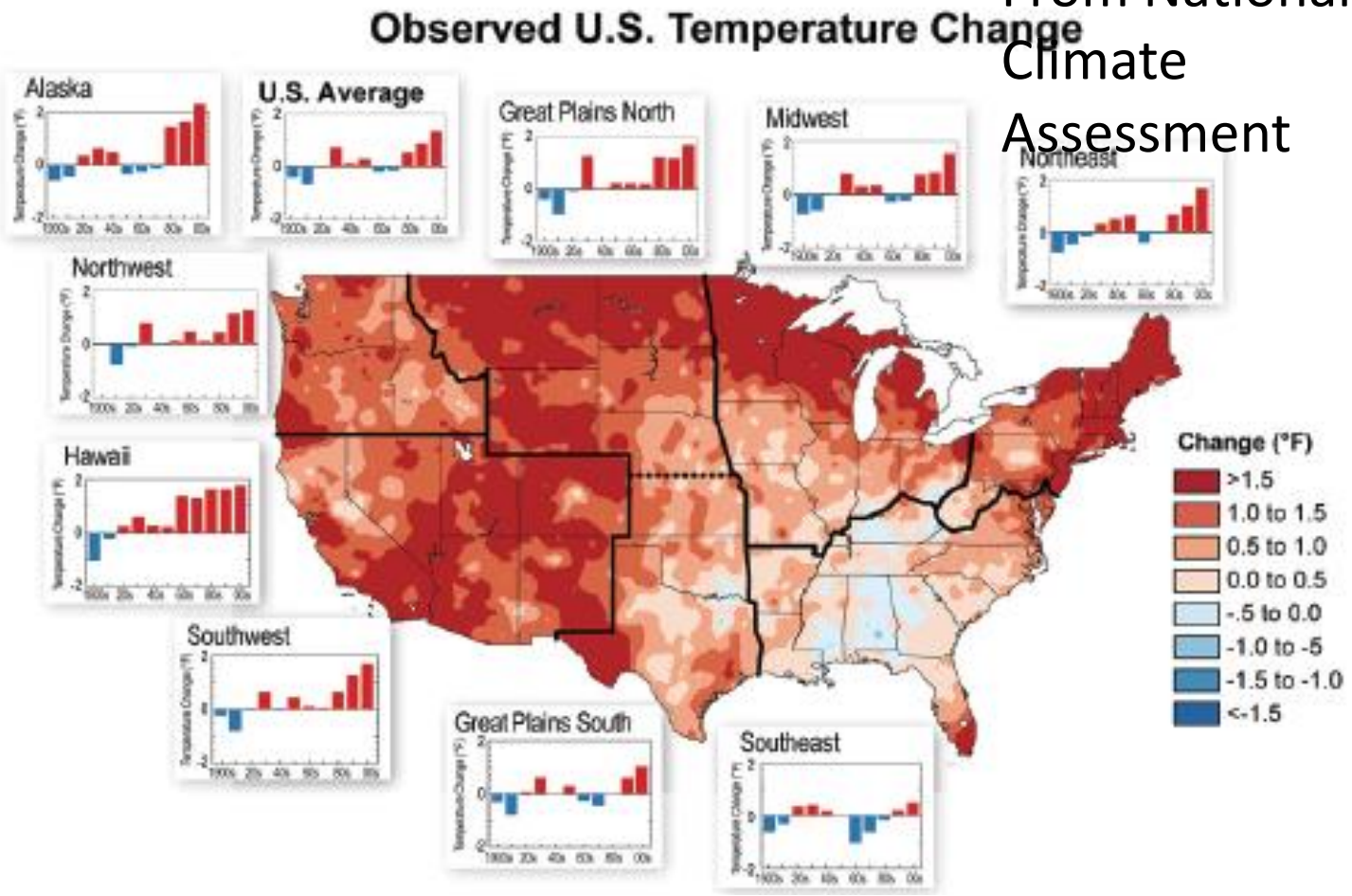


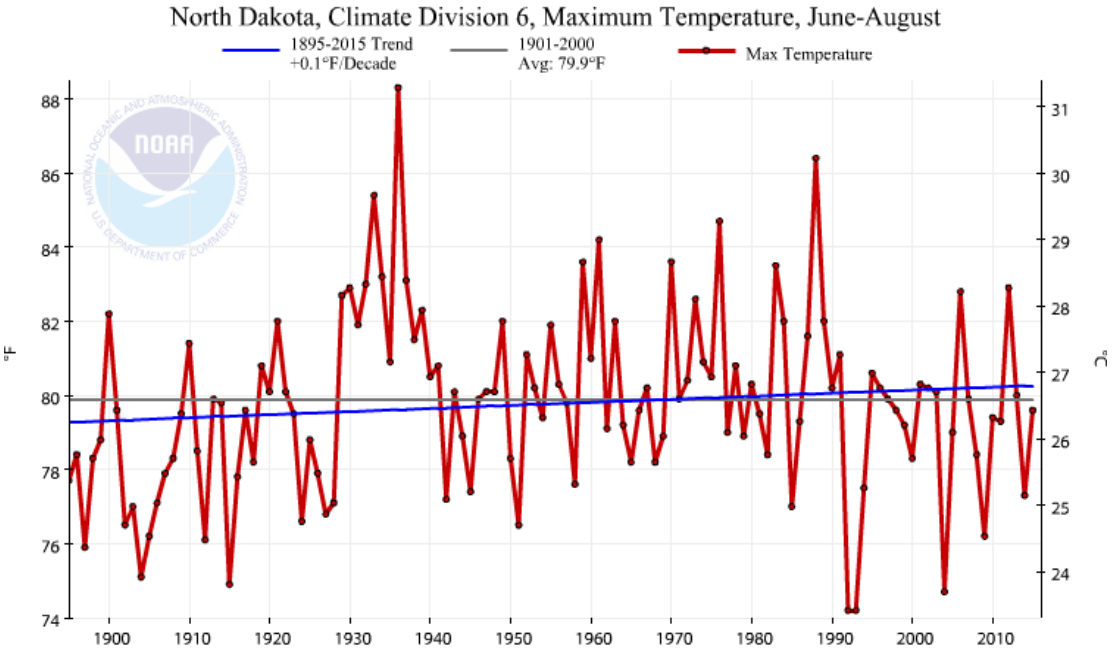
Trends in Flood Magnitude

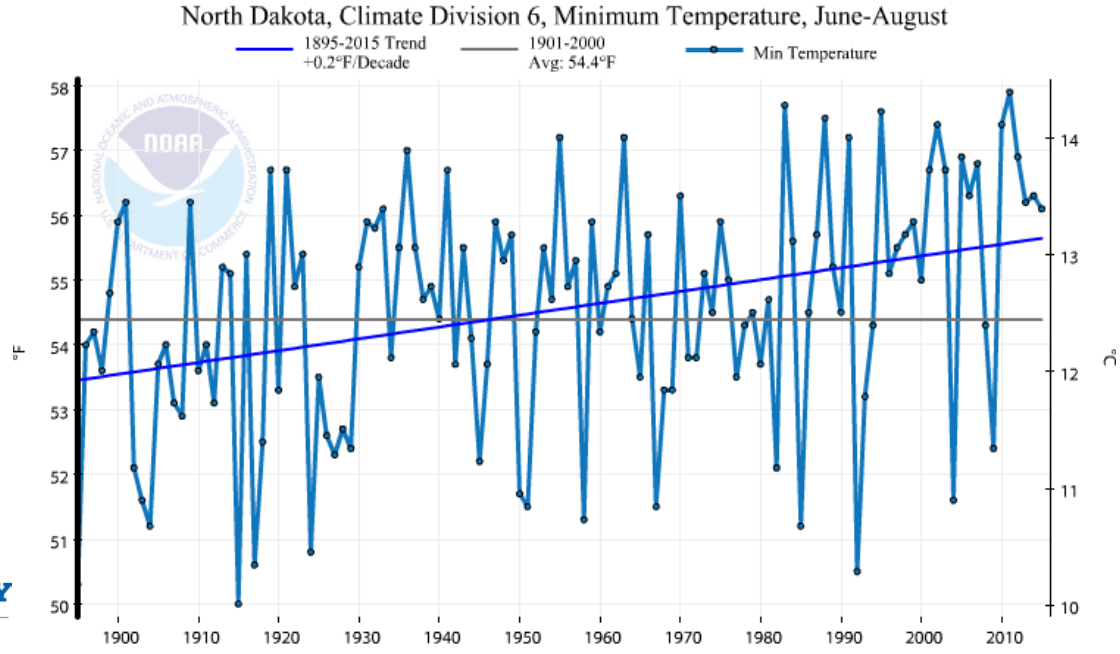


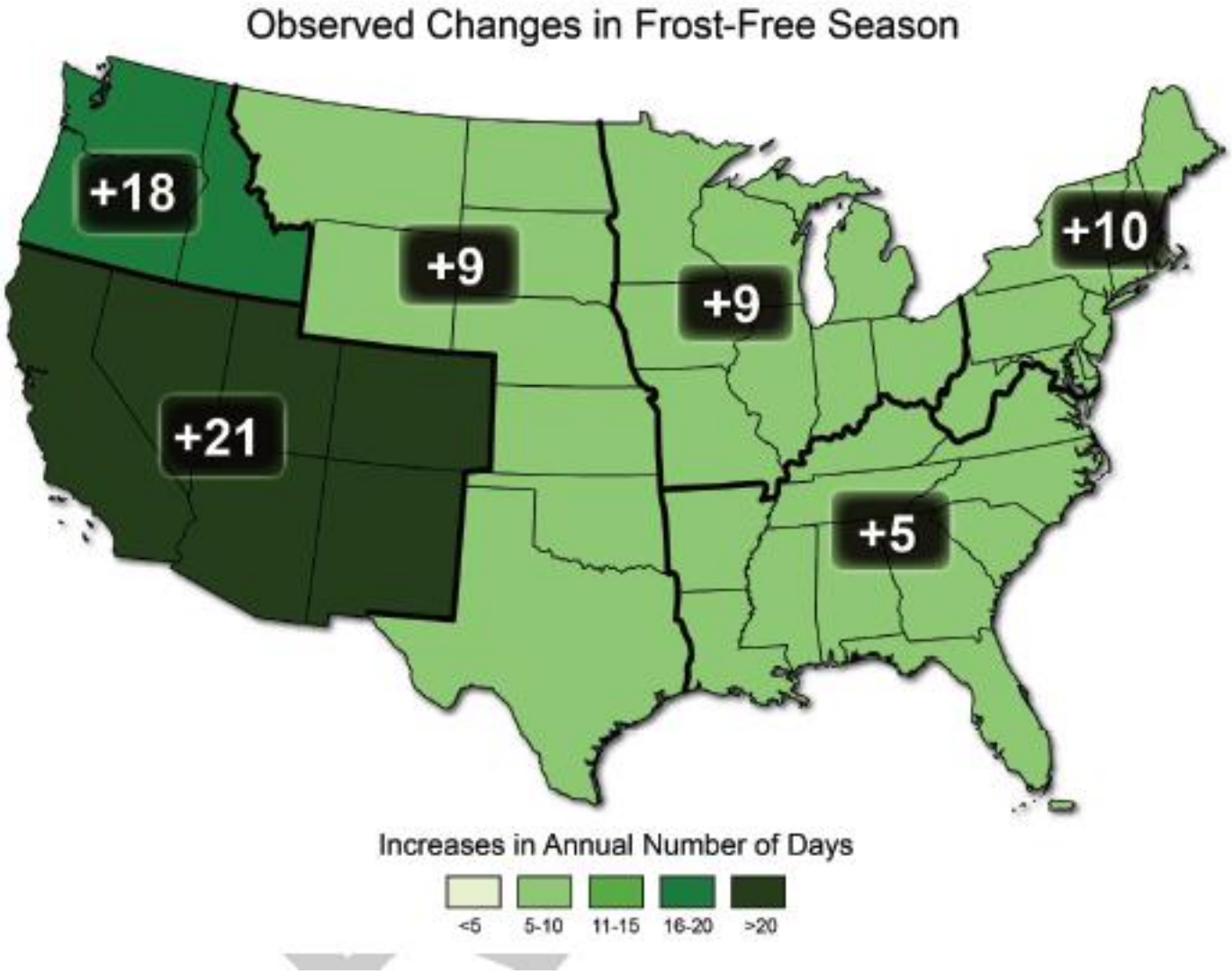

North Dakota, Climate Division 6, Precipitation, January-December
1901-2000
Avg: 19.75"
Precip
Inches
Millimeters
26
24
22
20
18
16
14
12
10
700
650
600
550
500
450
400
350
300
250
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

From National Climate Assessment




North Dakota, Climate Division 6, Maximum Temperature, June-August
1895-2015 Trend
+0.1°F/Decade
1901-2000
Avg: 79.9°F
Max Temperature
°F
°C
88
86
84
82
80
78
76
74
31
30
29
28
27
26
25
24
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

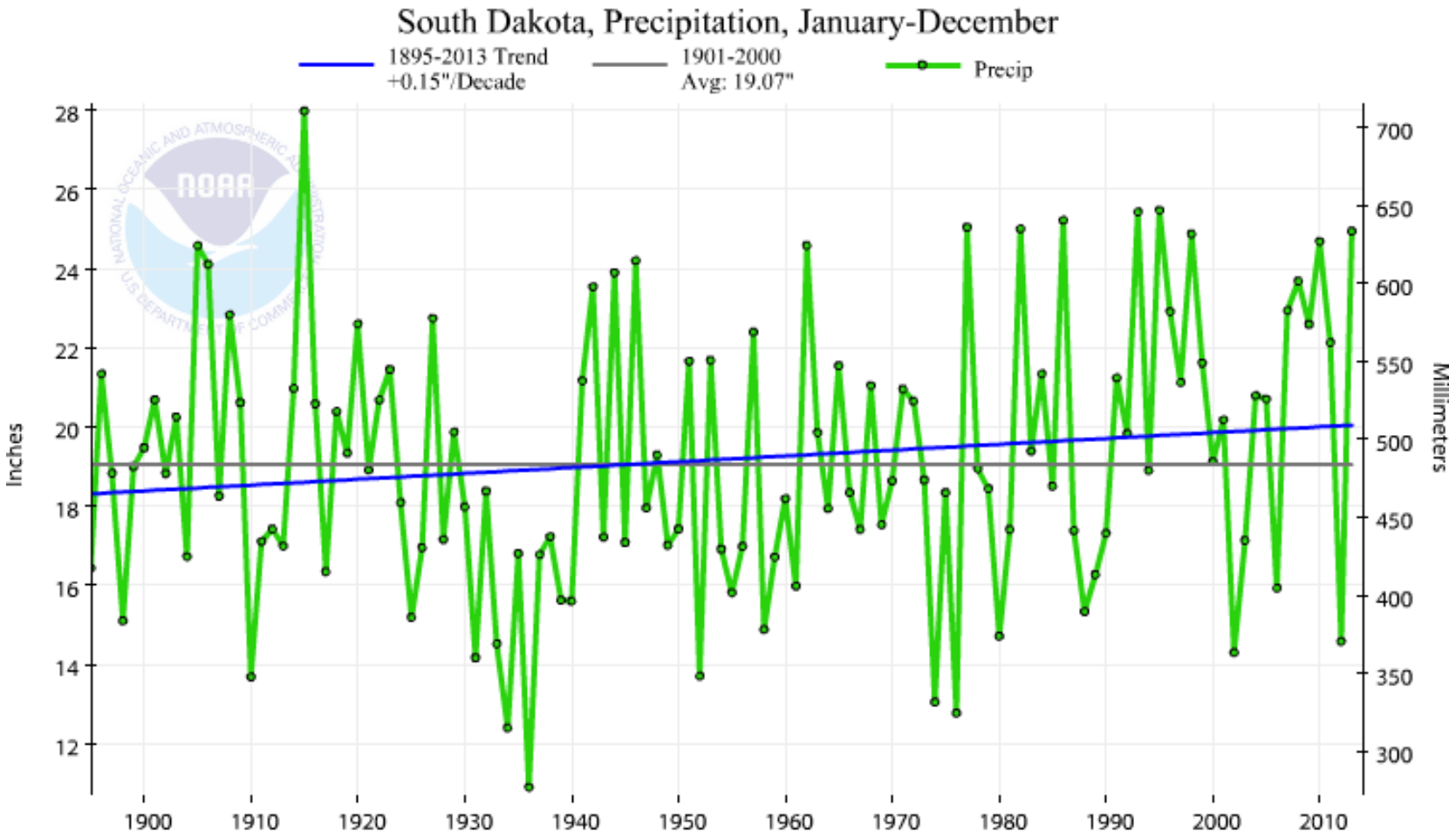

North Dakota, Climate Division 6, Minimum Temperature, June-August
1895-2015 Trend
+0.2°F/Decade
1901-2000
Avg: 54.4°F
Min Temperature
°F
°C
58
57
56
55
54
53
52
51
50
14
13
12
11
10
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

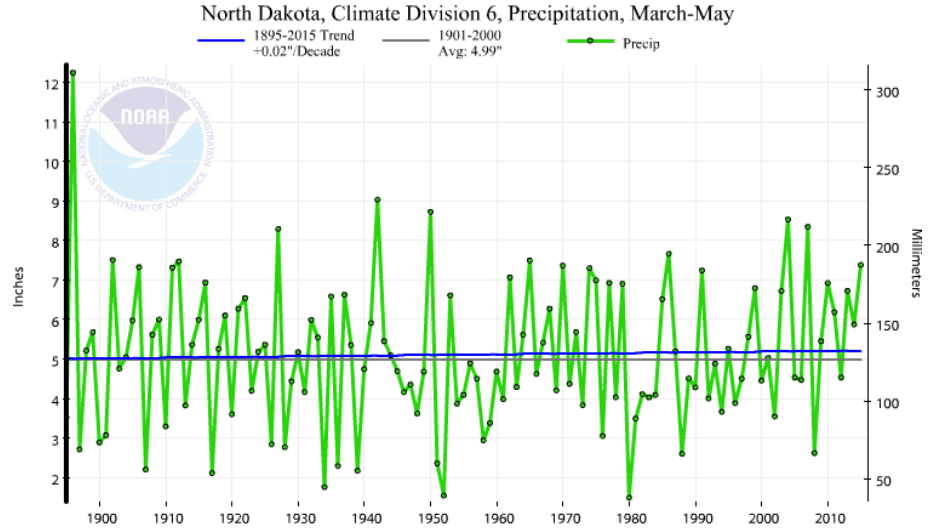

Observed Changes in Frost-Free Season
+18
+9
+9
+10
+21
+5
Increases in Annual Number of Days
<5
5-10
11-15
16-20
>20

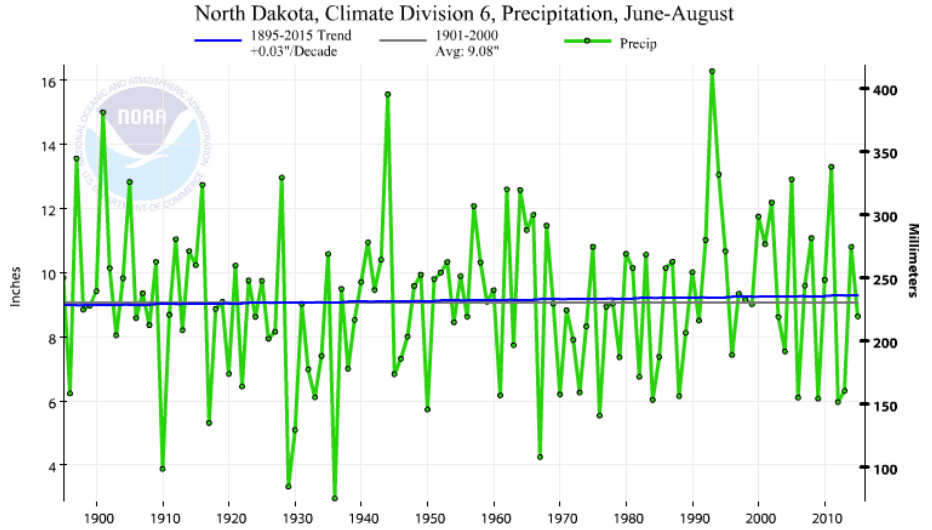
State and Regional T and P Trends

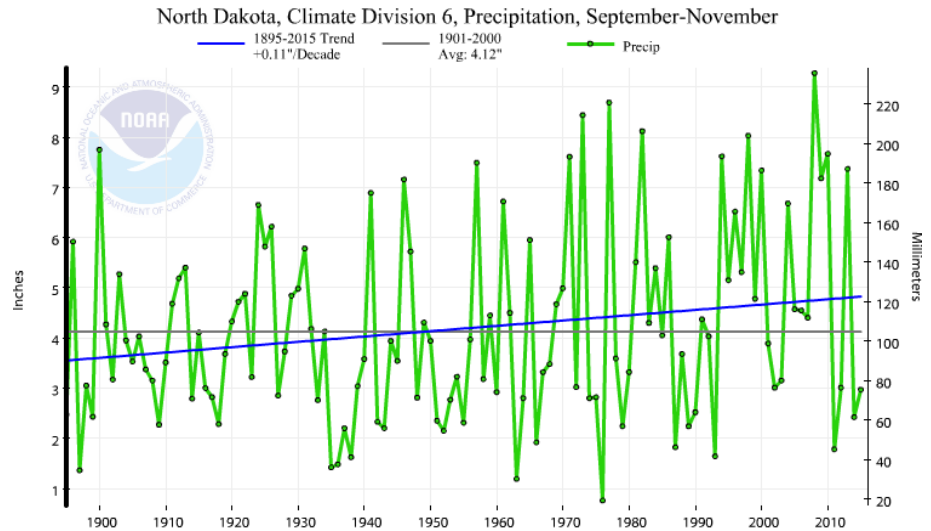
- http://www.ncdc.noaa.gov/cag/time-series/us
- Check out your locations
- Variabilities in seasons and trends
- Based on ~120 years of data

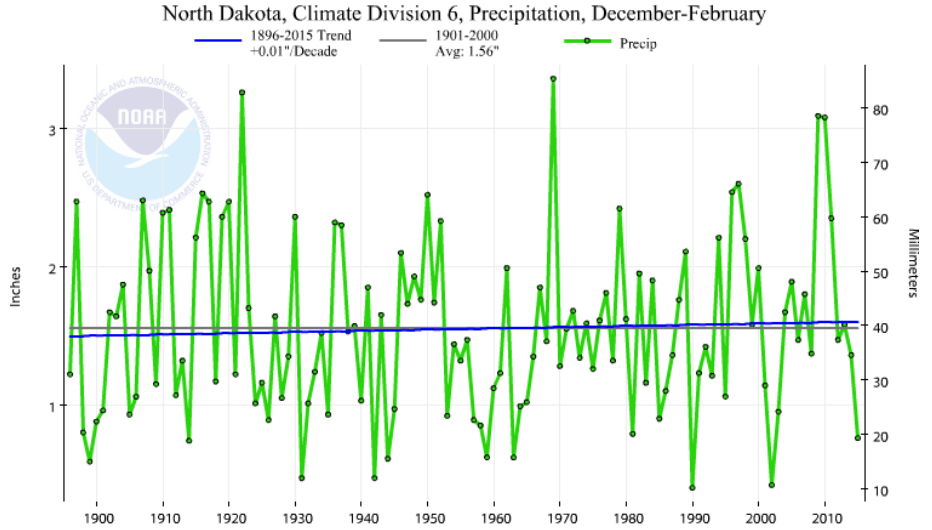
Annual Precipitation Trends SD











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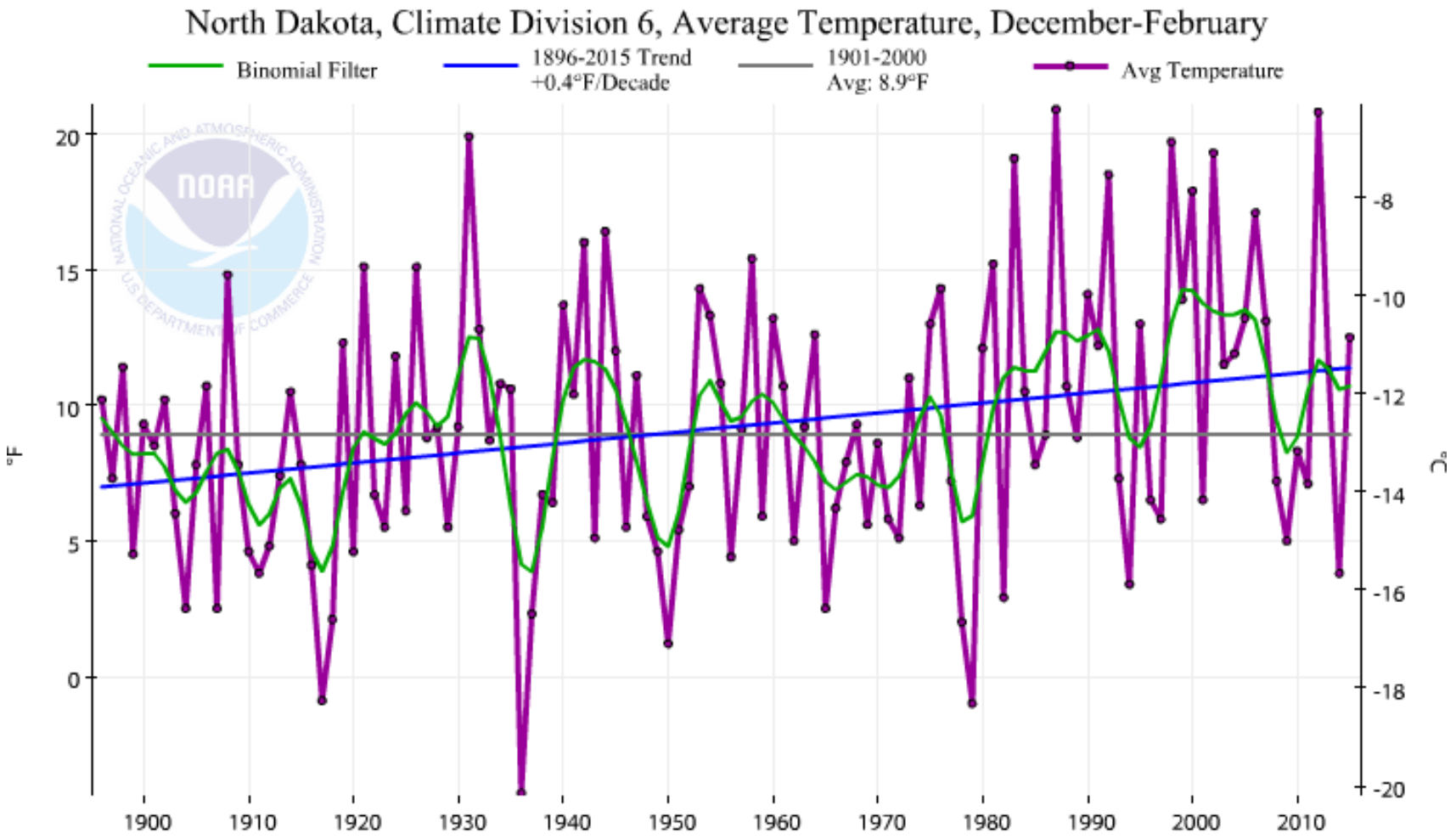
Seasonal Precipitation Trends ND


North Dakota, Climate Division 6, Average Temperature, December-February
Binomial Filter
1896-2015 Trend
+0.4°F/Decade
1901-2000
Avg: 8.9°F
Avg Temperature
°F
°C
20
15
10
5
0
-8
-10
-12
-14
-16
-18
-20
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

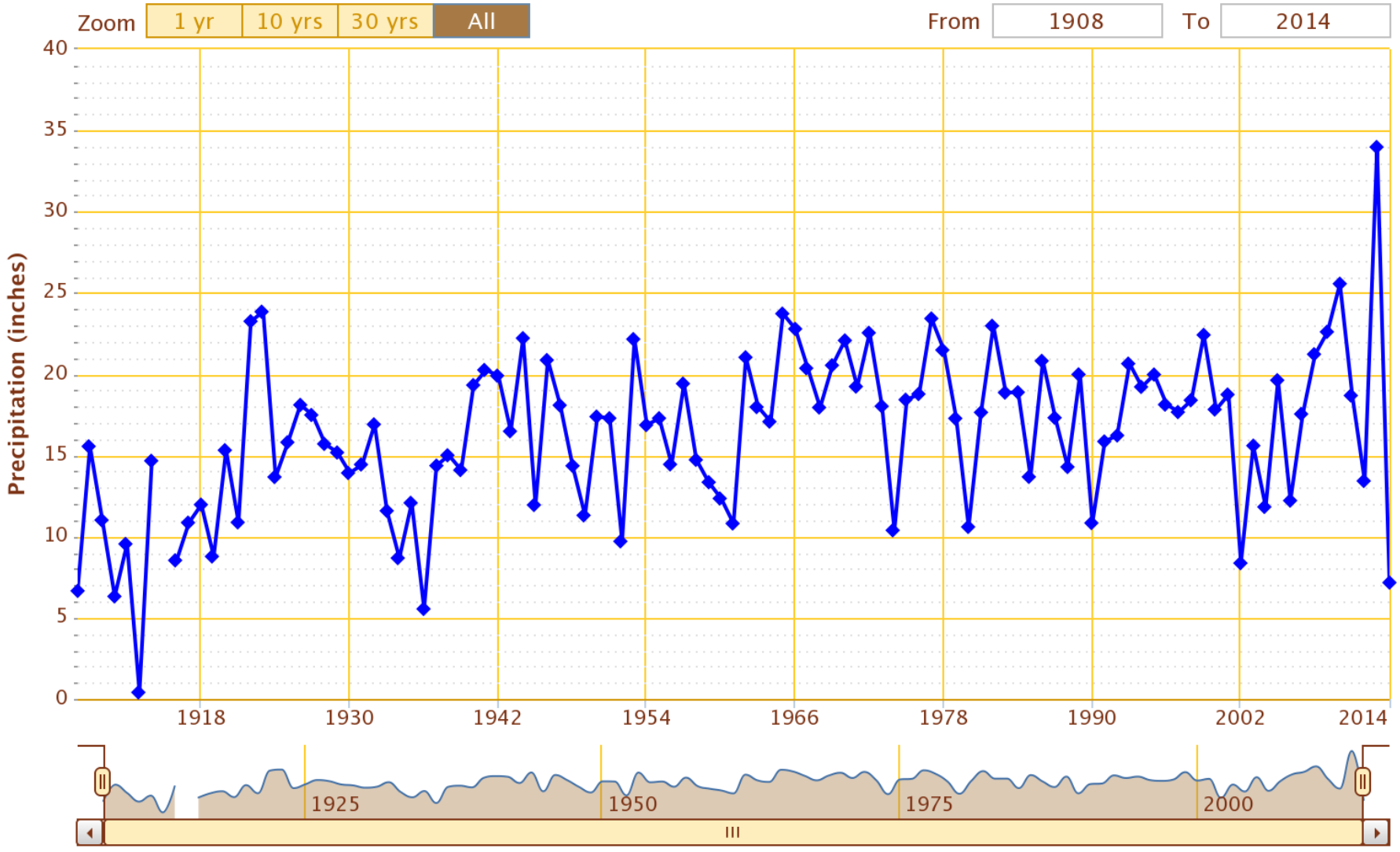
Bigger extremes

- Lemmon/Lead 2013 (near 50”)
- Canton/Sioux Falls 2014 (June 19.75”)
- Brookings 2010
- Iowa 2008
- 1993 everywhere…..

- Breaking records by large amounts

Total Precipitation – Jan through Dec – LEMMON, SD

Use navigation tools above and below chart to change displayed range



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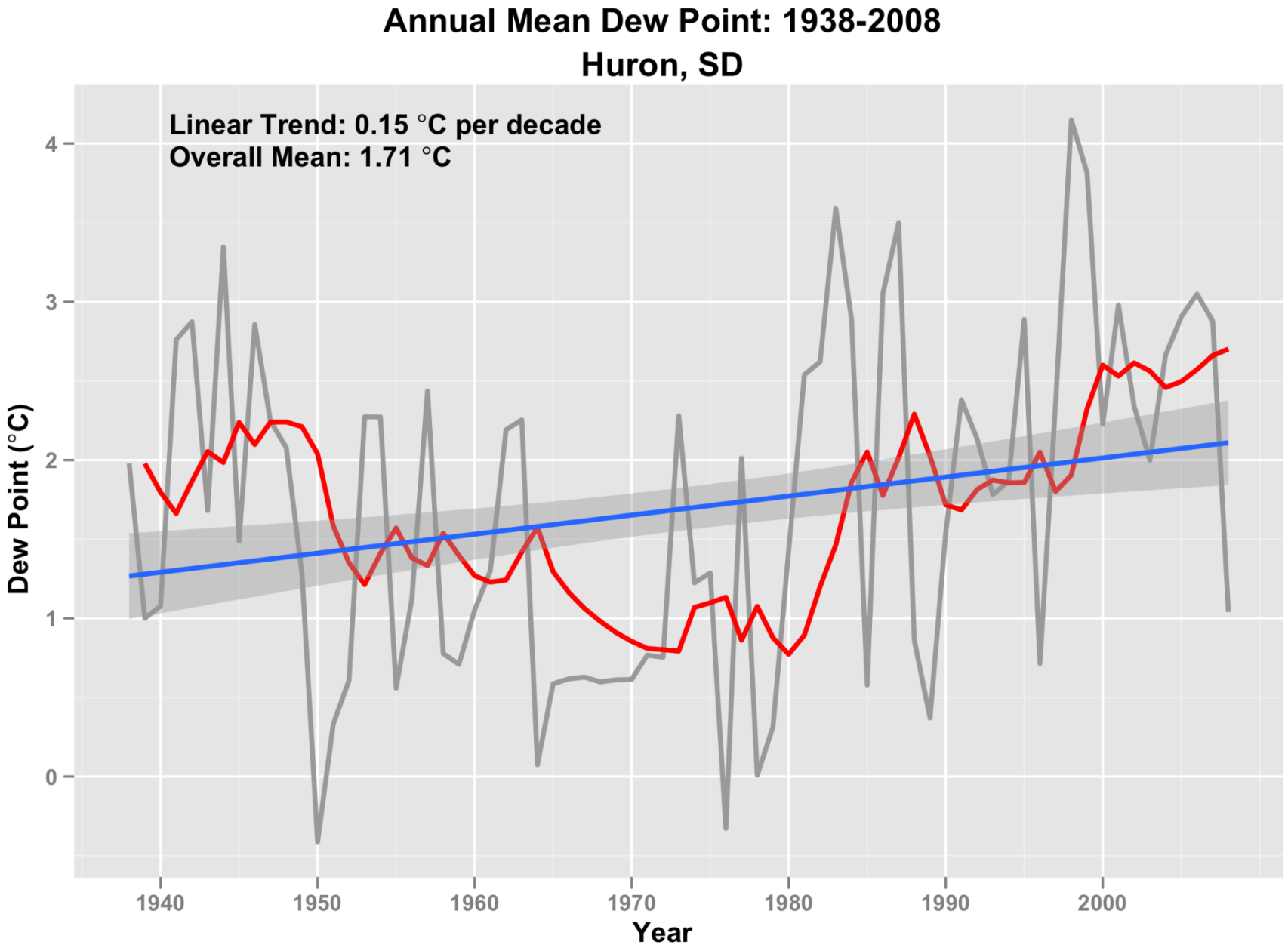
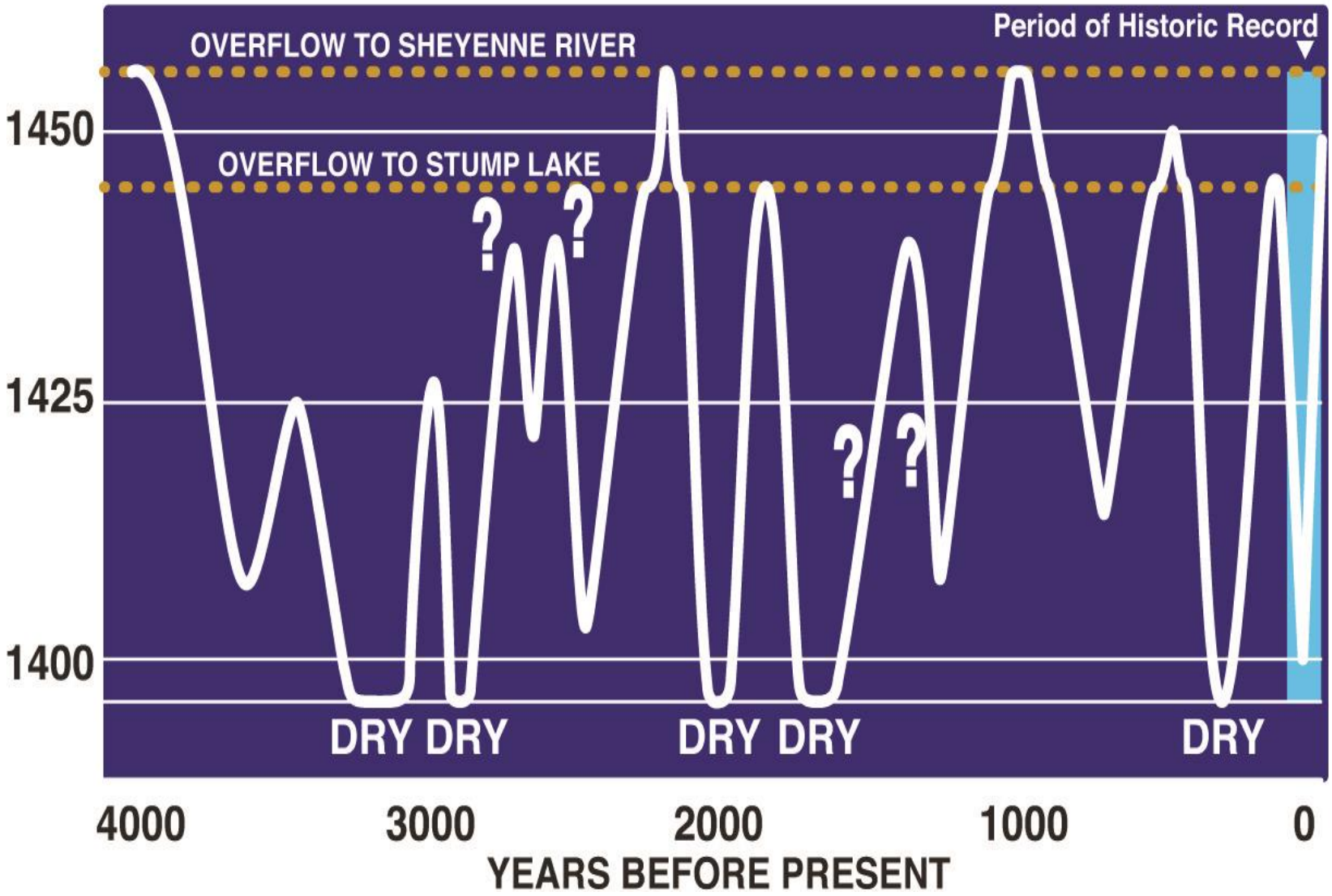
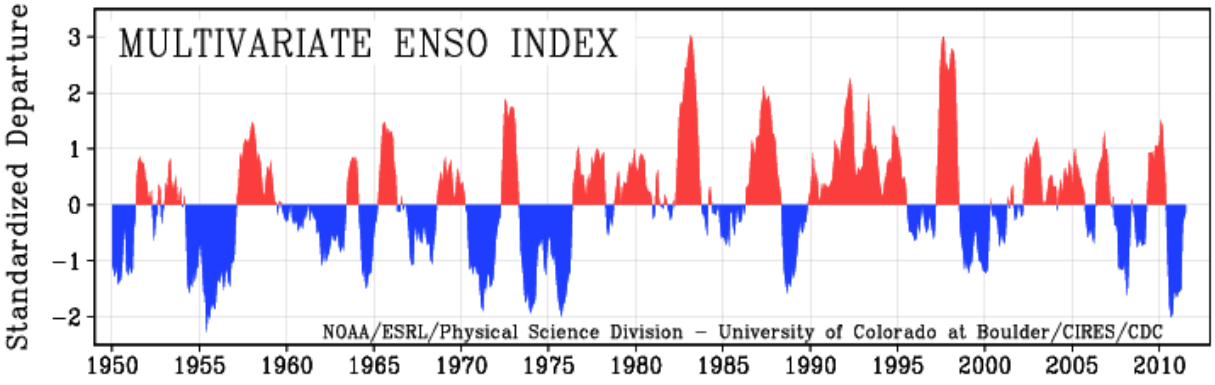

Annual Mean Dew Point: 1938-2008
Huron, SD
Linear Trend: 0.15 °C per decade
Overall Mean: 1.71 °C
Dew Point (°C)
4
3
2
1
0
1940
1950
1960
1970
1980
1990
2000
Year

DEVILS LAKE WATER LEVELS: 4000 YEARS OF FLUCTUATIONS



Climate

- **Climate Variability is not going away**
  - El Nino-Southern Oscillation (El Nino/La Nina cycle) will continue to be a factor on North American climate in the future
    - Although there is not a strong correlation for South Dakota
  - It is abnormal to be normal… even though the "normals" have changed, rarely are conditions ever normal
  - Cycles of wet and dry, hot and cold, will continue on interannual to decadal scales



http://www.esrl.noaa.gov/psd/enso/mei/

Climate Changes

- Wetter – bigger events
- Changing time of year precip – more in transition seasons (spring-fall)
- Longer growing season
- Increasing moisture content
- Warming (winter and minimum temperatures more prevalent)
- Precip extremes – bigger spring events

Climate Changes

- Wetter – bigger events (soil management)
- Changing time of year precip – more in transition seasons (spring-fall) (soil and water management)
- Longer growing season (hybrid changes)
- Increasing moisture content (disease issues)
- Warming (winter and minimum temperatures more prevalent) (disease-insect)
- Precip extremes – bigger spring events

At this point I give you permission to use your electronics!

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.

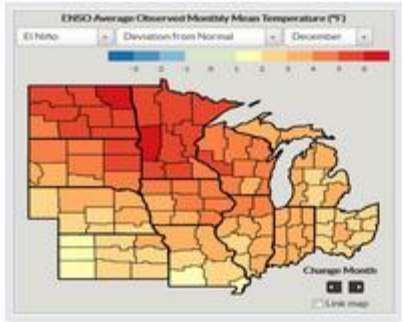
Decision Support Tools

U2U to useful to usable

U2U$_{DST}$ SUITE

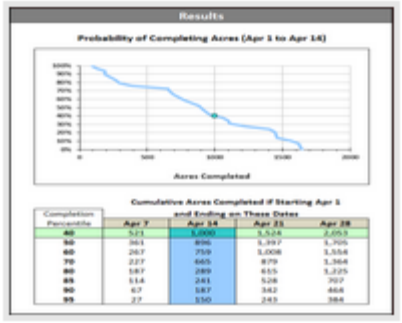
AgClimate View$_{DST}$

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.

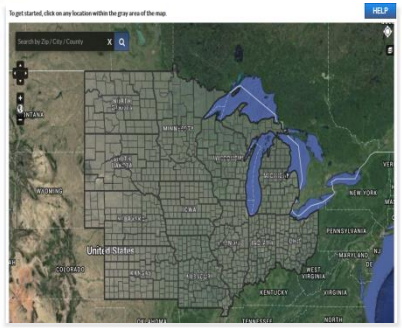


Probable Fieldwork Days$_{DST}$

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!)

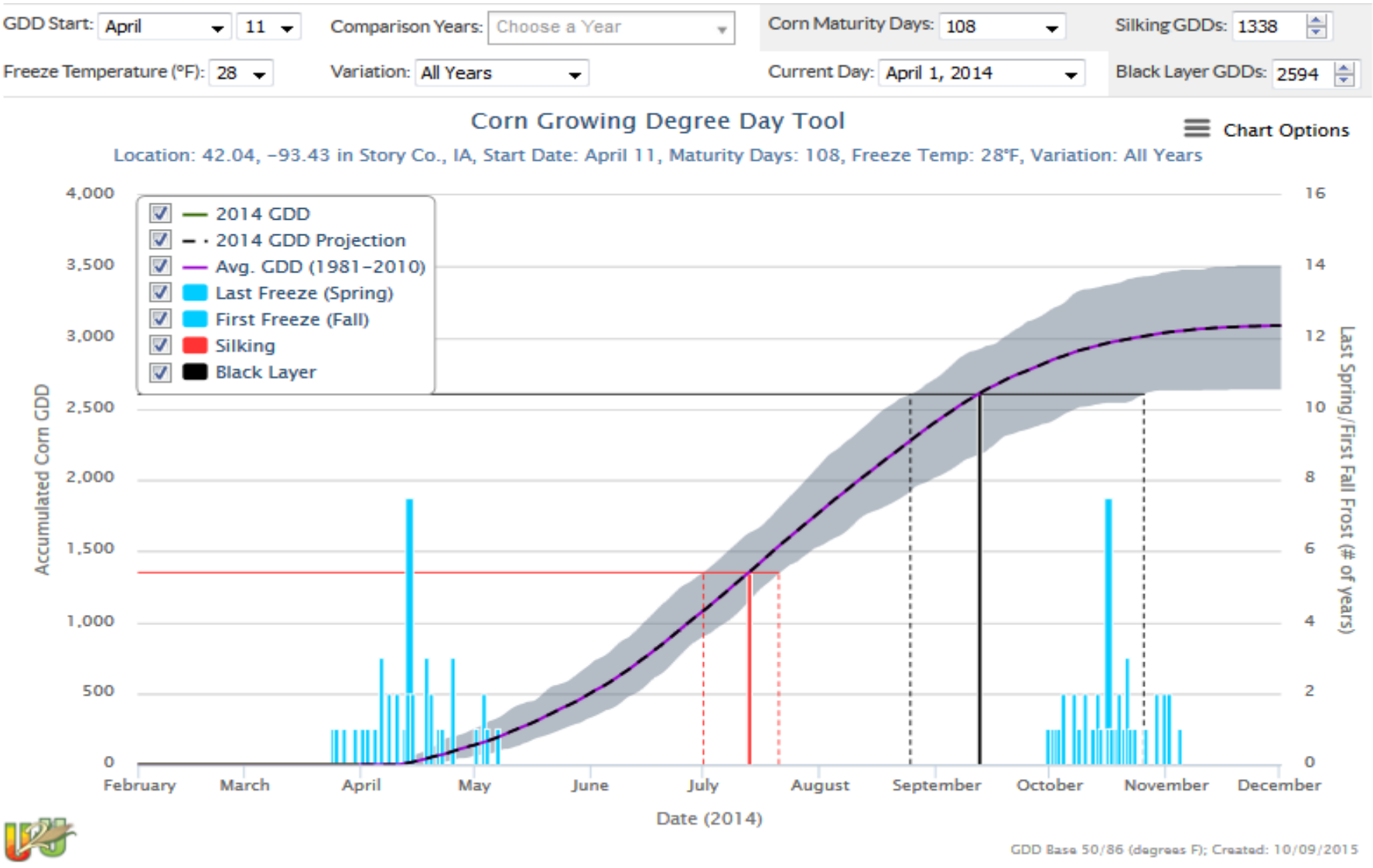
Determine the feasibility and profitability of using post-planting nitrogen application for corn production. This product combines historical data on crop growth and fieldwork conditions with economic considerations to determine best/worst /average scenarios of successfully completing nitrogen applications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

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.

GDD Graph



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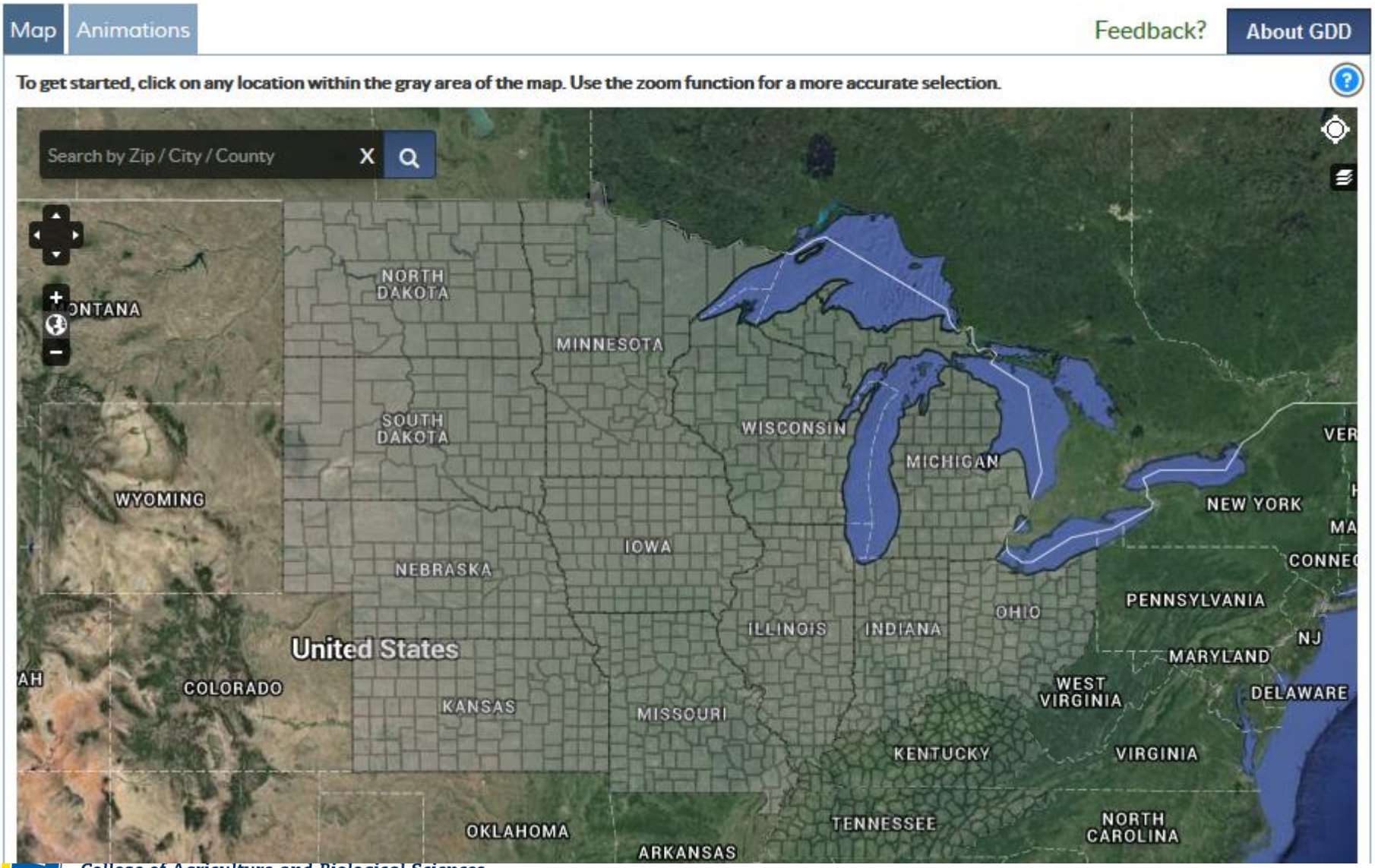
www.AgClimate4U.org

Pick Your Location



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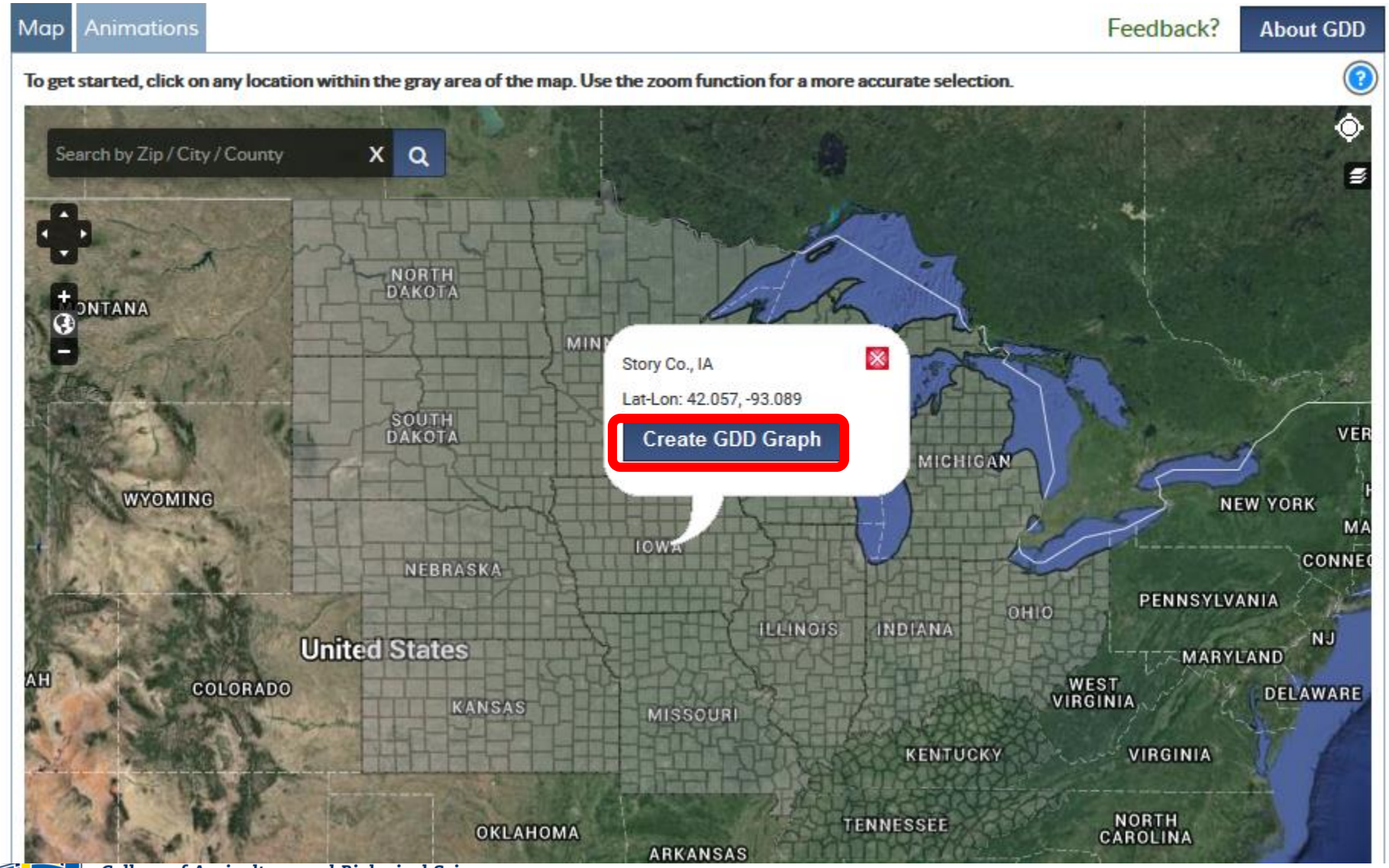
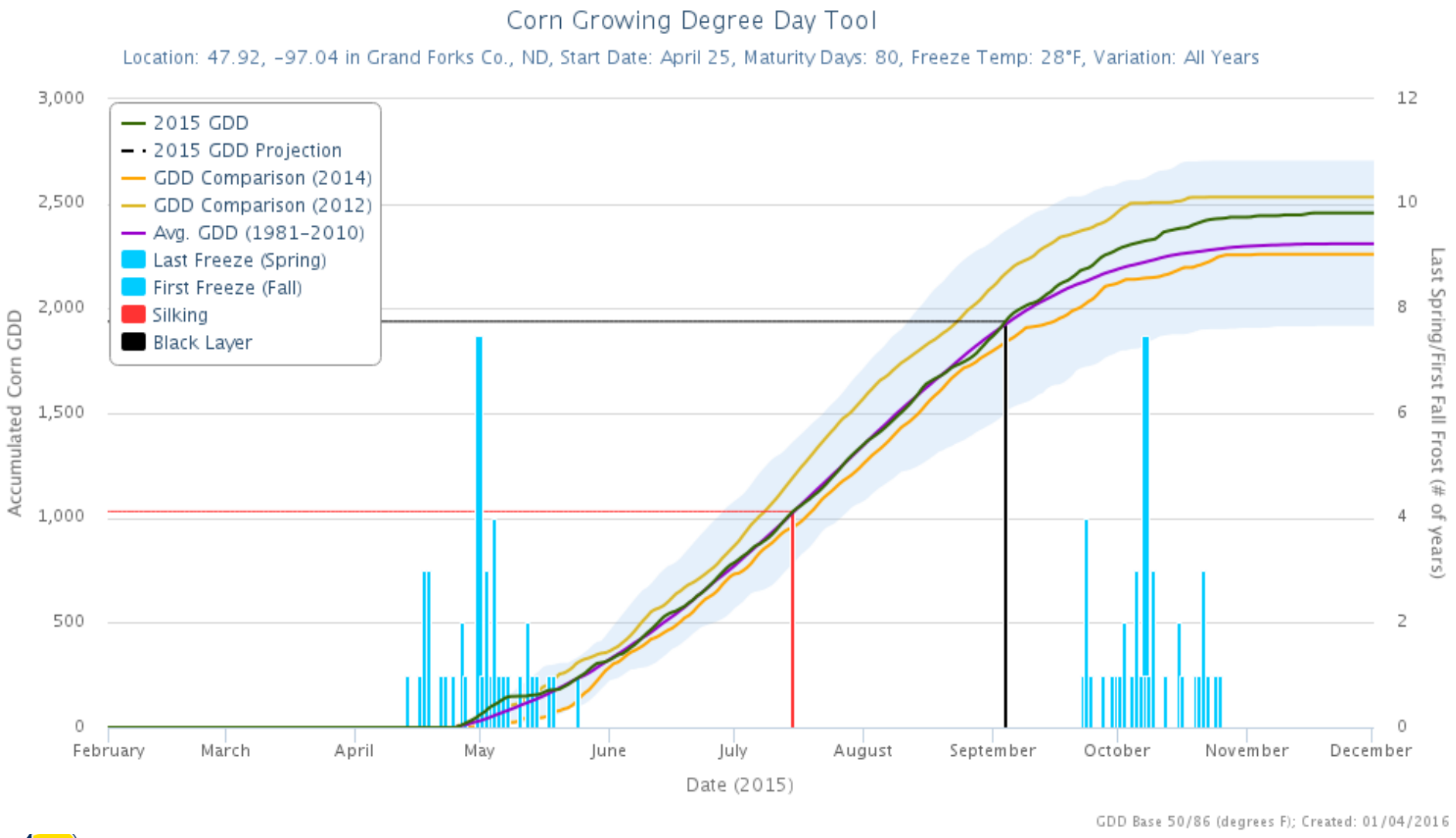
www.AgClimate4U.org

For Example:

useful to usable



GDD Graph


Corn Growing Degree Day Tool
Location: 47.92, -97.04 in Grand Forks Co., ND, Start Date: April 25, Maturity Days: 80, 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
3,000
2,500
2,000
1,500
1,000
500
0
Last Spring/First Fall Frost (# of years)
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: 01/04/2016

Data Details and Download

Map | Graph | Data | Animations

Feedback? About GDD

This tab provides a text-only view of current and historical Corn (86/50) GDD accumulations, silking and black layer dates, and first/last freeze dates.

GDD Start: April 11 | Corn Maturity Days: 108 | Silking GDDs: 1338

Freeze Temperature (°F): 28 | Variation: All Years | Current Day: Today | Black Layer GDDs: 2594

User Input Summary

Location (lat, long):	42.057, -93.089
Location (county, state):	Story Co., IA
GDD Start Date:	April 11, 2015
Today's Date:	March 16, 2015
Latest Data Available:	March 15, 2015
Corn Maturity Days:	108 days
Growing Degree Days to Silking:	1338
Growing Degree Days to Black Layer:	2594

Corn Growing Degree Day (GDD) Results

	This Year (2015)	30-Year History (1981 - 2010) Average	Occurs within 100% of the time
GDD Accumulation (not available)	**	**	**
V2 Date	**	May 15	May 3 - May 27
V4 Date	**	May 28	May 15 - June 10
V6 Date	**	June 7	May 28 - June 18
V8 Date	**	June 16	June 6 - June 26
V10 Date	**	June 24	June 14 - July 4
Silking Date	**	July 12	June 30 - July 21
Blacklayer Date	**	September 12	August 25 - October 10

Freeze Results (28°F)

Last Spring Freeze	March 15	April 14	March 25 - May 7
Freeze Probability after April 11	61%		
First Fall Freeze		October 16	September 23 - November 4
Freeze Probability before Black Layer	9%		

** = Not available since, GDD start date is after today's date; use information under 30-year history

Accumulated GDD Details

Tool Tips:

- Select the blue question mark icon in the top right corner of the tab section for instructions and other information.

Download Data

College of Agriculture and Biological Sciences

www.AgClimate4U.org

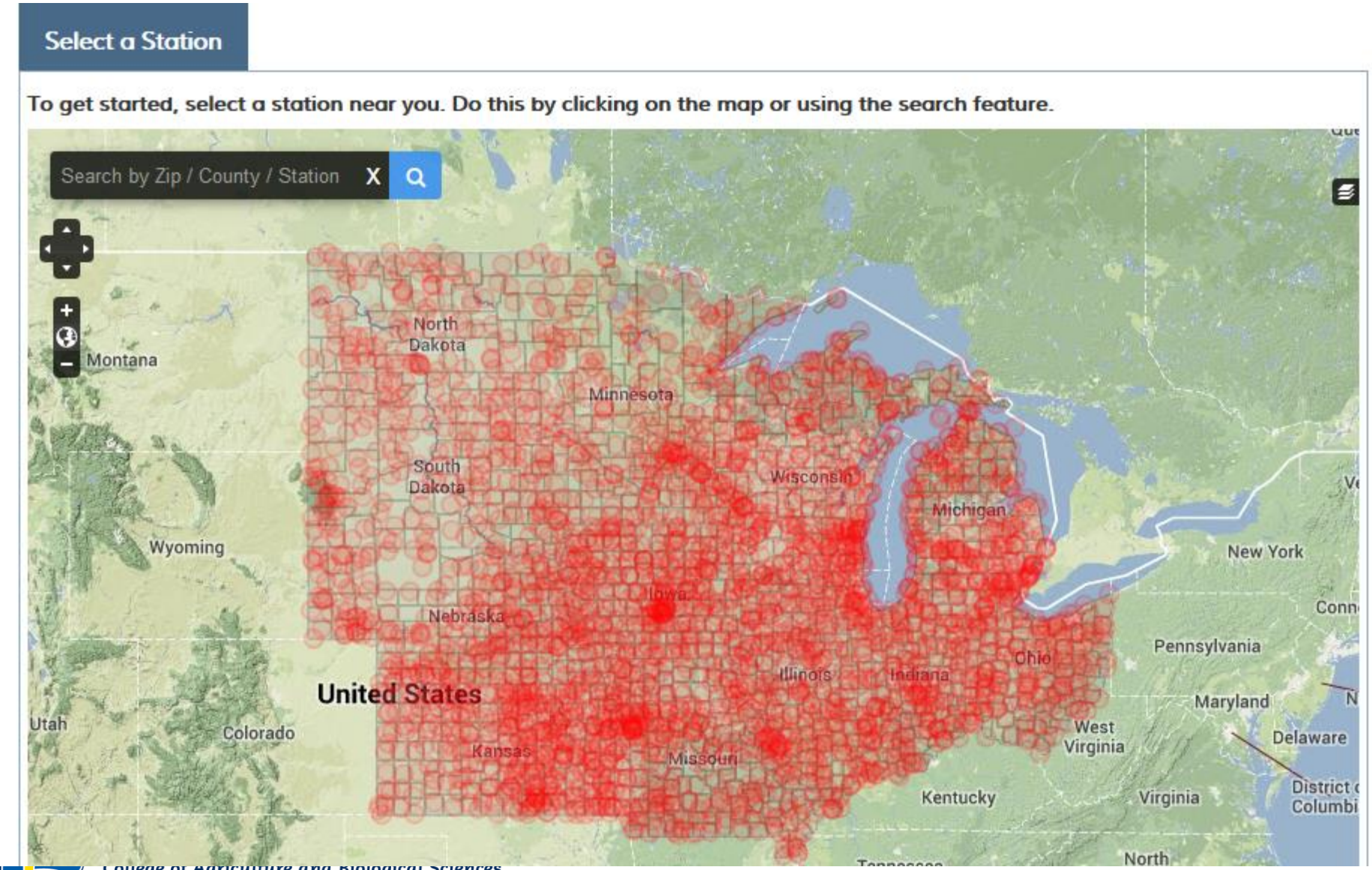
AgClimate View

- 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

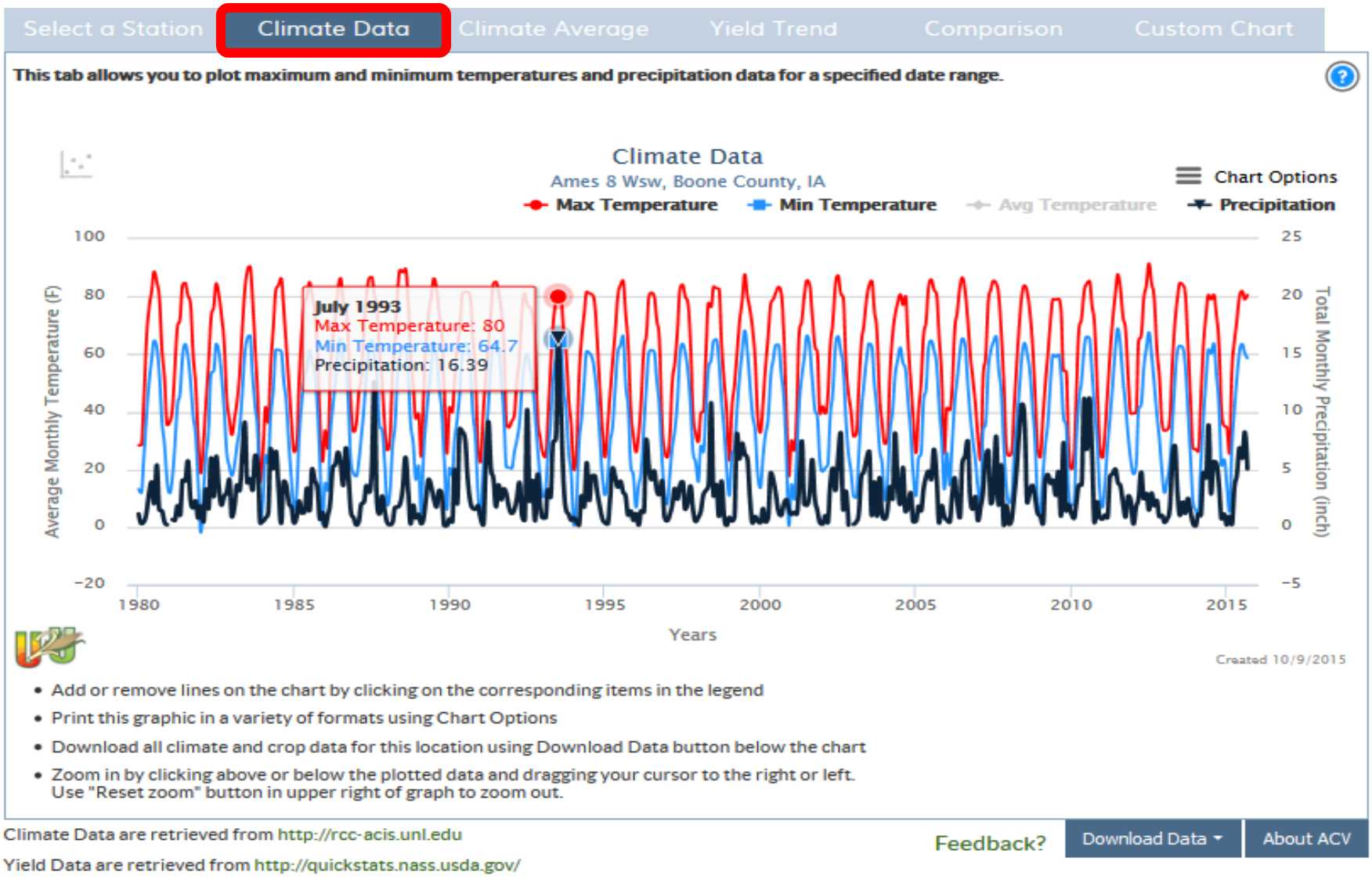
Used in tandem with other decision resources, AgClimate View can help you find long-term correlations between climate trends and yields, while helping you put your recent crop experience into historical context.

Start by Selecting a Location

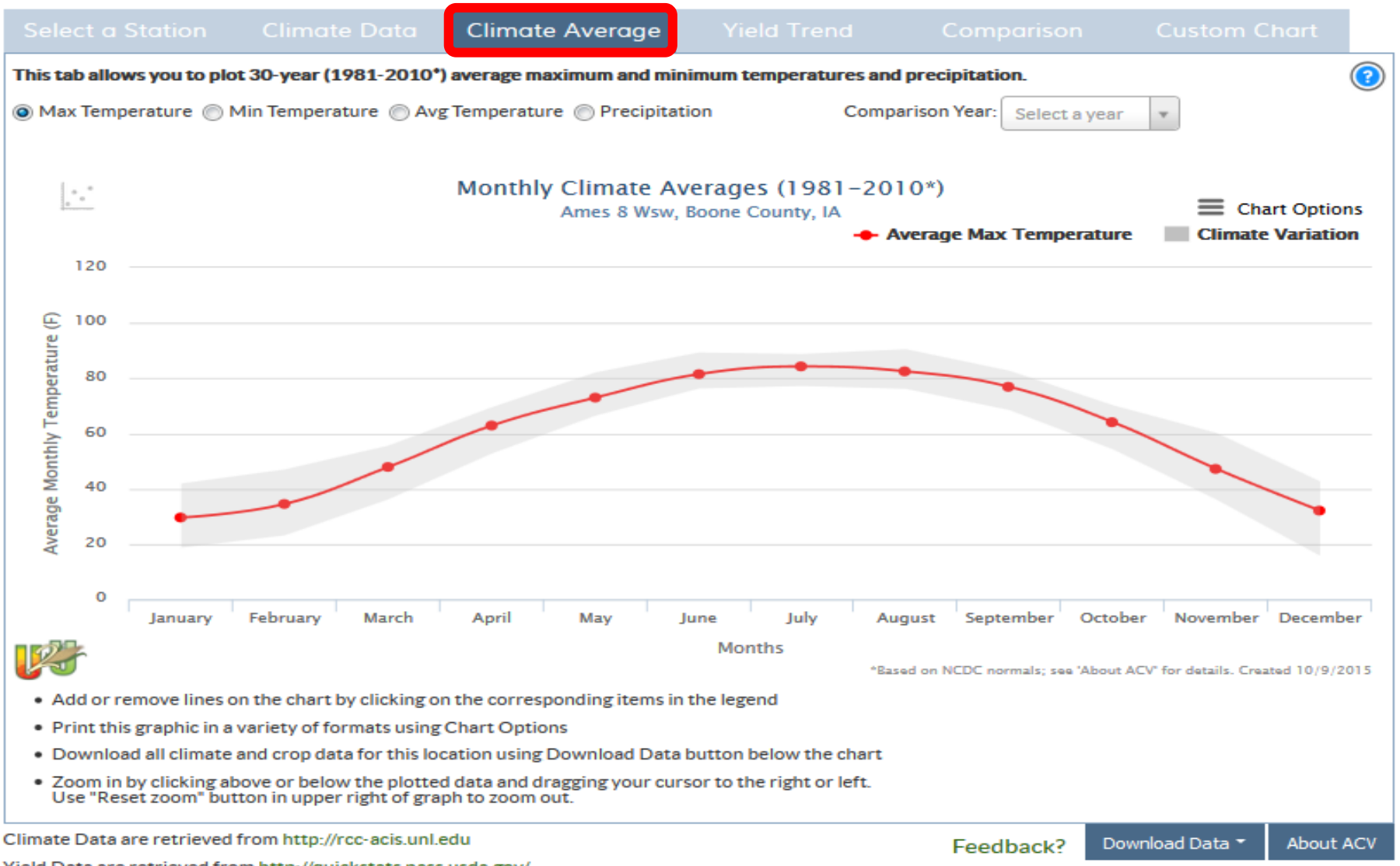
useful to usable



Historical Weather Data



Climate Averages

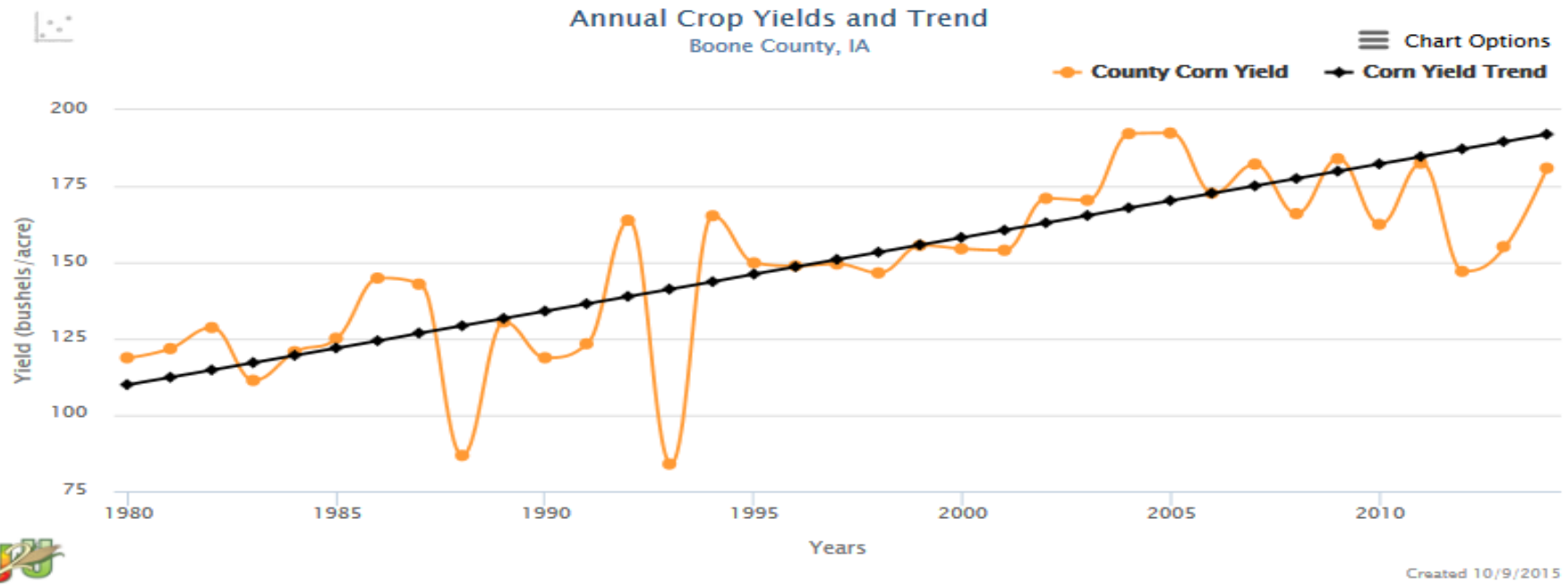


Crop Yields and Trends

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

Combine the Data

useful to usable

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

This tab allows you to plot countywide annual yield data with up to two climate variables.

Step 1: Select one of the crops

(•) Corn ( ) Soybean ( ) None

Step 2: Select up to two monthly climate variables

Show Weather Values

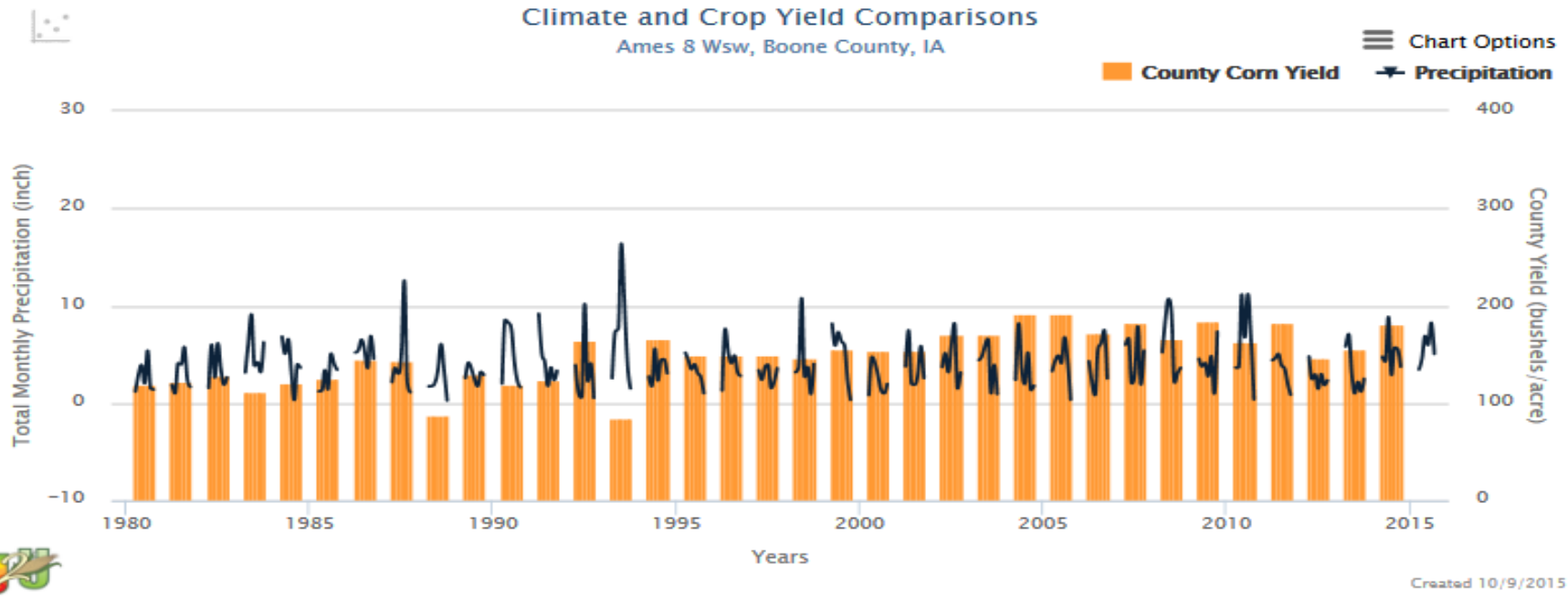
[ ] Max Temperature [ ] Min Temperature [x] Precipitation [ ] GDD50 [ ] SDD90

Step 3: Select start & end month range to plot

April — October

Step 4: Select start & end year range to plot

1980 — 2015



- 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

Climate Patterns Viewer

This tool provides a 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.

Mapping the Relationships

U2U Decision Support Tools - Climate Patterns Viewer

Welcome to Climate Patterns Viewer – connecting global climate conditions to local climate impacts.

This product provides a historical look at how the El Niño Southern Oscillation (ENSO) and Arctic Oscillation (AO) can influence local climate conditions and corn yield across the Corn Belt. You can use these simple maps and charts to show when and where specific phases of ENSO or AO have influenced:

- average monthly temperatures and precipitation,
- deviations of temperature and precipitation from 1981-2010 climate normals, and
- average detrended corn yields (adjusted to 2010 technology) and deviations from average

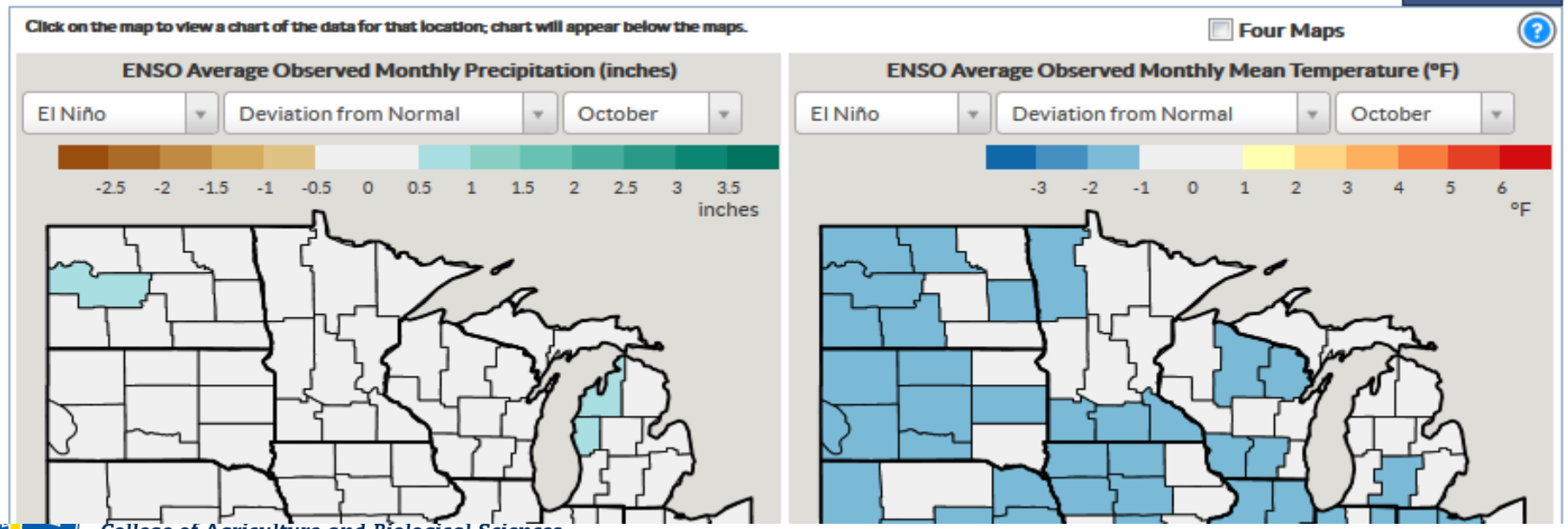
CURRENT CLIMATE PHASE
ENSO: El Niño
AO: Negative (July)

ENSO ALERT STATUS
El Niño Advisory

This tool is not intended to be a forecast. Rather, this tool uses historical data (1981-2010) to highlight locations where ENSO and AO can potentially impact climate conditions over the course of the year, which can help you make more informed farm management decisions.

Feedback? About CPV

Click on the map to view a chart of the data for that location; chart will appear below the maps. Four Maps



Types of Impacts

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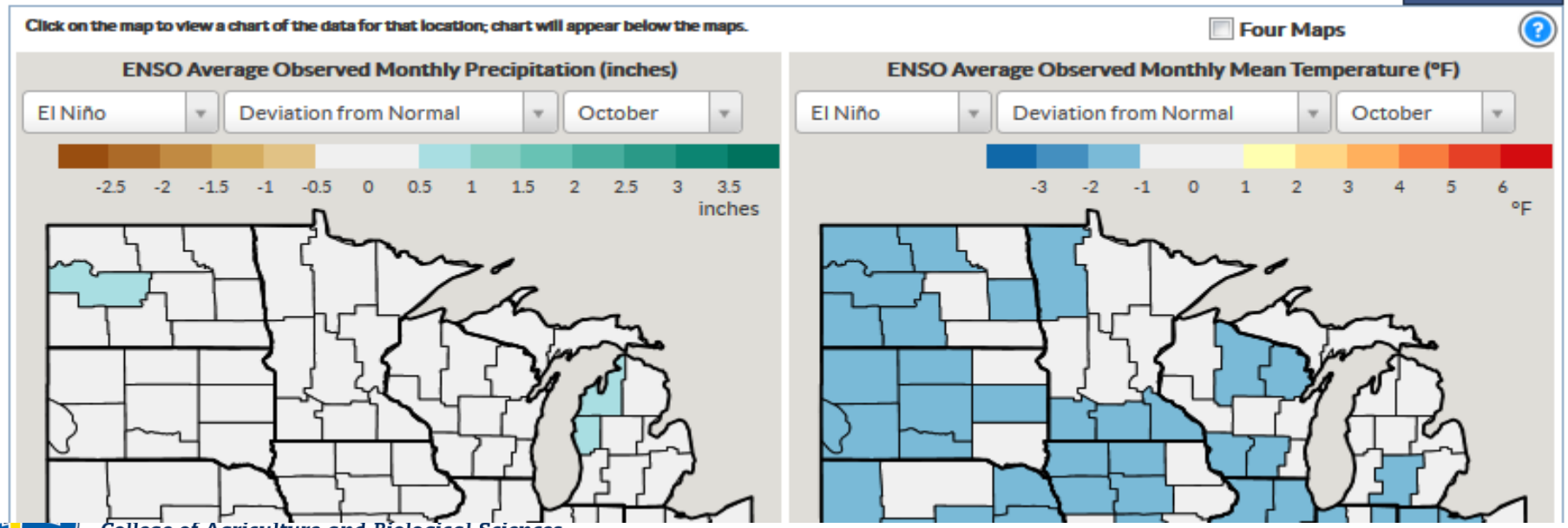

Current Conditions

U2U Decision Support Tools - Climate Patterns Viewer

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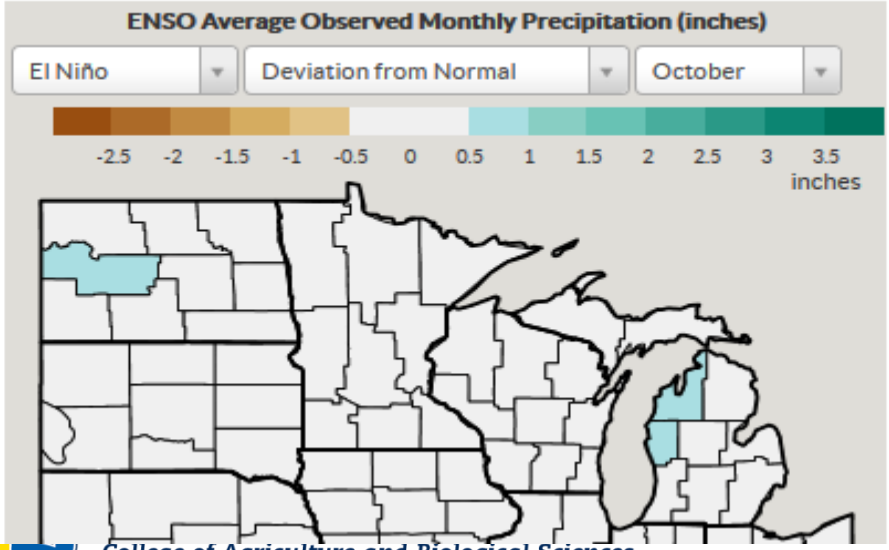
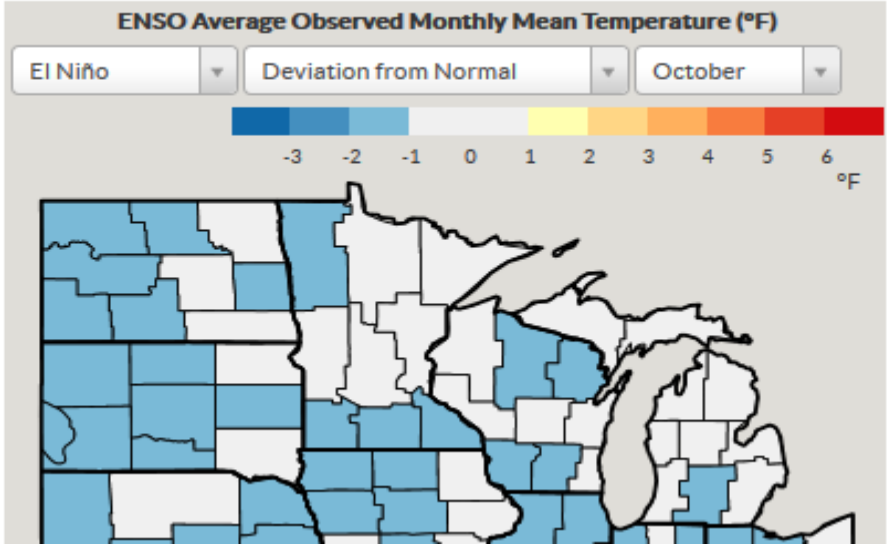
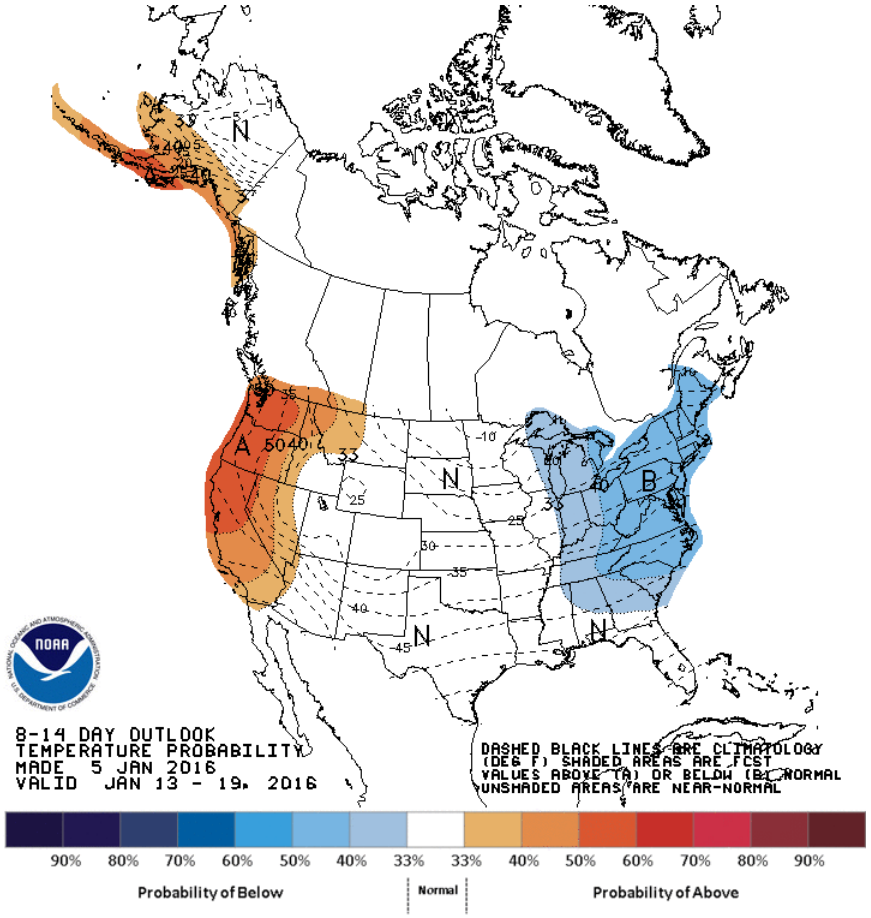
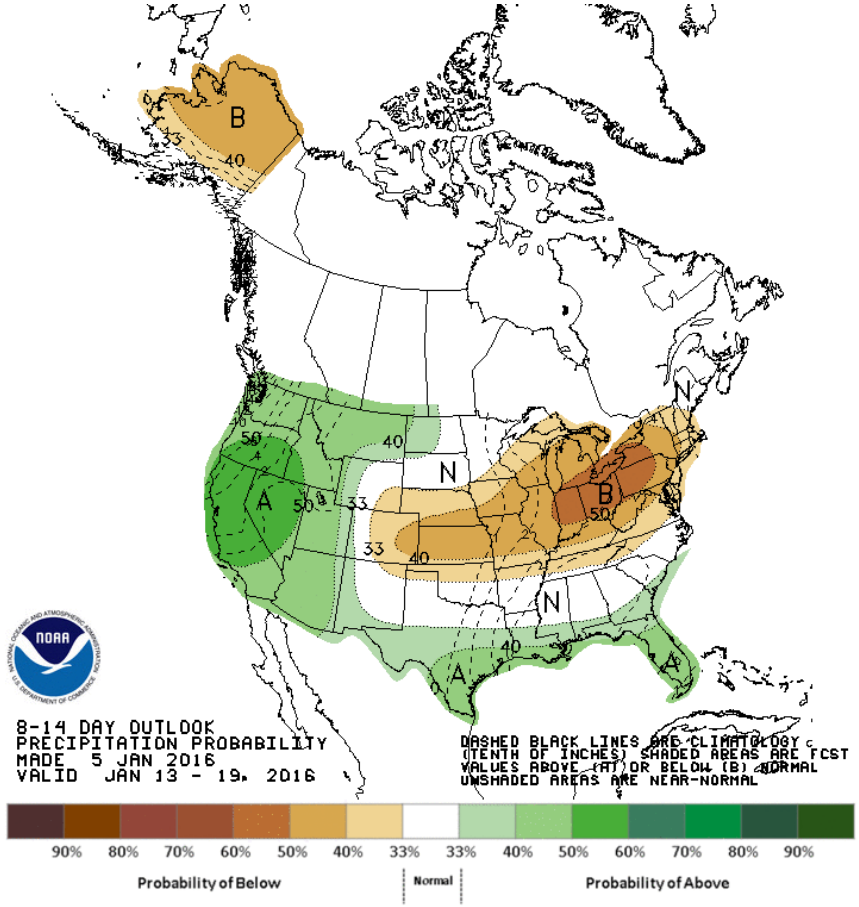




OUTLOOK 2016

8-14 Day Outlook



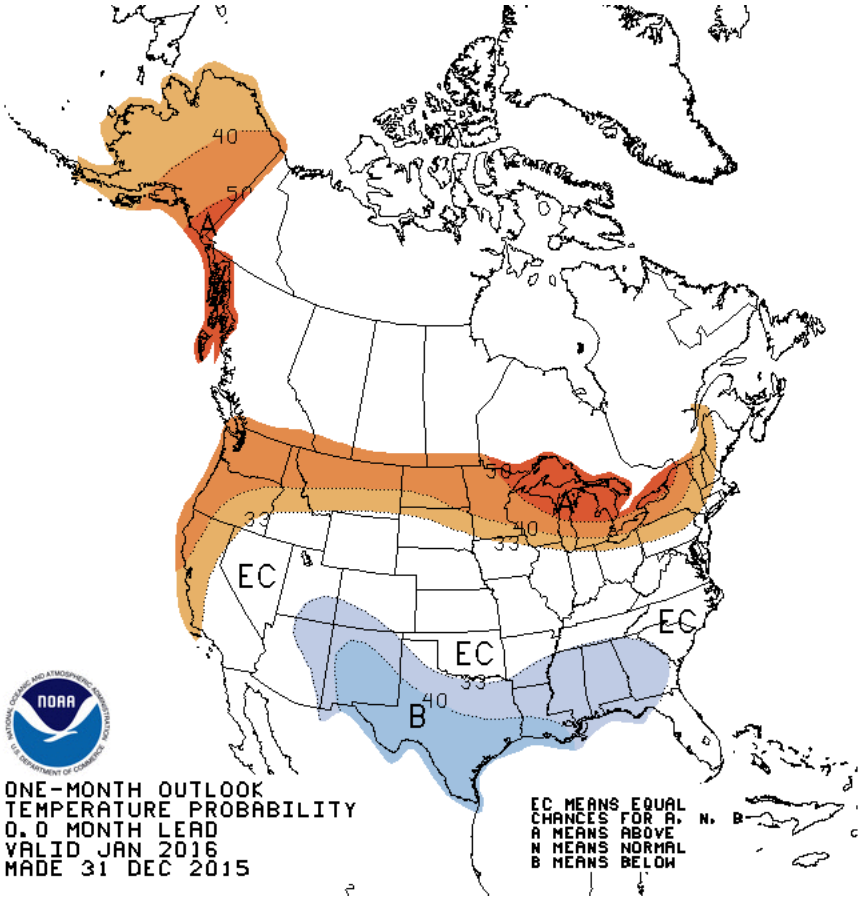


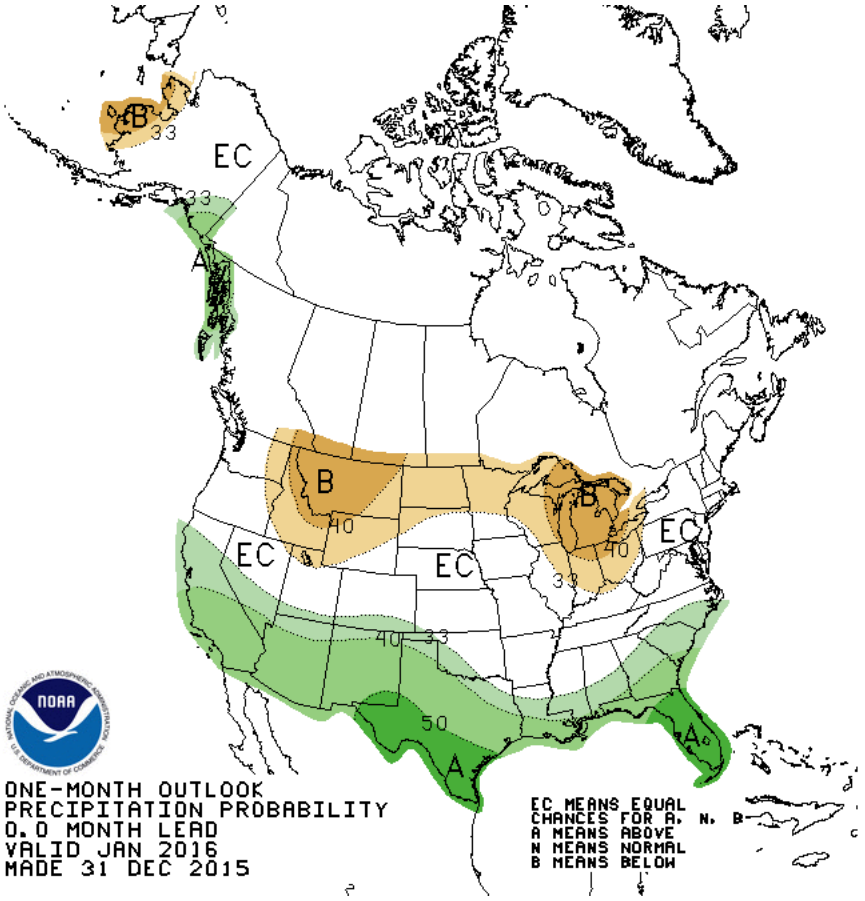
http://www.cpc.ncep.noaa.gov/

South Dakota State University
College of Agriculture and Biological Sciences

South Dakota Climate and Weather

30 Day Outlook





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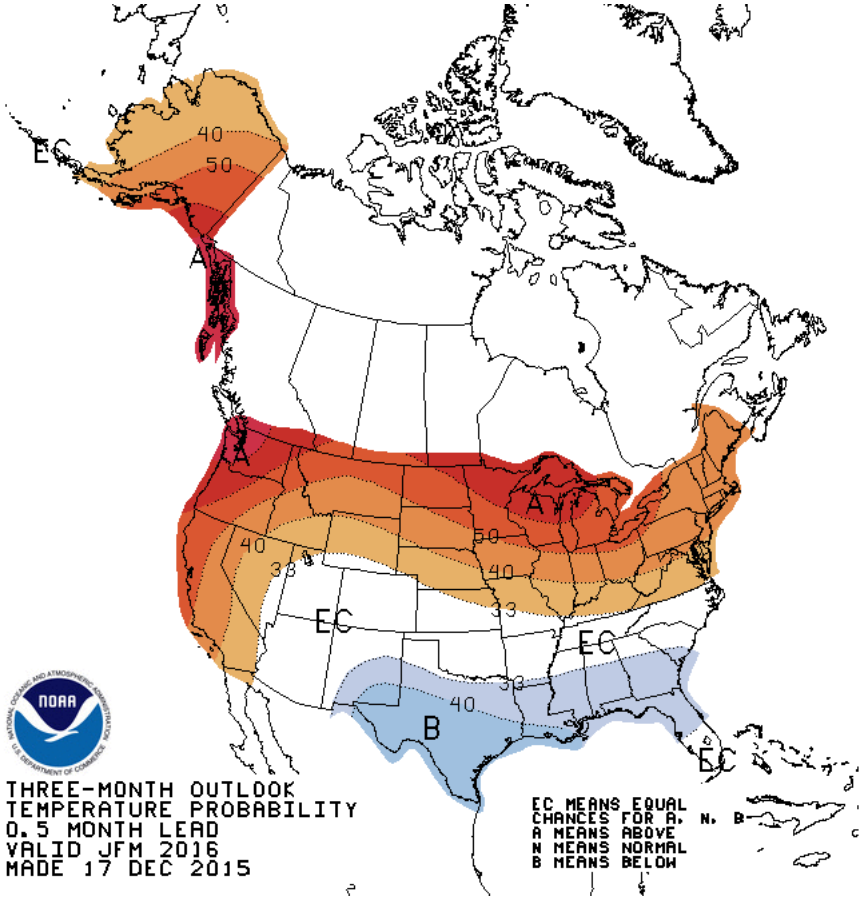
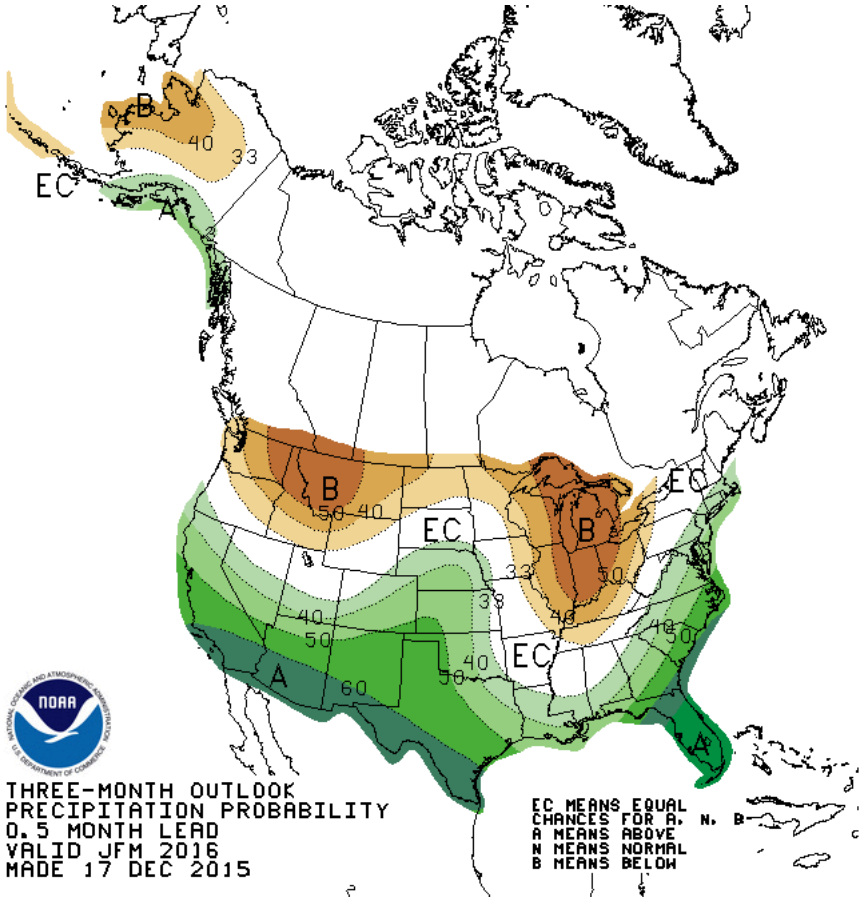
South Dakota Climate and Weather

90 Day Outlook



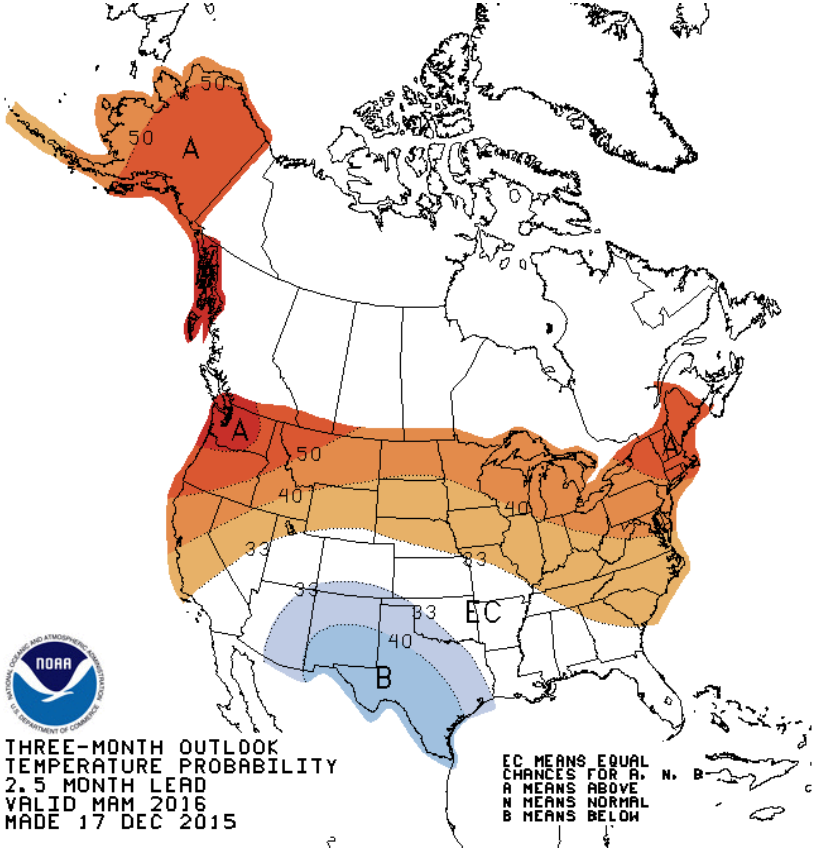


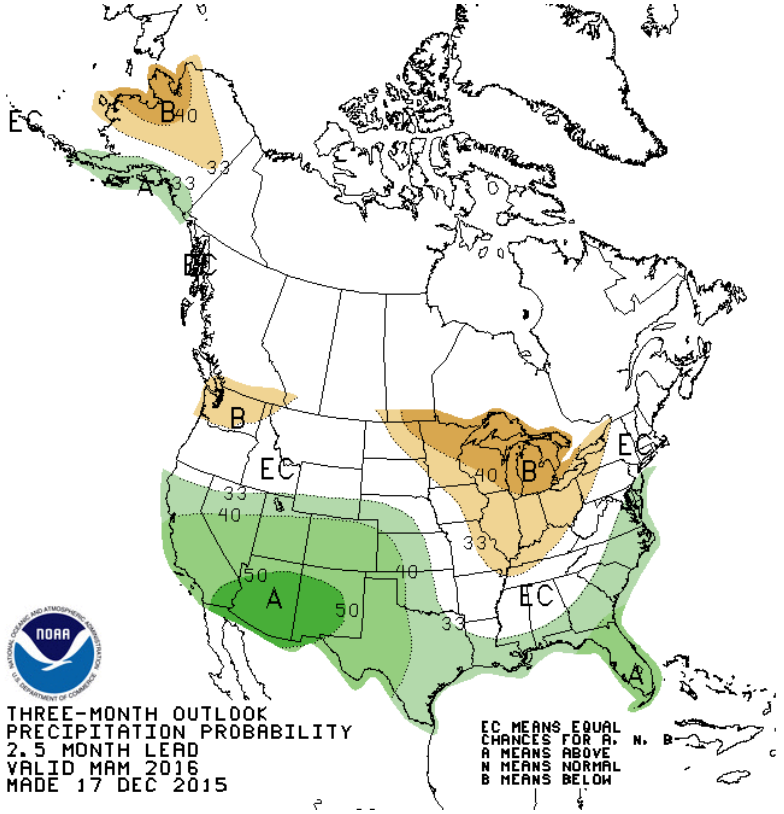
http://www.cpc.ncep.noaa.gov/

South Dakota State University
College of Agriculture and Biological Sciences

South Dakota Climate and Weather

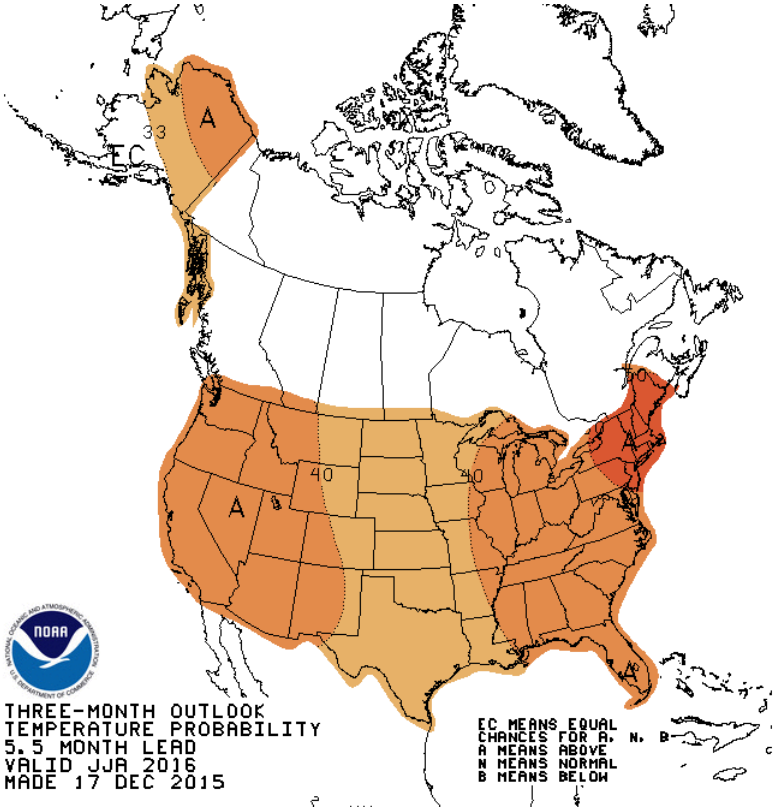
3 Month Temperature and Precipitation Probabilities (March - May)

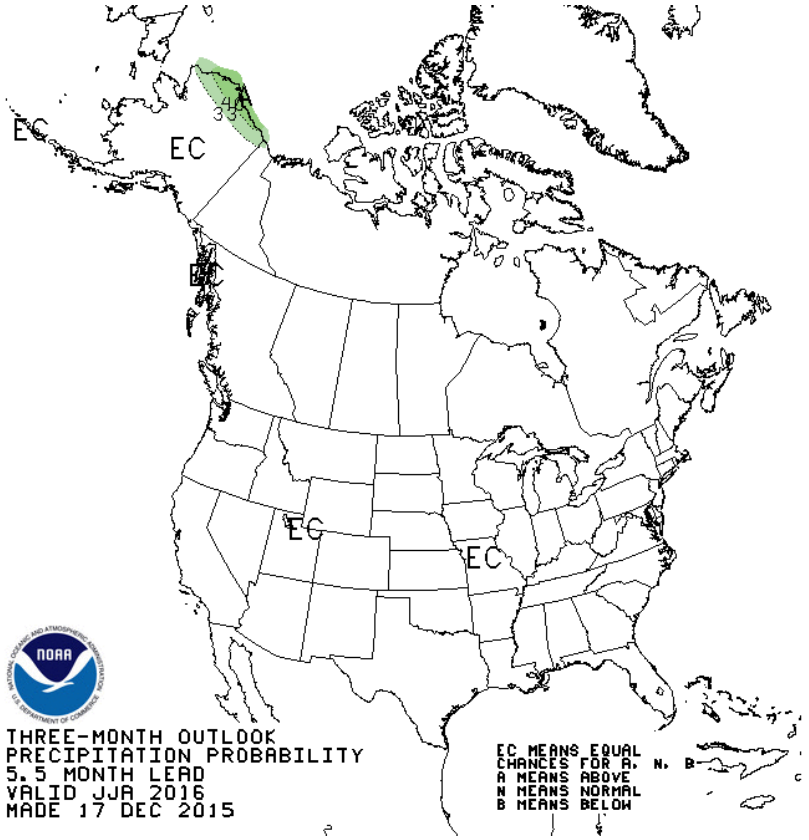




http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1

3 Month Temperature and Precipitation Probabilities (June - August)





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

Outlook Summary

- Summer leaning warmer.
- Little indication on precipitation
- Spring – more likely depend on local soil moisture situation (should not slow down too much – dry fall)
- Lesser chance of too cool spring.

Monthly Outlook Webinars

- State climatologists, regional climate centers, NOAA, NDMC, USDA cooperating on monthly drought outlook webinars

- Third Thursday of each month

  July 17, 2014

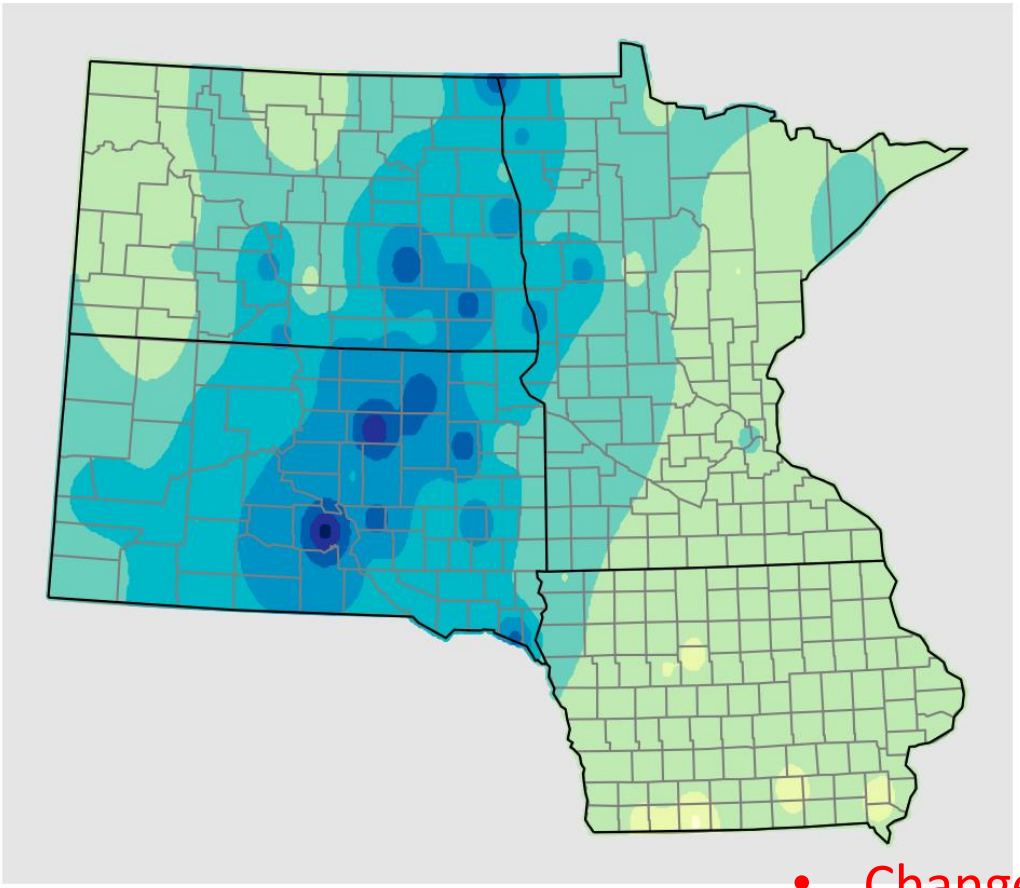
  You may sign up for the webinars here:

  http://drought.gov/drought/content/regional-programs/regional-drought-webinars

Questions?

- Dr. Dennis Todey
- South Dakota State Climatologist
- dennis.todey@sdstate.edu
- 605-688-5678
- http://climate.sdstate.edu
- Facebook: SDSUclimate
- Blog: http://www.sustainablecorn.org/blog/

Large increases in fall precip. across the eastern Dakotas



- Change in fall (SON) precipitation (%)
- 1991-2009 as compared to 1961-1990

June, July, August Outlook 2016