Needs for S2S Prediction of Summer Precipitation for Agricultural Water Users

Laura Edwards

South Dakota State Climatologist

May 24, 2019

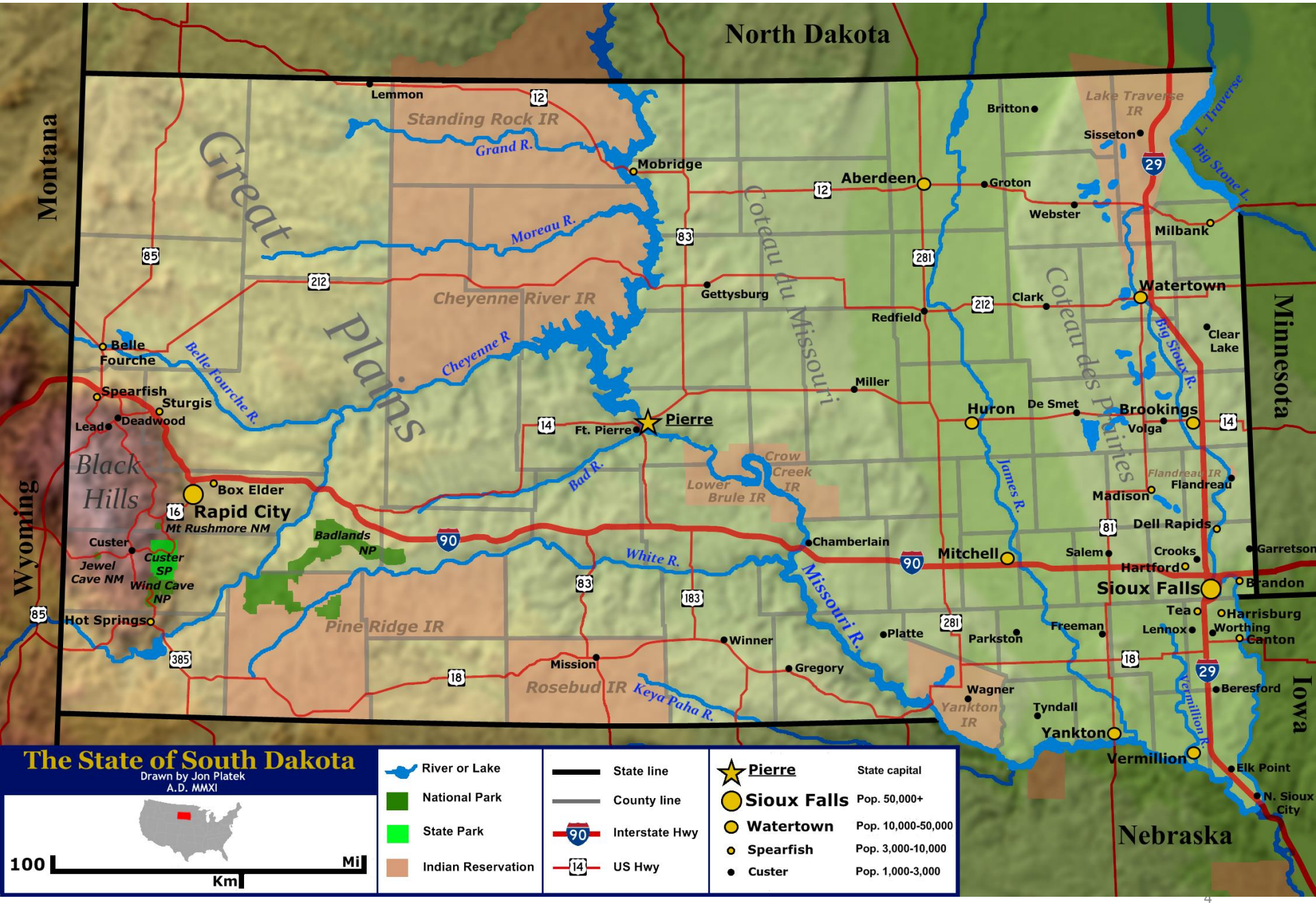
What does the SD state climatologist do?

- Communication, communication, communication
- Interface between research & users/decision makers
- Translate federal agency info to public
- Focus on agricultural& natural resource audiences (Extension), planning/preparedness on S2S timescales
- State level task forces and hazard team
- No forecasting/modeling capabilities
- Traditional media & social media

South Dakota: Land of Extremes

- Flooding
- Drought
- Tornado, thunderstorms
- Hail, wind
- Blizzards

- All can have some long lasting impacts on the agricultural sector

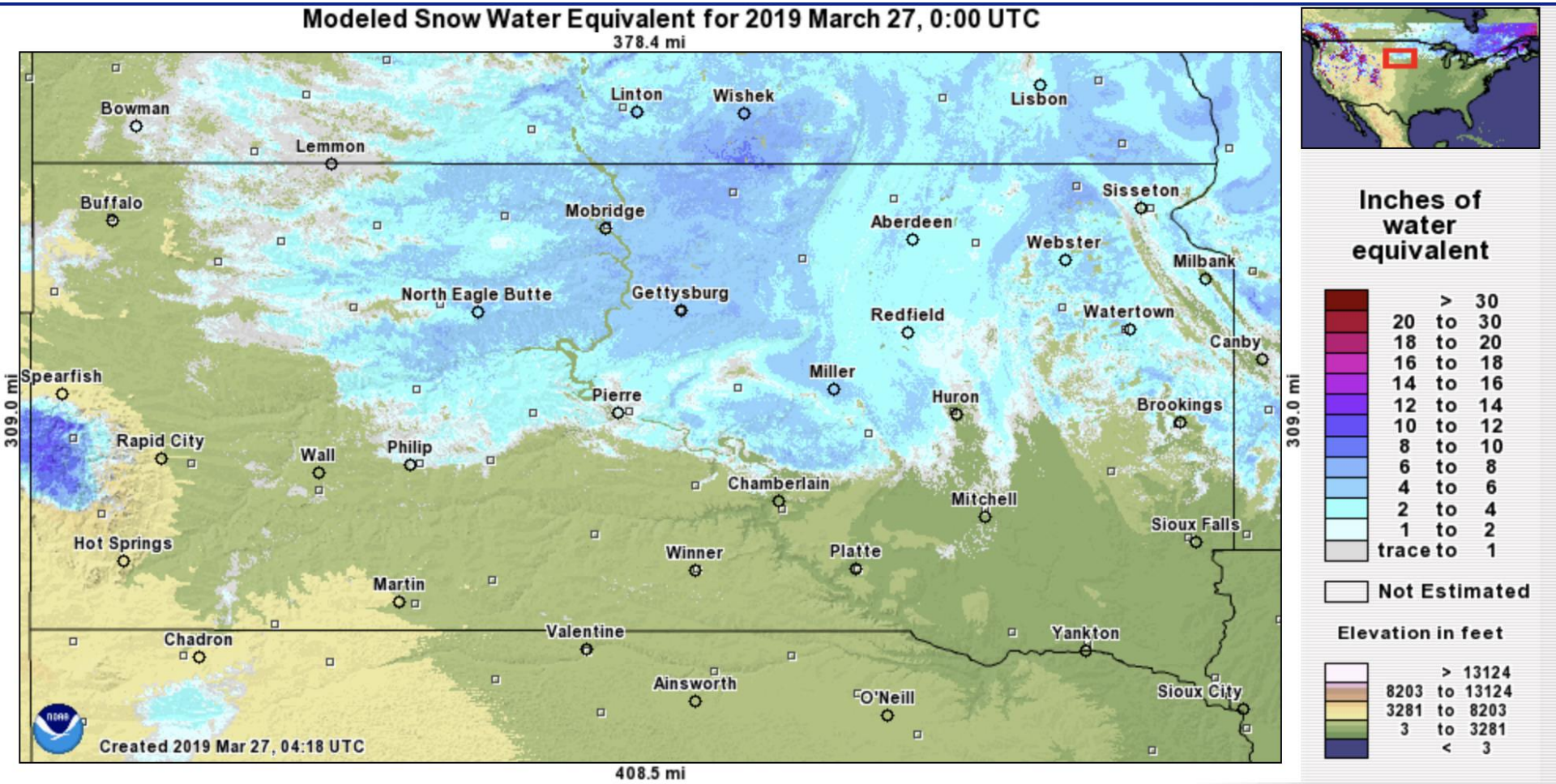


https://commons.wikimedia.org/wiki/File:South_Dakota_general_map_2.png

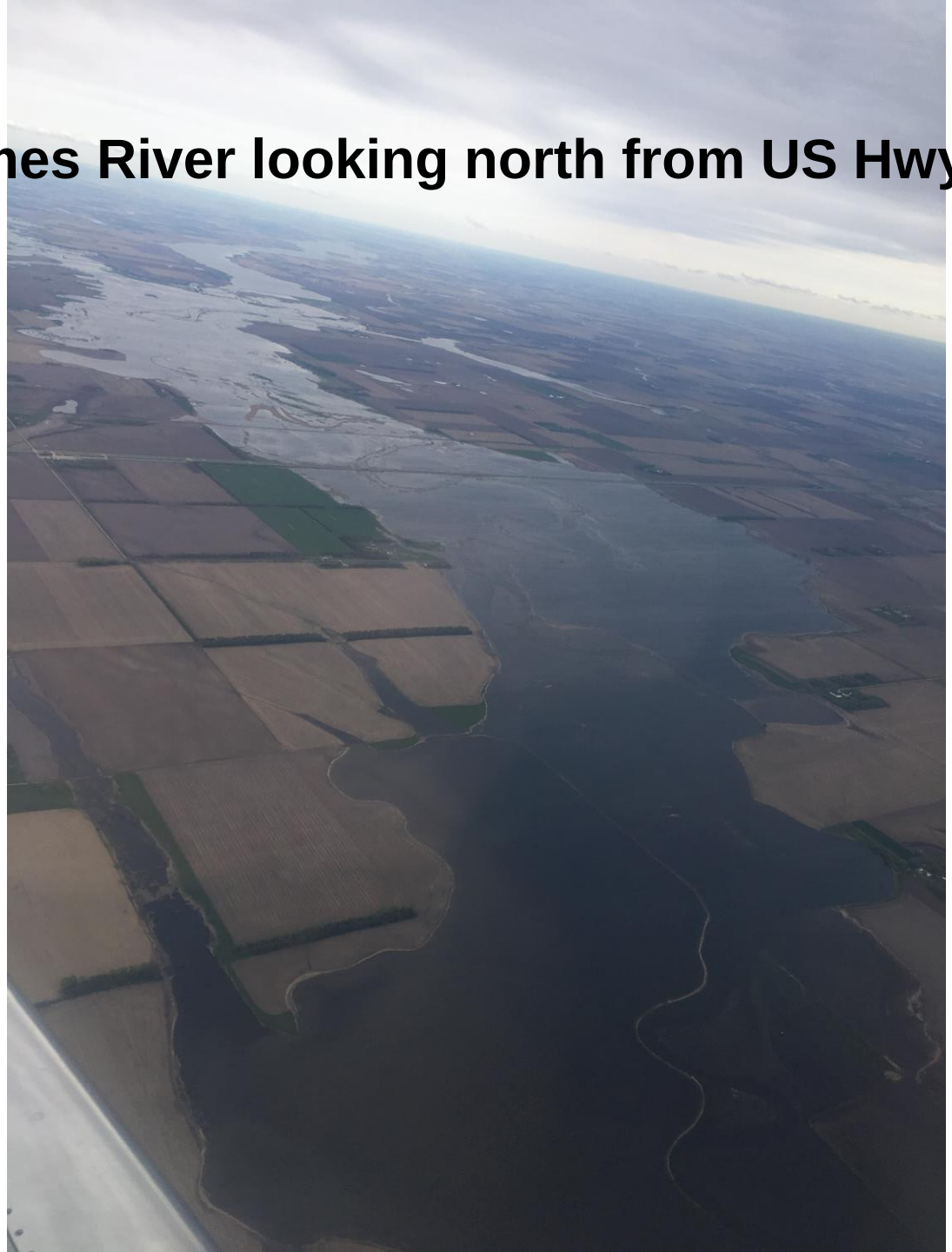
James River looking south from US Hwy 12

March 27, 2019

SWE 3/27/19

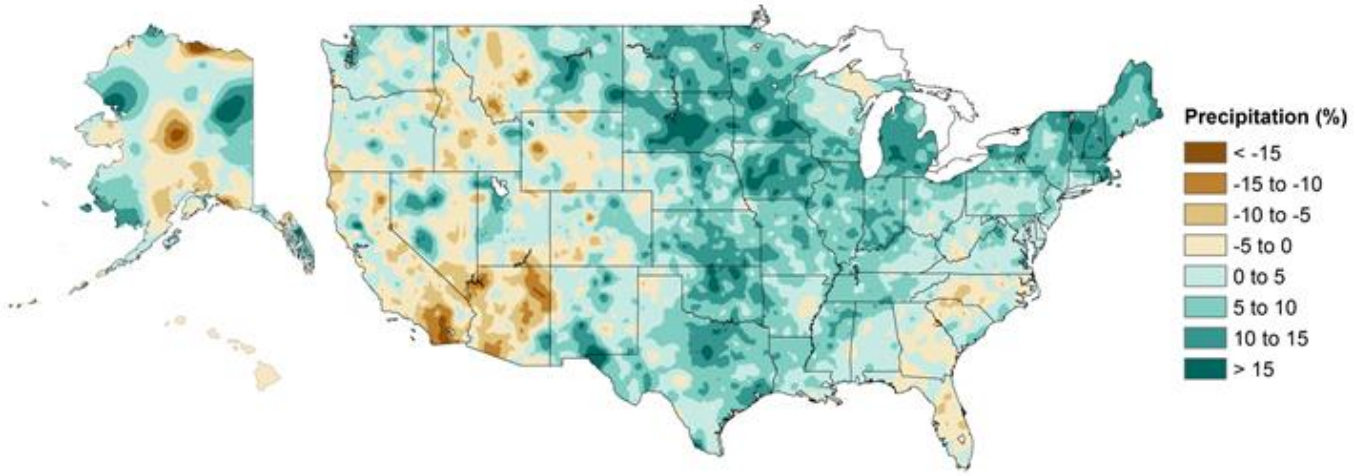

Modeled Snow Water Equivalent for 2019 March 27, 0:00 UTC
378.4 mi
309.0 mi
309.0 mi
408.5 mi
Bowman
Lemmon
Buffalo
Linton
Wishek
Lisbon
Mobridge
Aberdeen
Sisseton
Webster
Milbank
North Eagle Butte
Gettysburg
Redfield
Watertown
Canby
Spearfish
Miller
Pierre
Huron
Brookings
Rapid City
Wall
Philip
Chamberlain
Mitchell
Sioux Falls
Hot Springs
Winner
Platte
Martin
Chadron
Valentine
Yankton
Ainsworth
O'Neill
Sioux City
Created 2019 Mar 27, 04:18 UTC
Inches of water equivalent
> 30
20 to 30
18 to 20
16 to 18
14 to 16
12 to 14
10 to 12
8 to 10
6 to 8
4 to 6
2 to 4
1 to 2
trace to 1
Not Estimated
Elevation in feet
> 13124
8203 to 13124
3281 to 8203
3 to 3281
< 3

James River looking north from US Hwy 12



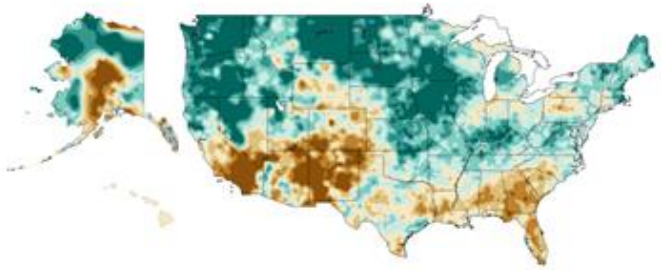
May 21, 2019

Annual Precipitation

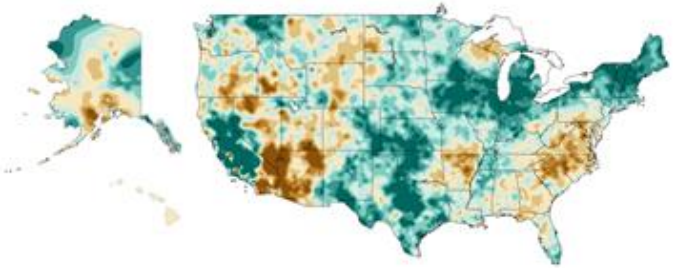


Winter Precipitation

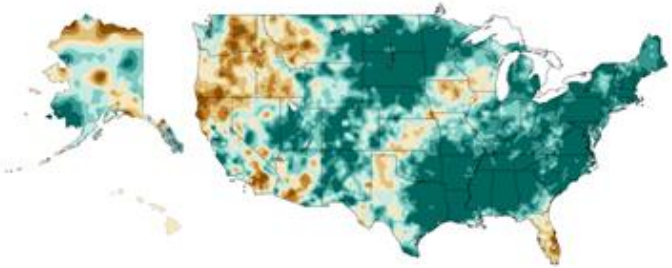
Spring Precipitation



Summer Precipitation

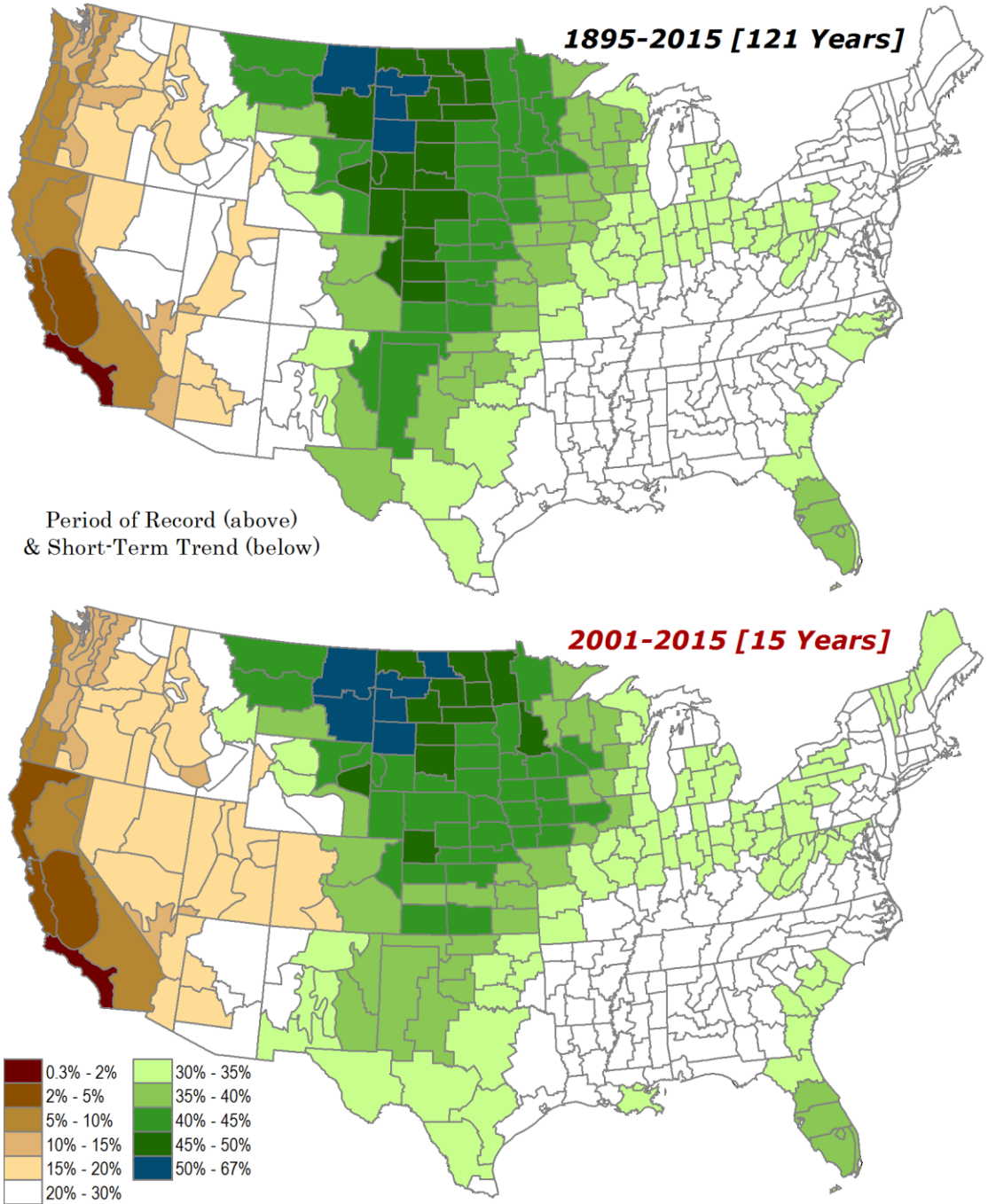


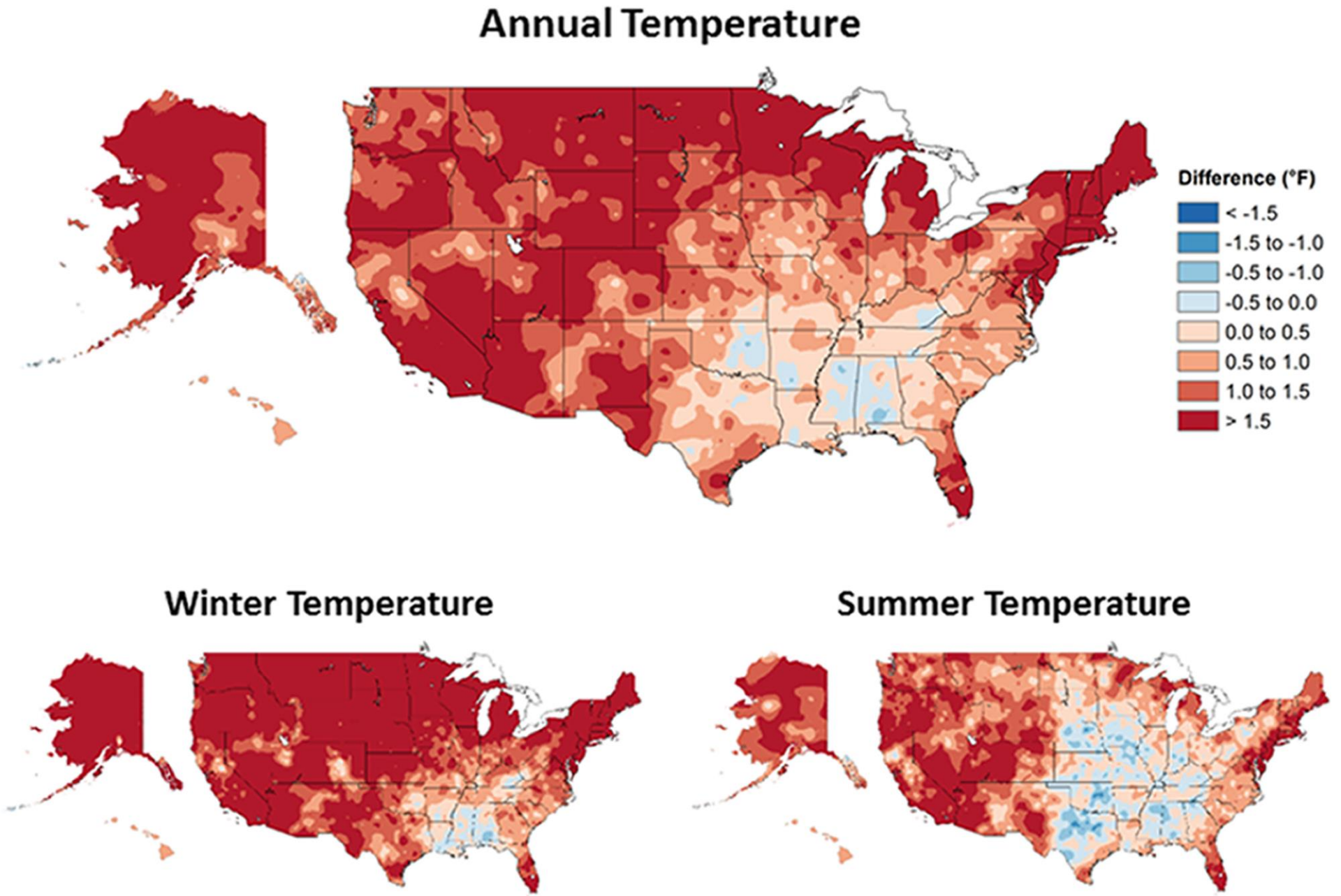
Fall Precipitation



https://science2017.globalchange.gov/

Median Percent of Annual Precipitation -- MJJ





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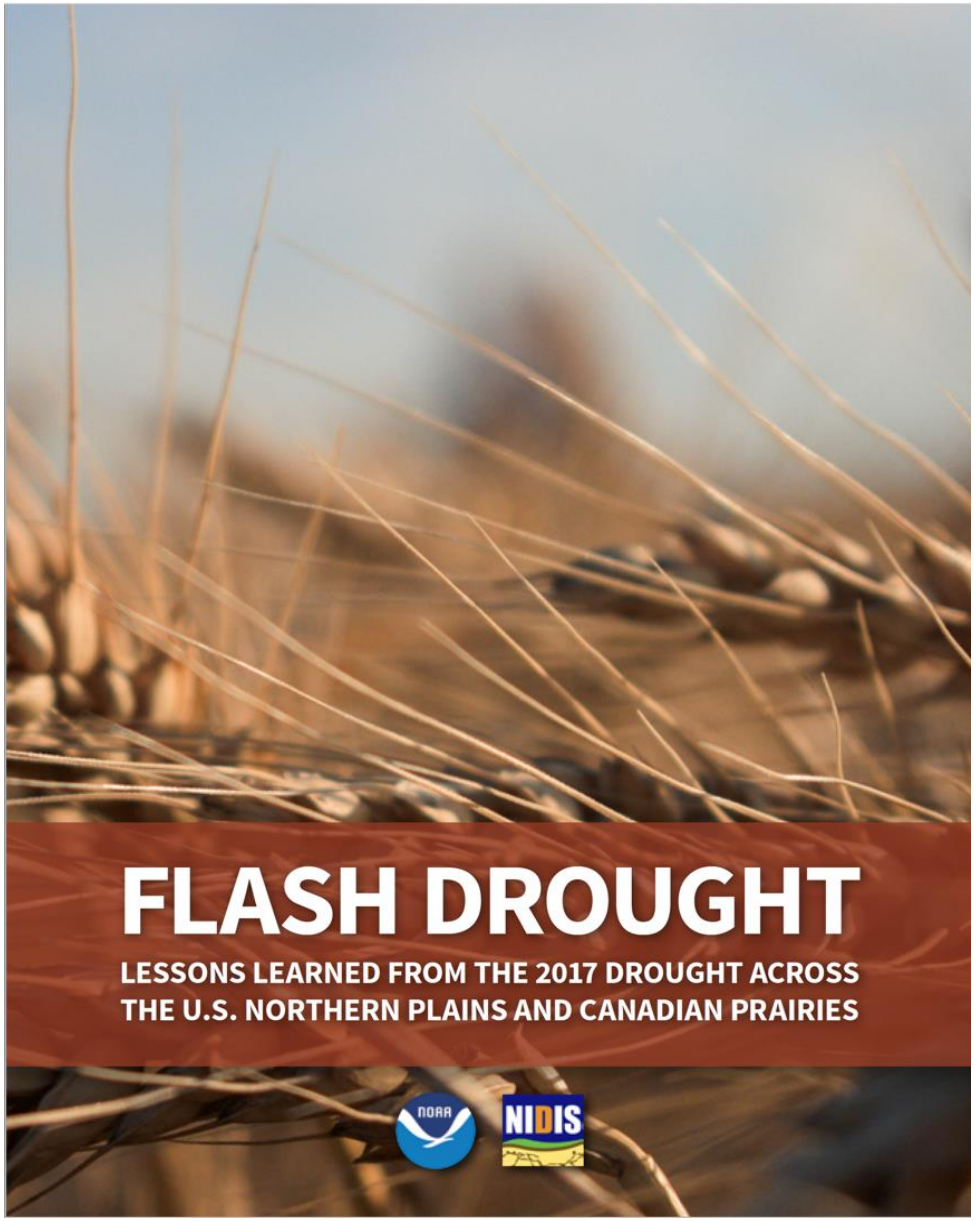


Flash Drought: Lessons Learned from the 2017 Drought Across the U.S. Northern Plains and Canadian Prairies

The goals of the assessment were to inform forecasters on current drought prediction capabilities, to quantify how drought risk changes in a warming world, and to aid to policy makers better define drought risk.

Impacts of the 2017 Drought

U.S. Agricultural losses of over $2.6 billion.

Livestock production was especially hard-hit due to the widespread scarcity of feed and water.

4,837,599 acres burned across the U.S. Northern Plains and Canadian Prairies.

Despite near-normal stream flows for the entire 2017 season, water supply to rural water providers was reduced in some areas.

Tribal cultural resources were impacted, putting these resources at risk for future generations.

Lodgepole Fire Complex near Roundup, MT Credit: Michael Downey (MT DNRC)

Livestock Forage Program

	2011	2012	2013	2014	2015	2016	2017	2018	Total
SD # claims	0	13,439	6,883	0	0	2,112	9,081	0	31,515
SD % of US	--	5 %	4%	--	--	3%	15%	--	4%
SD $ claims	0	$172.4 M	$98.5 M	0	0	$22.8 M	$72.3 M	0	$366.2 M
SD % of US	--	7%	6%	--	--	8%	20%	--	5%

Annual Runoff above Sioux City, IA

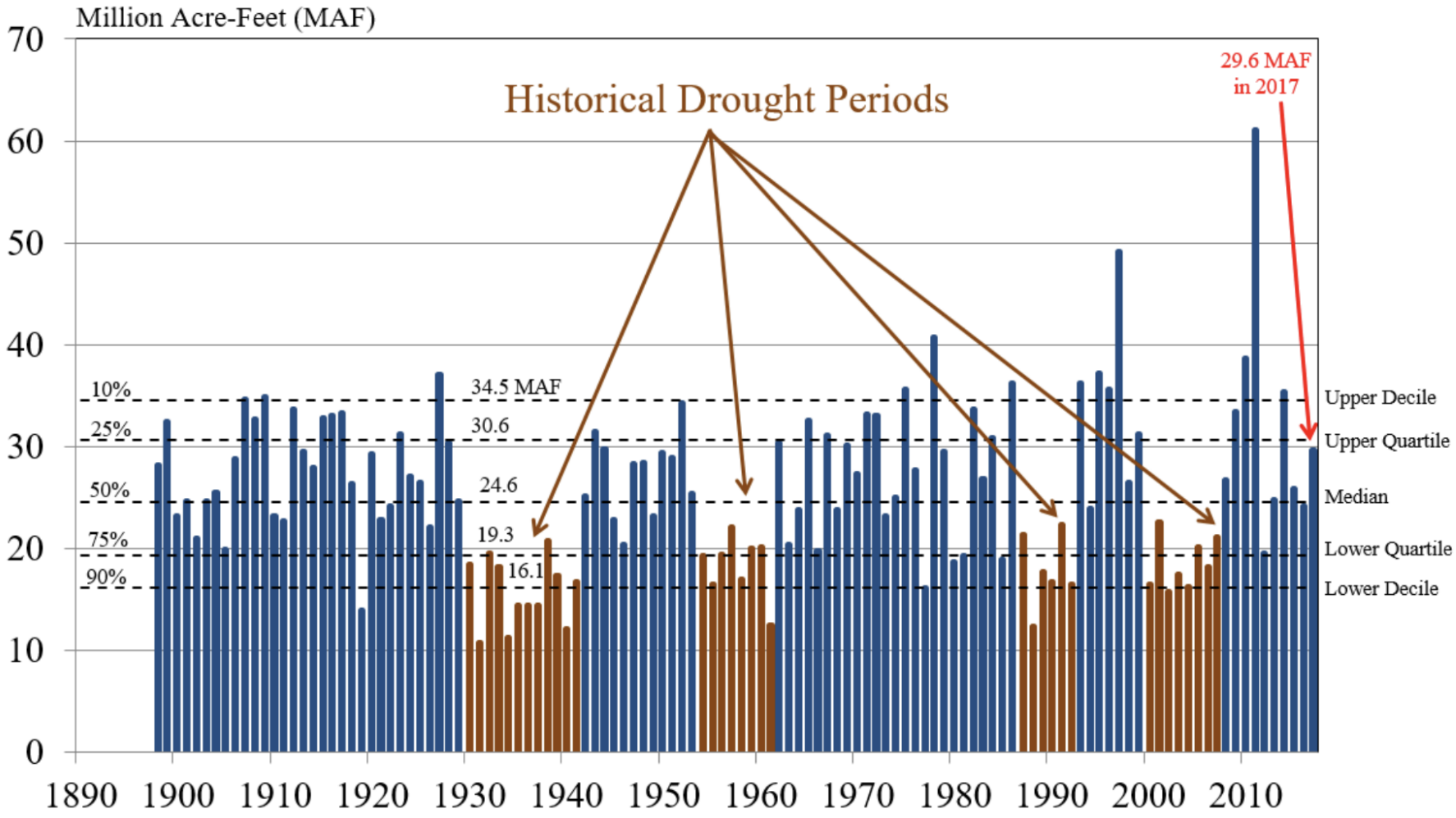


Figure 17. Missouri River Basin annual runoff above Sioux City, IA.

https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7971

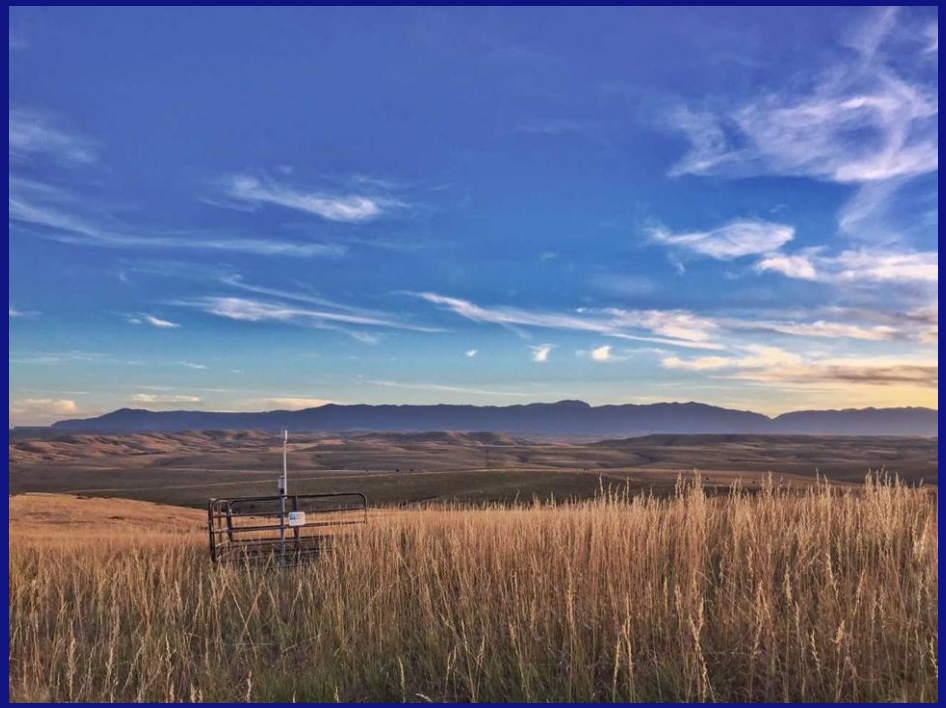
Lessons Learned from the 2017 Drought

Neither the drought's swift onset nor its severity were forecast.

Investment is needed in new and existing drought monitoring and observation networks to provide improved early warning.

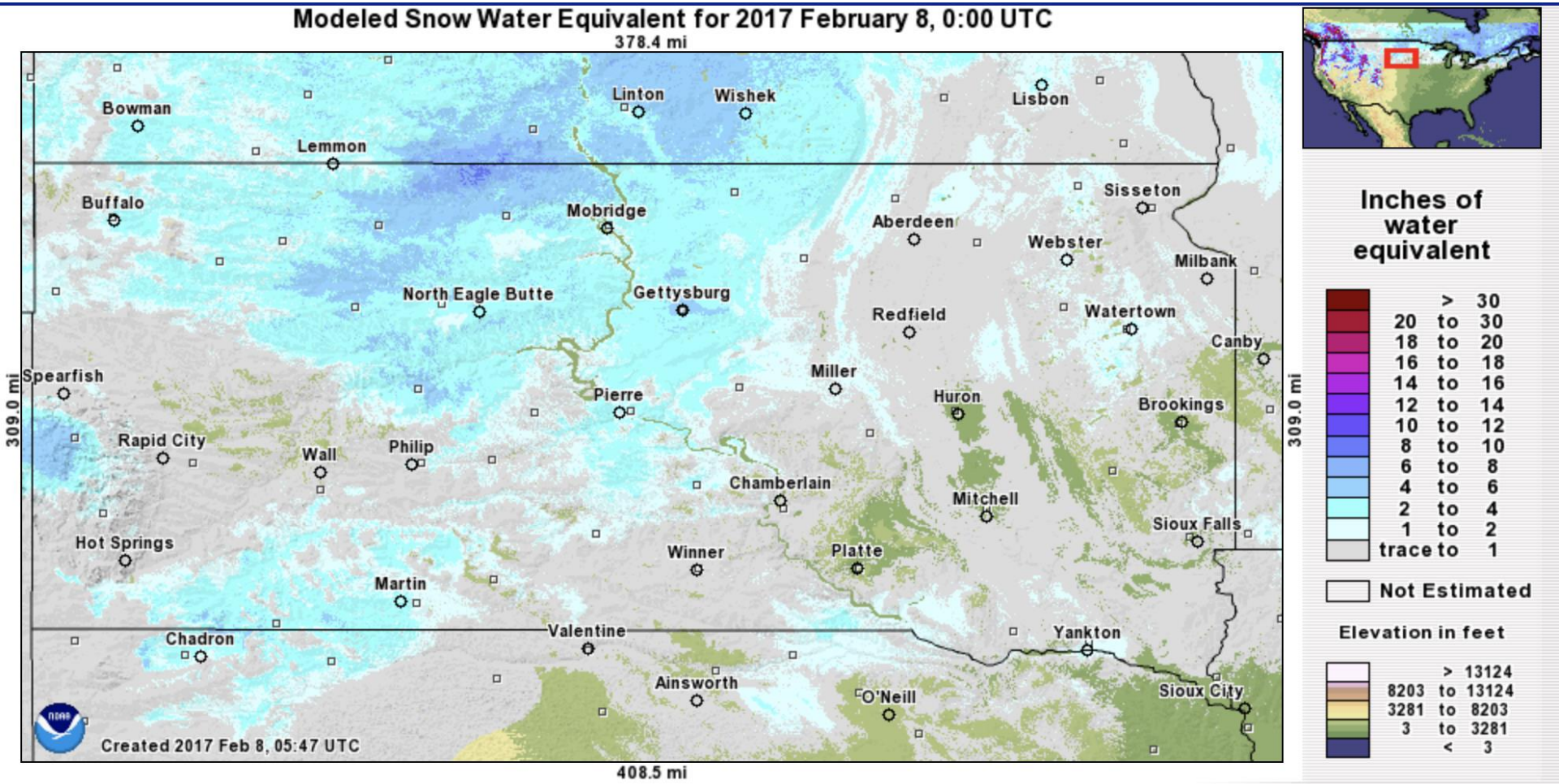
Investment is needed in soil moisture monitoring as soil moisture conditions can change quickly and soil moisture monitoring is a critical indicator in drought early warning.

Improving drought mitigation and response plans that consider trade-offs and actions that benefit both the human and ecosystem health and services should be in place before drought hits.



Mesonet Station, Stillwater County, MT Credit: Kevin Hyde (MT Climate Office)

SWE 2/8/2017


Modeled Snow Water Equivalent for 2017 February 8, 0:00 UTC
378.4 mi
309.0 mi
309.0 mi
408.5 mi
Bowman
Linton
Wishek
Lisbon
Lemmon
Buffalo
Mobridge
Sisseton
Aberdeen
Webster
Milbank
North Eagle Butte
Gettysburg
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Watertown
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Rapid City
Wall
Philip
Chamberlain
Mitchell
Sioux Falls
Hot Springs
Winner
Platte
Martin
Chadron
Valentine
Yankton
Ainsworth
O'Neill
Sioux City
Created 2017 Feb 8, 05:47 UTC
Inches of water equivalent
> 30
20 to 30
18 to 20
16 to 18
14 to 16
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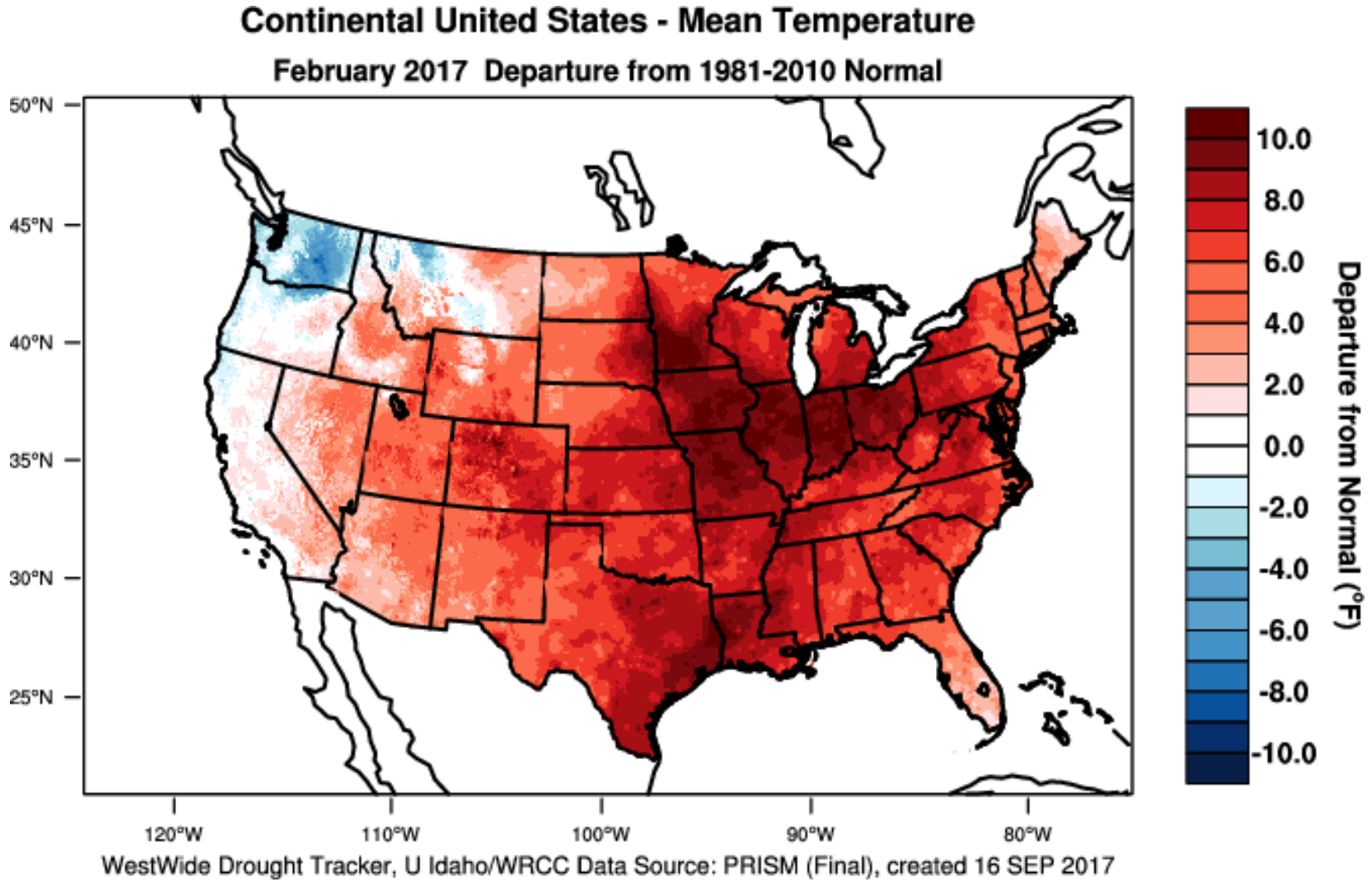
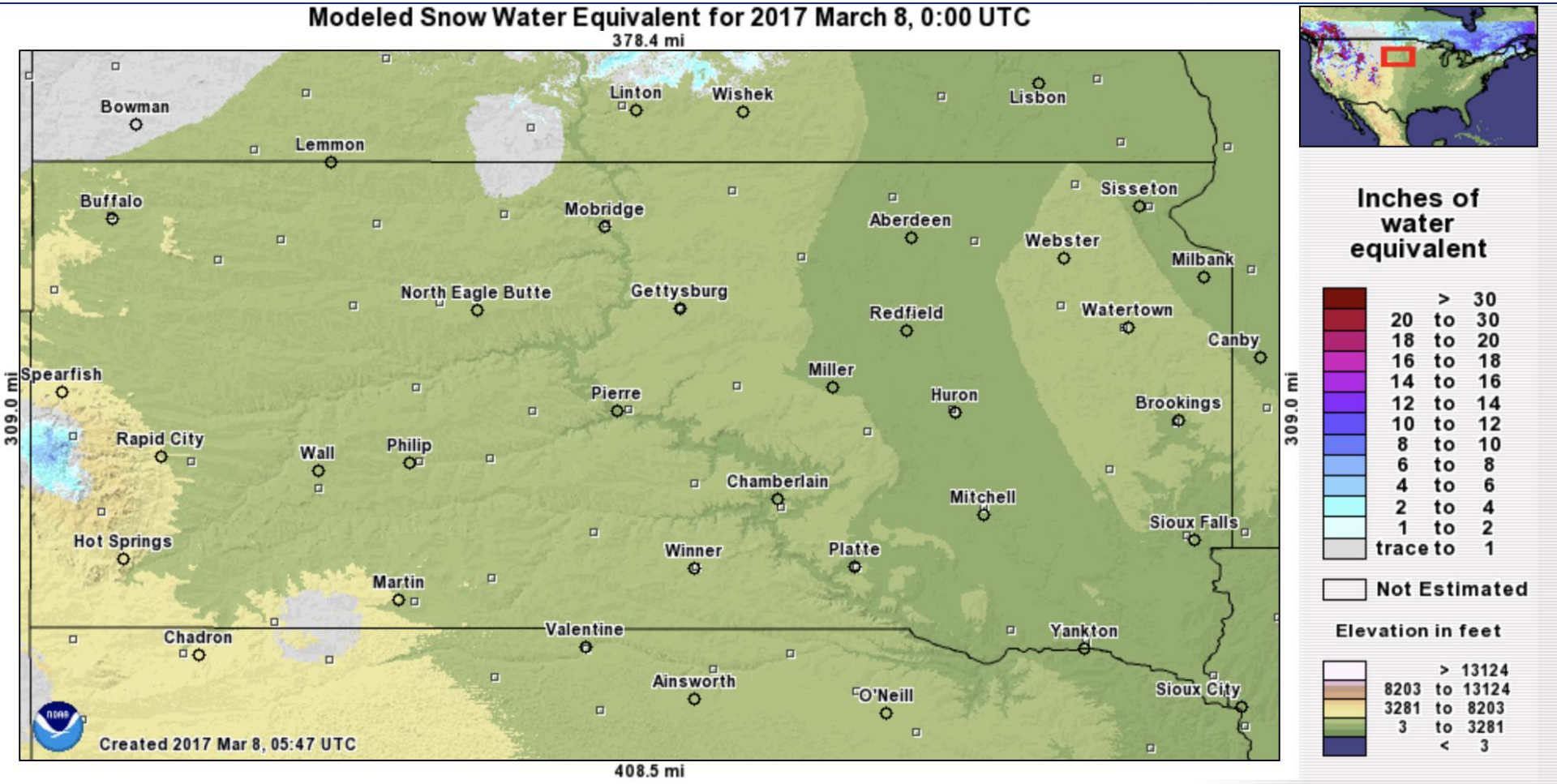
Driven by warm temps?



SWE 3/8/2017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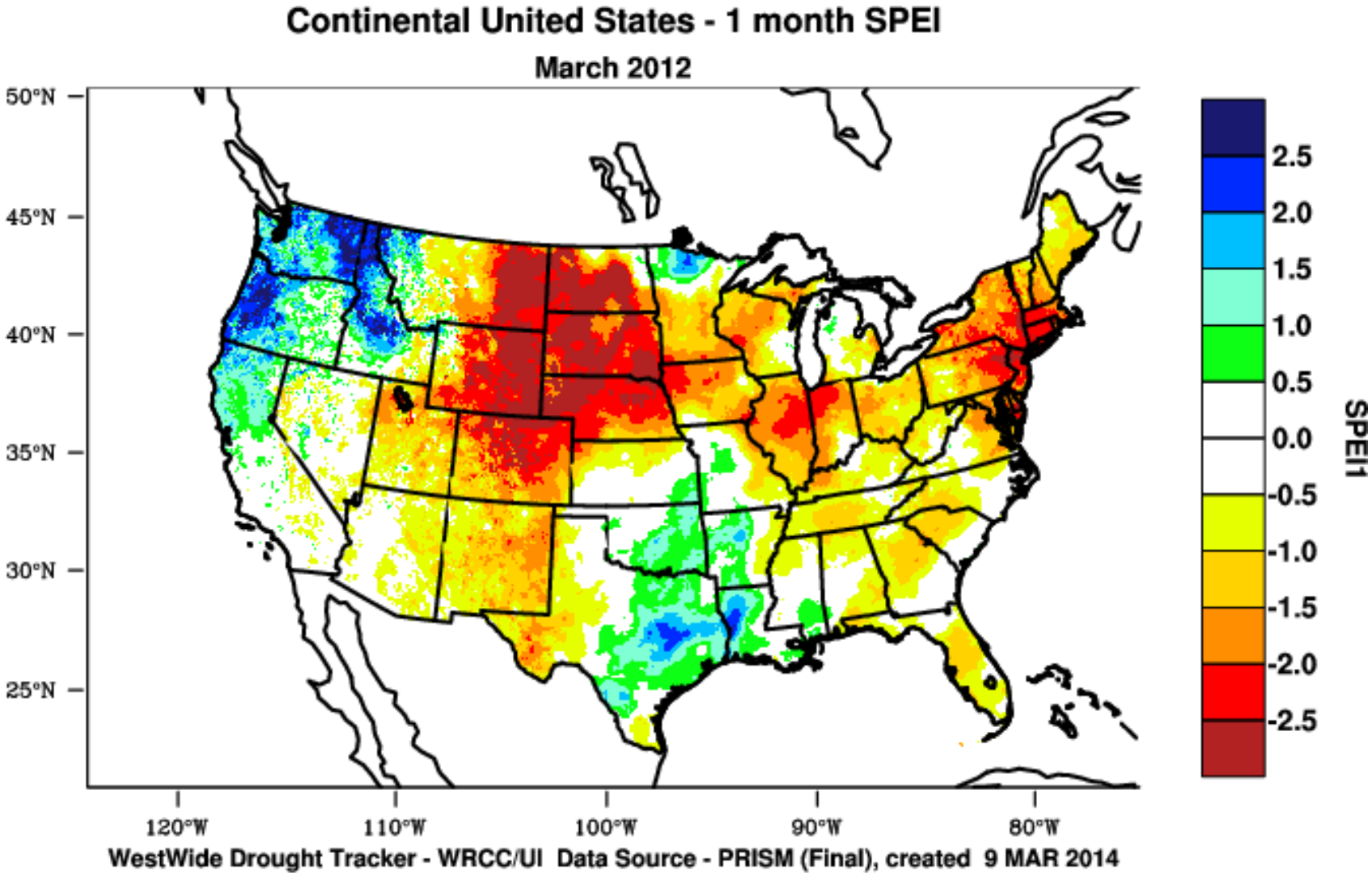
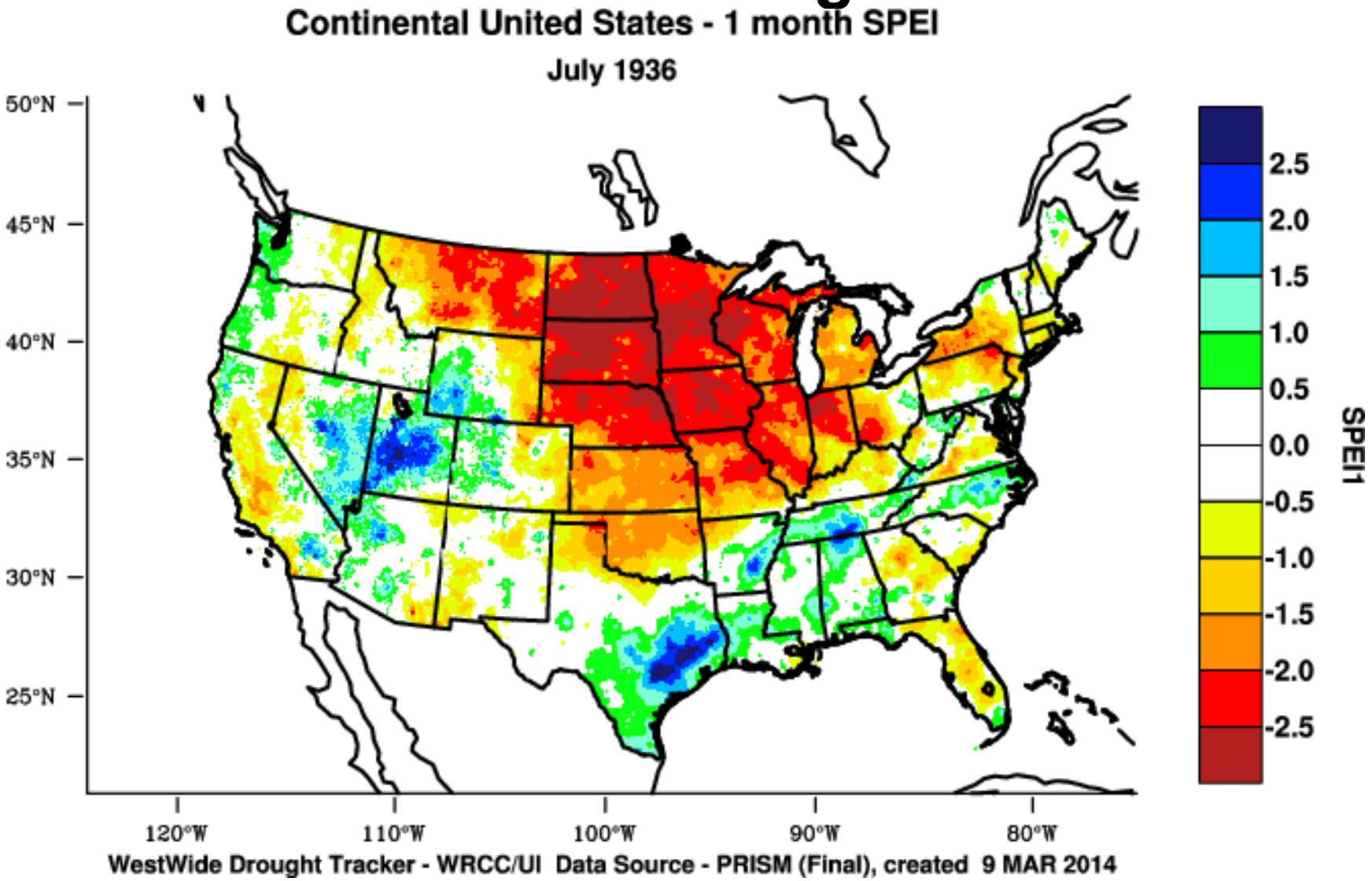
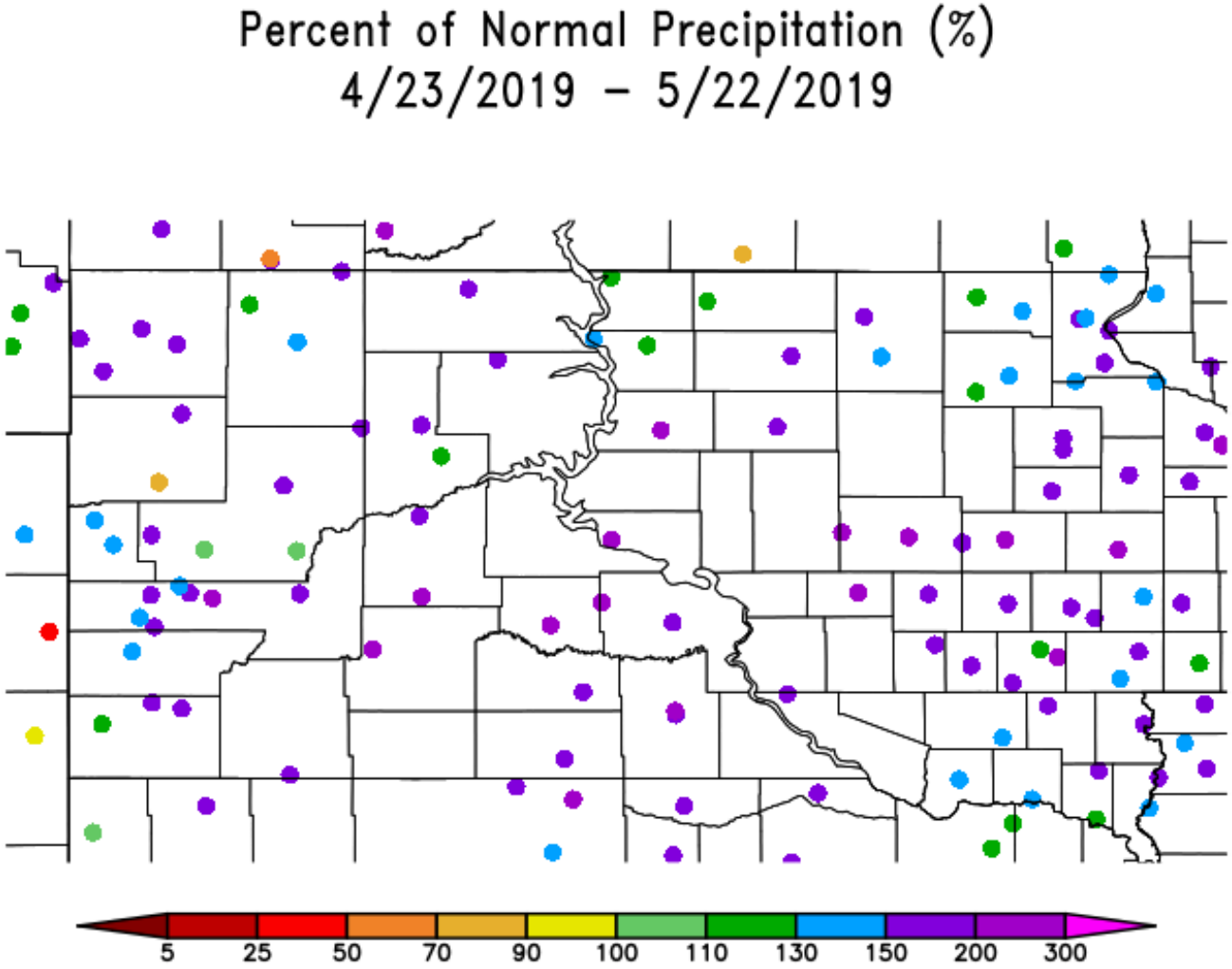
Other “heat-driven” droughts



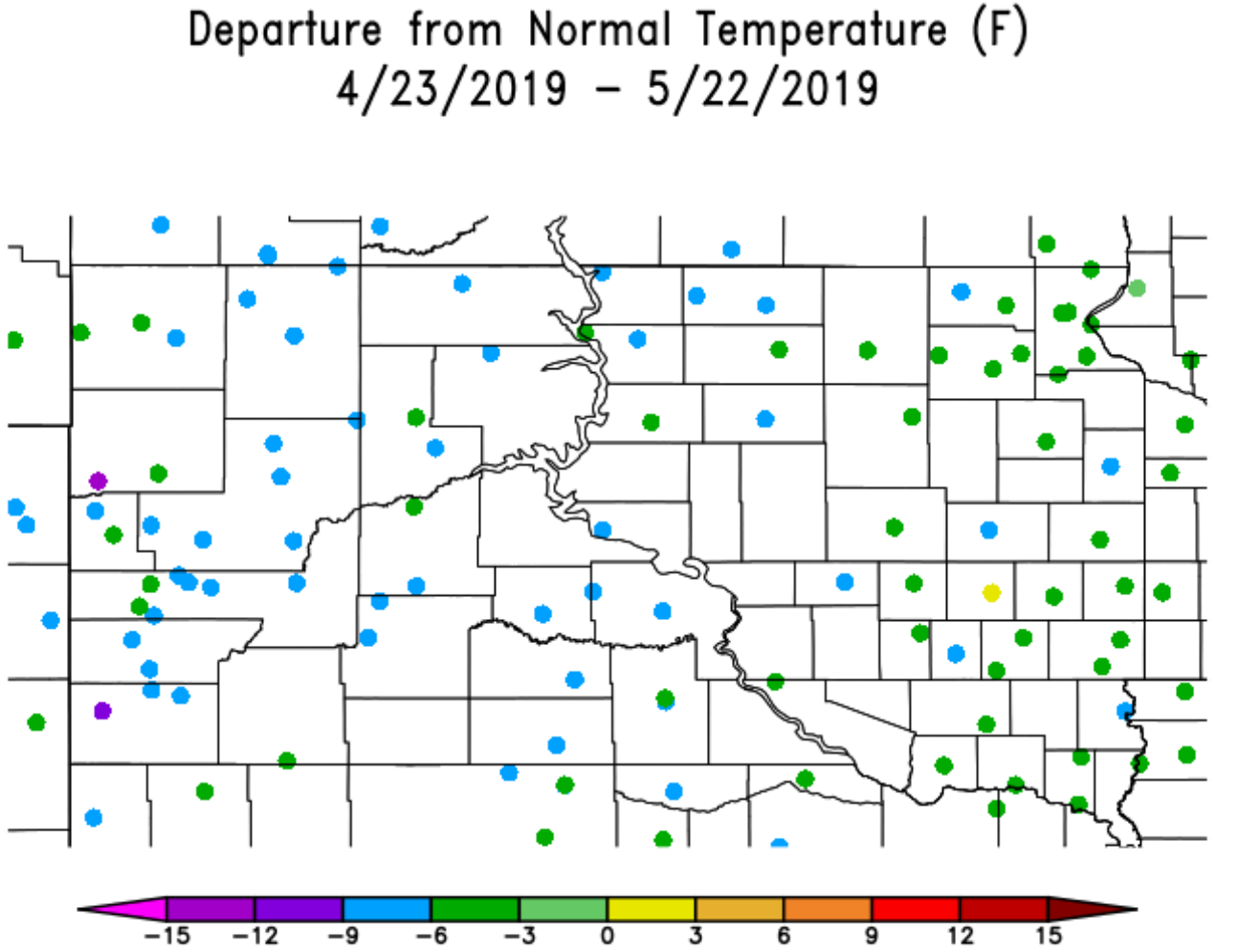
Other “heat-driven” droughts

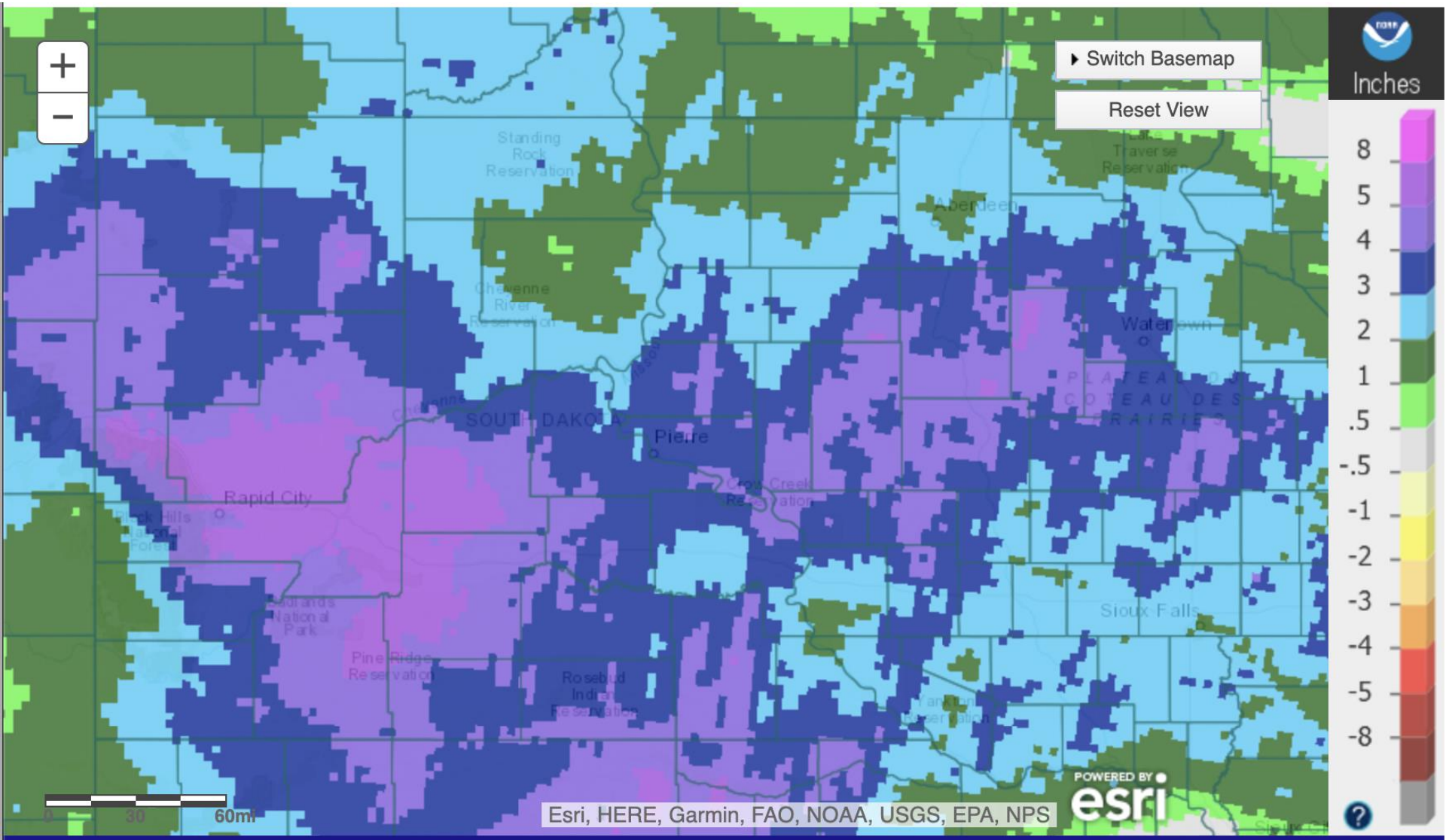


Monitoring


Percent of Normal Precipitation (%)
4/23/2019 – 5/22/2019
5
25
50
70
90
100
110
130
150
200
300
Generated 5/23/2019 at HPRCC using provisional data.
NOAA Regional Climate Centers

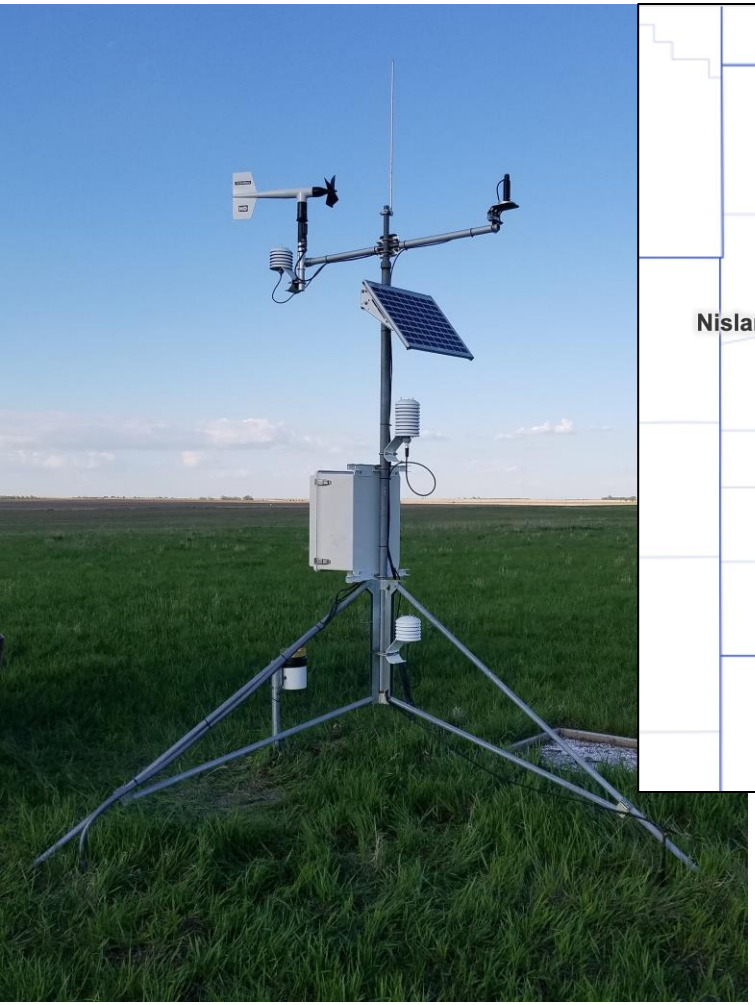
Monitoring

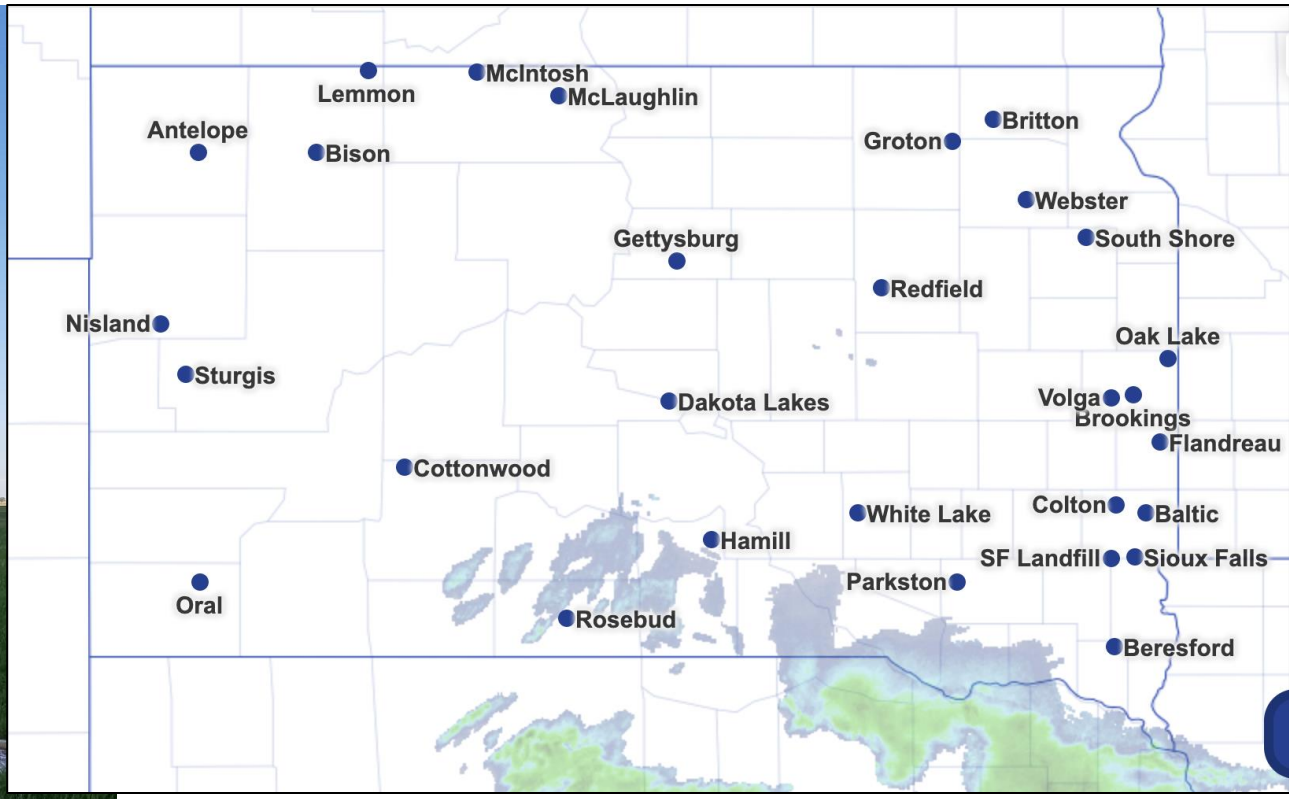

Departure from Normal Temperature (F)
4/23/2019 – 5/22/2019
−15 −12 −9 −6 −3 0 3 6 9 12 15
Generated 5/23/2019 at HPRCC using provisional data.
NOAA Regional Climate Centers



South Dakota: Last 30-Day Departure from Normal Precipitation
Valid on: May 23, 2019 12:00 UTC
What is UTC time? Map Help

SD Mesonet: Current Weather
mesonet.sdstate.edu





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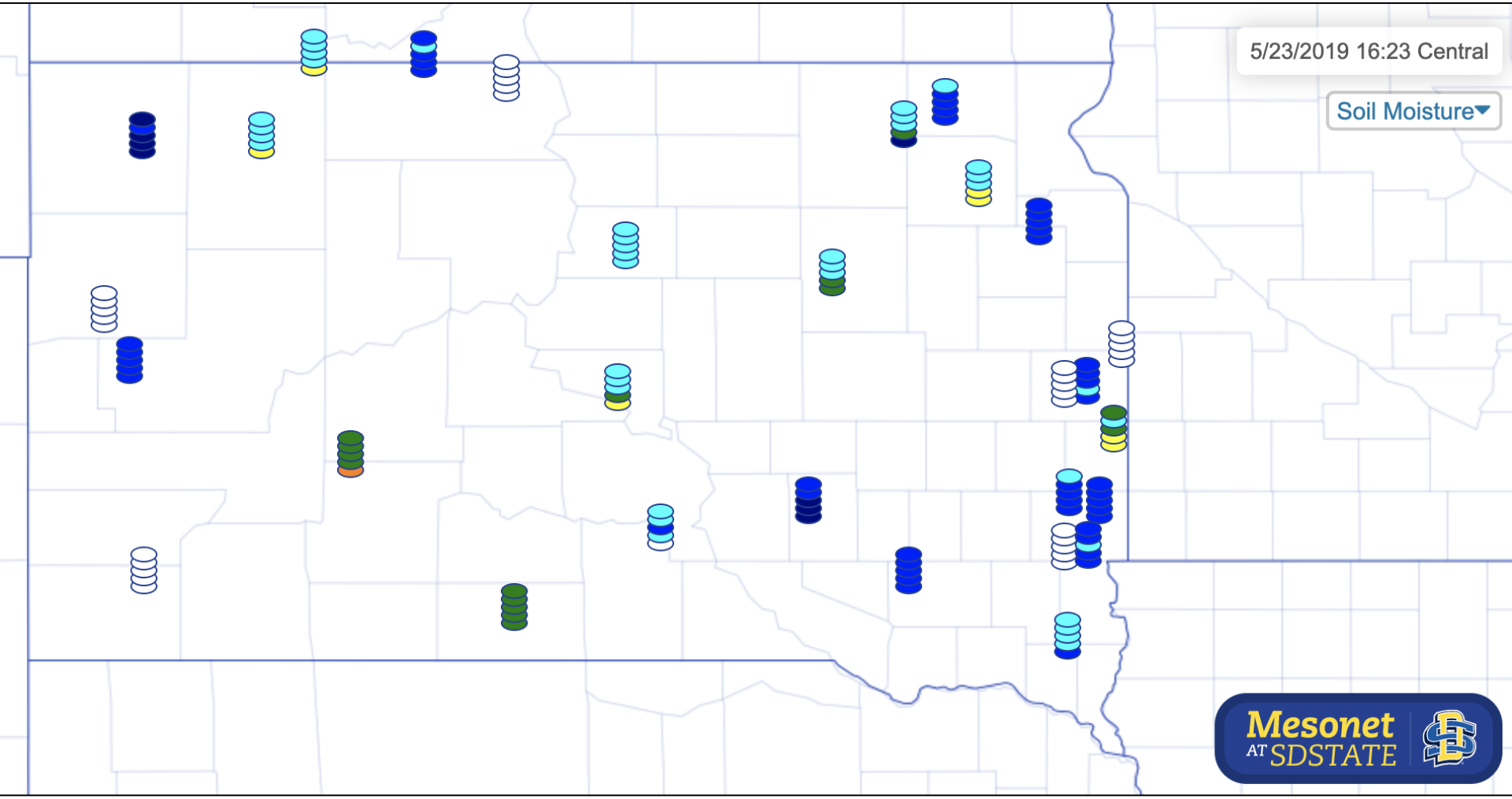
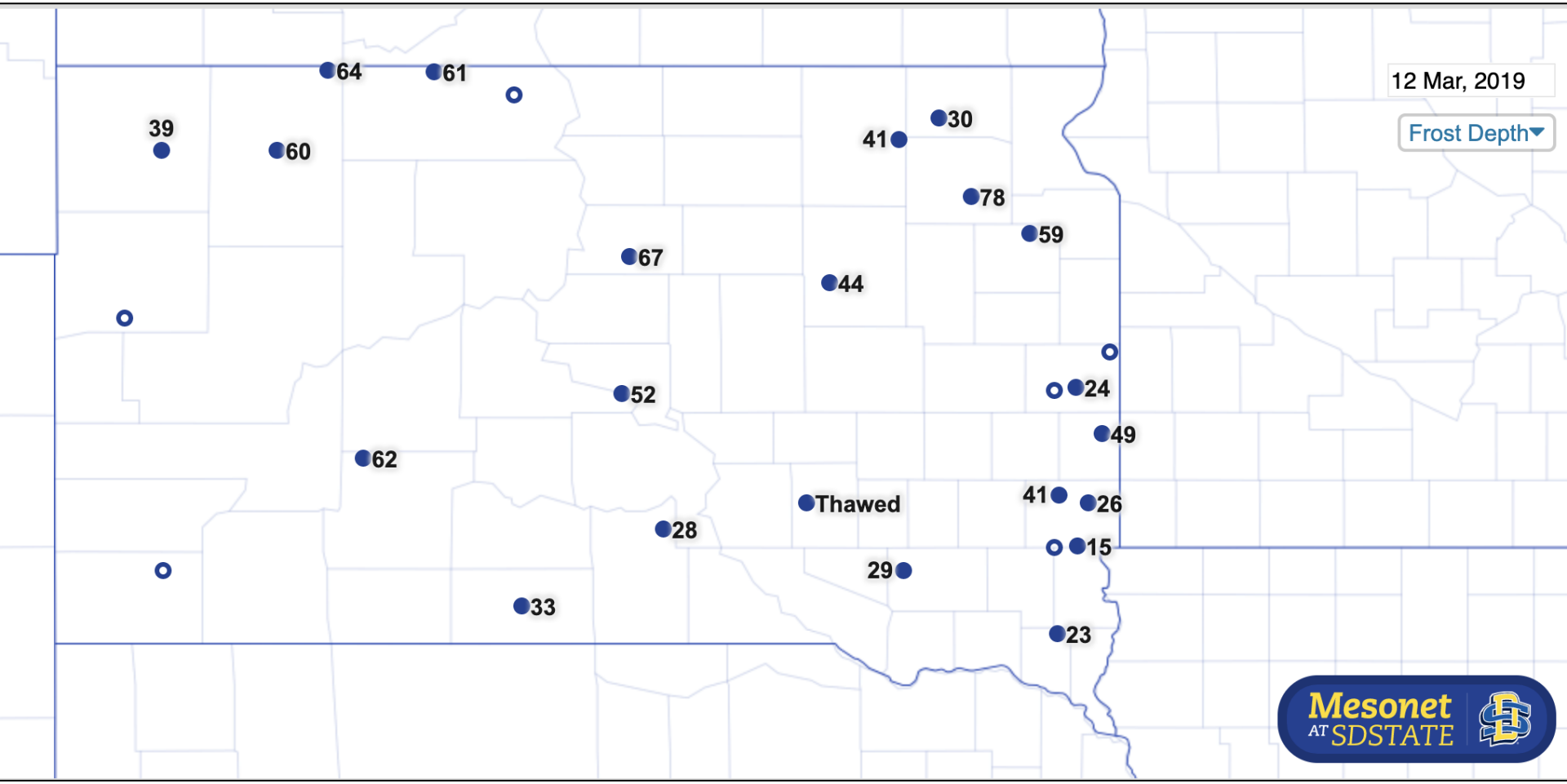
Soil Moisture



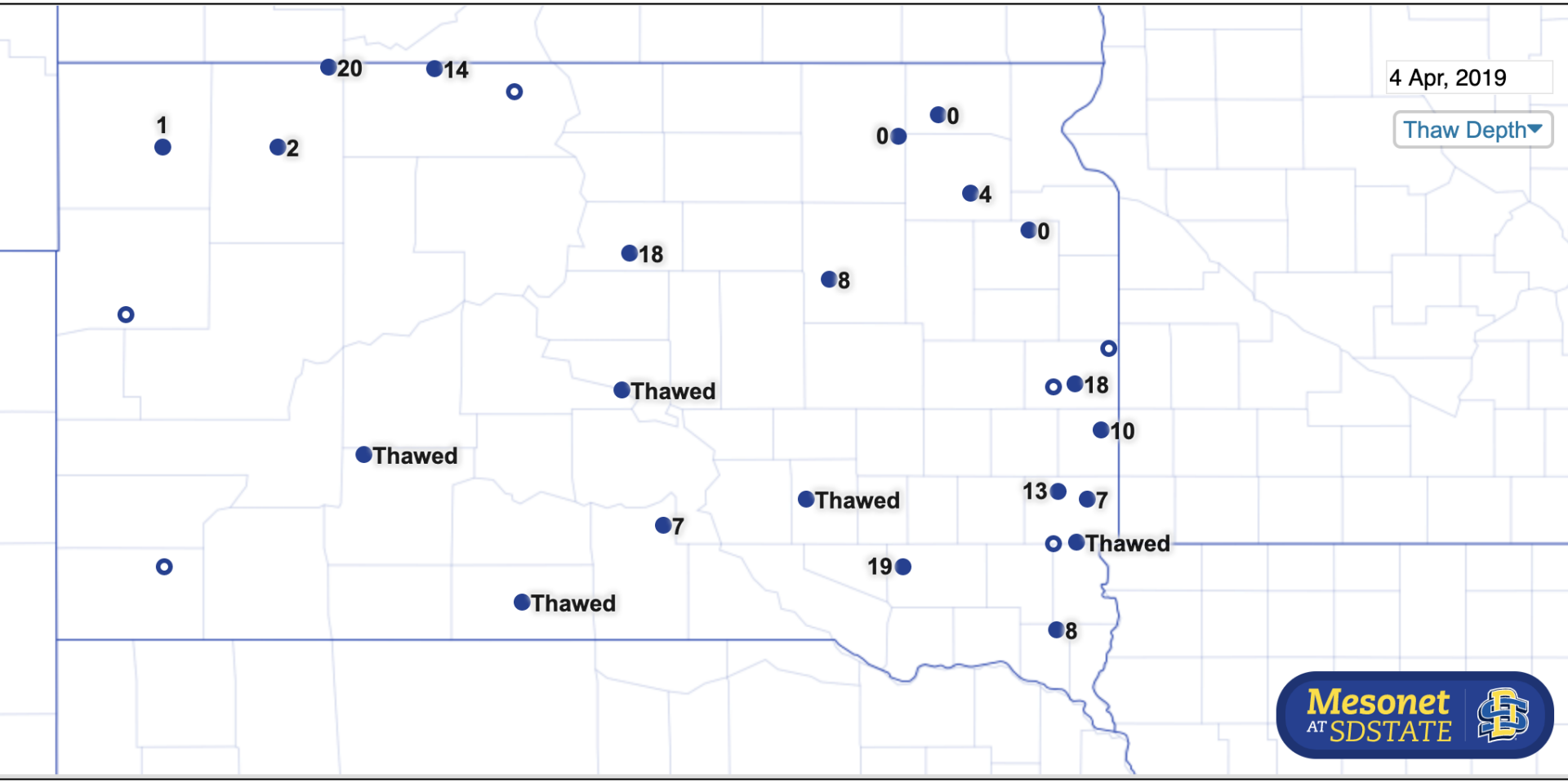
Mesonet.sdstate.edu

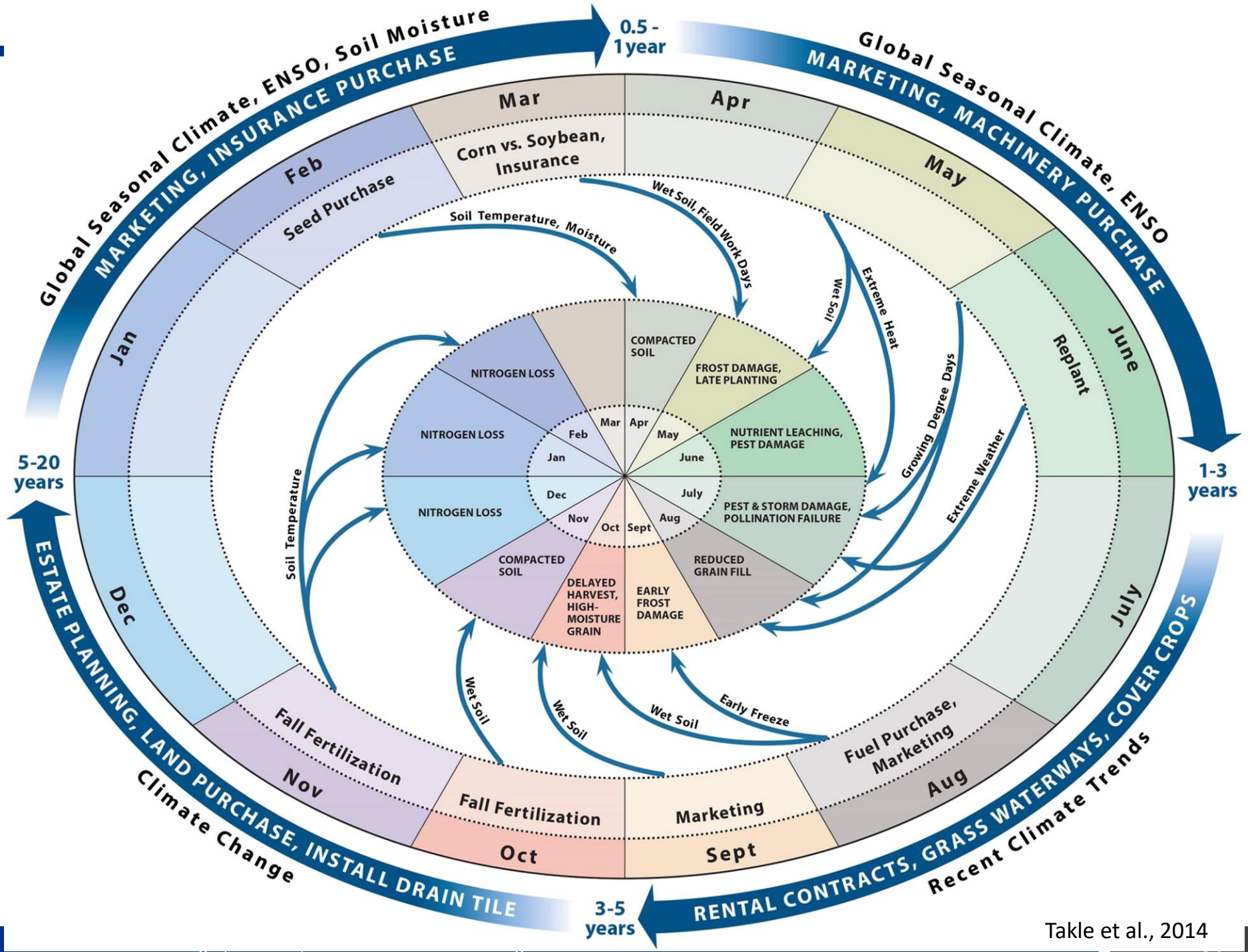
Soil Frost Depth



Mesonet.sdstate.edu

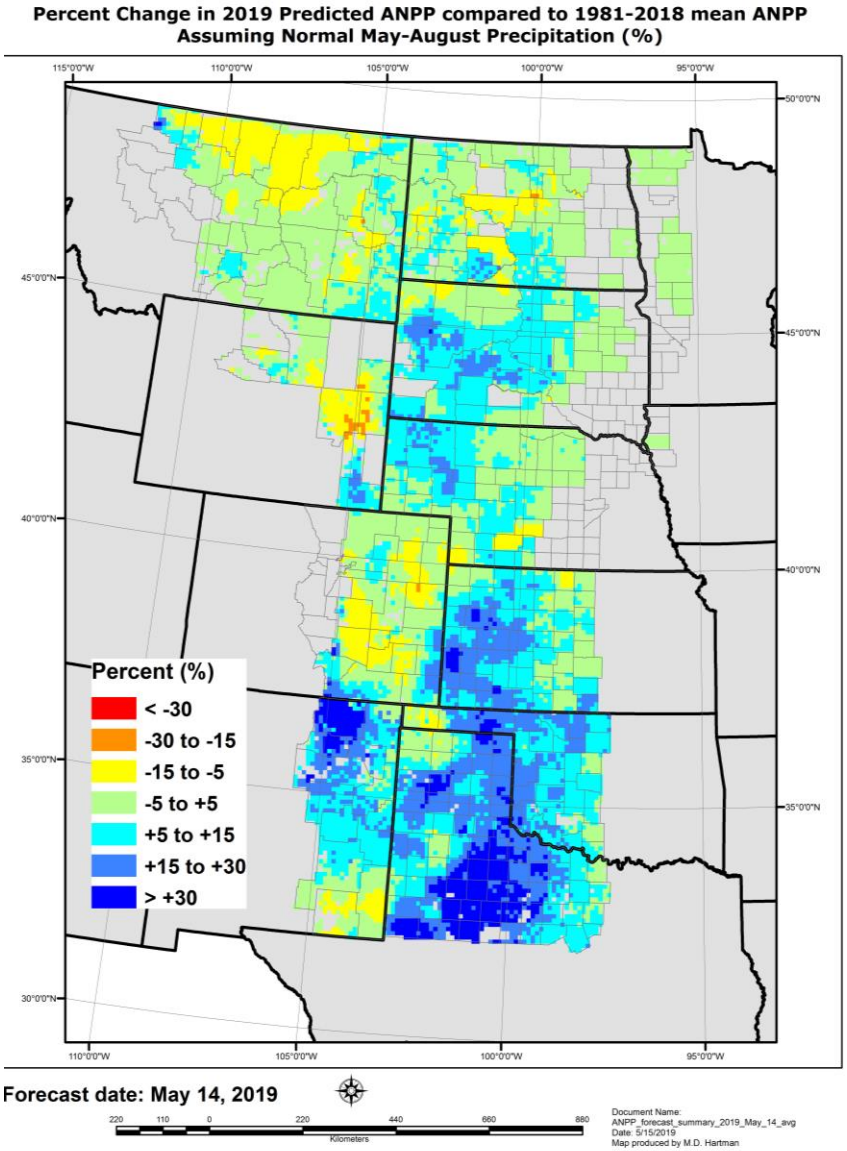
Soil Thaw Depth





Takle et al., 2014

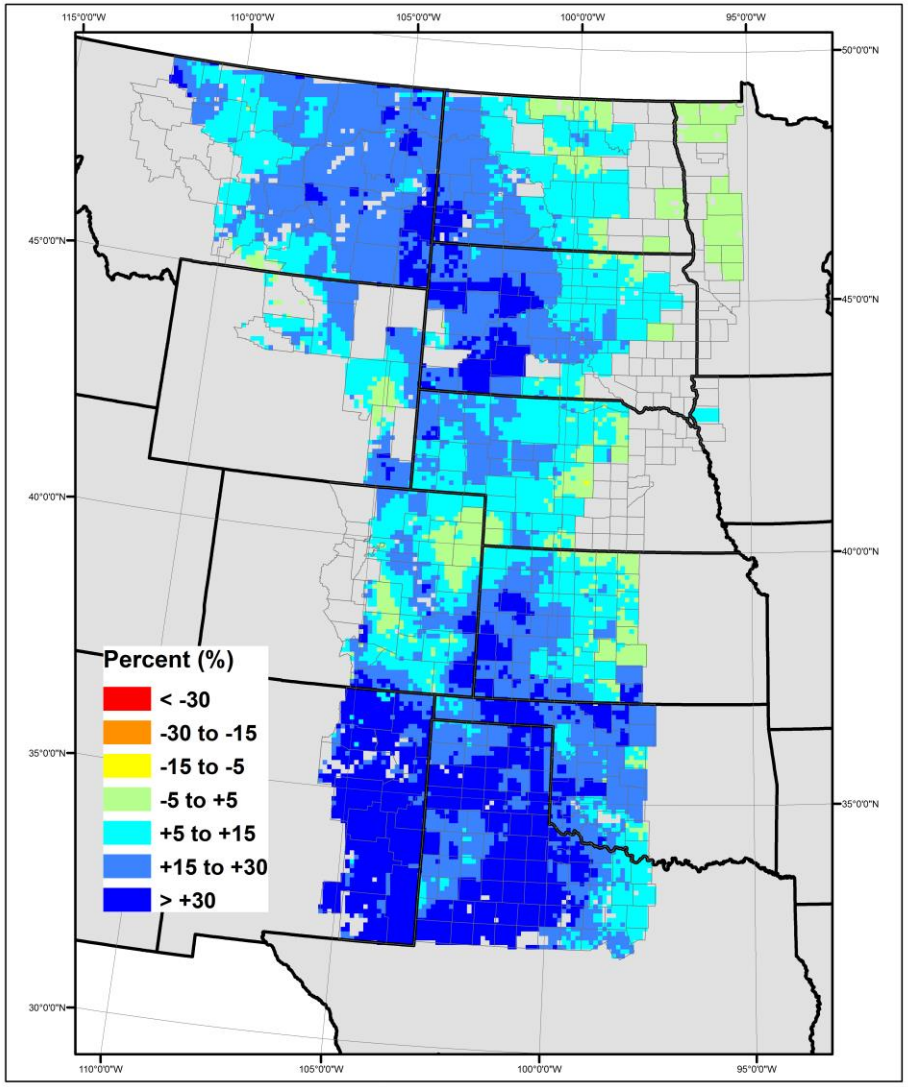
GrassCast



- Grass & forage production prediction
- Produced biweekly in spring season
- Range of possible production based on precip outlook

- http://grasscast.agsci.colostate.edu/

Percent Change in 2019 Predicted ANPP compared to 1981-2018 mean ANPP Assuming Above Normal May-August Precipitation (%)

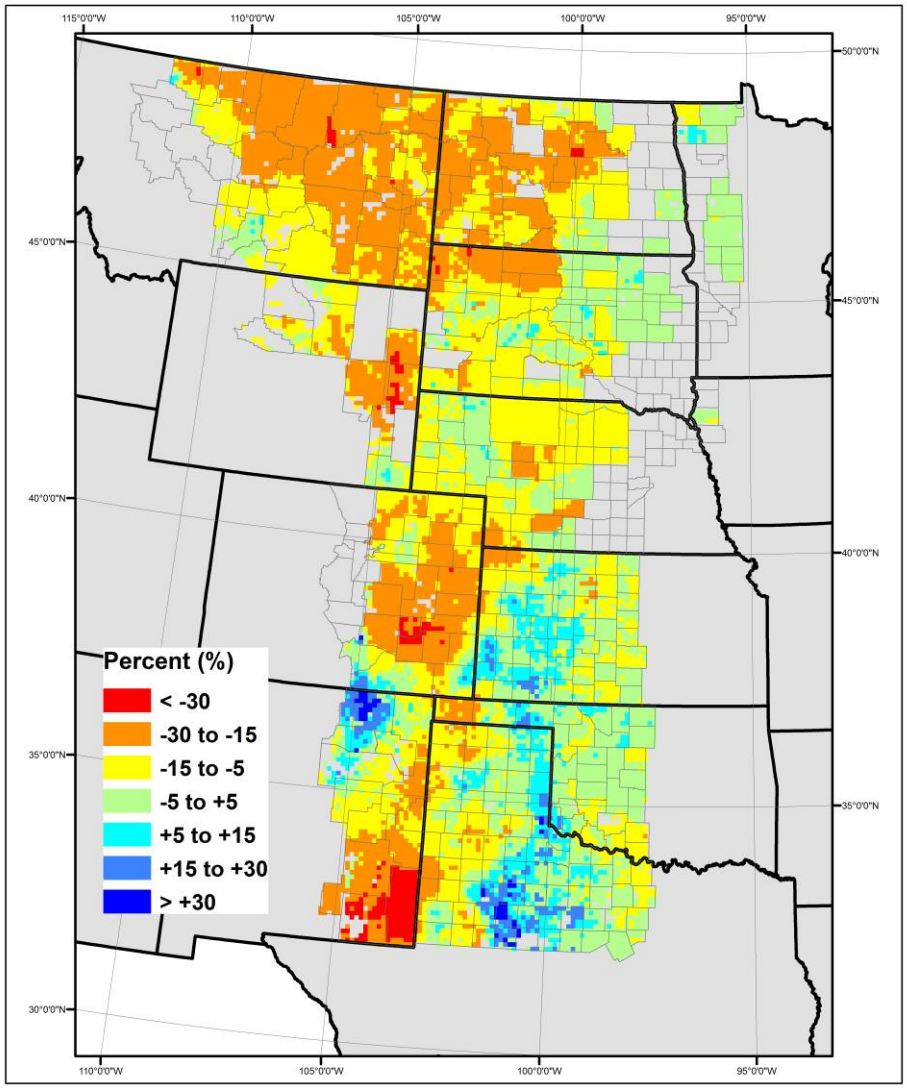


Forecast date: May 14, 2019

220 110 0 220 440 660 880
Kilometers

Document Name:
ANPP_forecast_summary_2019_May_14_above
Date: 5/15/2019
Map produced by M.D. Hartman

Percent Change in 2019 Predicted ANPP compared to 1981-2018 mean ANPP Assuming Below Normal May-August Precipitation (%)



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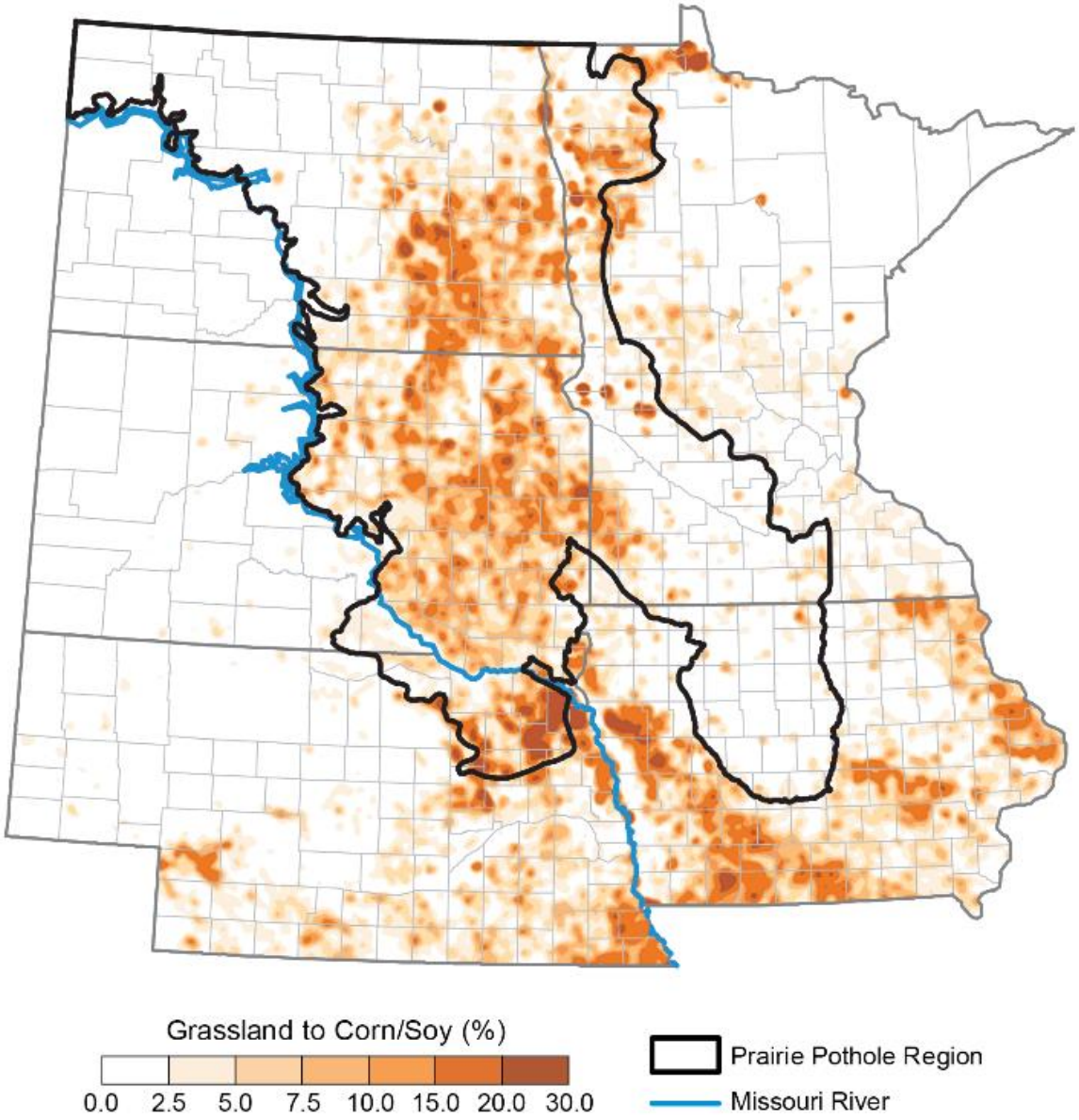
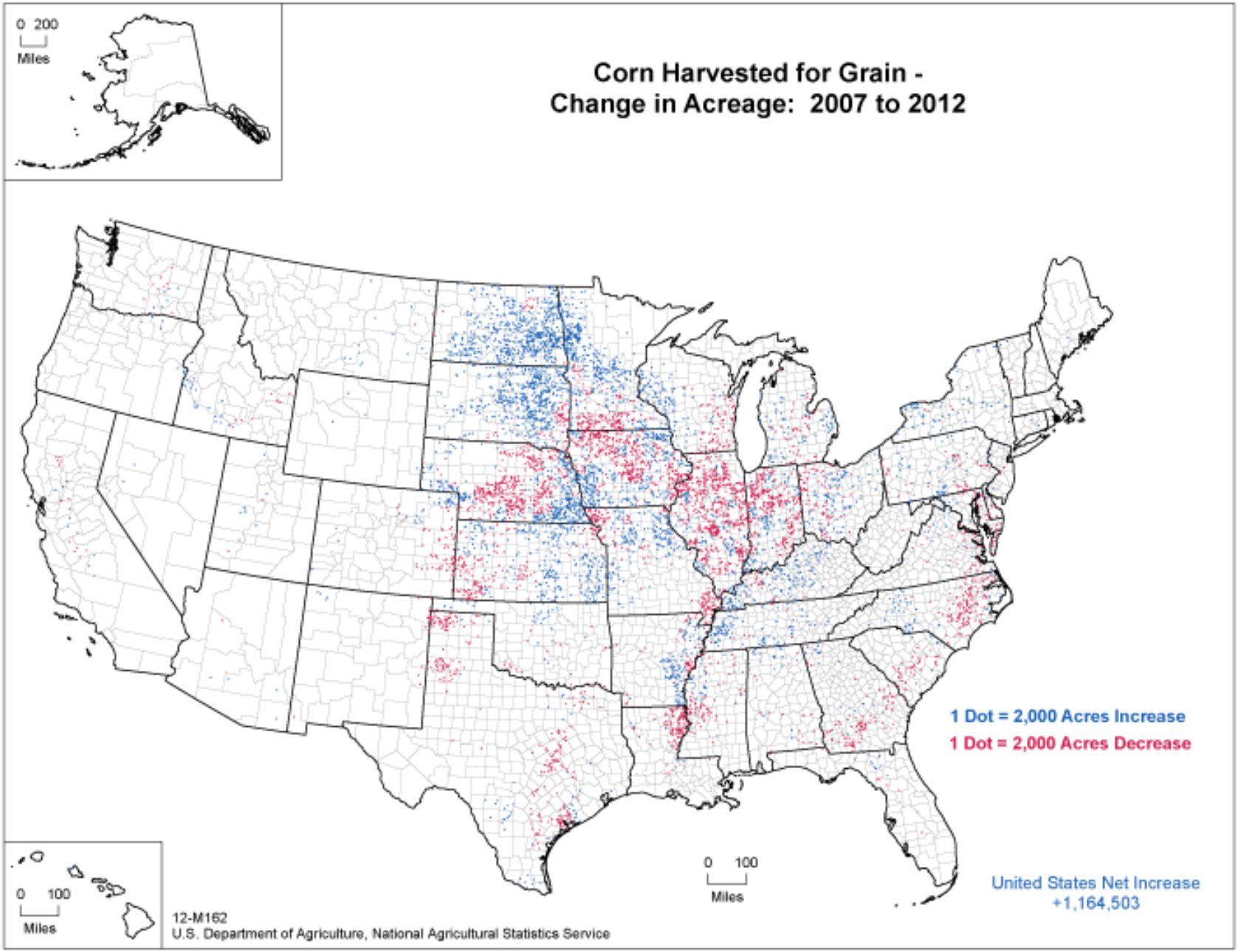


Figure 22.4: The figure shows the loss of grassland to corn/soy between 2006 and 2011 in the eastern states of the Northern Great Plains (Nebraska, South Dakota, and North Dakota), expressed as a percentage of 2006 grassland acres. Outlined in black is the boundary of the U.S. portion of the Prairie Pothole Region, a substantial portion of which was converted from grassland to corn/soy between 2006 and 2011. *Source: adapted from Wright and Wimberly 2013.*[46]



https://www.nass.usda.gov/Publications/AgCensus/2012/Online_Resources/Ag_Atlas_Maps/

Hail damage

Record Hail Stone

https://www.weather.gov/abr/vivianhailstone

Forecast Questions

- How meaningful is winter precipitation for warm season drought?
- What is the response/role of soil moisture in growing season feedbacks, in both wet and dry periods?
- Does temperature play a role in drought onset?
- Role of landscape change to regional feedback?
- Can we better predict summertime severe storms?
- How can NOAA better utilize mesonets or non-federal networks?

April 5, 2019 near Aberdeen, SD

SDSU Extension

Laura Edwards

SDSU Extension State Climatologist

SDSU Extension Aberdeen Regional Center
13 Second Ave. SE
Aberdeen, SD 57401

Office: 605.626.2870

Email: laura.edwards@sdstate.edu

Twitter: @SDSUclimate

Facebook: SDSUExtClimate

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April 28, 2019 near Aberdeen, SD