



2020 Missouri Basin River and Climate Summary & Outlook

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February 26th, 2020
Missouri Basin Navigator's Meeting
Kansas City, MO



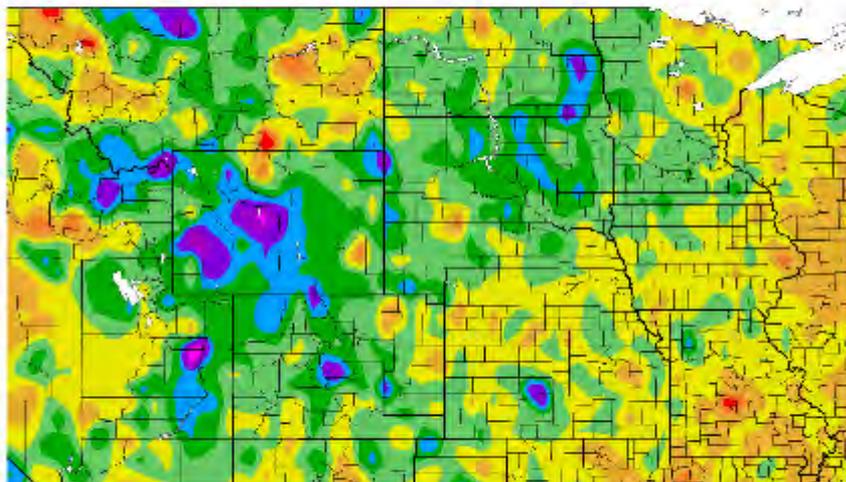
Outline



- **Current status of the basin compared to last winter/spring**
- **Climate outlooks (short to long term)**
- **Flood Outlooks 2020**
- **More 2019 Retrospective (if time)**

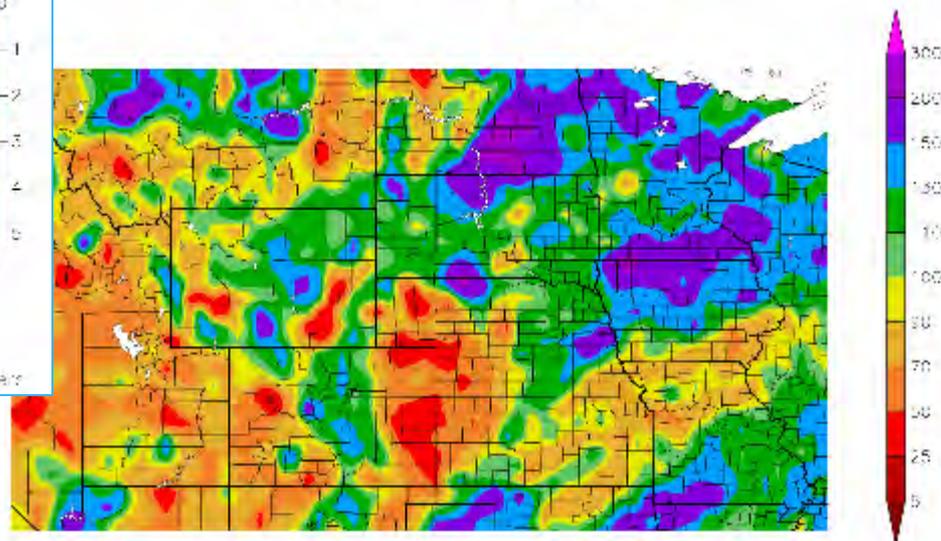
Temperature & Precipitation Water Year (10/1/19 to present)

Departure from Normal Temperature (F)
10/1/2019 - 2/23/2020



- Temperatures near normal
- Precip mixed

Percent of Normal Precipitation (%)
10/1/2019 - 2/23/2020

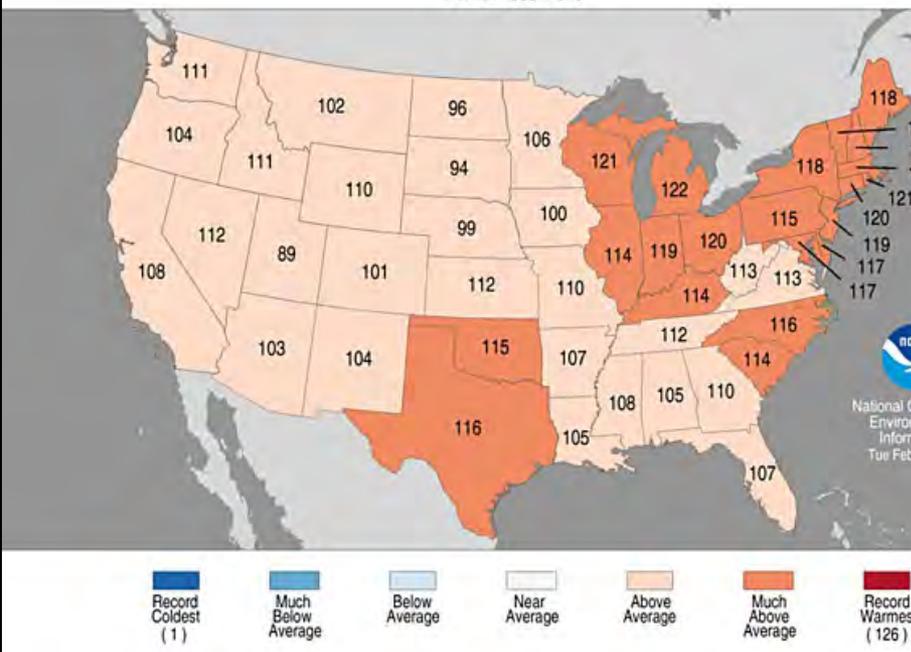


Temperature & Precipitation

Last 30 days

Statewide Average Temperature Ranks

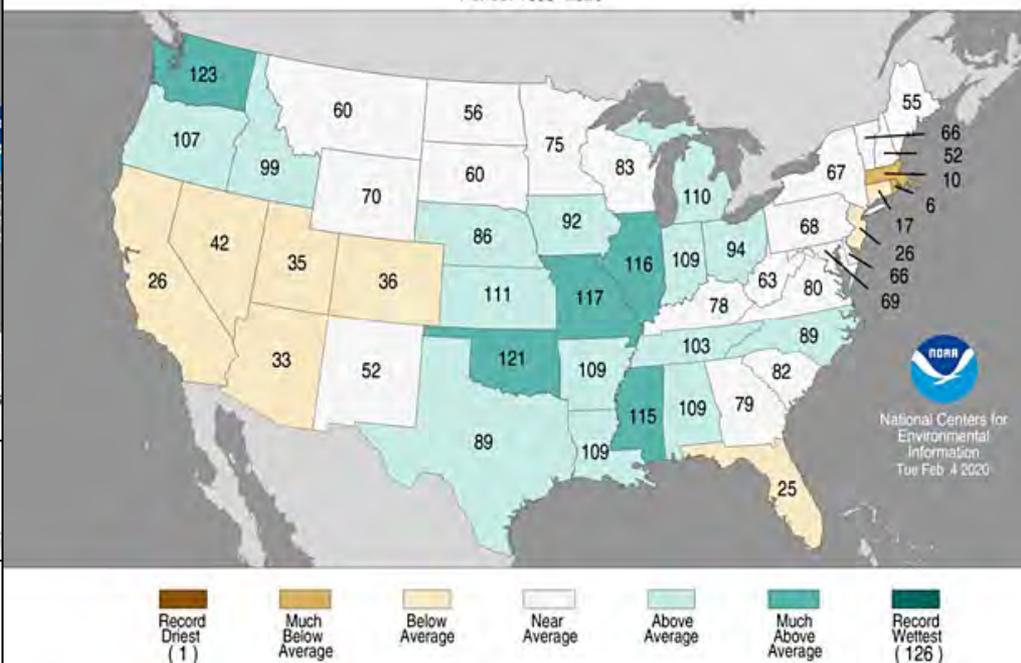
January 2020
Period: 1895-2020



- Temperatures above normal
- Precip. Mixed

Statewide Precipitation Ranks

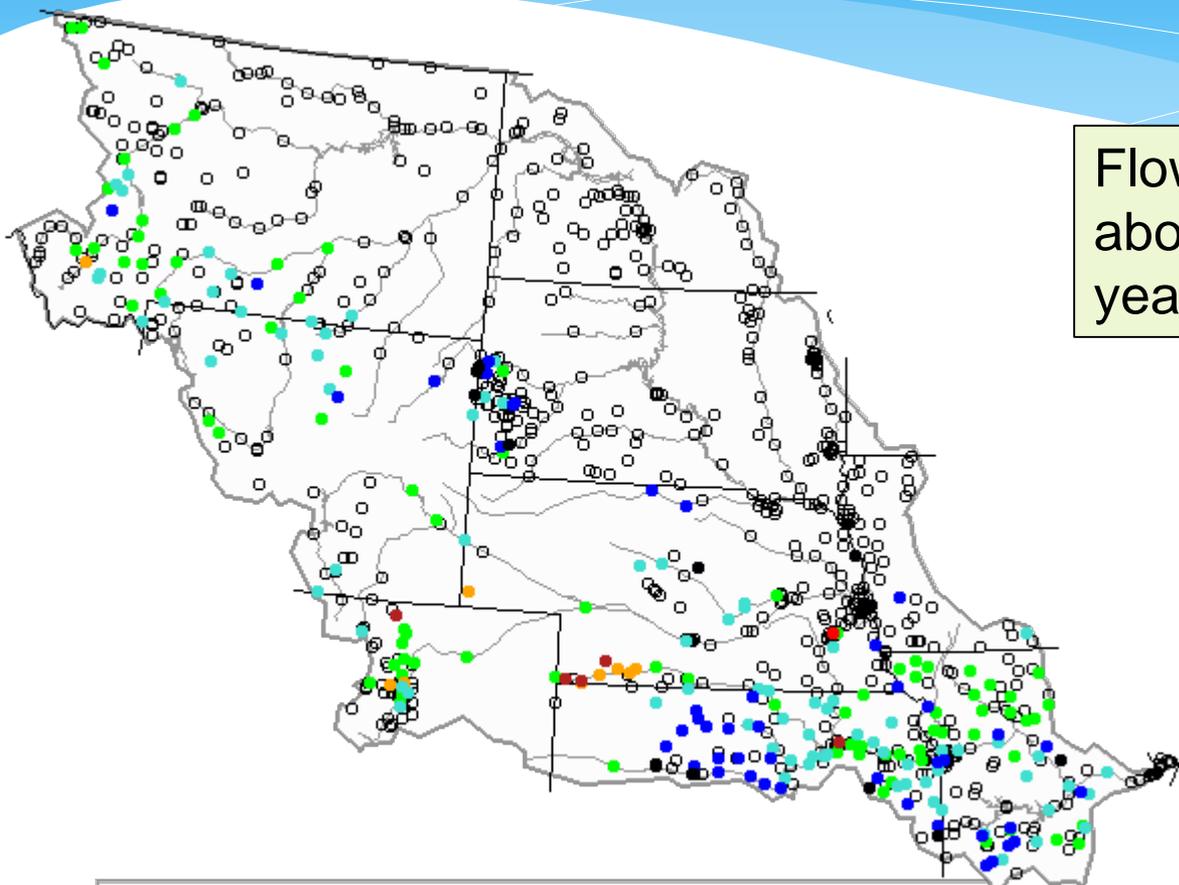
January 2020
Period: 1895-2020





Current Streamflow vs Historical Flows (USGS)

Monday, February 24, 2020 16:30ET



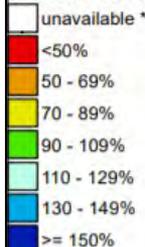
Flows continue to be well above normal for this time of year

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Feb 24, 2020

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median



* Data unavailable at time of posting or measurement is not representative at this time of year

Provisional data subject to revision



The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
<http://www.wcc.nrcs.usda.gov>

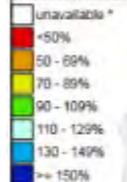
Mountain Snowpack (snow water equivalent % of normal)

Above normal snow pack

Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Feb 11, 2019

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median



* Data unavailable at time of posting or measurement is not representative at this time of year

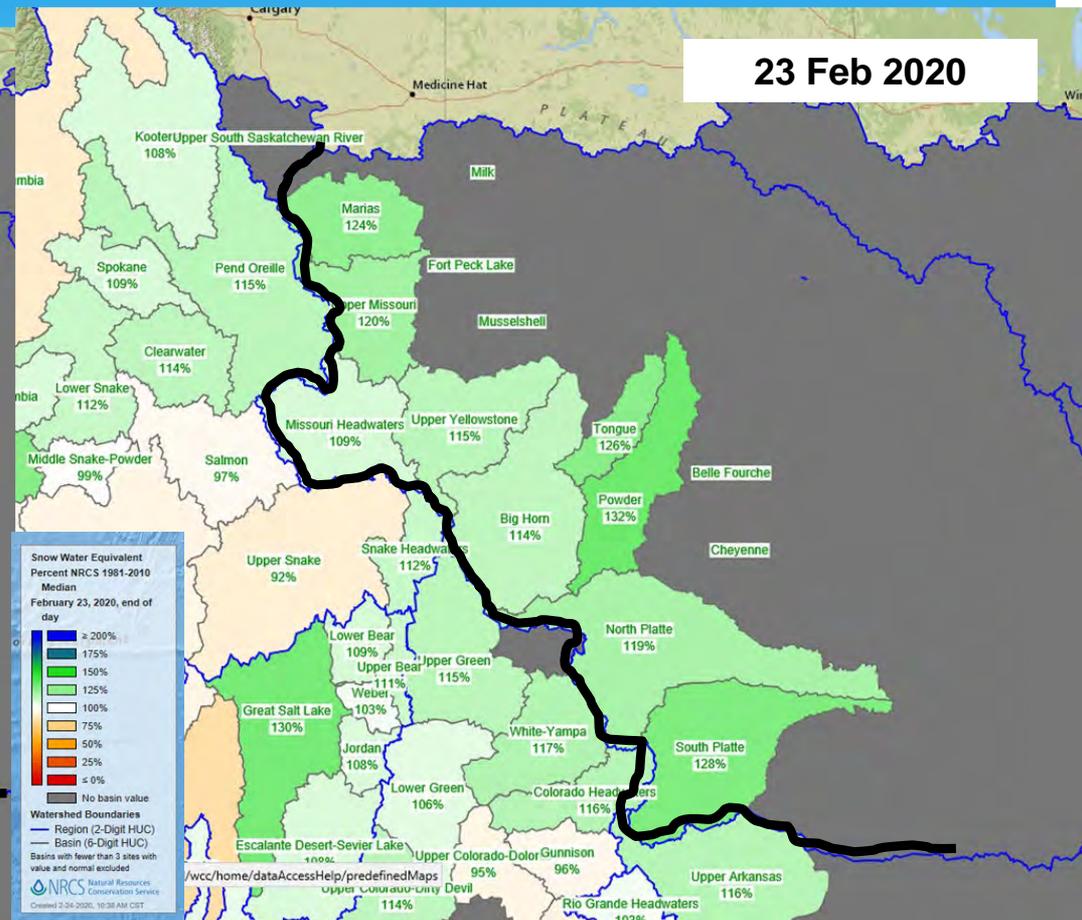
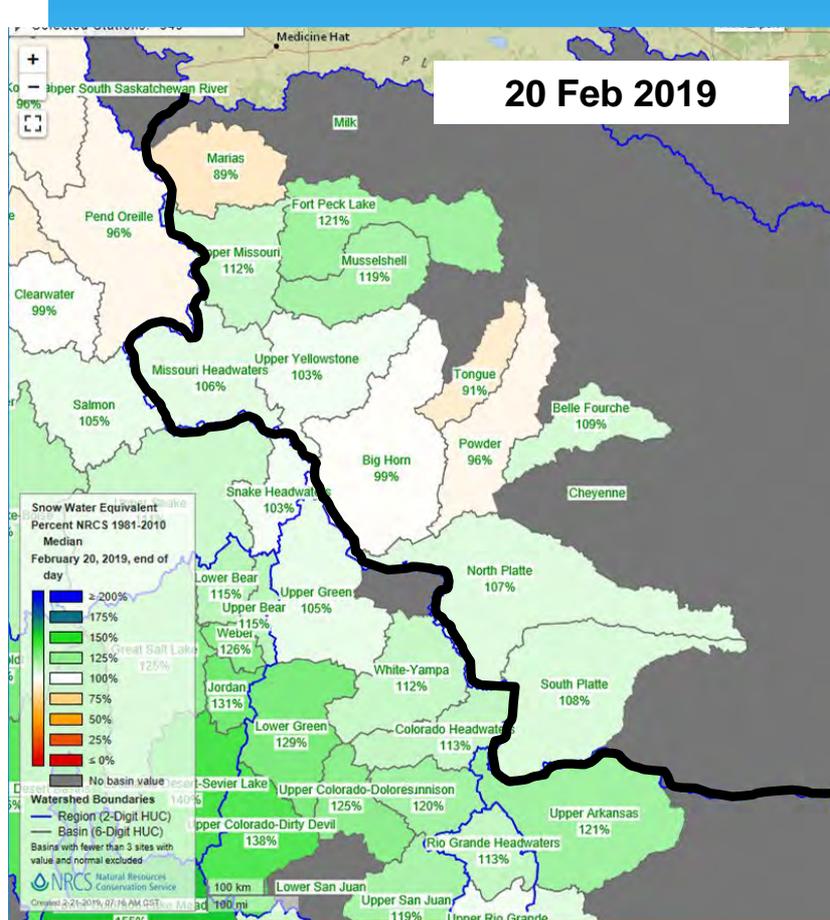
Provisional data subject to revision



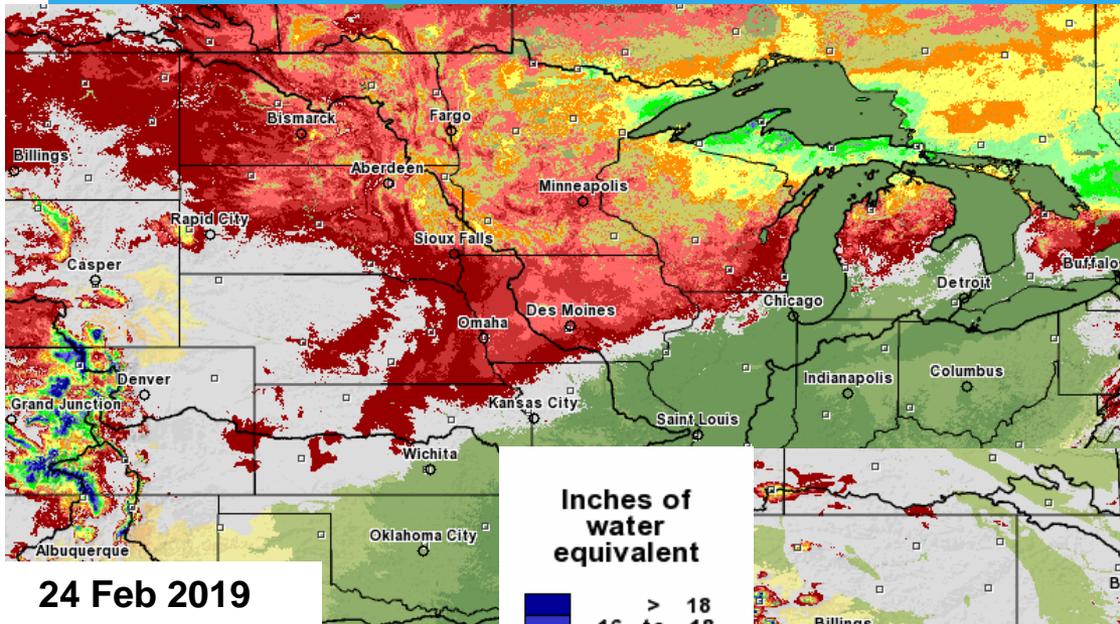
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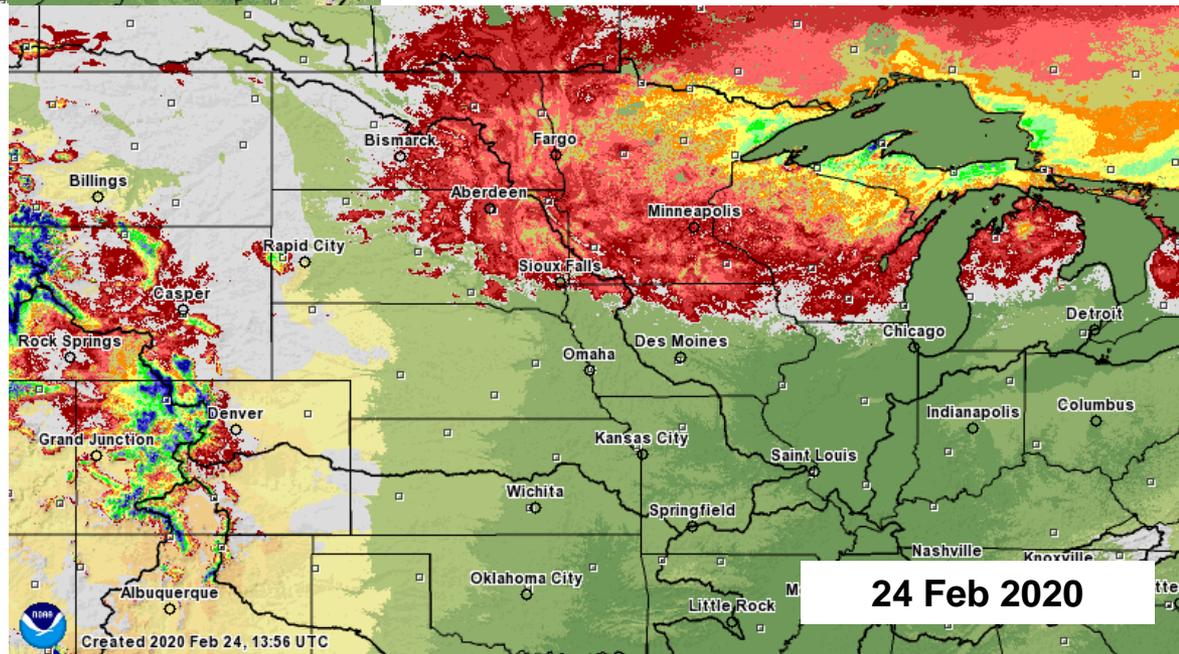
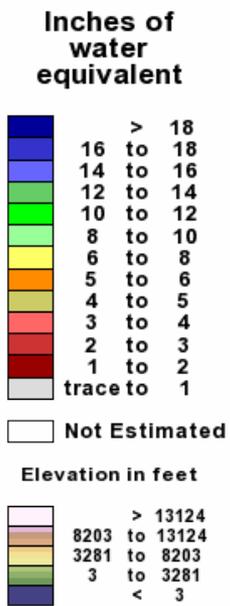
Comparing now to this time last year..... MOUNTAIN SNOWPACK



Comparing now to this time last year..... PLAINS SNOWPACK



24 Feb 2019



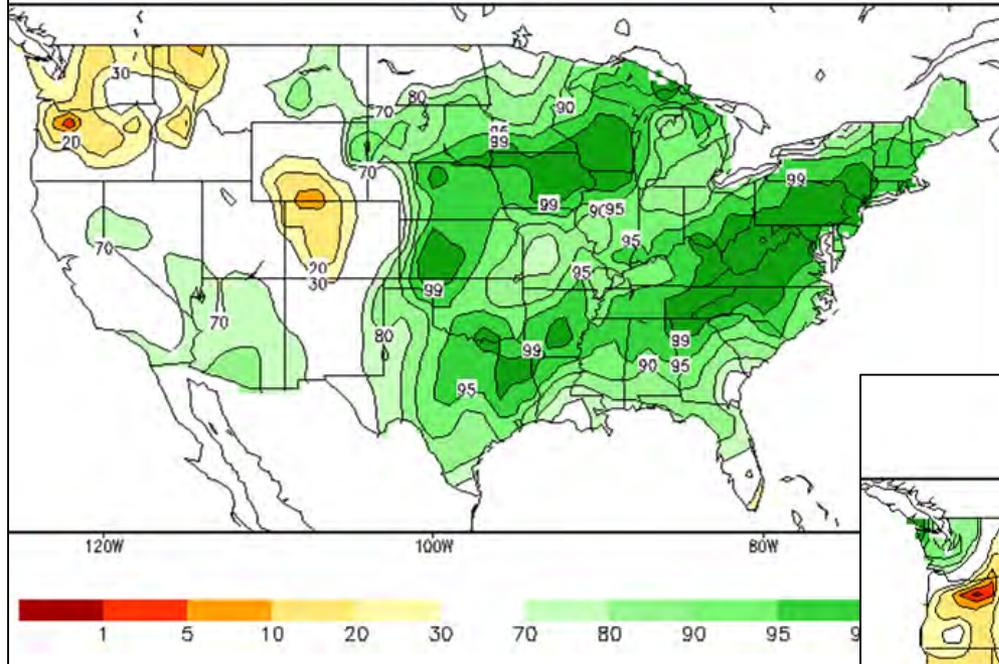
24 Feb 2020



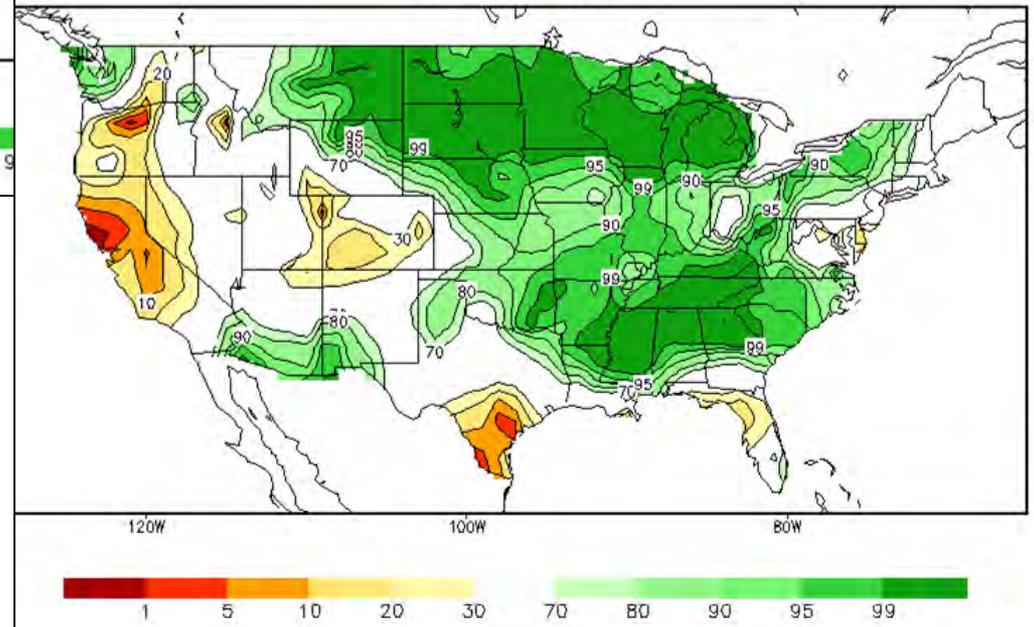
Created 2020 Feb 24, 13:56 UTC

Comparing now to this time last year..... SOIL MOISTURE

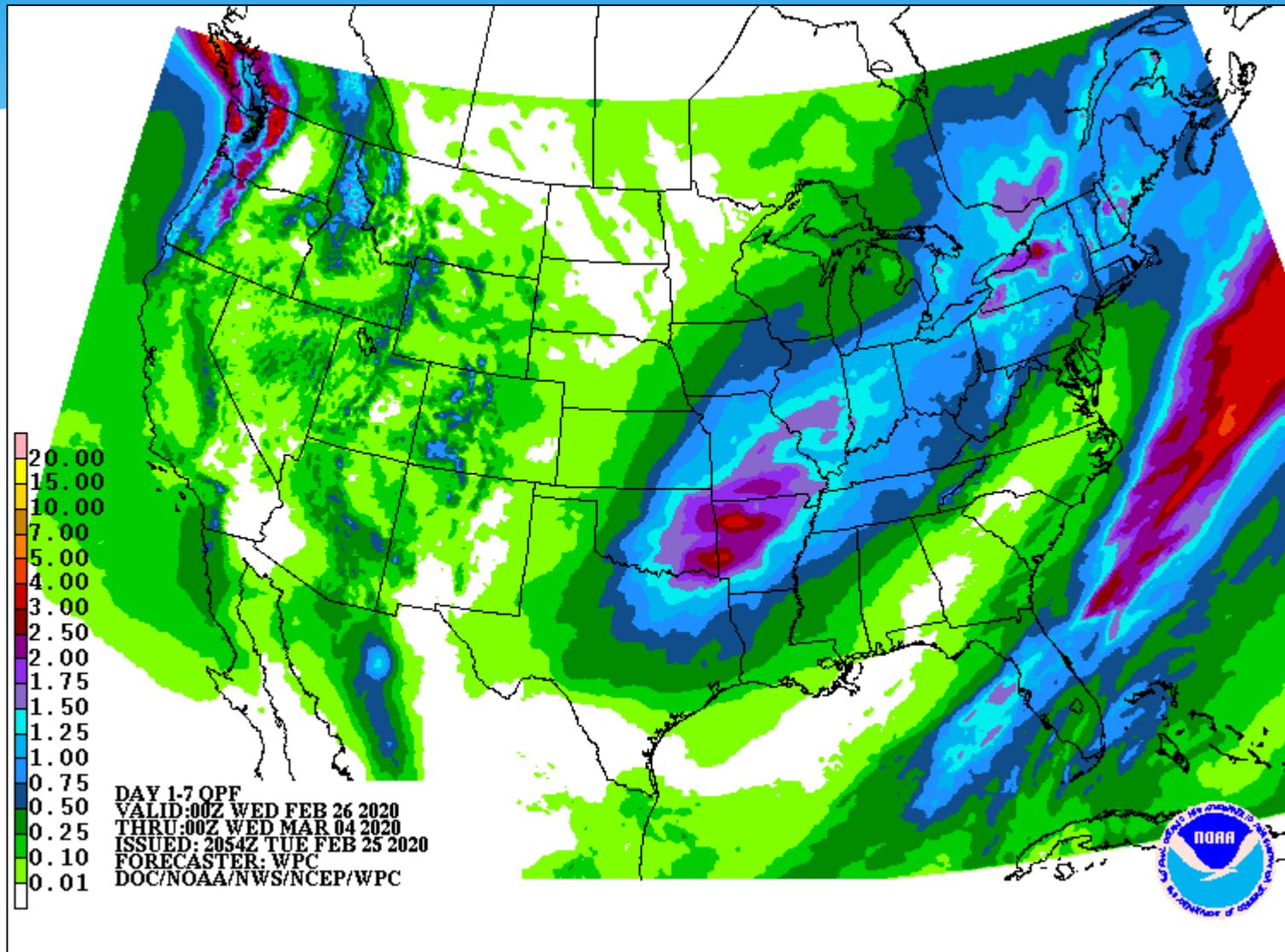
Calculated Soil Moisture Ranking Percentile
FEB, 2019



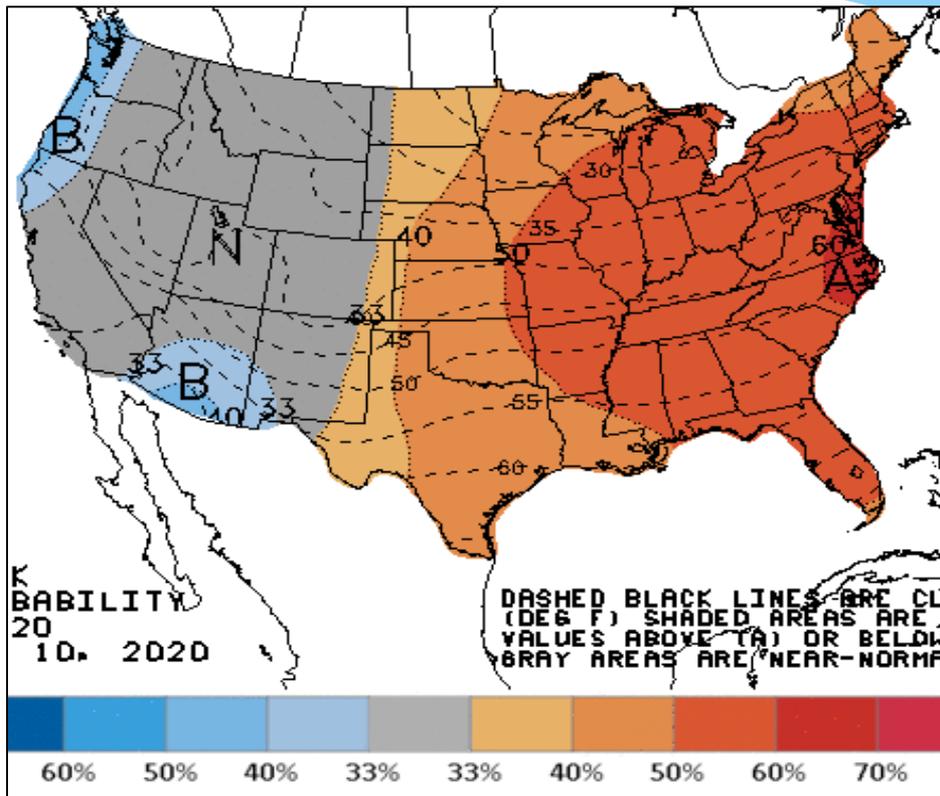
Calculated Soil Moisture Ranking Percentile
FEB 23, 2020



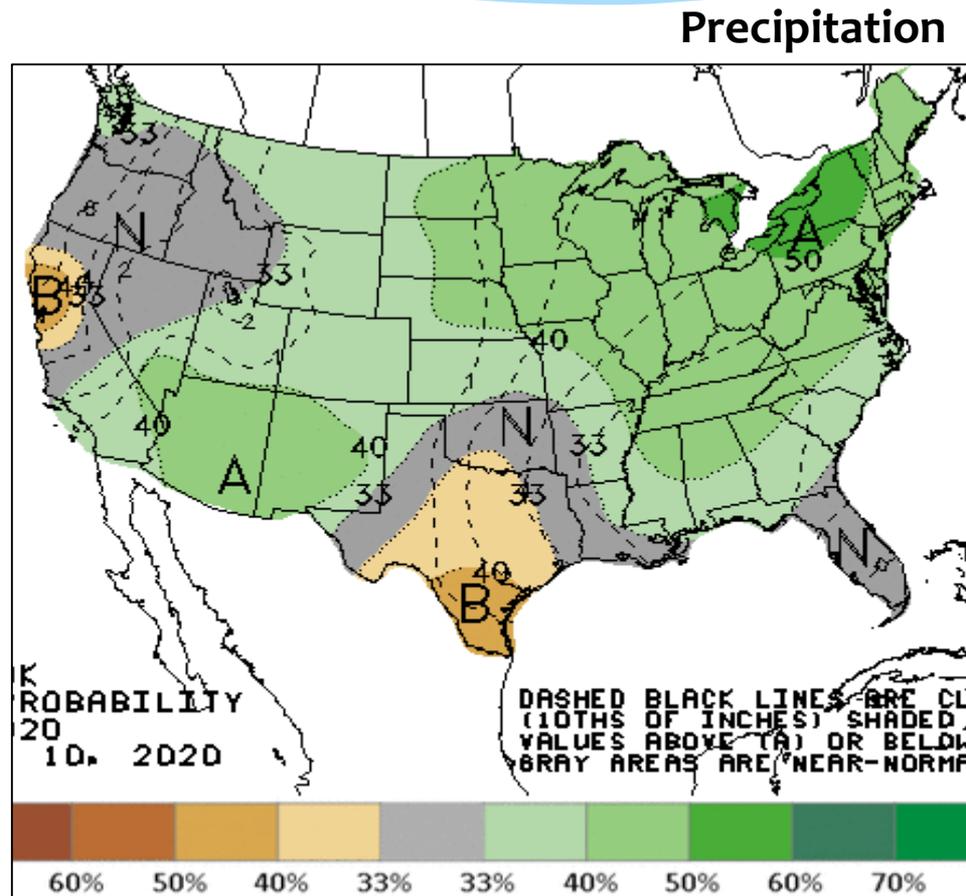
Total Precipitation Outlook Through 3/4/20



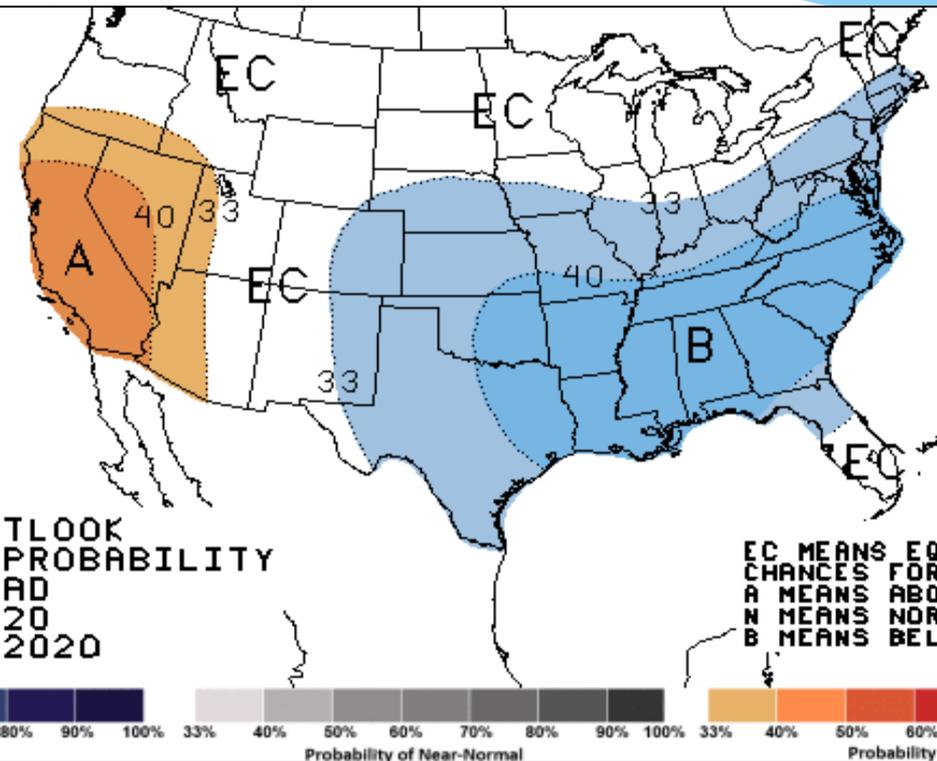
Week 2 Temperature & Precipitation Outlook (3/4-10/20)



Temperature

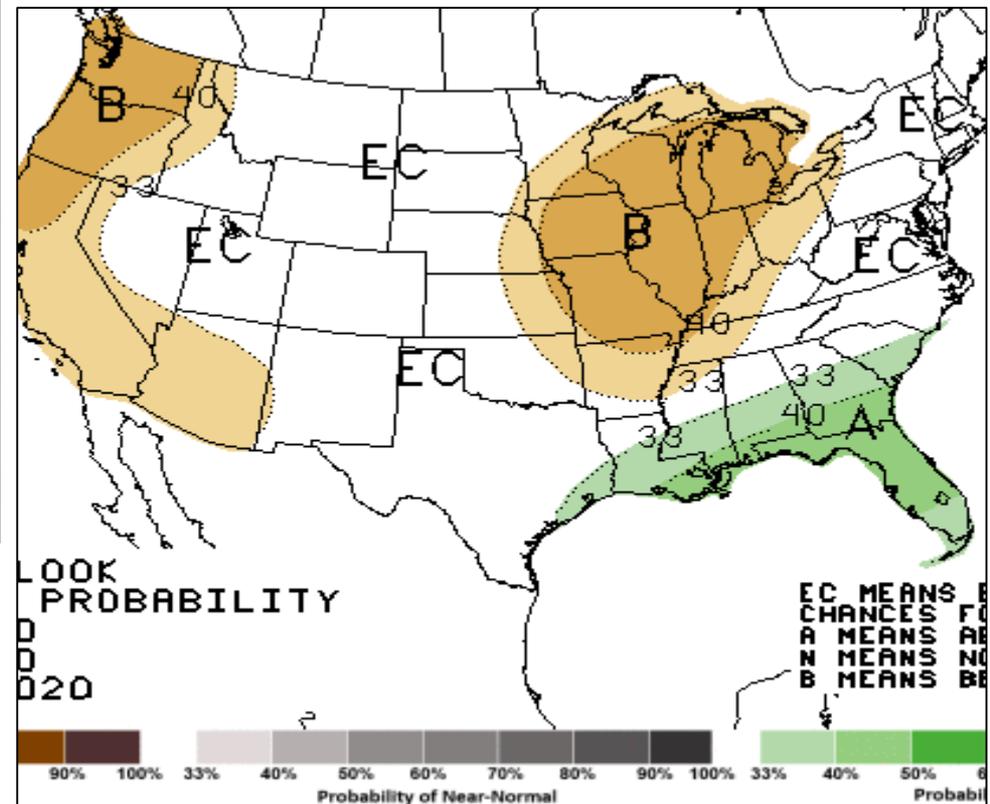


March 2020 Temperature & Precipitation Outlook

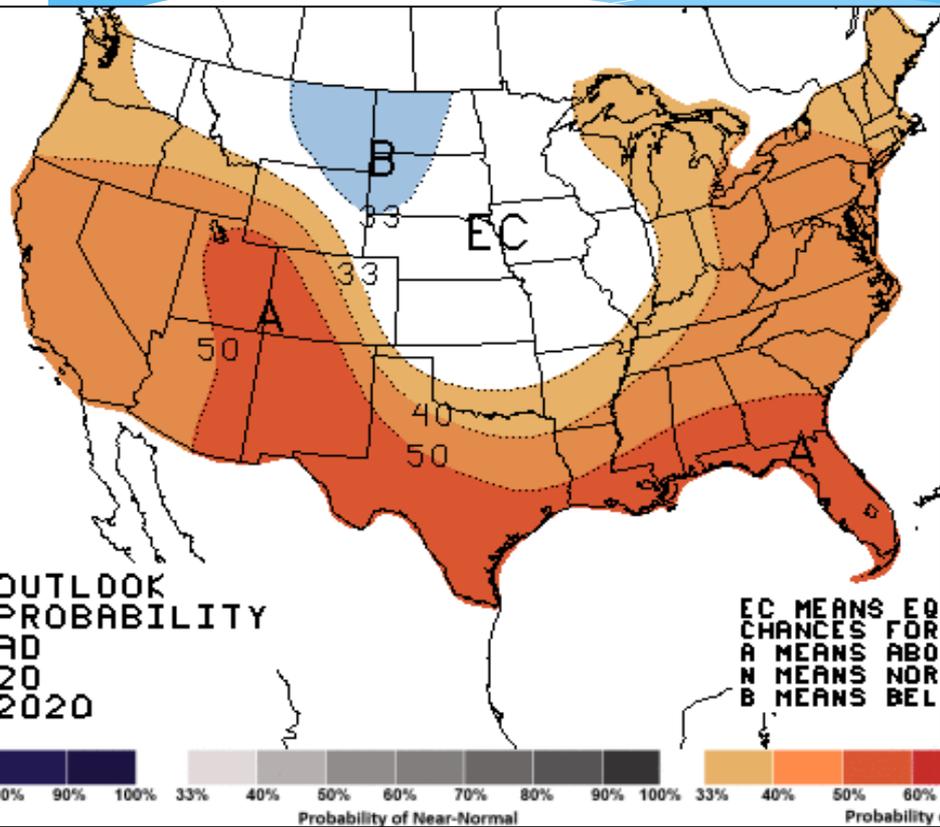


Temperature

Precipitation



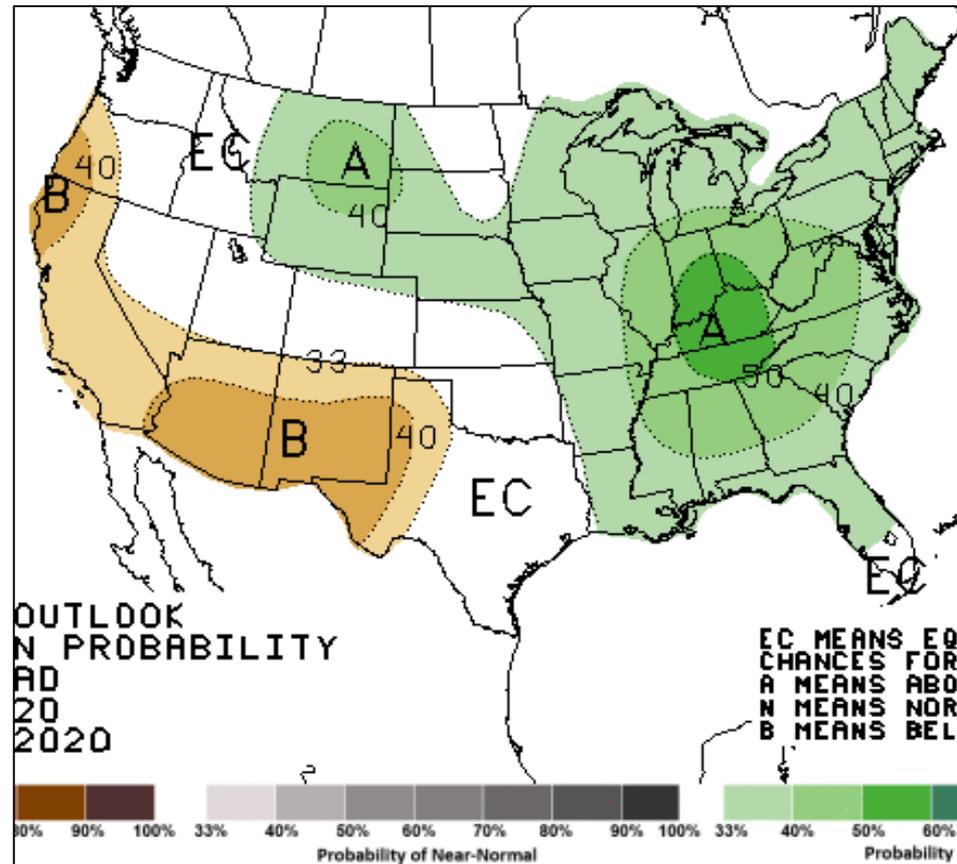
March – May 2020 Temperature & Precipitation Outlook



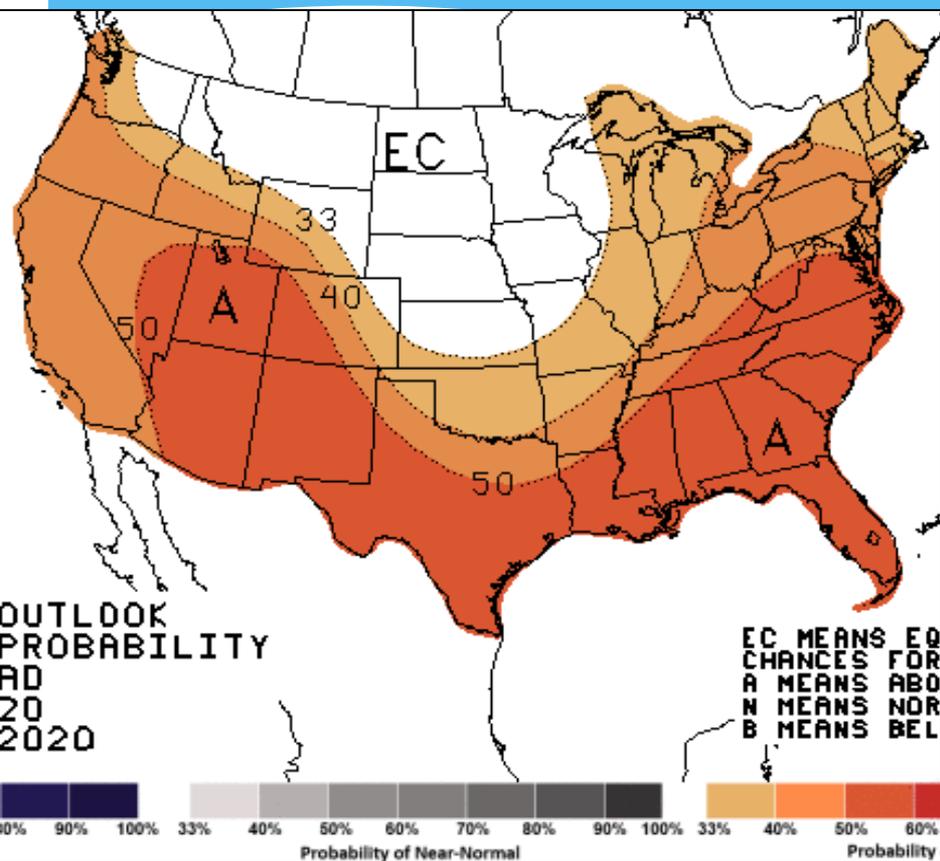
Temperature

<http://www.cpc.noaa.gov/>

Precipitation



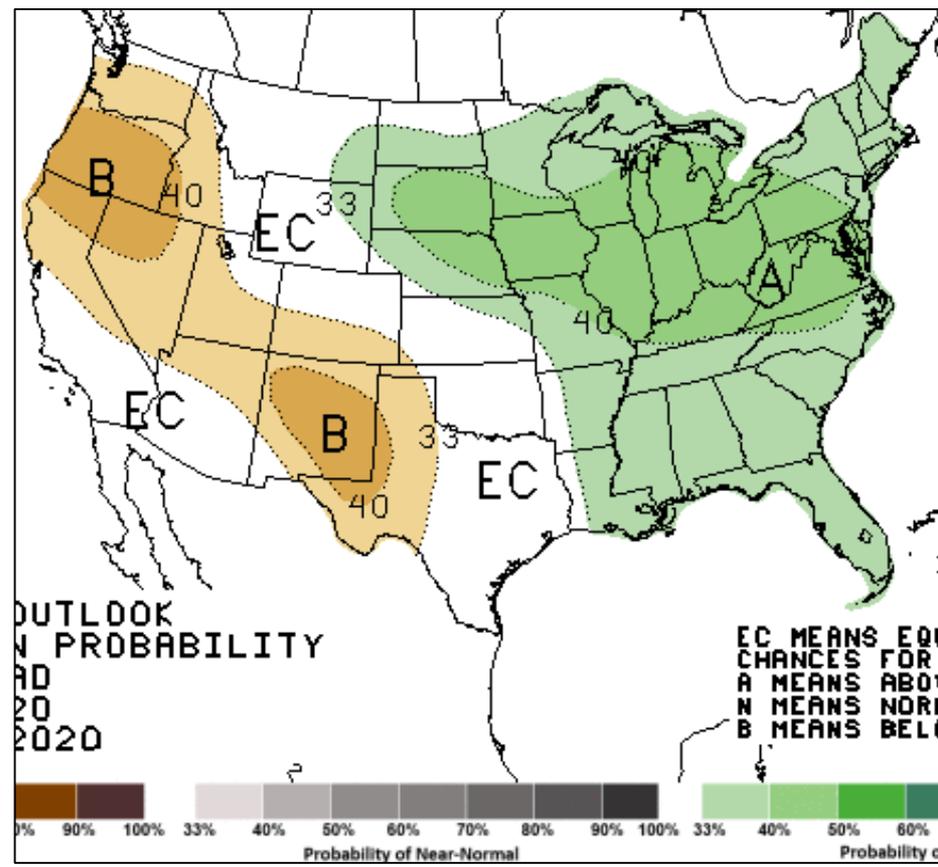
April – June 2020 Temperature & Precipitation Outlook



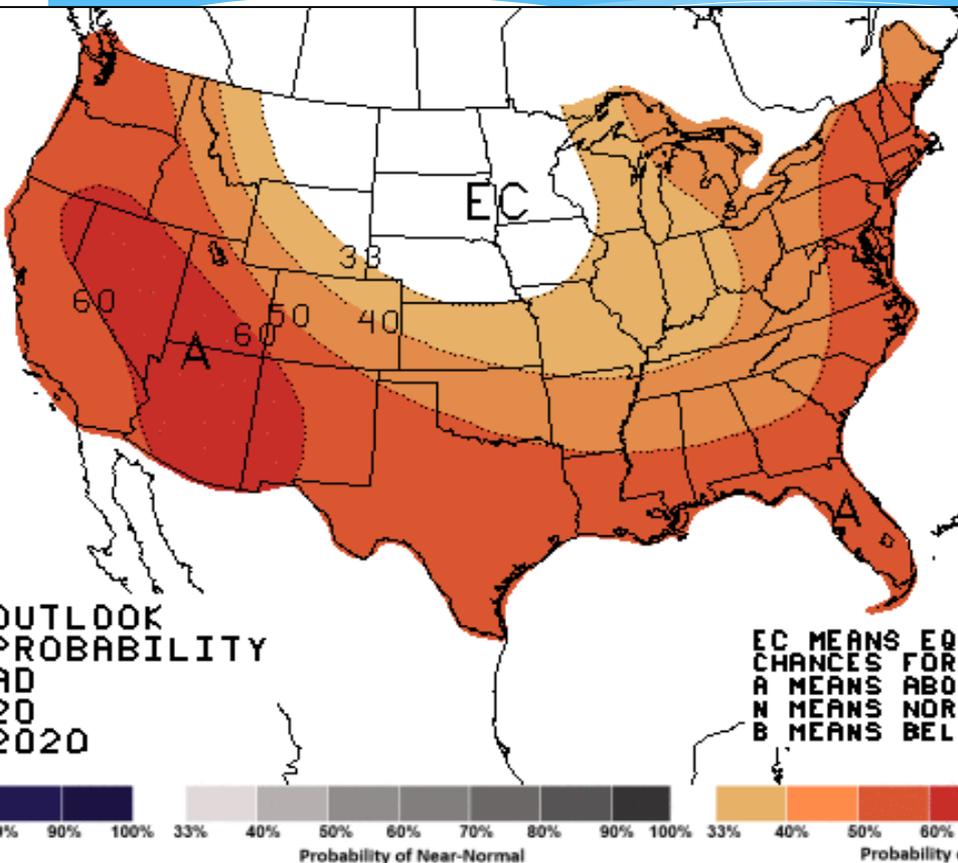
Temperature

<http://www.cpc.noaa.gov/>

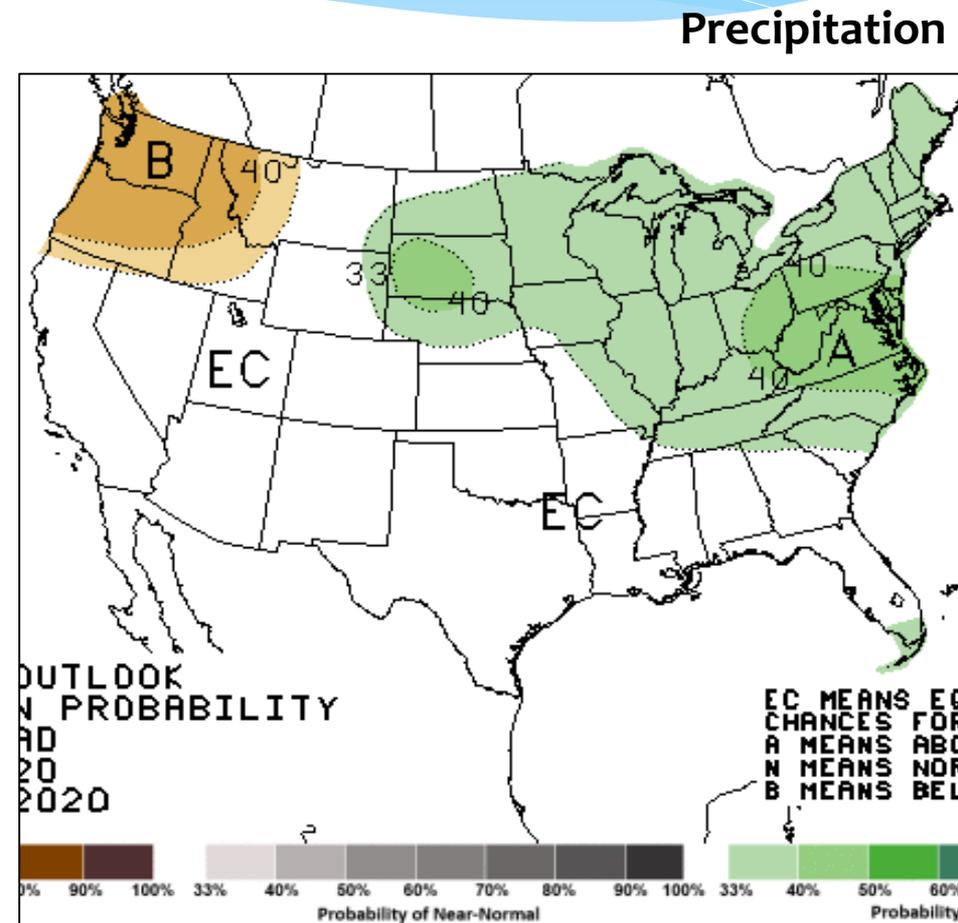
Precipitation



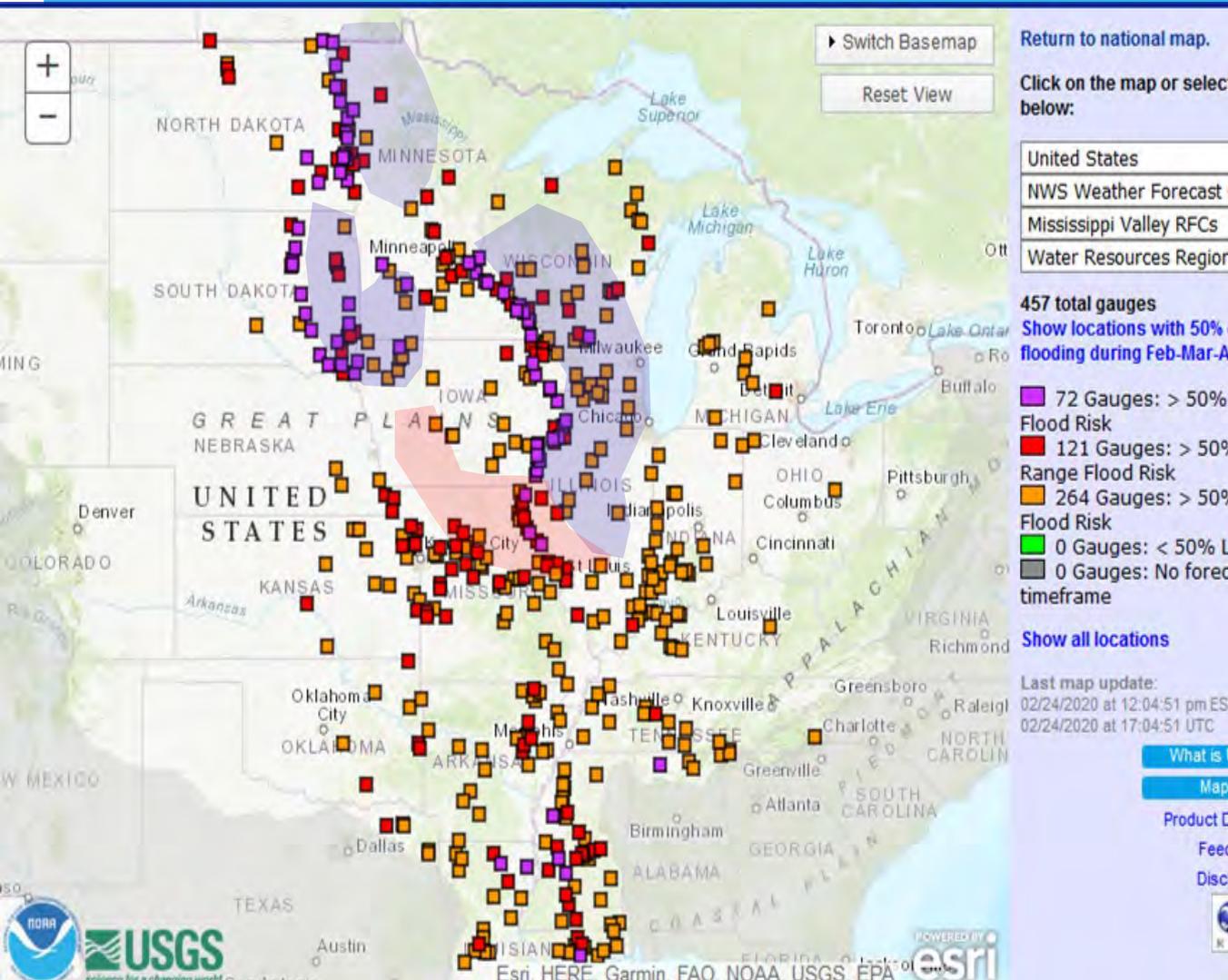
May - July 2020 Temperature & Precipitation Outlook



Temperature



Greater Mississippi River Valley 2020 Feb-March-April Flood Outlook



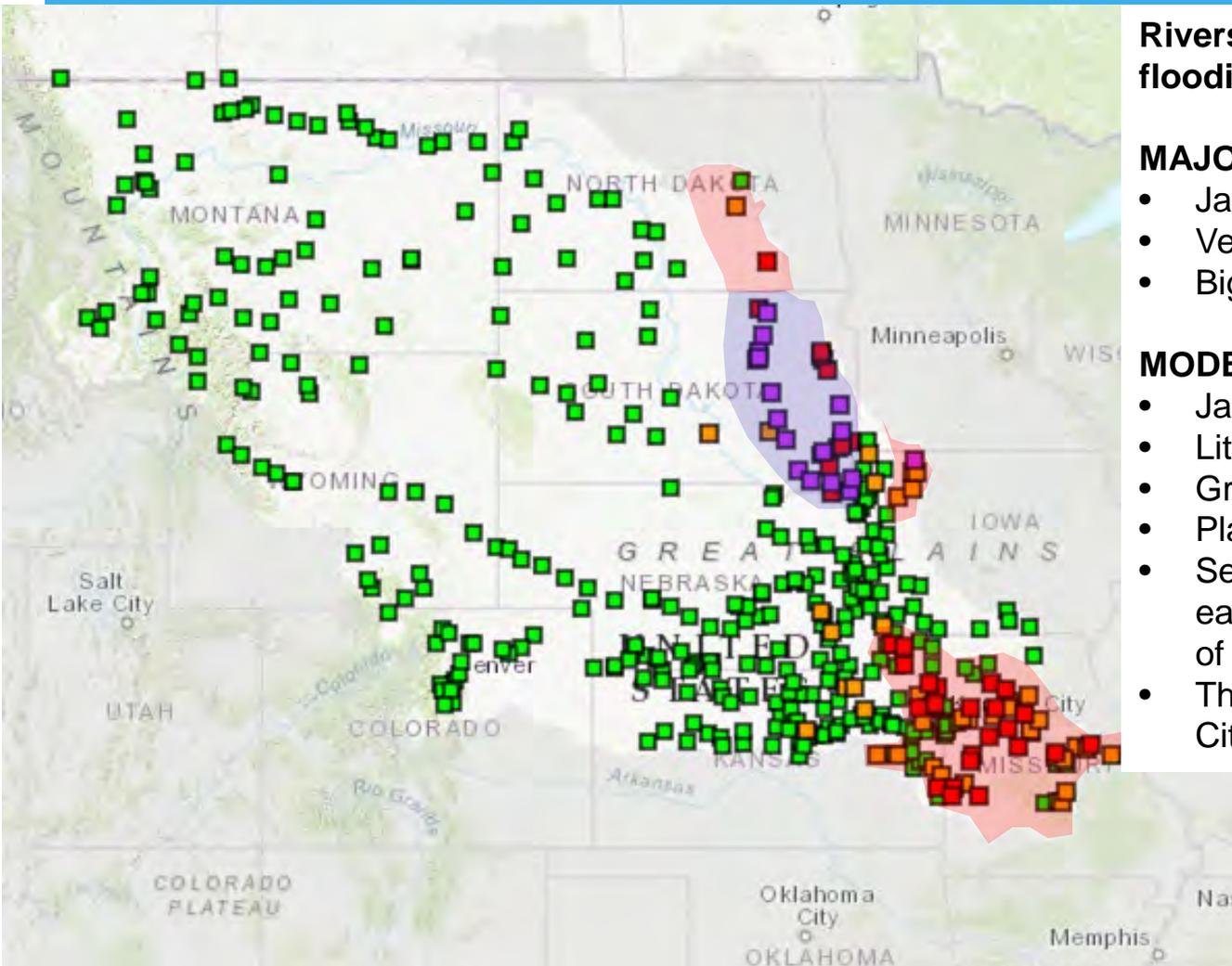
~30% of the 1500 forecast locations within the MS Basin are likely to flood.

Particular concern along:

- Red River of the North
- James River
- Big Sioux River
- Upper Mississippi River
- Lower Missouri River*

Missouri River Basin

2020 March-April-May Flood Outlook



Rivers of particular concern for >50% flooding include:

MAJOR FLOODING EXPECTED:

- James River (South Dakota)
- Vermillion R (South Dakota)
- Big Sioux R (South Dakota & Iowa)

MODERATE FLOODING EXPECTED:

- James River (North Dakota)
- Little Sioux River (South Dakota)
- Grand River (Missouri)
- Platte River (Missouri)
- Several of the smaller tributaries in eastern Kansas and across the state of MO
- The Missouri River from Nebraska City to the mouth.

Missouri River Basin Spring Flood Outlook Summary

- The set-up is “grim”. Saturated soils throughout the basin, and significant snowpack in eastern Dakotas. Widespread flooding in the eastern portion of the Missouri Basin is assured.
- Mountain snowpack is above average, but not concerning.....yet.
- Frozen ground conditions no where like they were last year. River ice formation is not as bad, either. Mild winter has helped with both.
- NWS Spring Outlooks will be issued 27 Feb (tomorrow!!!!) and 12 March. Register at:
<https://attendee.gotowebinar.com/register/5268300473561473293>
- National Hydrologic Assessment released 19 March.



National Centers for
Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



THANKS!

**NATIONAL WEATHER SERVICE
MISSOURI BASIN RIVER FORECAST CENTER**

<https://www.weather.gov/mbrfc/>

&

National Centers for Environmental Information (NCEI)

<https://www.ncei.noaa.gov/>



Building a Weather-Ready Nation

If there is time.....

2019 Retrospective



Credit: Jim Hoppe





MISSOURI RIVER BASIN 2019 PRECIPITATION



Jan-Dec 2019 12-Month	26.80" (680.72mm)	20.19" (512.83mm)	6.61" (167.89mm)	123rd Driest	Driest since: 2018	1934
				3rd Wettest	Wettest since: 1993	1915

Calendar year 2019 was the third wettest year (26.80 in.) in the 125 year record. Outdone only by 1993 (27.38 in.) and 1915 (28.02 in.)

Jan 2018-Dec 2019 24-Month	49.92" (1,267.97mm)	40.40" (1,026.16mm)	9.52" (241.81mm)	124th Driest	Driest since: 2018	1937
				1st Wettest	Wettest to Date	2019
Jan 2017-Dec 2019 36-Month	70.23" (1,783.84mm)	60.59" (1,538.99mm)	9.64" (244.85mm)	125th Driest	Driest since: 2018	1936
				1st Wettest	Wettest to Date	2019

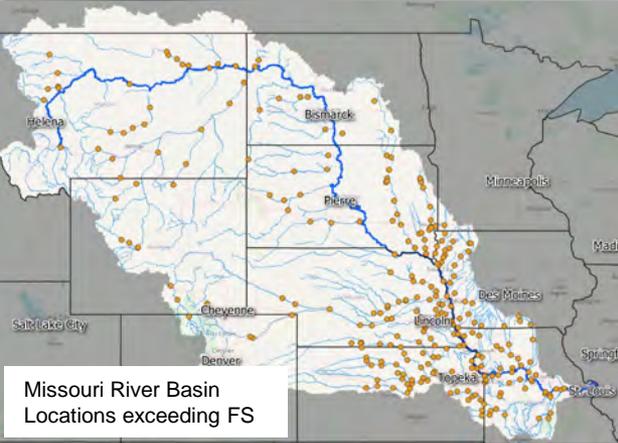
NOAA National Centers for Environmental information



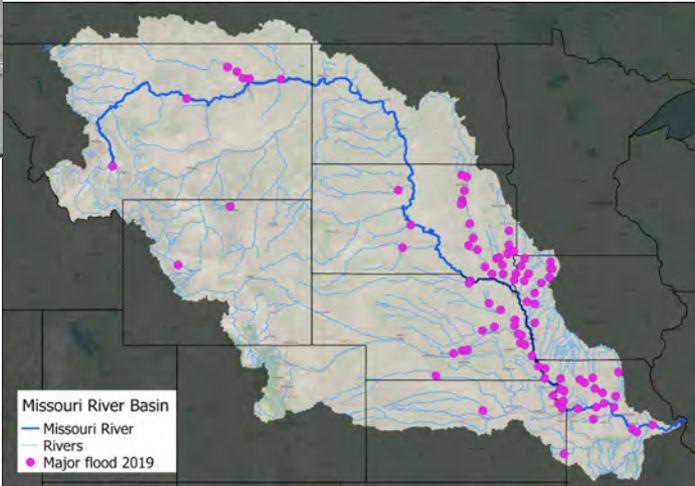
Building a Weather-Ready Nation



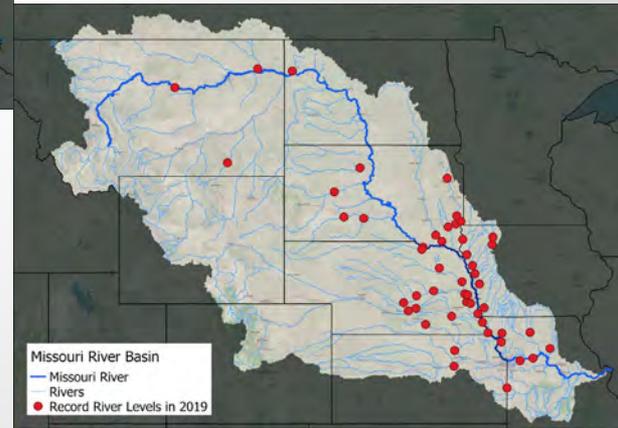
Missouri Basin Flooding 2019



285 locations went to flood



93 locations went to major



50 locations set new record

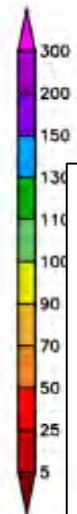
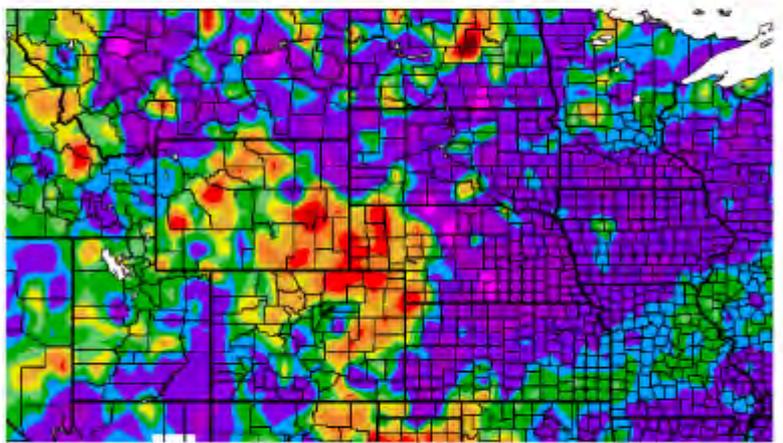




2019 Winter vs 2020 Winter Precipitation



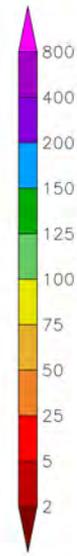
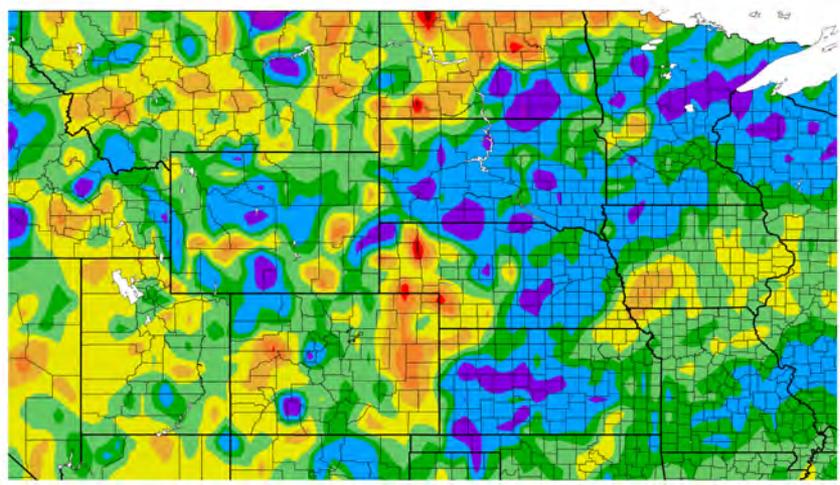
Percent of Normal Precipitation (%)
12/1/2018 - 2/28/2019



December 2018 - February 2019

Generated 3/20/2019 at HPRCC using provisional data. NOAA Regional Climate Centers

Percent of Normal Precipitation (%)
11/27/2019 - 2/24/2020



November 27, 2019 - February 24, 2020

Generated 2/25/2020 at HPRCC using provisional data. NOAA Regional Climate Centers

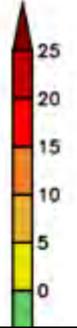
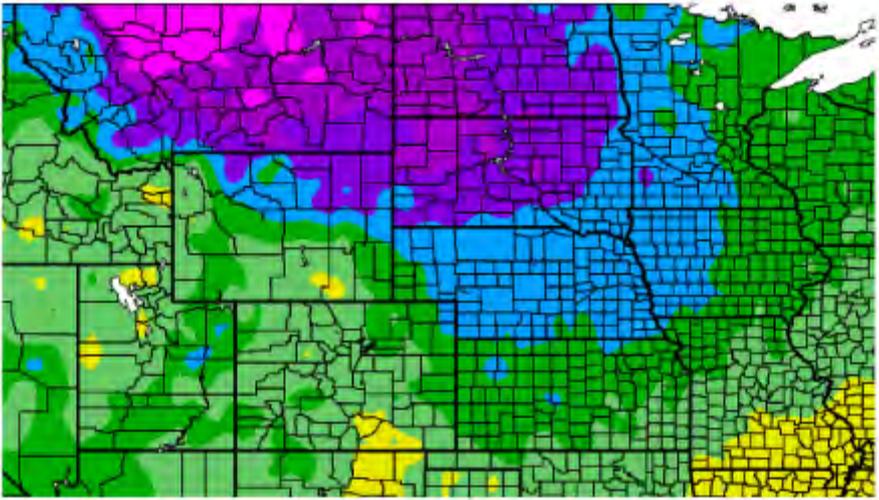




2019 Winter vs 2020 Winter Temperature



Departure from Normal Temperature (F)
2/1/2019 - 2/28/2019

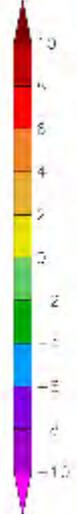
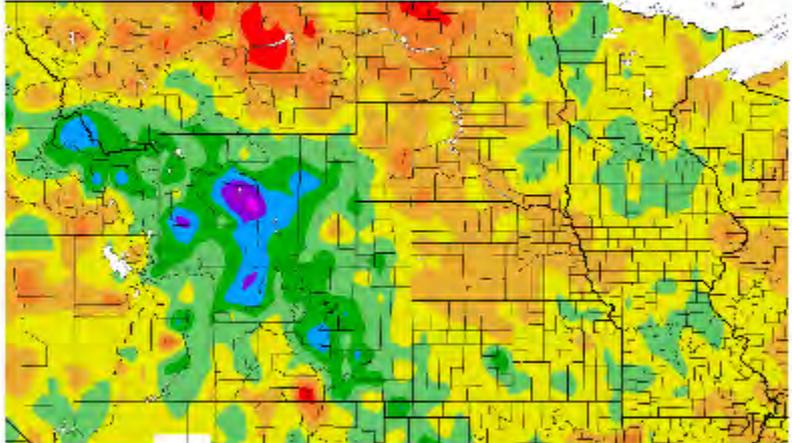


February 2019

Generated 3/20/2019 at HPRCC using provisional data.

NOAA Regional Climate

Departure from Normal Temperature (F)
1/26/2020 - 2/24/2020



Last 30 days

Generated 2/29/2020 at HPRCC using provisional data.

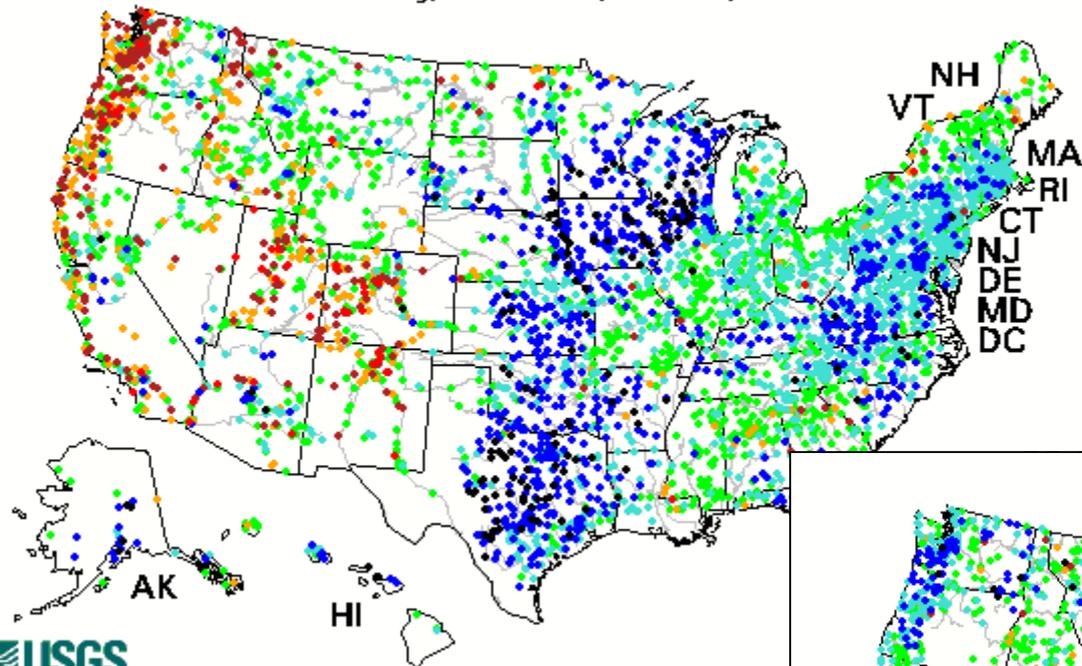
NOAA Regional Climate Center



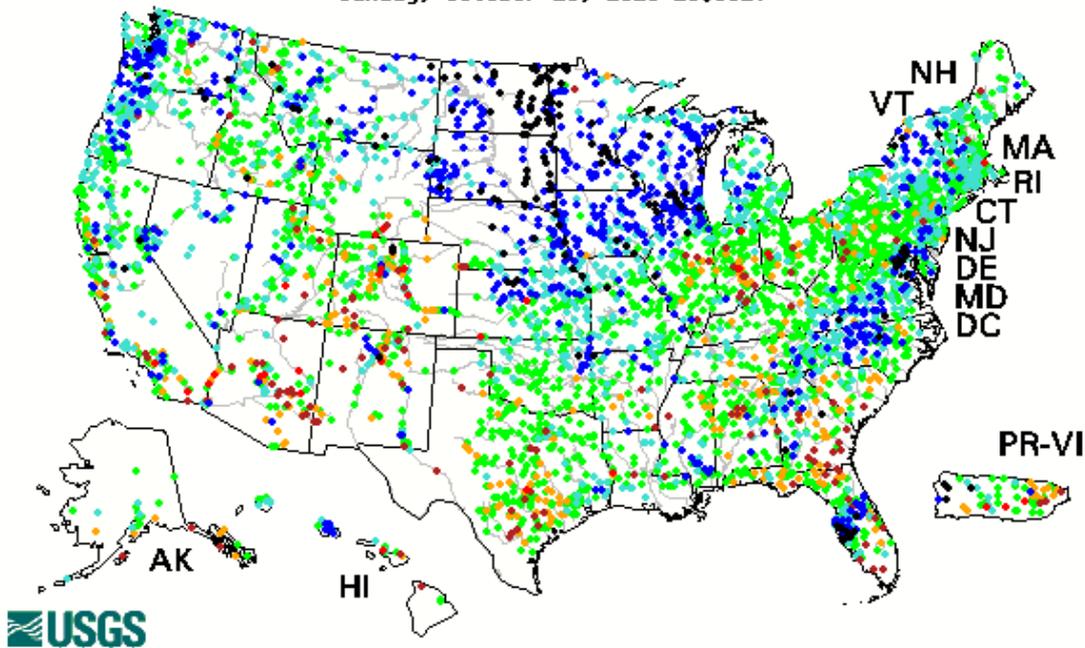
Building a W

Comparing October 2019 to 2018 STREAMFLOW GOING INTO FREEZE-UP

Saturday, October 20, 2018 19:30ET



Sunday, October 20, 2019 19:30ET



Explanation - Percentile classes

Low						High
	<10	10-24	25-75	76-90	>90	
	Much below normal	Below normal	Normal	Above normal	Much above normal	

USGS

An Amazing Stretch of Months

- **As of October 2019, the Missouri Basin was the wettest 18, 48, 60 months**
- **2nd Wettest 3, 12, 24, 36 months**
- **3rd Wettest 4, 6, 7, 8, 9, 10, 11 months**

- **125 years of record**



Midwest States Annual Records

(MN, IA, MO, WI, IL, IN, MI, KY, OH)

Ranked Listing of State & Climate Division Data

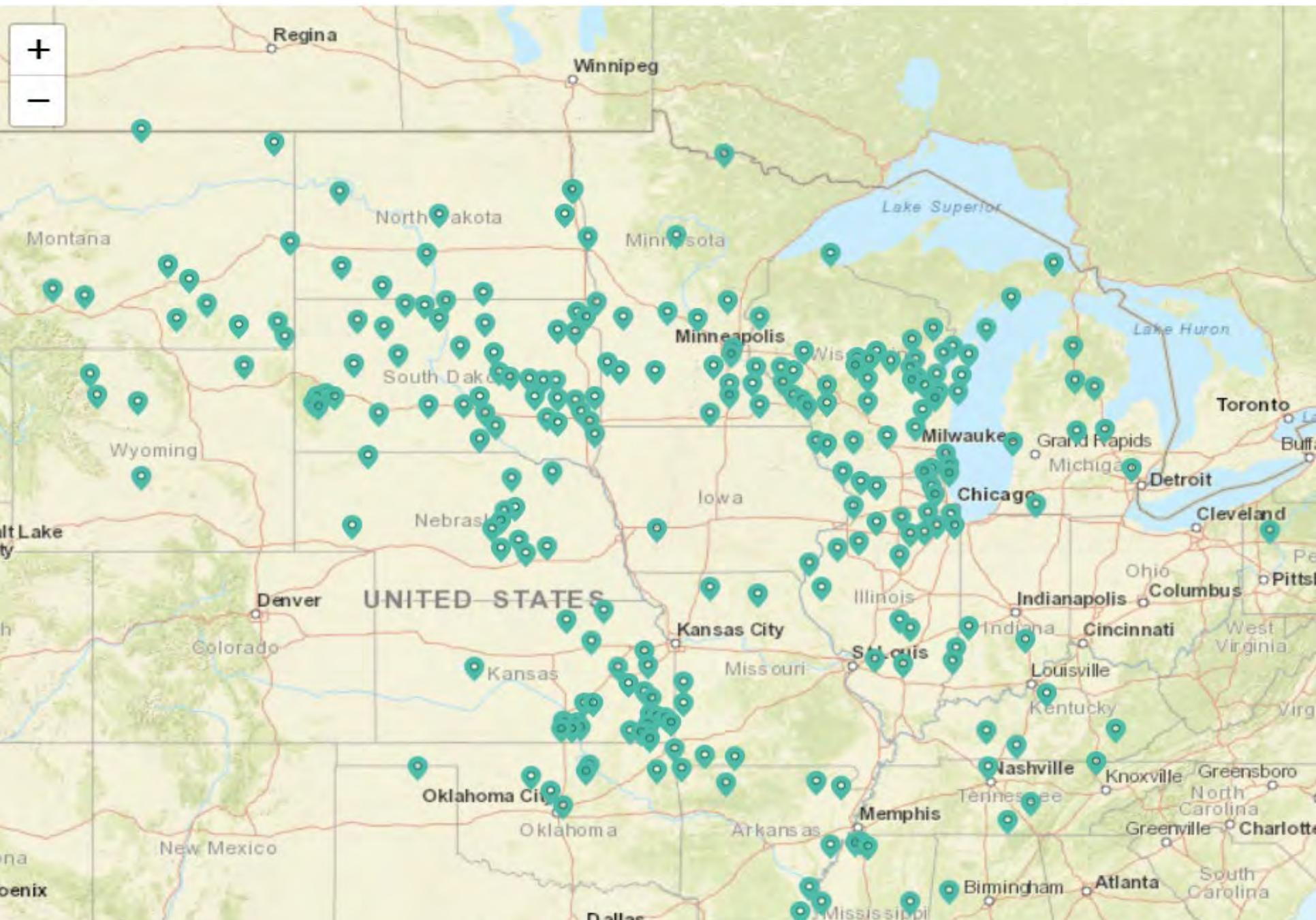
Precipitation

MRCC Region

January to December values listed in decreasing order (125 years, 1895 to 2019).

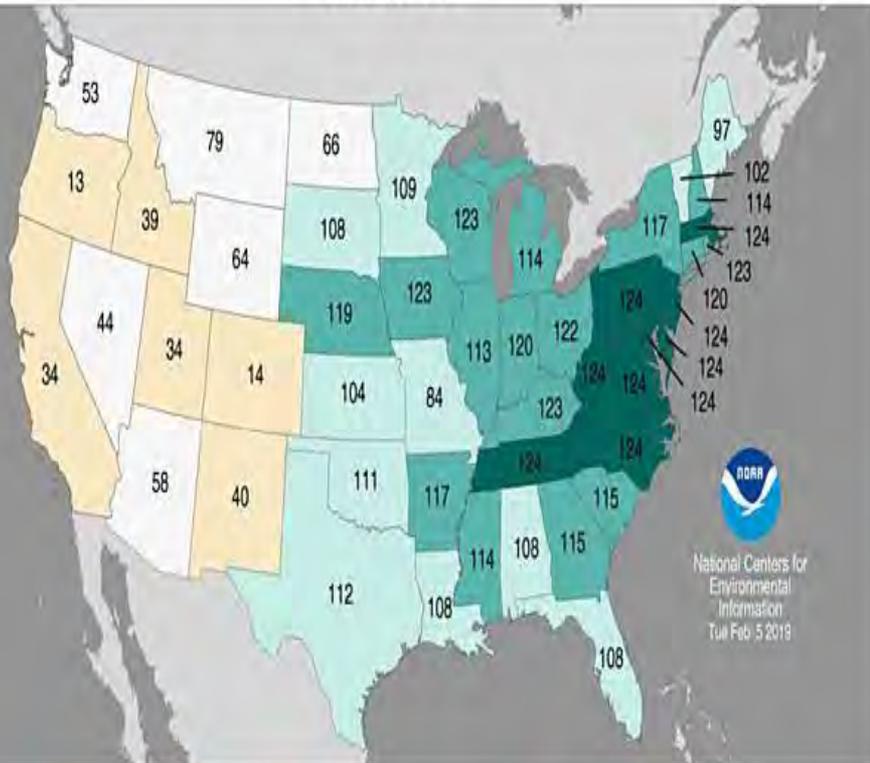
Rank	Year *	Total	Normal	Dep.	%Norm
1	2019 *	46.09	36.94	9.14	125
2	2018	43.06	36.94	6.11	117
3	1993	42.73	36.94	5.79	116
4	2015	42.52	36.94	5.58	115
5	1990	42.42	36.94	5.48	115
6	2008	41.98	36.94	5.04	114
7	1973	41.81	36.94	4.87	113
8	1951	41.49	36.94	4.54	112
9	2011	40.94	36.94	4.00	111
10	1982	40.67	36.94	3.73	110



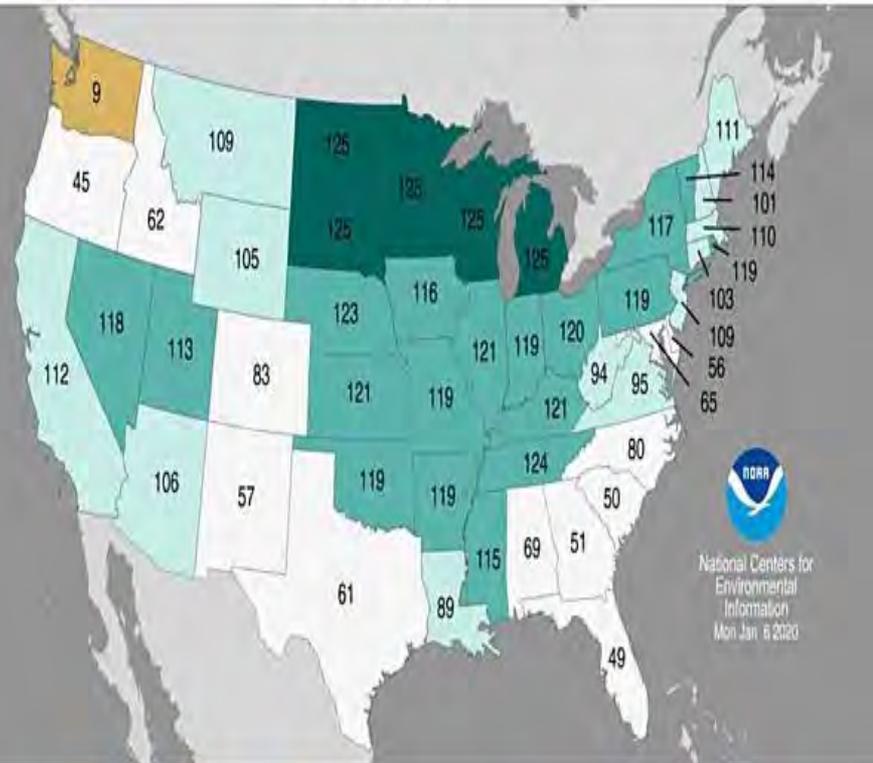


2018 vs 2019

Statewide Precipitation Ranks
January–December 2018
Period: 1895–2018



Statewide Precipitation Ranks
January–December 2019
Period: 1895–2019



**Ranked Listing of State & Climate Division Data
Precipitation
MRCC Region
January to December values listed in decreasing order**

Rank	Year *	Total	Normal	Dep.	%Norm
1	2019 *	46.09	36.94	9.14	125
2	2018	43.06	36.94	6.11	117
3	1993	42.73	36.94	5.79	116
4	2015	42.52	36.94	5.58	115
5	1990	42.42	36.94	5.48	115
6	2008	41.98	36.94	5.04	114
7	1973	41.81	36.94	4.87	113
8	1951	41.49	36.94	4.54	112
9	2011	40.94	36.94	4.00	111
10	1982	40.67	36.94	3.73	110

Midwest Region Wettest Ten-Year Periods

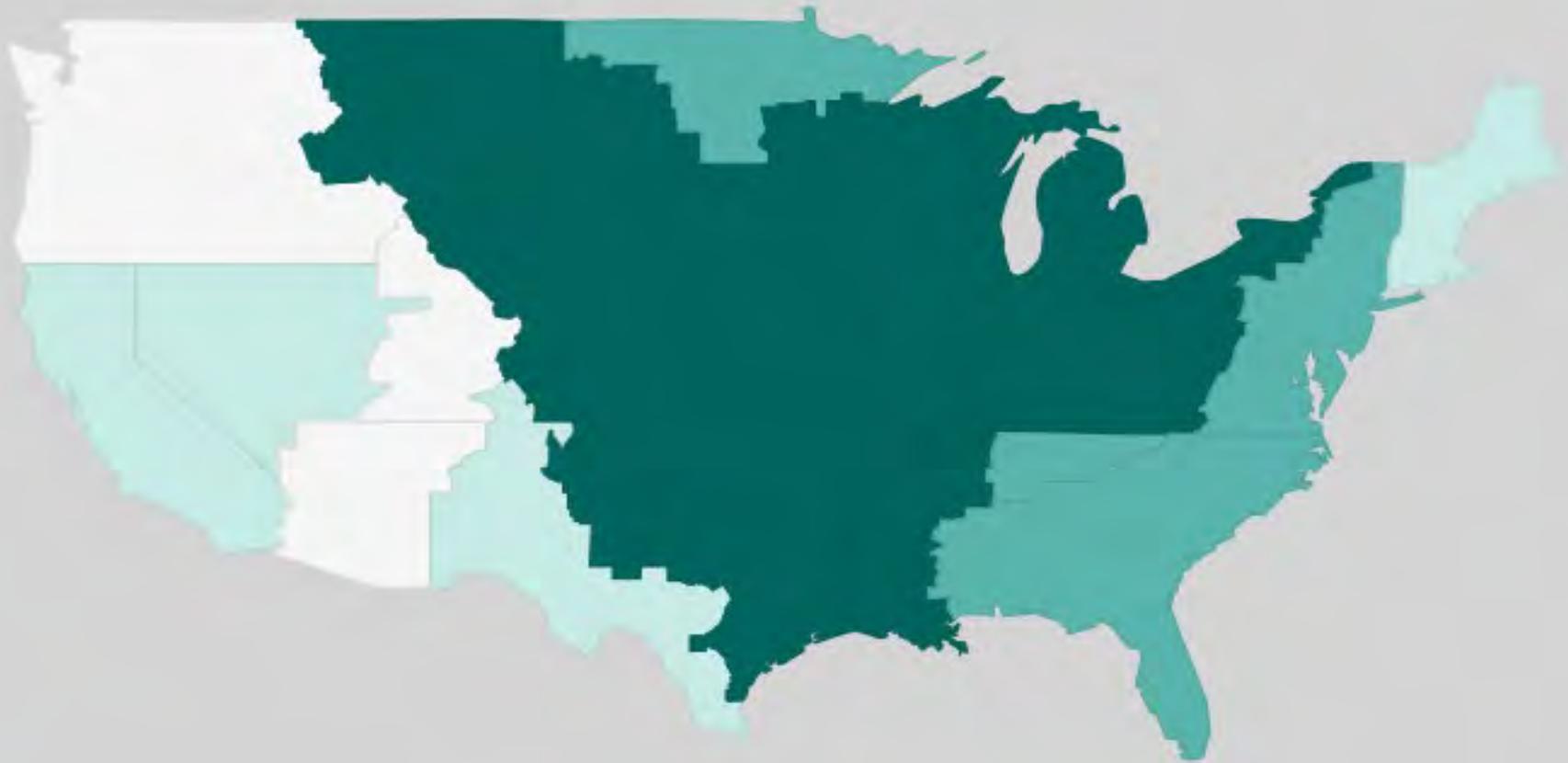
Ten-Year Period	Ten-Year Precipitation (in)	Rank
2010-2019	397.45	1
2009-2018	391.29	2
2008-2017	390.21	3
2007-2016	388.32	4
2006-2015	386.04	5
2002-2011	379.25	6
2004-2013	378.28	7
2005-2014	377.07	8
2001-2010	375.74	9
1977-1986	374.43	10
2003-2012	373.87	11

Using NCEI nClim Div Data 1895-2019

Shows 10-year totals. Each of the past 5 (overlapping) 10-year periods was a new record. The most recent 10 10-year totals all rank in the top 11 cases with only 1977-1986 also among the top 11.

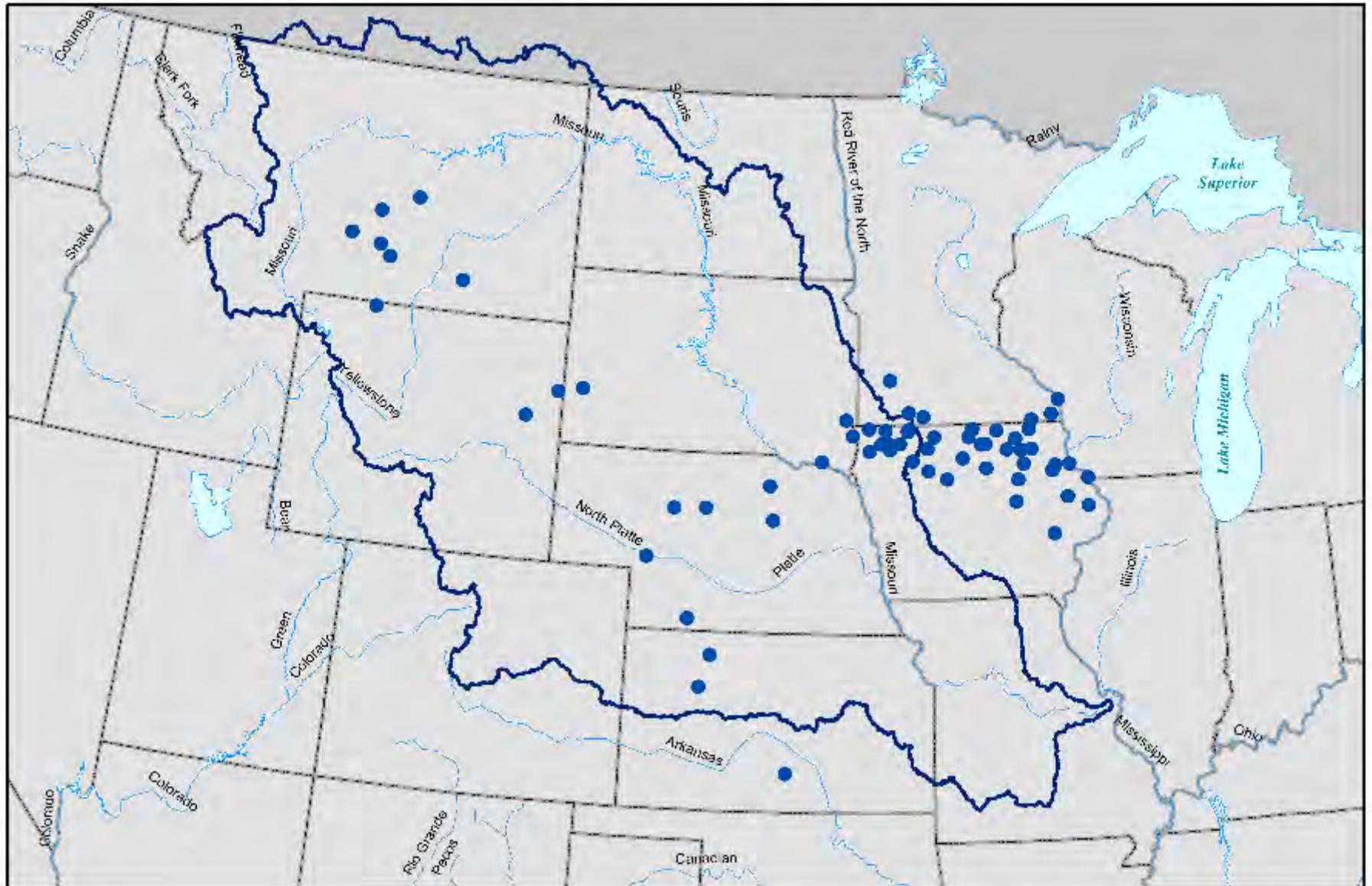
Wettest 5-Year Total Precipitation Ranks

2015-2019 (121 year record)



1 121

2018 Precipitation Records in and near the Missouri River Basin



Legend

- New Precipitation Records
- ▭ Missouri River Basin

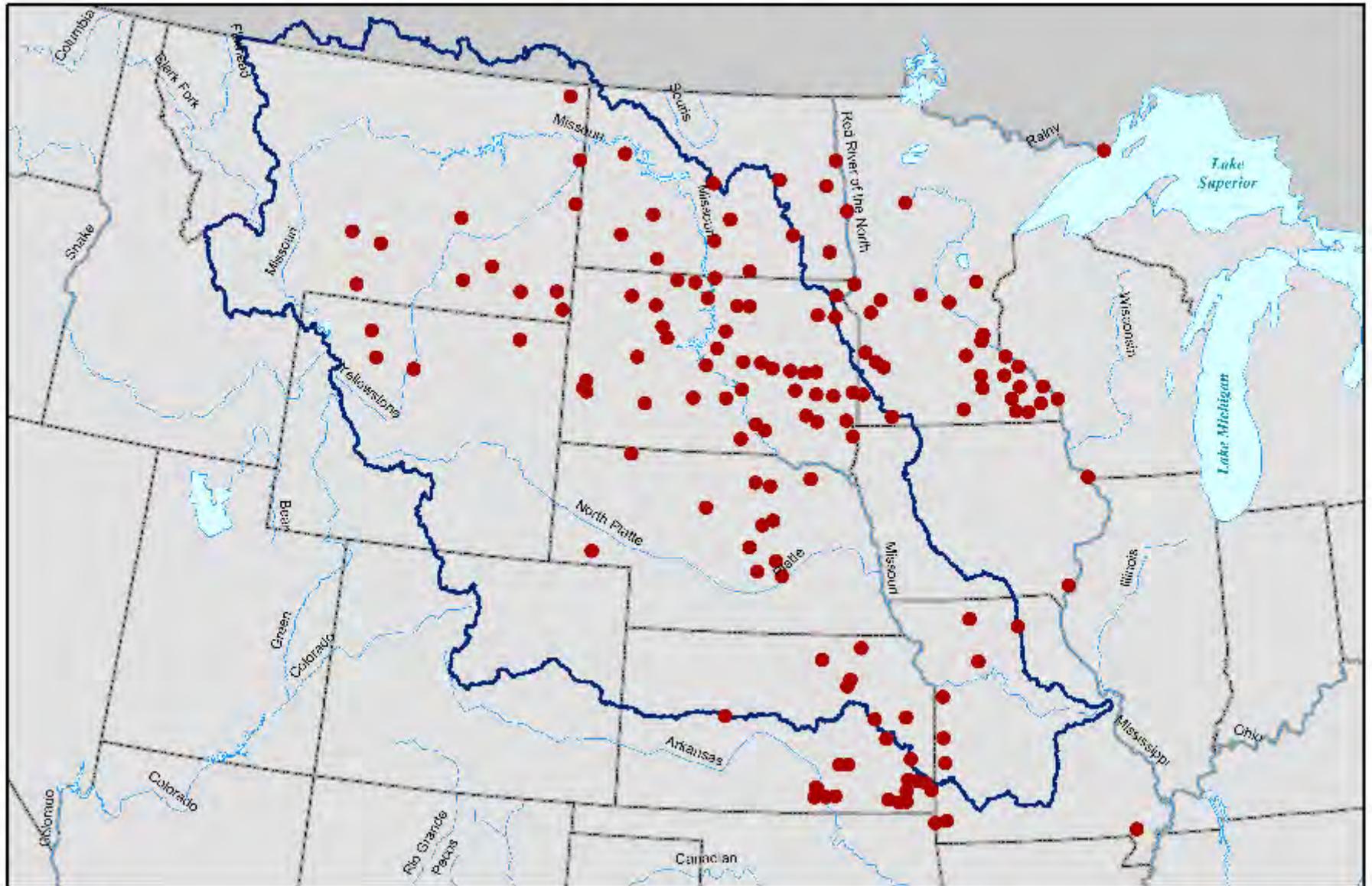
0 20 40 80 120 160



Miles

Albers Projection
Central Meridian: -95
1st Standard Parallel: 20
2nd Standard Parallel: 30
Latitude of Origin: 40

2019 Precipitation Records in and near the Missouri River Basin



Legend

- New Precipitation Records
- ▭ Missouri River Basin

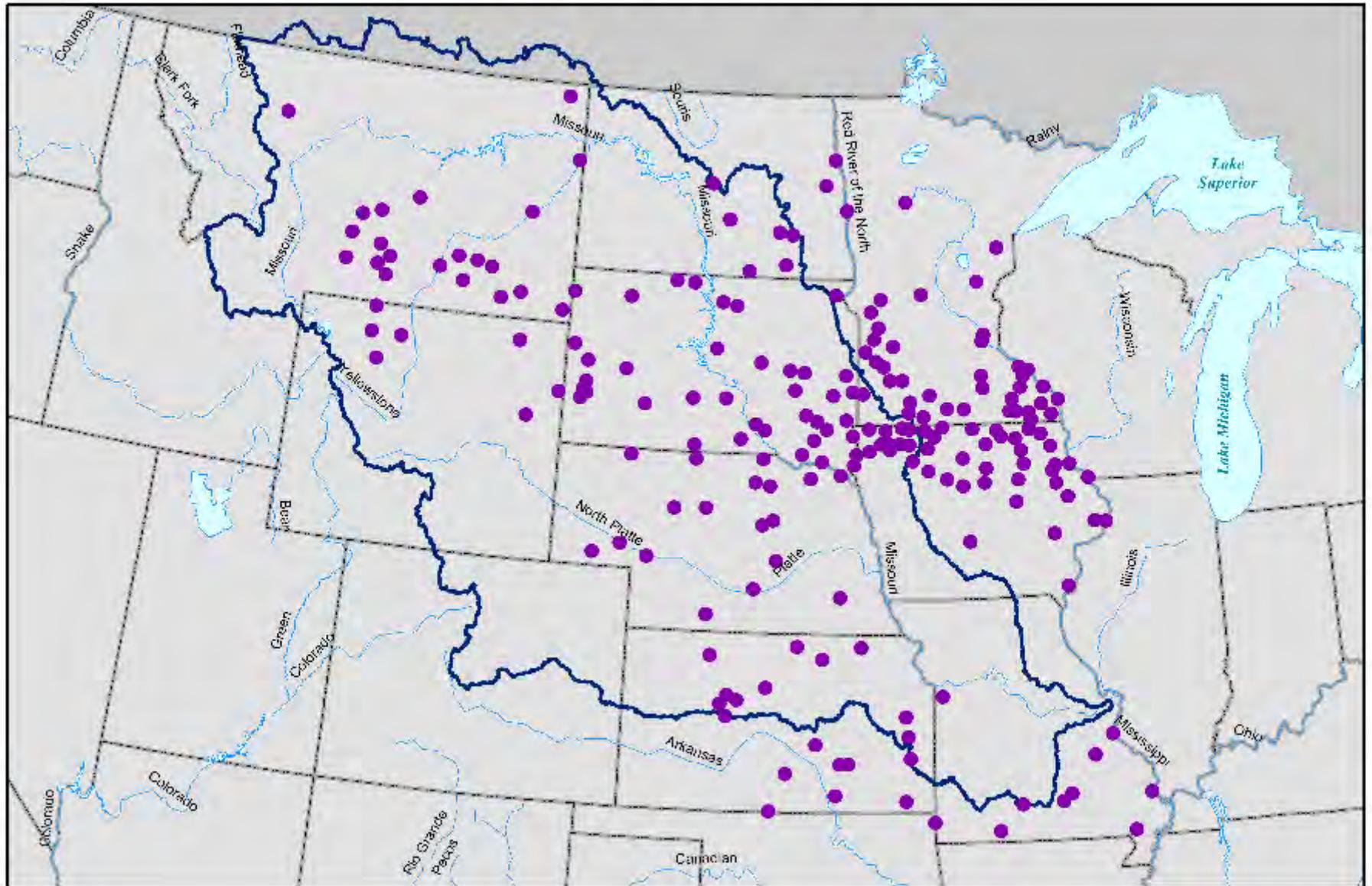
0 20 40 80 120 160



Miles

Albers Projection
Central Meridian: -95
1st Standard Parallel: 20
2nd Standard Parallel: 30
Latitude of Origin: 40

2018-19 Biannual Precipitation Records in and near the Missouri River Basin



Legend

- New Precipitation Records
- ▭ Missouri River Basin

0 20 40 80 120 160

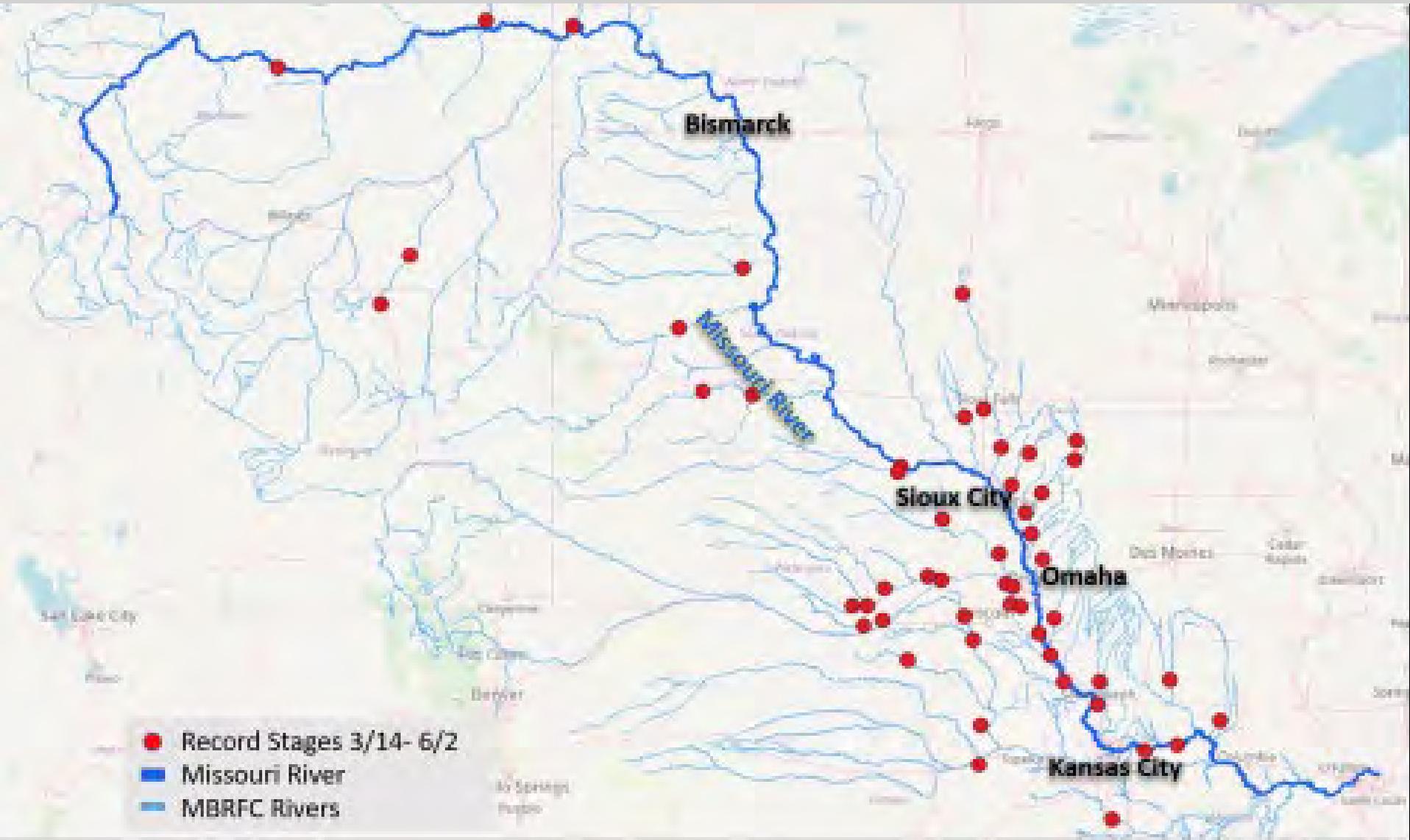


Miles

Albers Projection
Central Meridian: -95
1st Standard Parallel: 20
2nd Standard Parallel: 30
Latitude of Origin: 40

Missouri Basin Record Stages (2019)

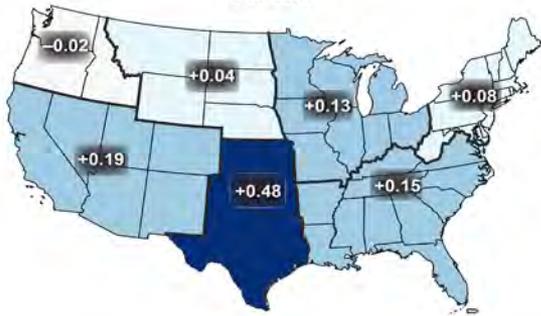
Preliminary



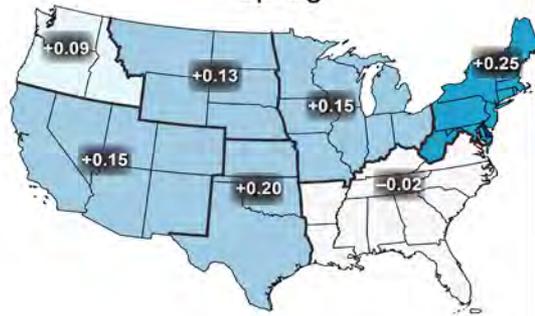
Heavy Rainfall

Observed Change in Daily, 20-year Return Level Precipitation

Winter



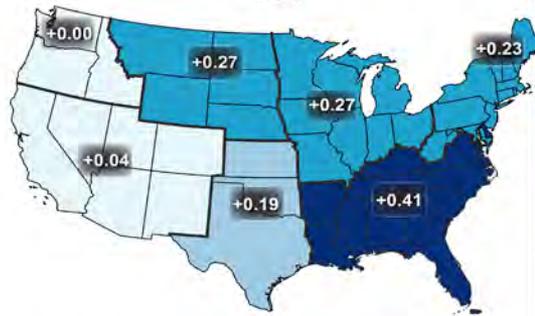
Spring



Summer

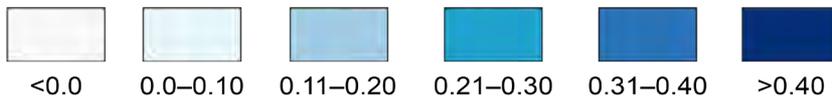


Fall



NCA4

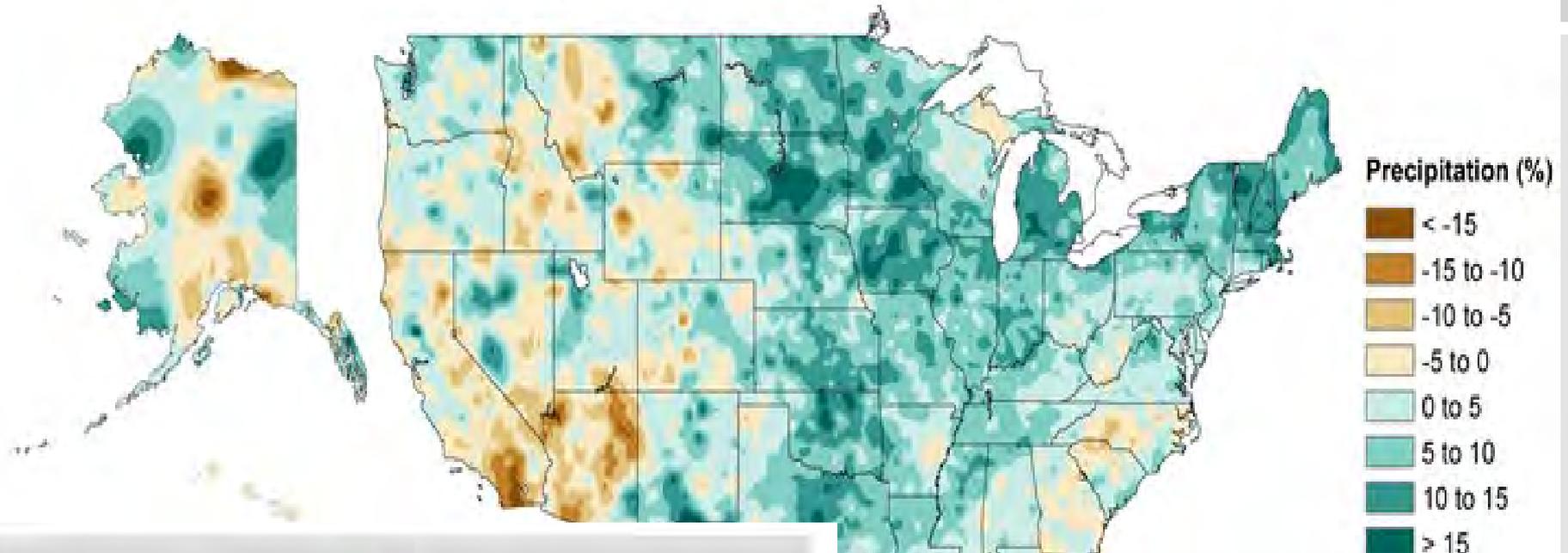
Change (inches)



- Daily 20-year Return means amount of rainfall expected to occur, on average, once every 20 years
- Amounts have increased more than 0.4 inch in places (slight decrease in some places)
- Varies geographically by season

Recent 30 years (1986-2015) compared to the past (1901-1960)

Annual Precipitation



Trends in Flood Magnitude



99th Percentile Precipitation (1958-2016)

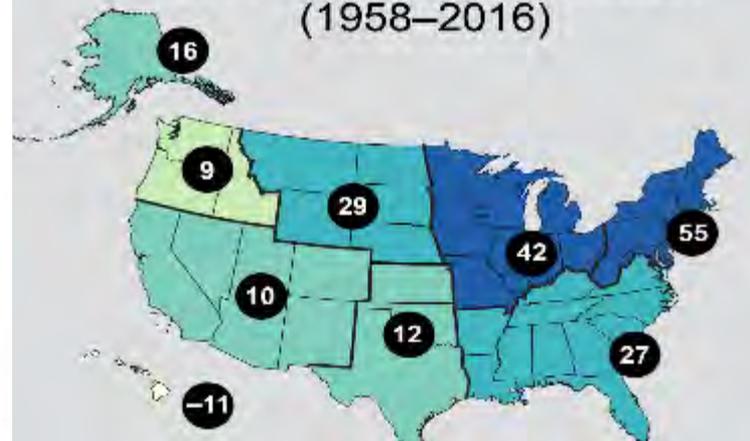
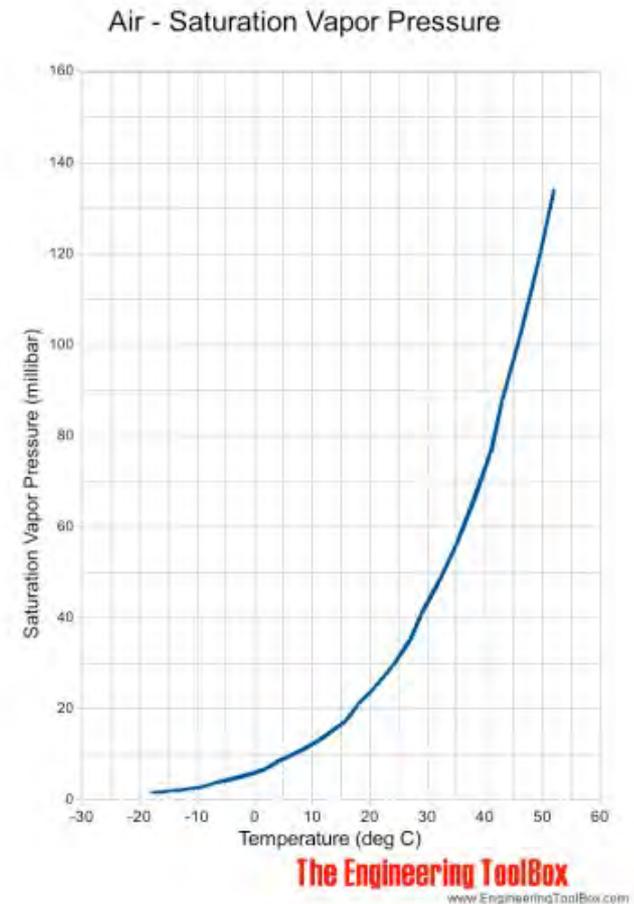


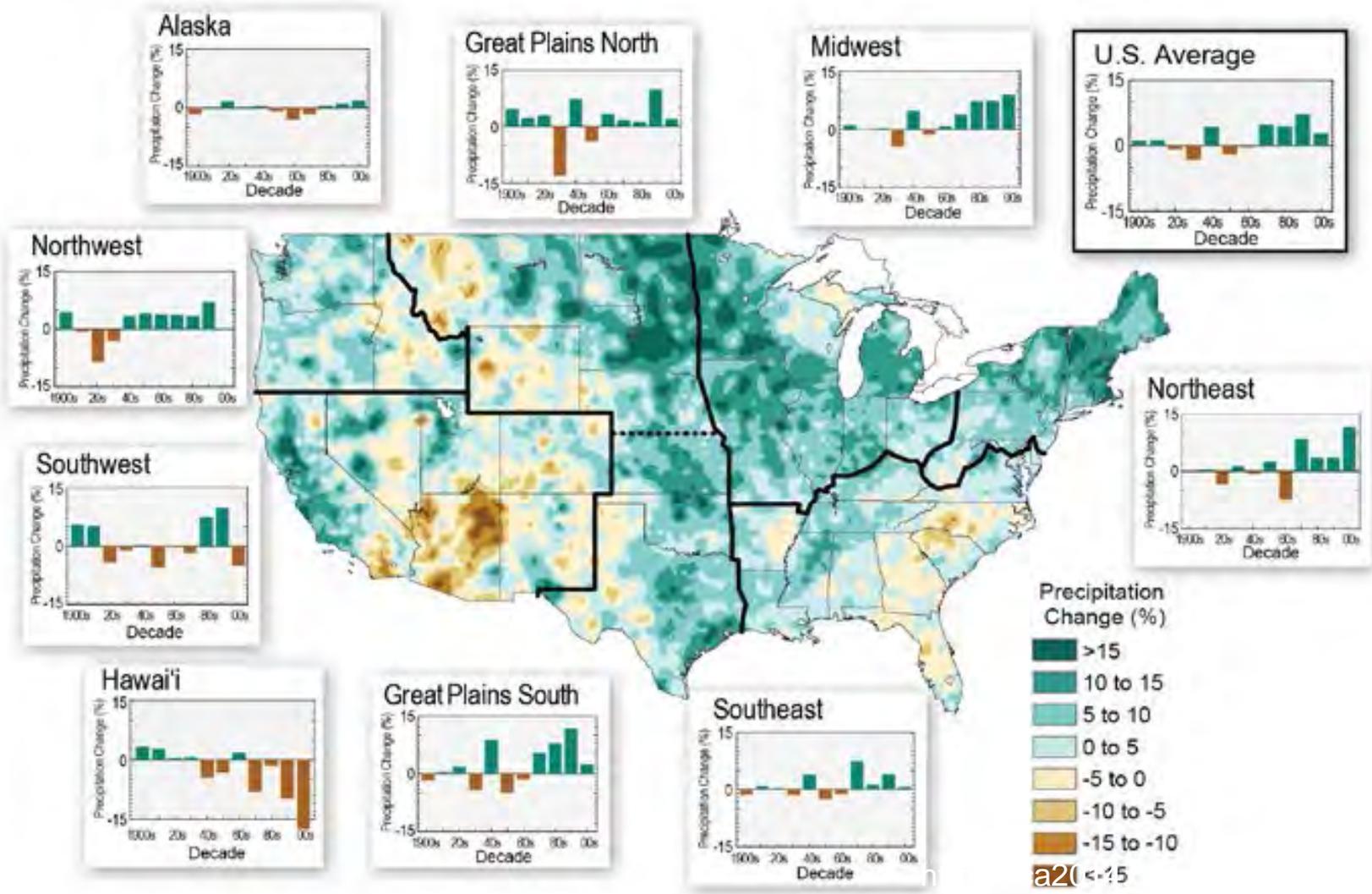
Figure source: Peterson et al. 2013

Warm Air Holds More Water Vapor

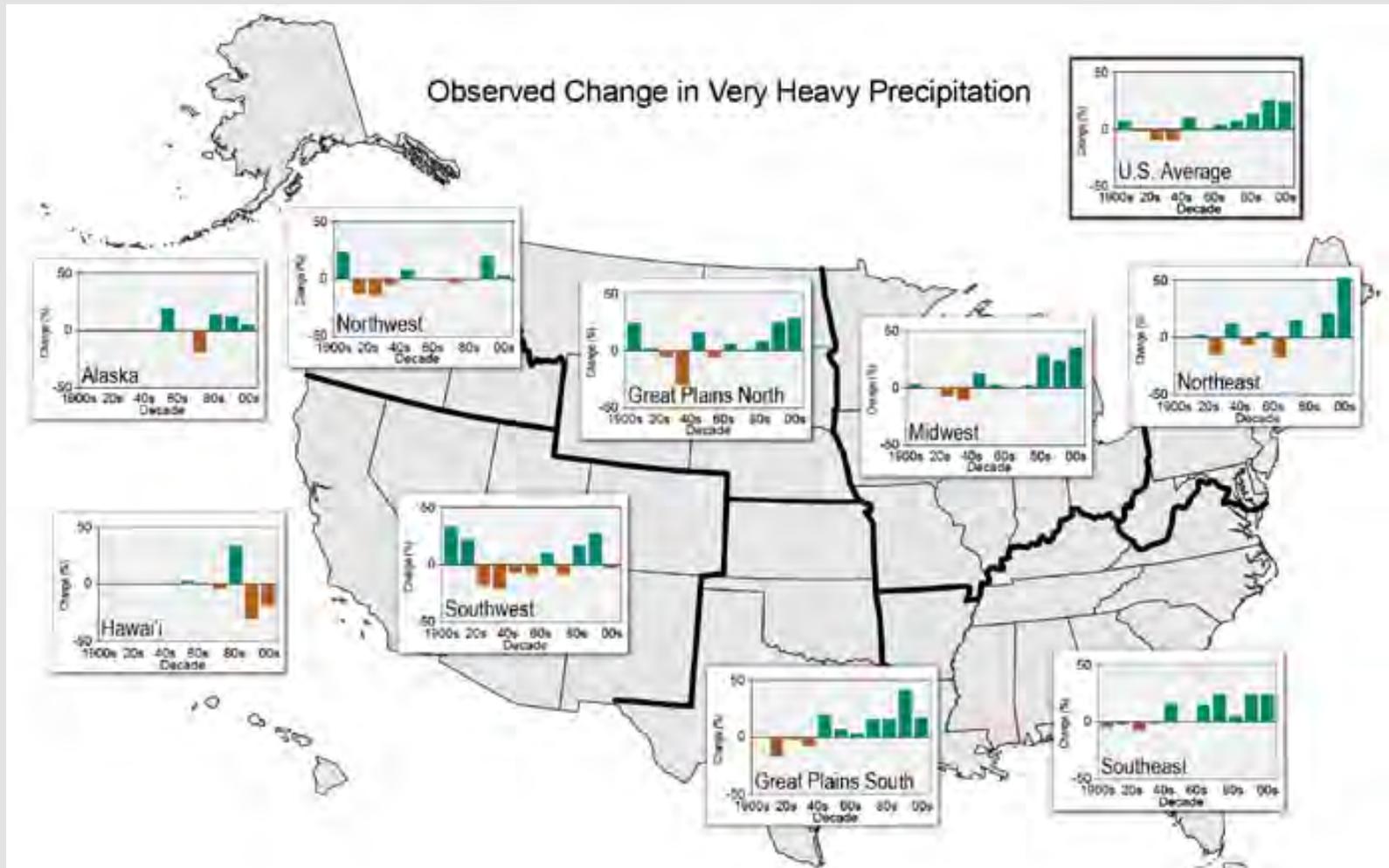
- Saturation vapor pressure is the total amount of pressure exerted if the air were saturated (relative humidity 100%)
 - Nearly doubles for every 10 deg C increase in temperature
 - Warm tropical air can hold 4-10 times as much vapor as cold, dry air
 - Consequently more latent heat release in storms, more precipitation



Precipitation Trends (from NCA3)



Observed Change in Very Heavy Precipitation



Billion Dollar Weather and Climate Events

United States Billion-Dollar Disaster Events 1980-2019 (CPI-Adjusted)

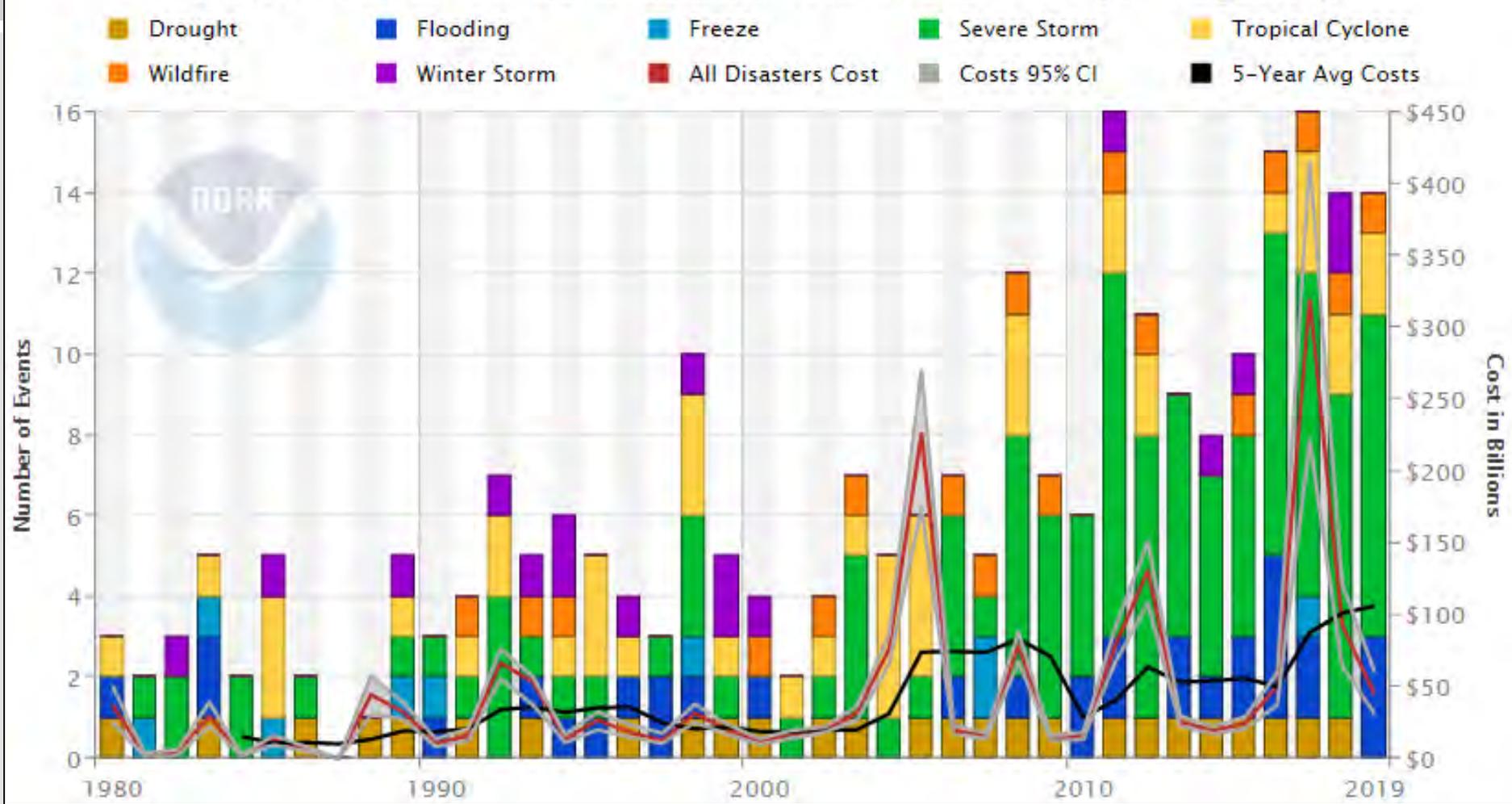


Fig. 2.5: Projected Changes in U.S. Seasonal Precipitation Amounts

In the future, under the higher scenario, the northern U.S. is projected to receive **more precipitation, especially in winter and spring** by 2070-2099, relative to 1986-2015. Areas with red dots show where projected changes are large compared to natural variations; areas that are hatched show where projected changes are small and relatively insignificant. *Adapted from Easterling et al. 2017.*

Late 21st Century, Higher Scenario (RCP8.5)

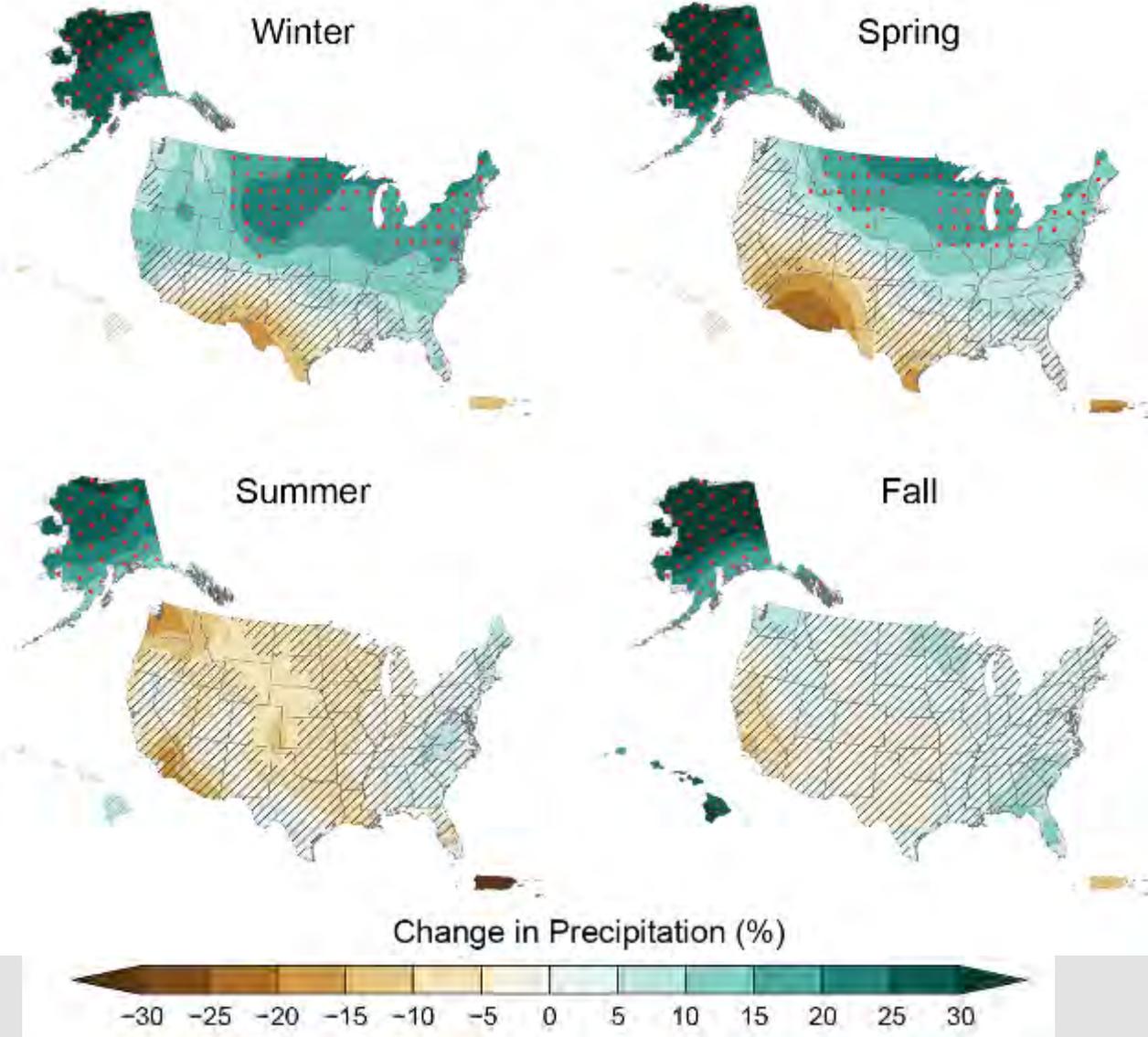
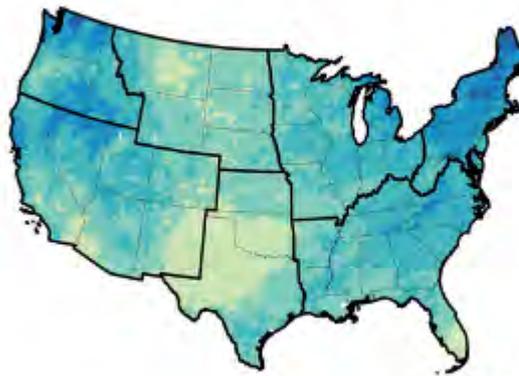


Fig. 2.6: Projected Changes in U.S. Heavy Precipitation Events

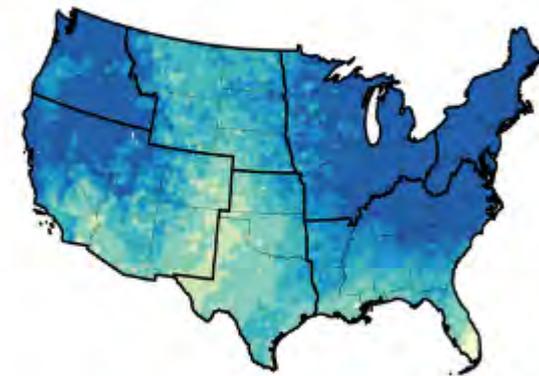
Heavy precipitation is becoming more intense and more frequent across most of the U.S., and these trends are projected to continue in the future. Projected trends are shown for a lower and a higher scenario for the period 2070-2099 relative to 1986-2015. Adapted from Easterling *et al.* 2017.

Projected Change in Total Annual Precipitation Falling in the Heaviest 1% of Events by Late 21st Century

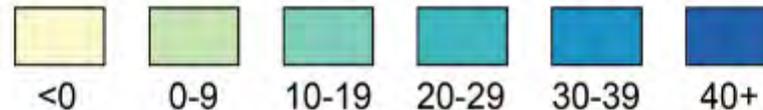
Lower Scenario (RCP4.5)



Higher Scenario (RCP8.5)



Change (%)



Thanks

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Credit: Jim Hoppe