

# The Disturbing Recent Heavy Precipitation Trend Across Parts of the Upper Mississippi River Valley

2019-10-23 09:59:33



Dan Baumgardt Todd Shea Jeff Boyne

NOAA/National Weather Service

La Crosse, WI

S-W 245.0°, 4.9° x1



# Motivation

- Has it been raining more? flooding more?



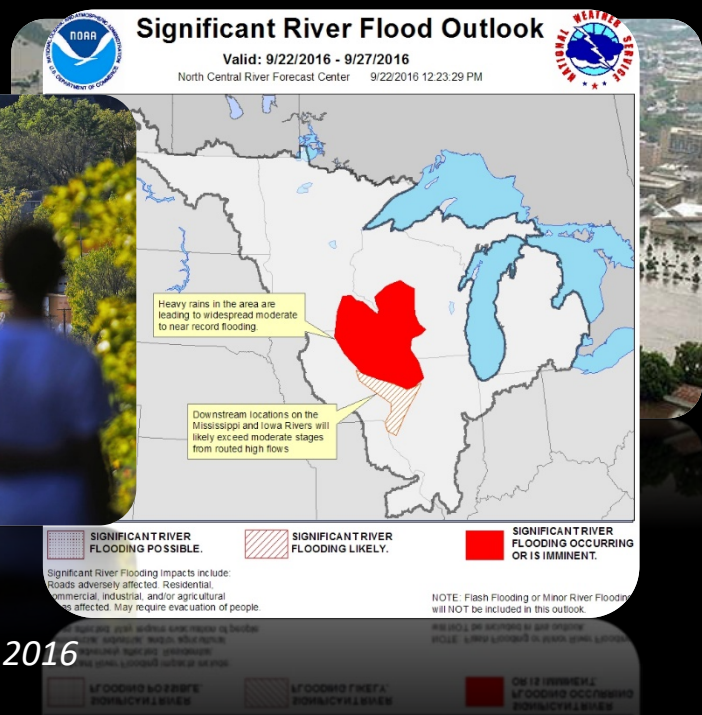
Kickapoo  
2007, 2011

Missouri River Floods of 2011



Wisconsin

Midwest Flooding 2016

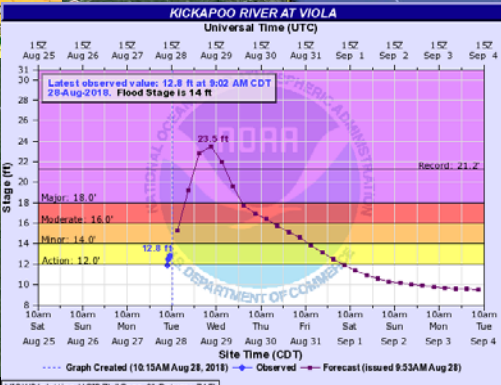
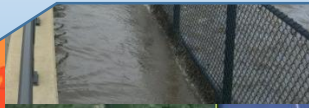
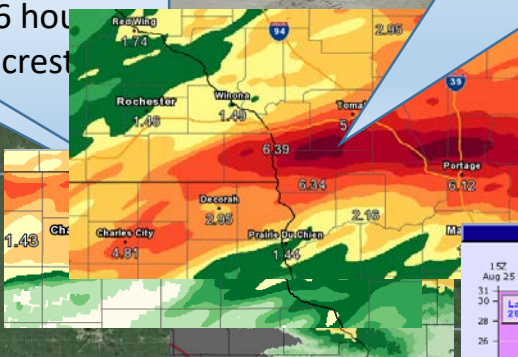


# Motivation

- Has it been raining more?

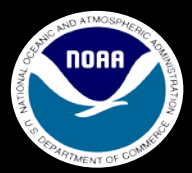
**August 23 2016**  
Flash Flood Emergency  
5.2" Rain / 5-6 hours  
River crest

**August 27-28 2018**  
Flash Flood Emergency  
10-12" rain  
Flood of Record: Kickapoo River

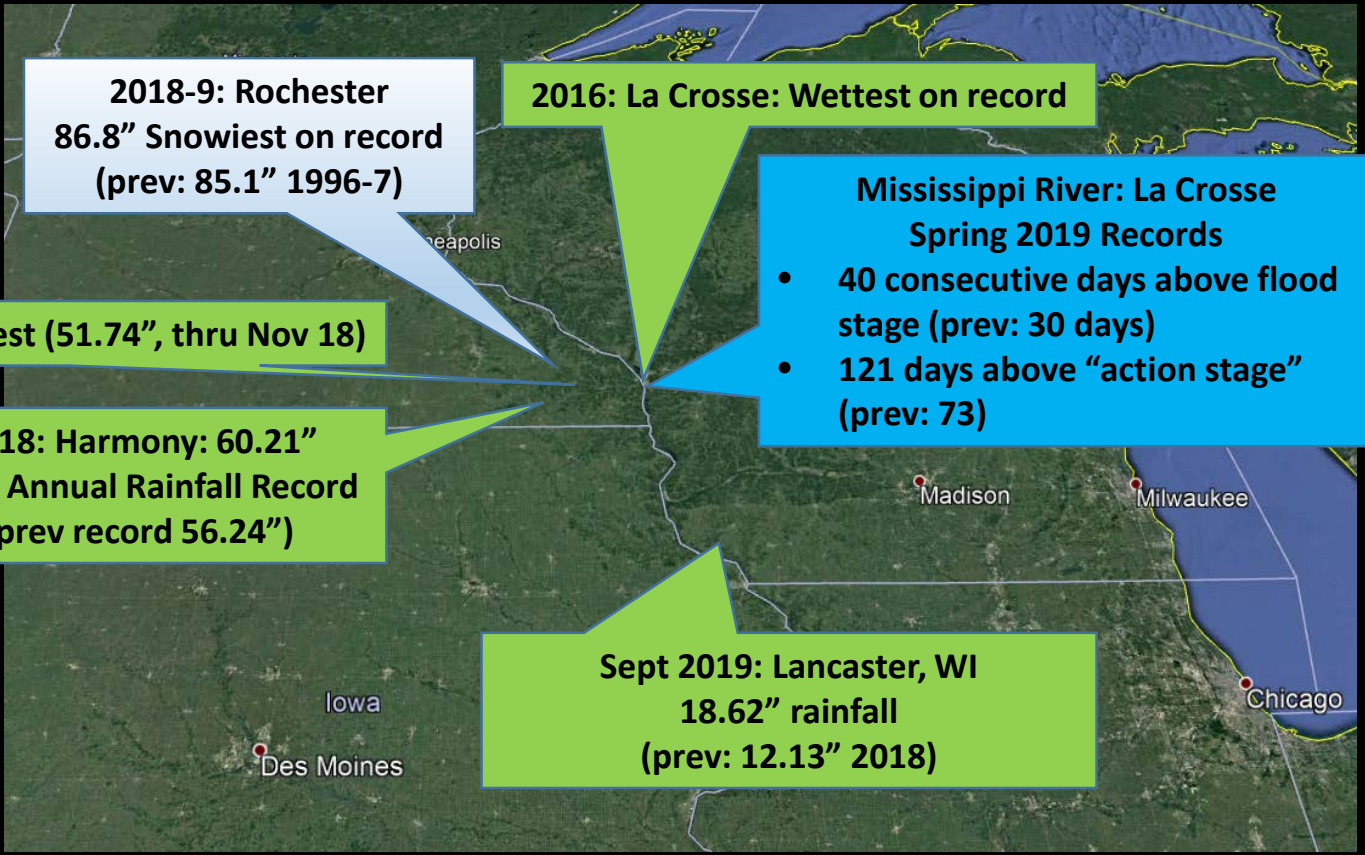


NOAA(plotting HGR2) \*Gage 0' Datum: 745'

NOAA(plotting HGR2) \*Gage 0' Datum: 745'



# Really? Is this the new normal?



**2018-9: Rochester**  
**86.8" Snowiest on record**  
(prev: 85.1" 1996-7)

**2016: La Crosse: Wettest on record**

**Mississippi River: La Crosse**  
**Spring 2019 Records**

- 40 consecutive days above flood stage (prev: 30 days)
- 121 days above "action stage" (prev: 73)

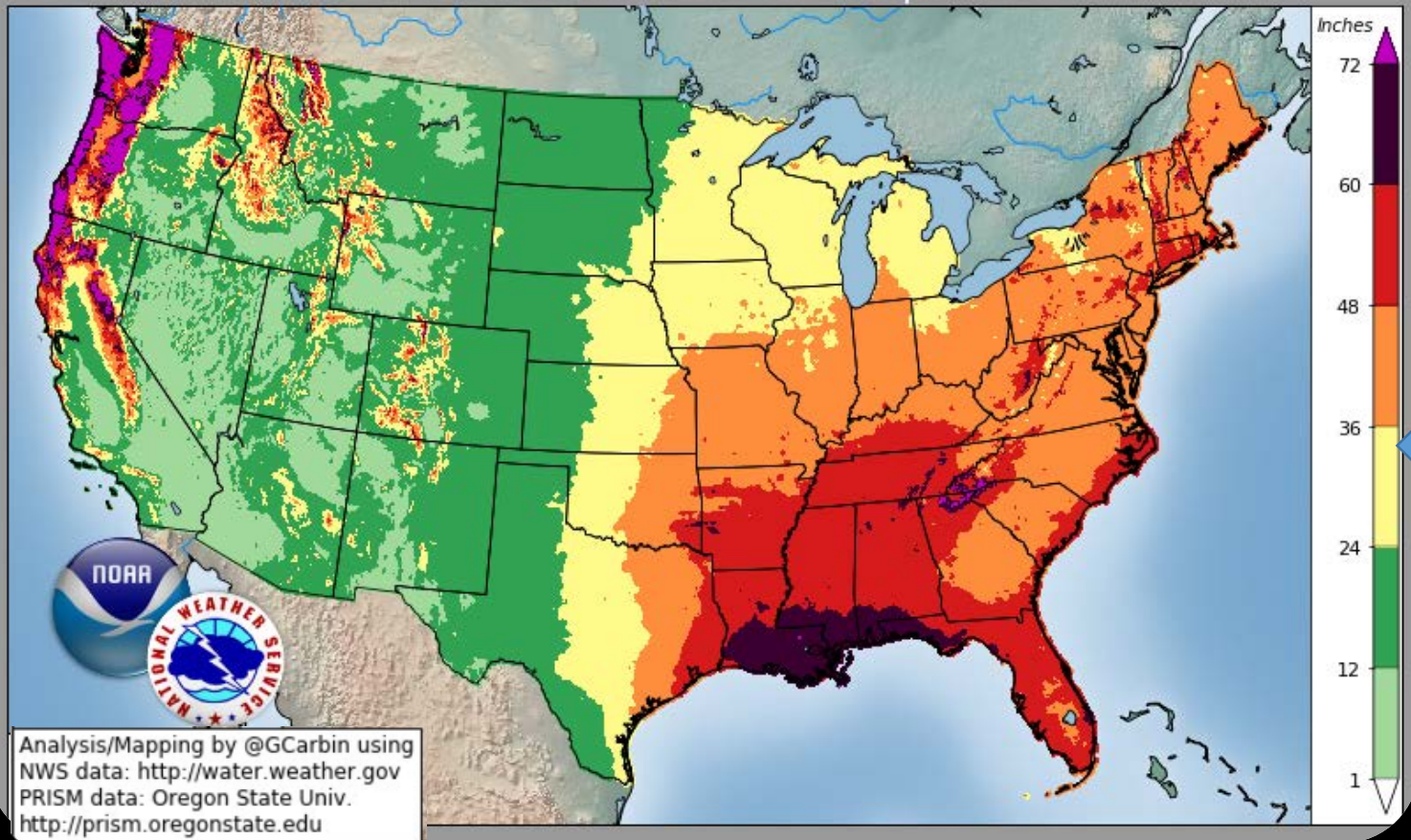
**2019: Rochester: Wettest (51.74", thru Nov 18)**

**2018: Harmony: 60.21"**  
**State Annual Rainfall Record**  
(prev record 56.24")

**Sept 2019: Lancaster, WI**  
**18.62" rainfall**  
(prev: 12.13" 2018)



# 1977-1997 Annual Mean Precipitation

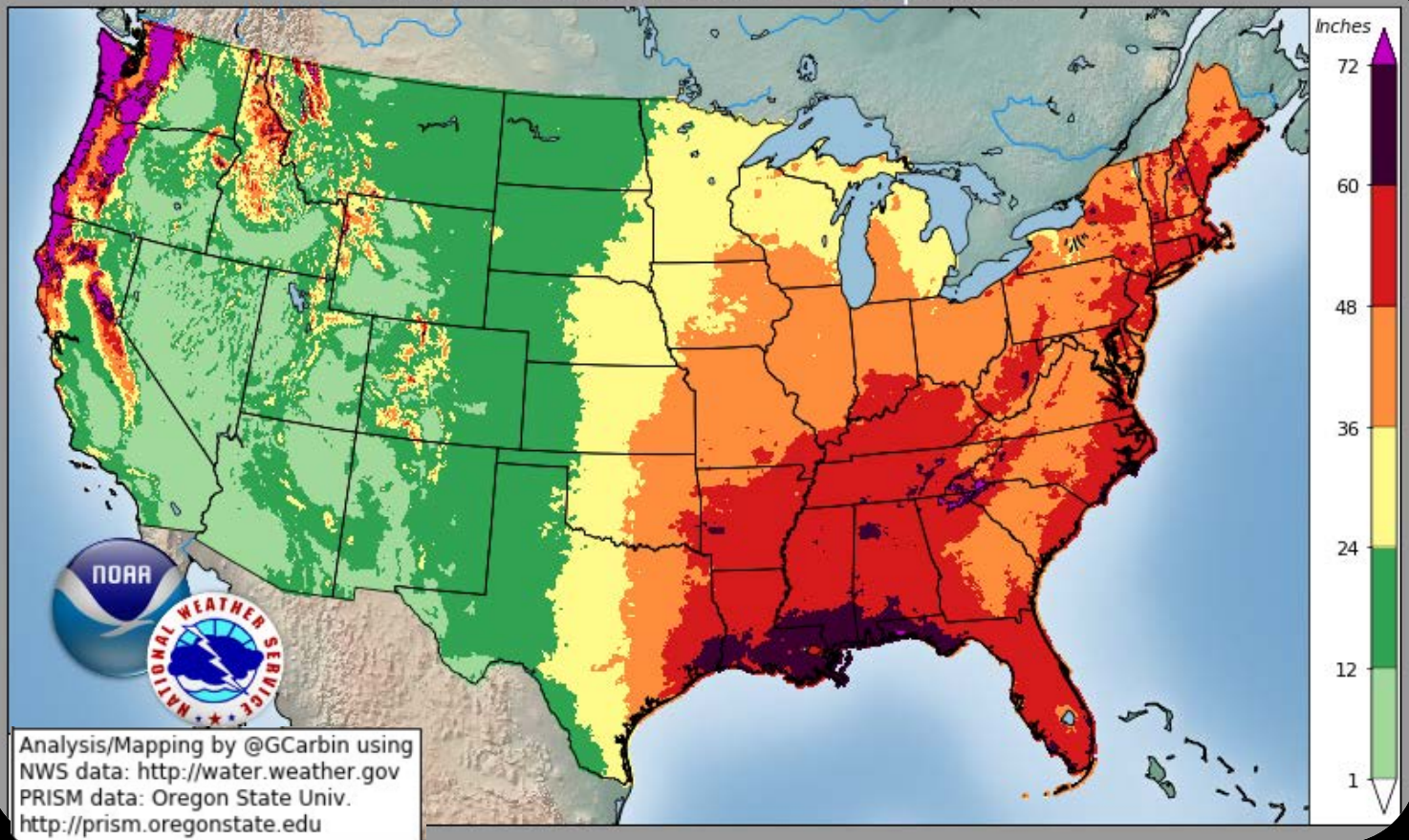


Analysis/Mapping by @GCarbin using  
NWS data: <http://water.weather.gov>  
PRISM data: Oregon State Univ.  
<http://prism.oregonstate.edu>



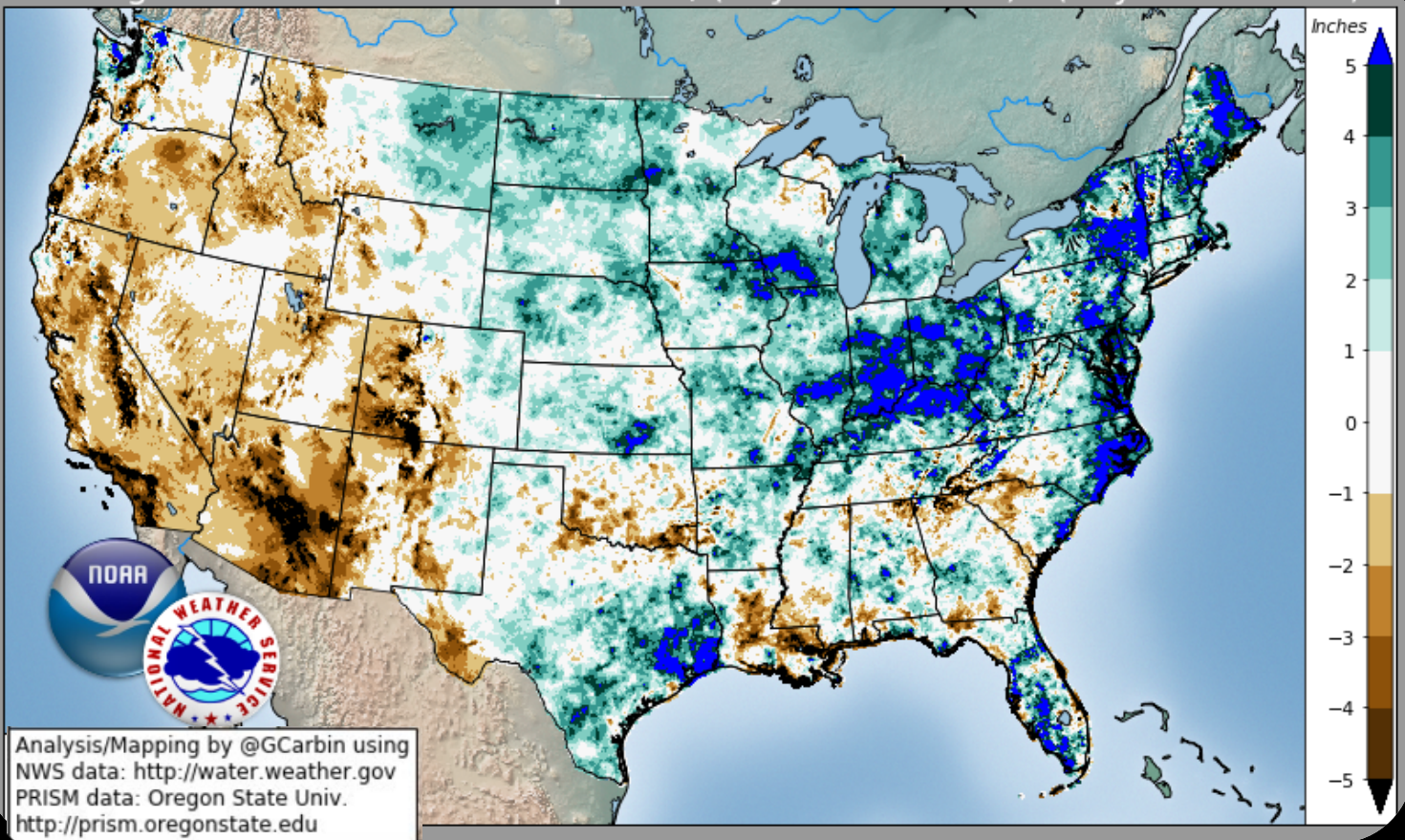


# 1998-2018 Annual Mean Precipitation



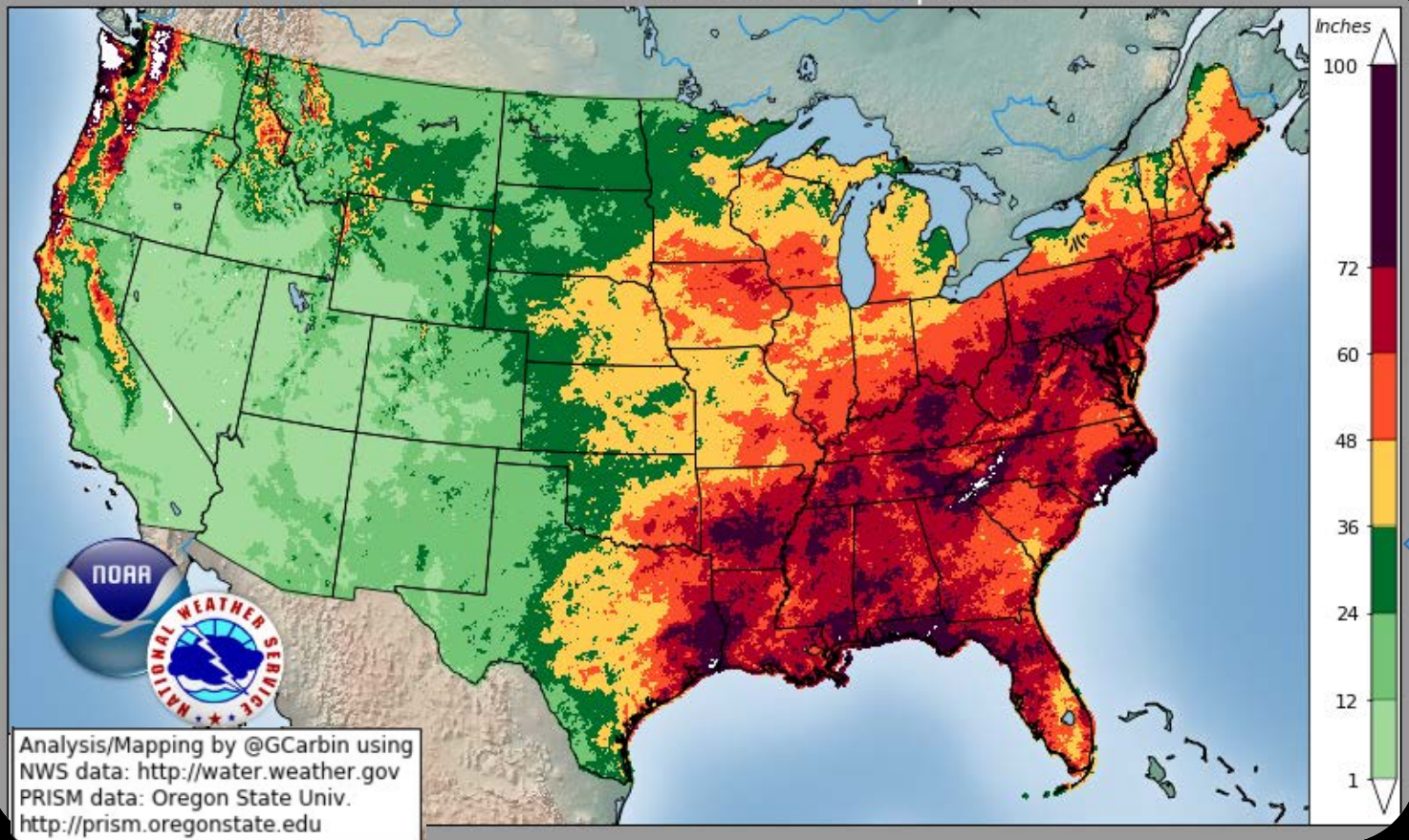


# Change in Mean Annual Precipitation, (21y: 1998-2018) - (21y: 1977-1997)





# 2018 CONUS Total Annual Precipitation



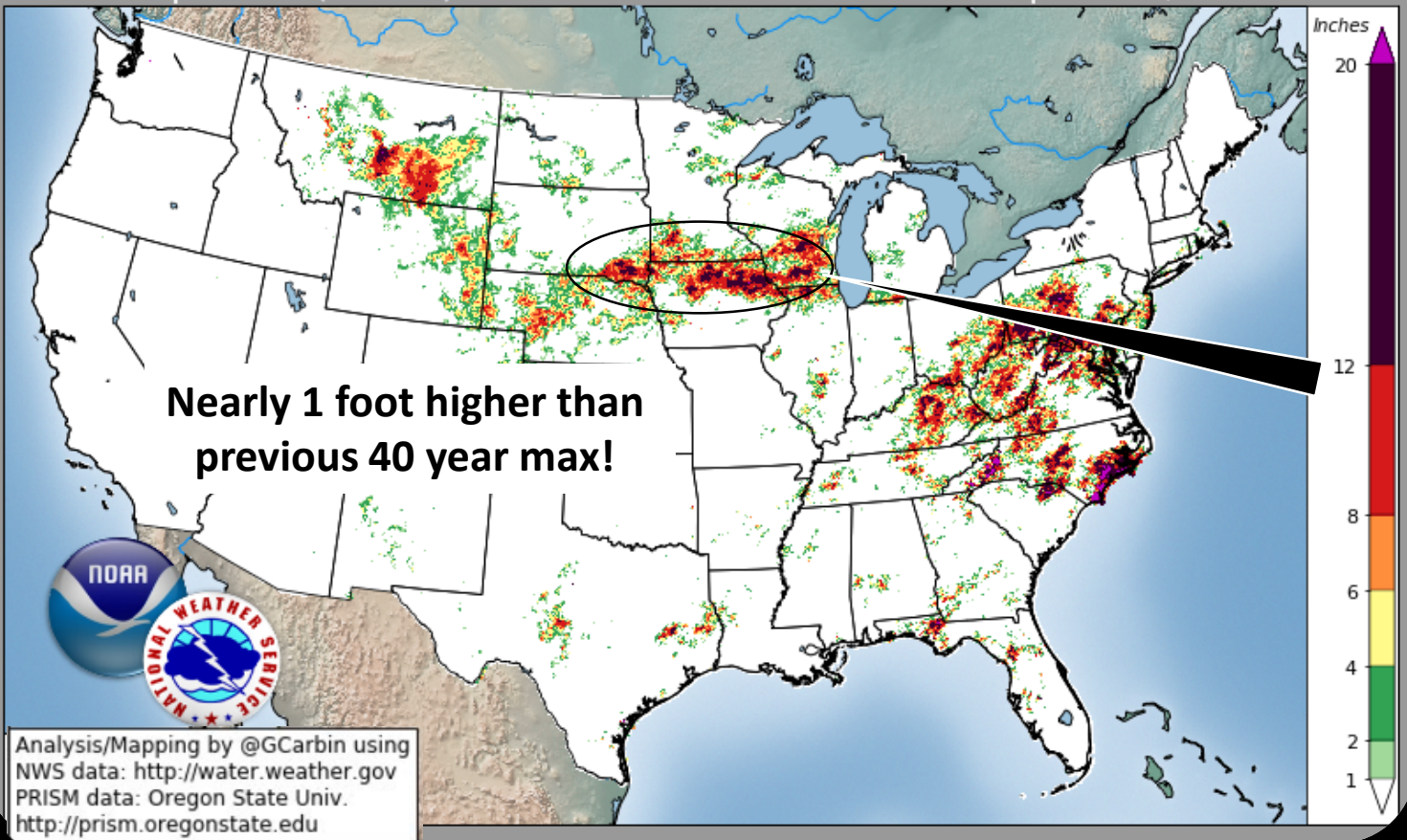
Normal:  
~30-35"







# 2018 Departure (inches) from Previous Annual Max Precipitation, 1977-2017

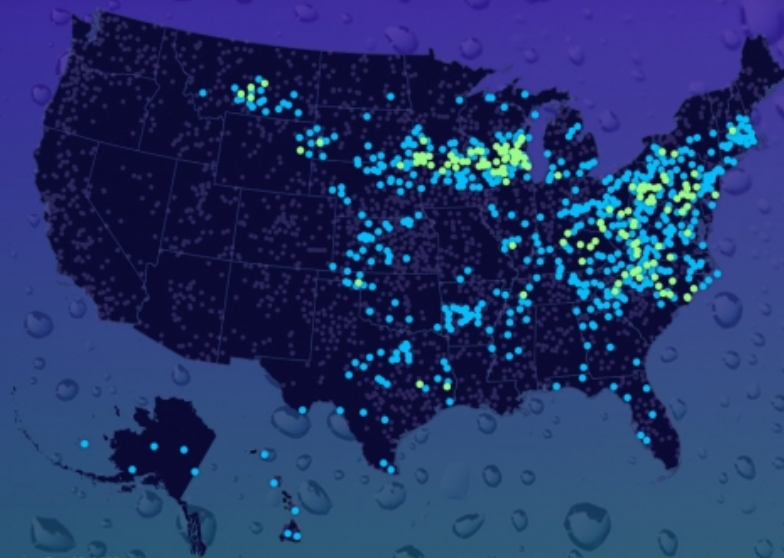




# 2018 Precipitation: Records

## HOW WET IS 2018?

● TOP 10 ON RECORD ● WETTEST ON RECORD



Data retrieved on Dec 10, 2018  
Source: Applied Climate Information System

CLIMATE  CENTRAL

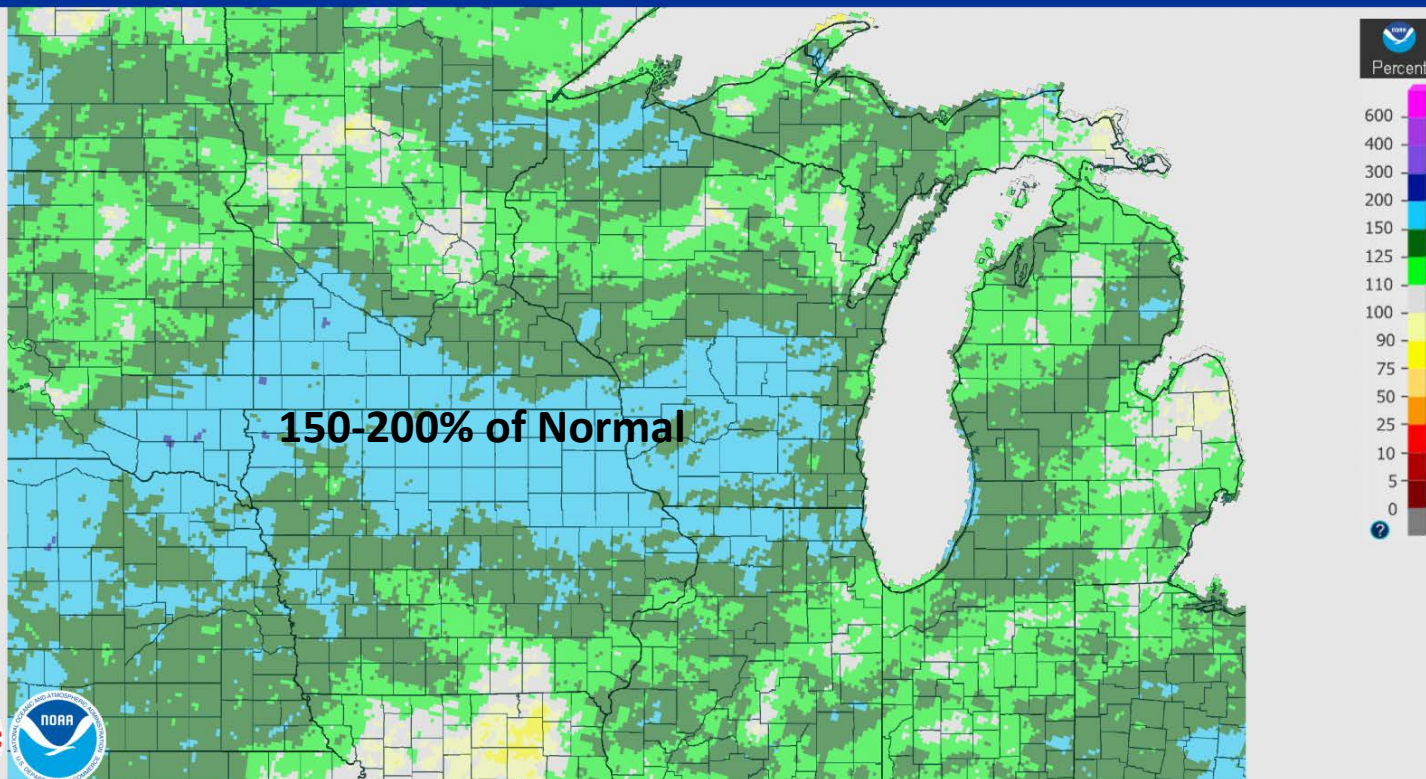


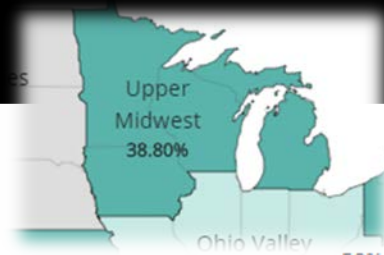
# 2018 Precipitation: Percent Normal

January 01, 2018 Annual Percent Precipitation

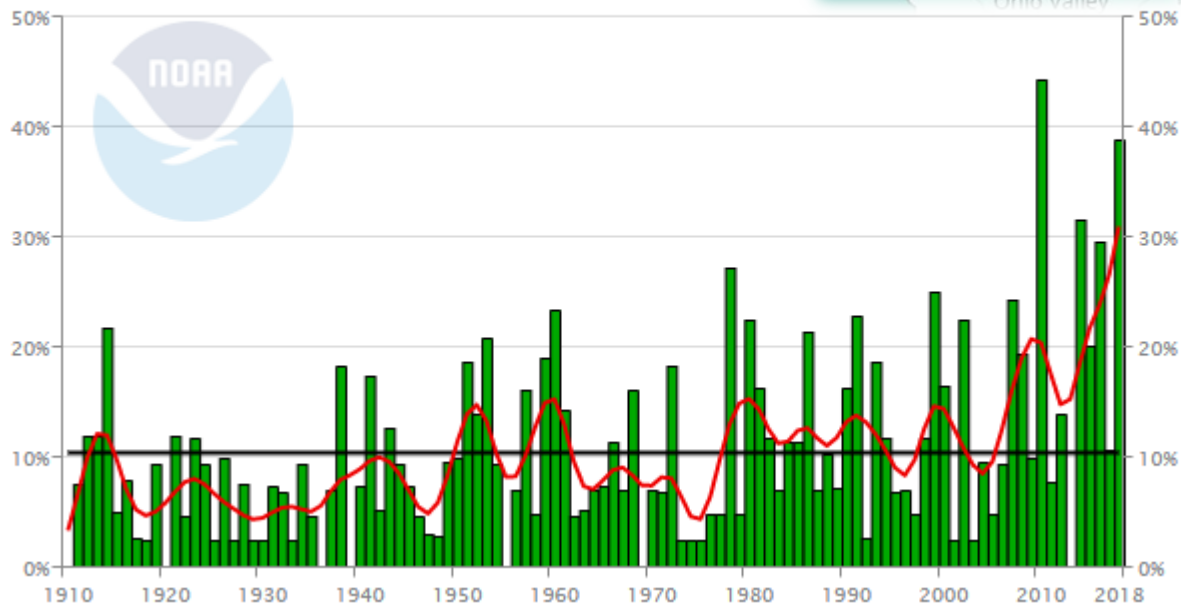
Created on: January 03, 2019 - 17:28 UTC

Valid on: January 01, 2019 12:00 UTC



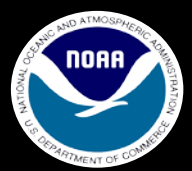


### Upper Midwest Extremes in 1-Day Precipitation (Step 4\*) Annual (January–December)

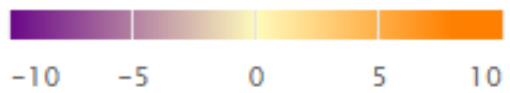
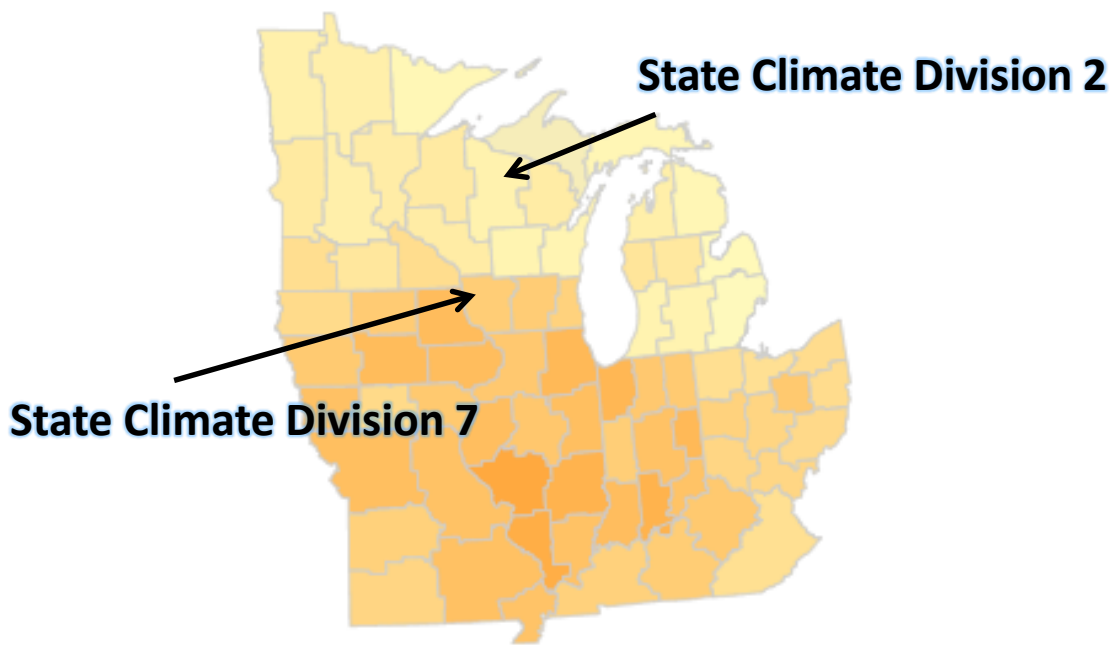


- Actual Percent
- Mean: 10.46%
- 9-Point Binomial Filter

Top 10%

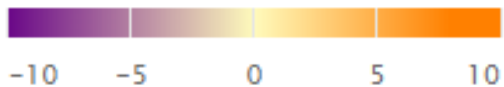
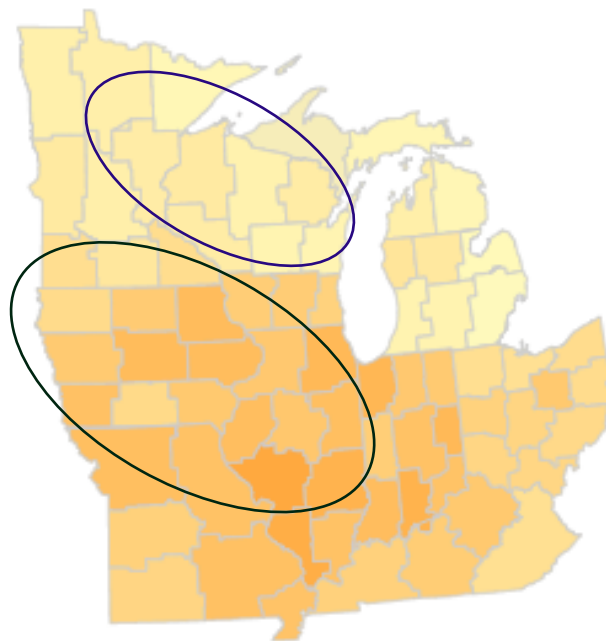


# Annual Number of Days with Precipitation $\geq 1$ in Trend based on 1900–2017 (Days per century)



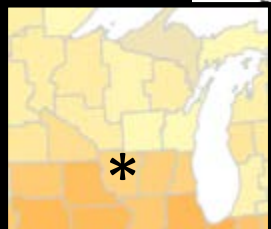
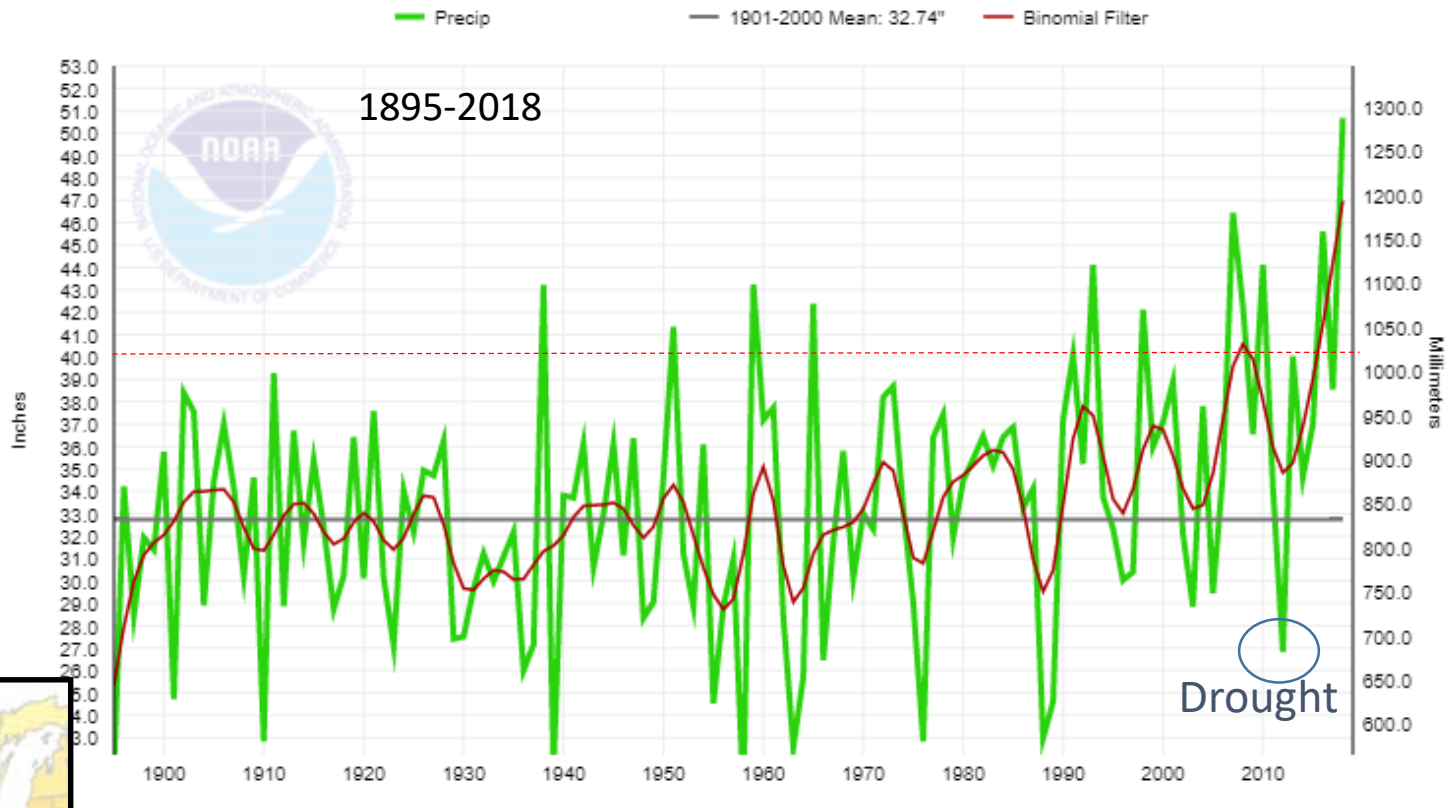


# Annual Number of Days with Precipitation $\geq 1$ in Trend based on 1900–2017 (Days per century)





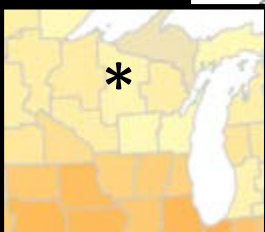
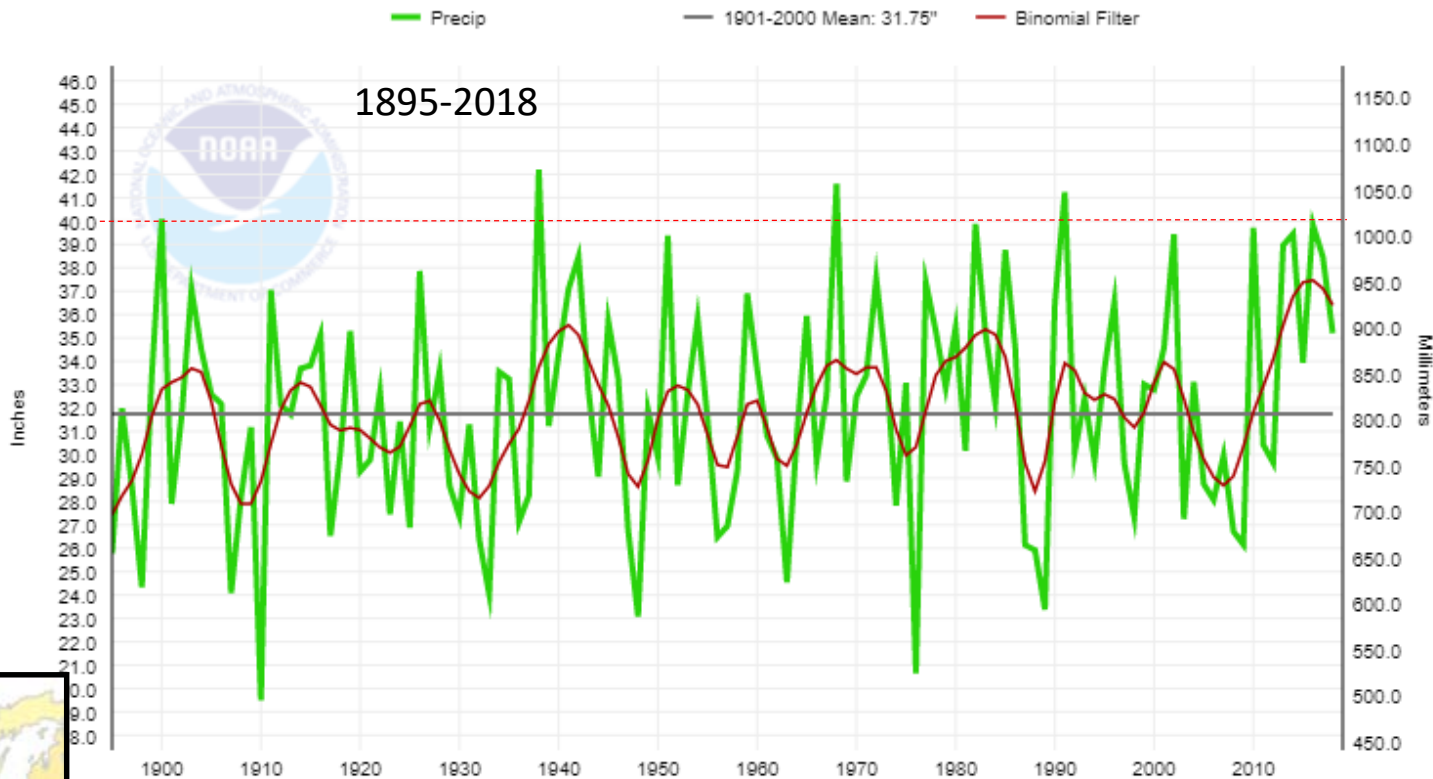
# Wisconsin, Climate Division 7, Precipitation, January-December



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



# Wisconsin, Climate Division 2, Precipitation, January-December

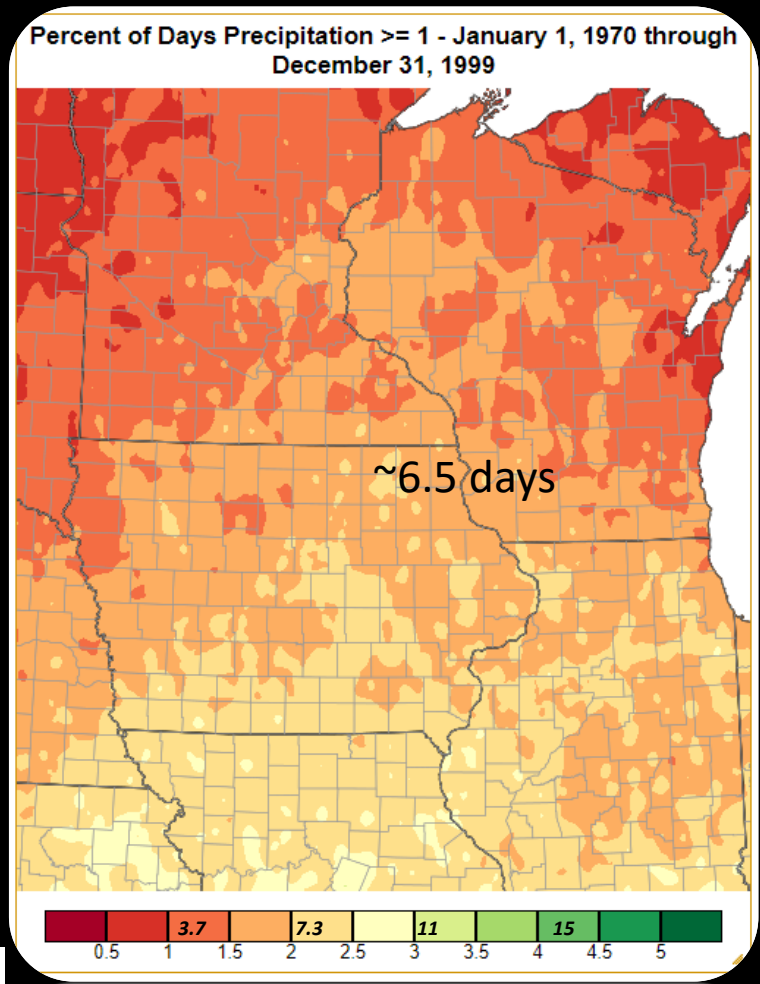


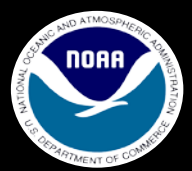
<https://www.ncdc.noaa.gov/cag/>



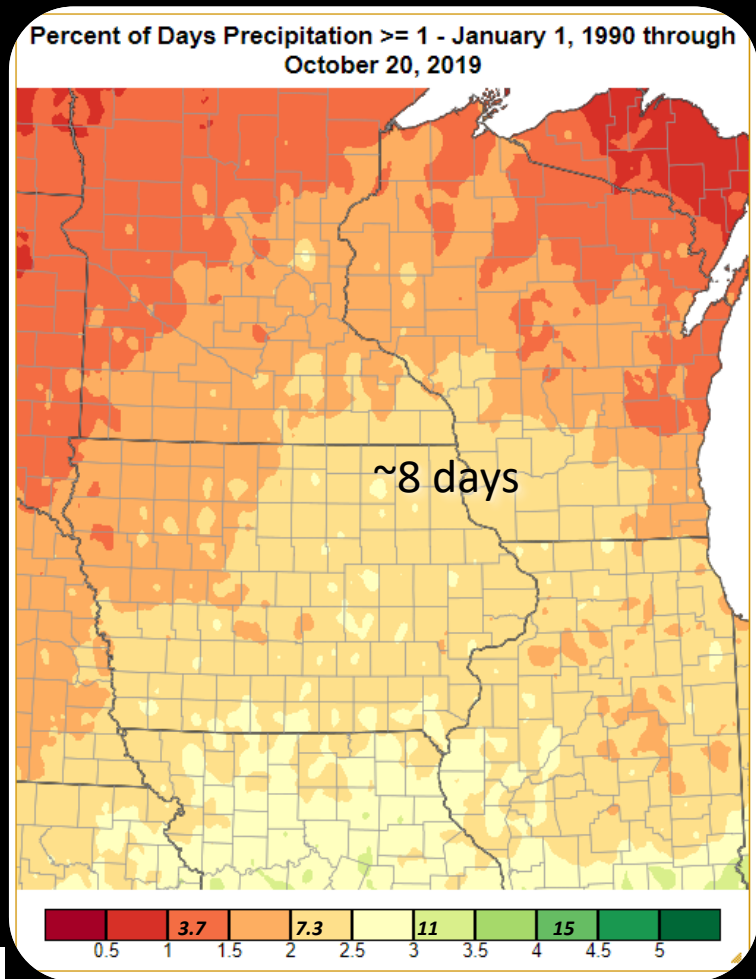


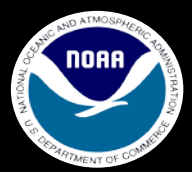
- Percent of Days  $\geq 1''$
- 1970 to 1999
- $\sim 1.75\%$  or  $\sim 6.5$  days per year



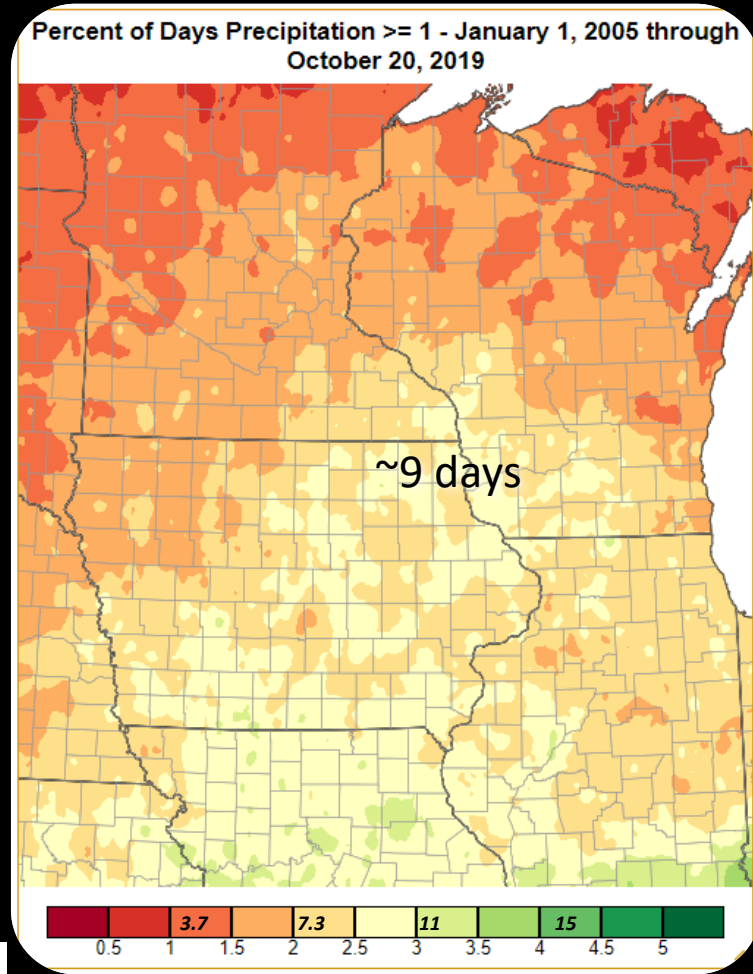


- Percent of Days  $\geq 1''$
- 1990 to Oct 20, 2019
- $\sim 2.25\%$  or  $\sim 8$  days per year



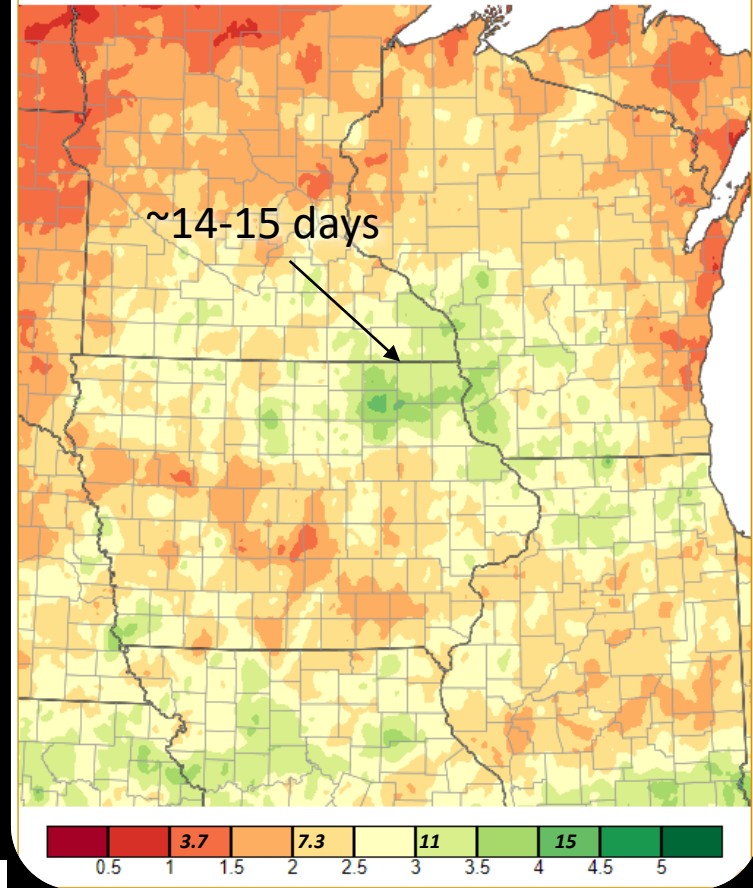


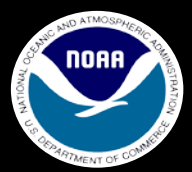
- Percent of Days  $\geq 1''$
- 2005 to Oct 20, 2019
- $\sim 2.75\%$  or  $\sim 9$  days per year



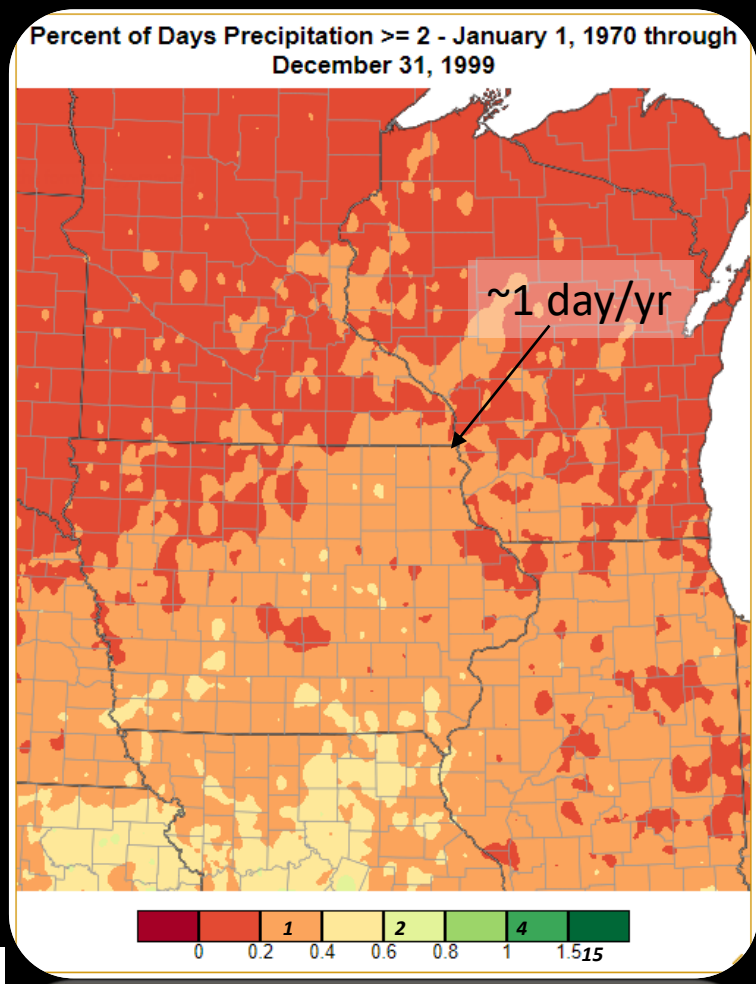
- Percent of Days  $\geq 1''$
- 2016 to Oct 20, 2019
- ~ 4% or ~14-15 days per year
- **DOUBLING** over the 1970-1999 normal values!

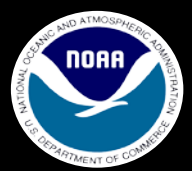
Percent of Days Precipitation  $\geq 1$  - January 1, 2016 through October 20, 2019



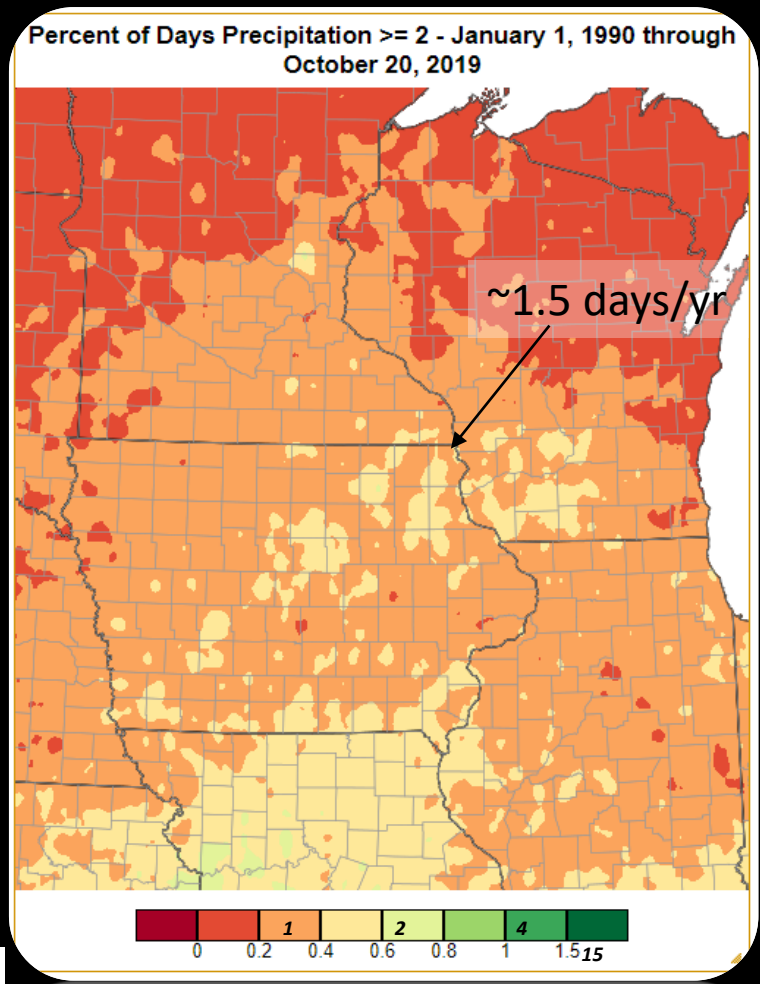


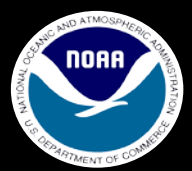
- Percent of Days  $\geq 2''$
- 1970 to 1999
- $\sim 0.3\%$  or  $\sim 1$  day per year



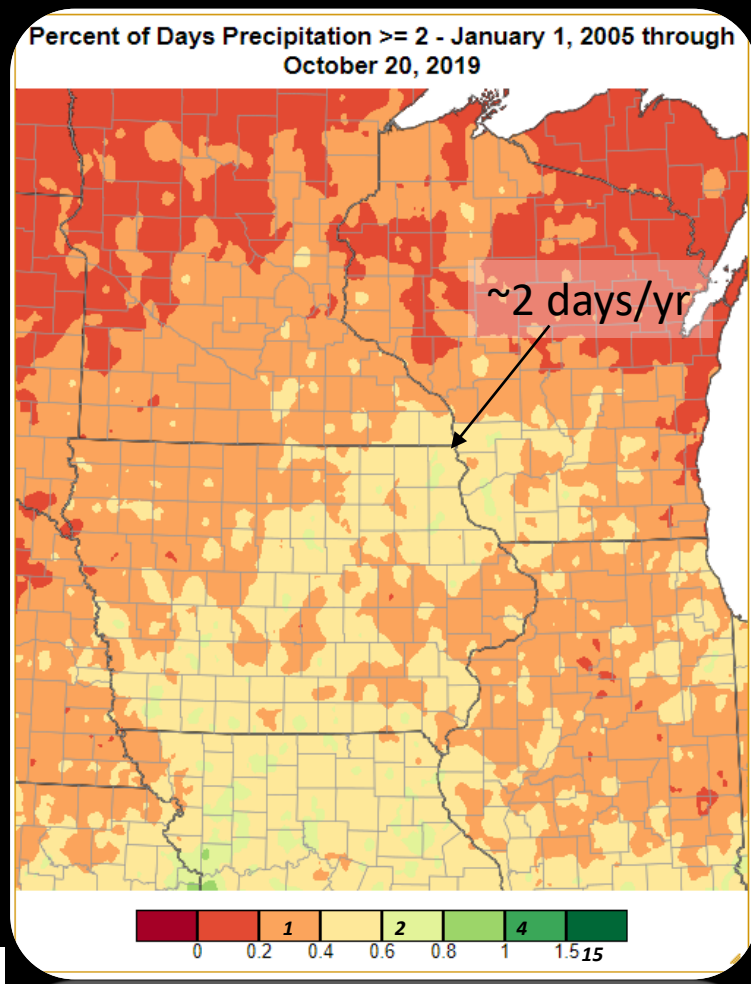


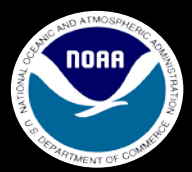
- Percent of Days  $\geq 2''$
- 1990 to Oct 20, 2019
- $\sim 0.4\%$  or  $\sim 1.5$  days per year



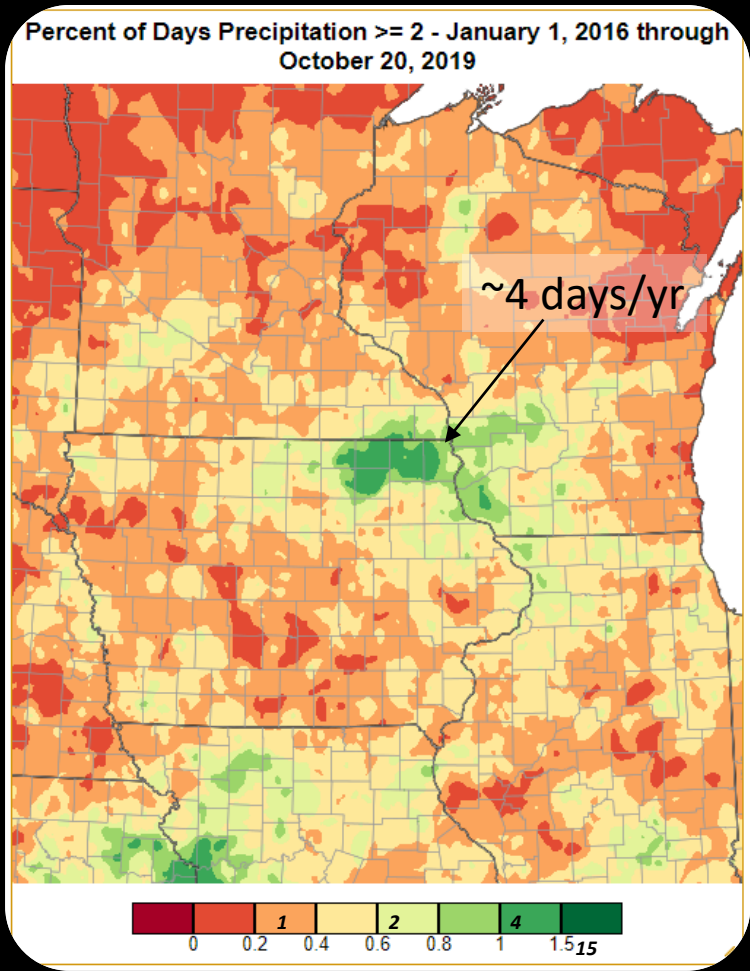


- Percent of Days  $\geq 2''$
- 2005 to Oct 20, 2019
- $\sim 0.6\%$  or  $\sim 2$  days per year

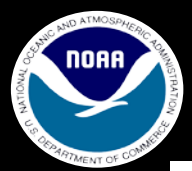




- Percent of Days  $\geq 2''$
- 2016 to Oct 20, 2019
- ~ 1-1.25% or ~4 days per year

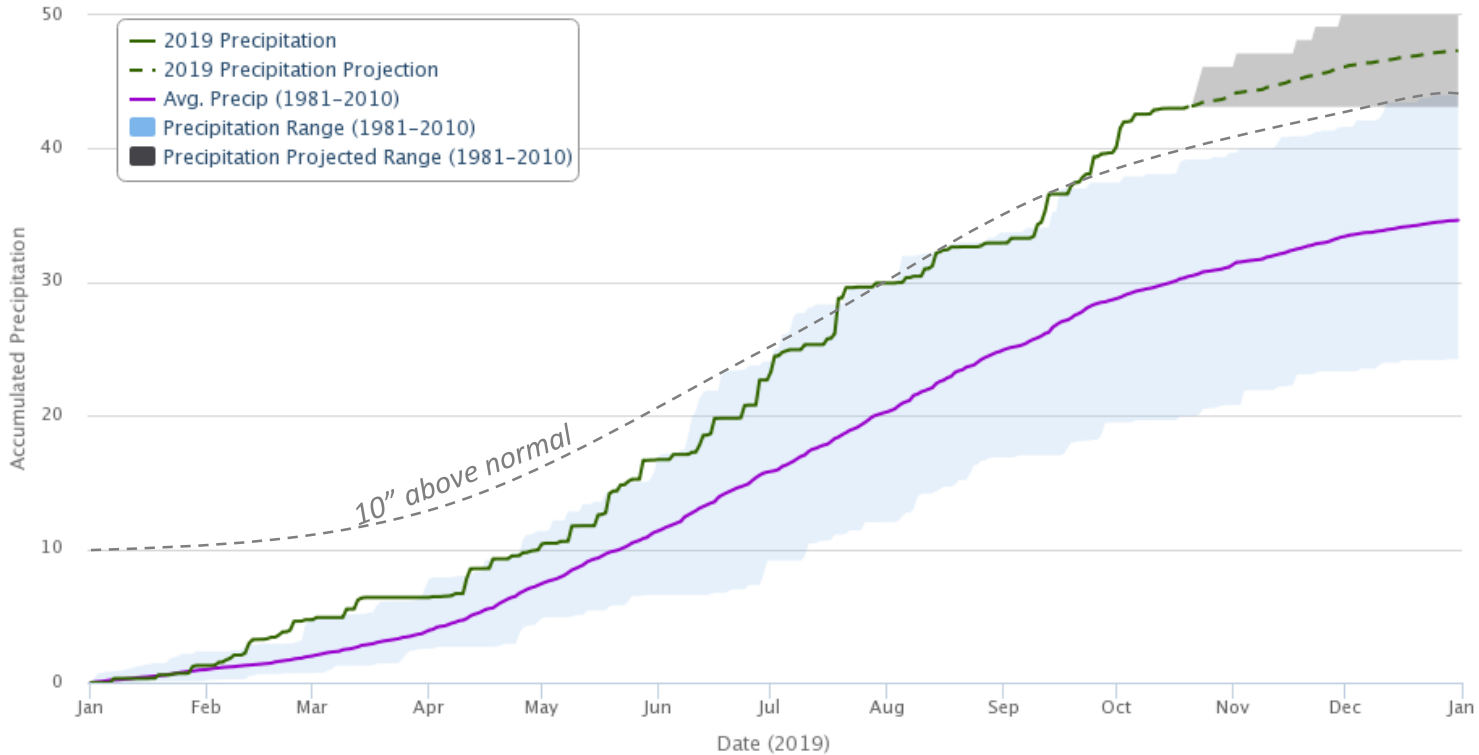


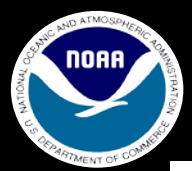




## Accumulated Precipitation Tool

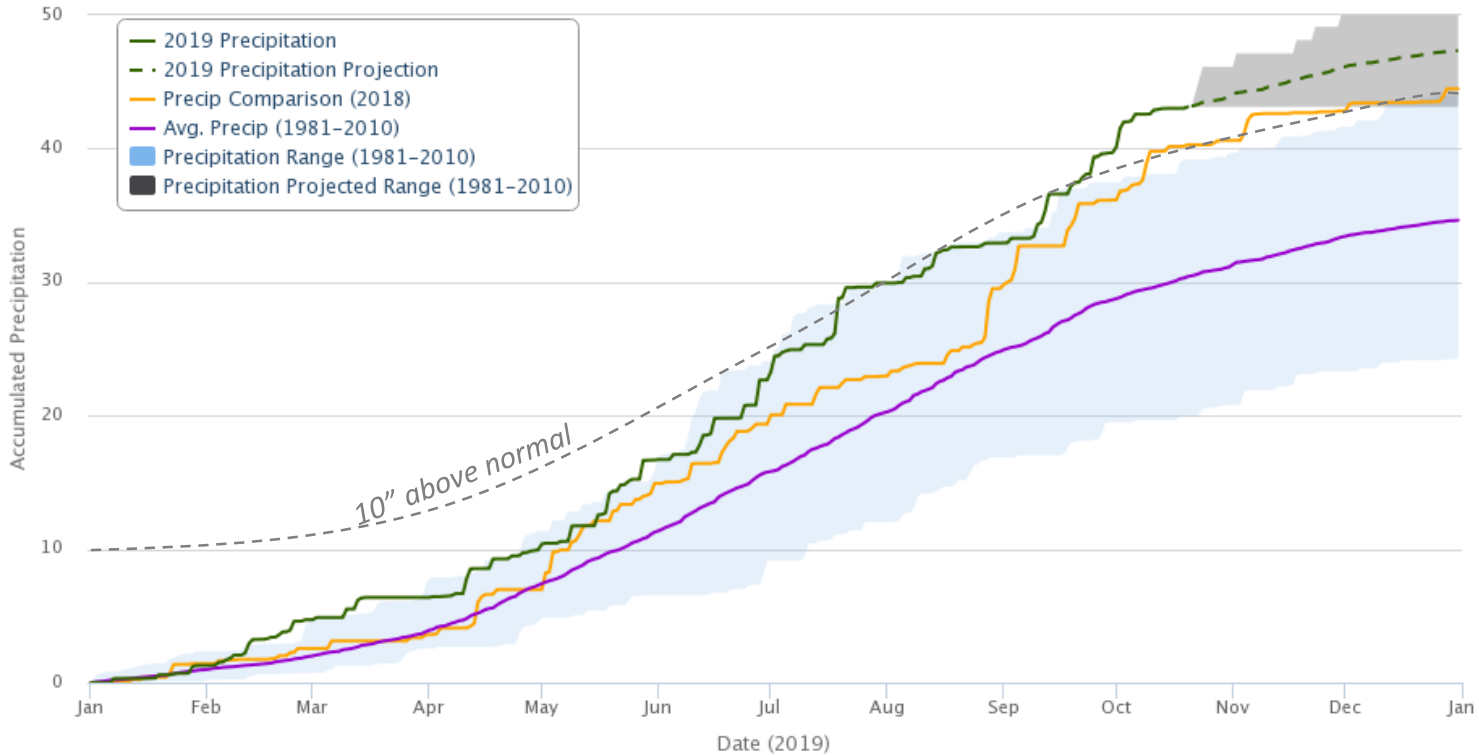
Location: 43.95, -91.16 in La Crosse Co., WI, Start Date: January 1 2019





## Accumulated Precipitation Tool

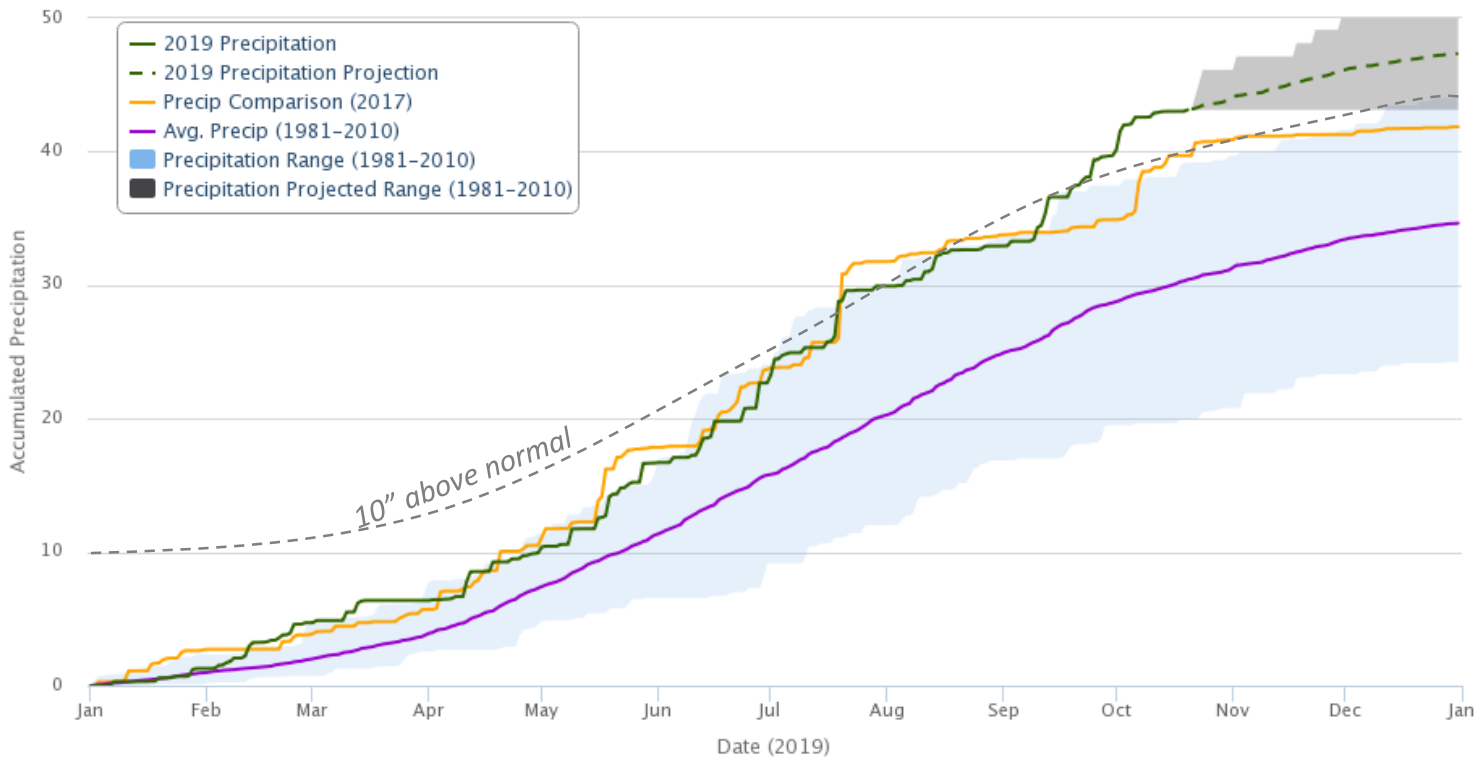
Location: 43.95, -91.16 in La Crosse Co., WI, Start Date: January 1 2018





## Accumulated Precipitation Tool

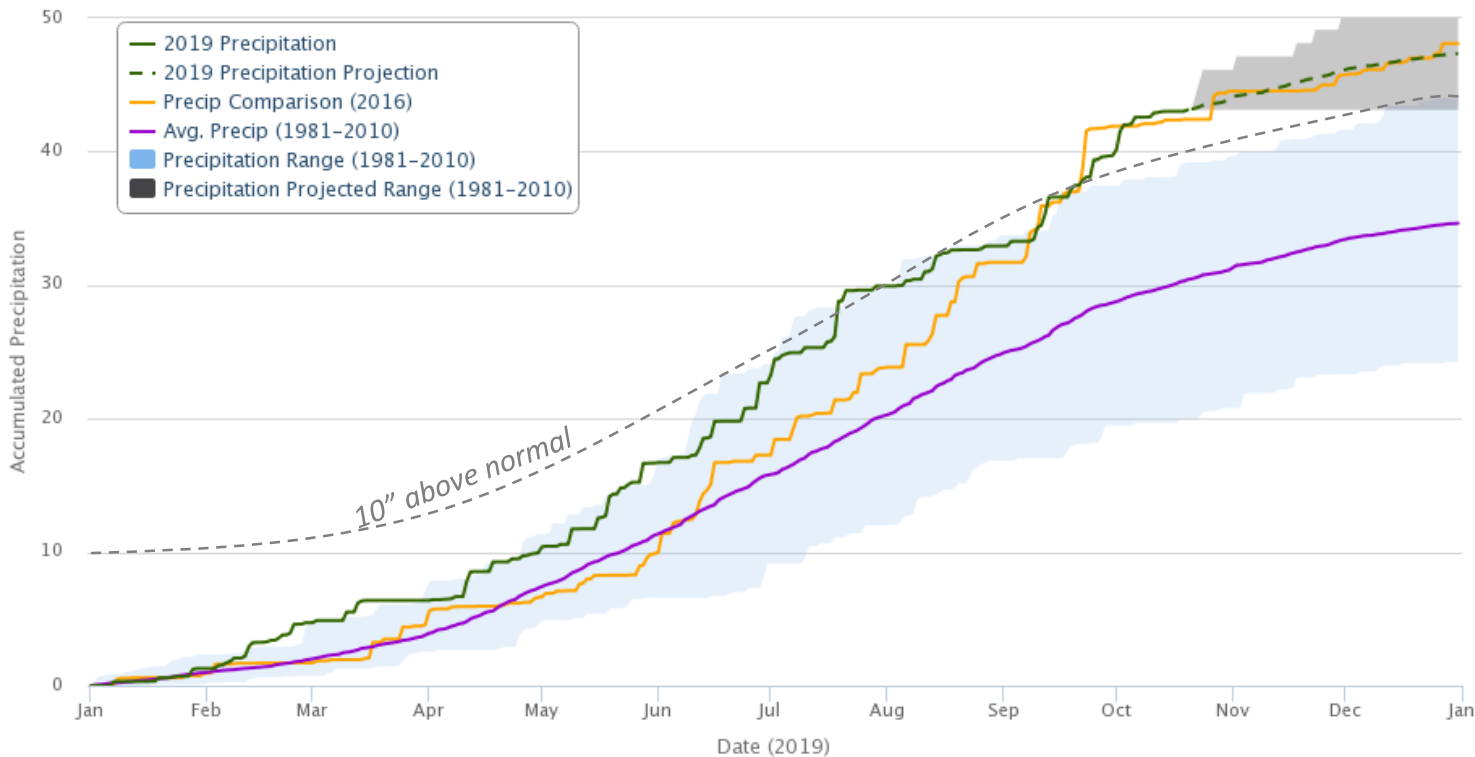
Location: 43.95, -91.16 in La Crosse Co., WI, Start Date: January 1 2017

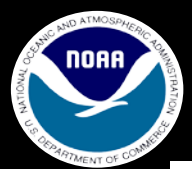




## Accumulated Precipitation Tool

Location: 43.95, -91.16 in La Crosse Co., WI, Start Date: January 1 2016



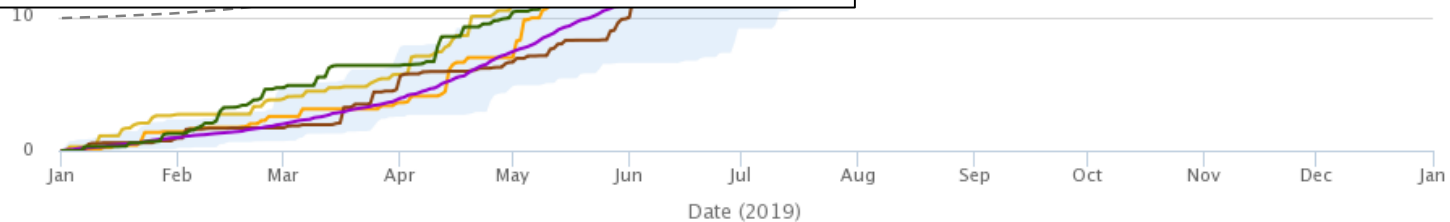
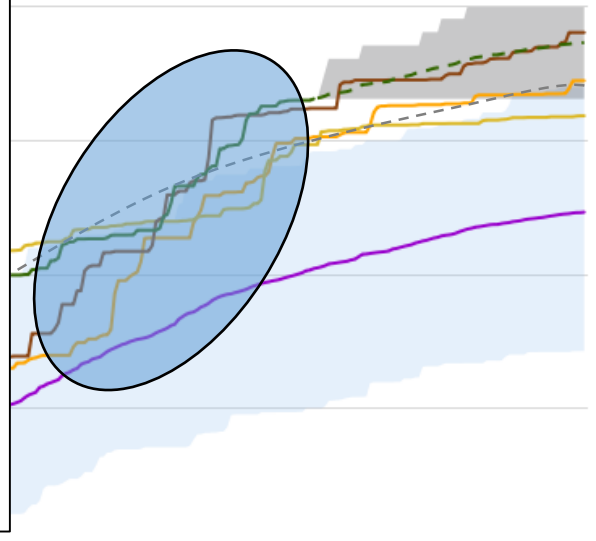
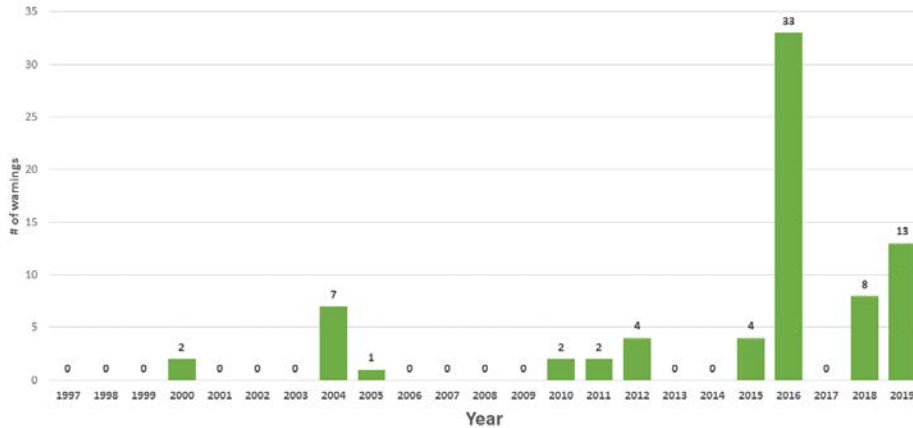


## Accumulated Precipitation Tool

Location: 43.95, -91.16 in La Crosse Co., WI, Start Date: January 1

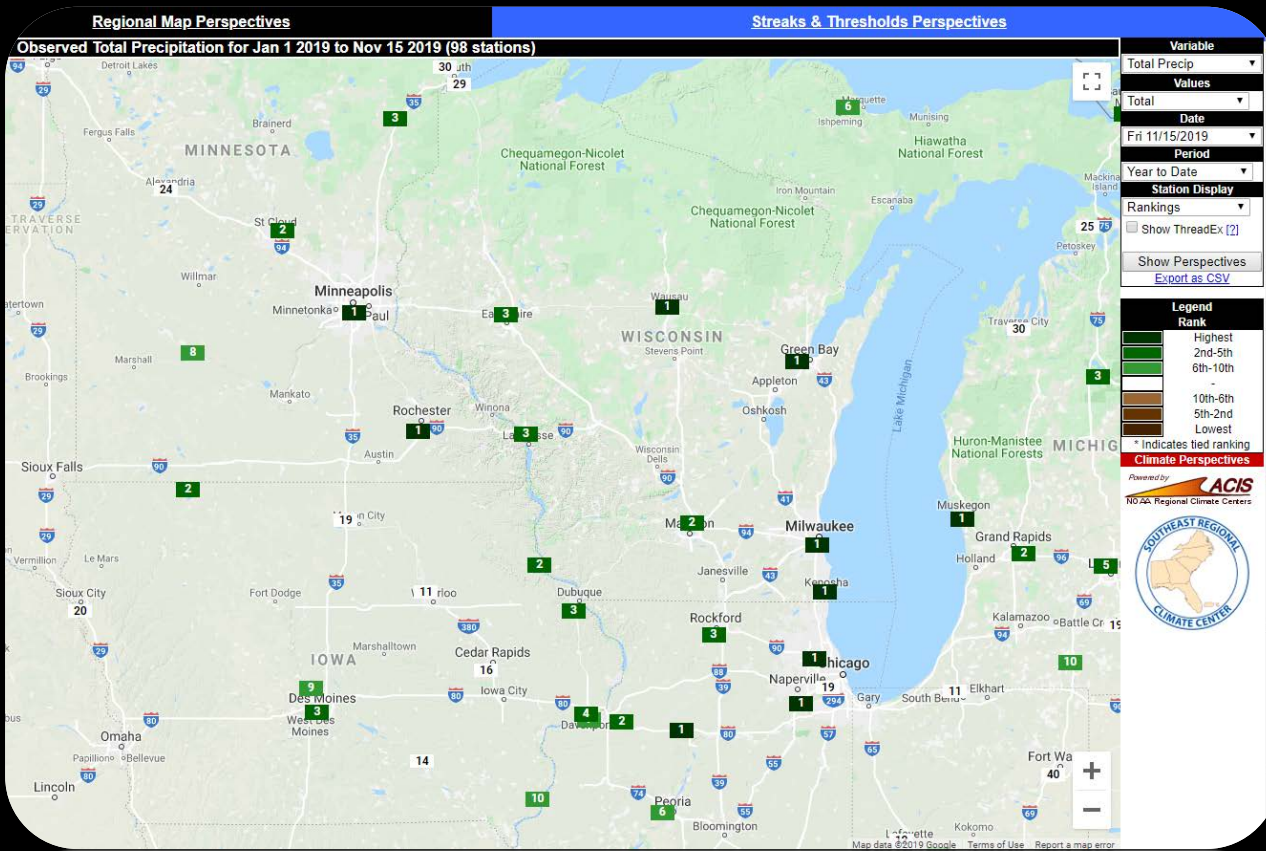
### # of FFWs in September

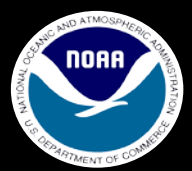
NWS La Crosse





# Rank: Jan 1- Nov 15 2019 (~70 Years)

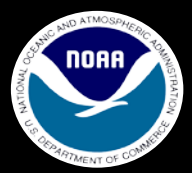




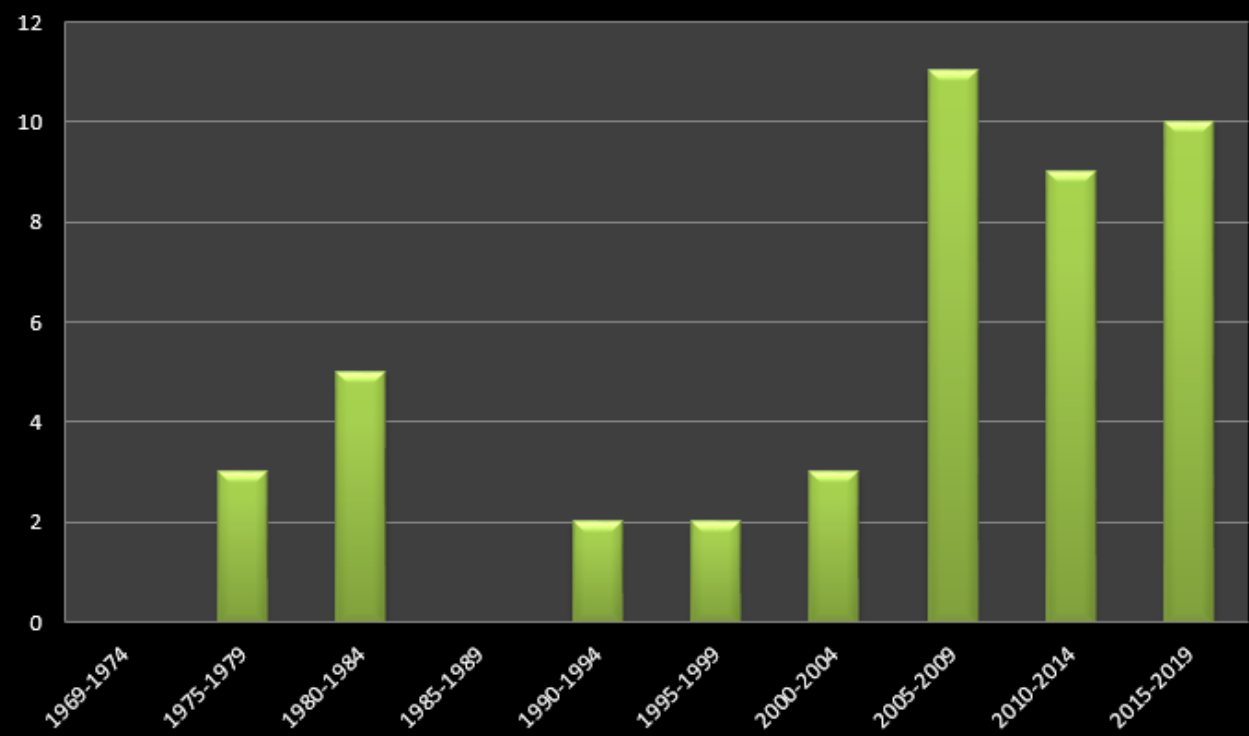
# 2019 Record Annual Precipitation



Records began  
in late 1800s



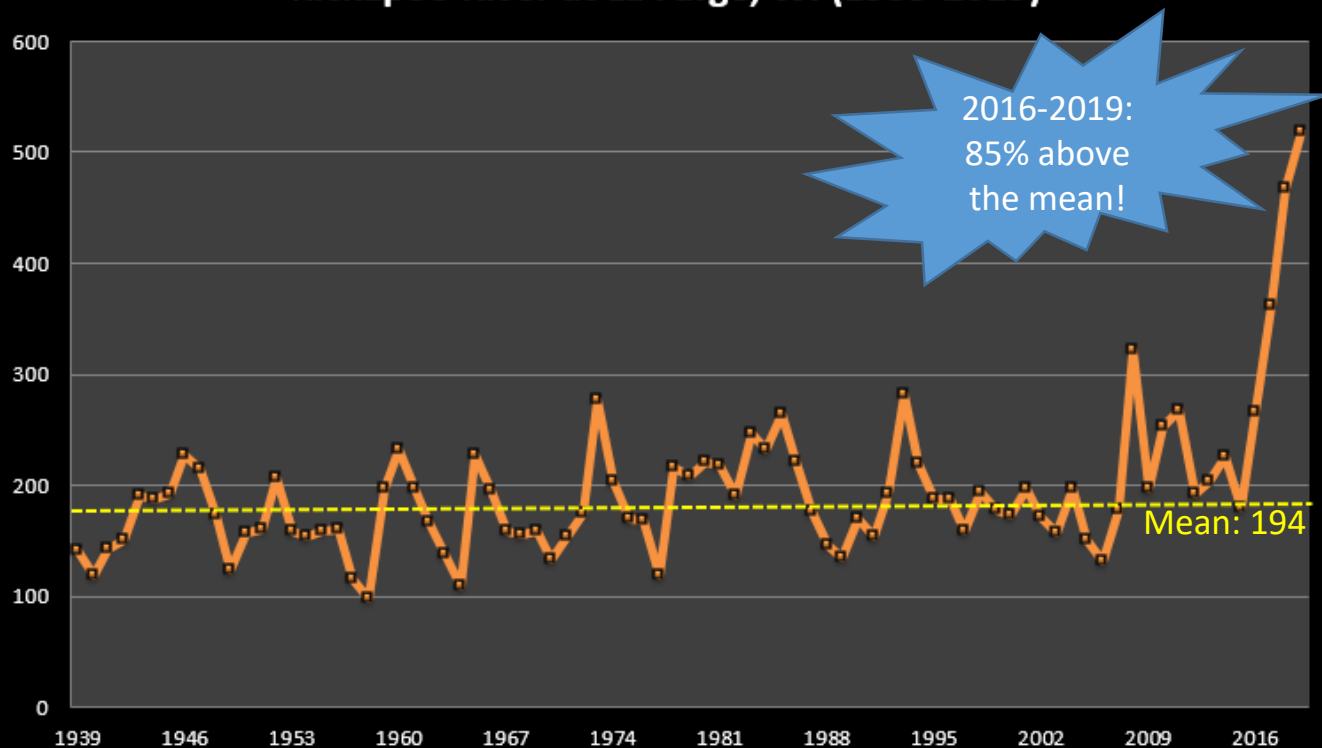
# Current 2-Day Rainfall Records 1969-2019 NWS La Crosse COOP (45 total)



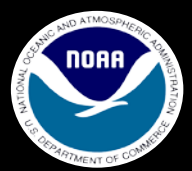




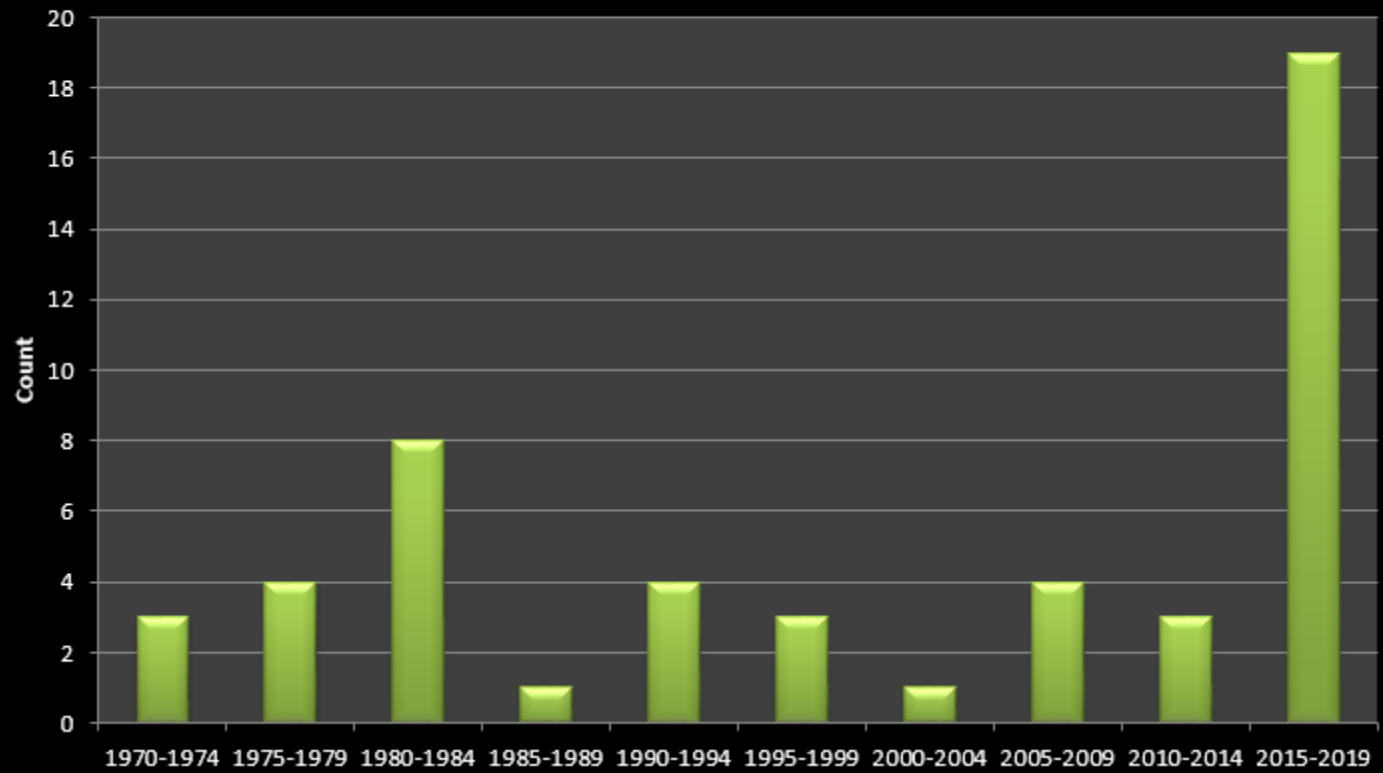
## Annual Mean Discharge (cfs) Kickapoo River at La Farge, WI (1939-2019)



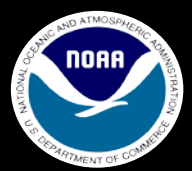
Data Provided by:  
**USGS**  
science for a changing world



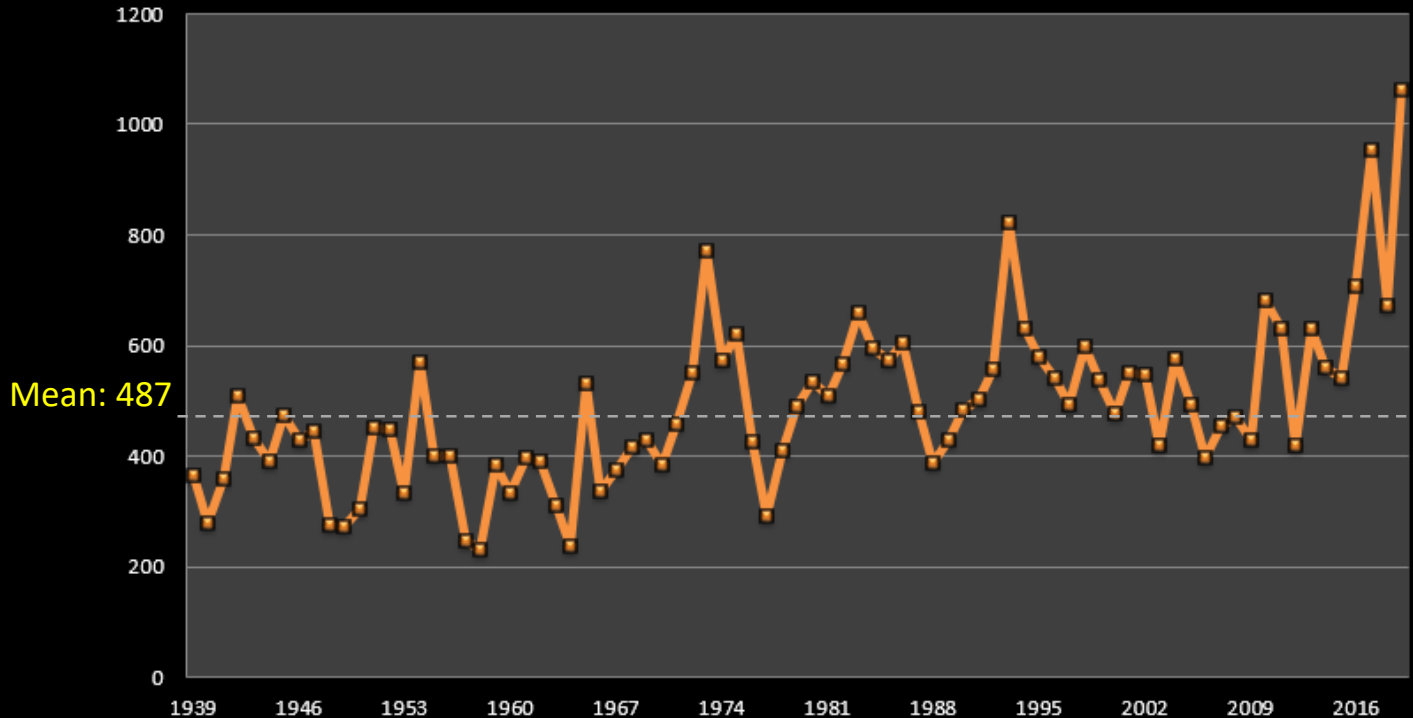
# Top 50 Mean Streamflow Days 1970-2019 Kickapoo River at La Farge, WI



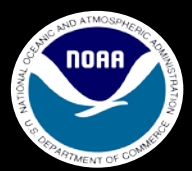
Data Provided by:  
  
science for a changing world



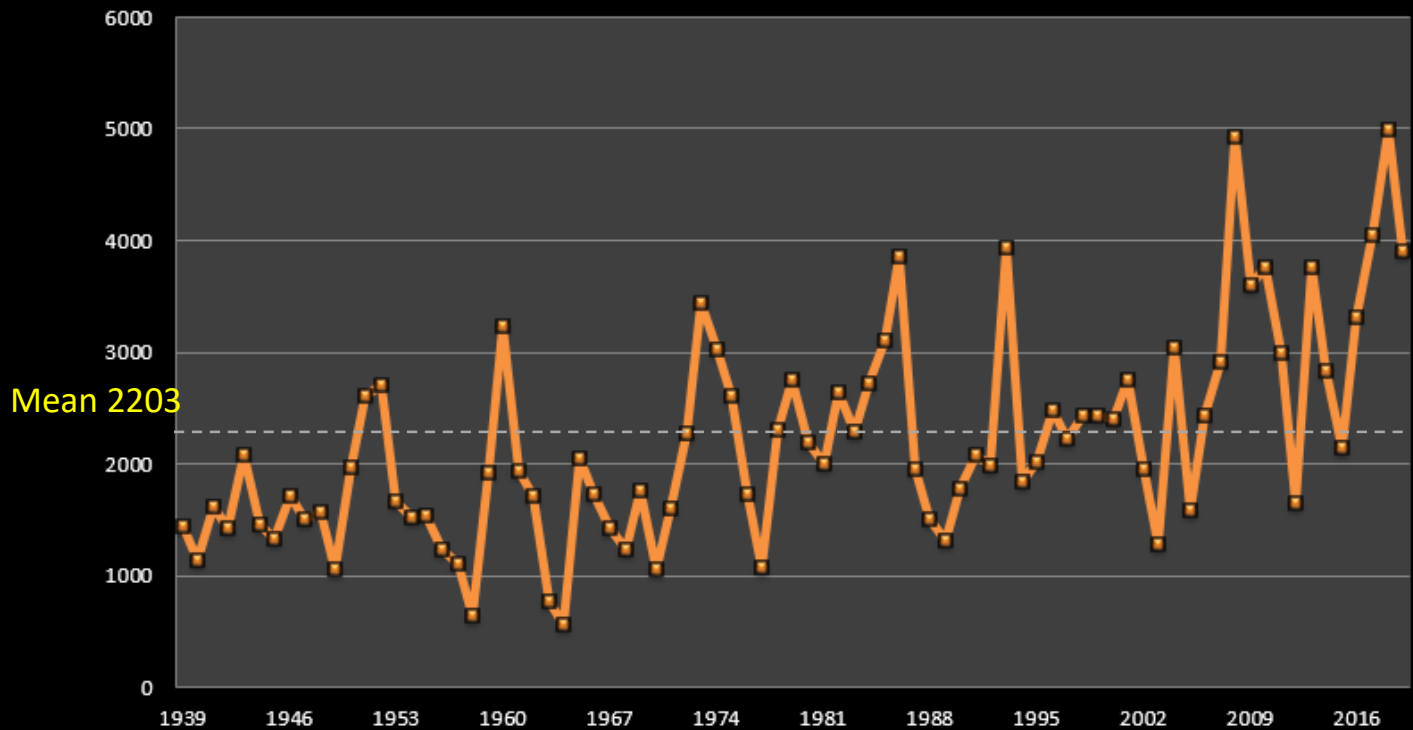
## Annual Mean Discharge (cfs) Trempealeau River at Dodge, WI (1939-2019)



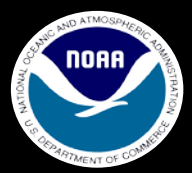
Data Provided by:  
**USGS**  
science for a changing world



## Annual Mean Discharge (cfs) Rock River at Afton, WI (1939-2019)

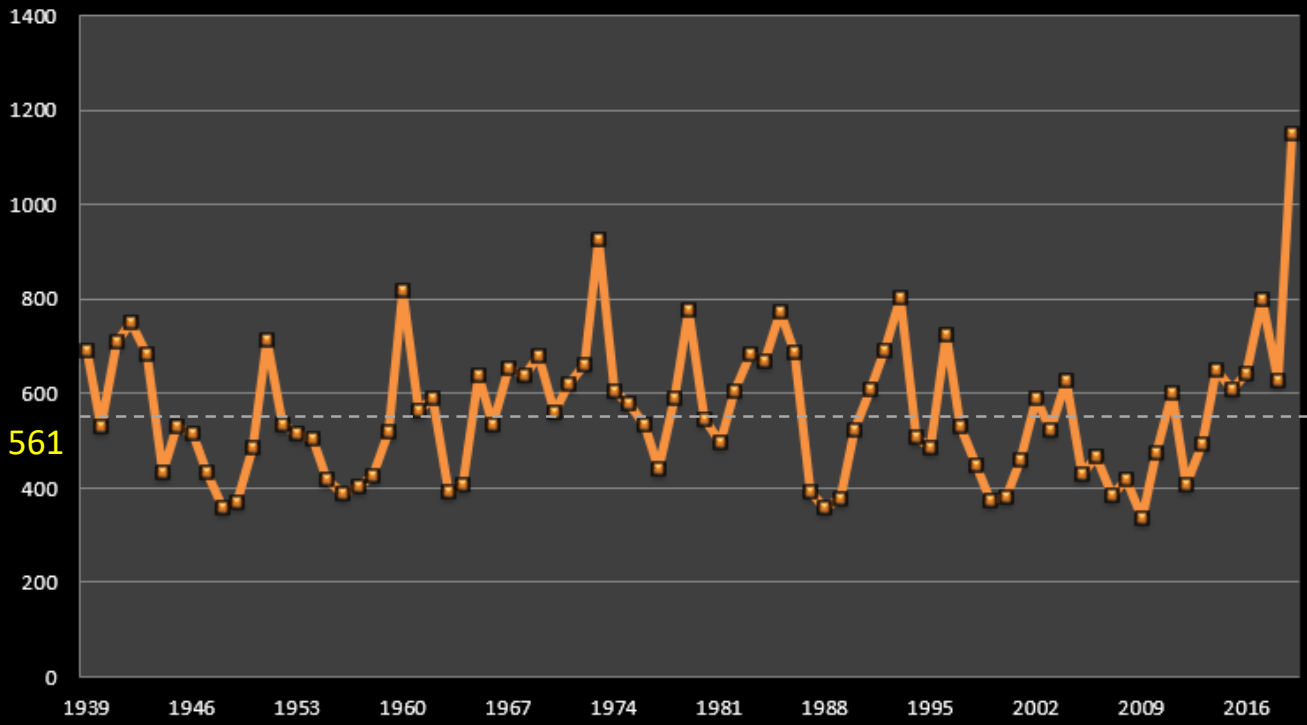


Data Provided by:  
**USGS**  
science for a changing world

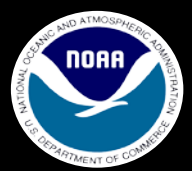


# Annual Mean Discharge (cfs) Oconto River at Gillett, WI (1939-2019)

Mean: 561

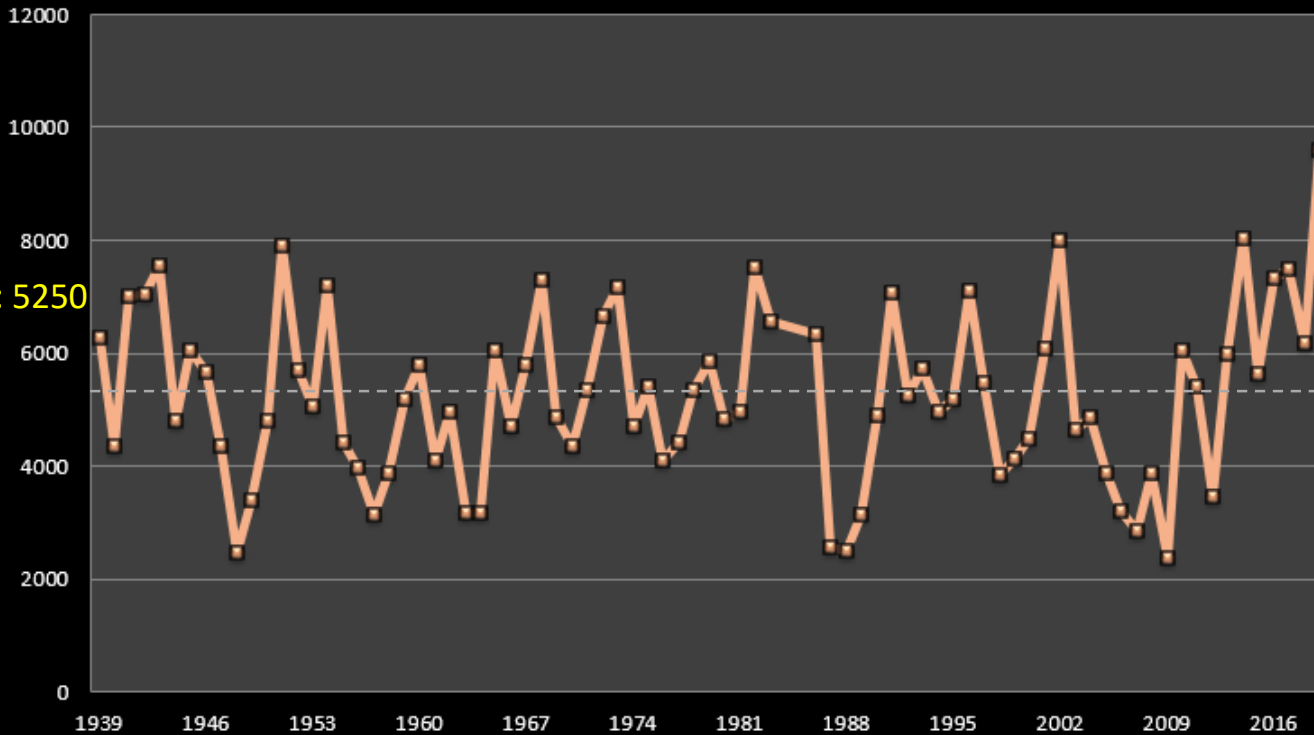


Data Provided by:  
**USGS**  
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## Annual Mean Discharge (cfs) Chippewa River at Chippewa Falls, WI (1939-2019)

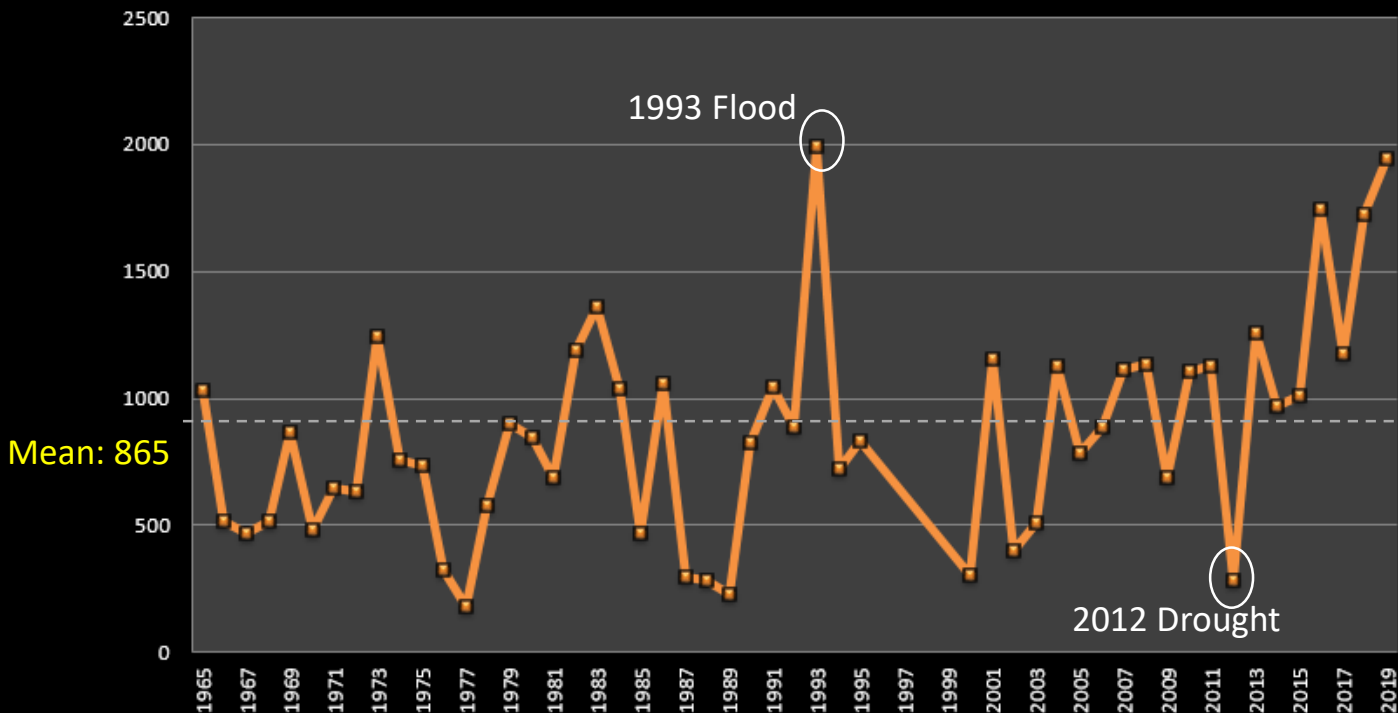
Mean: 5250



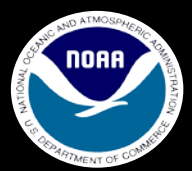
Data Provided by:  
**USGS**  
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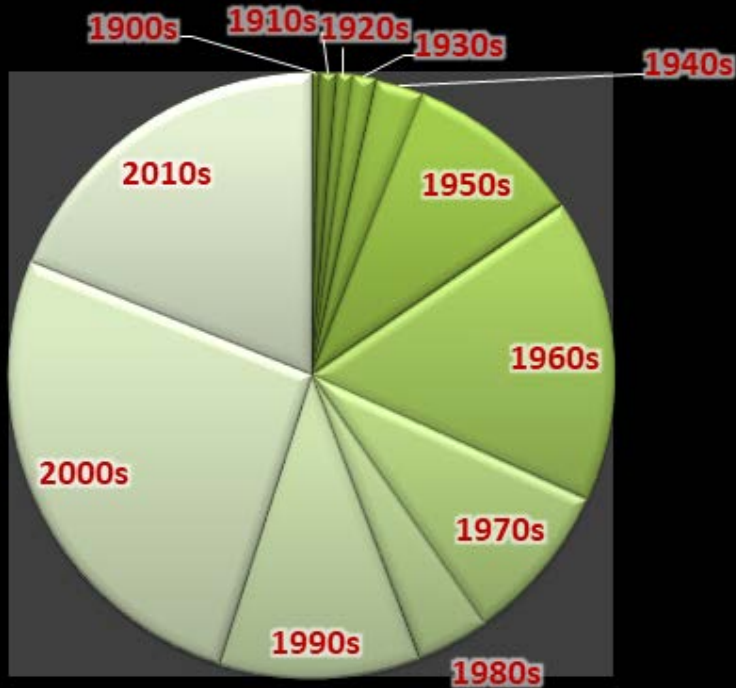
## Annual Mean Discharge (cfs) Cedar River at Charles City, IA (1965-2019)



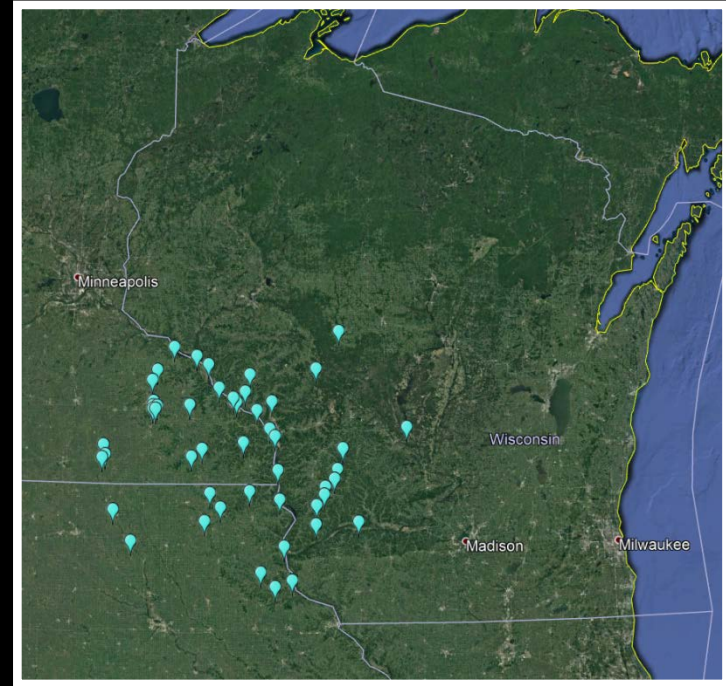
Data Provided by:  
**USGS**  
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# Top 5 Historical Crests @ 48 River Gauges in NWS La Crosse Area (to 2018)



232 Total Crests







# Long Term Trends (Climate)

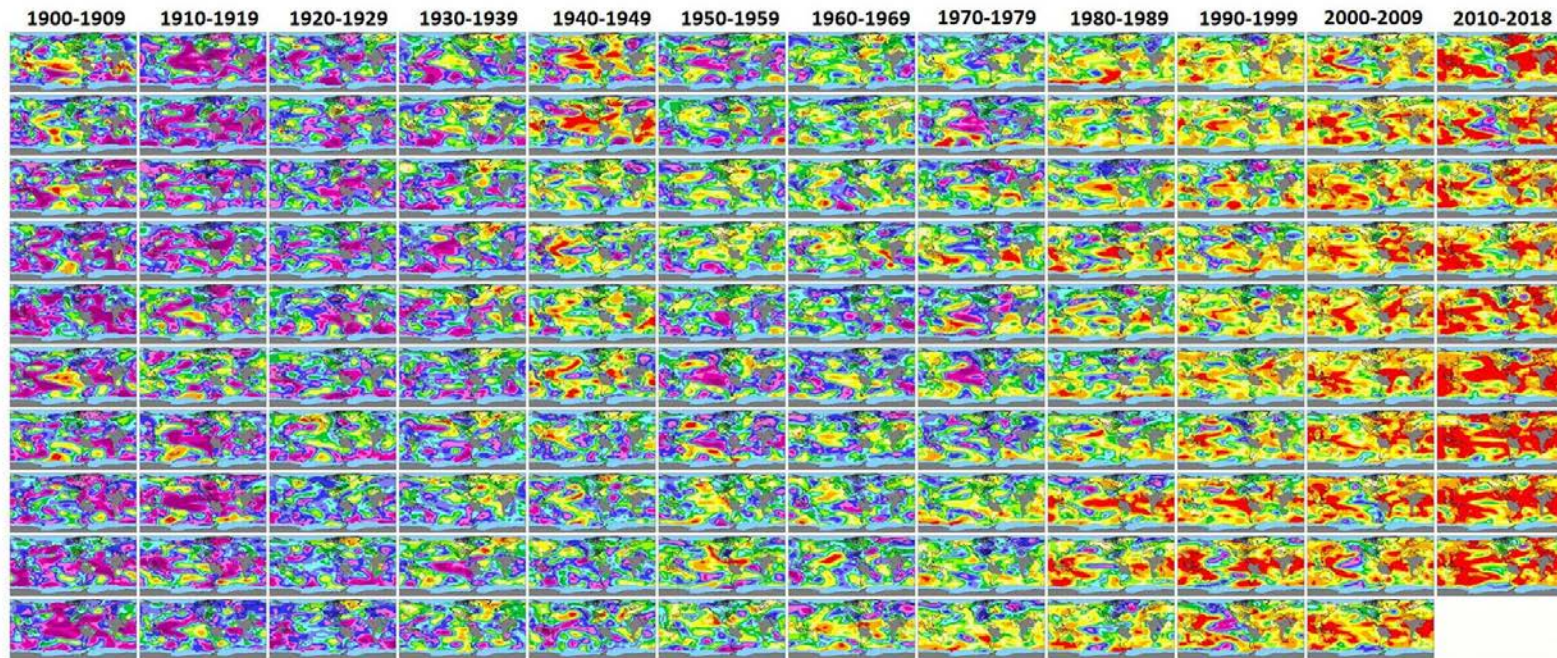


<https://www.youtube.com/watch?v=JObGveVUz7k>

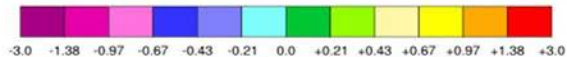


# Long Term Trends (Climate)

## Global Temperature Departure From 20<sup>th</sup> Century Average: 1900-2018



Source: NASA GISS Surface Temperature Analysis and maps by Brian Brettschneider



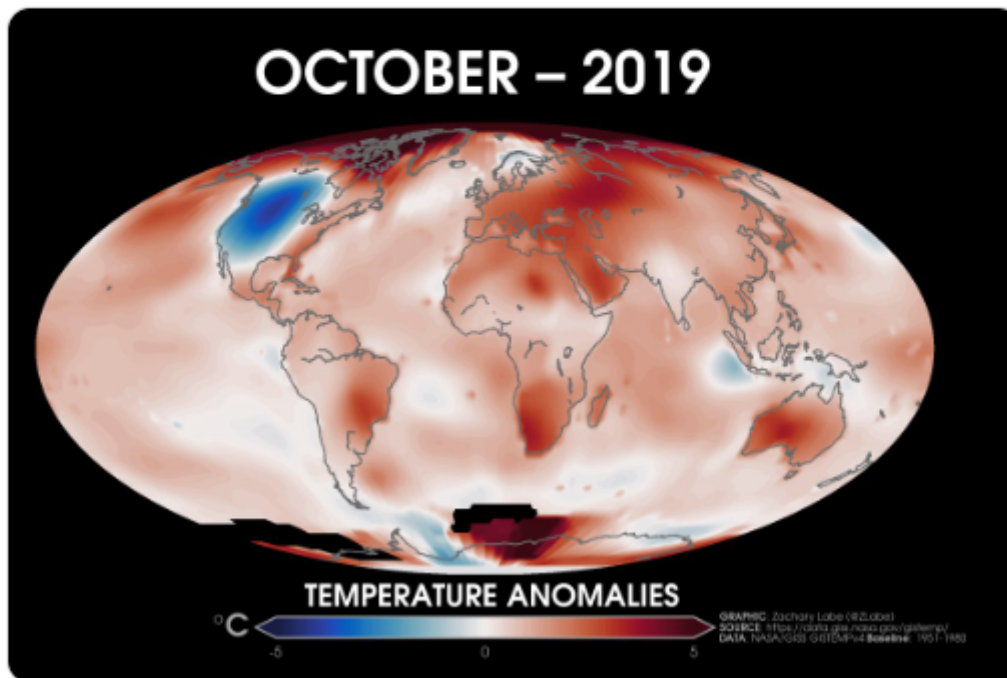
Standard Deviations from 20<sup>th</sup> Century Average  
[Each category has equal chance of occurrence]



**Zack Labe** @ZLabe · Nov 15

Your backyard is not representative of global weather/climate.

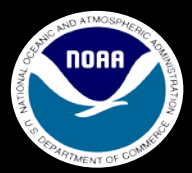
Overall, the average October global air temperature was  $+1.04^{\circ}\text{C}$  above 1951-1980 climate baseline ( $+1.27^{\circ}\text{C}$  above the 1880-1920 baseline).



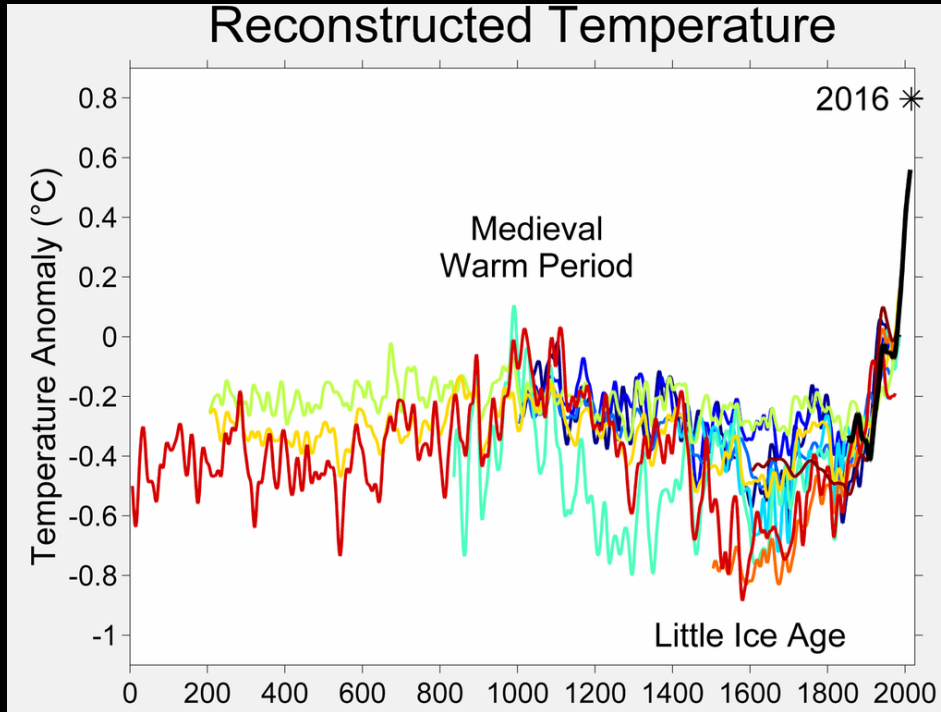
**DATA:** National Snow & Ice Data Center, Boulder CO (Sea Ice Index v3; 1979-2019\*)

**SOURCE:** [ftp://sidads.colorado.edu/DATASETS/NOAA/](http://sidads.colorado.edu/DATASETS/NOAA/)

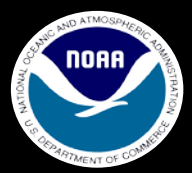
**GRAPHIC:** Zachary Labe (@ZLabe)



# Long Term Trends (Climate)



Source: National Research Council (U.S.). Committee on Surface Temperature Reconstructions for the Last 2,000 Years *Surface temperature reconstructions for the last 2,000 years* (2006), National Academies Press [ISBN 978-0-309-10225-4/](https://doi.org/10.17226/11484)



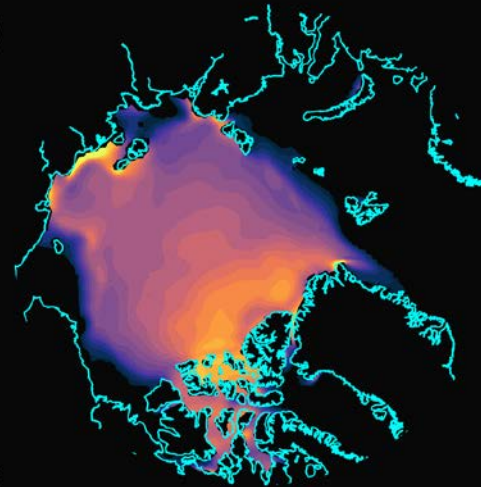
# Long Term Trends (Climate)

# 1979

16,911



SEA ICE VOLUME (km<sup>3</sup>)



SEA ICE THICKNESS (m)

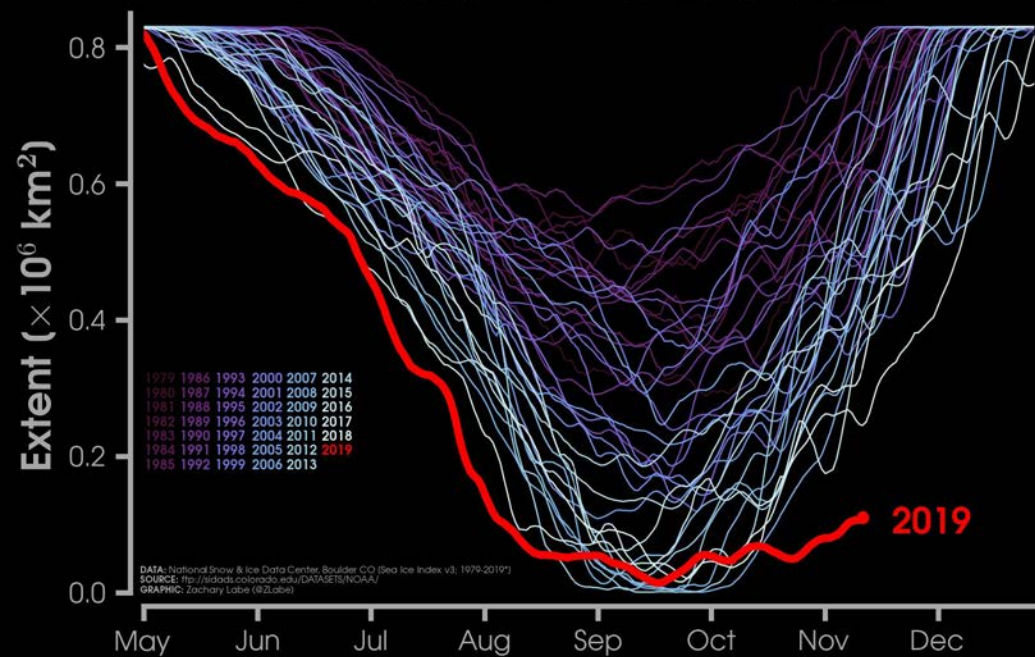
GRAPHIC: Zachary Labo (@ZLabe)  
SOURCE: <https://pic.orst.wisc.edu/research/projects/arctic-sea-ice-volume-anomaly/>  
DATA: PIOMAS V2.1 (Zhang and Rothrock, 2003) (SEPTEMBER)

Twitter: @ZLabeTrends While sea ice thickness observations are sparse, here we utilize the ocean and sea ice model, PIOMAS (Zhang and Rothrock, 2003), to visualize September sea ice thickness and volume from 1979 to 2019.



# Long Term Trends (Climate)

## CHUKCHI SEA ICE



DATA: National Snow & Ice Data Center, Boulder CO (Sea Ice Index v3; 1979-2019\*)  
SOURCE: <ftp://sidads.colorado.edu/DATASETS/NOAA/>  
GRAPHIC: Zachary Labe (@ZLabe)