

Colorado Climate Center – *WATF Climate Update*

Becky Bolinger

Water Availability Task Force

November 13, 2018



ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY

WY2018 Noteworthy Events By Becky Bolinger (Colorado Climate Center)

For the first time ever, a call was placed on the Yampa River on August 22, when flows at Deerlodge Park were a meager 19 cubic feet per second.

*photo courtesy Becky Bolinger

A severe hailstorm battered Colorado Springs on August 6. Baseball-sized hail fell at the Cheyenne Mountain Zoo, killing 5 zoo animals and injuring 14 people. This was one of many large hail events in a very active season.

*photo courtesy Emma Pinell (Facebook)

Two tornadoes were reported in Park County over the summer, taking their total number of tornadoes ever recorded in the county to 7.

*photo courtesy CBS Denver



The Spring Creek Fire and 416 Fire burned a combined 162,000 acres in southern CO. The Spring Creek Fire was human caused on June 27 and the suspect charged with 141 counts of arson. It grew to over 100,000 acres to become the state's 3rd largest wildfire on record.

*photo courtesy Tomi Price (Facebook)



On April 17, a cold front brought significant winds. Extensive damage was reported from the Front Range across the eastern plains where gusts were 70-90mph. Wind was blamed for shutting down DIA runways and starting the Badger Hole Fire in Baca County, which burned more than 30,000 acres.

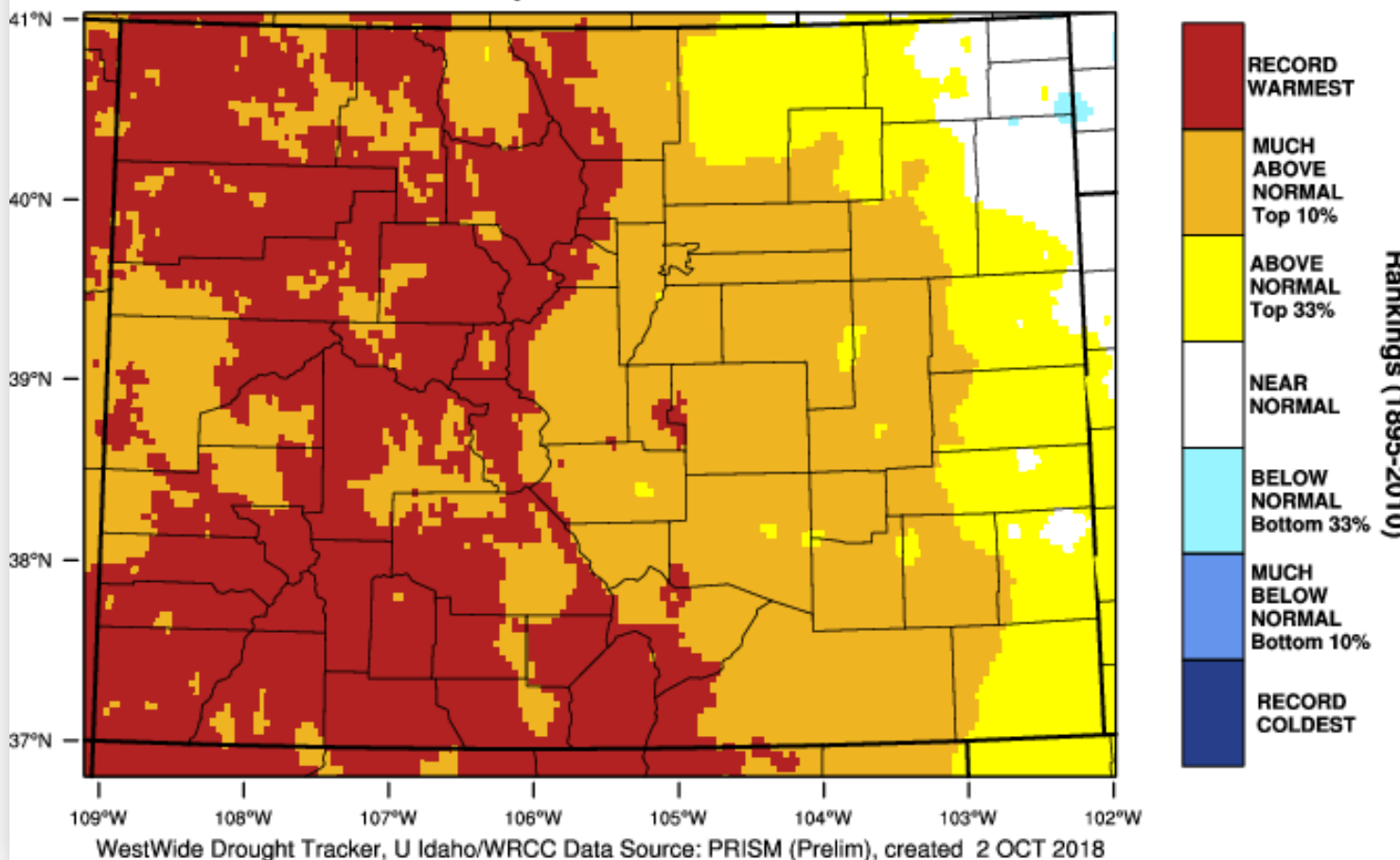
*photo courtesy Jeremiah Bellile (Twitter)

Water Year 2018

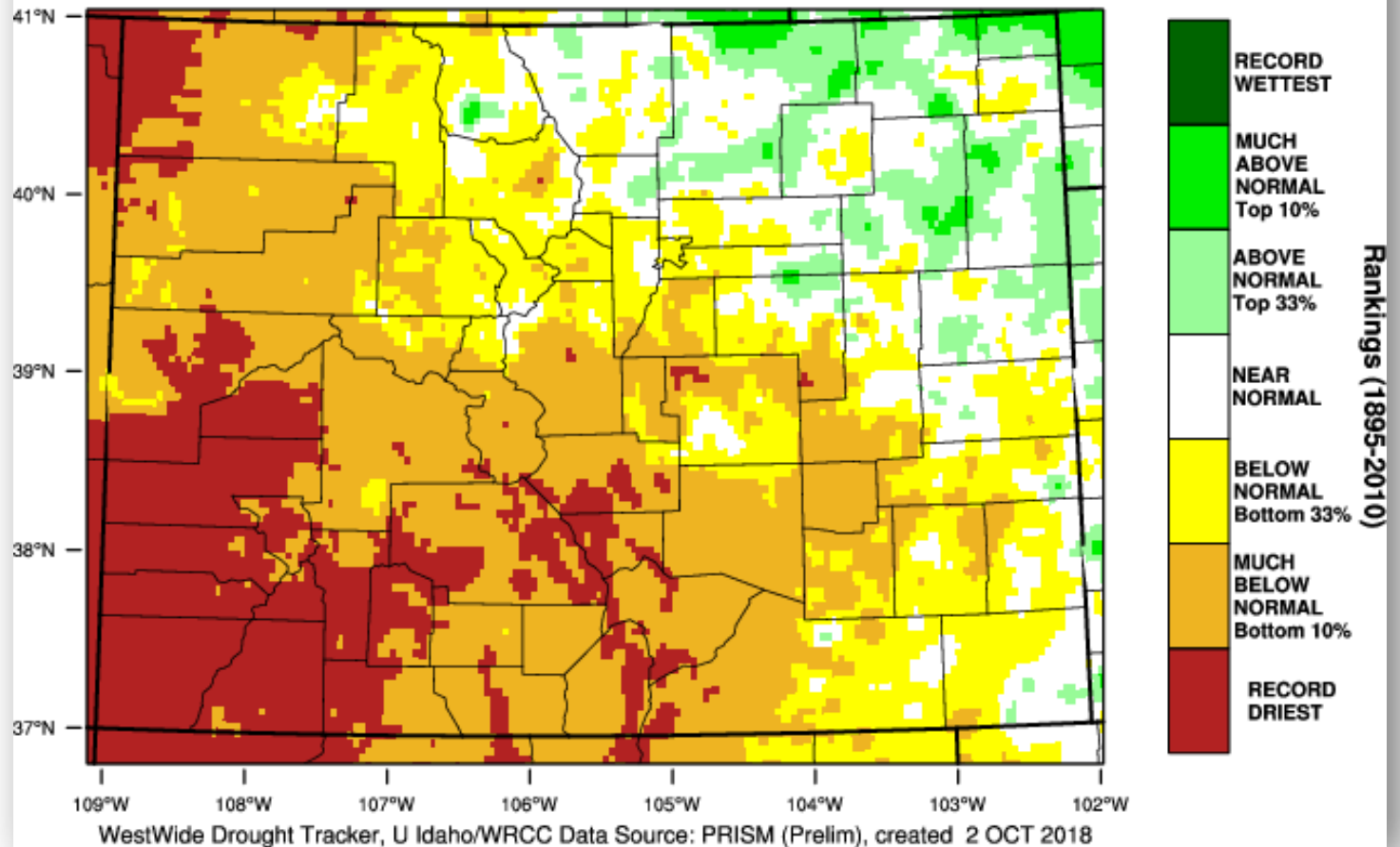
Colorado's Climate in Review...



Colorado - Mean Temperature October-September 2018 Percentile



Colorado - Precipitation October-September 2018 Percentile



CO STATEWIDE RANKING in 124-YEAR RECORD

MONTH	T RANK	P RANK
Oct 2017	near average	37 th driest
Nov 2017	record warmest	18 th driest
Dec 2017	8 th warmest	7 th driest
Jan 2018	8 th warmest	37 th driest
Feb 2018	near average	near average
Mar 2018	25 th warmest	26 th driest
Apr 2018	near average	34 th driest
May 2018	2 nd warmest	38 th driest
Jun 2018	3 rd warmest	26 th driest
Jul 2018	10 th warmest	near average
Aug 2018	33 rd warmest	25 th driest
Sep 2018	3 rd warmest	19 th driest
Water Year	record warmest	2 nd driest

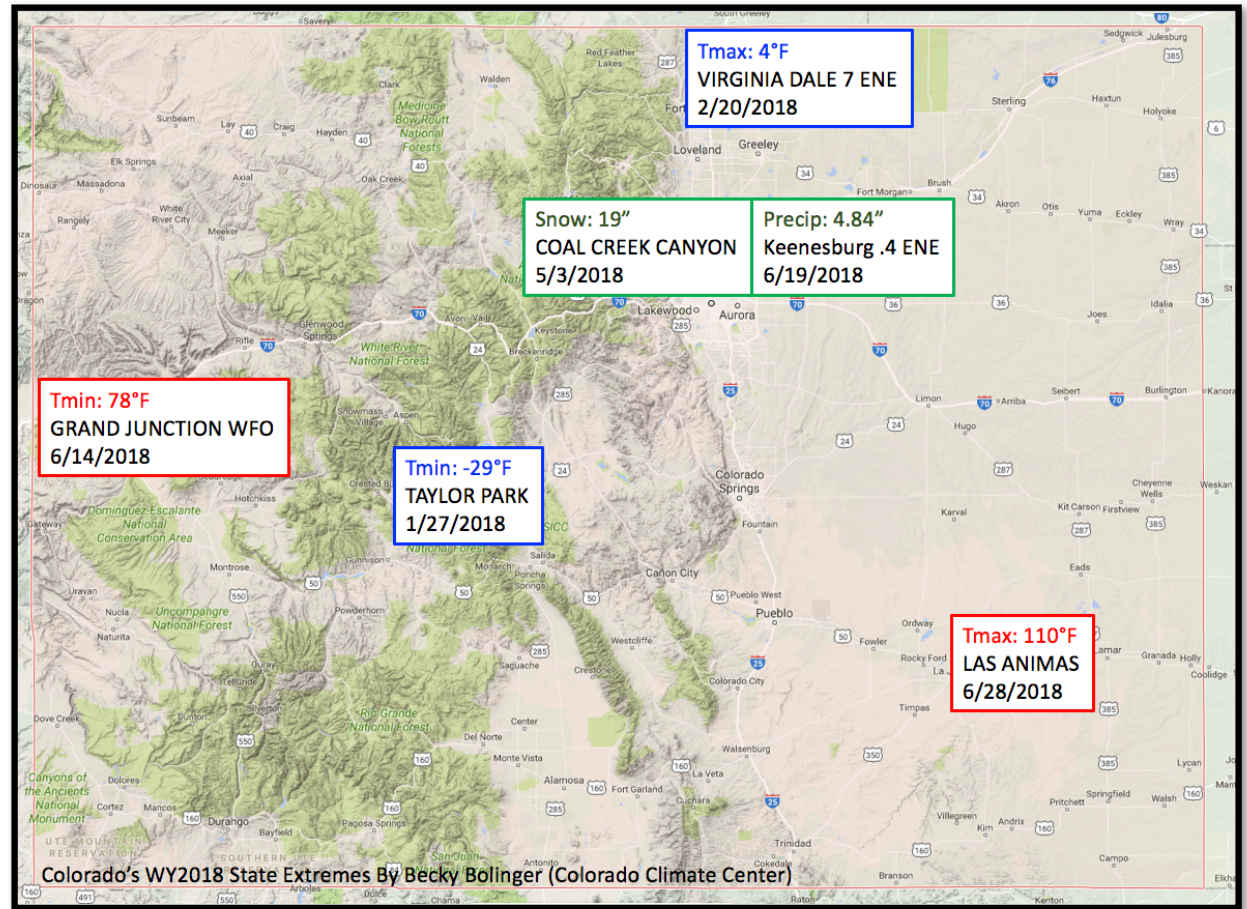
From NOAA NCEI's National Temperature and Precipitation Rank Maps:
www.ncdc.noaa.gov/sotc/national



NUMBER OF DAILY AND MONTHLY STATION RECORDS BROKEN in CO

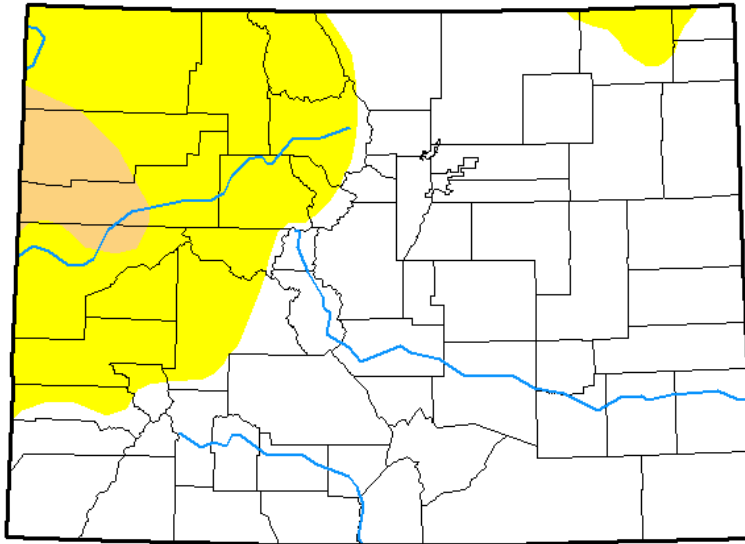
Weather Record Broken	Record broken for a day	Record broken for a month
Highest Max Temperature	1,696	22
Highest Min Temperature	2,971	100
Lowest Max Temperature	560	0
Lowest Min Temperature	292	0
Highest Precipitation	786	17
Highest Snowfall	196	2

From NOAA NCEI's Select U.S. Records: www.ncdc.noaa.gov/extremes/records



U.S. Drought Monitor Colorado

October 3, 2017
(Released Thursday, Oct. 5, 2017)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	70.54	29.46	3.70	0.00	0.00	0.00
Last Week <i>09-26-2017</i>	67.63	32.37	3.72	0.00	0.00	0.00
3 Months Ago <i>07-04-2017</i>	85.58	14.42	0.00	0.00	0.00	0.00
Start of Calendar Year <i>01-03-2017</i>	31.88	68.12	37.21	2.88	0.00	0.00
Start of Water Year <i>09-26-2017</i>	67.63	32.37	3.72	0.00	0.00	0.00
One Year Ago <i>10-04-2016</i>	75.77	24.23	2.45	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

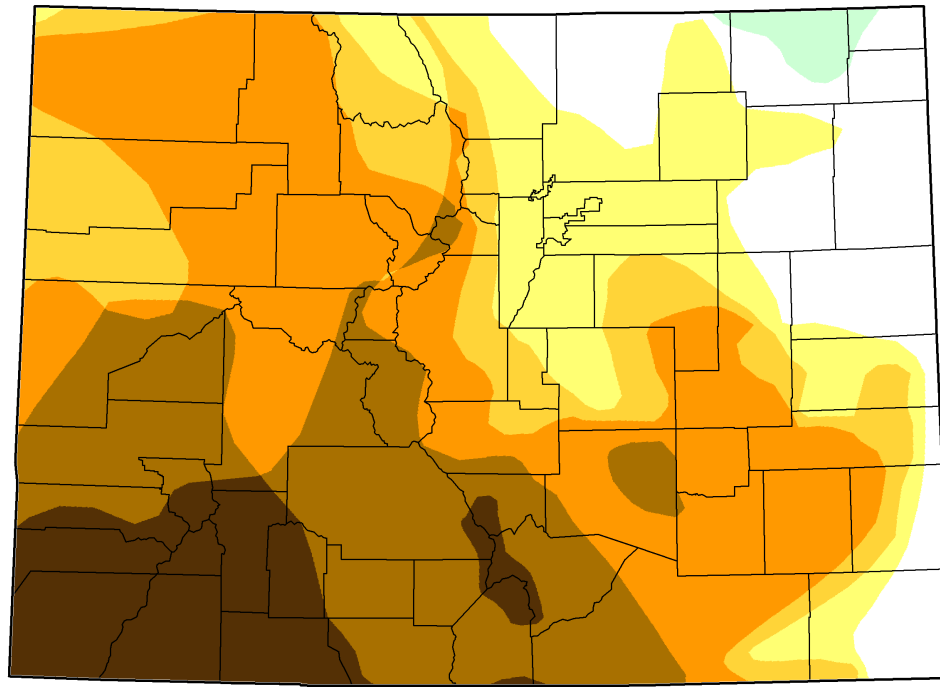
Anthony Artusa
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Class Change - Colorado 1 Year



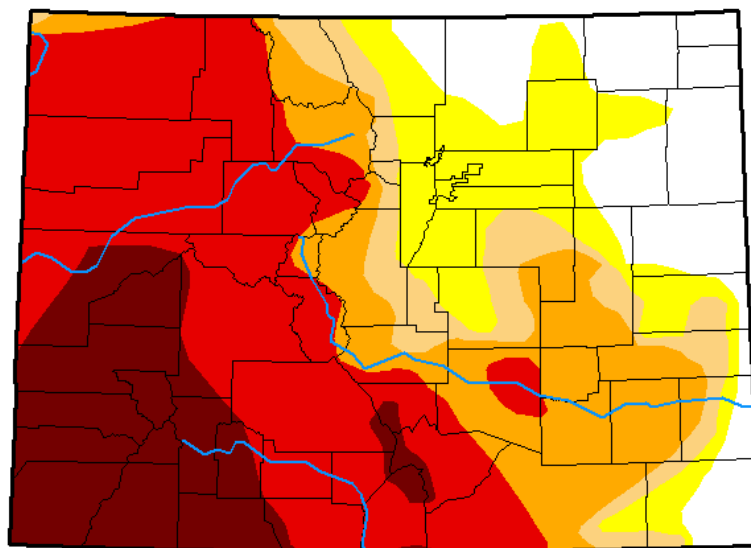
- 5 Class Degradation
- 4 Class Degradation
- 3 Class Degradation
- 2 Class Degradation
- 1 Class Degradation
- No Change
- 1 Class Improvement
- 2 Class Improvement
- 3 Class Improvement
- 4 Class Improvement
- 5 Class Improvement

October 2, 2018
compared to
October 3, 2017

<http://droughtmonitor.unl.edu>

U.S. Drought Monitor Colorado

October 2, 2018
(Released Thursday, Oct. 4, 2018)
Valid 8 a.m. EDT



Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	14.19	85.81	72.30	64.41	48.47	16.21
Last Week 09-25-2018	14.19	85.81	72.30	64.41	48.47	16.21
3 Months Ago 07-03-2018	20.46	79.54	67.30	52.31	36.46	8.81
Start of Calendar Year 01-02-2018	6.57	93.43	33.53	7.27	0.00	0.00
Start of Water Year 09-25-2018	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago 10-03-2017	70.54	29.46	3.70	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>



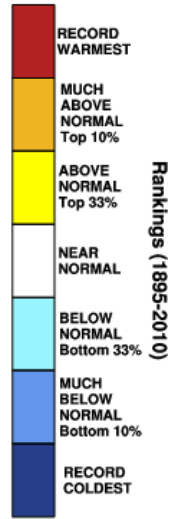
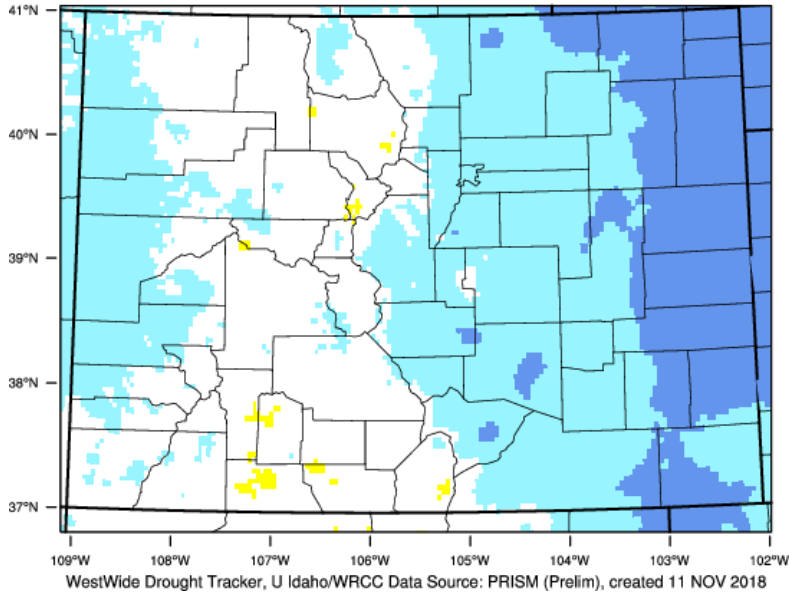


2018 Water Year To Date

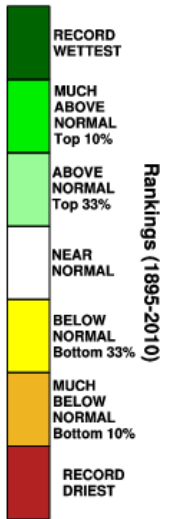
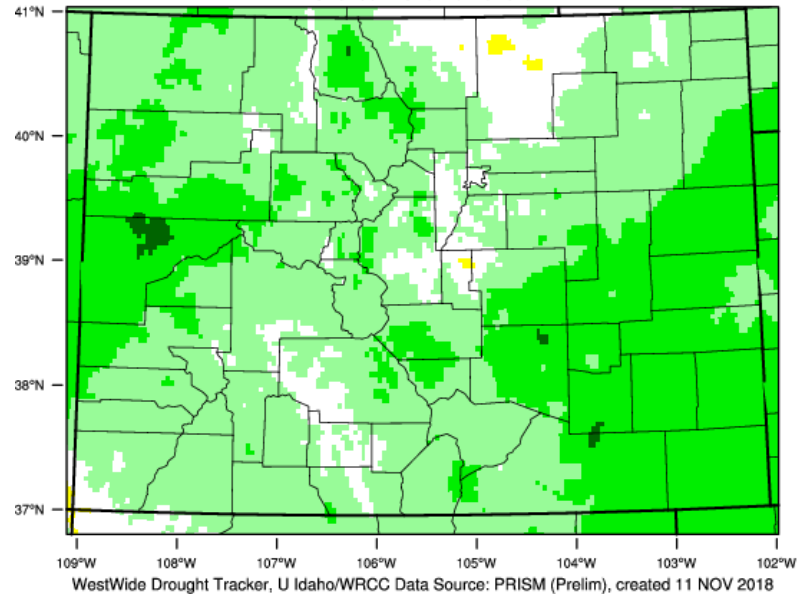
temperature, precipitation,
anomalies, drought conditions



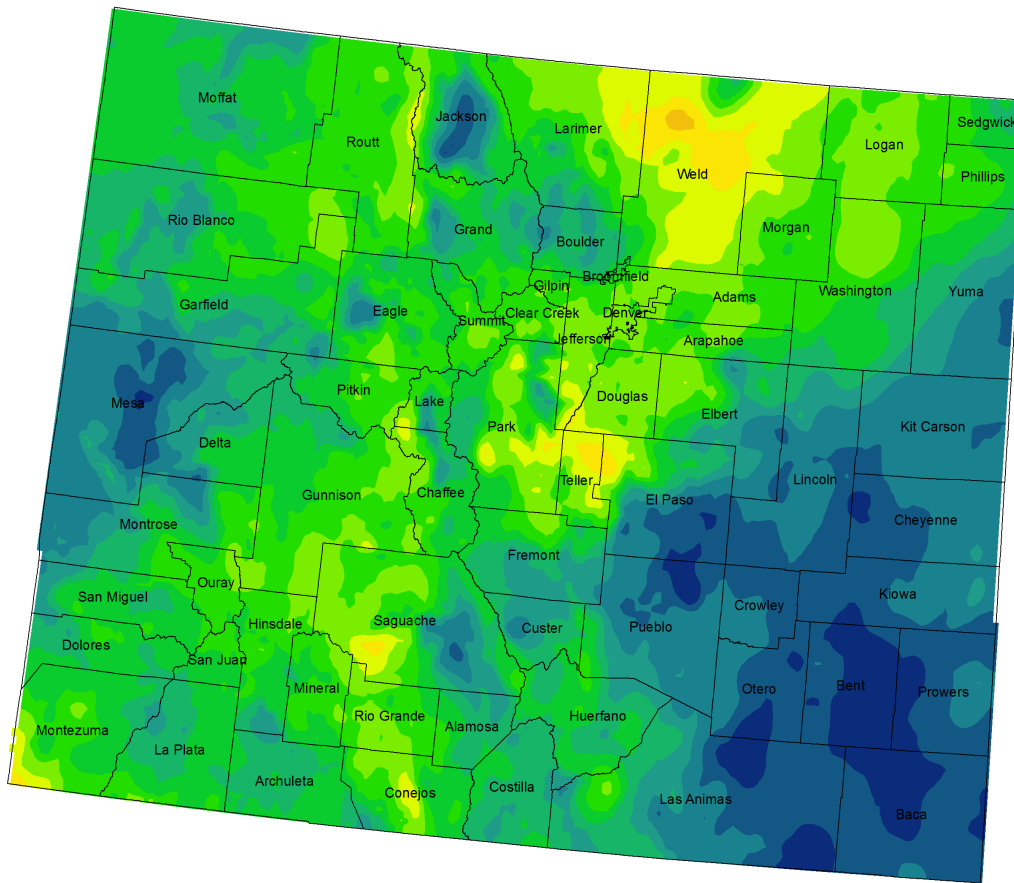
Colorado - Mean Temperature
October 2018 Percentile



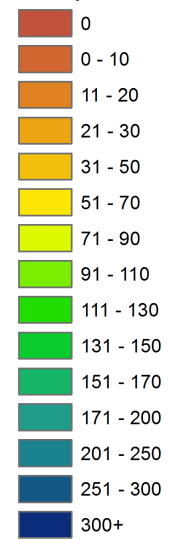
Colorado - Precipitation
October 2018 Percentile



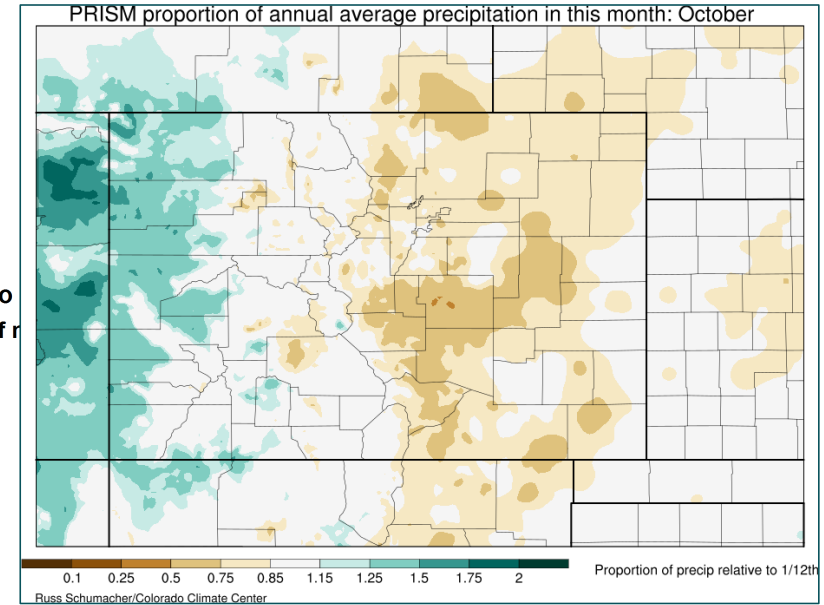
Colorado October 2018 Precipitation as a Percentage of Normal



oct2018_pnc
Precip as % of n



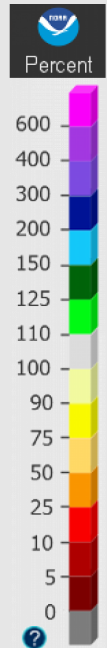
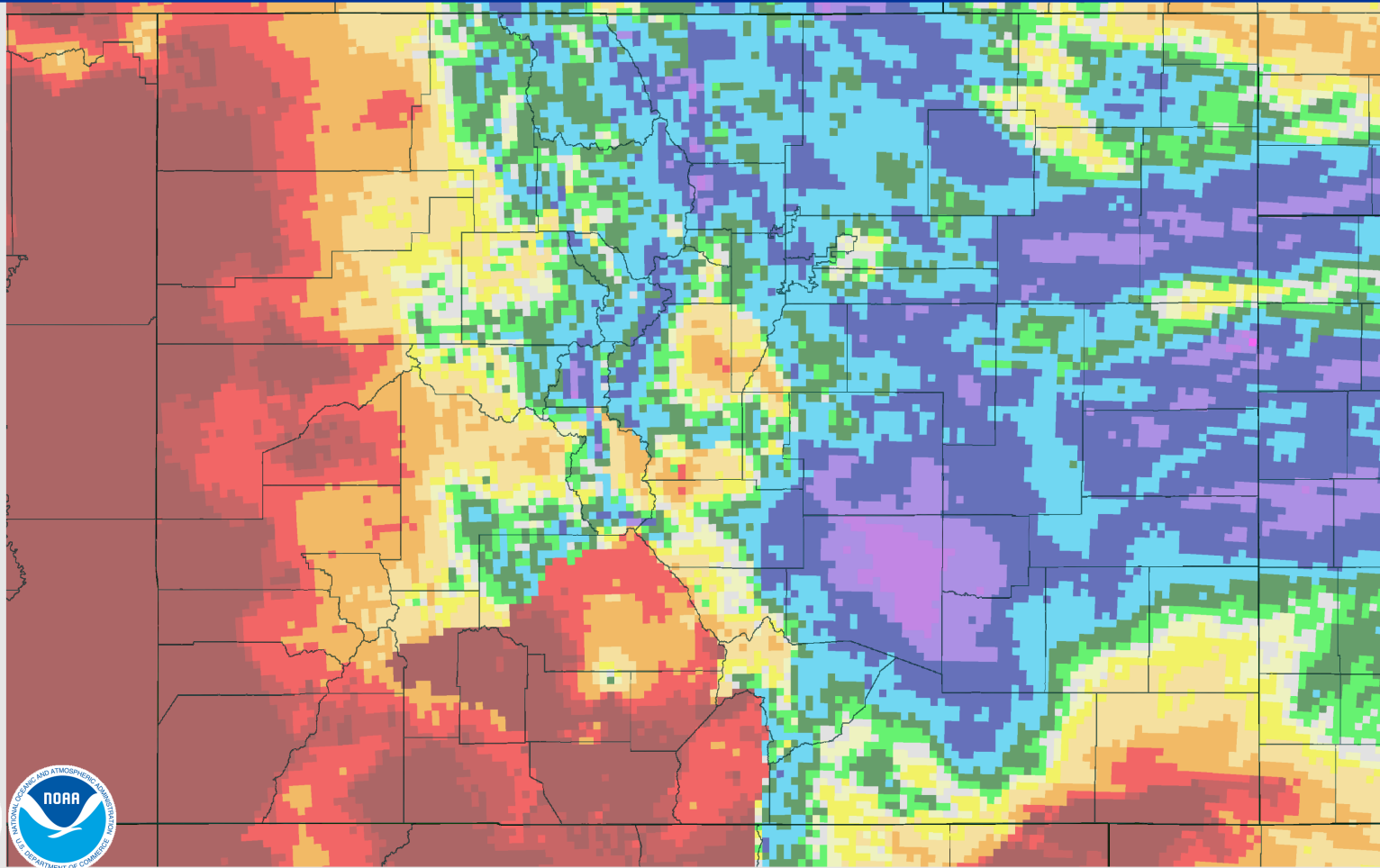
Data from PRISM Climate Group



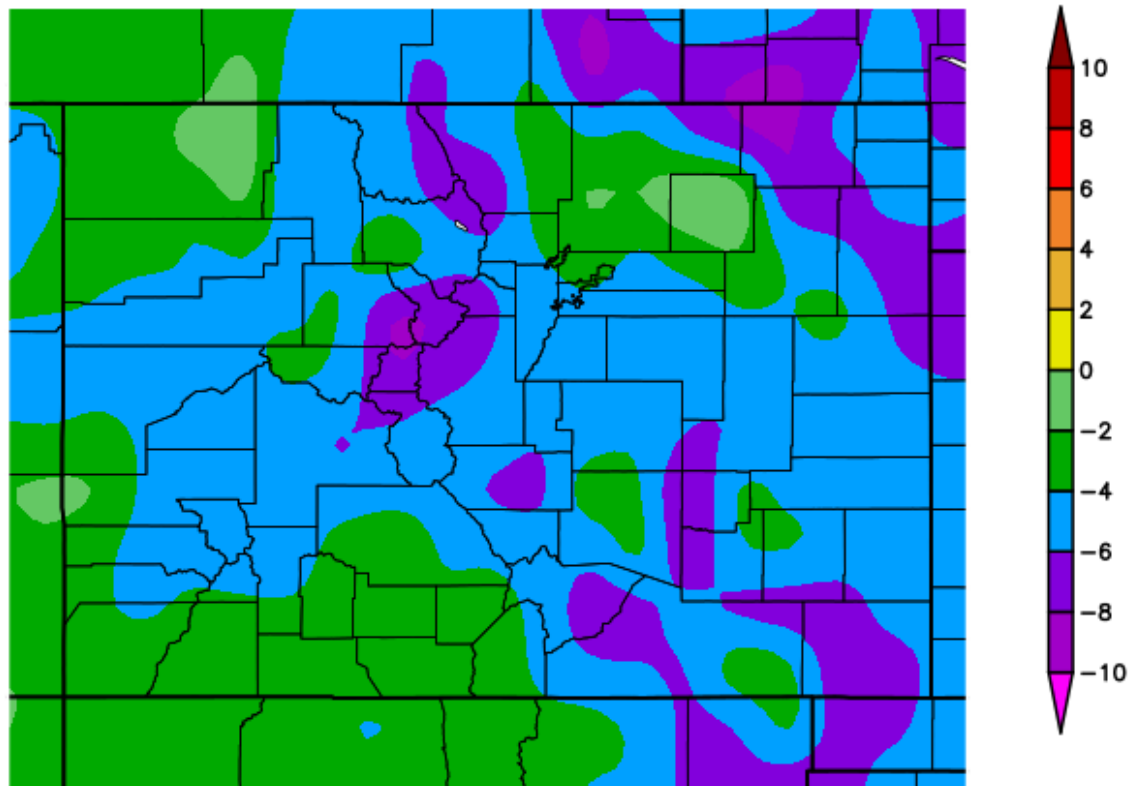
November 12, 2018 Month to Date Percent Precipitation

Created on: November 12, 2018 - 22:50 UTC

Valid on: November 12, 2018 12:00 UTC



Departure from Normal Temperature (F) 11/1/2018 - 11/11/2018



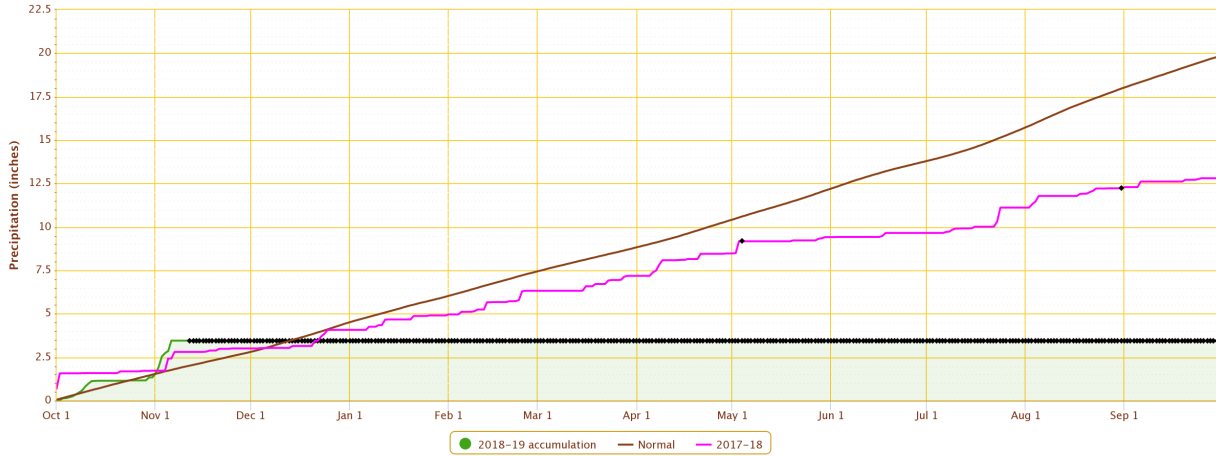
Generated 11/12/2018 at HPRCC using provisional data.

NOAA Regional Climate Centers



Accumulated Precipitation – GRAND LAKE 1 NW, CO

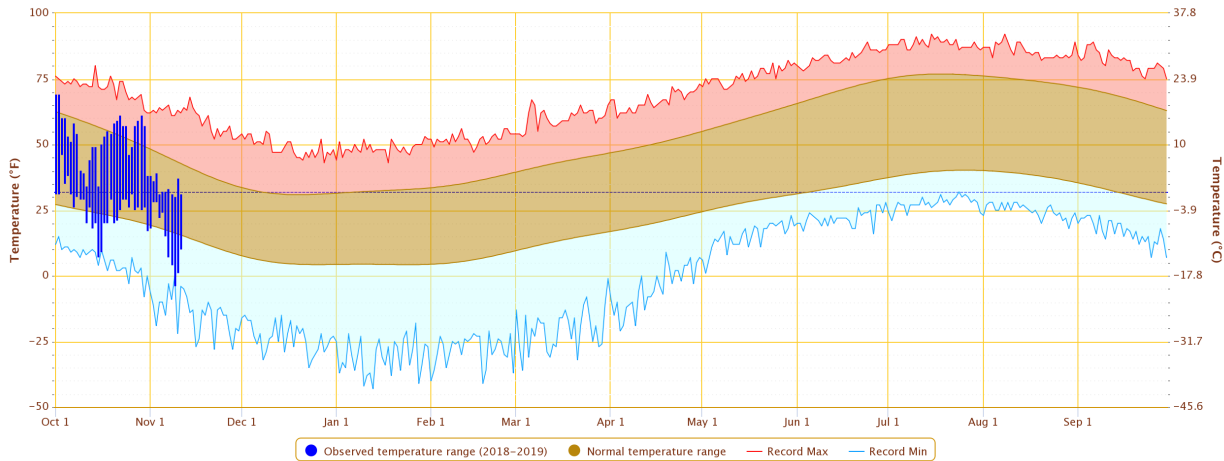
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



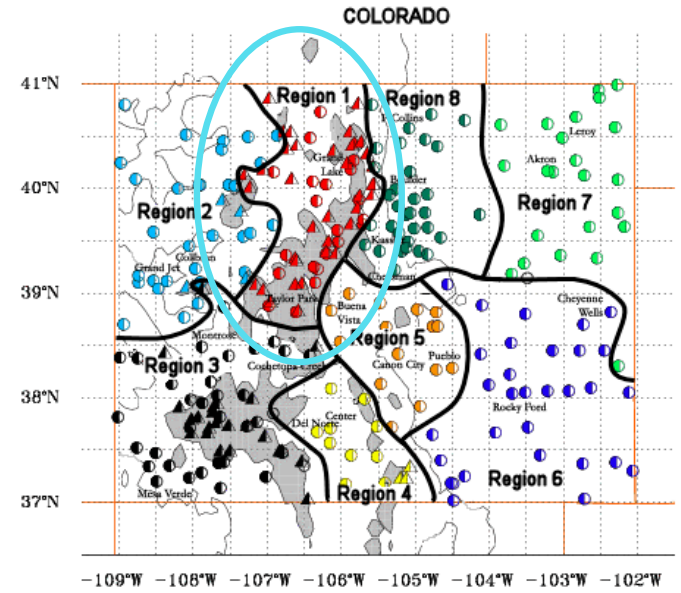
Powered by ACIS

Daily Temperature Data – GRAND LAKE 1 NW, CO

Period of Record – 1939-10-01 to 2018-11-11. Normals period: 1981-2010. Click and drag to zoom chart.

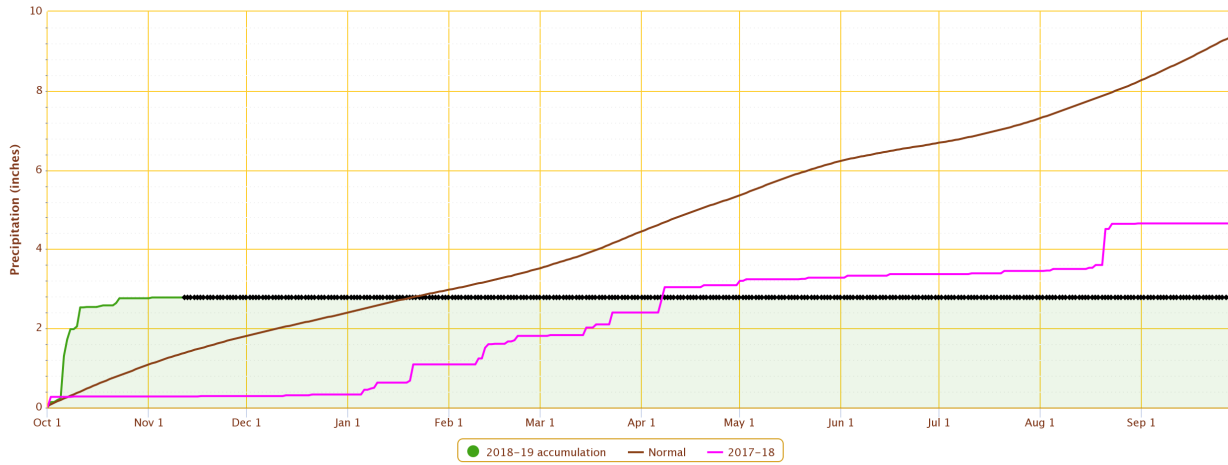


Powered by ACIS



Accumulated Precipitation – GRAND JUNCTION WALKER FIELD, CO

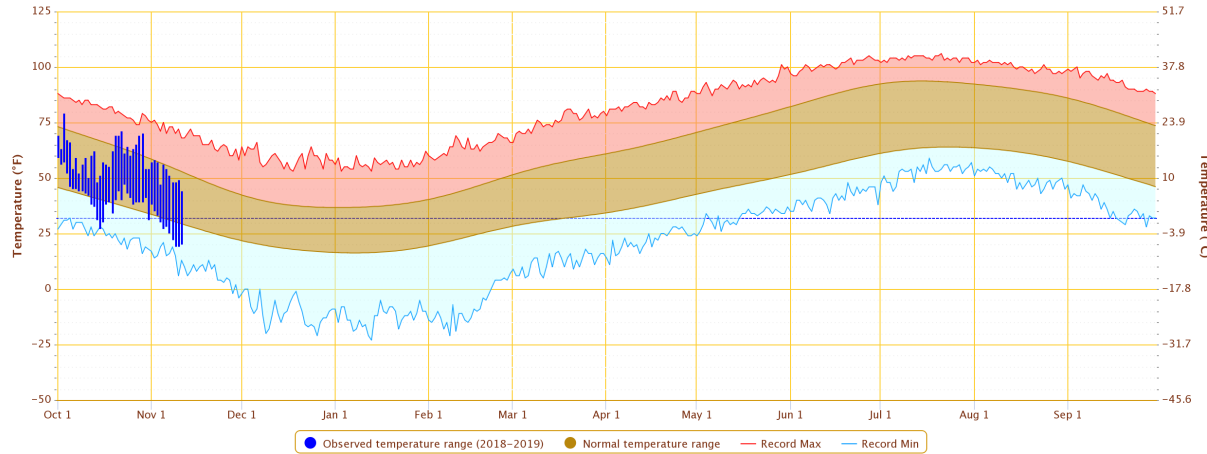
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



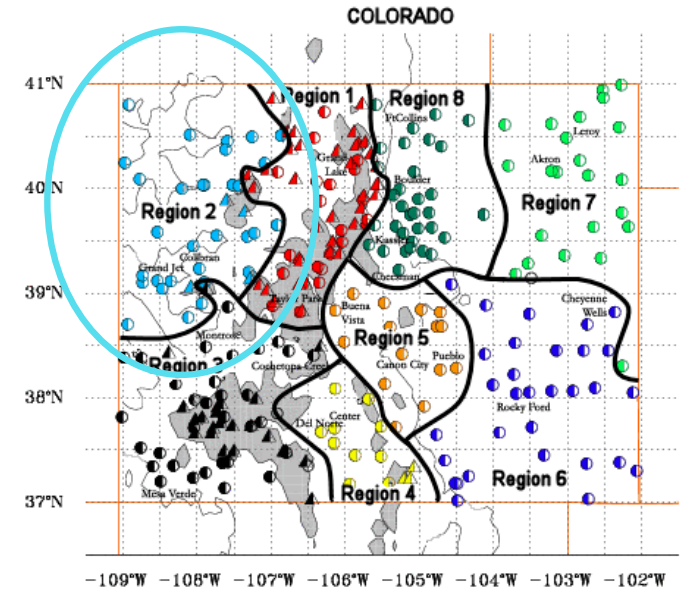
Powered by ACIS

Daily Temperature Data – GRAND JUNCTION WALKER FIELD, CO

Period of Record – 1900-01-01 to 2018-11-11. Normals period: 1981-2010. Click and drag to zoom chart.

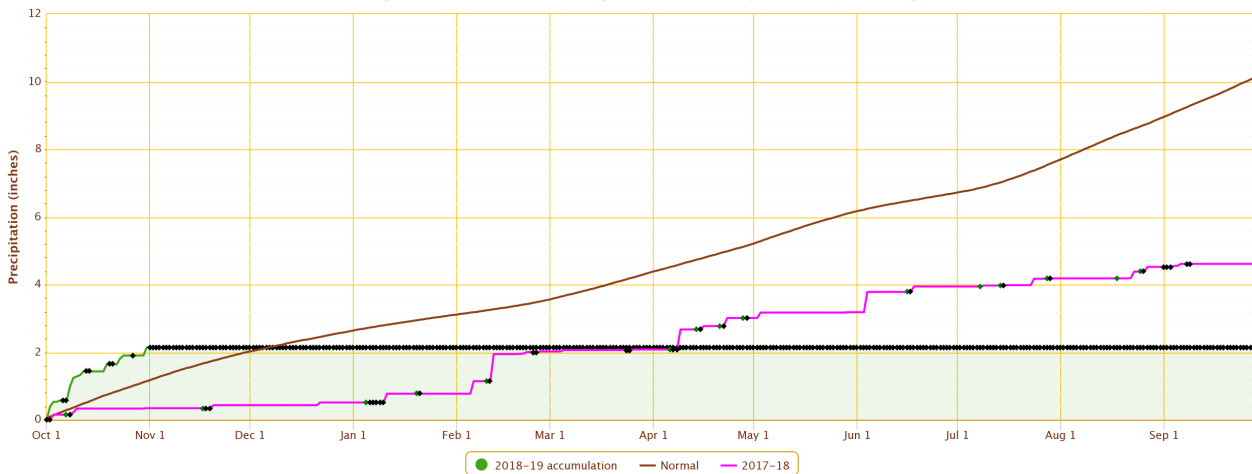


Powered by ACIS



Accumulated Precipitation – MONTROSE NO 2, CO

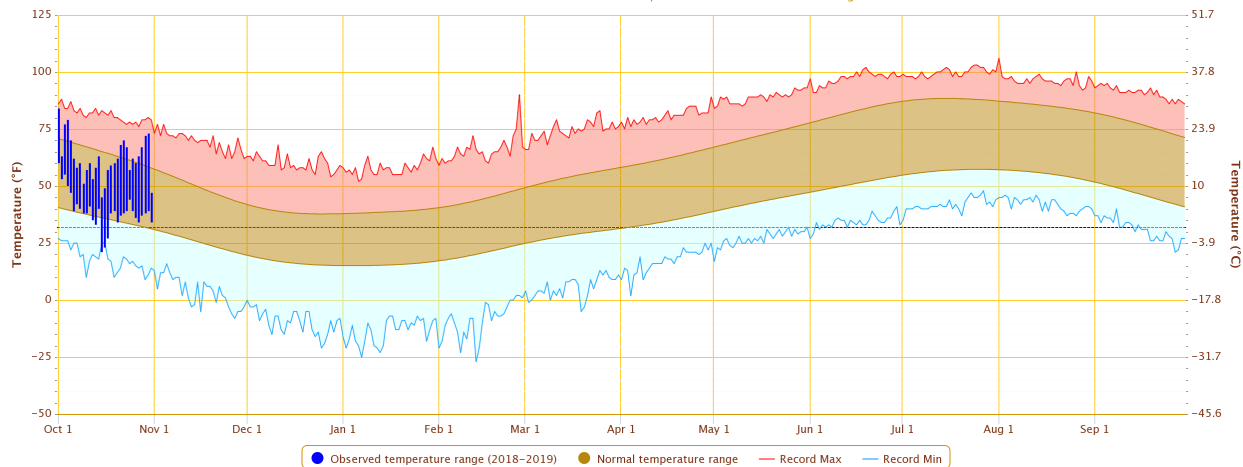
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Daily Temperature Data – MONTROSE NO 2, CO

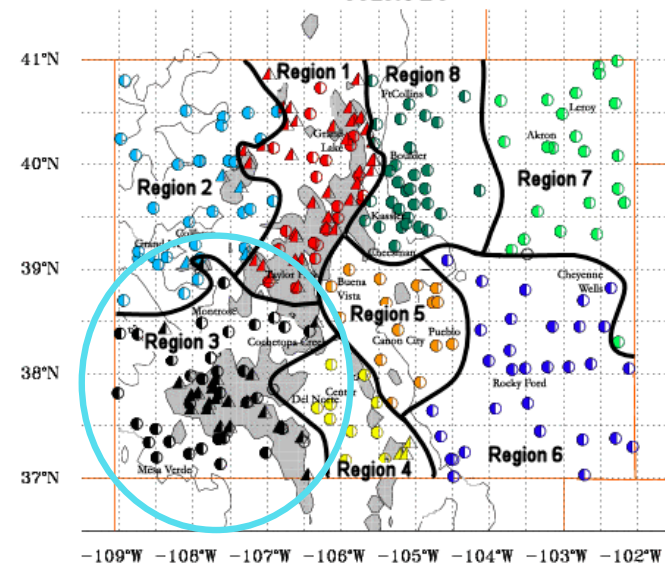
Period of Record – 1895-10-01 to 2018-10-31. Normals period: 1981-2010. Click and drag to zoom chart.

Powered by ACIS



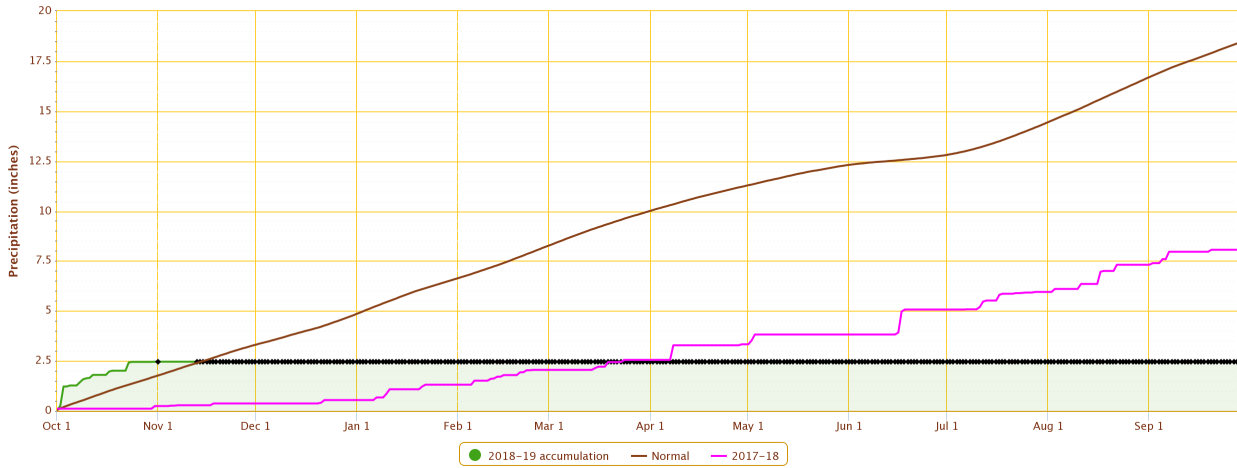
Powered by ACIS

COLORADO



Accumulated Precipitation – MESA VERDE NP, CO

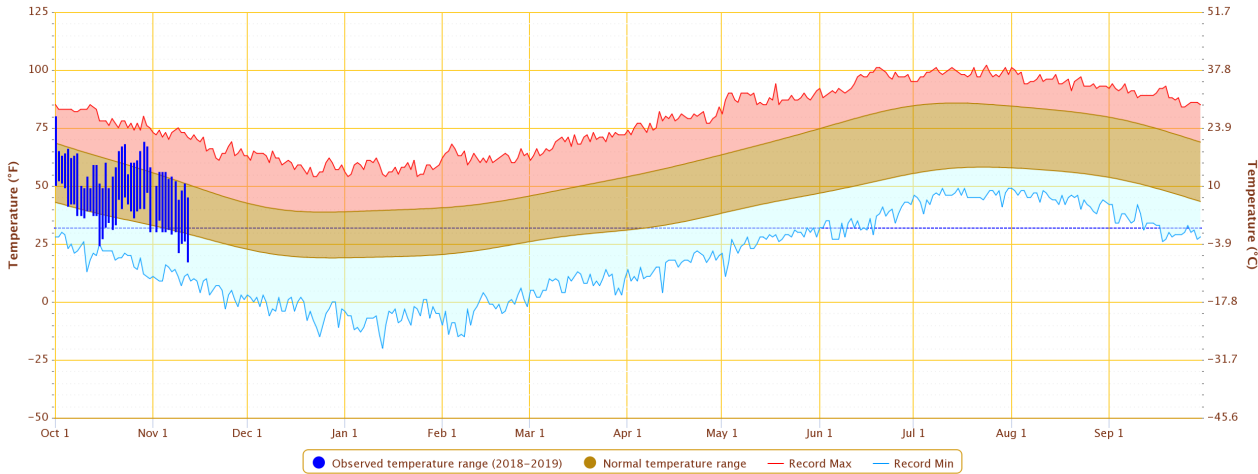
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

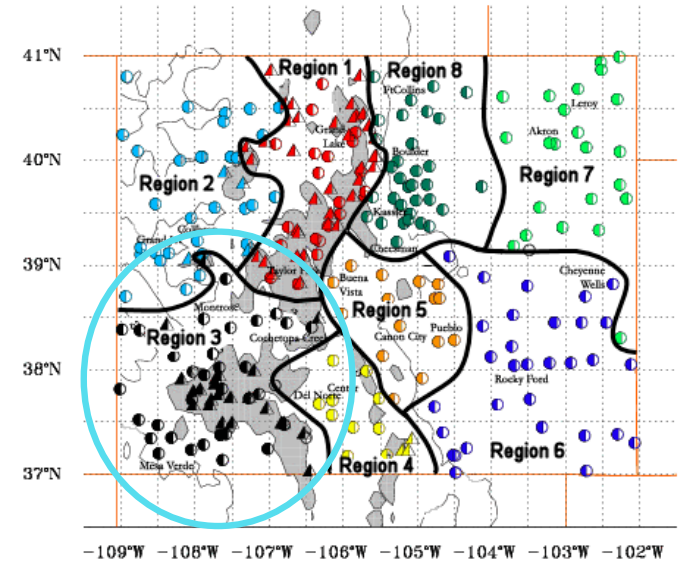
Daily Temperature Data – MESA VERDE NP, CO

Period of Record – 1922-02-16 to 2018-11-12. Normals period: 1981-2010. Click and drag to zoom chart.

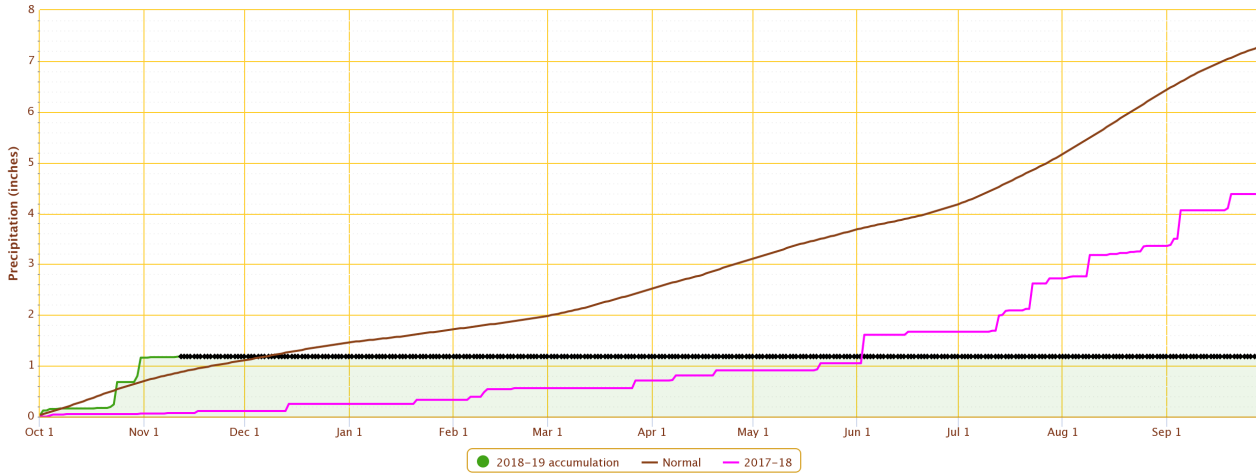


Powered by ACIS

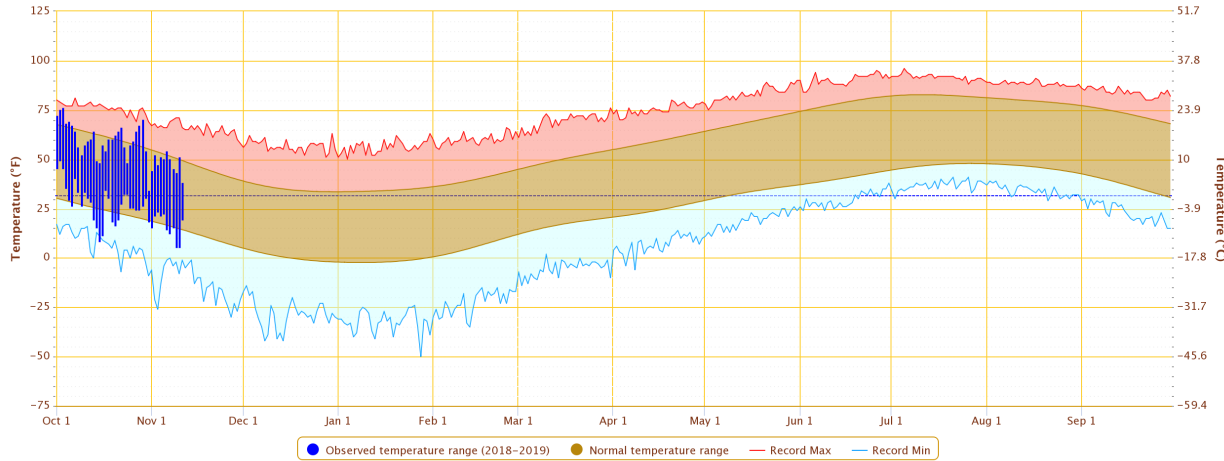
COLORADO



Accumulated Precipitation – ALAMOSA SAN LUIS VALLEY REGIONAL AP, CO
 Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



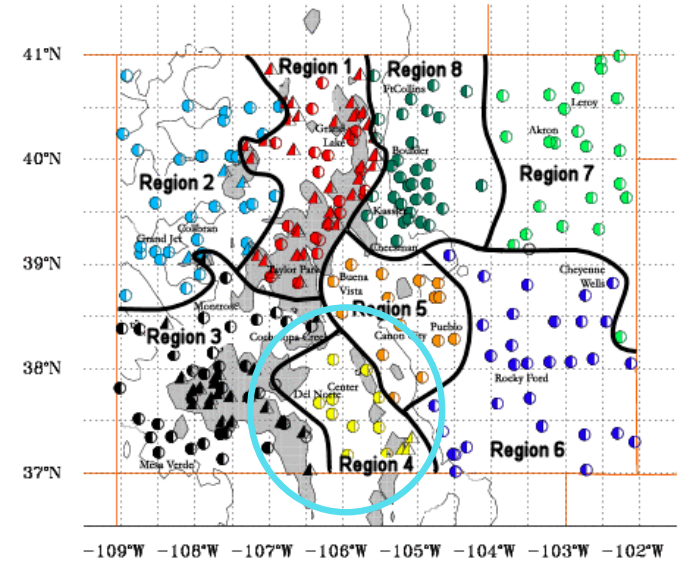
Daily Temperature Data – ALAMOSA SAN LUIS VALLEY REGIONAL AP, CO
 Period of Record - 1948-01-01 to 2018-11-11. Normals period: 1981-2010. Click and drag to zoom chart.



Powered by ACIS

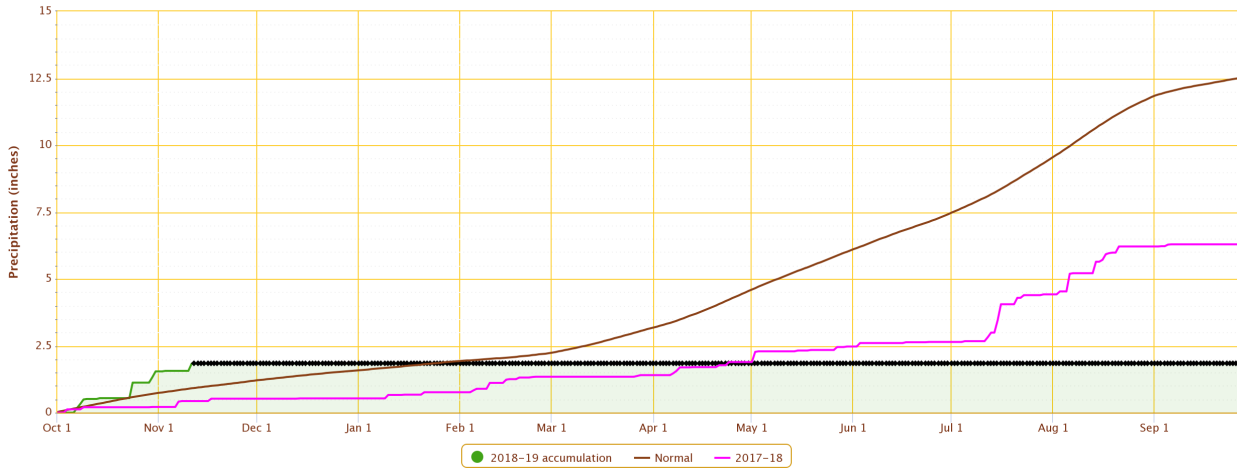
Powered by ACIS

COLORADO



Accumulated Precipitation – PUEBLO MEMORIAL AP, CO

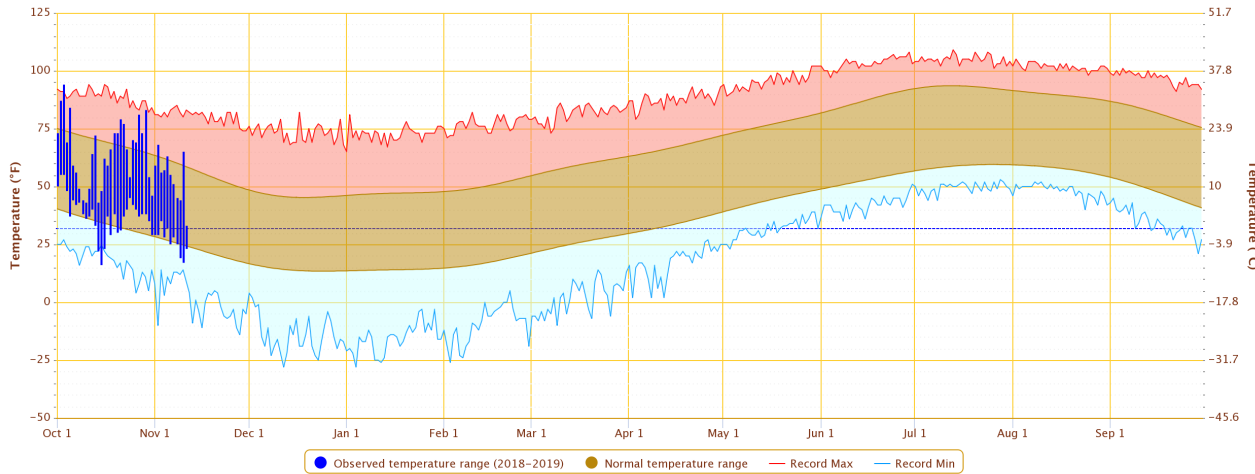
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Daily Temperature Data – PUEBLO MEMORIAL AP, CO

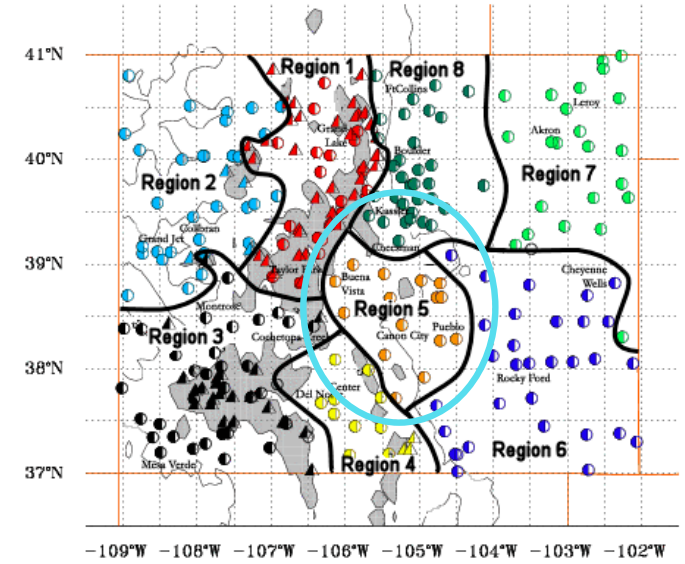
Period of Record – 1954-06-16 to 2018-11-11. Normals period: 1981-2010. Click and drag to zoom chart.

Powered by ACIS



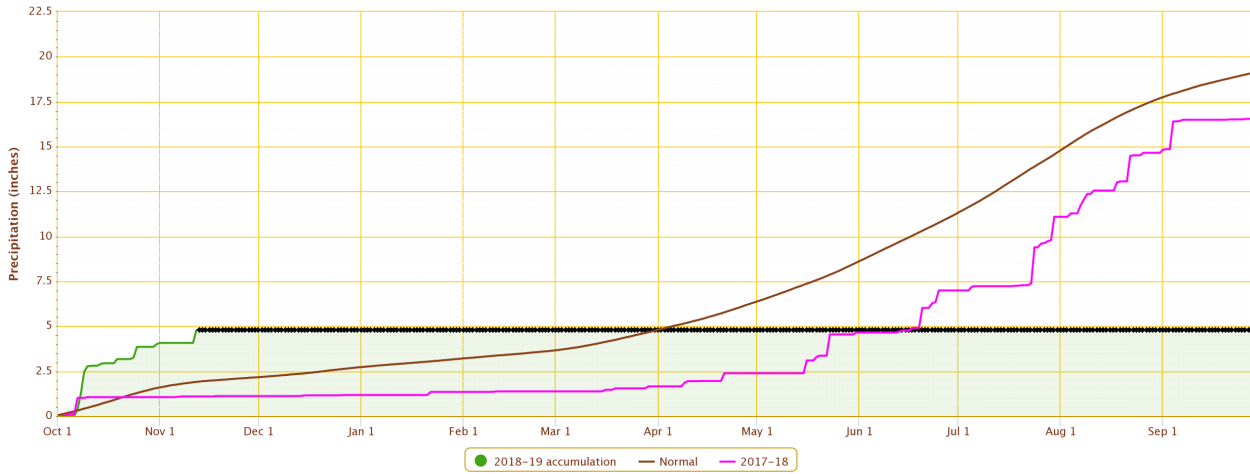
Powered by ACIS

COLORADO



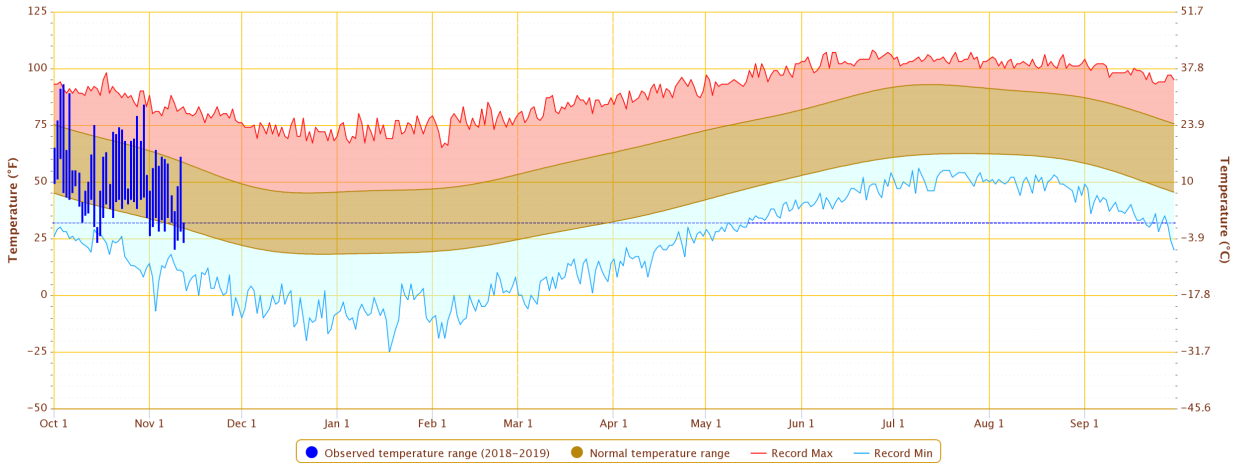
Accumulated Precipitation – WALSH 1 W, CO

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

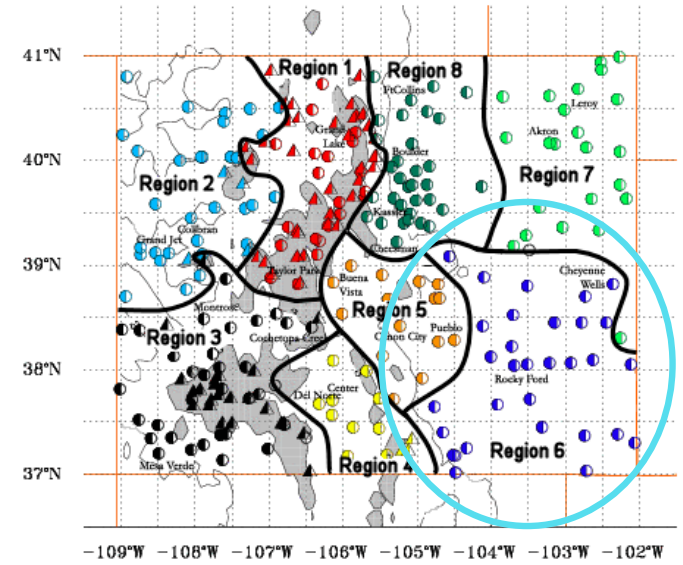


Daily Temperature Data – WALSH 1 W, CO

Period of Record – 1967-09-01 to 2018-11-12. Normals period: 1981-2010. Click and drag to zoom chart.



COLORADO



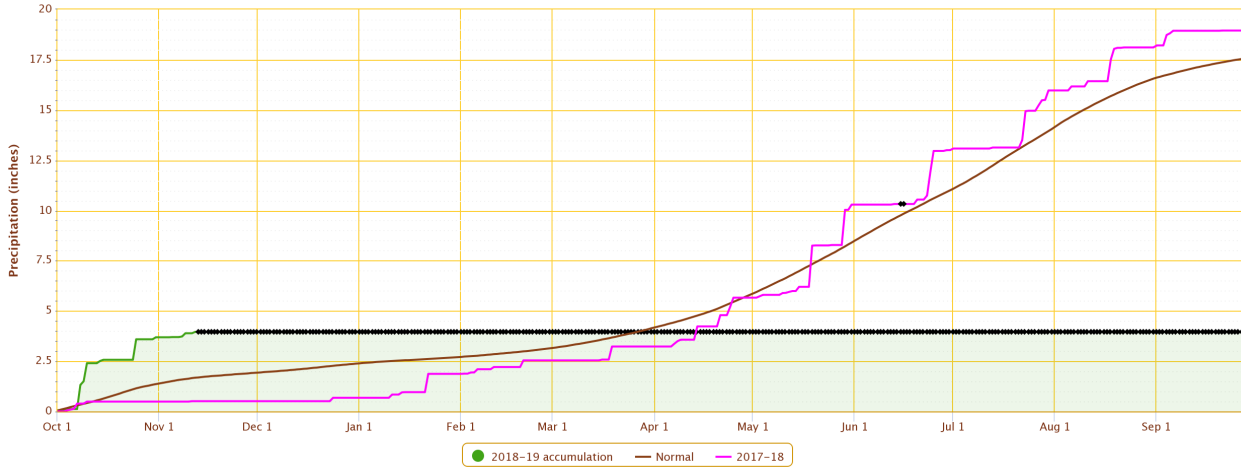
Powered by ACIS

Powered by ACIS



Accumulated Precipitation – BURLINGTON, CO

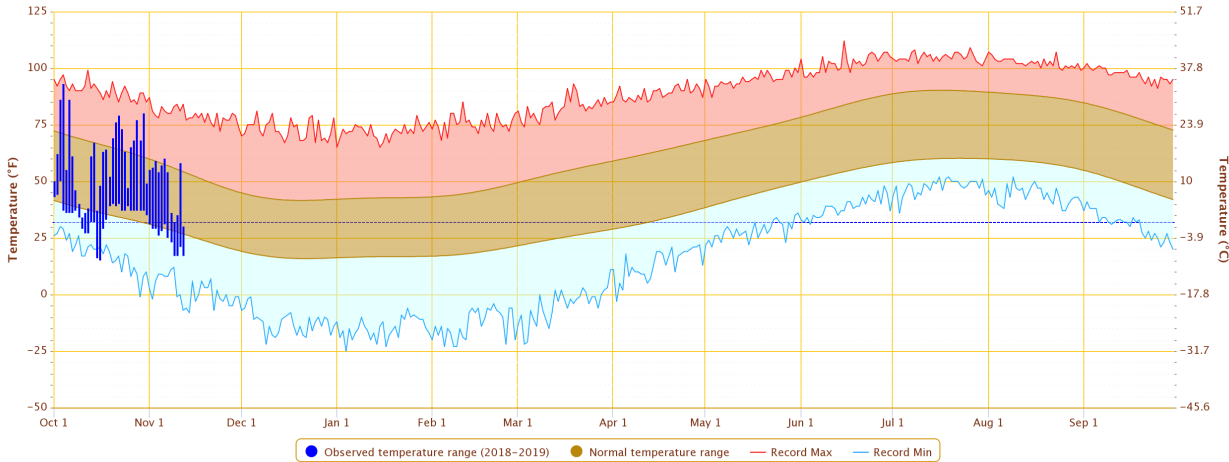
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Daily Temperature Data – BURLINGTON, CO

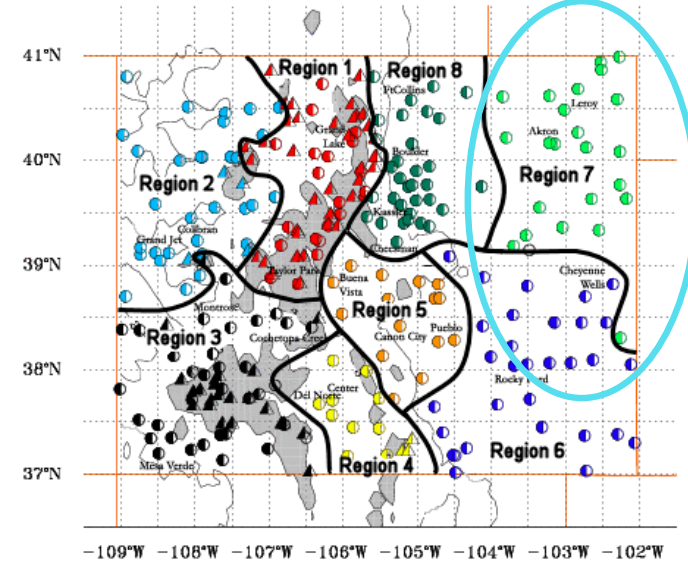
Period of Record – 1903-12-01 to 2018-11-12. Normals period: 1981-2010. Click and drag to zoom chart.

Powered by ACIS



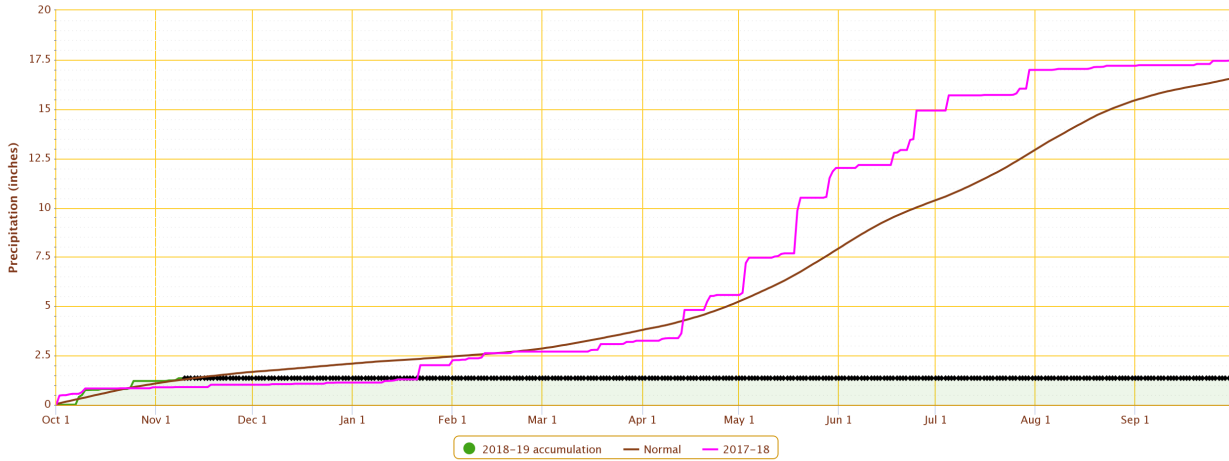
Powered by ACIS

COLORADO



Accumulated Precipitation – AKRON 4 E, CO

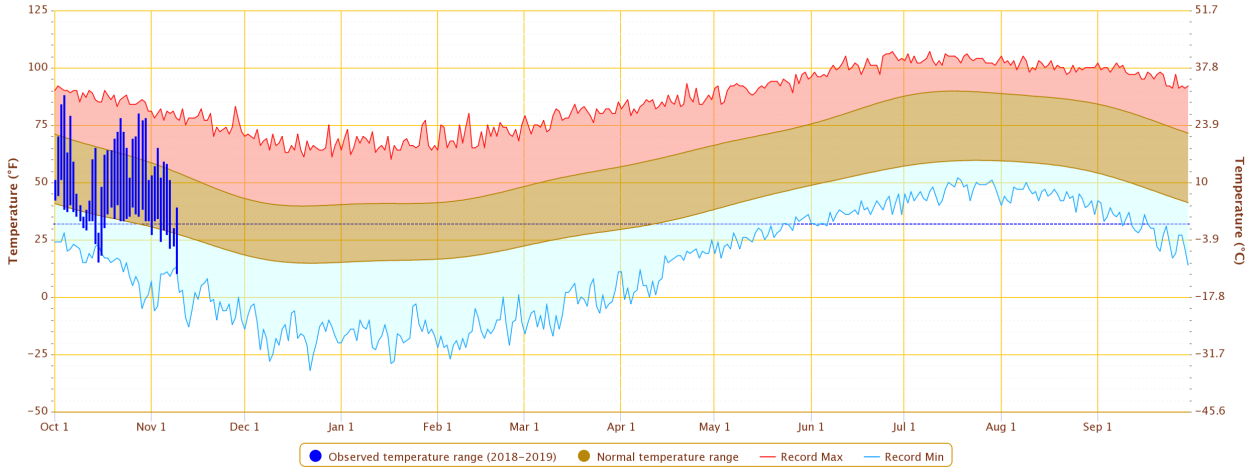
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



Powered by ACIS

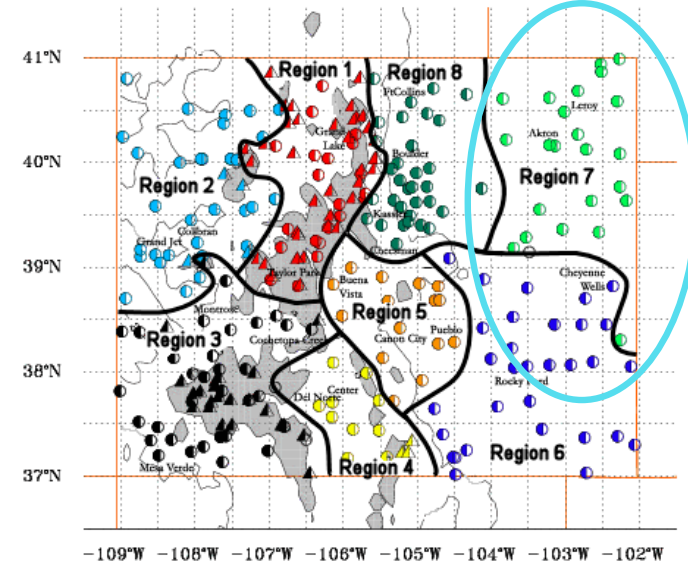
Daily Temperature Data – AKRON 4 E, CO

Period of Record – 1893-06-01 to 2018-11-09. Normals period: 1981-2010. Click and drag to zoom chart.



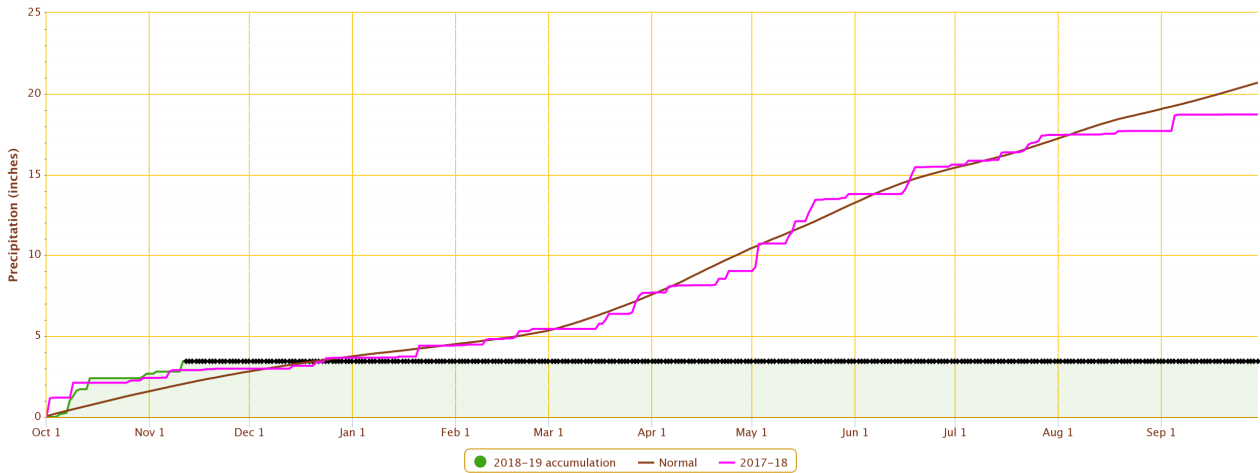
Powered by ACIS

COLORADO



Accumulated Precipitation – BOULDER, CO

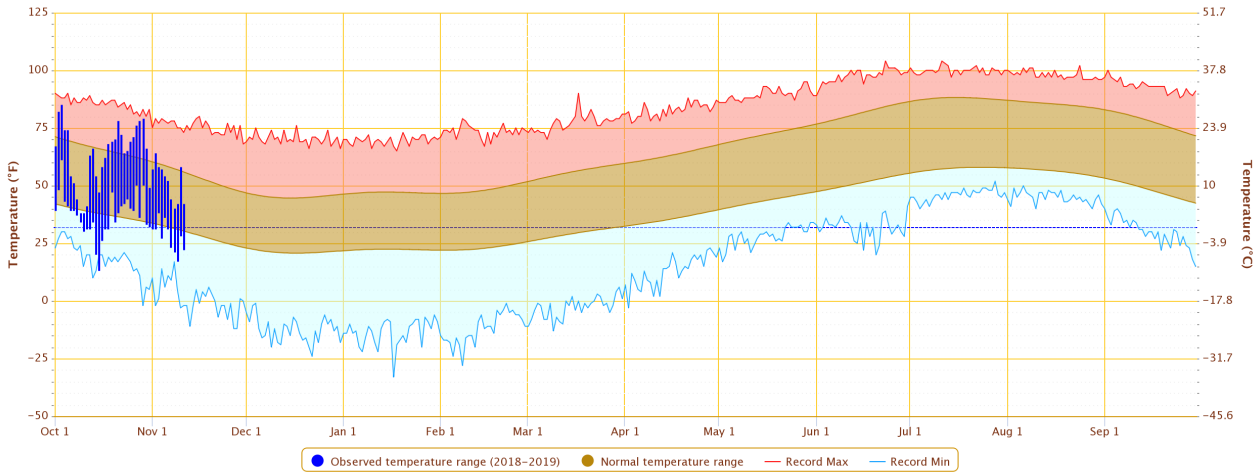
Click and drag to zoom to a shorter time interval; green/black diamonds represent subsequent/missing values



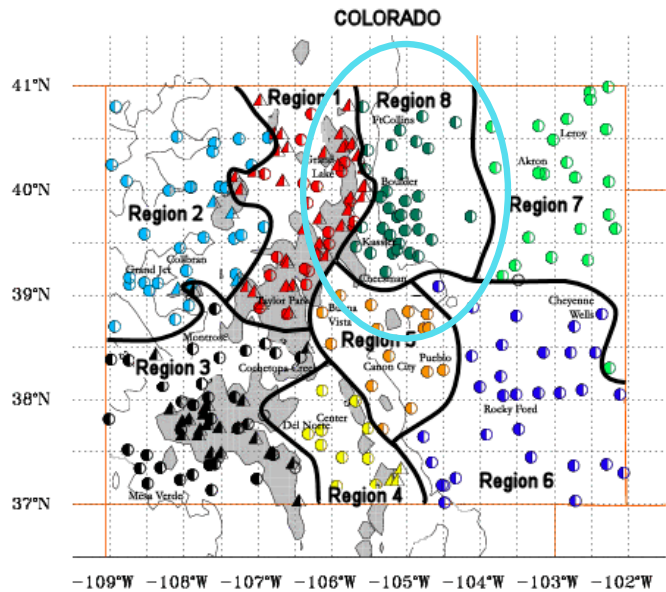
Powered by ACIS

Daily Temperature Data – BOULDER, CO

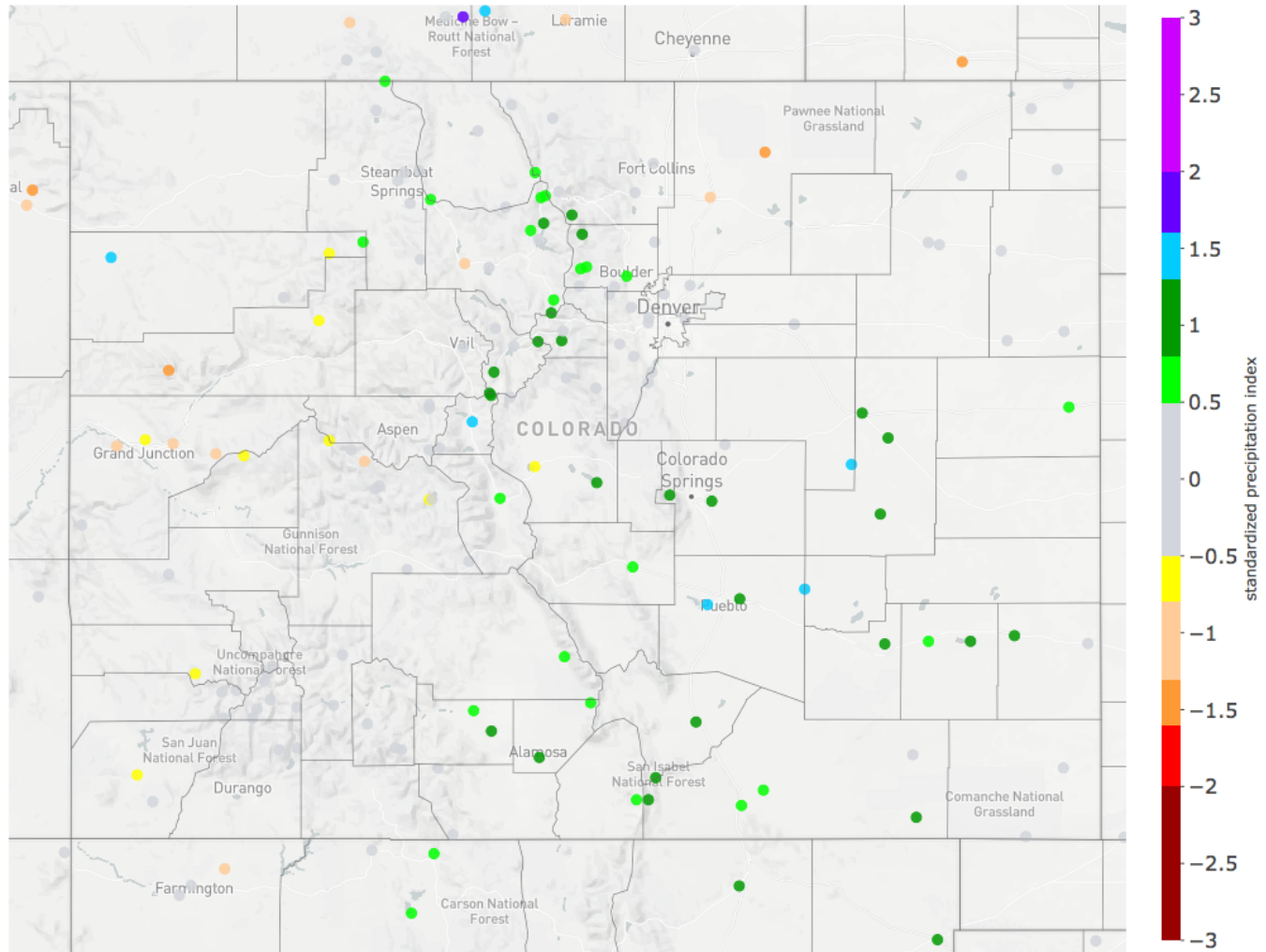
Period of Record – 1893-10-01 to 2018-11-11. Normals period: 1981-2010. Click and drag to zoom chart.



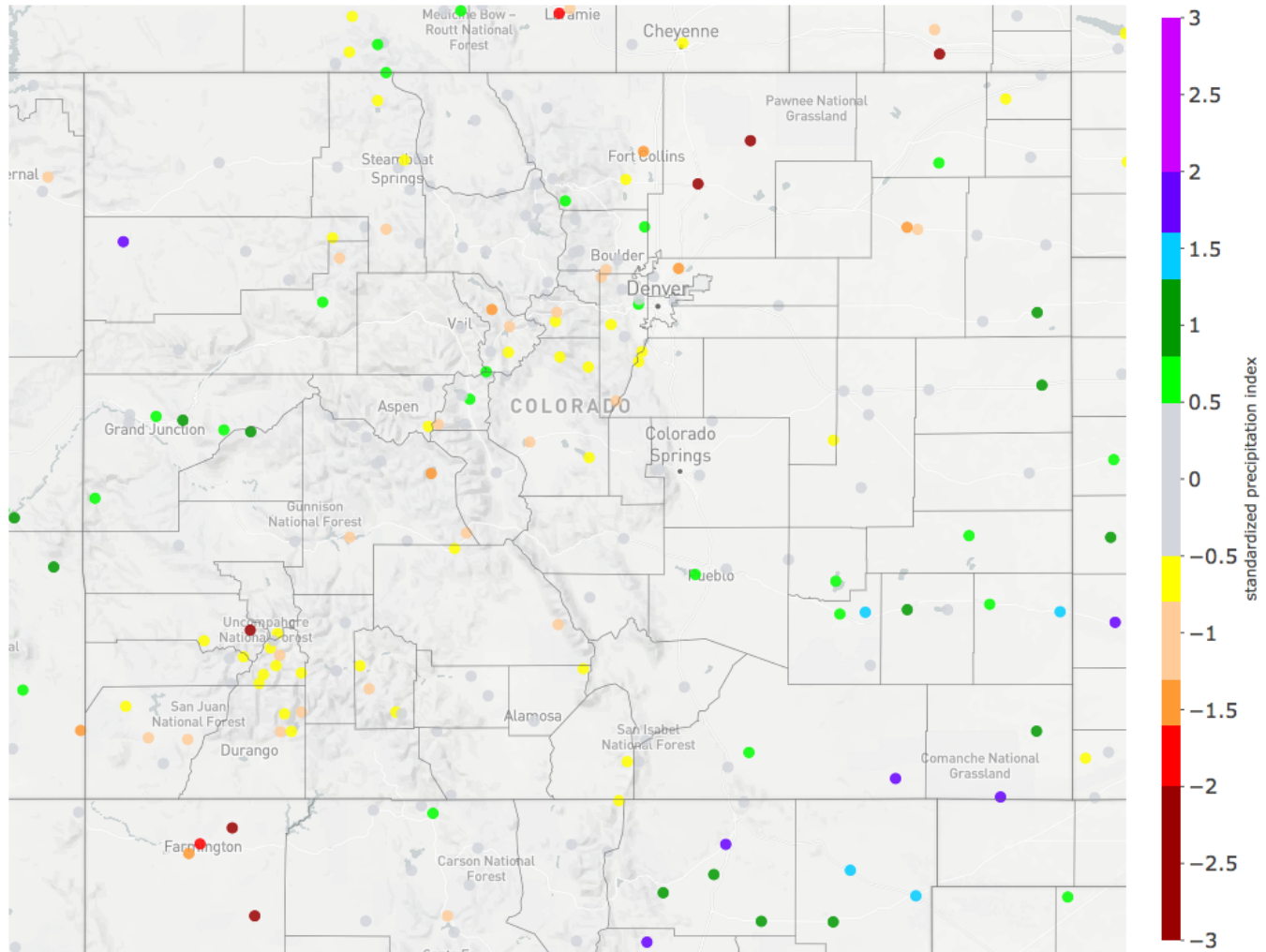
Powered by ACIS



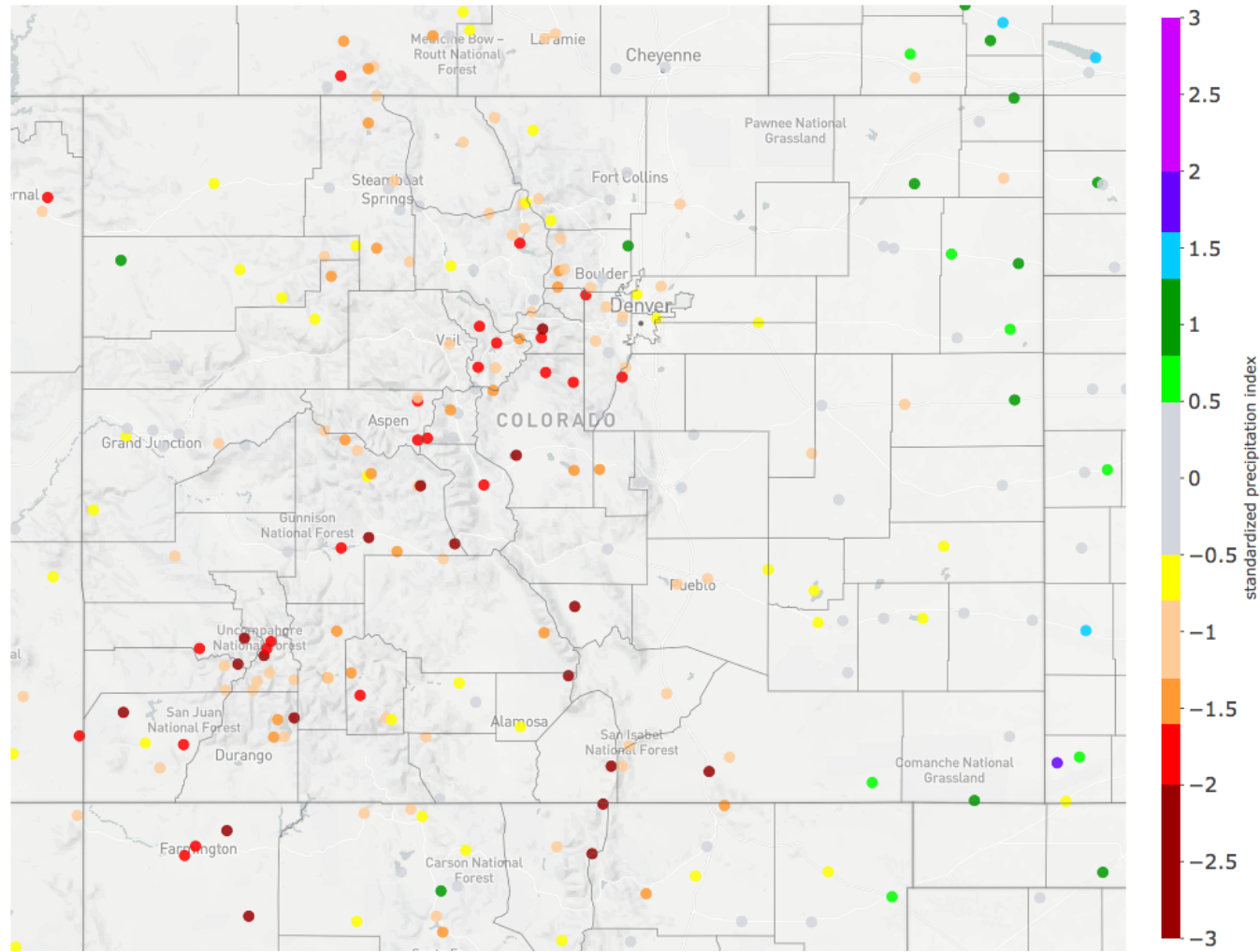
30-day Standardized Precipitation Index: 10/13/2018 - 11/11/2018



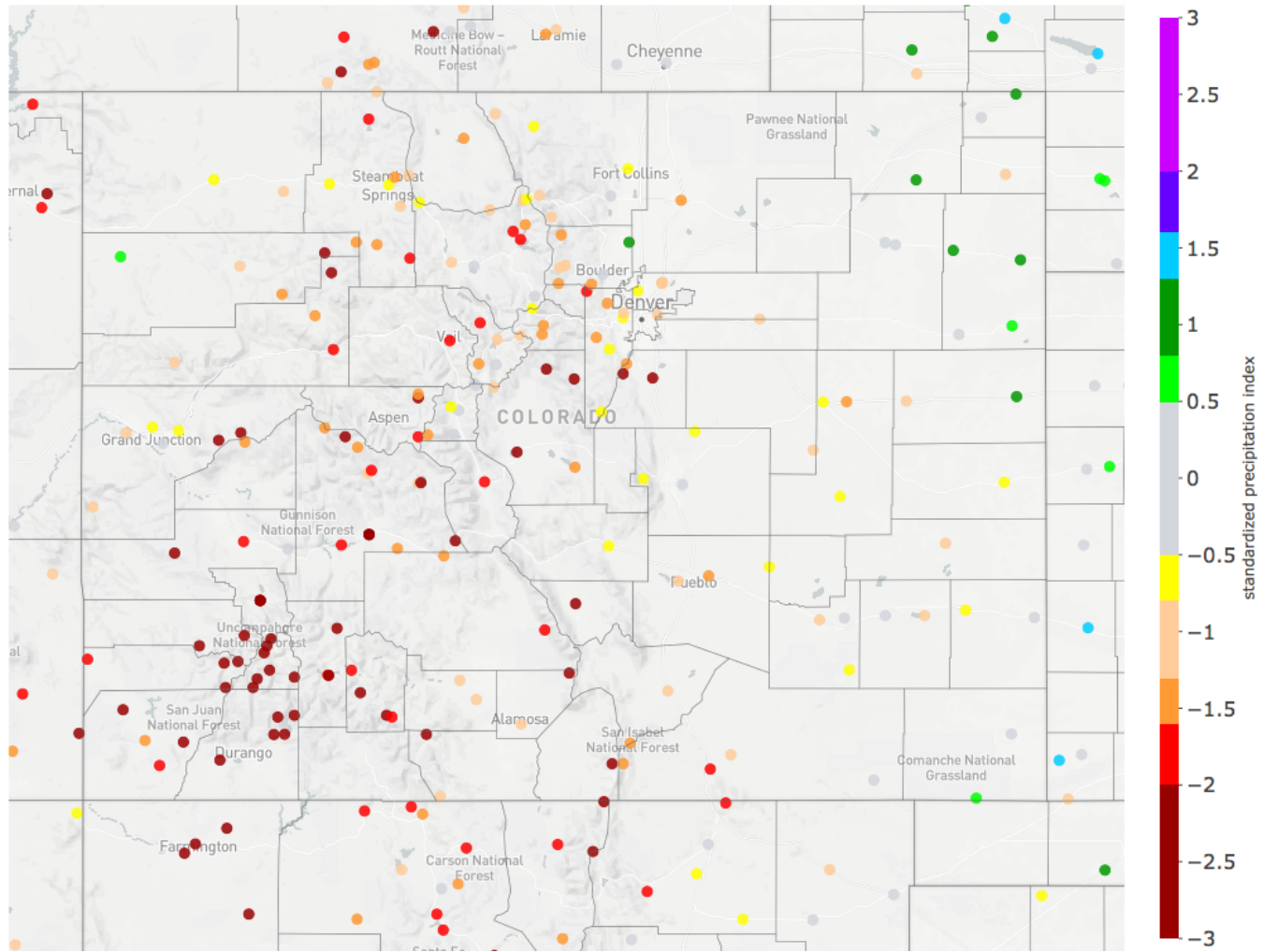
90-day Standardized Precipitation Index: 8/14/2018 - 11/11/2018



9-month Standardized Precipitation Index: 2/12/2018 - 11/11/2018

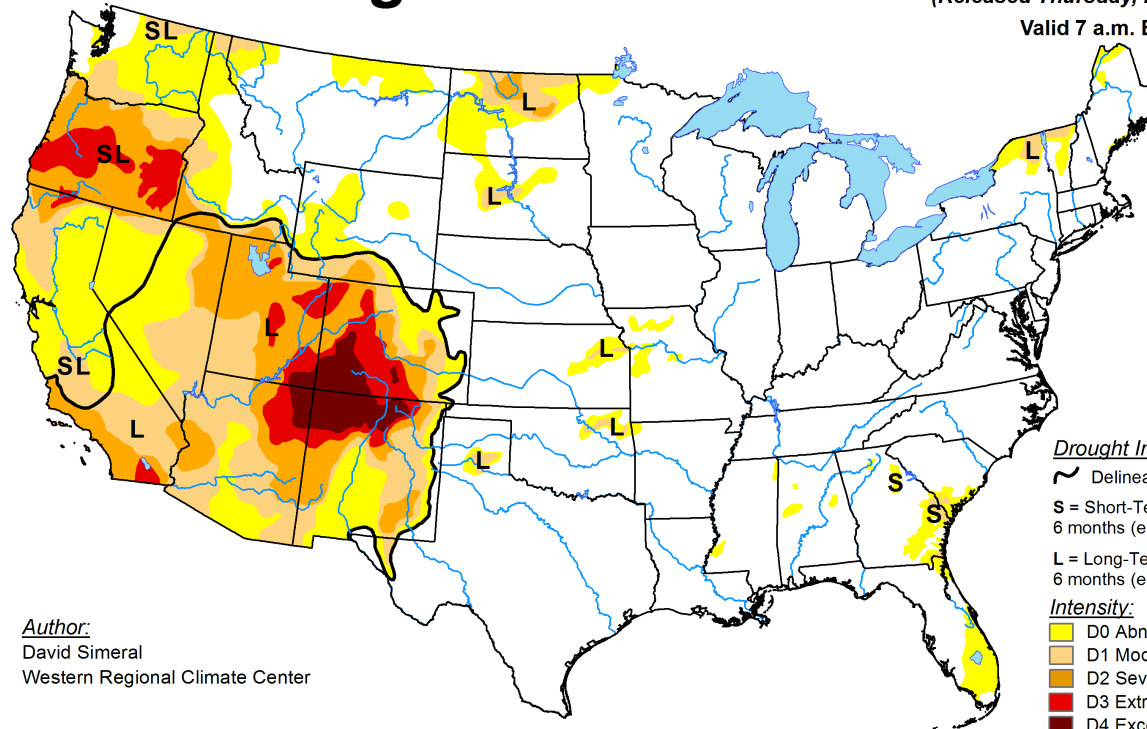


12-month Standardized Precipitation Index: 11/12/2017 - 11/11/2018



U.S. Drought Monitor

November 6, 2018
 (Released Thursday, Nov. 8, 2018)
 Valid 7 a.m. EST



Author:
 David Simeral
 Western Regional Climate Center

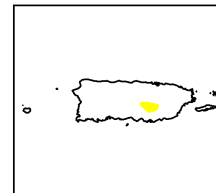
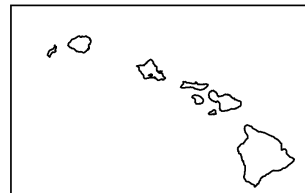
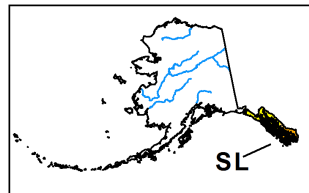
Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Colorado

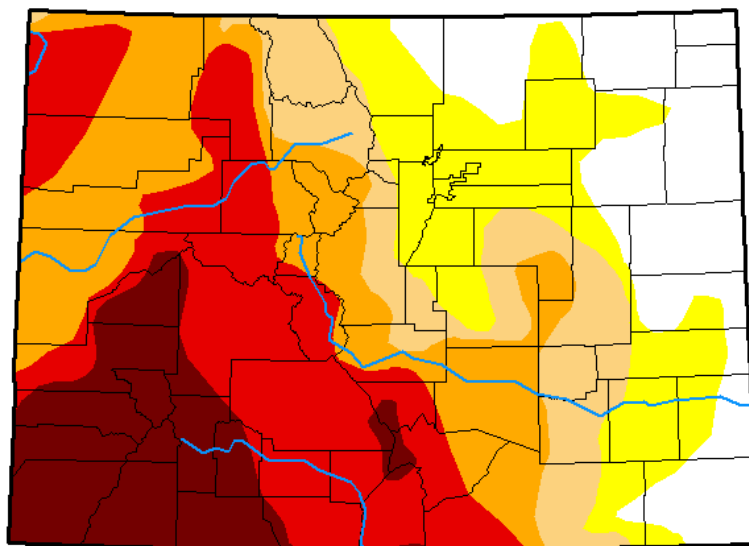
November 6, 2018

(Released Thursday, Nov. 8, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	16.64	83.36	66.80	54.82	35.19	13.37
Last Week 10-30-2018	16.64	83.36	66.80	57.07	37.48	13.64
3 Months Ago 08-07-2018	18.20	81.80	75.86	64.65	35.10	8.50
Start of Calendar Year 01-02-2018	6.57	93.43	33.53	7.27	0.00	0.00
Start of Water Year 09-25-2018	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago 11-07-2017	71.26	28.74	1.22	0.00	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

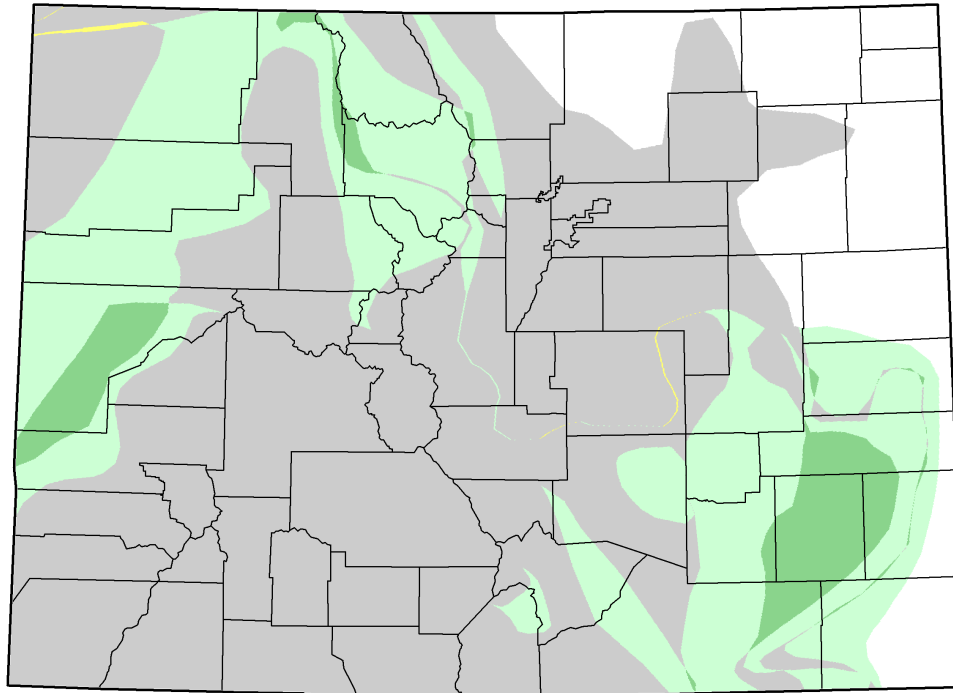
David Simeral
Western Regional Climate Center



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Class Change - Colorado Start of Water Year



- 5 Class Degradation
- 4 Class Degradation
- 3 Class Degradation
- 2 Class Degradation
- 1 Class Degradation
- No Change
- 1 Class Improvement
- 2 Class Improvement
- 3 Class Improvement
- 4 Class Improvement
- 5 Class Improvement

November 6, 2018
compared to
September 25, 2018

<http://droughtmonitor.unl.edu>



Winter Outlook

What does El Niño mean?

CPC Outlooks

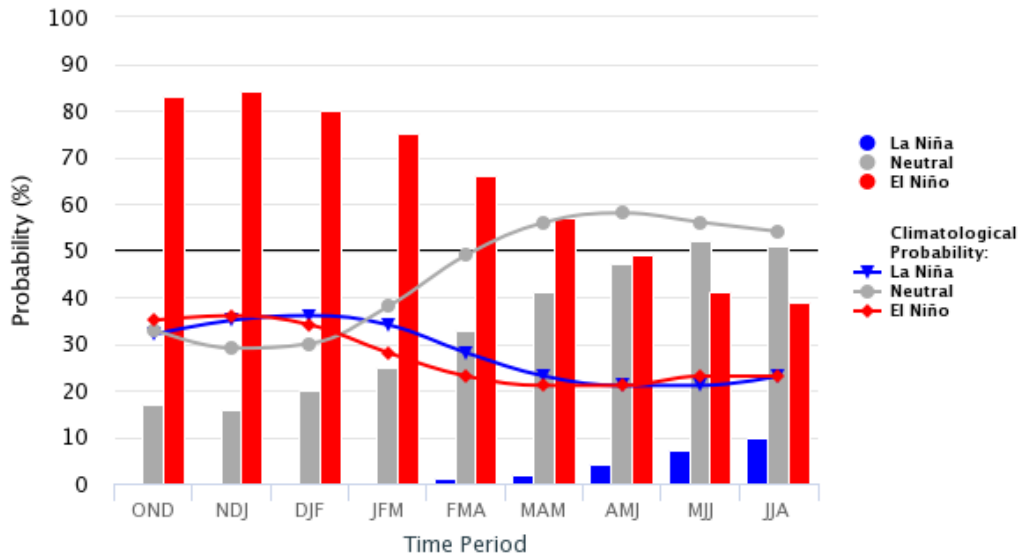
Is a wet October important?



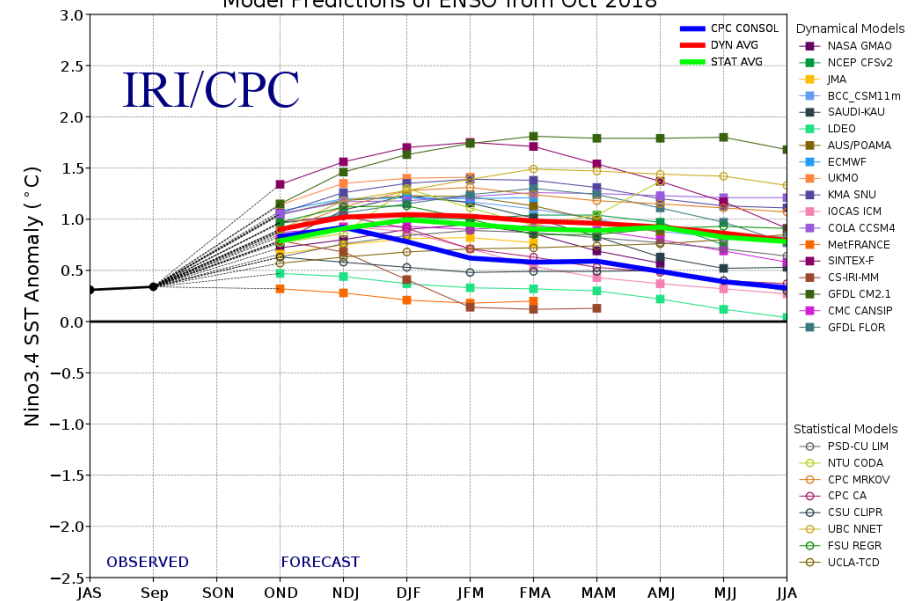
What's the El Niño forecast?

Early-Nov CPC/IRI Official Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly
Neutral ENSO: $-0.5\text{ }^{\circ}\text{C}$ to $0.5\text{ }^{\circ}\text{C}$



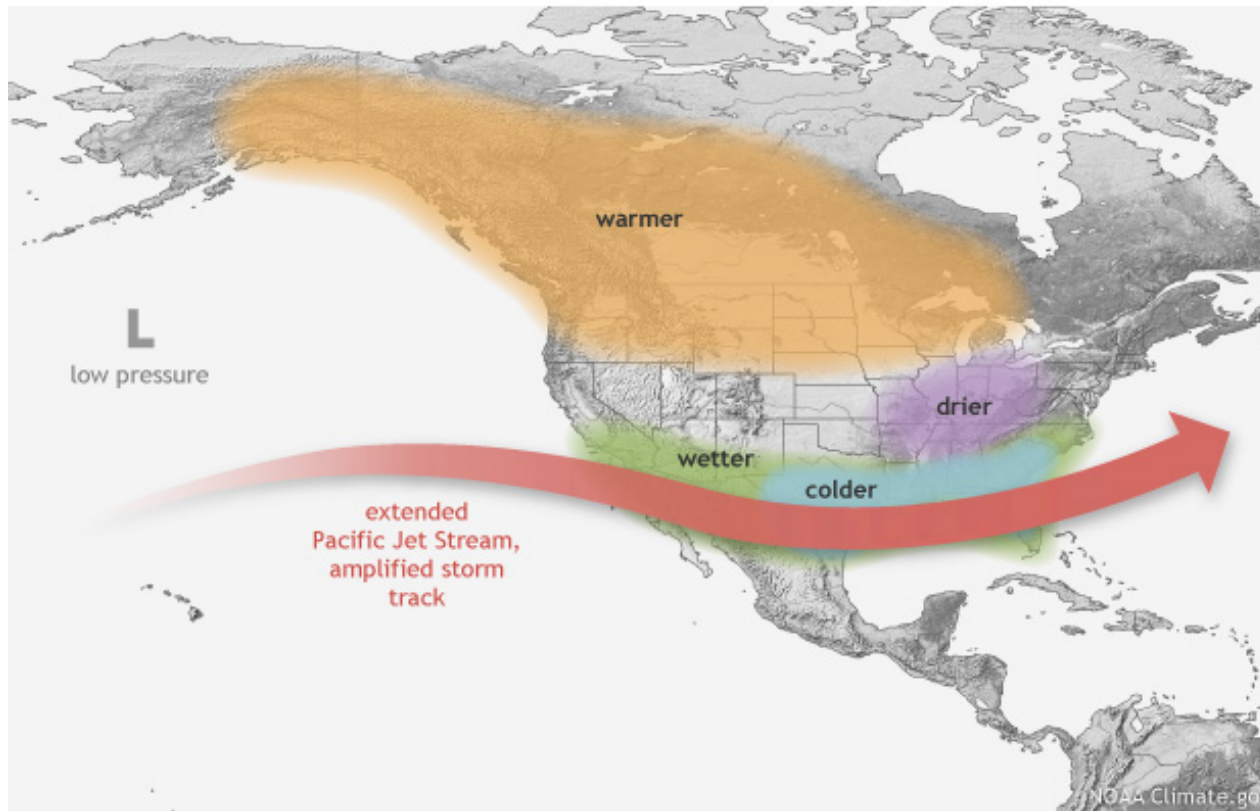
Model Predictions of ENSO from Oct 2018



An El Niño Watch is in effect...



WINTER EL NIÑO PATTERN



Warmer to the north

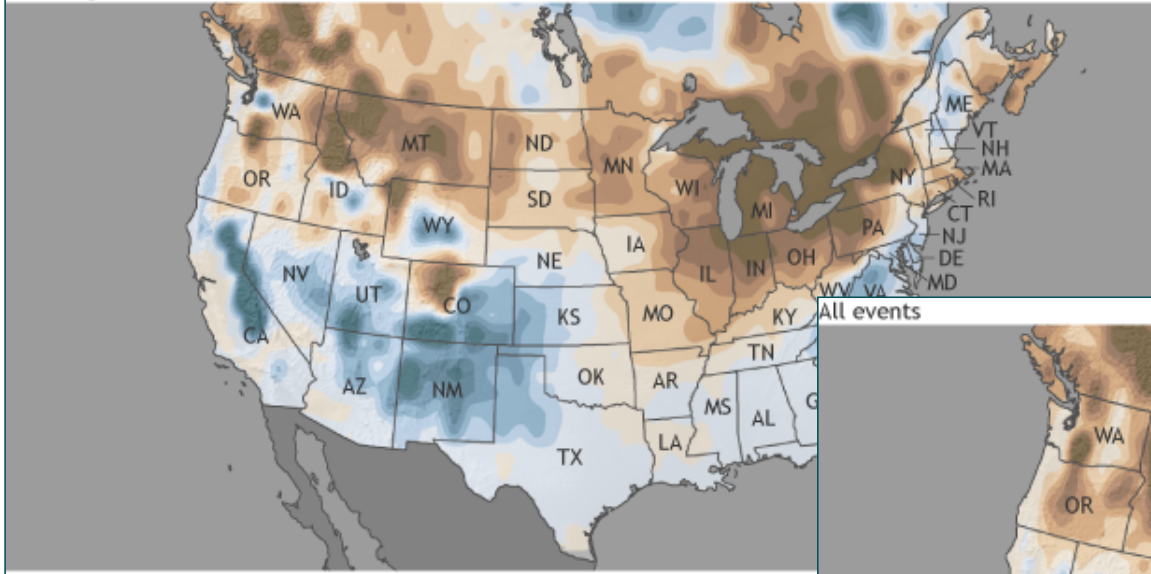
More likely to be dry to the north

More likely to be wet to the south

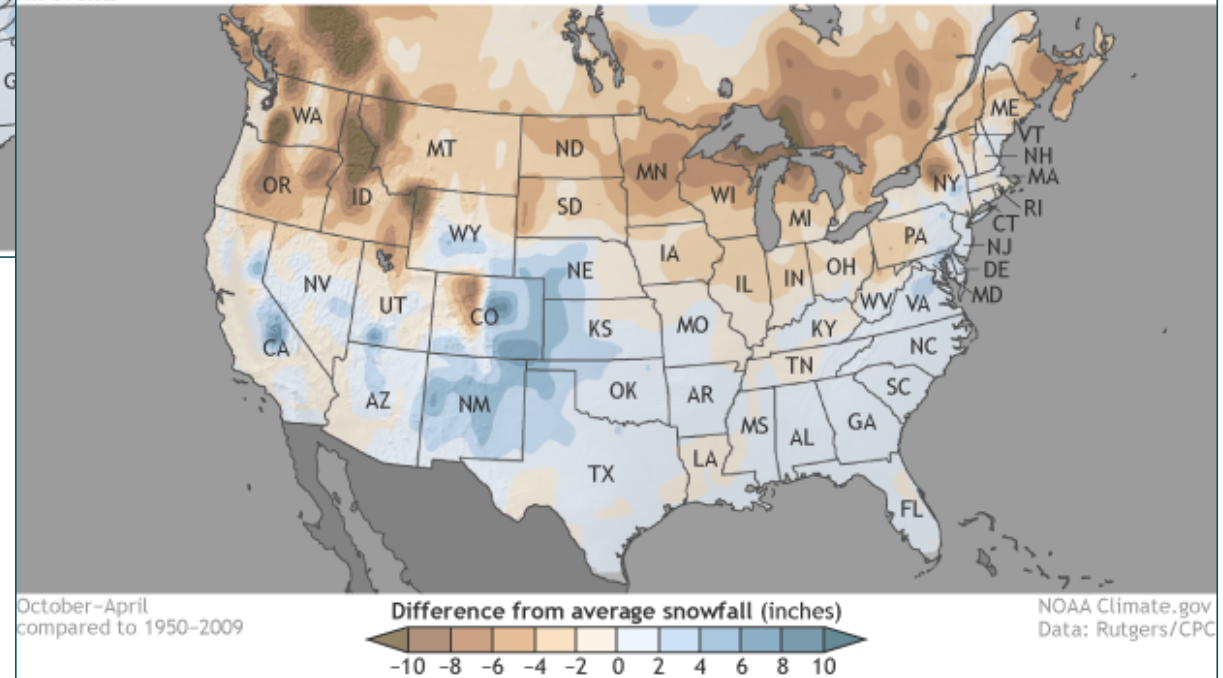
from climate.gov



Snow during El Niño winters (1950-2009)
10 strongest events



All events



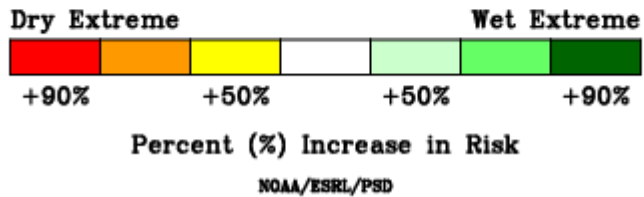
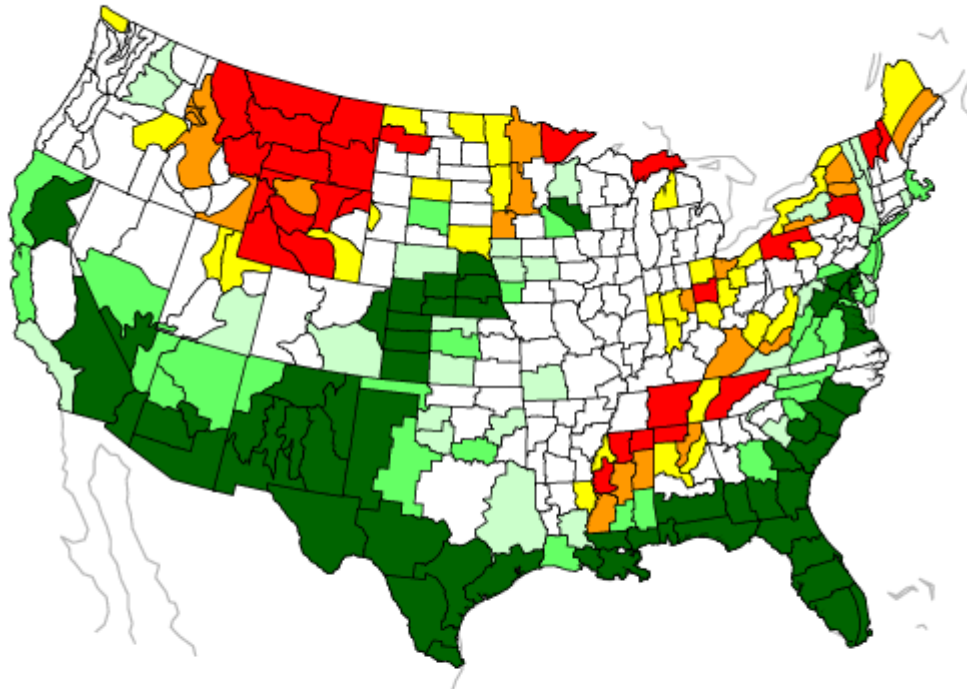
from climate.gov



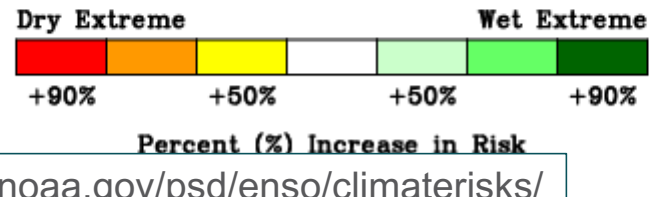
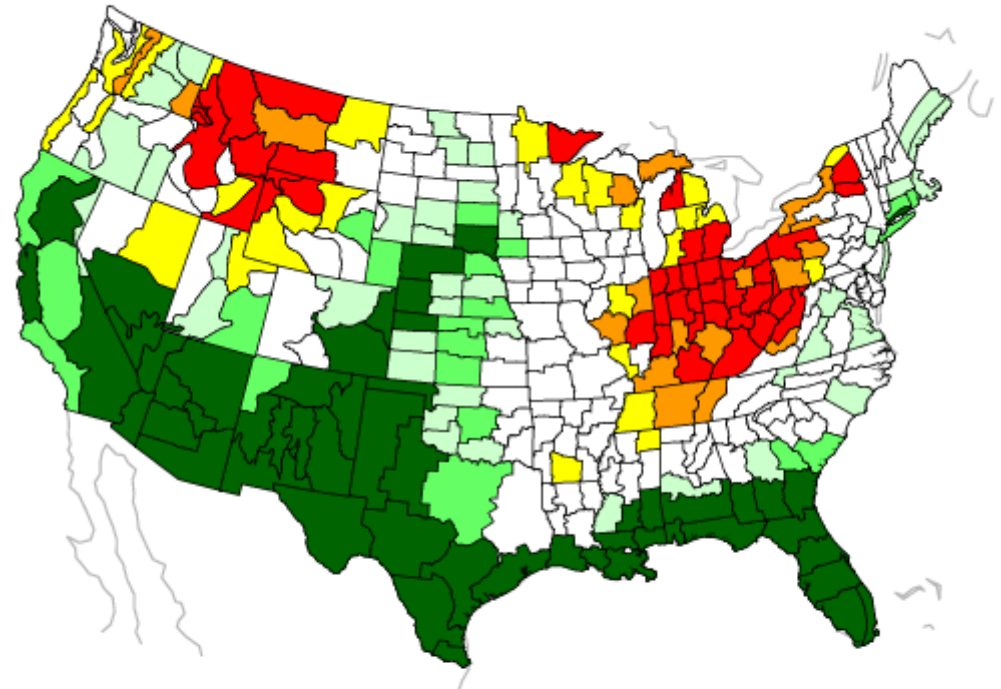
COLORADO CLIMATE CENTER



DJF Precipitation During El Nino
Increased Risk of Wet or Dry Extremes



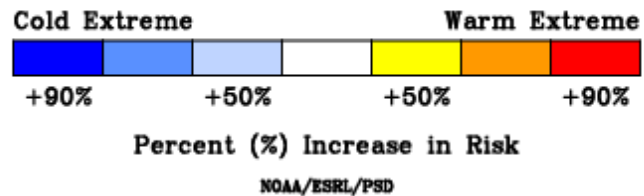
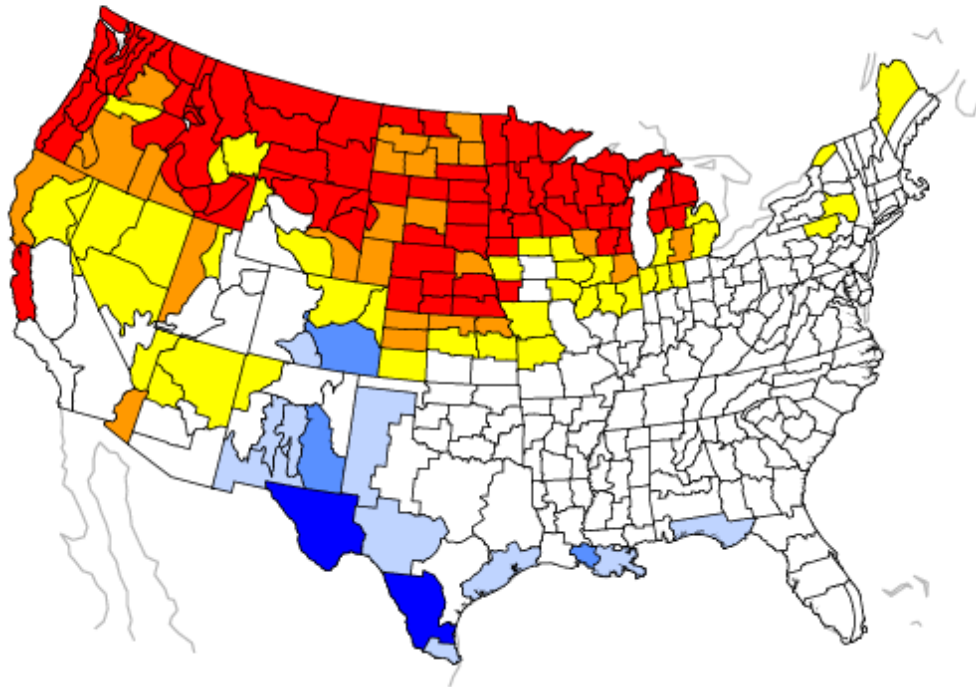
JFM Precipitation During El Nino
Increased Risk of Wet or Dry Extremes



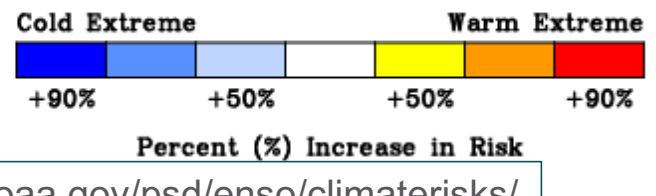
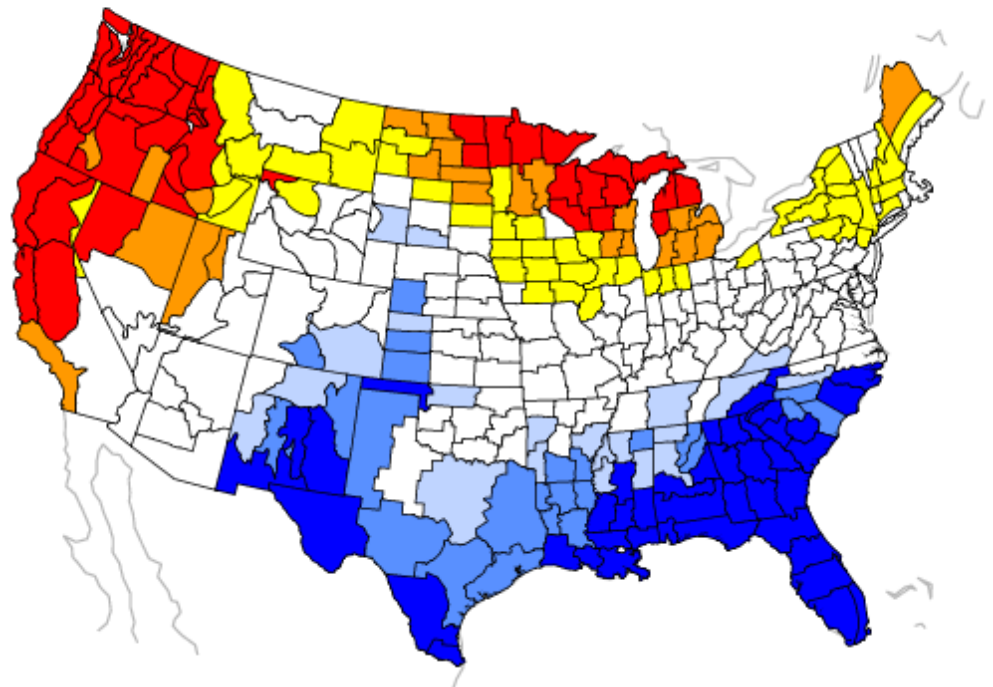
<https://www.esrl.noaa.gov/psd/enso/climaterisks/>



DJF Temperature During El Nino
Increased Risk of Warm or Cold Extremes

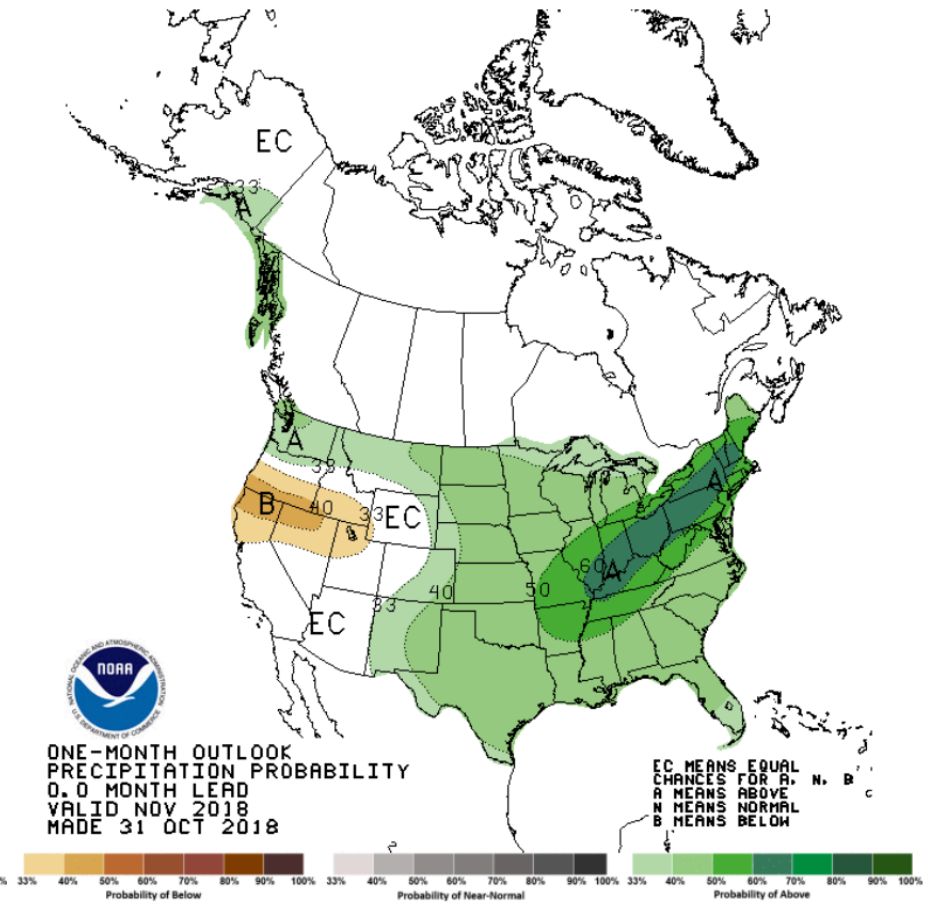
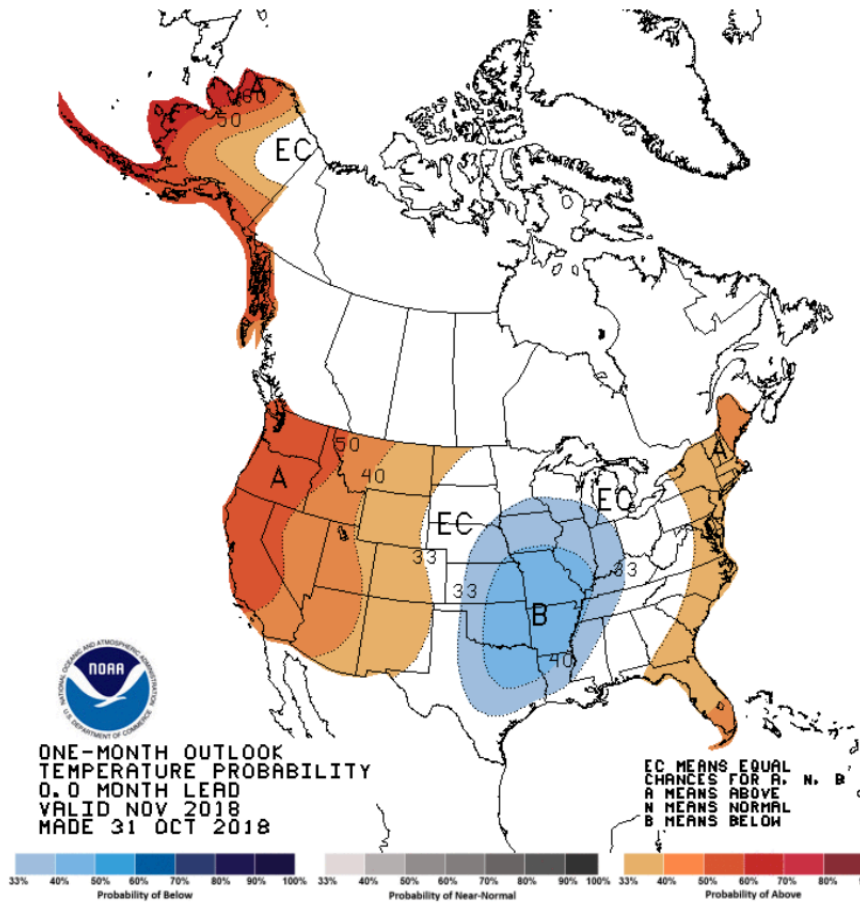


JFM Temperature During El Nino
Increased Risk of Warm or Cold Extremes

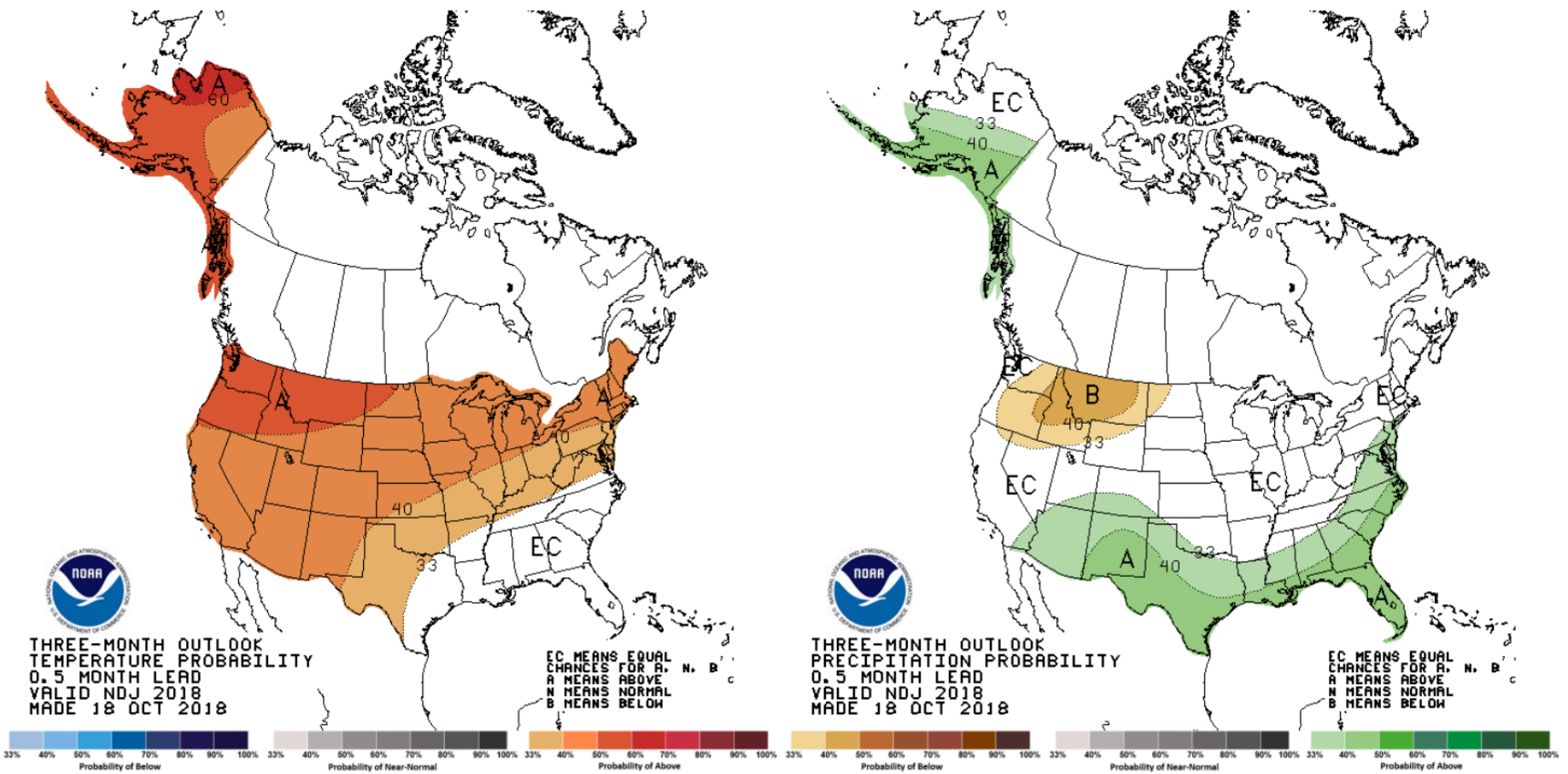


<https://www.esrl.noaa.gov/psd/enso/climaterisks/>

One Month Outlook



Nov-Dec-Jan Outlook



CPC and Model Outlooks...

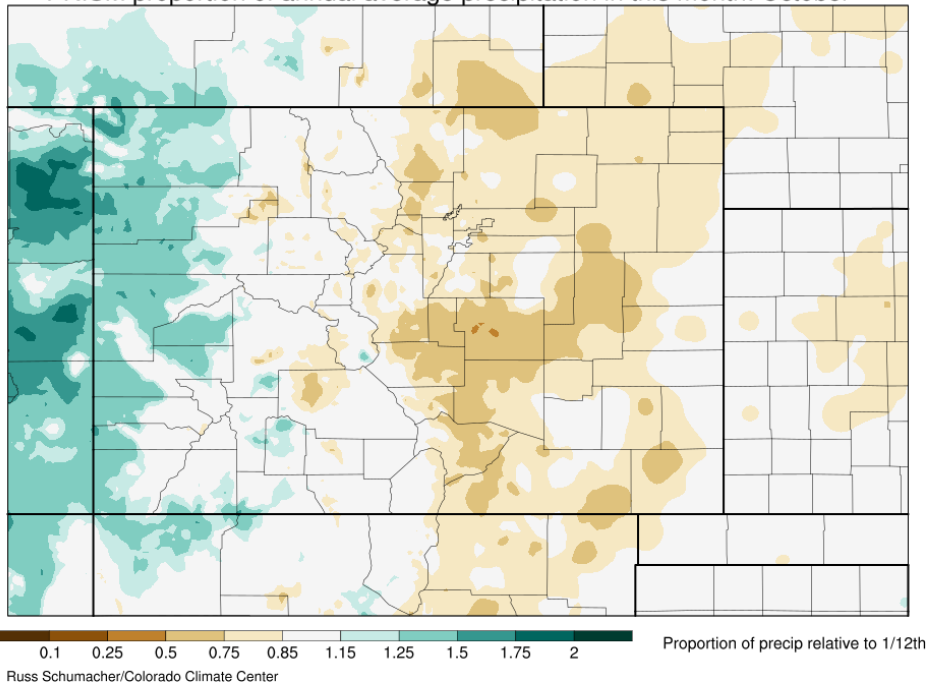
- ✓ Warmer than average temperatures are likely to be dominant for fall, winter, and into spring
- ✓ CPC seasonal outlook shows classic El Niño signature:
 - ✓ Increased probability of wetter than average conditions in the southern part of the state
 - ✓ Increased probability of drier than average conditions to the north, but could possibly make its way into northern CO
- ✓ North American Multi-Model Ensemble is showing some confidence in a wet spring for the entire state
- ✓ Stay tuned for adjustments in January – if the forecast holds then, that'll be a very good sign

Key Takeaway El Niño Points...

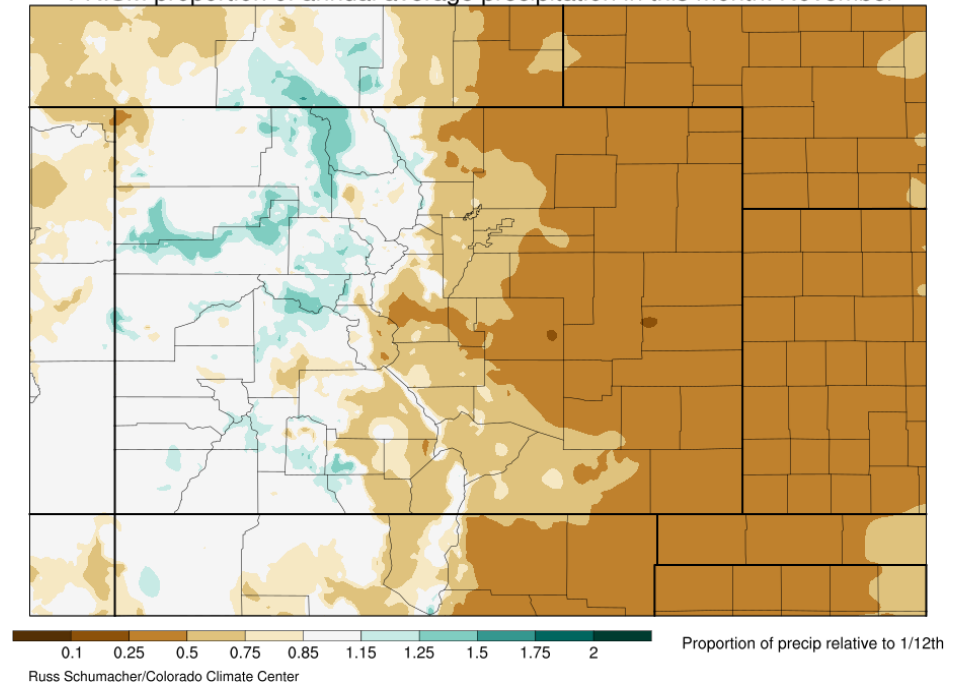
- ✓ Expect a weak-to-moderate El Niño event within the next month
- ✓ Not always clear what that will mean for Colorado....
 - ✓ but more common to see warmer conditions to the north
 - ✓ and more common to see wetter conditions to the south
- ✓ Northern Colorado mountains don't fare as well for snowfall
- ✓ Eastern plains tend to see more snow
- ✓ Generally an increased risk of wet extremes to the south and an increased risk of dry extremes to the north
 - ✓ This is good news for drought relief around the Four Corners
 - ✓ This is bad news for the more recently parched Yampa basin
- ✓ Despite temperature signals, expect to see warmer than average winter

Is a wet start to WY2019 significant?

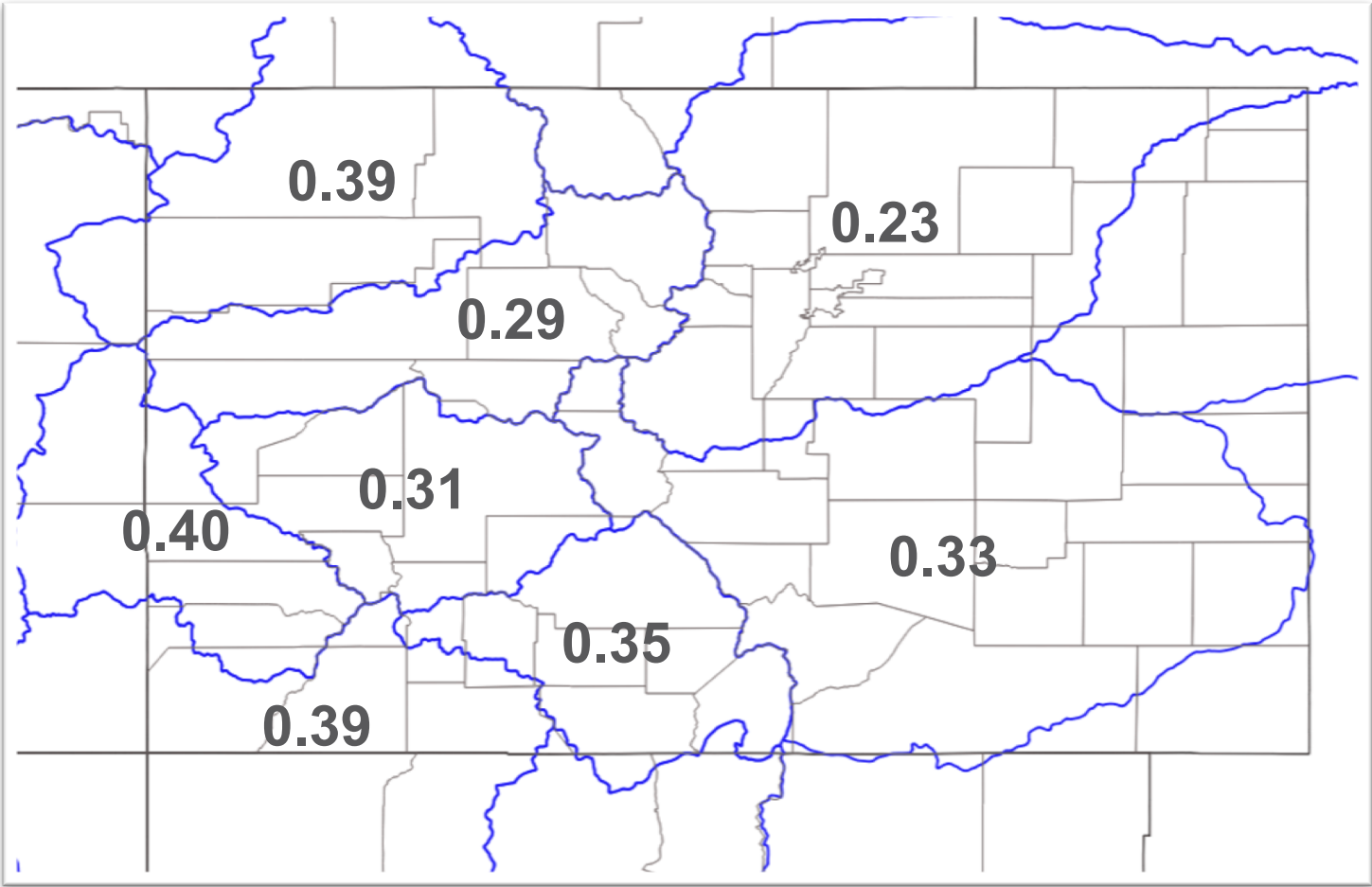
PRISM proportion of annual average precipitation in this month: October



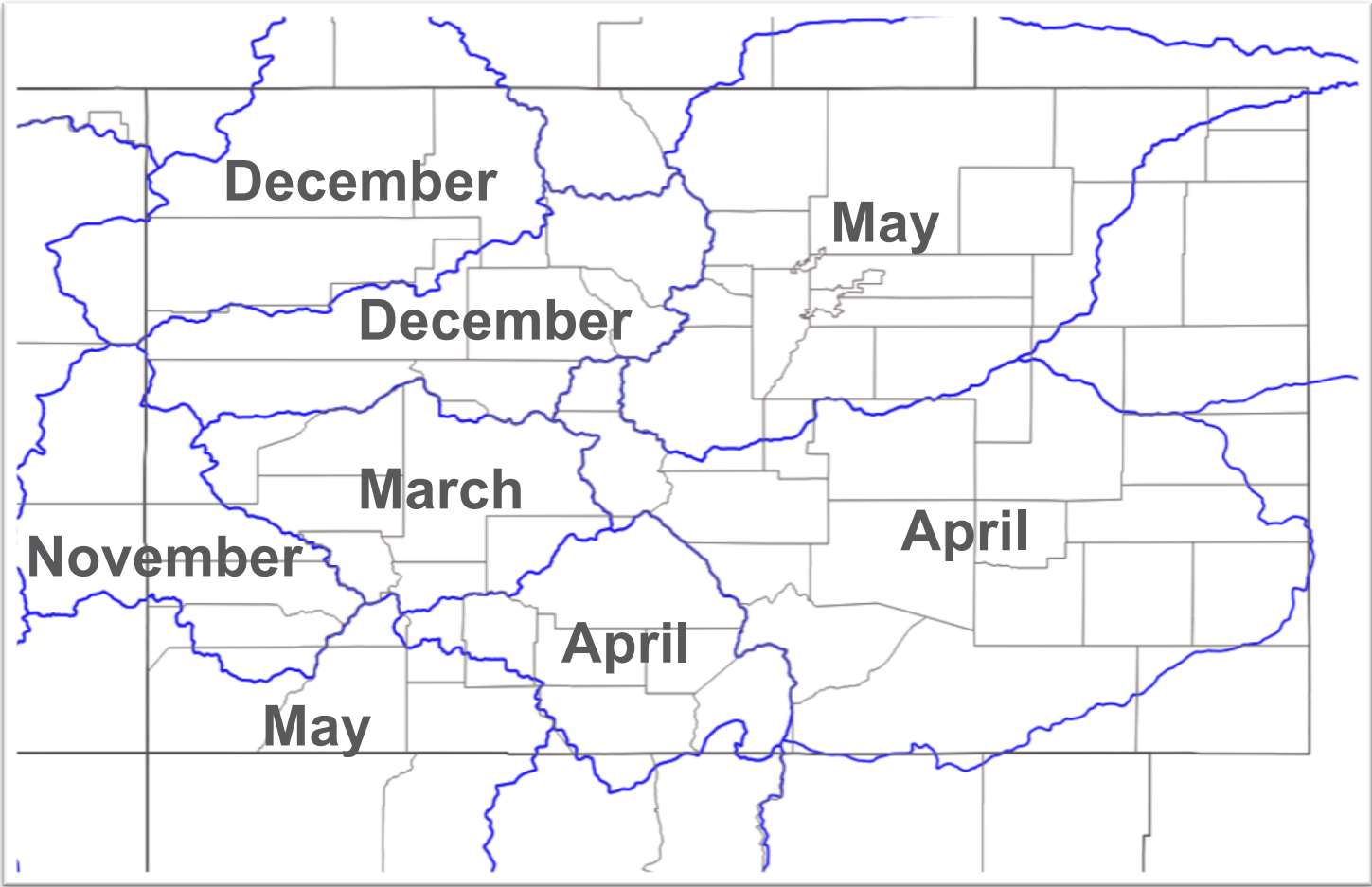
PRISM proportion of annual average precipitation in this month: November



Correlation between October precipitation and water year accumulations



Month with the highest correlation to the total water year accumulations



Based on similar Octobers in history, what is the expected water year accumulation?

Basin	October 2018 Precip	Composite WY Total
South Platte	Above Average	Average
Arkansas	Much Above Average	113%
Rio Grande	Above Average	104%
San Juan	Much Above Average	109%
Dolores	Much Above Average	110%
Gunnison	Much Above Average	105%
Colorado	Much Above Average	109%
Yampa-White	Much Above Average	112%



Key Takeaway October Points...

- ✓ October-November are important contributing months for portions of the west slope
- ✓ The western basins show a strong correlation between what happens in October and how the water year ends up
- ✓ Spring months are clearly more important in defining the annual totals for the Eastern Plains
- ✓ Winter months are the winners for the western basins
- ✓ A "much above average" October is generally promising for the water year
- ✓ It's early and there's still a lot of room for variability!

Becky.Bolinger@colostate.edu

**To view this and other presentations:
http://climate.colostate.edu/ccc_archive.html**

Thank you



ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY