Water Year 2023 in Review

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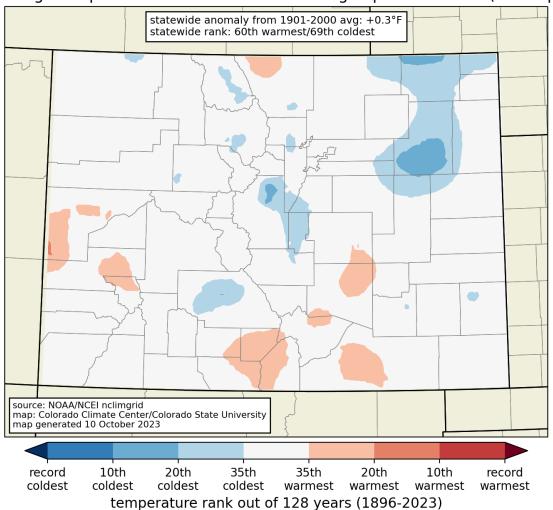
Peter Goble, Climatologist

Alistair Vierod, CoAgMET Tech/Analyst





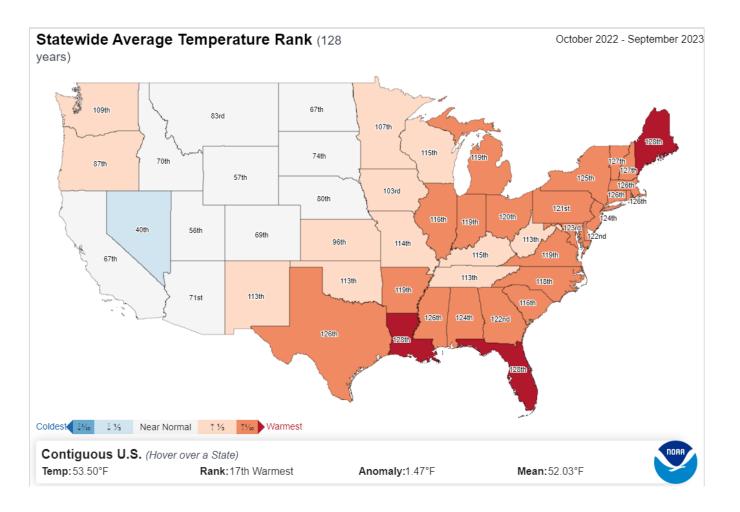
average temperature rank: 12 months ending September 2023 (Oct-Sep)



Coolest water year since 2010

Cooler temperatures in fall/winter

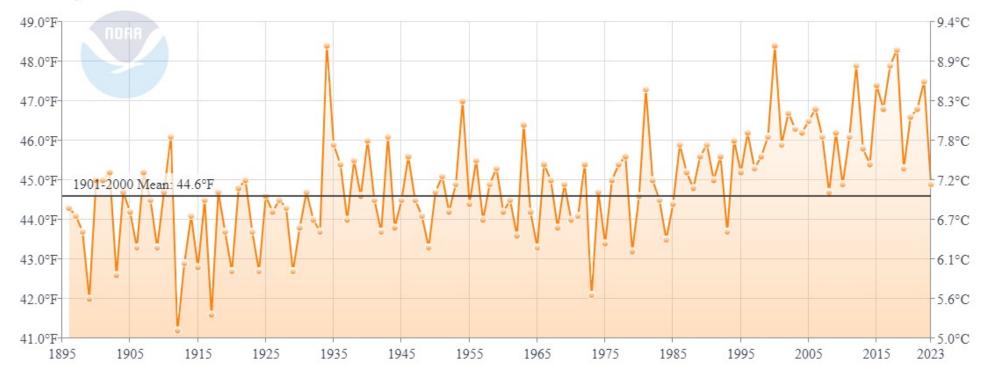
Warm final quarter to the water year



Cool and snowy year by recent standards across the Intermountain West

Colorado Average Temperature

October-September



Average statewide temperature: 44.6 $^{\circ}\text{F.}$ Coolest in 13 years! Still above the 20^{th} century average

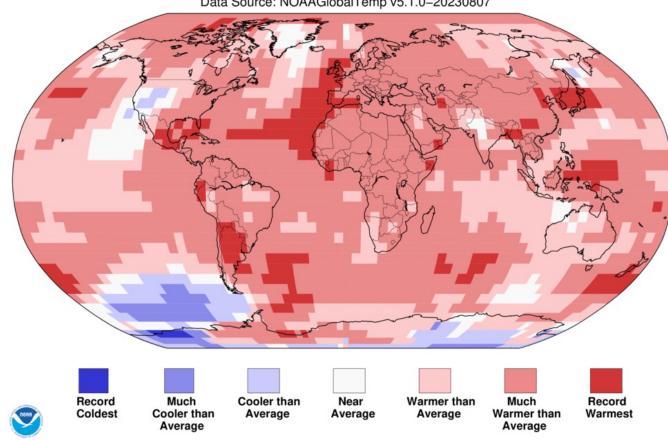


Calendar year 2023 has the potential to be record-warm globally we are one of the few cool exceptions in the western US

Land & Ocean Temperature Percentiles Jan-Jul 2023

NOAA's National Centers for Environmental Information

Data Source: NOAAGlobalTemp v5.1.0-20230807

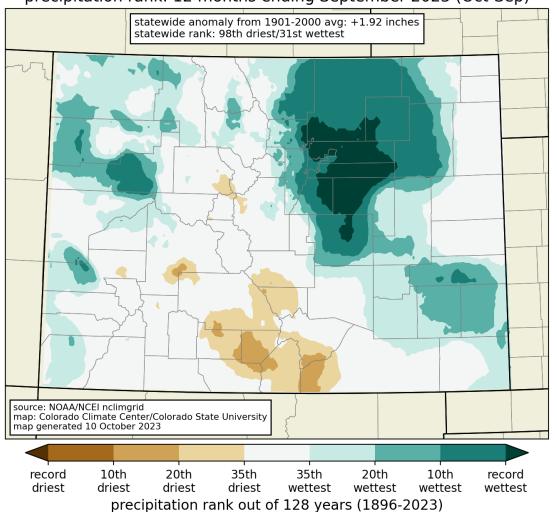








precipitation rank: 12 months ending September 2023 (Oct-Sep)

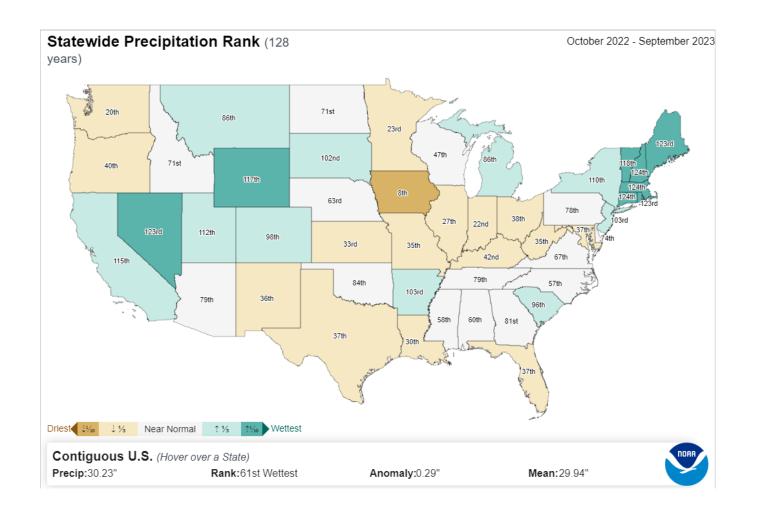


Only the 31st wettest year on record but...

Record wet in portions of Weld, Morgan, Boulder, Adams, Denver, Arapahoe, Washington, Elbert, Douglas, and El Paso Counties

Drier than normal for San Luis Valley





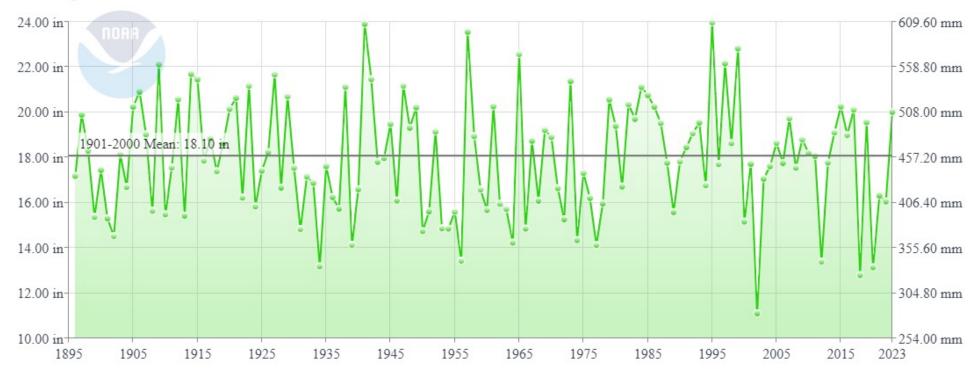
Colorado was part of an area of cooler, wetter conditions over the Intermountain West and California

Meanwhile the
Midwest was dry. High
pressure conditions over
the Midwest may
have helped to trap
some of our May/June
moisture against the
eastern Rockies



Colorado Precipitation

October-September



Statewide average: 20.02". Wettest since 2017. Wet by recent standards, but not compared to the 80's and 90's



Back in the cool and wet "quadrant"

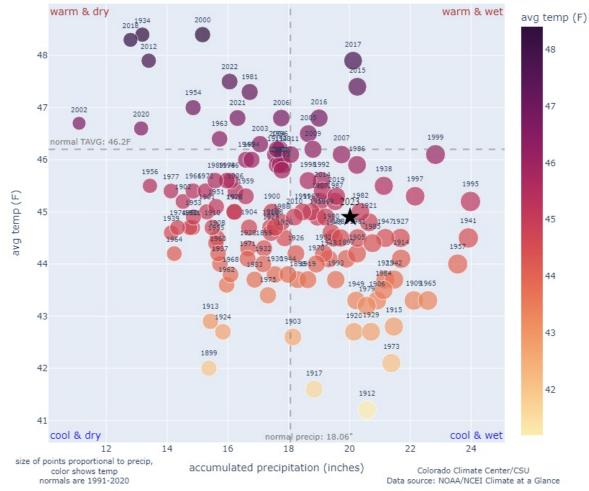
2023 fairly similar to 2019

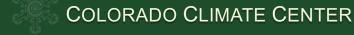
An improvement over 2020-2022

1.3 °F below 1991-2020 normal

1.96" above normal precipitation









Month	T Rank (of 128 years)	Above, below, or near 20 th century avg?	
Oct	45 th warmest	near avg	
Nov	29 th coolest	below	
Dec	52 nd coolest	near avg	
Jan	55 th coolest	near avg	
Feb	41st coolest	below	
Mar	22 nd coolest	below	
May	18 th warmest	above	
Jun	30 th coolest	below	
Jul	21 st warmest	above	
Aug	10 th warmest	much above	
Sep	14 th warmest	above	

Month	P Rank (of 128 years)	Above, below, or near 20 th century avg?		
Oct	63 rd driest	near avg		
Nov	52 nd driest	near avg		
Dec	20 th wettest	above		
Jan	10 th wettest	much above		
Feb	61st driest	near avg		
Mar	32 nd wettest	above		
Apr	37 th driest	below		
May	22 nd wettest	above		
Jun	6 th wettest	much above		
Jul	35 th driest	below		
Aug	58 th wettest	near avg		
Sep	52 nd driest	near avg		



daily records broken

Month	High max T	High min T	Low max T	Low min T	Precipitation	Snowfall
October	4	37	87	8	68	8
November	5	58	106	91	67	35
December	36	178	100	41	86	23
January	9	147	130	39	162	68
February	16	19	153	134	47	47
March	0	37	245	264	170	19
April	109	105	6	8	49	22
May	6	42	7	0	103	3
June	1	24	88	10	117	0
July	184	279	37	6	58	3
August	108	338	31	17	126	0
September	28	53	29	1	68	0
TOTAL	506	1317	1019	619	1121	228
	warm records: 1,823		cold reco	ords: 1,638		

https://www.ncdc.noaa.gov/cdoweb/datatools/records





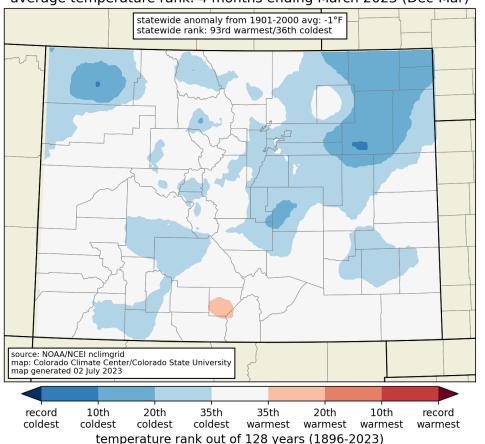
A walk through water year 2023



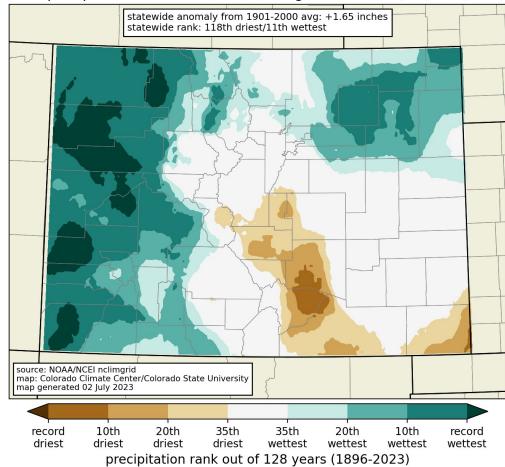


A snowy, cold winter and early spring

average temperature rank: 4 months ending March 2023 (Dec-Mar)



precipitation rank: 4 months ending March 2023 (Dec-Mar)



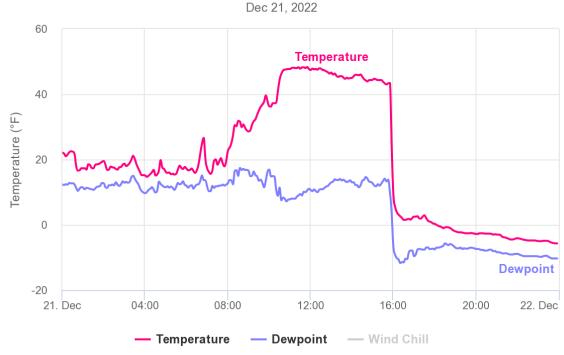


The incredible cold front on December 21, 2022

Christman Field, Fort Collins

Dropped 18.9°F in 5 minutes and 38.7°F in 15 minutes – fastest temperature drops in the record of the station (back to 1997)

Temperature and Dewpoint for Christman Field (FCC01)

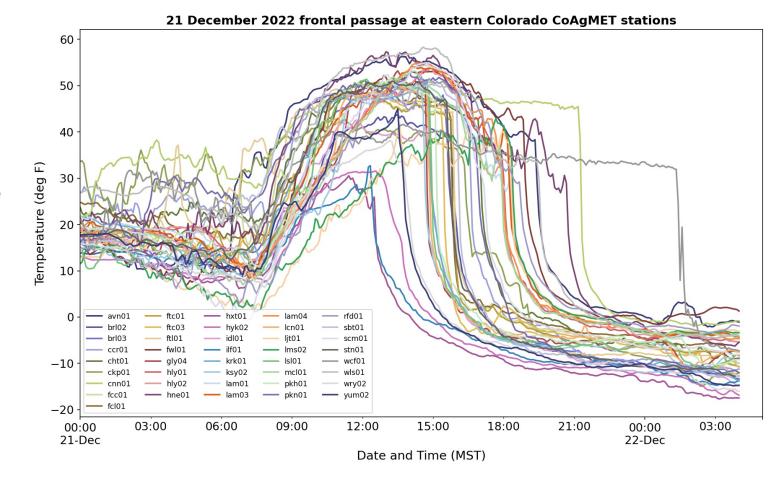


Highcharts.com



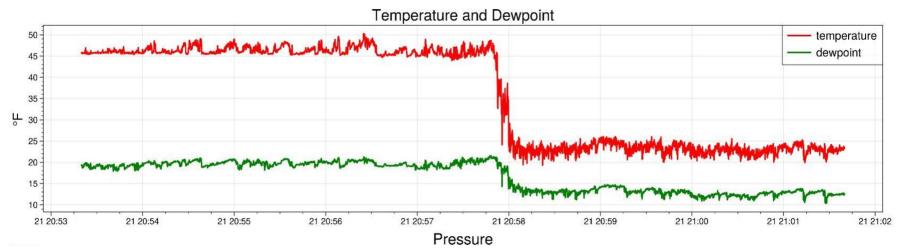
The incredible cold front on December 21, 2022

CoAgMET stations
throughout eastern
Colorado show
extremely fast drops
in temperature, from
the 40s and 50s in the
afternoon to below
zero a few hours later





High-resolution data from Akron USDA



Temperature dropped 11°F in 30 seconds and 14.7°F in one minute!

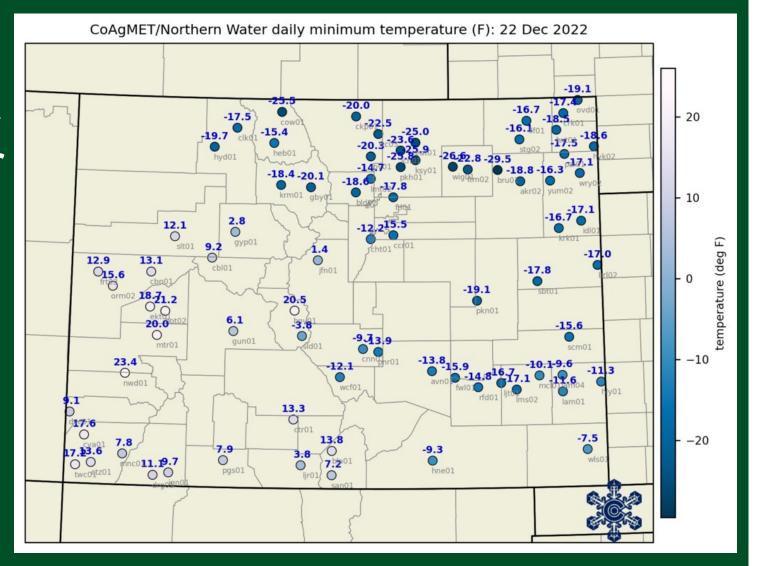
(figure courtesy Megan Franke, data courtesy of David Poss)



November-February: A Cold Winter

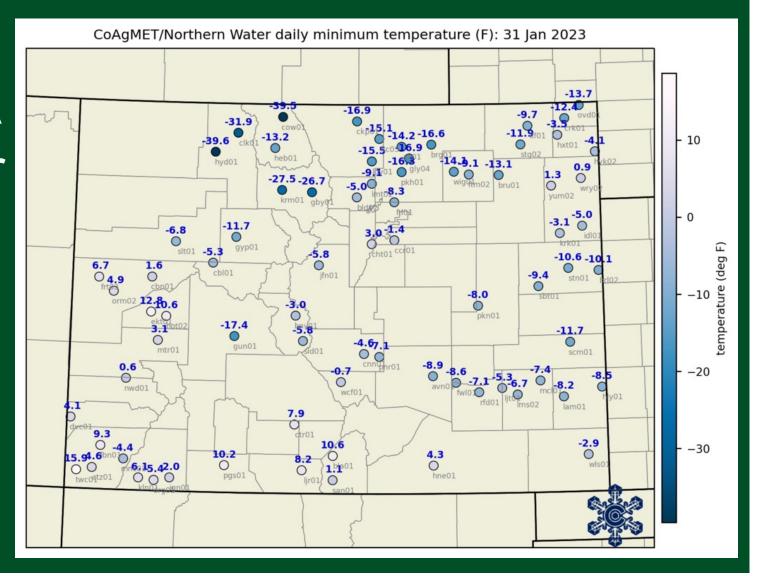
Some of the lowest temperatures came just before Christmas

The Fort Collins weather station had its lowest recorded temperature of the 21st century: -17 °F



November-February: A Cold Winter

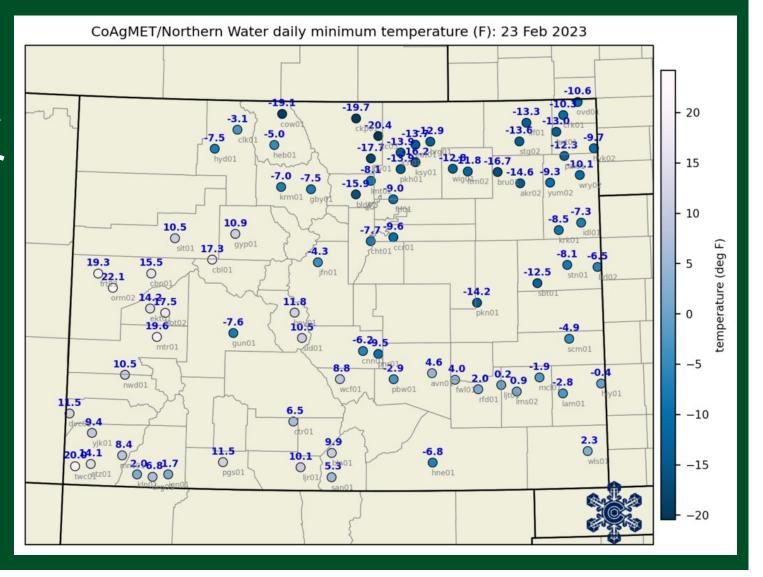
The Hayden and Cowdrey CoAgMET stations reached their stations' thermometer limits on January 31st, 2023



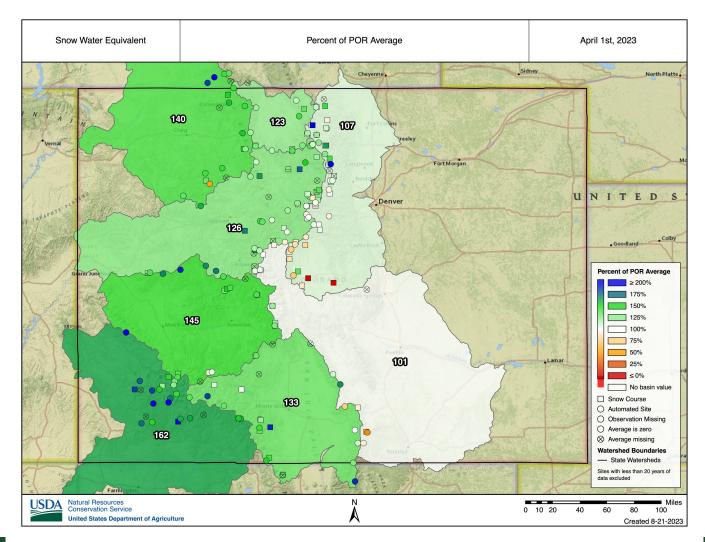
November-February: A Cold Winter

More winter cold the 4th week of February, but not as far south or west

Taylor Park Reservoir -33 °F on March 28th!

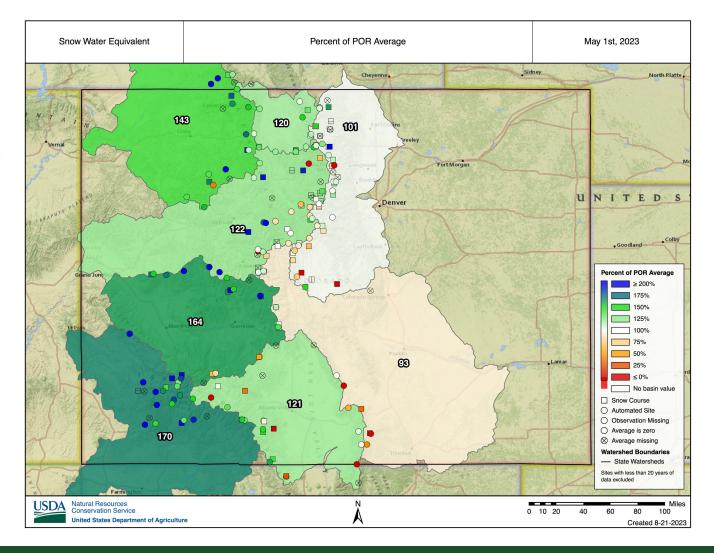


Snowpack on April 1 – above average in all basins





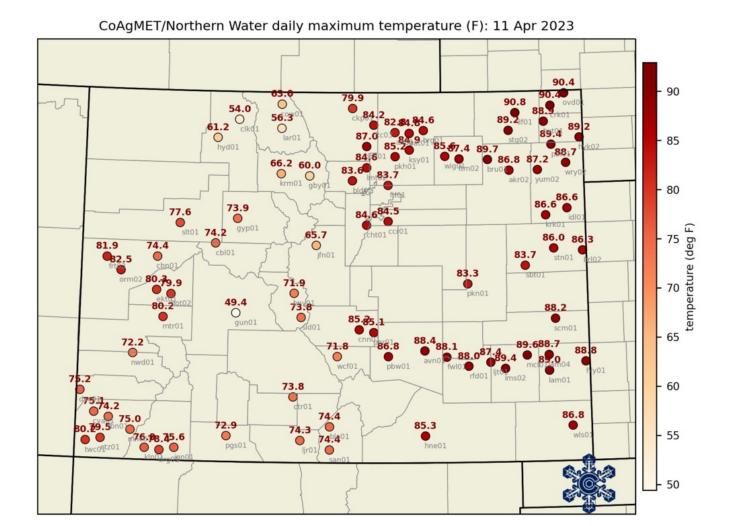
Snowpack on
May 1 – above
average in all
basins except the
Arkansas





Record Warmth in April

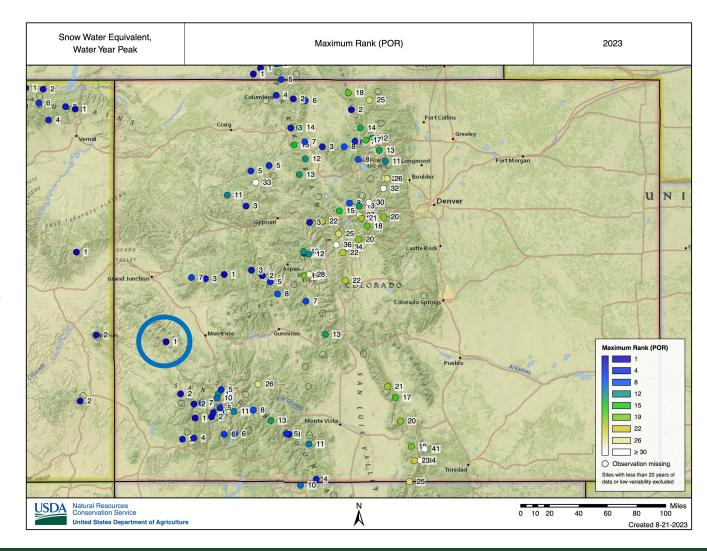
Over 90 degrees in NE
 CO. Fort Collins did not
 equal its April 11th
 temperature for over two
 months





Peak snow water equivalent – ranking among years

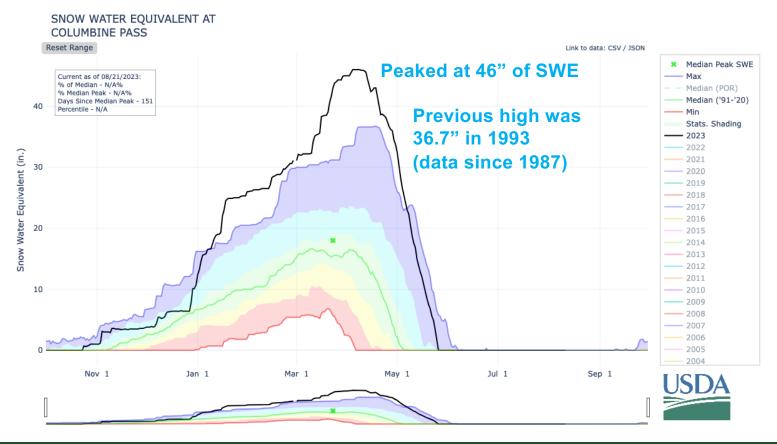
A top-10 snow year at most stations west of the divide, with even some record-breakers





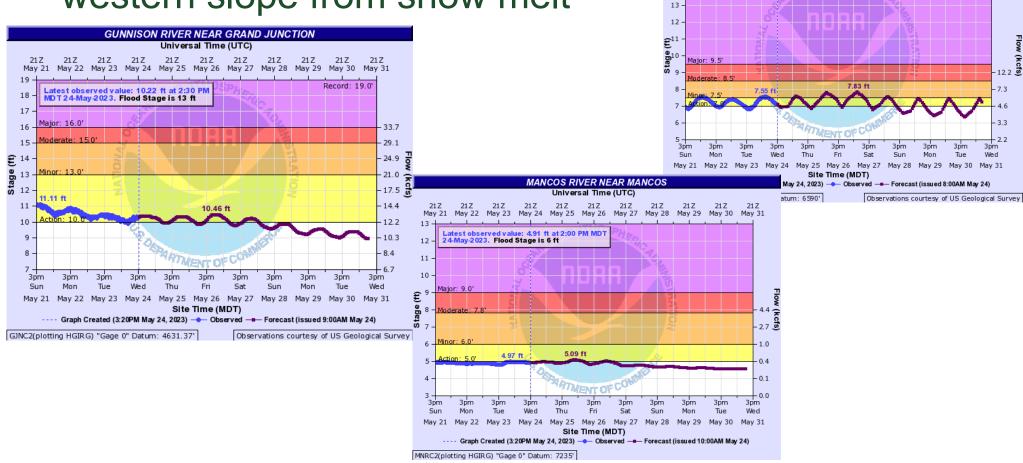
Snowpack accumulation was especially huge at lower-elevation sites

Columbine Pass, on the Uncompangre Plateau at ~9200 ft, destroyed their previous record SWE





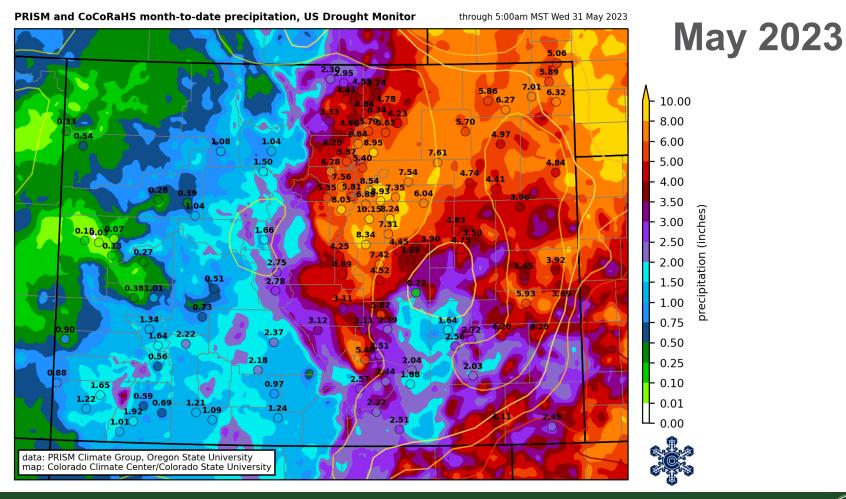
This led to some flooding on the western slope from snow melt



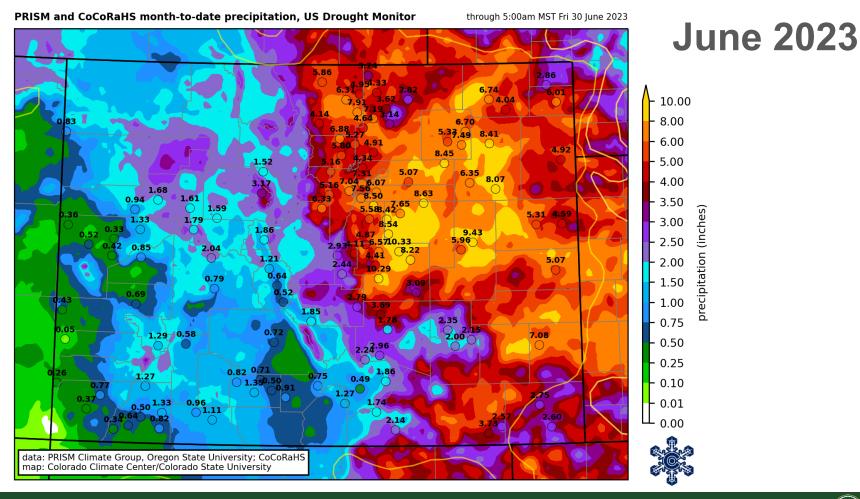


ELK RIVER (CO) NEAR MILNER

Latest observed value: 7.1 ft at 2:30 PM MDT 24-May-2023. Flood Stage is 7.5 ft







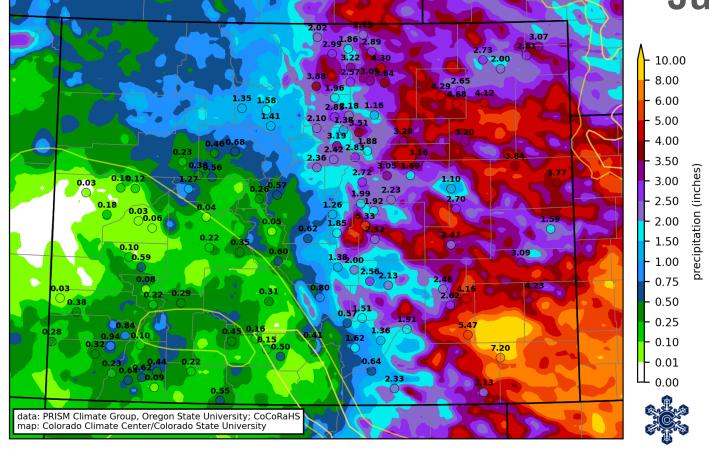




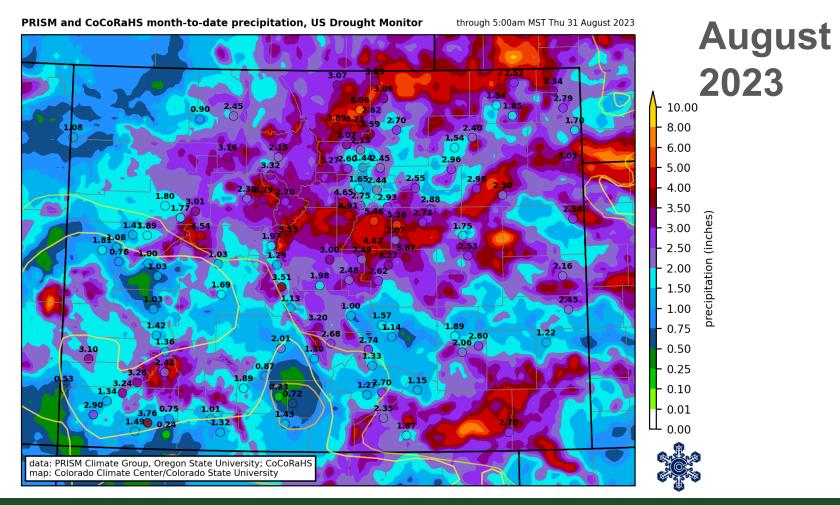
through 5:00am MST Mon 31 July 2023

July 2023

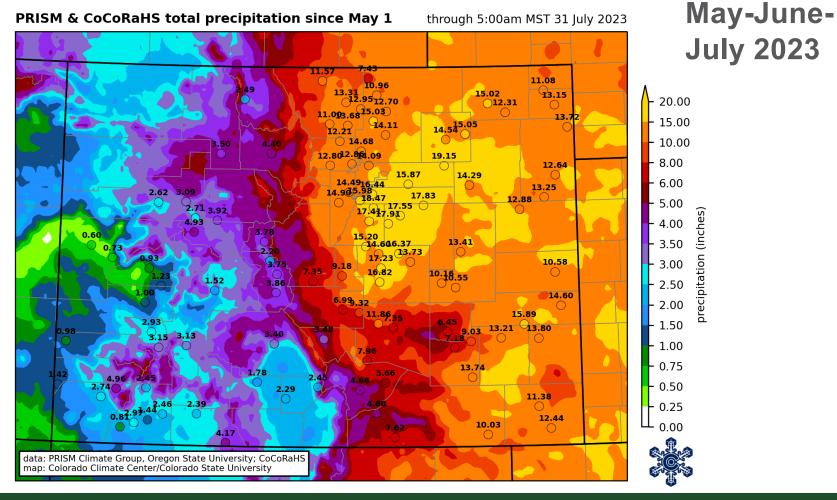






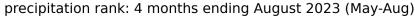


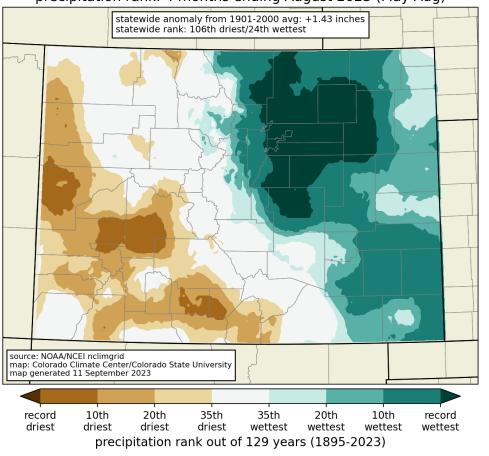






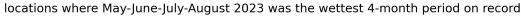
May-June-July-August 2023

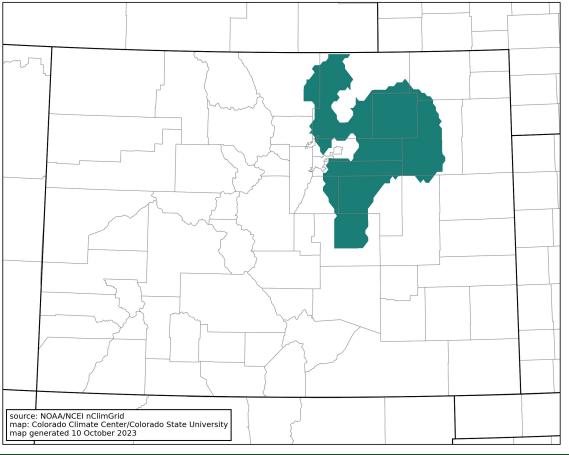




Record wet May through August for a large part of northeast Colorado

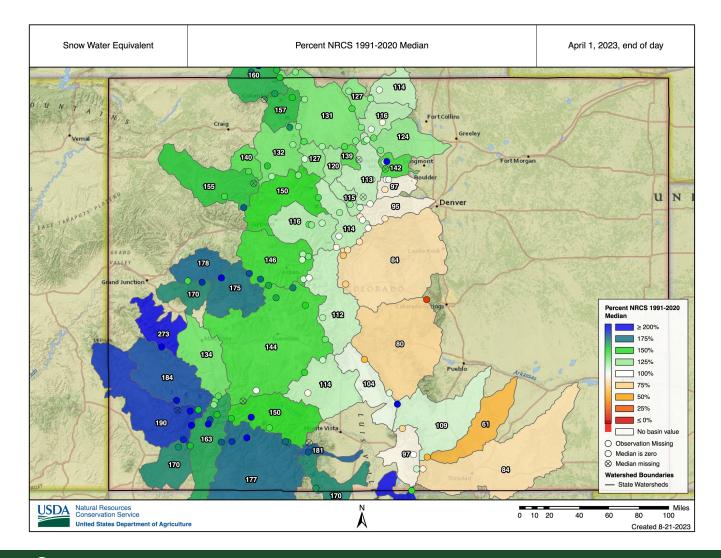
May-June-July-August 2023





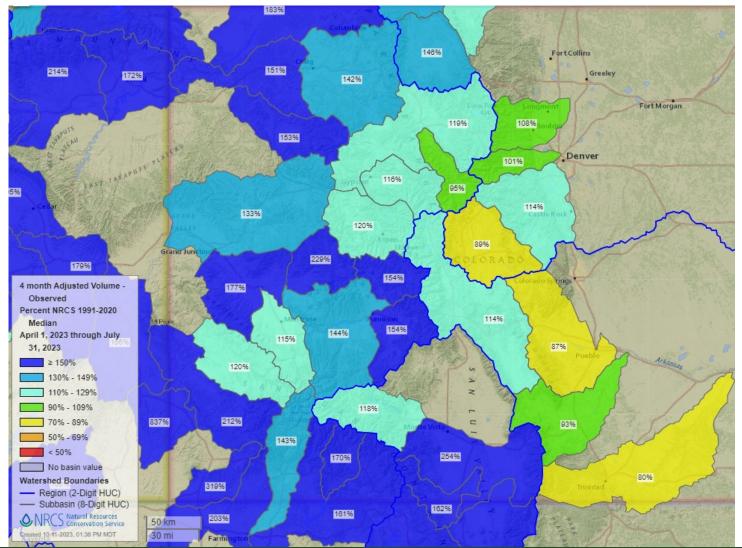
Wettest 4-month period on record for the areas shown here

Snowpack on April 1





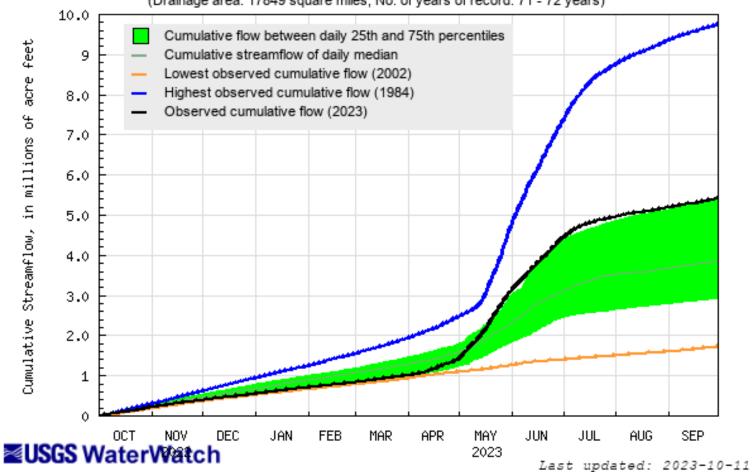
April-July streamflow





USGS 09163500 COLORADO RIVER NEAR COLORADO-UTAH STATE LINE

(Drainage area: 17849 square miles, No. of years of record: 71 - 72 years)

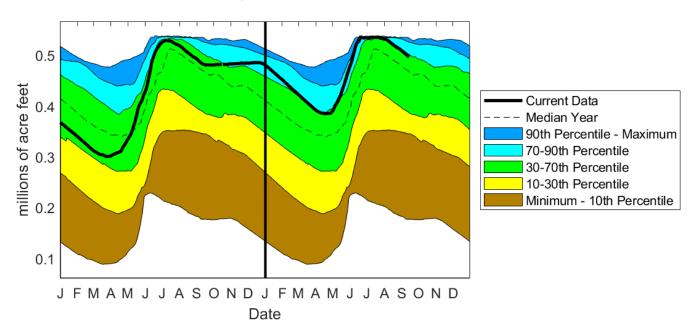






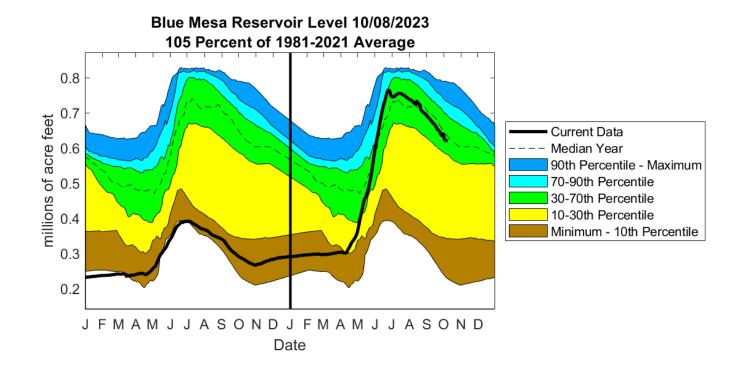
Colorado's reservoirs refilled nicely...

Lake Granby Level 10/08/2023





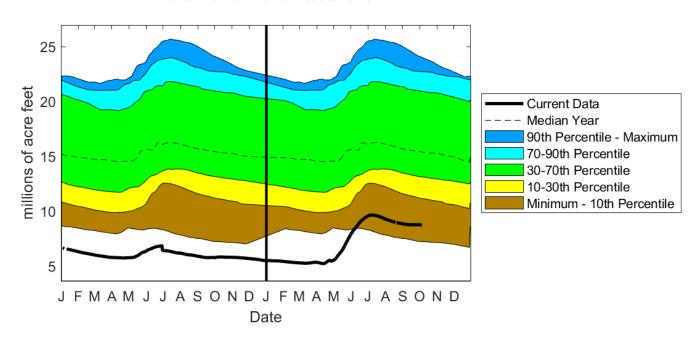
Colorado's reservoirs refilled nicely...





But Powell and Mead will need a lot more than one snowy year

Lake Powell Level 10/08/2023

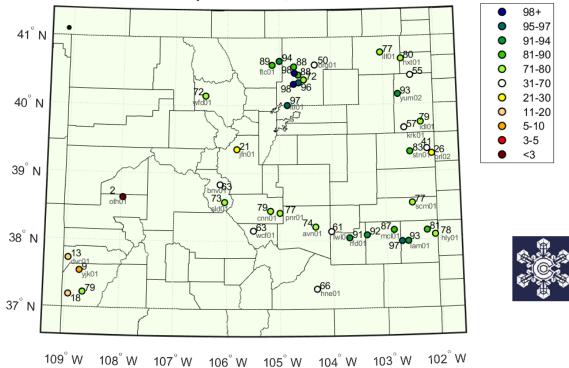




Seasonal Water Balance Over Heavily Agricultural Areas

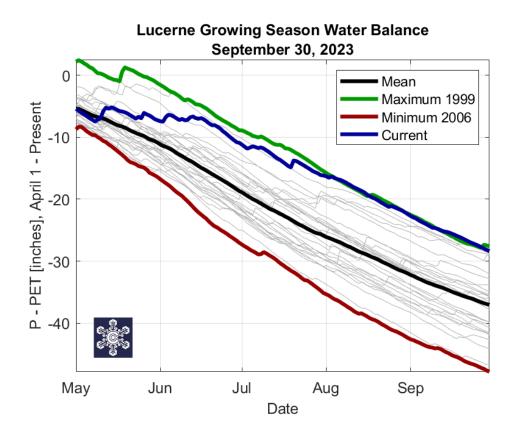
- Precipitation was above average and evaporative demand was below average for eastern CO
- This was a good thing for most agricultural operations in our semiarid state
- The west slopes were much hotter and drier than normal over summer, but had above normal irrigation supplies

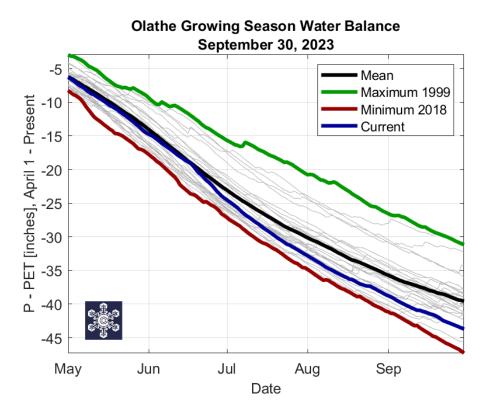
Growing Season Water Balance (P/PET) Percentiles September 30, 2023





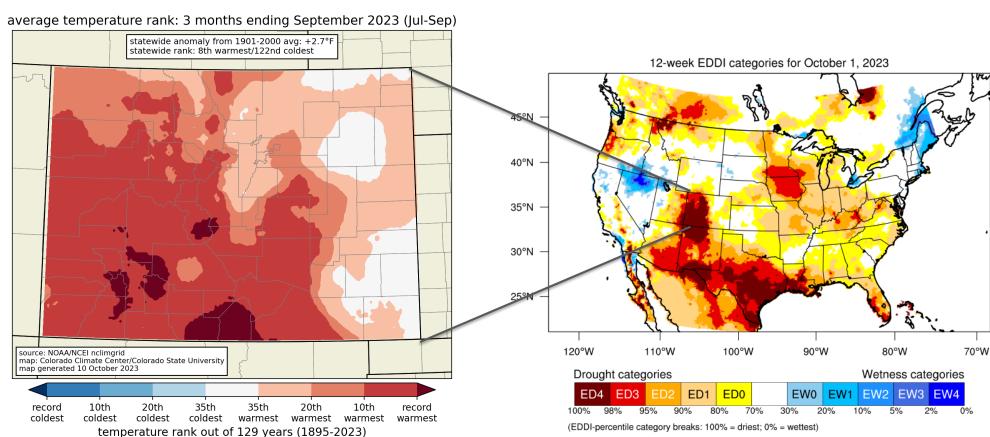
Seasonal Water Balance Over Heavily Agricultural Areas





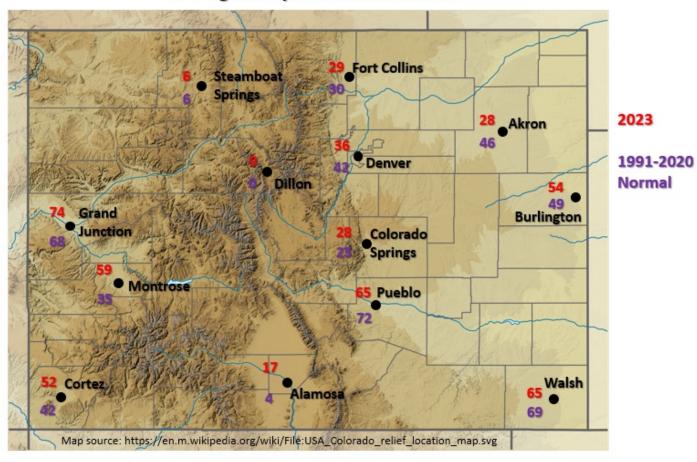


Summer Heat and Evaporative Demand



Generated by NOAA/ESRL/Physical Sciences Laboratory

90-Degree Days in Water Year 2023



Less hot days than normal east of the Continental Divide, but more west of the Divide

A slow start, but plenty of 90's later in the season

Record Hail

- Storm chaser Dan Fitts collected a record large hailstone near Yuma, CO on August 8th, 2023
- While the stone lost a lot of size before its official measurement, the high quality photographs were enough to cement this stone as the new record (5.25")
- Read more in the full report at:
 https://www.ncei.noaa.gov/monitoring-content/extremes/scec/reports/202309

 26-Colorado-Hailstone.pdf

Photo courtesy of Dan Fitts

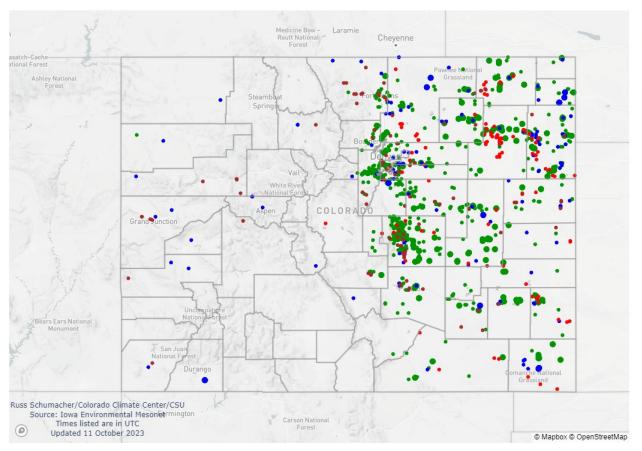




Colorado PRELIMINARY severe thunderstorm and flood/flash flood reports, 2023

Record Hail

 The 2023 severe storm season was much more active than normal, especially for hail





- hail 1-2"

tornadoes
flood/flash flood

wind 50-64 kt

2023: a hail of a year in Colorado

Hail size	Number of reports in 2023 in Colorado	Previous most
1" or greater	796	561 (2018)
2" or greater	176	91 (2018)
3" or greater	37	12 (2019)
4" or greater	15	5 (2005)

*NOTE: 2023 data are preliminary and subject to confirmation and revision





Water Year 2023 Notable Events

Dates	Description
December 21-23 rd , 2022	Christmas week cold front sets record low temps across eastern Colorado
January 31 st , 2023	CoAgMET stations in Routt and Jackson County reach -40 °F
February 23 rd , 2023	Another major cold front. Temps -15 °F or lower
April 2023	Peak snowpack values 150-190% of normal in San Juan Mountains
April 12-13 th 2023	Record heat wave jump-starts snowmelt
May-July 2023	Wettest three-month period on record for portions of urban corridor and eastern plains
June 21, 2023	34 tornadoes were observed in Washington County; a major hailstorm hit Red Rocks causing nearly 100 injuries
July 31 st , 2023	Major flash flooding in Fort Collins and Wellington (4+" of rainfall in two hours)
August 8 th , 2023	New record diameter hailstone (5.25"), first EF-3 tornado in Yuma County in modern records
July-September, 2023	Hot and dry across western Colorado with some areas (such as the southern San Luis Valley) seeing record hot conditions



Recap of Colorado's water year 2023

- Relatively cool overall (in contrast to nearly everywhere else on the planet)
- A very big year for snow in Colorado's mountains, especially toward the west side of the state
- Widespread heavy rain in eastern Colorado during May-August with an active severe weather season
- Streamflows were good, reservoirs recharged within Colorado but not nearly enough water to solve the larger problems in the Colorado River system
- A poor monsoon season and warm temperatures in western Colorado dried out soils and surface conditions to begin water year 2024





Thanks, and let's keep in touch!

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