

Recapping Water Year 2022

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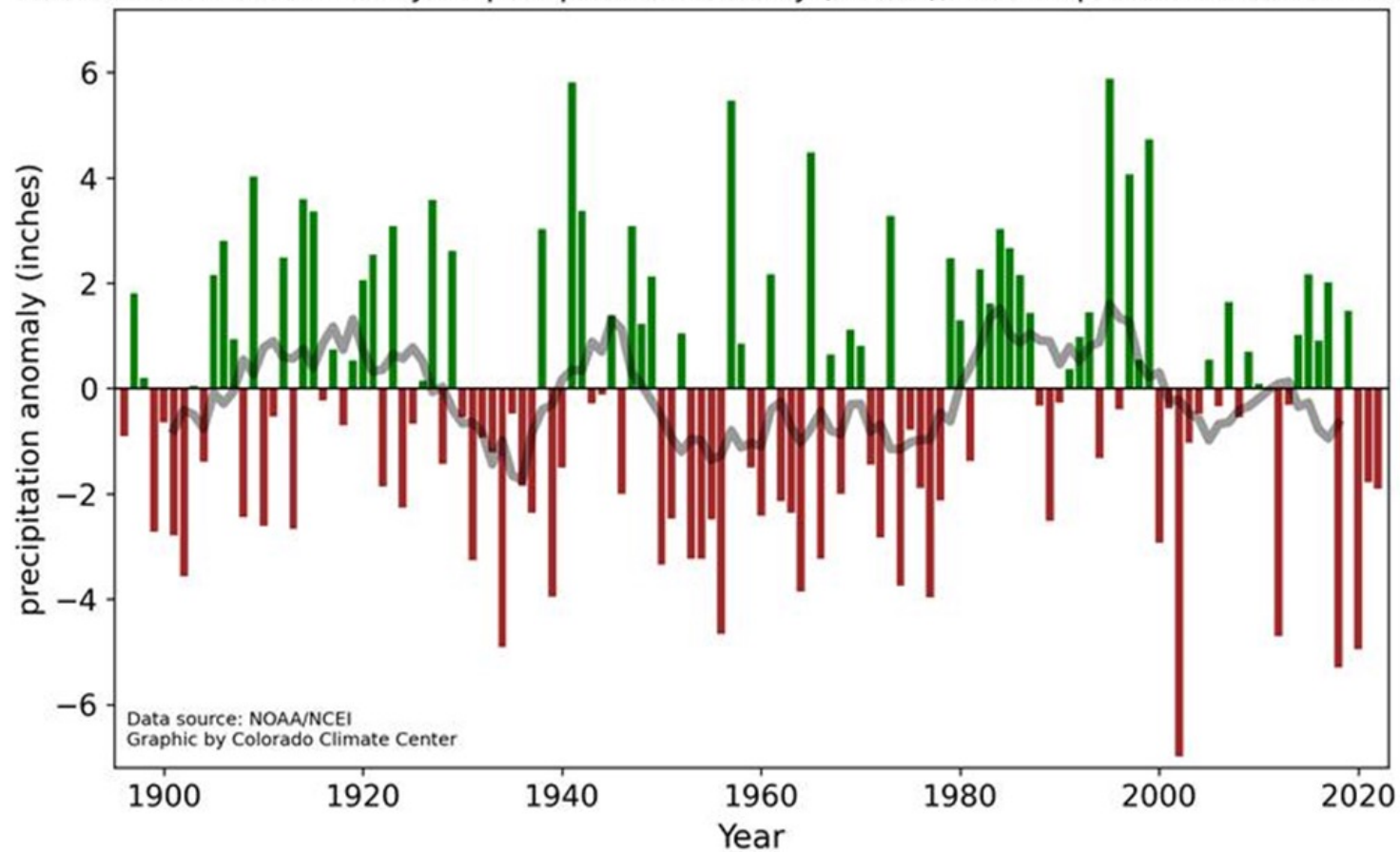
ATMOSPHERIC SCIENCE
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Today's Roadmap

- Water Year (WY) 2022 Overview
- WY 2022 Timeline
- Events and Extremes



Colorado statewide water year precipitation anomaly (inches), with respect to 1901-2000 average



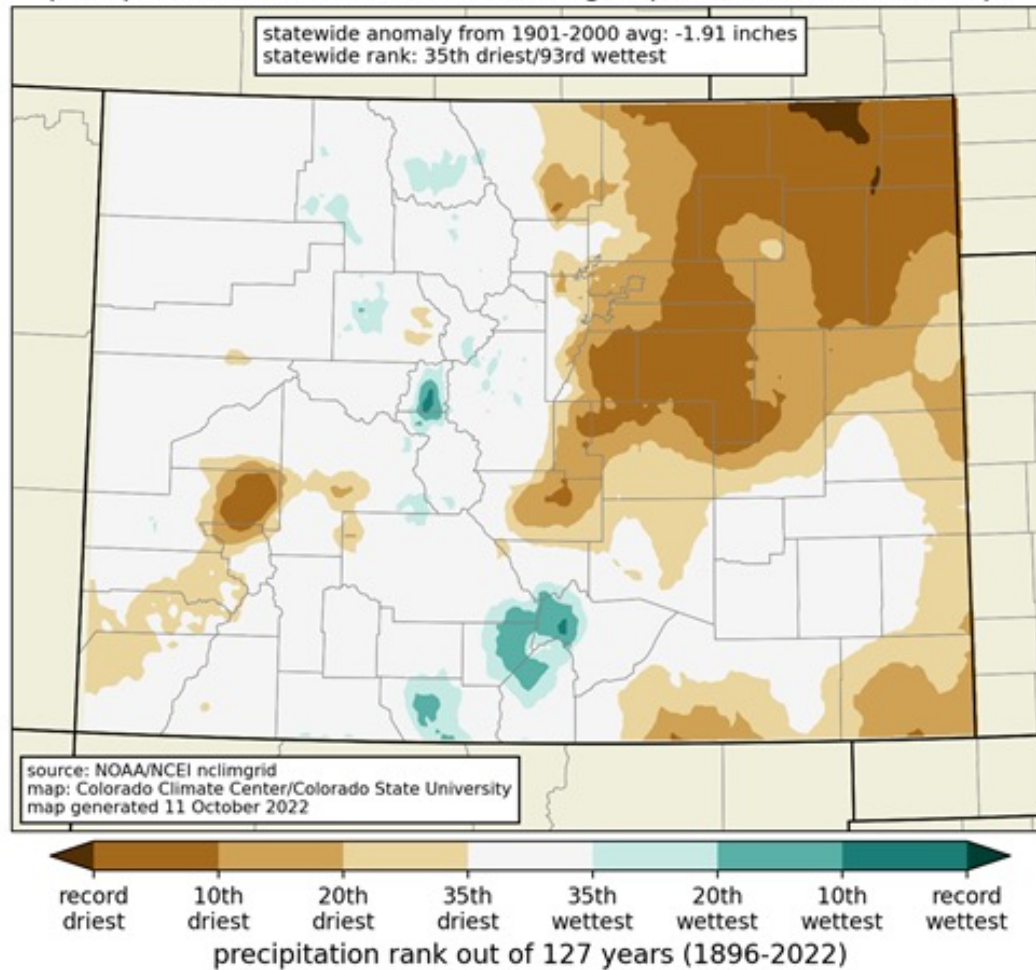
35th driest year
on record

16.19" on
average

Dry for 4/5 years
(3 in a row)



precipitation rank: 12 months ending September 2022 (Oct-Sep)



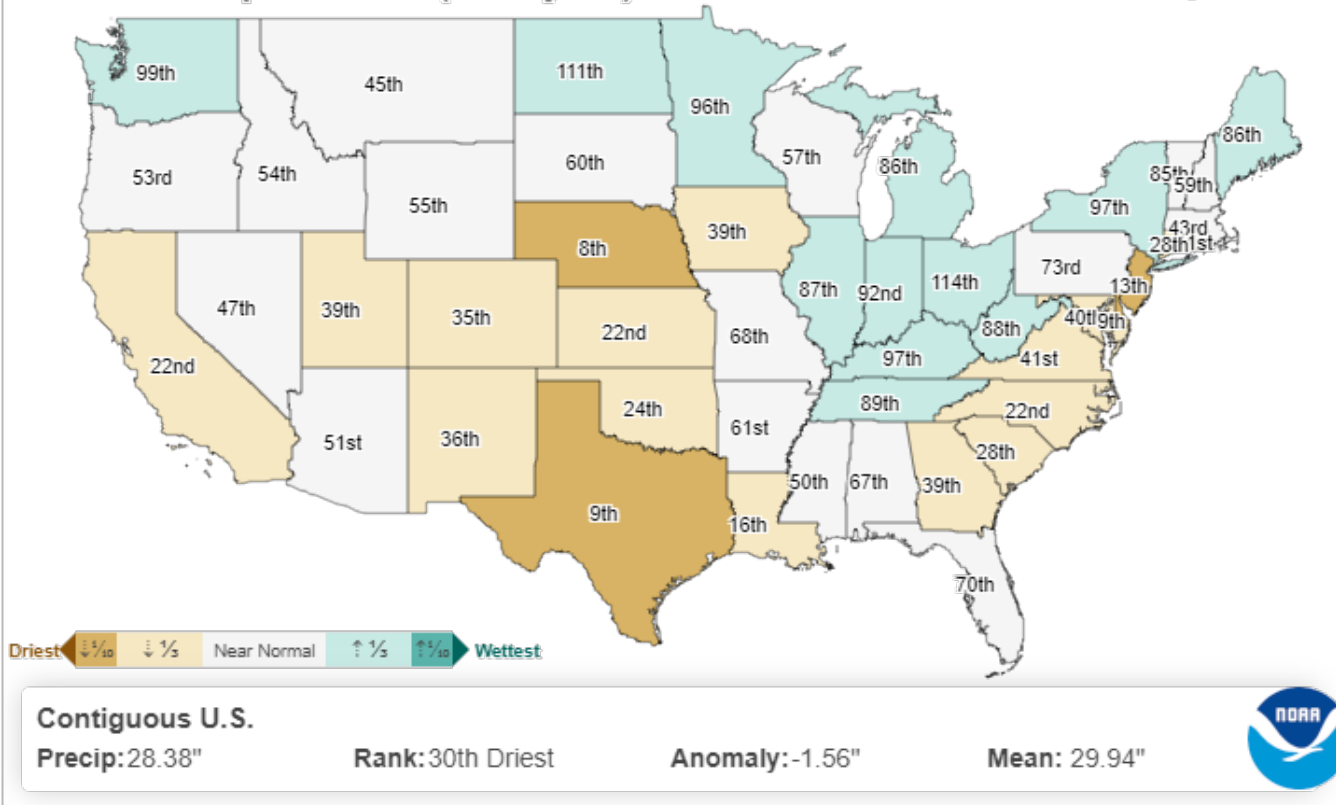
Much drier than normal
for northeast Colorado

Average out west: dry
spring and strong summer
monsoon



Statewide Precipitation Rank (of 127 years)

October 2021 - September 2022



Eastern Colorado part of a dry pattern across the south-central US

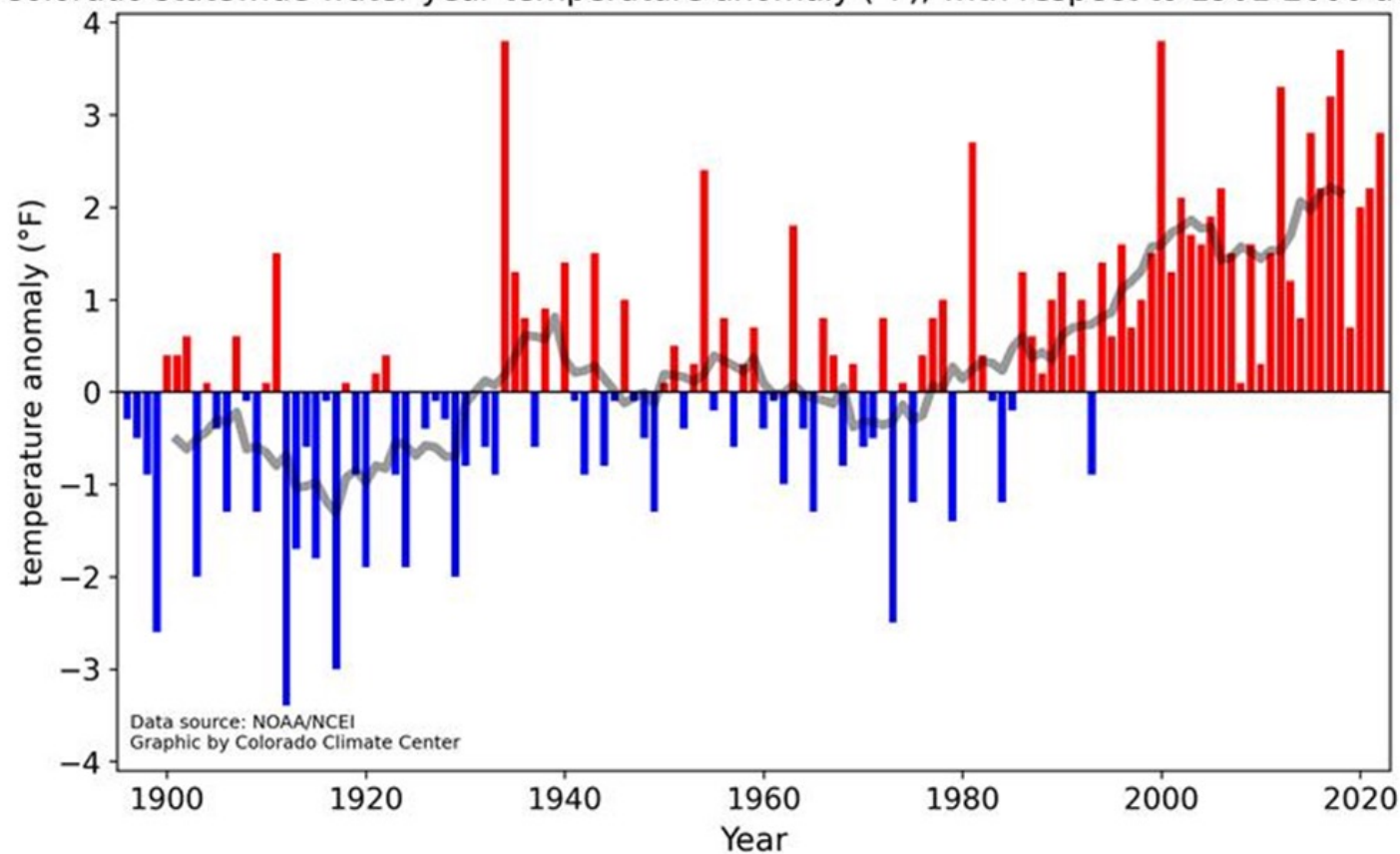
It was not just eastern Colorado farmers with failing dryland crops and culling herds



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Colorado statewide water year temperature anomaly (°F), with respect to 1901-2000 average

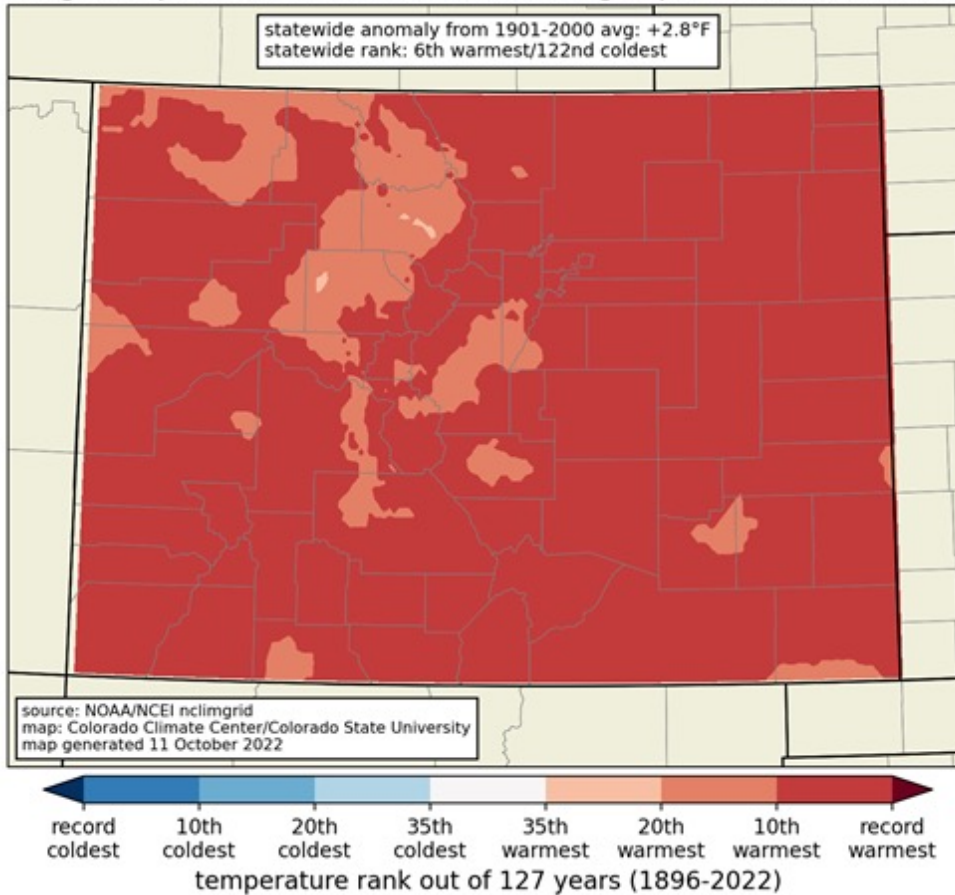


6th warmest year on record, but in line with recent trends

Average temperature: 47.4 °F



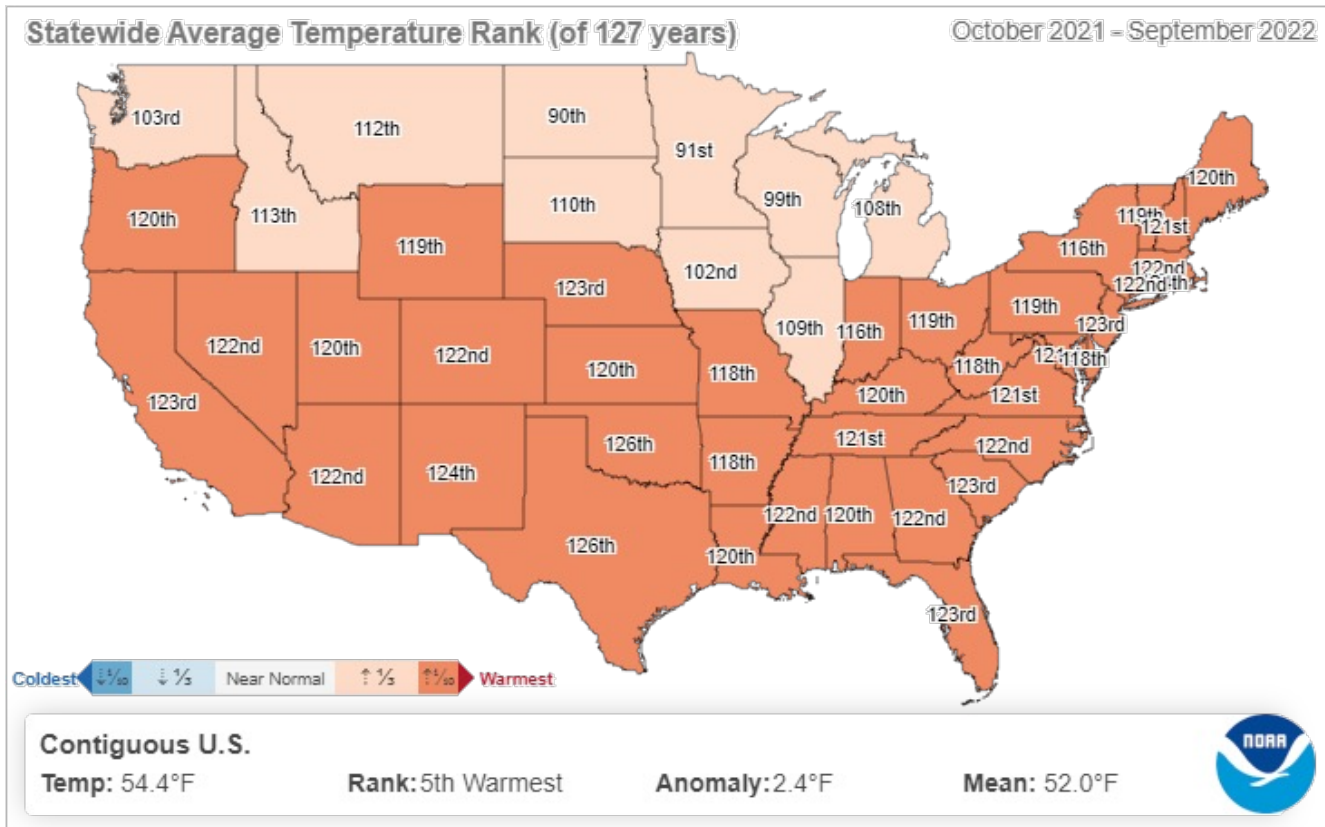
average temperature rank: 12 months ending September 2022 (Oct-Sep)



Conditions were warmer than historical averages everywhere

High mountain valley areas in northern Colorado experienced closer to normal temperatures. We did still record cold temperatures in late winter



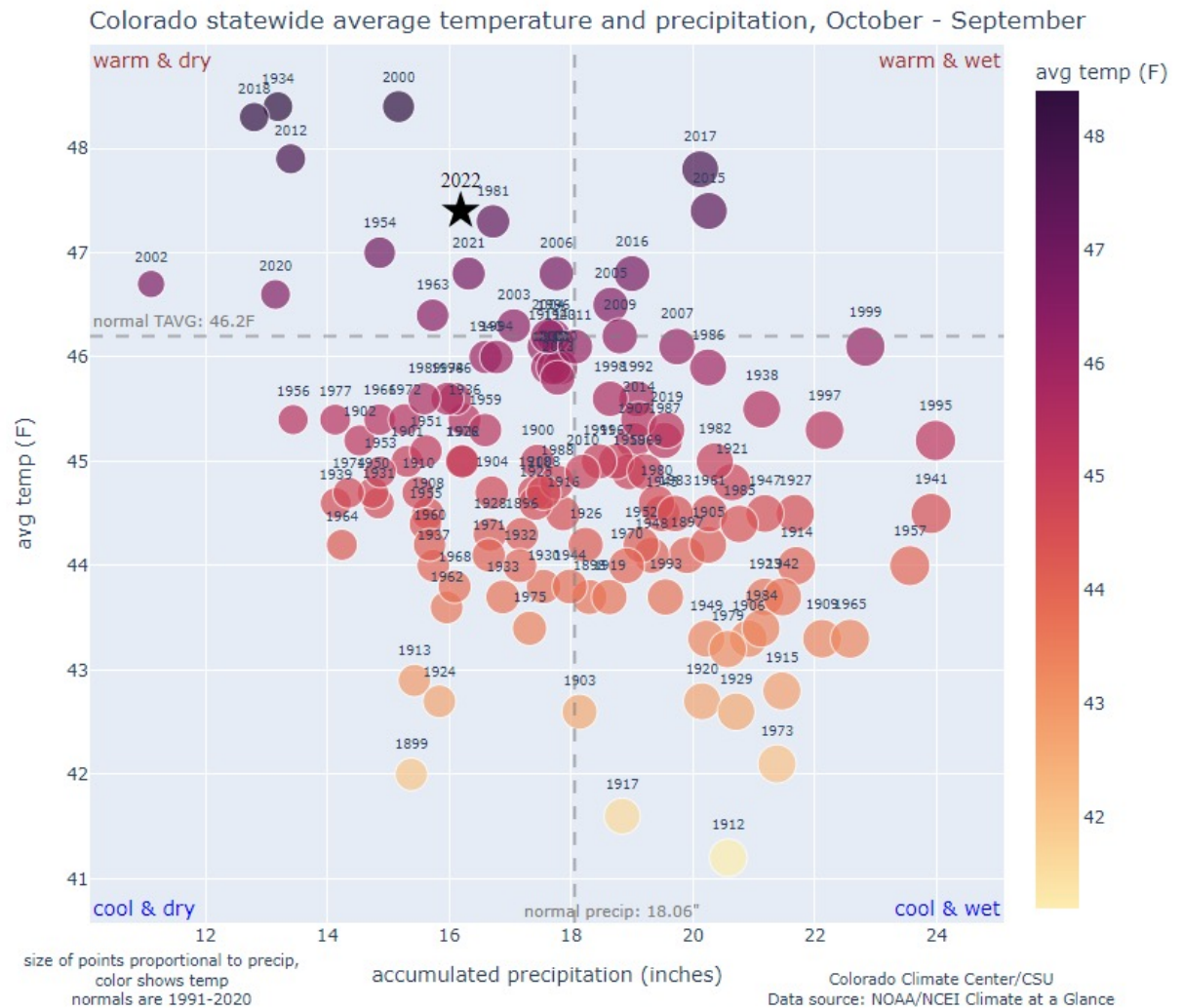


It's not your grandpa's climate anymore. Warmer than historical averages all across CONUS.

La Niña -> cooler to the north/warmer to the south. Colorado in the middle



An improvement over 2020



Month	T Rank (of 128 years)	Above, below, or near 20 th century avg?
Oct	41 st warmest	above
Nov	3 rd warmest	much above
Dec	2 nd warmest	much above
Jan	33 rd warmest	above
Feb	31 st coldest	below
Mar	54 th warmest	near avg
Apr	49 th warmest	near avg
May	41 st warmest	above
Jun	24 th warmest	above
Jul	5 th warmest	much above
Aug	14 th warmest	above
Sep	3 rd warmest	much above

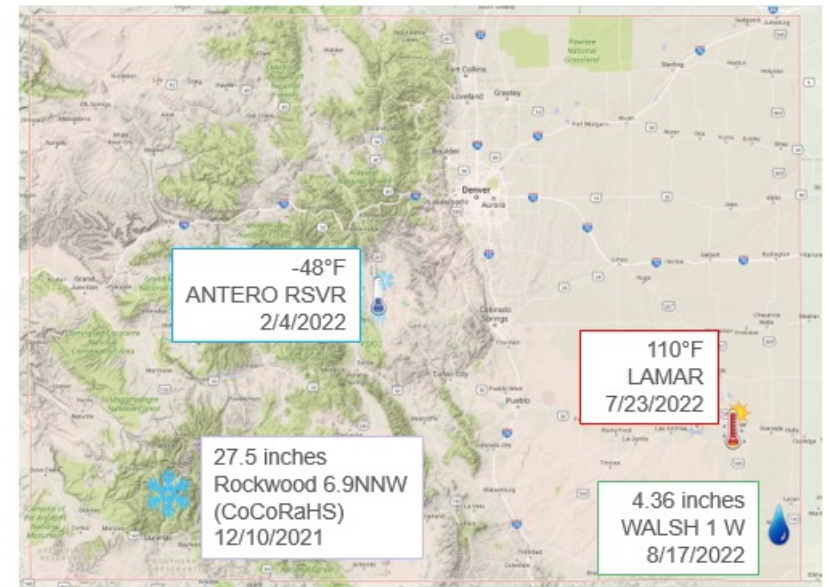
Month	P Rank (of 128 years)	Above, below, or near 20 th century avg?
Oct	62 nd driest	near avg
Nov	10 th driest	much below
Dec	13 th wettest	much above
Jan	40 th driest	below
Feb	49 th driest	near avg
Mar	62 nd wettest	near avg
Apr	5 th driest	much below
May	47 th driest	near avg
Jun	57 th wettest	near avg
Jul	18 th wettest	above avg
Aug	64 th wettest	near avg
Sep	58 th driest	near avg



daily records broken

Month	High max T	High min T	Low max T	Low min T	Precipitation	Snowfall
October	62	101	130	16	67	8
November	182	234	1	1	19	1
December	360	358	4	12	184	9
January	71	98	39	31	111	59
February	13	6	142	188	61	48
March	252	158	318	263	81	45
April	60	91	108	44	23	9
May	128	254	172	131	92	74
June	192	340	98	27	139	5
July	64	240	55	4	104	0
August	19	167	61	11	103	0
September	291	267	5	3	43	0
TOTAL	1694	2314	1133	731	1027	258
	warm records: 4,008		cold records: 1,864			

WY2022 extremes around the state



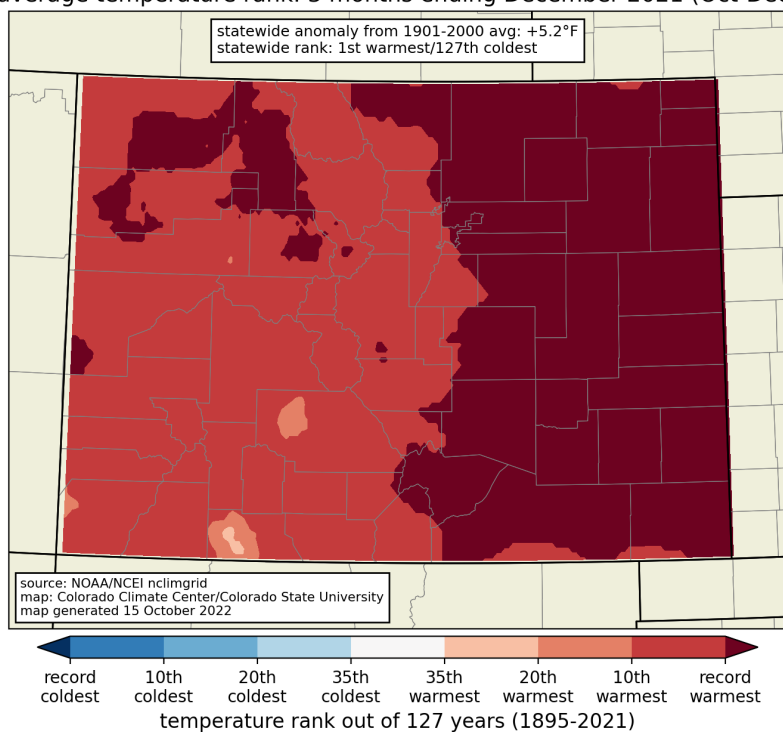
notable events of Water Year 2022

Dates	Description
Oct - Dec	Record warmest October – December for the state
December 10	Latest first snow for Denver on record. Denver had never made it to December without snow
December 15	Dust storm blankets southeast CO, accompanied by high winds. Gust of 107 mph reported at Lamar
December 30	Record warm and dry conditions lead up to extreme windy day and the devastating Marshall Fire
February	Fifth consecutive February with below average temperatures. 30 th coldest for the state
April	CoAgMET station across northeast CO reported their windiest April on record
Apr 1 – May 18	16 inches of rapid snowpack melt in the San Juan basin resulted in record early melt out
May 21	Late season snow dumps 12-18 inches on the Palmer Divide and 5-10 inches around southern Front Range cities
July 14 – 23	Hot days and warm nights helped 4 stations break records for warmest 10-day period
July 15	Flash flooding over the Cameron Peak burn scar resulted in 2 deaths
August 7	Heavy rains in Denver caused flooding on I-70 and 19 people had to be rescued from vehicles
September 5 – 9	5 stations broke their record for hottest September maximum temperature. Additional 11 stations tied their monthly record highest temperature

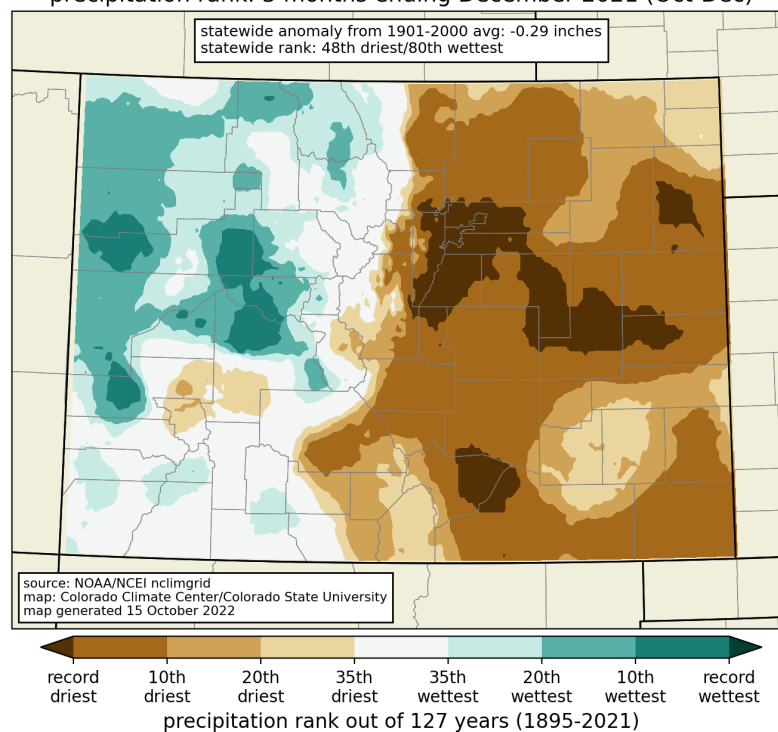


2021 Timeline: A Toasty Start

average temperature rank: 3 months ending December 2021 (Oct-Dec)



precipitation rank: 3 months ending December 2021 (Oct-Dec)



Plenty of clear skies and pleasant weather. A surge of snow west of the Divide in December



Extreme Winds December 15th (Snow in Western CO)

107 MPH at Lamar at 844 AM MST

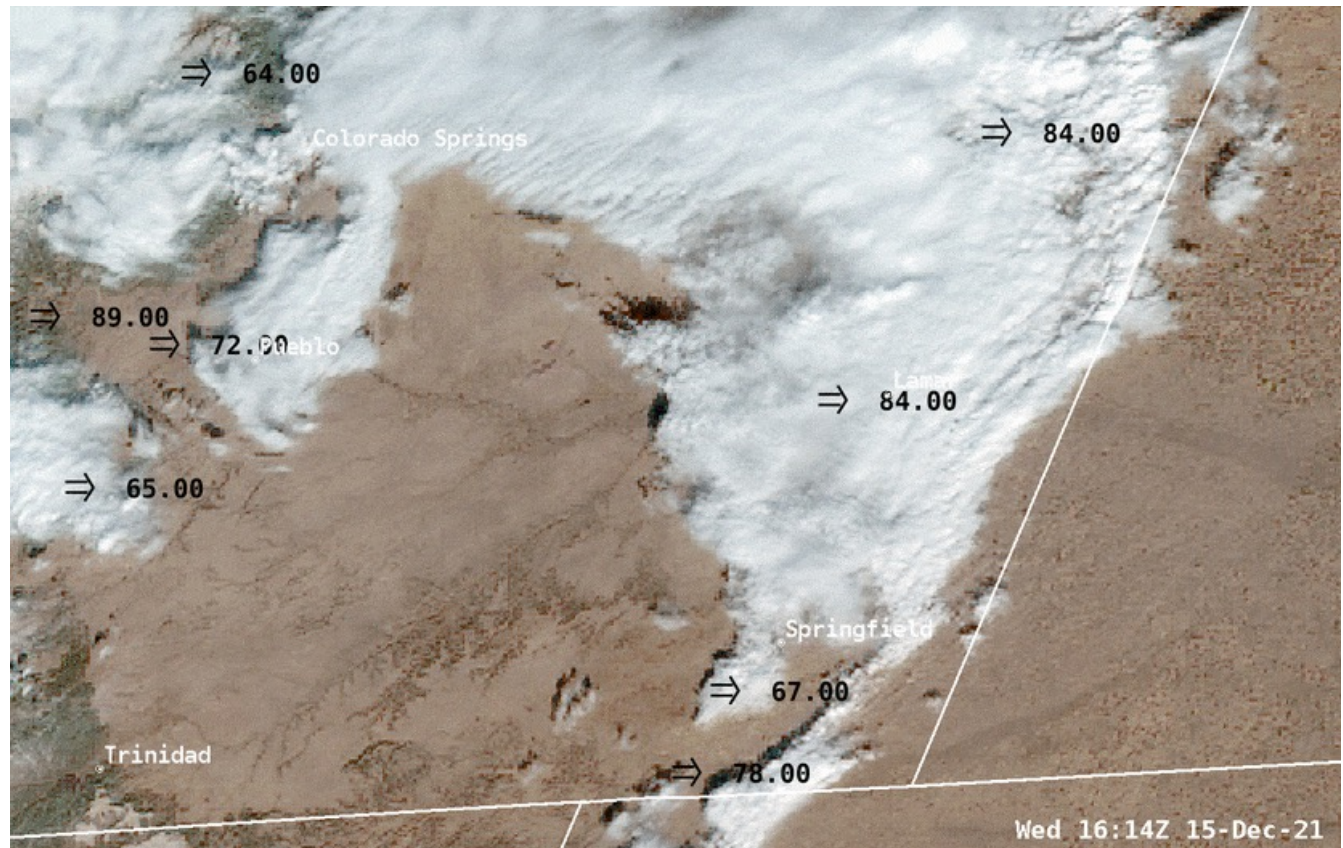
101 MPH at 2 SSW Manitou
Springs 1156 AM MST

100 MPH at US Air Force Academy
at 1118 AM MST

92 MPH at Colorado Springs Airport
at 1254 PM MST

89 MPH at Pueblo Airport at 1016
AM MST

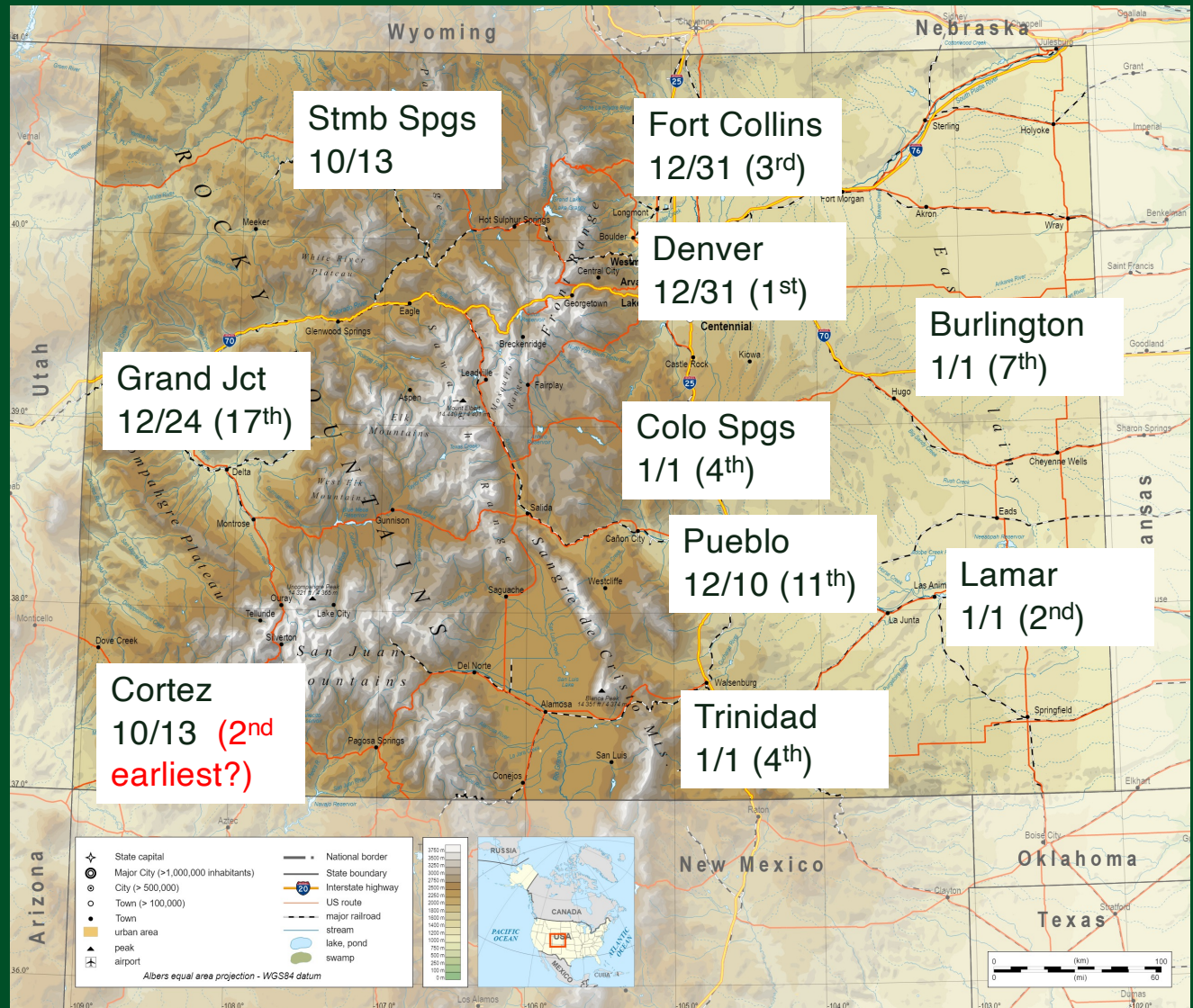
Gif and stats from NWS Pueblo



The Late Start

Map of 1st snow dates ($\geq 1"$) and ranks (e.g. 3rd latest first snow for Fort Collins)

Loveland's 1st snow was the latest on record (only goes back to 2000)



The
Marshall
Fire was
enabled in
part by a
late snow
season



Photo credit: NWS Boulder

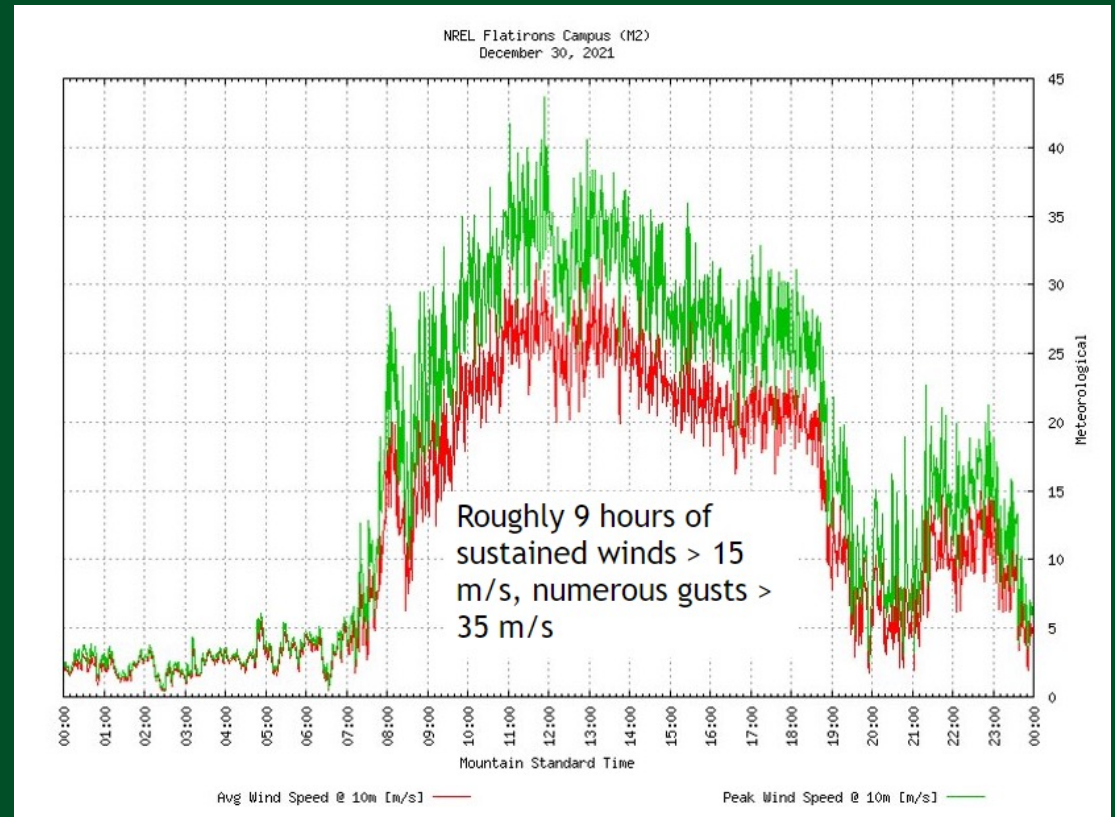


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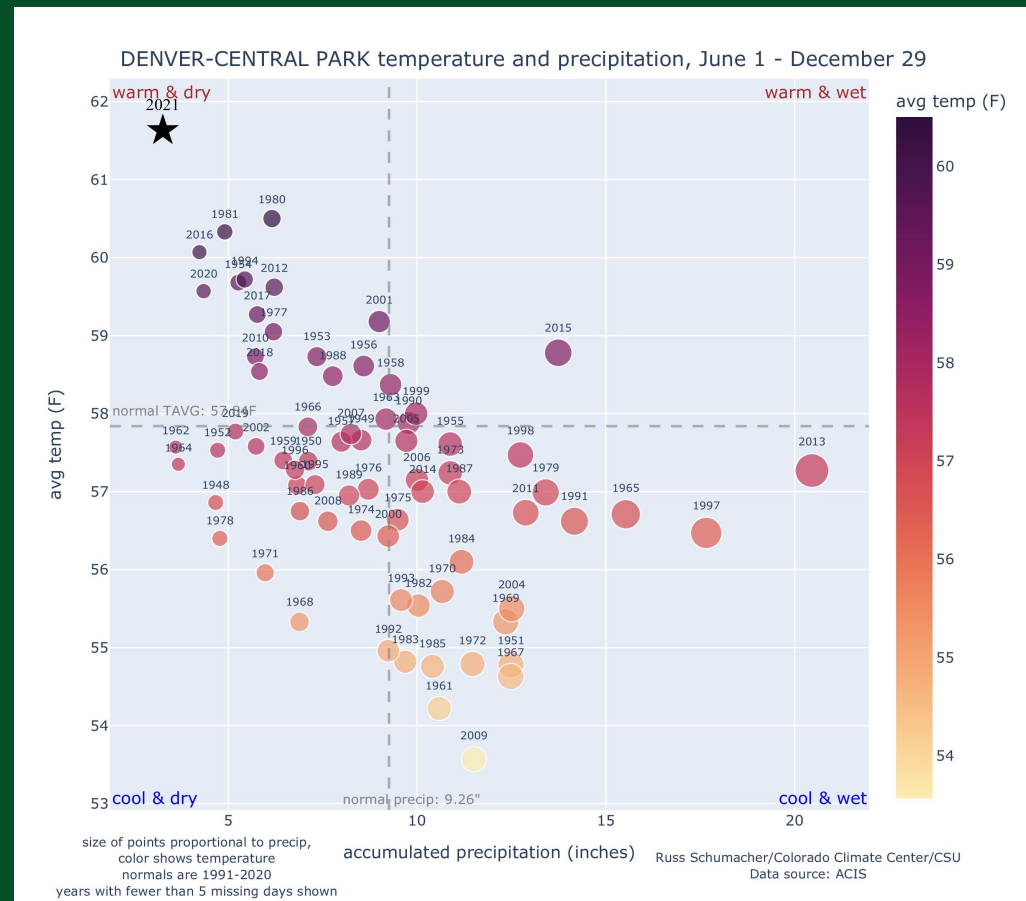
The Marshall Fire was enabled in part by a late snow season

- The event was also weather-driven
- Boulder received sustained downslope wind gusts > 80mph with extremely dry air



The Marshall Fire was enabled in part by a late snow season

The beginning of the snow season was part of an unprecedented warm and dry stretch from June-December 2021



The air hurts my face

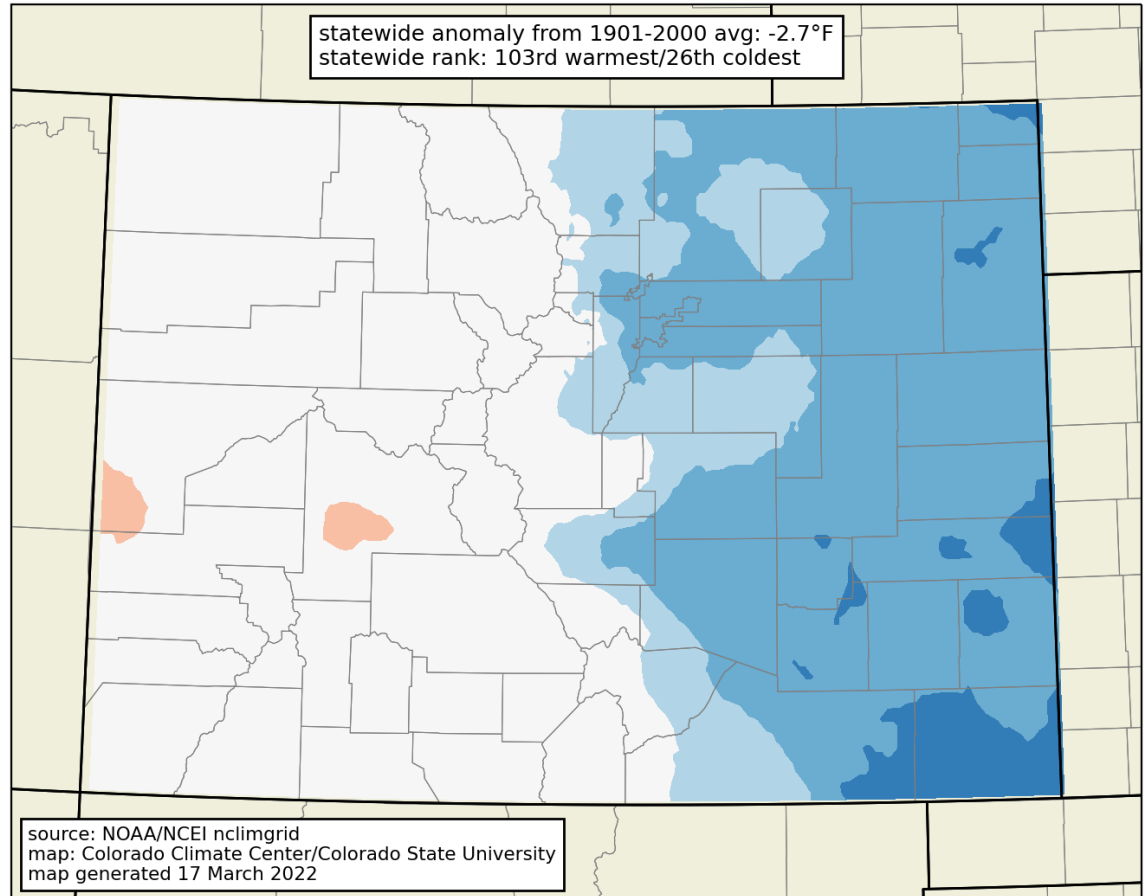


DepressedAlien.com

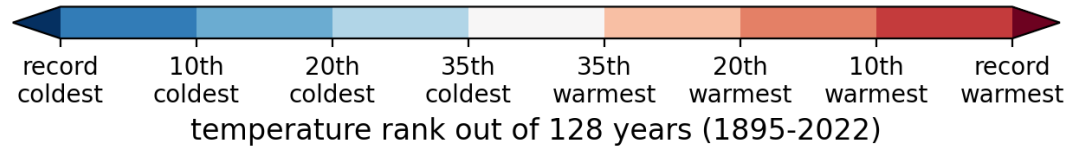
Why am I living where
the air hurts my face

average temperature rank: February 2021

statewide anomaly from 1901-2000 avg: -2.7°F
statewide rank: 103rd warmest/26th coldest

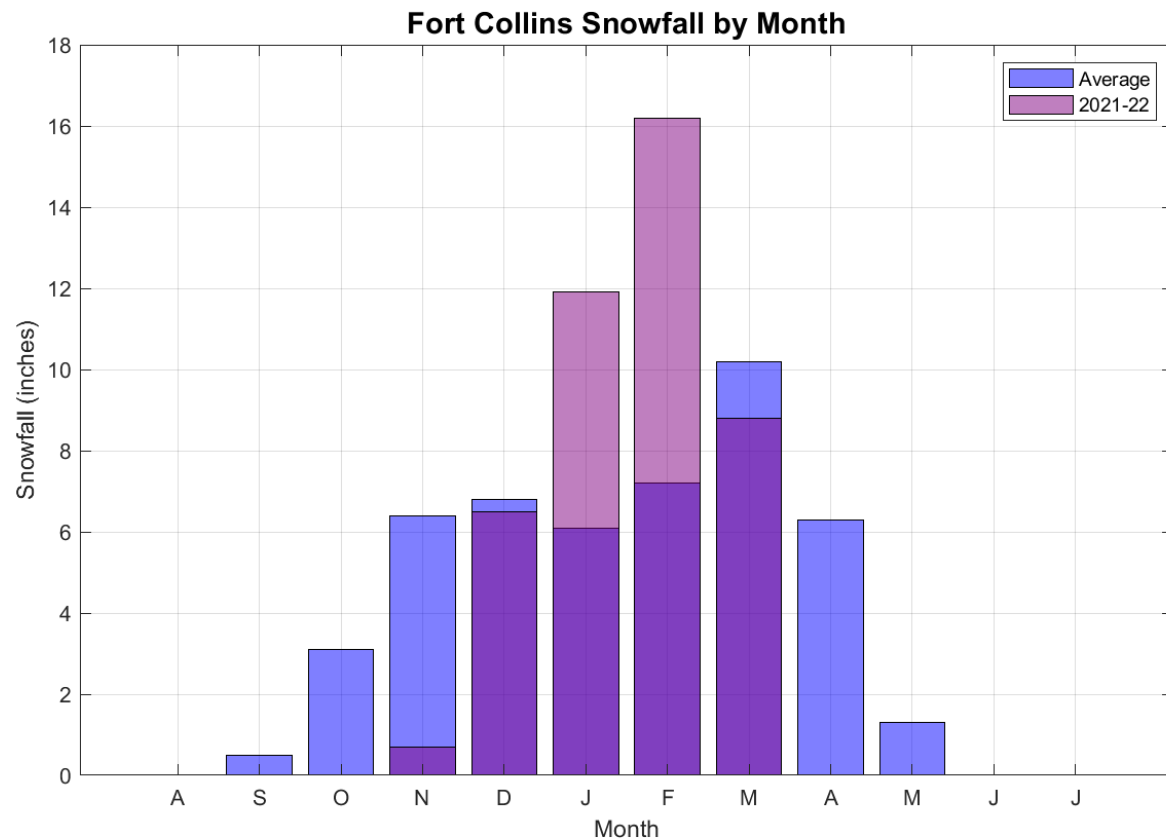


source: NOAA/NCEI nclimgrid
map: Colorado Climate Center/Colorado State University
map generated 17 March 2022



Monthly Breakdown

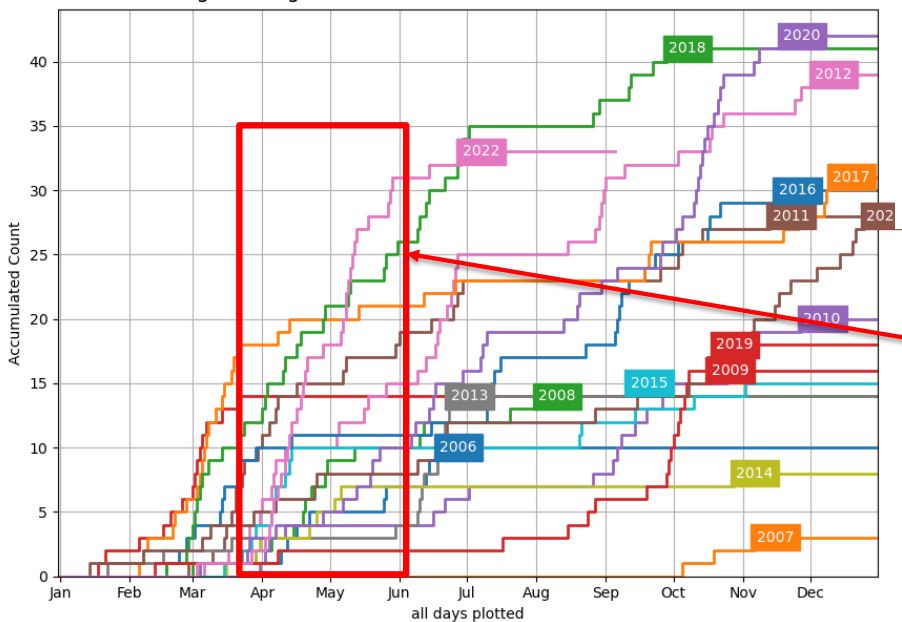
- The snow season started late, but was active through mid-winter
- February was cold and snowy



Wind with no Snow



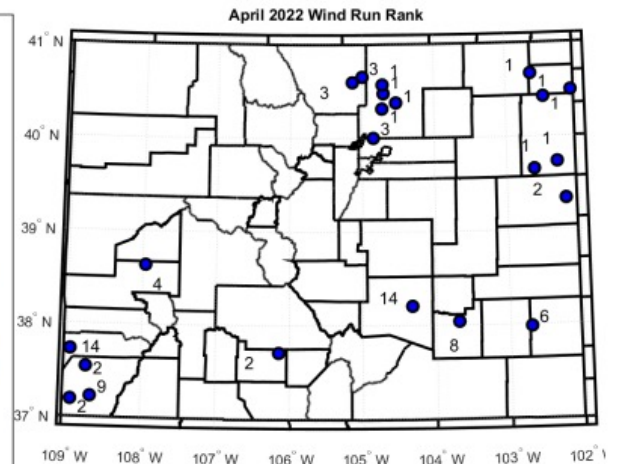
NWS WFO: Denver (BOU)
Red Flag Warning Count



Generated at 6 Sep 2022 5:35 PM CDT in 0.88s

IEM AutoPlot App #44

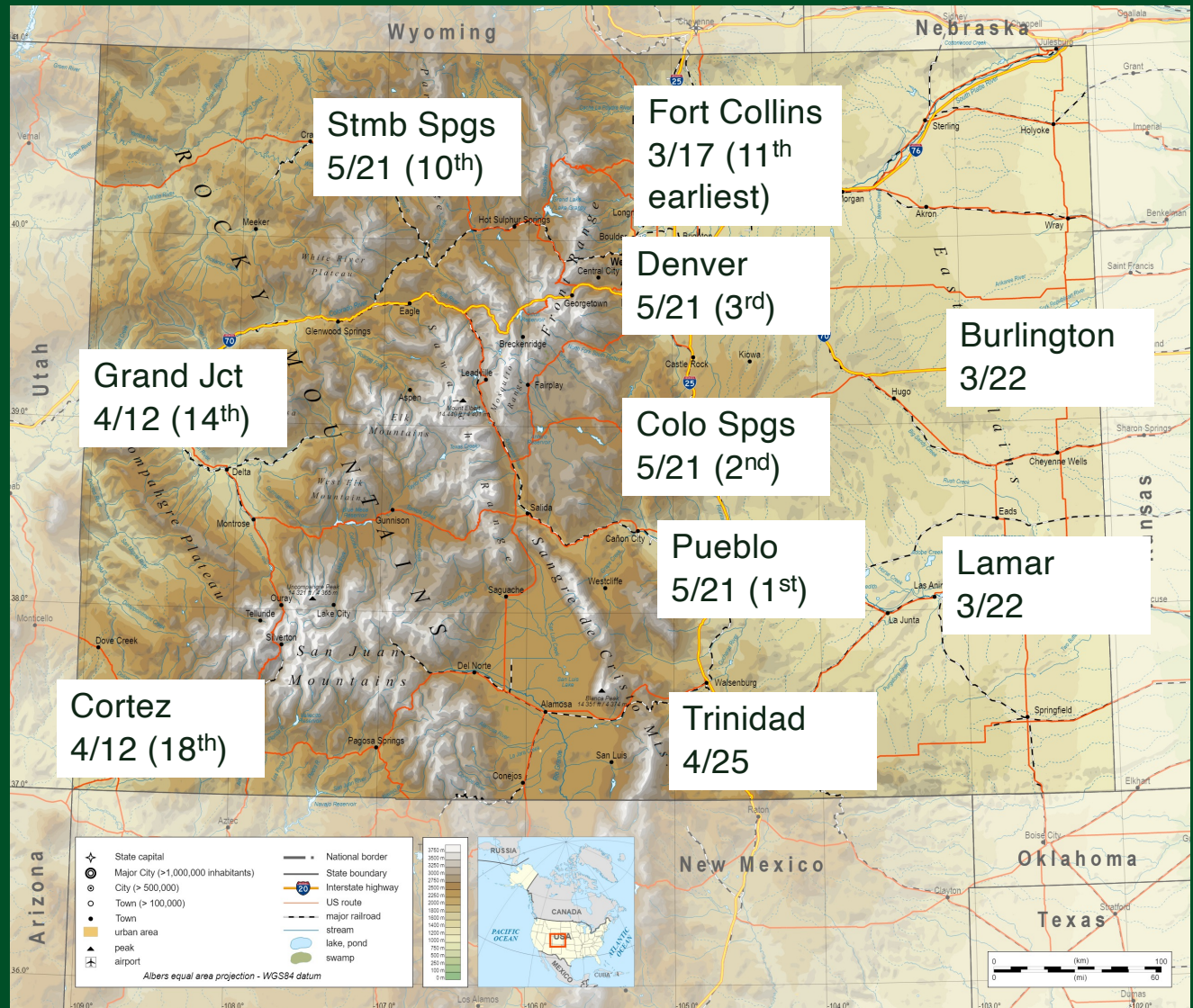
The biggest weather story in April was the relentless wind. Although April is typically the windiest month of the year for much of Colorado, 2022 took that to a new level. For many CoAgMET stations in northeast CO (with records back to the 1990s), it was the windiest April on record. It was also very windy in southeast and southwest CO, though not as extreme. The sunny, windy conditions also led to record evaporative demand (PET Rank below) in many locations.

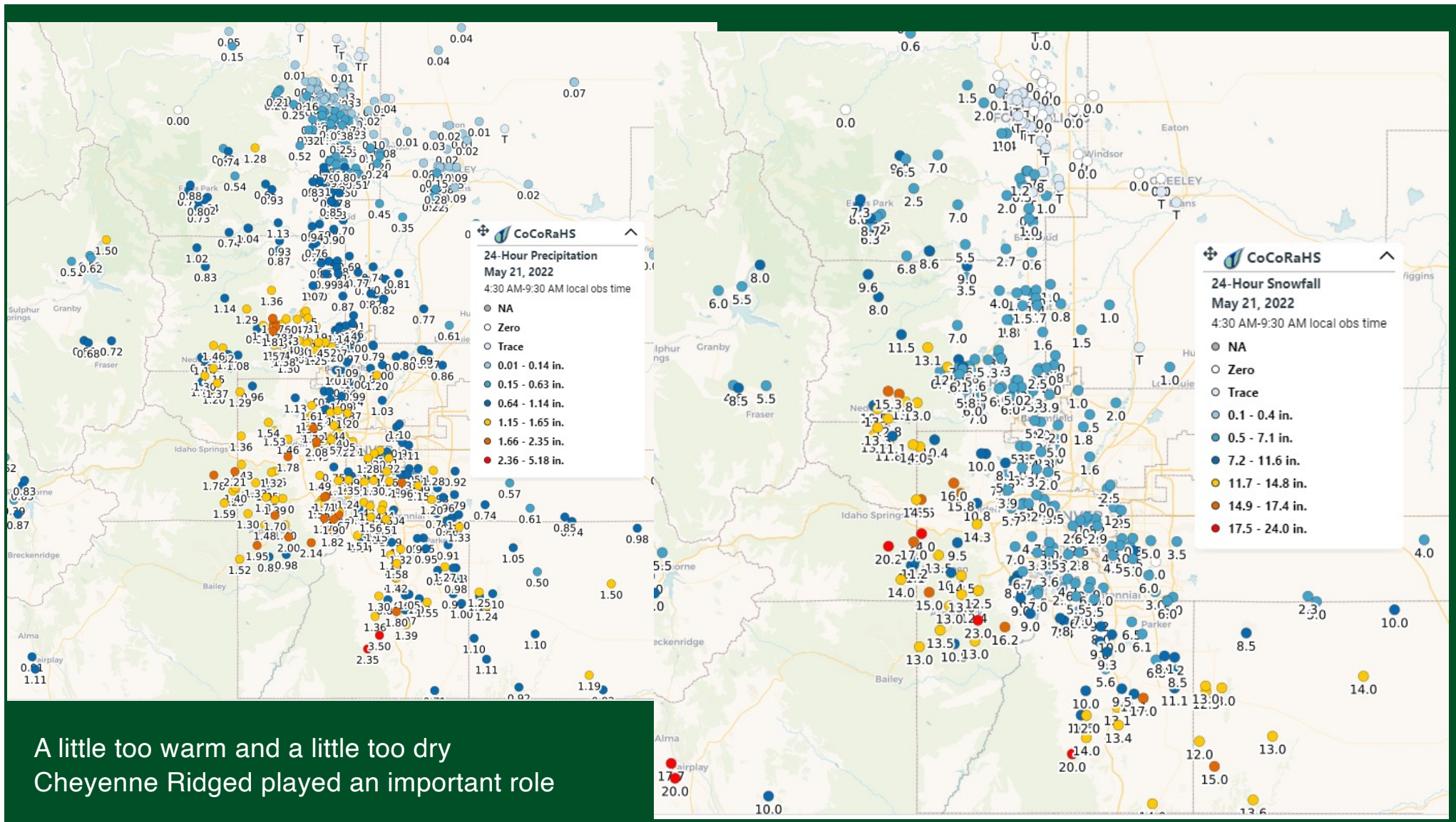


(above) April ranking for wind run at long-term CoAgMET stations.
(below) April rankings of wind and potential evapotranspiration at long-term CoAgMET stations

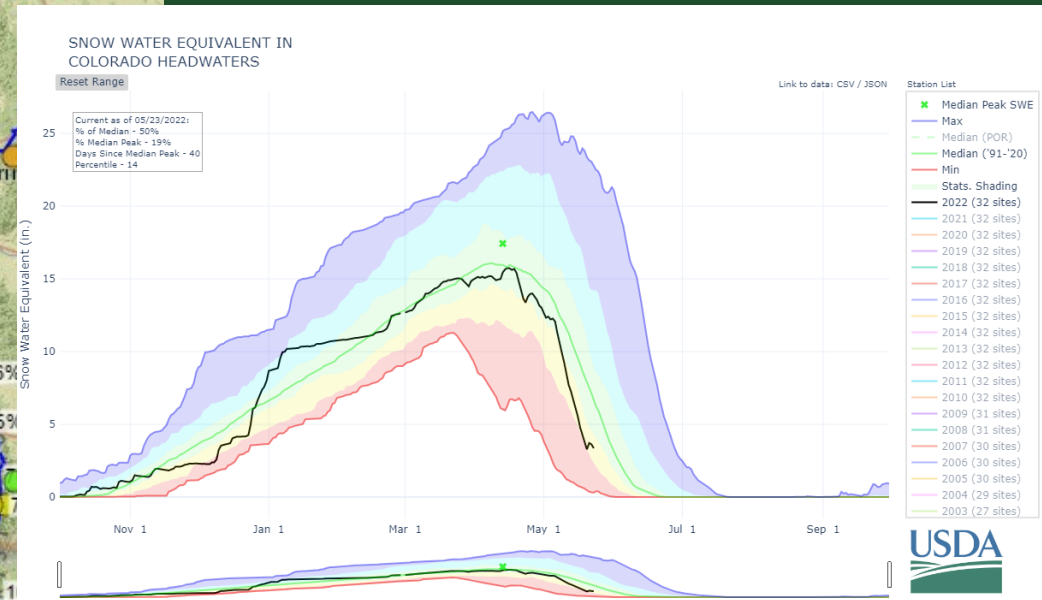
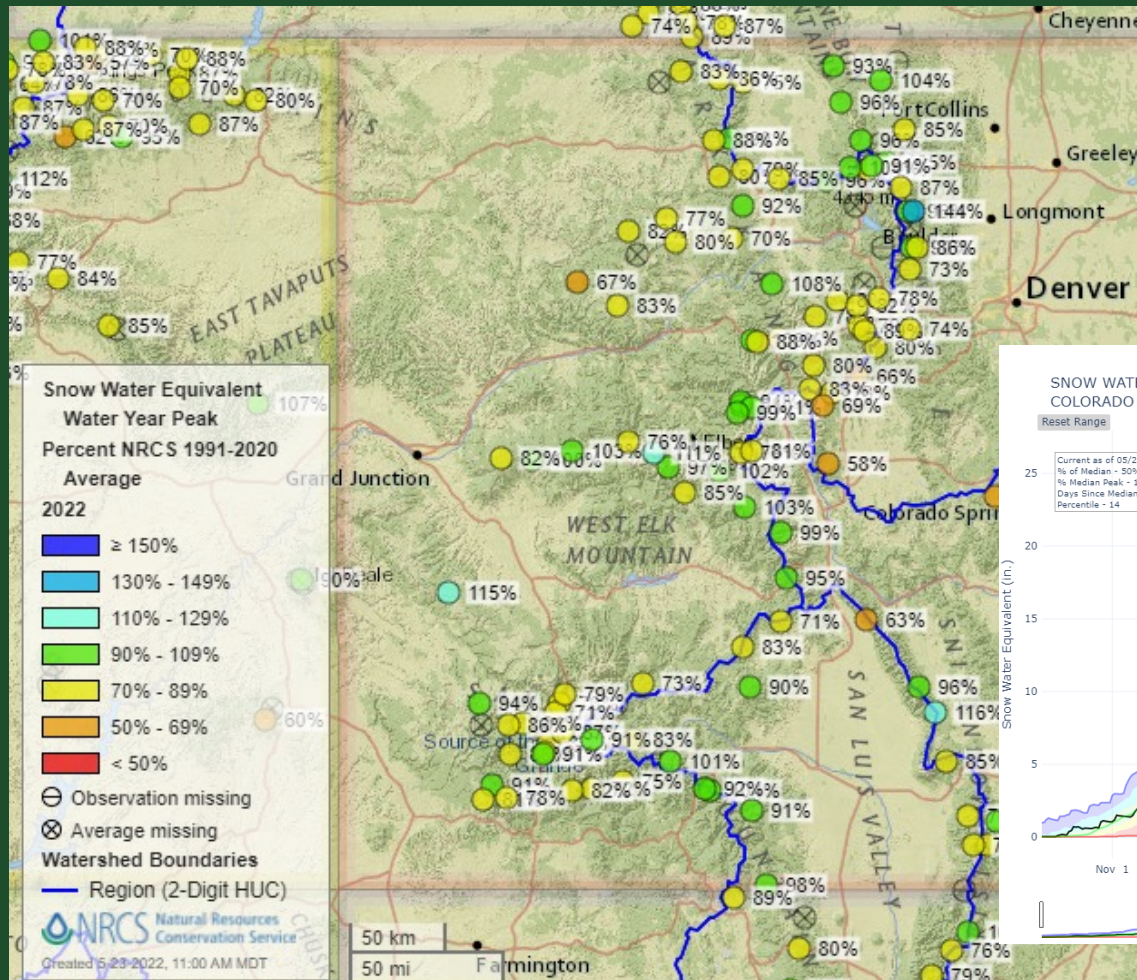
Many red flag warnings through the dry/windy months of April and early May

The Late End





Below Normal Peak Snowpack for most of CO



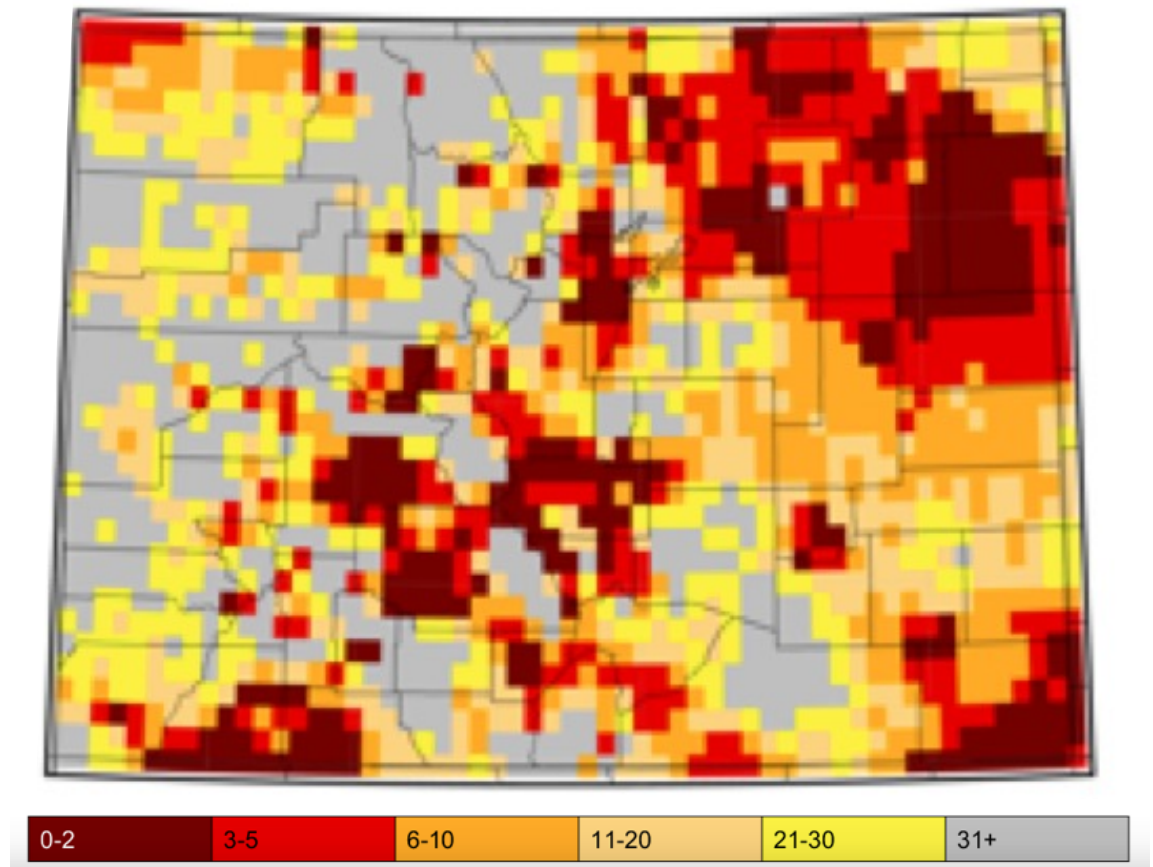
Dry soil conditions can reduce runoff efficiency

Dry soils prior to snowpack season could reduce runoff

This is not as important as snowpack for predicting runoff

Not as bad as the last two years, but soils still a bit drier

Top meter soil moisture percentiles
November 23, 2021



How much runoff do we expect from snowpack?

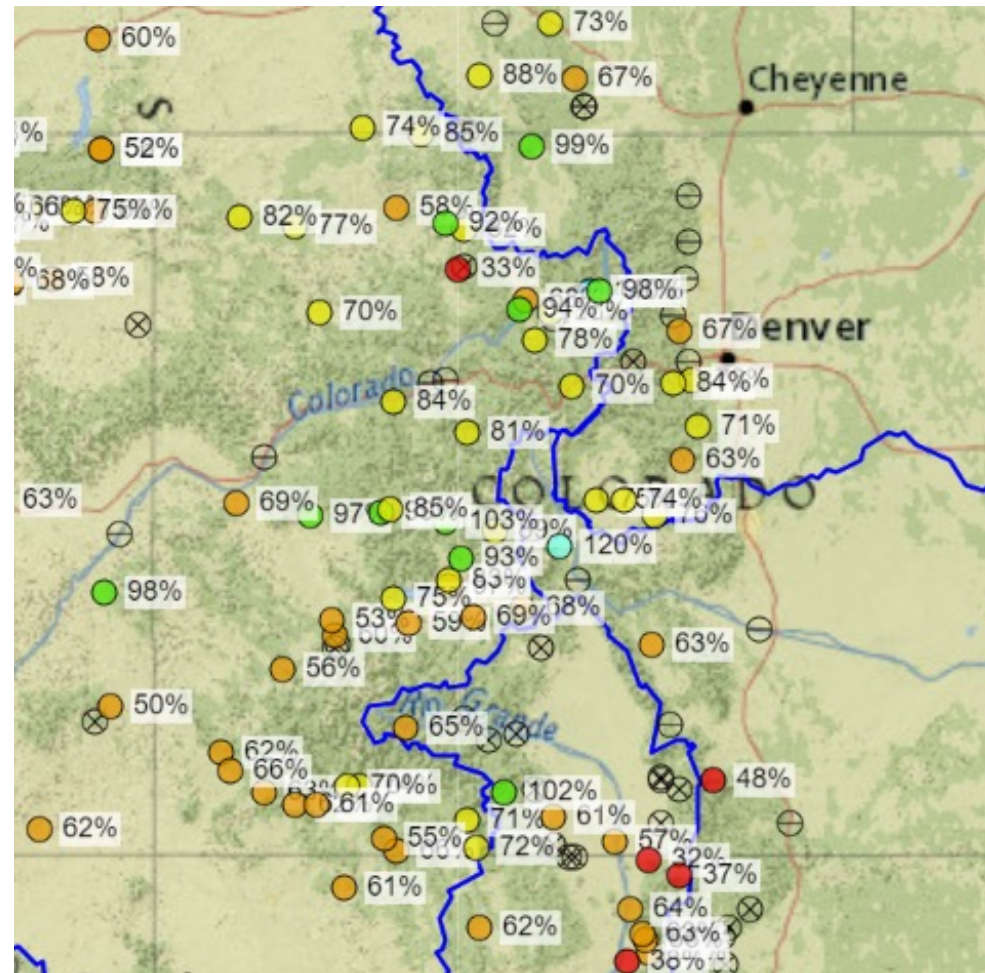
A reminder that lower snowpack values can amplify lower runoff

Percent of Normal Peak Snowpack (1991-2020)	Percent of Normal Naturalized Flows (1991-2020) Headwaters	Percent of Normal Naturalized Flows (1991-2020) Gunnison	Percent of Normal Naturalized Flows (1991-2020) Yampa	Percent of Normal Naturalized Flows (1991-2020) San Juan
60	42	39	40	48
70	57	54	55	61
80	71	69	70	74
90	86	85	85	87
100	100	100	100	100
110	114	115	115	113
120	129	131	130	126
130	143	146	145	139
140	158	162	160	152

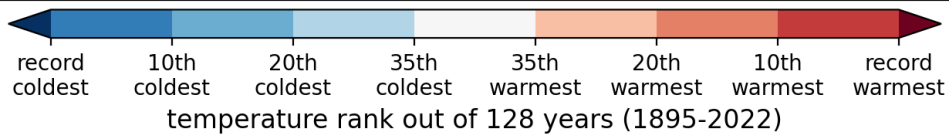
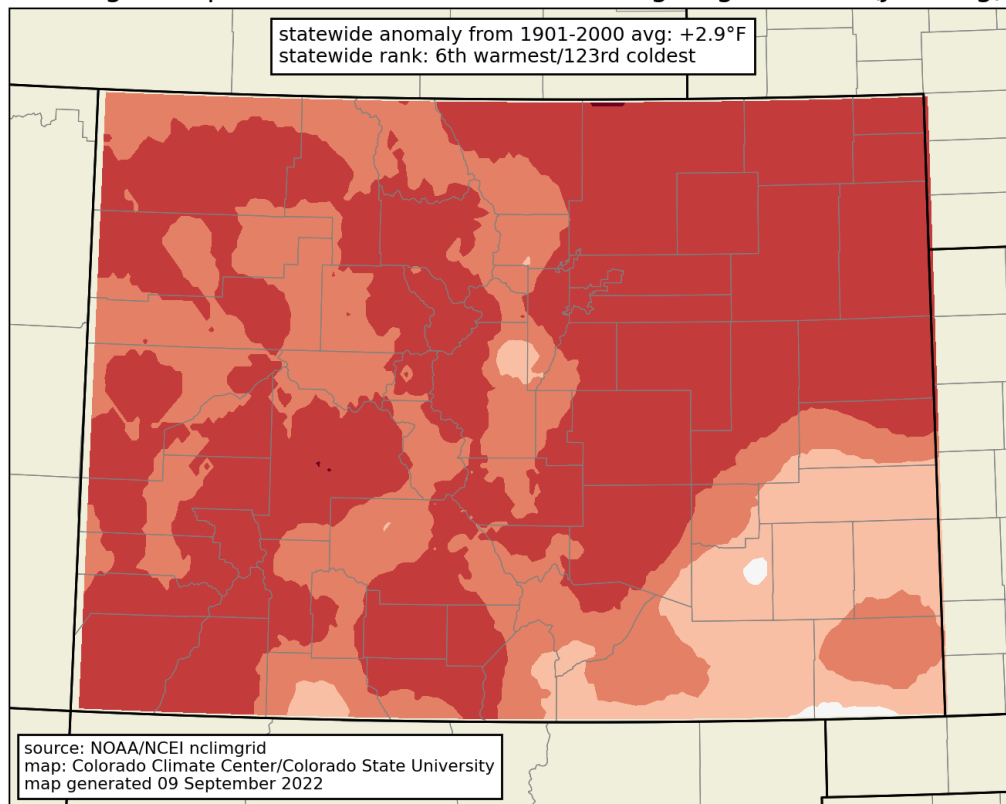


Another Low Runoff Year

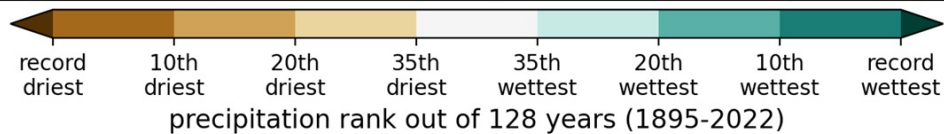
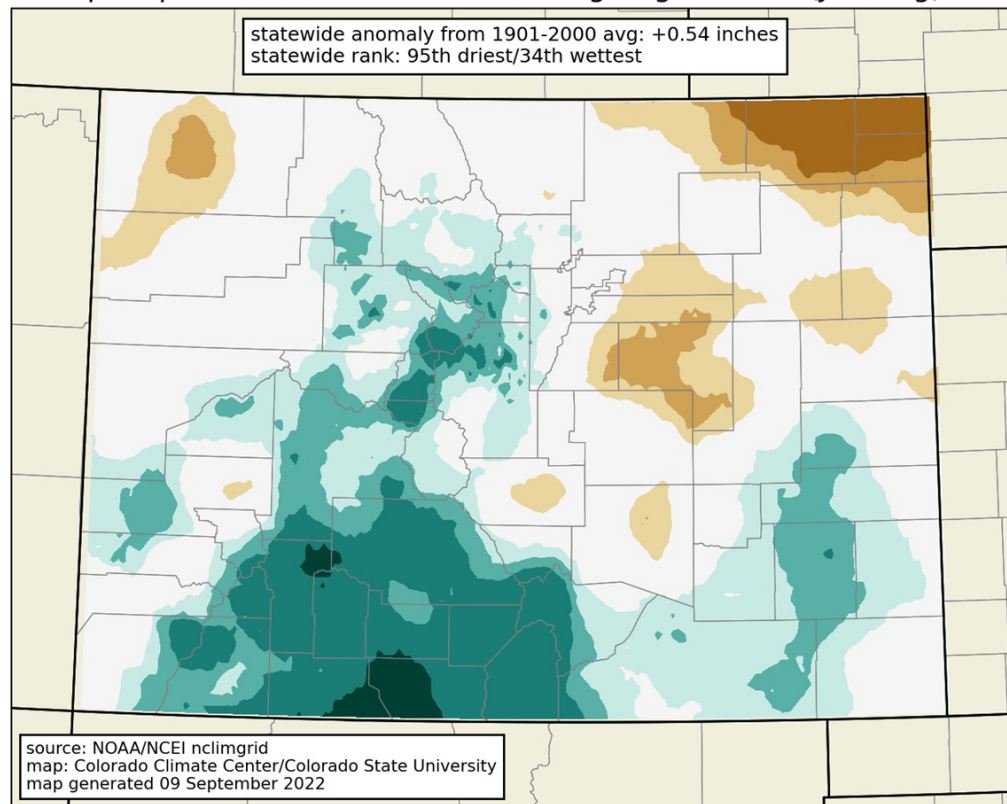
- Both low antecedent soil conditions and a dry, windy spring contributed to an inefficient runoff in 2022
- Both 2020 and 2021 were inefficient runoff years as well, especially 2021!



average temperature rank: 3 months ending August 2022 (Jun-Aug)



precipitation rank: 3 months ending August 2022 (Jun-Aug)



Cameron Peak Flood

Heavy rain over the
Cameron Peak burn
scar on July 15th,
2022 responsible for
two fatalities

Photo credit:
Larimer County
Sheriff



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July 2022 heat wave: Where did it rank?

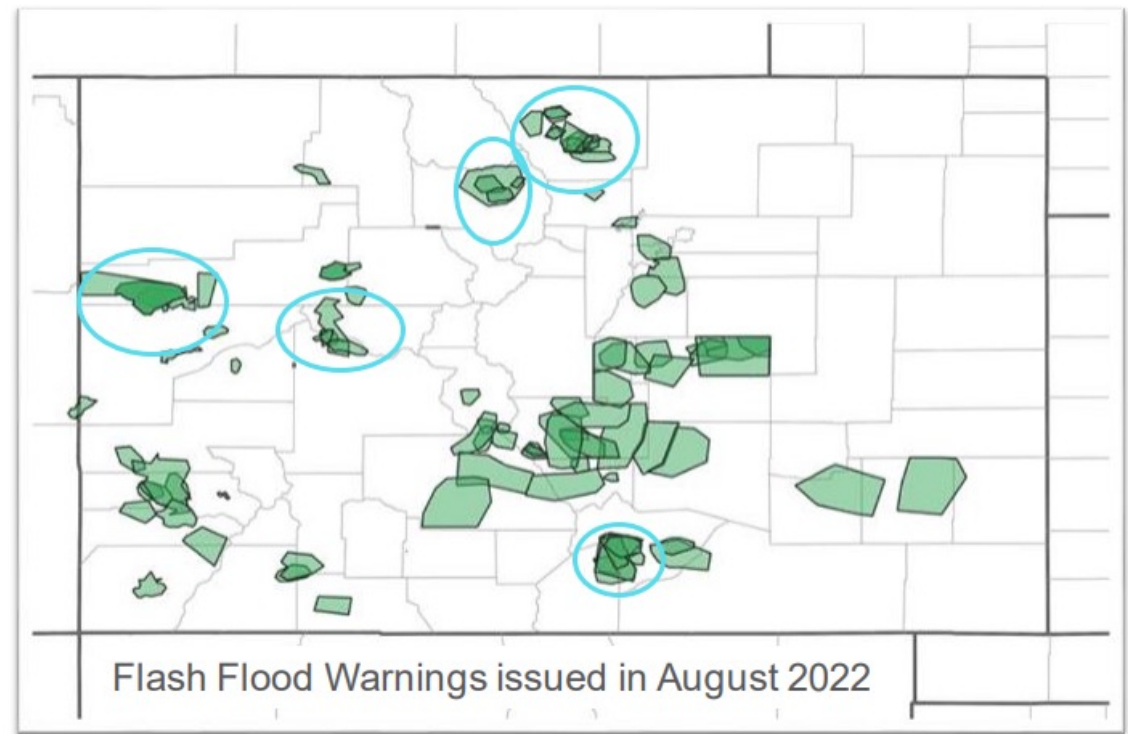
A combination of hot days and unusually warm nights during mid-July led to new records for the warmest 10-day period at some long-term stations.

Station	Rank among all-time hottest 10-day periods	Dates	10-day average temperature
Fort Collins	1 st	July 14-23	79.4°F
Greeley UNC	1 st	July 14-23	84.0°F
Montrose	1 st	July 14-23	80.5°F
Walsh 1 W	1 st	July 15-24	86.2°F
Denver International AP	6 th	July 14-23	82.0°F
Colorado Springs	8 th	July 14-23	78.4°F
Denver-Central Park	12 th	July 14-23	80.4°F
Pueblo	17 th	July 14-23	83.1°F
Grand Junction	22 nd	July 14-23	85.1°F

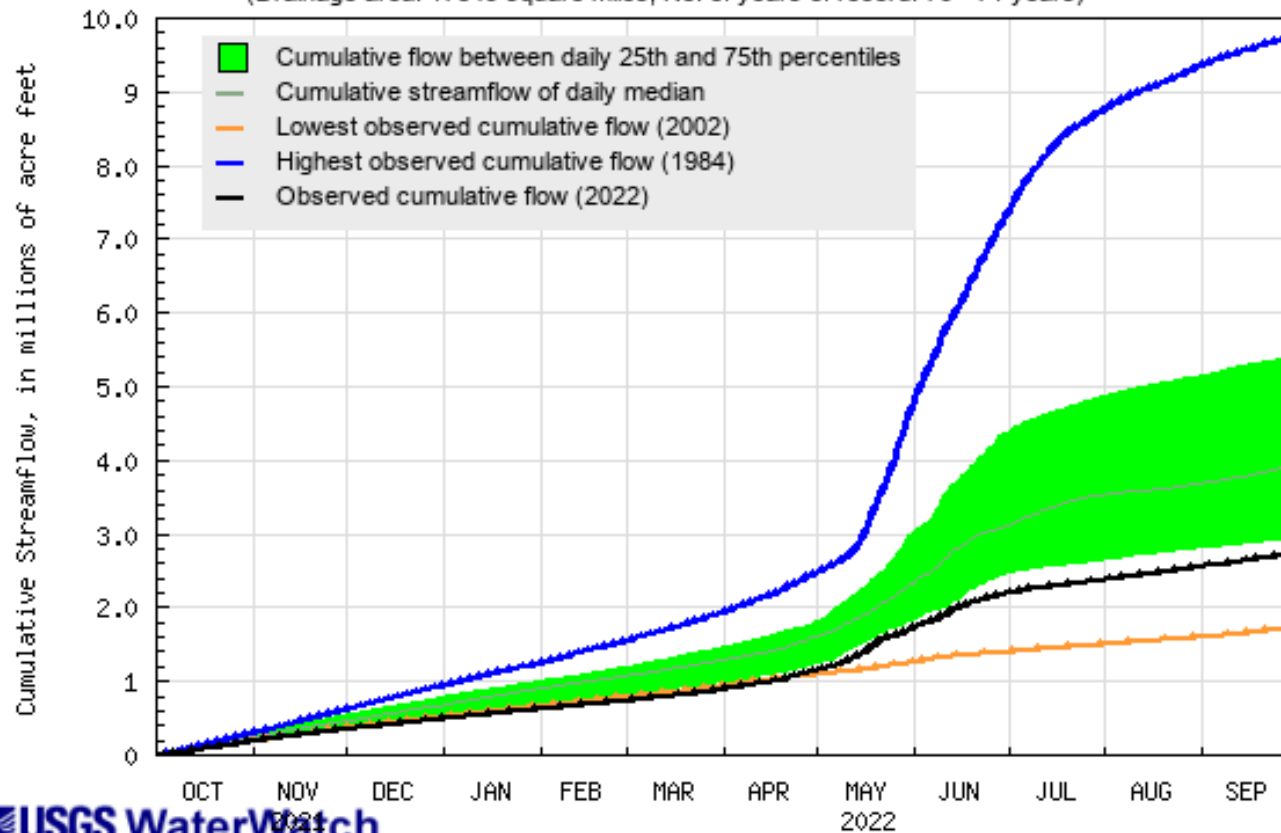


August Flash Flooding

- 19 people rescued from vehicles in August 7th flash flood on I70
- Walsh recorded 4.36" of rain on August 17, which set a new all time single-day precipitation record at that station, with records
- back to the 1960s. The previous record was 4.30" on July 8, 1982.
- Alamosa received 1.60" of rain in 37 minutes on August 22. That
- makes it the 2nd wettest day in their record



USGS 09163500 COLORADO RIVER NEAR COLORADO-UTAH STATE LINE
(Drainage area: 17849 square miles, No. of years of record: 70 - 71 years)



USGS WaterWatch

Last updated: 2022-10-18

Our best runoff
year since 2019,
but still below
historical
averages

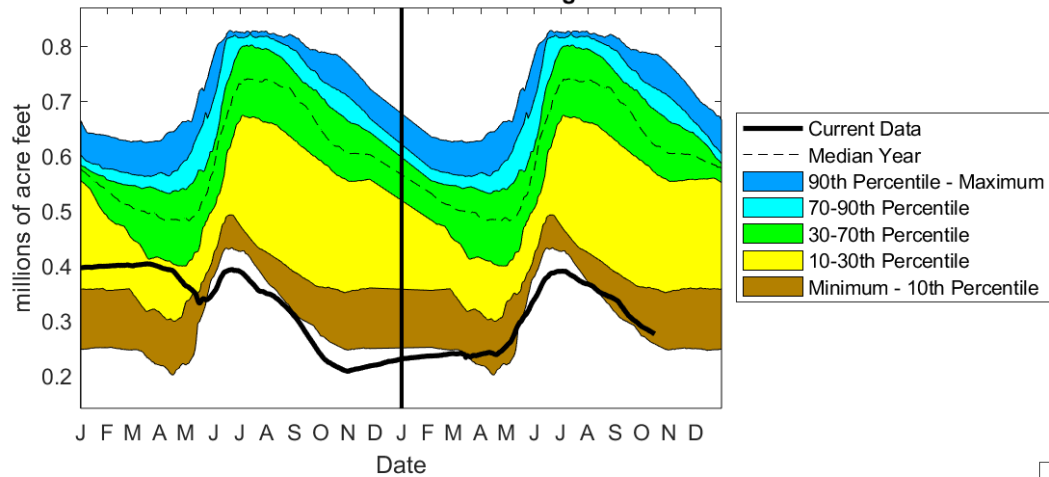
This isn't your
grandpa's
hydroclimate
anymore either



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Blue Mesa Reservoir Level 10/16/2022
47 Percent of 1981-2020 Average

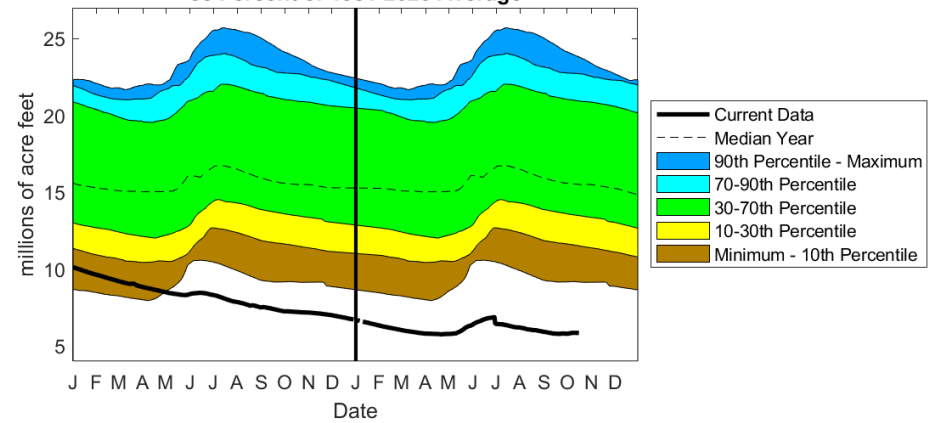


Western Colorado reservoirs
 impacted by long-term drought

Lake Powell and Lake Mead
 are still at all-time low storage
 values

See others on our drought page:
<https://climate.colostate.edu/drought/>

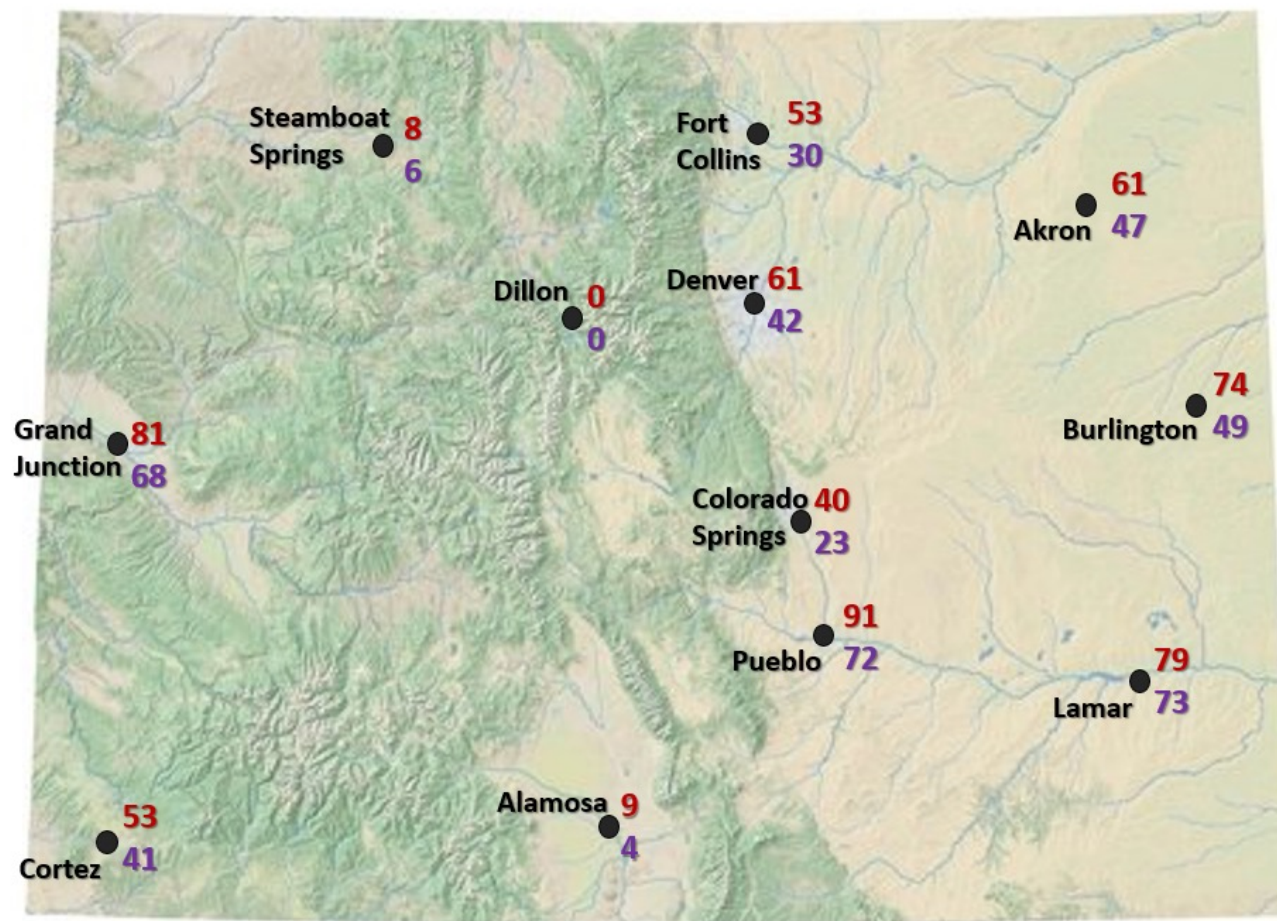
Lake Powell Level 10/16/2022
35 Percent of 1981-2020 Average



90 Degree Days in 2022

More heat than normal all across the state.

5 of Steamboat's 8 90 degree days occurred in September



2022

1991-2020
Average

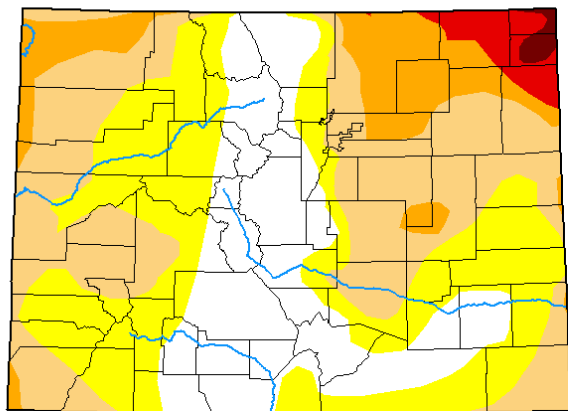


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2022 Drought Changes

U.S. Drought Monitor Colorado



October 4, 2022

(Released Thursday, Oct. 6, 2022)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	24.95	75.05	43.62	13.41	3.16	0.57
Last Week 09-27-2022	15.46	84.54	45.65	15.47	3.73	0.57
3 Months Ago 07-05-2022	1.52	98.48	82.84	44.60	5.06	0.07
Start of Calendar Year 01-04-2022	0.00	100.00	95.49	67.08	22.25	0.00
Start of Water Year 09-27-2022	15.46	84.54	45.65	15.47	3.73	0.57
One Year Ago 10-05-2021	10.34	89.66	54.10	26.59	12.97	1.95

Intensity

None	D2 Severe Drought
D0 Abnormally Dry	D3 Extreme Drought
D1 Moderate Drought	D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

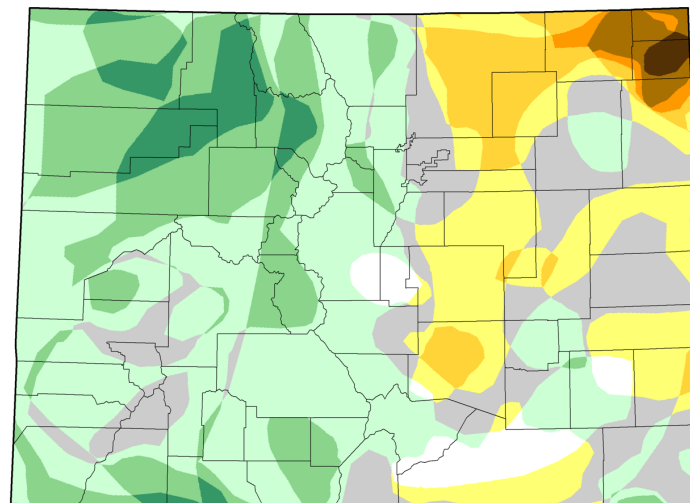
Author:

Brad Pugh
CPC/NOAA



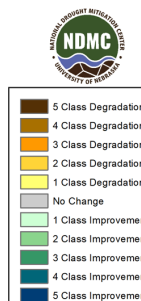
droughtmonitor.unl.edu

U.S. Drought Monitor Class Change - Colorado 52 Week



October 4, 2022
compared to
October 5, 2021

droughtmonitor.unl.edu



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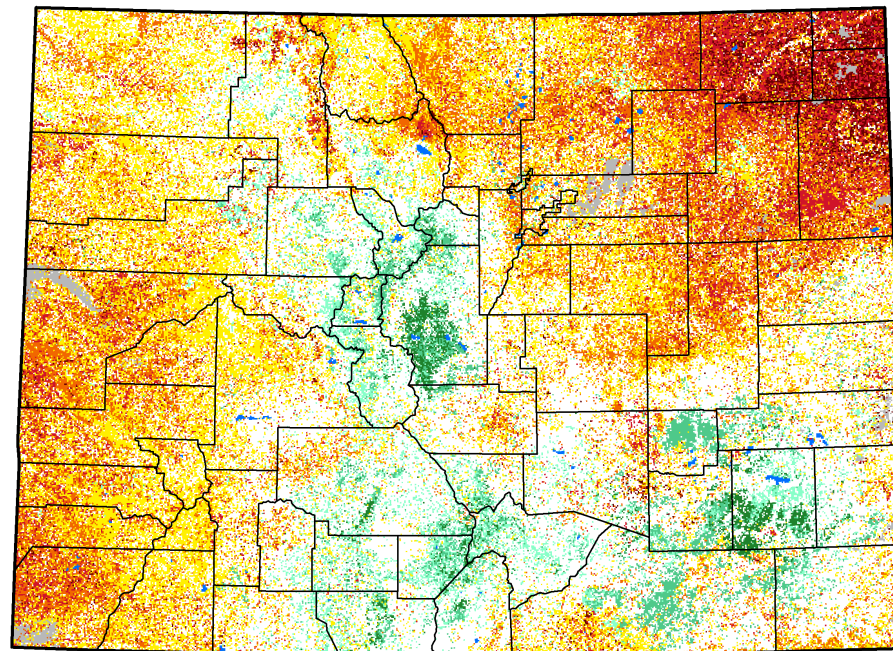


Warm and Dry -> Stressed Vegetation

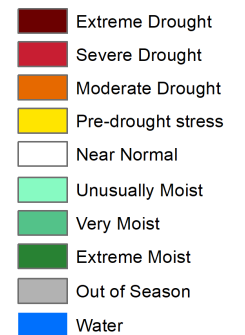
- Satellite vegetative health measurements show extreme drought in NE CO, but moist vegetation over the High Country
- Douglas County leans toward the dry side (moderate drought)

Vegetation Drought Response Index Complete: Colorado

September 18, 2022



Vegetation Condition



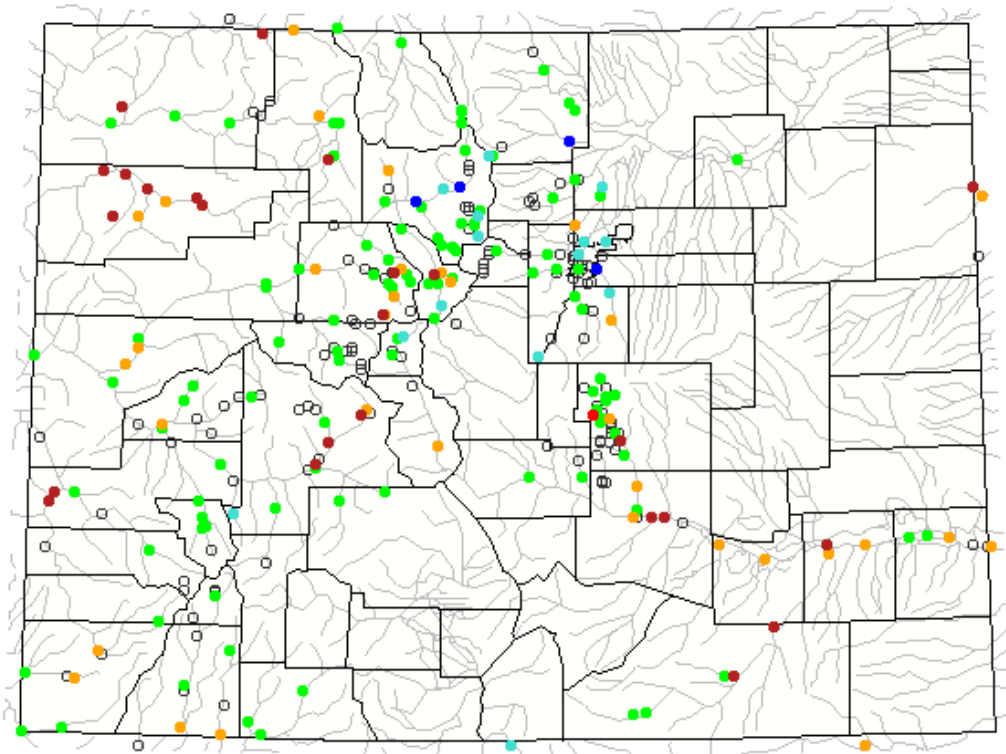
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Sunday, September 25, 2022

Streamflow

- River flows across Colorado are mostly in the normal range, but expected to return to slightly below normal baseflows this fall
- Reservoir levels in central CO are still near normal
- (yes, much of Douglas County uses aquifer water, but strong surface water supplies are needed to recharge the aquifer)



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



In Summation

- WY 2022 was Colorado's 3rd consecutive warmer (6th) and drier (35th) than normal year.
- Long-term drought persists, but has shifted. Western Colorado experienced some amelioration while conditions worsened for northeast Colorado. It was a third straight year with below normal runoff.
- The water year started with unprecedented warmth October-December. The snow season started late for low elevations. A wet spring followed by a hot/dry summer/fall set the stage for an event like the Marshall Fire to occur.
- Late winter and early spring were relatively cool and windy, setting records in April for most wind and red flag warnings. May snowfall ended the snow season later than usual.
- Summer was warm and dry for some, but we had an active monsoon with many flash flood warnings over the high country.





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Providing information and expertise on Colorado's complex climate

Thanks, and let's keep in touch!

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