

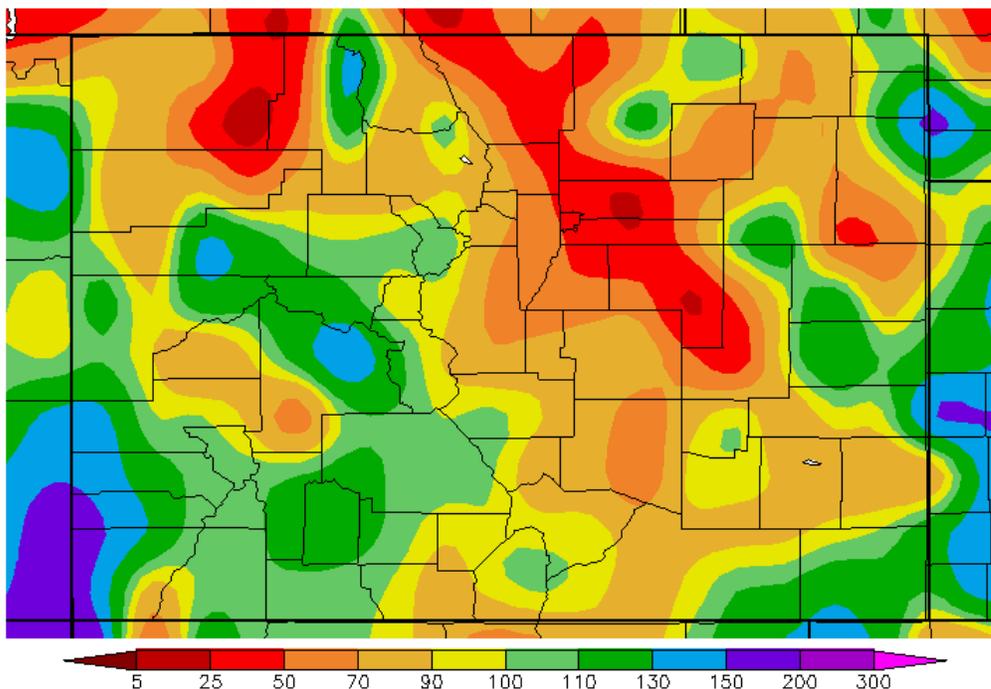
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Monsoon Season Review

Overall, the southwest monsoon was fairly underwhelming this summer with much of Colorado experiencing below average precipitation during July and August, especially across the Front Range and northern I-25 corridor. Portions of southwest Colorado and the western slope, along with spotty areas across the far eastern plains did experience near to above average precipitation this summer, however.

Percent of Average Precipitation (%)
7/1/2016 – 9/5/2016



Generated 9/06/2016 at WRCC using provisional data.
NOAA Regional Climate Centers

The first half of July ended up very dry statewide as the seasonal monsoonal pattern took longer than usual to get going. Over the second half of July through early August, the monsoonal pattern finally developed, but it was not particularly impressive outside of a few active days. By mid August, an active upper level pattern across the Western U.S. developed, which essentially put an early end to the typical monsoonal pattern, although low pressure systems over the second half of the month did tap into subtropical moisture to result in persistent thunderstorm activity across the state, with better rainfall existing over the mountains. Cooler air was associated with these weather systems as well, which resulted in some of the higher mountain ranges, such as the San Juans and Pikes Peak, receiving snowfall over the final week of August.

Across the I-25 corridor from Denver to Ft. Collins, precipitation was unimpressive for the most part, although an active pattern of low pressure systems during August did result in a persistent pattern of isolated thunderstorms, most of which were “high-based” and produced lighter and spotty rainfall. The Colorado Springs area received noticeably more rainfall this summer than the Denver area, but even so precipitation over the two-month period ended up slightly below average for this area. Below is a look at some select precipitation amounts across Colorado and the departure from average.

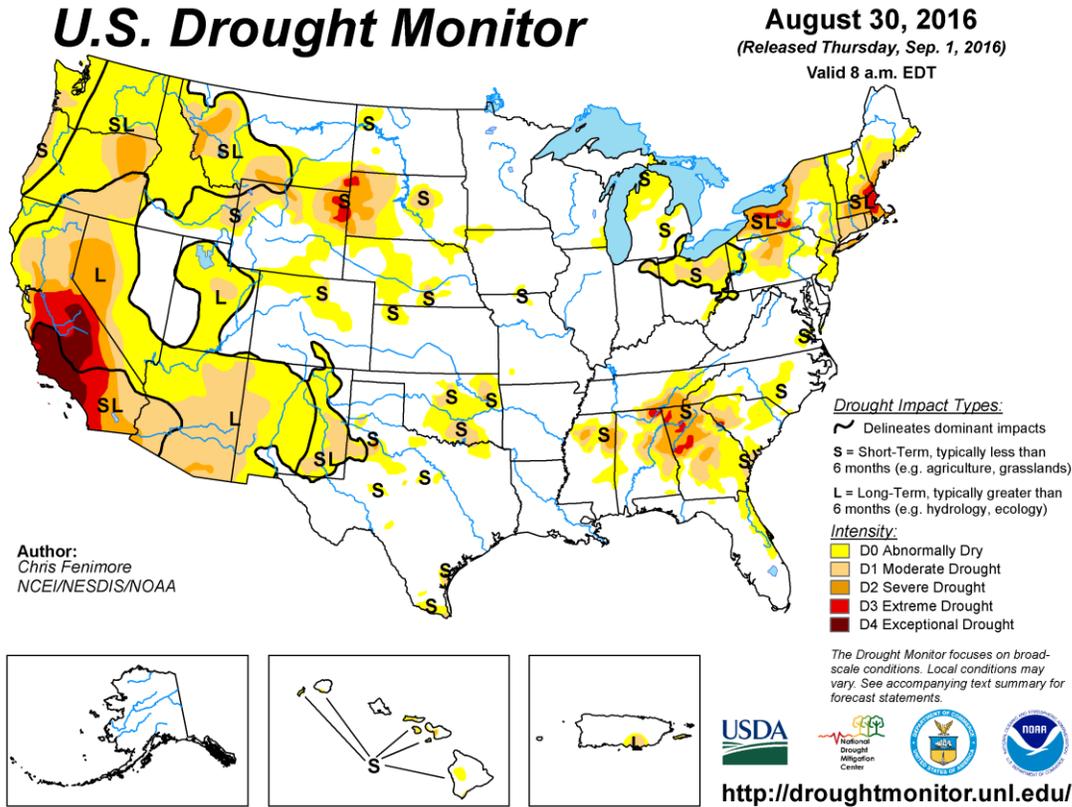
	July-Aug Precip.	Dept. from Avg.
Denver (DIA)	1.29”	-2.56”
Centennial	2.35”	-2.28”
Colorado Springs	5.47”	-0.71”
Pueblo	2.37”	-2.01”
Leadville	4.23”	+0.35”
Grand Junction	1.15”	-0.41”
Durango	3.51”	-0.39”
Aspen	4.28”	+0.89”

Even though there was a high frequency of thunderstorms from mid-July through Labor Day across most of the state, rainfall amounts were well below average across the Denver metro area. DIA only recorded 1.29” of rain over the two-month period, with about half of that occurring on July 1st. Rainfall amounts were higher across most of the metro area compared to DIA, but even in Centennial, rainfall was only about 50% of average. Heavier rains fell across Colorado Springs this summer, including several localized instances of flash flooding and severe weather, but overall precipitation at the Colorado Springs Airport ended up a little below average over the two-month period.

In the high country and western slope, rainfall amounts varied by location with Grand Junction and Durango finishing a little below average in precipitation, but in Leadville and Aspen, precipitation ended up above average this summer. Interestingly enough, this had just as much if not more to do with the active upper level pattern, more reminiscent of early fall, over the second half of August than the monsoonal pattern of July and early August. Overall, the monsoon was much weaker this summer compared to the past few summers, but some areas in the state still did ok with rainfall, and most (but not all) of the state remains drought-free thanks to good moisture last winter and spring.

Drought Update

Moderate drought has developed across a narrow portion of the I-25 corridor from the northern Denver metro area to near the Wyoming border. The rest of Colorado remains drought-free, although areas of abnormally dry conditions have developed across northern part of the state as well as portions of south central Colorado. Elsewhere across the west, areas of severe to exceptional drought exist across central/southern California as well as the Black Hills region of South Dakota.



The map below shows forecasted temperature deviances for September 2016. There are equal chances for above or below normal temperatures across the majority of Colorado, except for extreme southwest portions where there is a slight bias toward above normal temperatures.

August Stats

TEMPERATURE (IN DEGREES F)

AVERAGE MAX	86.3	NORMAL 87.2	DEPARTURE -0.9
AVERAGE MIN	56.2	NORMAL 57.9	DEPARTURE -1.7
MONTHLY MEAN	71.2	NORMAL 72.5	DEPARTURE -1.3
HIGHEST	97 on 8/9		
LOWEST	47 on 8/20, 8/25		

DAYS WITH MAX 90 OR ABOVE	15	NORMAL	11.5
DAYS WITH MAX 32 OR BELOW	0	NORMAL	0.0
DAYS WITH MIN 32 OR BELOW	0	NORMAL	0.0
DAYS WITH MIN ZERO OR BELOW	0	NORMAL	0.0

TEMPERATURE RECORDS

8/27 – record low of 48 tied

HEATING DEGREE DAYS

MONTHLY TOTAL	15	NORMAL 10	DEPARTURE 5
SEASONAL TOTAL	15	NORMAL 16	DEPARTURE -1

COOLING DEGREE DAYS

MONTHLY TOTAL	218	NORMAL 244	DEPARTURE -26
YEARLY TOTAL	762	NORMAL 688	DEPARTURE 74

PRECIPITATION (IN INCHES)

MONTHLY TOTAL	0.22	NORMAL 1.69	DEPARTURE -1.47
YEARLY TOTAL	10.01*	NORMAL 11.36	DEPARTURE -1.35*
GREATEST IN 24 HOURS	0.12 on 8/24		
DAYS WITH MEASURABLE PRECIP.	4		

*Error on 3/23 due to undercatch from snow

SNOWFALL (IN INCHES)

MONTHLY TOTAL	0.0	NORMAL 0.0	DEPARTURE 0.0
SEASONAL TOTAL	0.0	NORMAL 0.0	DEPARTURE 0.0
GREATEST IN 24 HOURS	0		

GREATEST DEPTH 0

WIND (IN MILES PER HOUR)

AVERAGE SPEED 9.9 mph
PEAK WIND GUST 55 mph from the N on 8/19

MISCELLANEOUS WEATHER

NUMBER OF DAYS WITH THUNDERSTORM	11	NORMAL	8
NUMBER OF DAYS WITH HEAVY FOG	3	NORMAL	1
NUMBER OF DAYS WITH HAIL	0		
NUMBER OF SUNNY DAYS	4		
NUMBER OF PARTLY CLOUDY DAYS	22		
NUMBER OF CLOUDY DAYS	5		
AVERAGE RELATIVE HUMIDITY	47%		

September Preview

September is the first month of meteorological autumn and a season of transition across the Denver metro area and Colorado. Temperatures start to cool off noticeably over the course of the month with an average monthly high of 78.5 and an average monthly low of 48.3. Hot weather can still occur during September, typically during the first half of the month, with an average of 3.4 days reaching or exceeding 90 degrees. Heat waves are usually short-lived by this time of year, though. The temperature has never reached 100 degrees in September, with an all-time record high of 97, which has occurred on multiple dates. Although not common, Denver can occasionally see early season tastes of winter in September. The earliest snowfall on record in Denver occurred on September 3rd, 1961. More often than not, Septembers end up snowless in Denver, but it does happen on occasion with a long-term average of 1.3" of snow during the month. There have even been some years in which heavy snow occurred in September, most notably in 1971 when a monthly record of 17.2" fell. The heaviest single-storm snowfall in September occurred in 1936 when 16.5" was recorded, which actually ranks as one of Denver's top 25 snowfalls of all-time. The Denver area is actually experiencing a September snow drought, as the last time measurable snow officially occurred in September was in 2000. On average, the first freeze of the season in Denver occurs in early October, but it occasionally happens in September. The earliest freeze on record occurred on September 8, 1962. September is typically one of Denver's drier and more pleasant months with an average monthly precipitation of only 0.96". However, there are exceptions such as during the historic flood event of 2013, which resulted in a monthly record of 5.61". Typically, however, thunderstorm season quickly winds down in early September with an average of just 4 thunderstorm days over the course of the month. Sunny days are more common through September, but the first early season wet system

of the fall often occurs during the month, bringing a day or two of cooler temperatures and steady light rain to the metro area, as well as the first meaningful snows of the season to the higher elevations of the Front Range. For September 2016, we are anticipating near to slightly below normal temperatures and near to slightly above normal precipitation. Thunderstorm season has largely tapered off with a warm and dry pattern expected to persist through the 11th. However, the middle part of the month is expected to feature a pattern shift to cooler and wetter than normal conditions, likely giving us a true taste of fall. Over the latter part of the month, there's a better chance of seeing a return to drier and more pleasant weather, as wet patterns in September tend to be shorter-lived.

**DENVER'S SEPTEMBER CLIMATOLOGICALLY NORMAL
(NORMAL PERIOD 1981-2010 DIA Data)**

TEMPERATURE

AVERAGE HIGH	78.5
AVERAGE LOW	48.3
MONTHLY MEAN	63.4
DAYS WITH HIGH 90 OR ABOVE	3.4
DAYS WITH HIGH 32 OR BELOW	0
DAYS WITH LOW 32 OR BELOW	0.8
DAYS WITH LOWS ZERO OR BELOW	0

PRECIPITATION

MONTHLY MEAN	0.96"
DAYS WITH MEASURABLE PRECIPITATION	6.5
AVERAGE SNOWFALL IN INCHES	1.3"
DAYS WITH 1.0 INCH OF SNOW OR MORE	NA

MISCELLANEOUS AVERAGES

HEATING DEGREE DAYS	125
COOLING DEGREE DAYS	76
WIND SPEED (MPH)	8.0mph
WIND DIRECTION	South
DAYS WITH THUNDERSTORMS	4
DAYS WITH DENSE FOG	1
PERCENT OF SUNSHINE POSSIBLE	74%

EXTREMES

RECORD HIGH	97 on multiple dates
RECORD LOW	17 o 9/29/1985
WARMEST	69.4 in 2015
COLDEST	54.7 in 1912
WETTEST	5.61" in 2013
DRIEST	Trace in 1892, 1924
SNOWIEST	17.2" in 1971
LEAST SNOWIEST	0.0" in many years

Rainfall

May 2016 to October 2016

City	May	Jun	Jul	Aug	Sep	Oct	Total
Aurora (Central)	2.64"	1.42"	2.09"	1.06"			7.21"
Brighton	2.52"	1.57"	0.59"	0.55"			5.23"
Broomfield	1.42"	0.35"	0.12"	1.26"			3.15"
Castle Rock	2.64"	2.95"	0.59"	0.91"			7.09"
Colo Sprgs Airport	2.38"	1.04"	3.04"	2.43"			8.89"
Denver DIA	2.38"	1.62"	1.07"	0.22"			5.29"
Denver Downtown	1.54"	2.83"	0.51"	0.59"			5.47"
Golden	1.26"	1.00"	1.20"	2.52"			5.98"
Fort Collins	2.05"	0.22"	0.94"	0.96"			4.17"
Highlands Ranch	0.79"	2.20"	0.47"	2.01"			5.00"
Lakewood	0.98"	2.68"	0.94"	2.01"			6.61"
Littleton	0.94"	1.06"	2.01"	0.98"			4.99"
Parker	2.32"	2.72"	0.98"	0.35"			6.37"
Sedalia - Hwy 67	2.32"	2.48"	0.32"	1.72"			6.84"
Thornton	1.26"	0.39"	0.12"	1.26"			3.03"
Westminster	0.83"	1.50"	0.63"	2.20"			5.15"
Wheat Ridge	1.02"	2.09"	0.24"	0.87"			4.22"

Skyview Weather
2350 N Rocky View Rd
Castle Rock, CO 80108

Phone: (303) 688-9175
Fax: (303) 380-3338

E-mail: Tim@SkyviewWeather.com
On the web at www.SkyviewWeather.com

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