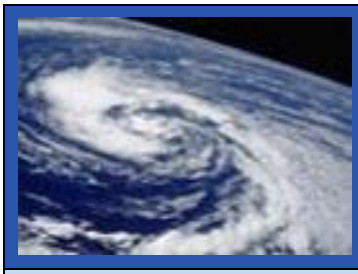


The Weather Wire

April 2019 **Volume 26 Number 4**

Contents:

Latent Heat & Diabatic Cooling – How Cold Does It Need to be to Snow?

Despite popular belief, the surface temperature does not need to be ≤ 32°F for it to snow. Remember that snowflake crystals are formed well above the surface, in a supersaturated/supercooled environment where the temperature is below freezing. The snowflakes grow larger and larger by accretion, eventually falling to the surface via gravity. Upon their descent, snowflakes begin to melt if they encounter above-freezing temperatures, but sometimes this process occurs very slowly. Snowflakes can sometimes survive thousands of feet of warmer temperatures as they fall, eventually arriving at the surface as an intact, frozen snowflake. However, like many concepts in meteorology, there's always a bit more to the story…

The concept of Latent Heat can be understood as a "hidden" form of heat energy which is either supplied or extracted when a substance changes phase. In our case, water is the substance and the phase is either solid, liquid, or gas (snow, rain, clouds). Latent Heat is common both higher in the atmosphere and also here at the surface where we live. Water is constantly changing phases on earth, resulting in either supplying or extracting heat to/from the environment. Why does this matter? Well, it's important to

consider Latent Heat when forecasting rain vs. snow, especially during the spring season here in Colorado.

Concerning the falling snowflake from earlier, consider the effect of melting on the surrounding environment. When a frozen snowflake begins to melt into a liquid, heat energy is taken from the environment. Thus, melting is a cooling process. Another example would be putting a few fresh ice cubes into your warm glass of iced tea. It doesn't take long to cool your iced tea down. Part of the reason it cools down is simply due to the heat transfer between the warm tea and cold ice (conduction), but it's also because the ice cubes are rapidly melting. The melting ice cubes extract heat from the environment, thus cooling the tea even faster.

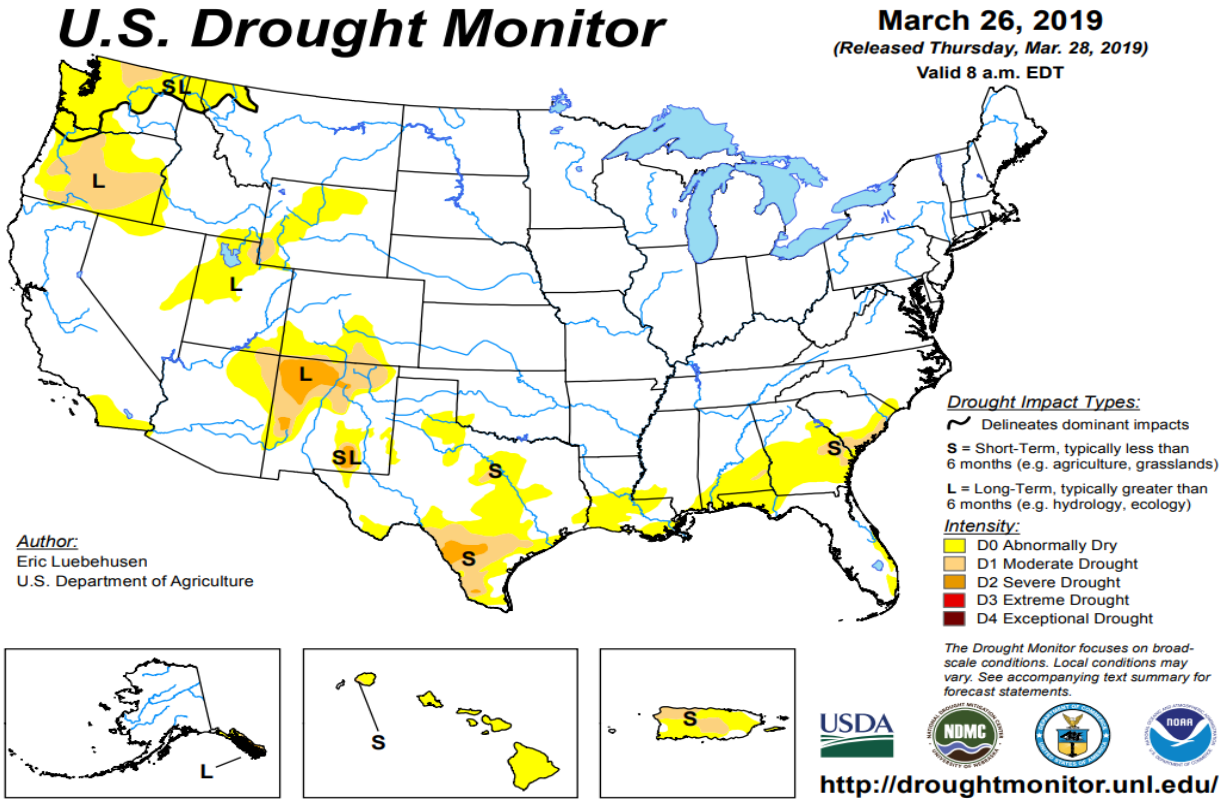
Suppose it's below freezing 5,000ft above the surface, and the supersaturated clouds are vigorously producing fluffy snowflakes which begin falling towards your neighborhood. But there's a problem – it's currently 53°F at your house. The air is just too warm for the snowflakes and they melt into rain drops. This process continues for a few hours, and you notice the temperature slowly dropping. Why is this happening? You guessed it – Latent Heat. The more the snowflakes continue melting, the colder it gets. Eventually, the temperature falls into the 30s, melting ceases, and the rain has become snow.

The cooling process associated with the phase change of water and addition/extraction of Latent Heat is known as Diabatic Cooling. Like melting, evaporation is also a cooling process. Sometimes the sub-cloud layer is simply too dry to support rain drops or snowflakes. The precipitation changes phases back into a gas, cooling the air via evaporation. This form of Diabatic Cooling is the exact same as what occurs with a swamp cooler. The more evaporation, the more cooling. If you've ever lived in a humid climate, you know swamp coolers are not very efficient. The ambient air is already moist, and water has trouble evaporating. But here in Colorado, the air is typically pretty dry, and we have a much greater potential for Diabatic Cooling to result.

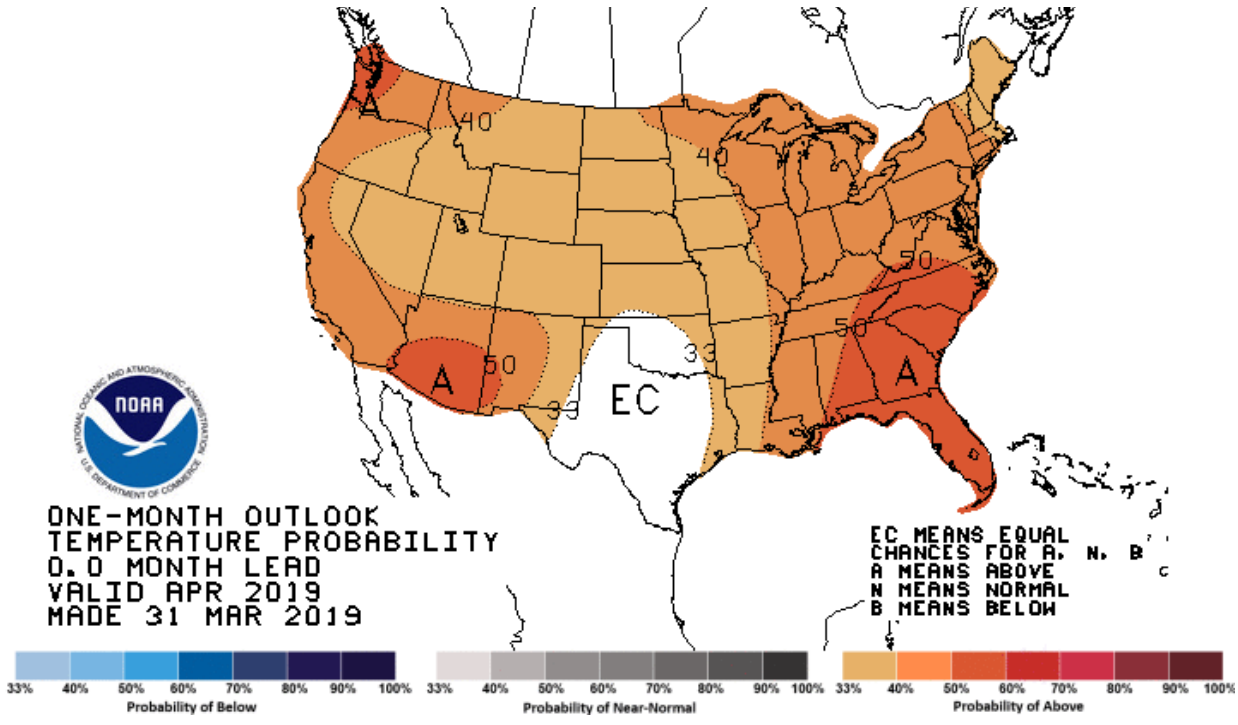
Thus, it’s fairly common during the spring months in Colorado for rain to eventually switch over to snow. Sometimes this is the result of a cold front arriving, actively transporting colder air into the area. But Diabatic Cooling also plays a major role. Once we introduce moisture into our warm and dry environment, melting and evaporation crank up the cooling, and before long we’re in the midst of a classic Colorado spring snowstorm.

Drought Update

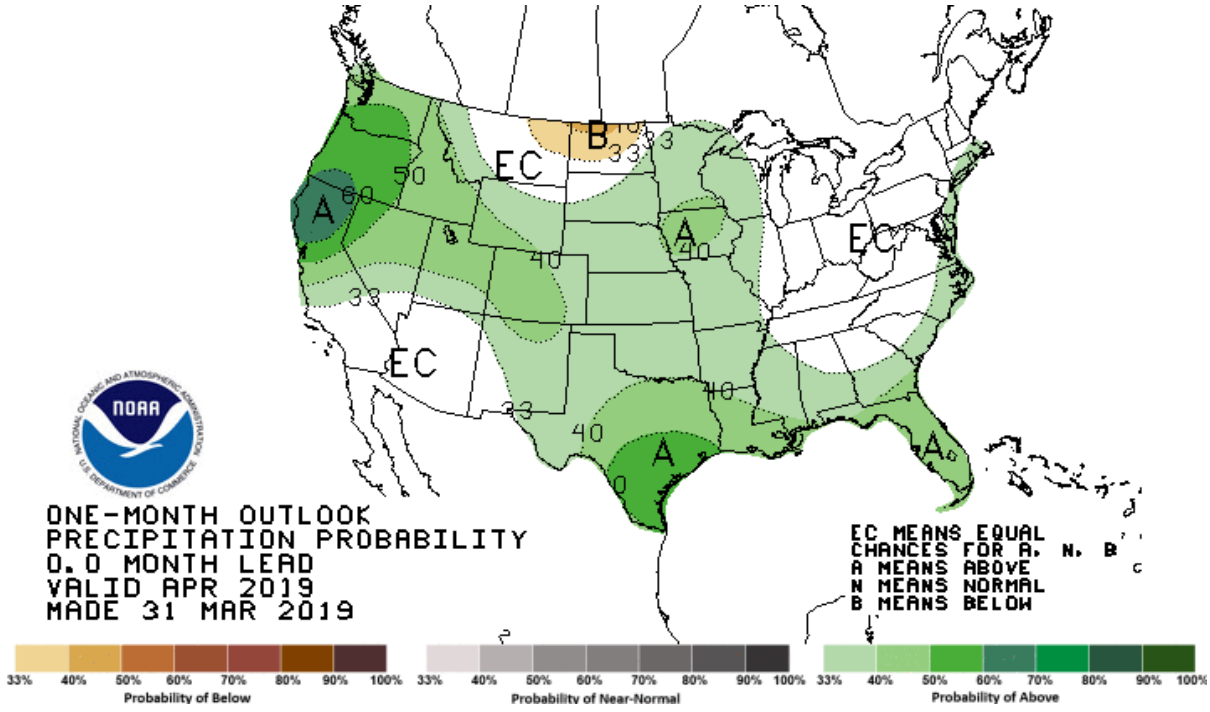
Drought conditions have been removed from most of Colorado with abnormally dry or moderate drought still lingering over far southern Colorado, but conditions continue to improve.



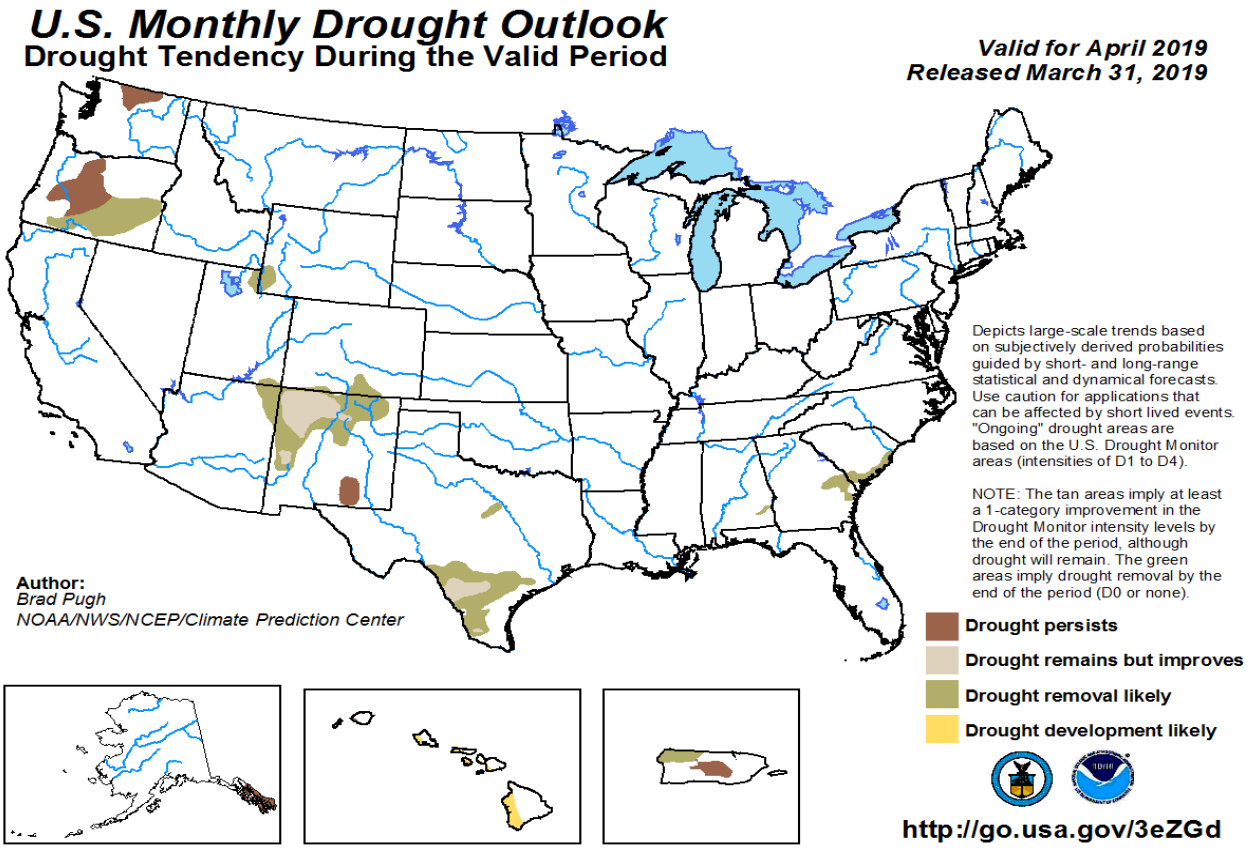
The map below shows forecasted temperature deviances for April 2019. There is a bias towards above normal temperatures all of Colorado.



The map below shows forecasted precipitation deviances for April 2019. There is a moderate bias towards above normal precipitation over Colorado, favoring areas west.

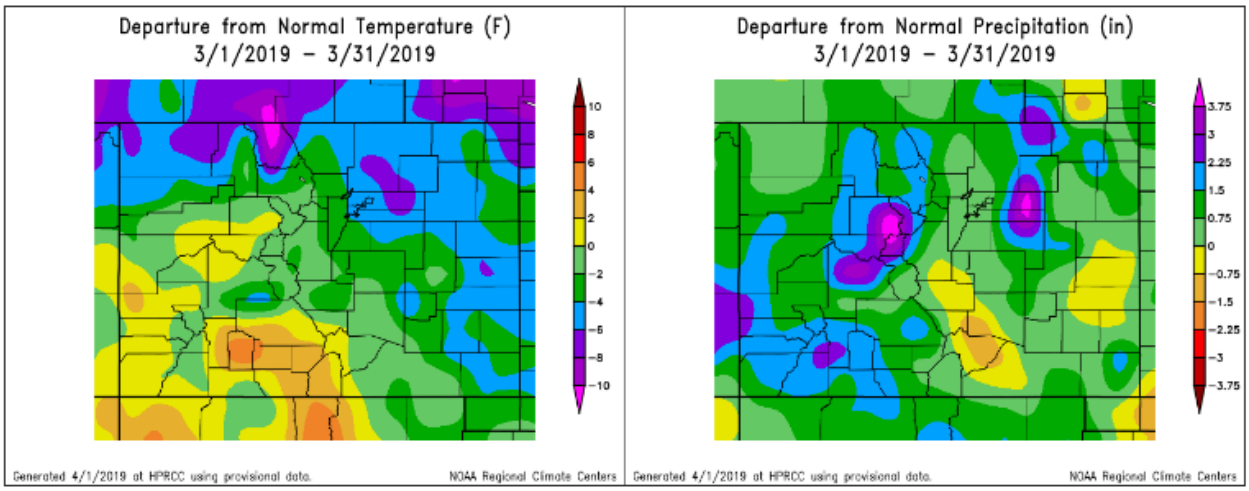


Drought removal is expected over the month of April over the southern portions of the state with drought free conditions over the majority of Colorado.



March Summary

March of 2019 was well below normal in temperature with well above normal precipitation and slightly above normal in snowfall at DIA. The month will be remembered for the blizzard that occurred on the 13th of the month producing the 2nd highest non-thunderstorm wind gust in Denver history at 80mph. This same storm produced a non-thunderstorm wind gust of 96mph at Colorado Springs which set an all time record. This system also set the record low pressure reading in the state at 970.4 millibars. The month began quite cold with 3 of the first 5 days of the month registering lows below zero. There as a daily low maximum temperature set on the 3rd of 6 degrees which shattered the old record of 14 back in 1978. The -6 on the 3rd did not set a record but the -5 on the 4th broke the old record low of -3. Average highs for the month was 46.7 degrees, 7.7 degrees cooler than the normal of 54.4 degrees. Average lows for the month was 23.5, 2.9 degrees below the normal of 26.4. The combination of high and low temperatures yielded a monthly mean temperature of 35.1 degrees which was 5.3 degrees below the normal of 40.4 degrees. The highest temperature during March was 73 on the 27th and the coldest was -6 on the 3rd. Precipitation for March at DIA came it at 1.39" which was 0.47" above the normal of 0.92". For the year to date 2.86" of moisture has been measured which is 1.16" above the normal of 1.70". Snowfall for March was 12.9", 2.2" above the normal of 10.7". For the snow season to date we are making up ground the past couple months but we still remain 5.2" below the normal of 45.9" with 40.7" currently tallied at DIA. The maps below show the below normal temperatures over eastern Colorado as well as the above normal precipitation for many areas of the state.



March Stats

TEMPERATURE (IN DEGREES F)

AVERAGE MAX	46.7	NORMAL	54.4	DEPARTURE	-7.7
AVERAGE MIN	23.5	NORMAL	26.4	DEPARTURE	-2.9
MONTHLY MEAN	35.1	NORMAL	40.4	DEPARTURE	-5.3
HIGHEST	73 on the 27th				
LOWEST	-6 on the 3rd				

DAYS WITH MAX 90 OR ABOVE	0	NORMAL	0.0
DAYS WITH MAX 32 OR BELOW	3	NORMAL	1.9
DAYS WITH MIN 32 OR BELOW	28	NORMAL	23.6
DAYS WITH MIN ZERO OR BELOW	3	NORMAL	0.1

TEMPERATURE RECORDS

Record low maximum temp of 6 on 3rd

New record low of -5 on the 4th

HEATING DEGREE DAYS

MONTHLY TOTAL	919	NORMAL	763	DEPARTURE	156
SEASONAL TOTAL	5336	NORMAL	5202	DEPARTURE	134

COOLING DEGREE DAYS

MONTHLY TOTAL	0	NORMAL	0	DEPARTURE	0
YEARLY TOTAL	0	NORMAL	0	DEPARTURE	0

PRECIPITATION (IN INCHES)

MONTHLY TOTAL	1.39	NORMAL	0.92	DEPARTURE	0.47
YEARLY TOTAL	2.86	NORMAL	1.70	DEPARTURE	1.16
GREATEST IN 24 HOURS	0.64” on the 13th				
DAYS WITH MEASURABLE PRECIP.	9				

SNOWFALL (IN INCHES)

MONTHLY TOTAL	12.9	NORMAL	10.7	DEPARTURE	2.2
SEASONAL TOTAL	40.7	NORMAL	45.9	DEPARTURE	-5.2
GREATEST IN 24 HOURS	7.1”				
GREATEST DEPTH	7.0”				

WIND (IN MILES PER HOUR)

AVERAGE SPEED	10.2 mph
PEAK WIND GUST	80 mph from the NNW on the 13th

MISCELLANEOUS WEATHER

NUMBER OF DAYS WITH THUNDERSTORM	0	NORMAL	0

NUMBER OF DAYS WITH HEAVY FOG	5	NORMAL	1
NUMBER OF DAYS WITH HAIL	0		
NUMBER OF SUNNY DAYS	4		
NUMBER OF PARTLY CLOUDY DAYS	16		
NUMBER OF CLOUDY DAYS	11		
AVERAGE RELATIVE HUMIDITY	67%		

April Preview

April is a transition month from winter to spring in the Denver, and although average temperatures quickly rise over the course of the month, it is also one of the wetter months on average. Periods of warm, sunny weather that give people “spring fever” are interspersed with periods of cooler and wetter, and occasionally snowy weather. April is Denver’s 5th snowiest month on average with a long-term average of 6.8”. Most of the snow accumulation that occurs in April tends to be limited primarily to grassy surfaces and melts quickly. To get meaningful pavement accumulation during April snow events, generally the timing must occur at night with temperatures in the 20s, and/or snow must fall heavily at rates of 1”/hour or greater for an extended period. Under the right patterns, this can occur in April. April 2013 was one of coldest and most active Aprils in recent memory, when 20.8” fell at DIA. This was the 10th snowiest April and 6th coldest April on record. In the higher elevations of the Front Range foothills, April is actually one of the snowiest months on average where colder average temperatures favor snow more so than rain. In terms of moisture, an average of 1.72” of precipitation occurs in April in Denver, making it the 3rd wettest month on average behind May and July. In an average year, roughly half of April’s precipitation falls as snow and the other half as rain. Thunderstorms occasionally occur during April as well with an average of two thunderstorm days in Denver the course of the month. Temperature-wise, the average high during April in Denver is 61.1 and the average low is 33.3, but as is the case for much of the year, large fluctuations are common. Historically, the latest subzero temperature on record (-2 in 1975) and the earliest 90 degree temperature on record (90 in 1992) both occurred in April, but in general extreme temperatures on either end of the spectrum are uncommon. On average, there are 13 days with below freezing temperatures in Denver in April. This year, the pattern favors warmer than normal temperatures and near normal precipitation through the first couple weeks with potentially an uptick in precipitation over the last 2 weeks of the month. Snowfall may be below normal for many areas as we will be dealing with a rain/snow line for many storms and elevations below 6k may be more rain than snow but time will tell… As all it takes is one good storm to make or break the month of April in the snowfall department.

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

TEMPERATURE

AVERAGE HIGH	61.1
AVERAGE LOW	33.3
MONTHLY MEAN	47.4
DAYS WITH HIGH 90 OR ABOVE	0
DAYS WITH HIGH 32 OR BELOW	0
DAYS WITH LOW 32 OR BELOW	13
DAYS WITH LOWS ZERO OR BELOW	0

PRECIPITATION

MONTHLY MEAN	1.71”
DAYS WITH MEASURABLE PRECIPITATION	9
AVERAGE SNOWFALL IN INCHES	6.8”
DAYS WITH TRACE OR MORE OF SNOW	NA

MISCELLANEOUS AVERAGES

HEATING DEGREE DAYS	529
COOLING DEGREE DAYS	1
WIND SPEED (MPH)	10.0mph
WIND DIRECTION	South
DAYS WITH THUNDERSTORMS	2
DAYS WITH DENSE FOG	1
PERCENT OF SUNSHINE POSSIBLE	67%

EXTREMES

RECORD HIGH	90 on 4/30/1992
RECORD LOW	-2 on 4/2/1975
WARMEST	56.4 in 1946, 1981
COLDEST	38.8 in 1920
WETTEST	8.42” in 1900
DRIEST	0.03” in 1963
SNOWIEST	33.8” in 1933
LEAST SNOWIEST	0.0” in 1888, 1930, 1943, 1992

Snowfall

October 2018 to May 2019

City	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Aurora (Central)	2.5	4.6	0.9	12.7	9.5	12.8			**43.0**
Boulder	10.0	15.9	5.7	13.9	12.8	16.2			**74.5**
Brighton	3.4	4.6	0.7	3.4	8.5	12.6			**33.2**
Broomfield	5.1	8.3	2.1	20.0	11.3	17.5			**64.3**
Castle Rock	5.5	9.2	3.2	25.0	8.3	19.7			**70.9**
Colo Sprgs Airpor	5.3	2.8	1.5	2.6	6.1	7.4			**25.7**
Denver DIA	3.2	4.5	0.5	6.2	13.4	12.9			**40.7**
Denver Downtowr	2.5	6.0	1.4	15.1	12.4	9.5			**46.9**
Golden	7.0	7.0	2.4	16.9	13.0	17.6			**63.9**
Fort Collins	6.0	5.6	1.1	1.6	3.8	11.7			**29.8**
Highlands Ranch	6.5	7.0	1.2	19.8	9.4	12.2			**56.1**
Lakewood	3.4	6.6	1.2	15.2	12.0	12.1			**50.5**
Littleton	4.5	6.2	2.2	16.5	15.5	12.3			**57.2**
Parker	3.8	7.4	2.1	17.6	8.3	13.4			**52.6**
Sedalia - Hwy 67	5.2	6.6	2.4	23.1	8.8	19.6			**65.7**
Thornton	5.0	5.9	0.7	13.4	10.6	12.4			**48.0**
Westminster	3.2	6.8	2.5	19.8	9.1	13.6			**55.0**
Wheat Ridge	4.1	8.5	1.5	13.8	13.7	11.7			**53.3**

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