

The Weather Wire

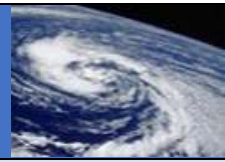
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Snow Crystal Science - The Art and Physics of Colorado Snowflakes

Introduction:

Colorado is best known for its snow-capped peaks and ski resorts. This makes snow and the formation of snowflakes one of the most important and interesting topics in the wintertime here in the Centennial State. Snowflakes can vary depending on many different physical characteristics in the atmosphere, which can determine the type of powder that a skier would experience on the slopes as well as on the roads.

Snowflake Formation:

How do snowflakes form? Humidity and temperature are the most important factors when it comes to snowflake development. The life of a snowflake starts as a very cold water droplet that attaches itself by means of freezing to an ice nuclei such as pollen or dust. This starts the hexagonal ice particle that will eventually evolve as it falls through the atmosphere. The processes of facet formation and branch development are responsible for creating the iconic shape of a snowflake. No two snowflakes are the same, due to the varying atmospheric conditions at each stage.

Microscale Dynamics:

While a snowflake falls it encounters many different physical nuances that change how it is shaped. Conditions such as varying temperatures, humidity, and different ice nuclei as well as the timing and order of these conditions can create an infinite amount of snowflake shapes. This is why no two snowflakes are the same.

Snow Crystal vs. Snowflake:

Snowflakes are slightly different from snow crystals in that they are often used as an umbrella term for many different types of winter precipitation. This could include one snow crystal or a group that collide into each other resulting in larger flakes. Snow crystals on the other hand result from water vapor skipping the liquid phase and turning directly into ice.

Types of Snow Crystals:

- Hoarfrost: Ice crystals deposited on surfaces below the frost point, directly transitioning from vapor to solid.
- Rime Frost: Formed when supercooled droplets freeze and attach onto exposed surfaces, often arising from freezing fog or mist droplets.
- Graupel: Rounded, opaque pellets formed as ice crystals fall through supercooled cloud droplets, distinct from hail with a softer, crumbly texture.
- Polycrystals: Snowflakes composed of numerous individual ice crystals.

Controlling Powder Type for Skiing:

The type of powder that a skier or snowboarder would experience depends on the size and shape of the snowflakes. The lightest or “fluffiest” powder is typically created when larger snowflakes fall. These can vary in shape to form



larger dendrites, sectorial plates, or thin plates. These form when the moisture content is higher with colder temperatures.

Temperature and Moisture:

Warmer temperatures between 26 and 32 degrees Fahrenheit, can create heavier snow flakes taking the shape of small dendrites and plates [Fig. 1]. Temperatures between 0 and 14 degrees Fahrenheit can create needle shapes and with more moisture, can create solid prism shapes. On the other hand, very cold temperatures between -6 to -31 degrees Fahrenheit can provide smaller columns and plates due to the lack of moisture.

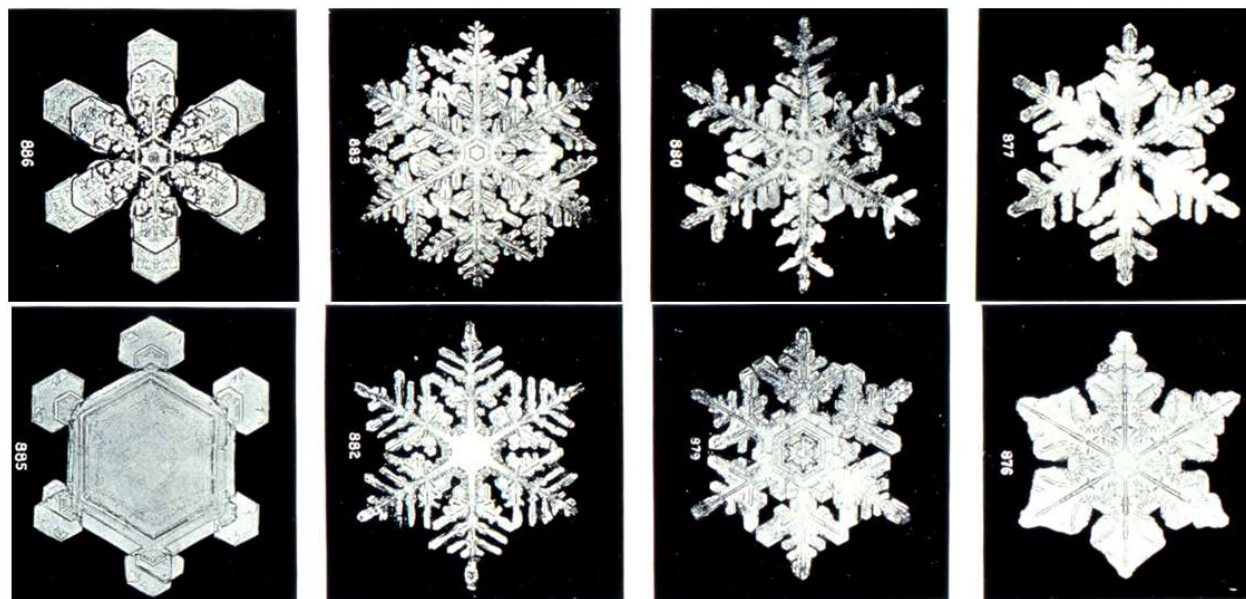


Figure 1 – Microscopic view of snowflakes by Wilson Bentley. From the Annual Summary of the Monthly Weather Review for 1902. Bentley was a farmer whose hobby was photographing snow flakes. Source: NOAA Photo Library archives Weather Wonders collection, www.photolib.noaa.gov. (Image credit: NOAA)

Perfect Conditions for Blower Powder:

The term “blower” powder is often used for the ideal type of snow for skiing and snowboarding. The snowflakes that are responsible for this type of powder typically form in the temperature range of 0 to 10 degrees Fahrenheit. Large dendrites form and begin to stack amongst and on top of each other, forming air pockets. These air pockets give the snow a “bouncy” quality and are ideal for snow sports.

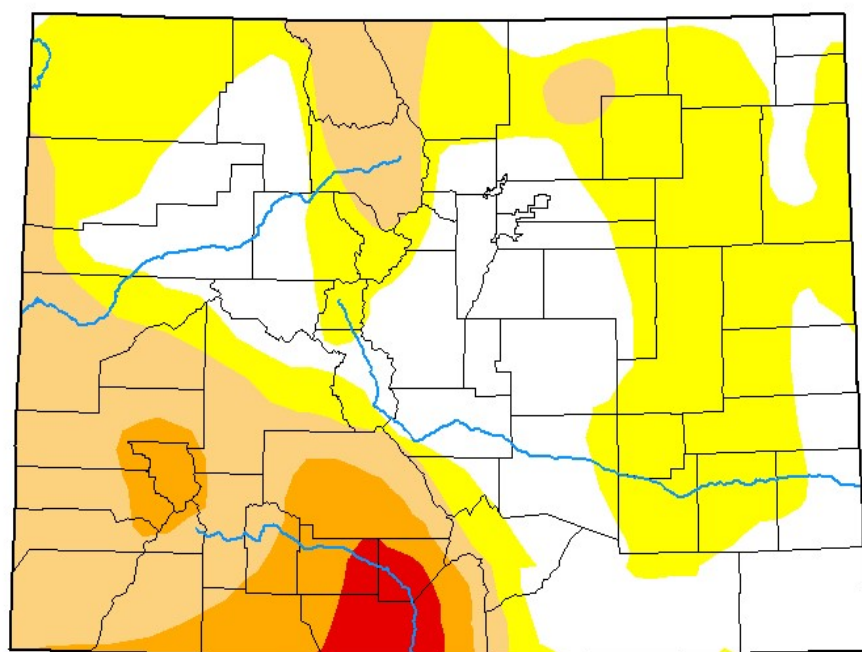
The next time that you hit the slopes of the Colorado Rockies, take a look at the incredibly intricate snowflake patterns that have fallen. Colorado is rich in nature’s wonders and continues to amaze everyone who gets to experience its beauty.



Drought Update

U.S. Drought Monitor Colorado

January 2, 2024
(Released Thursday, Jan. 4, 2024)
Valid 7 a.m. EST



Intensity:

- None
- 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. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

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droughtmonitor.unl.edu

Not much overall change for western portions of the state, mainly due to the fact their precipitation is mostly snowfall and won't help areas until springtime. Due to the lack of precipitation for northeastern Colorado during the month of December, drought conditions have increased to moderate for areas in Weld County.



Temperature Anomaly Forecast

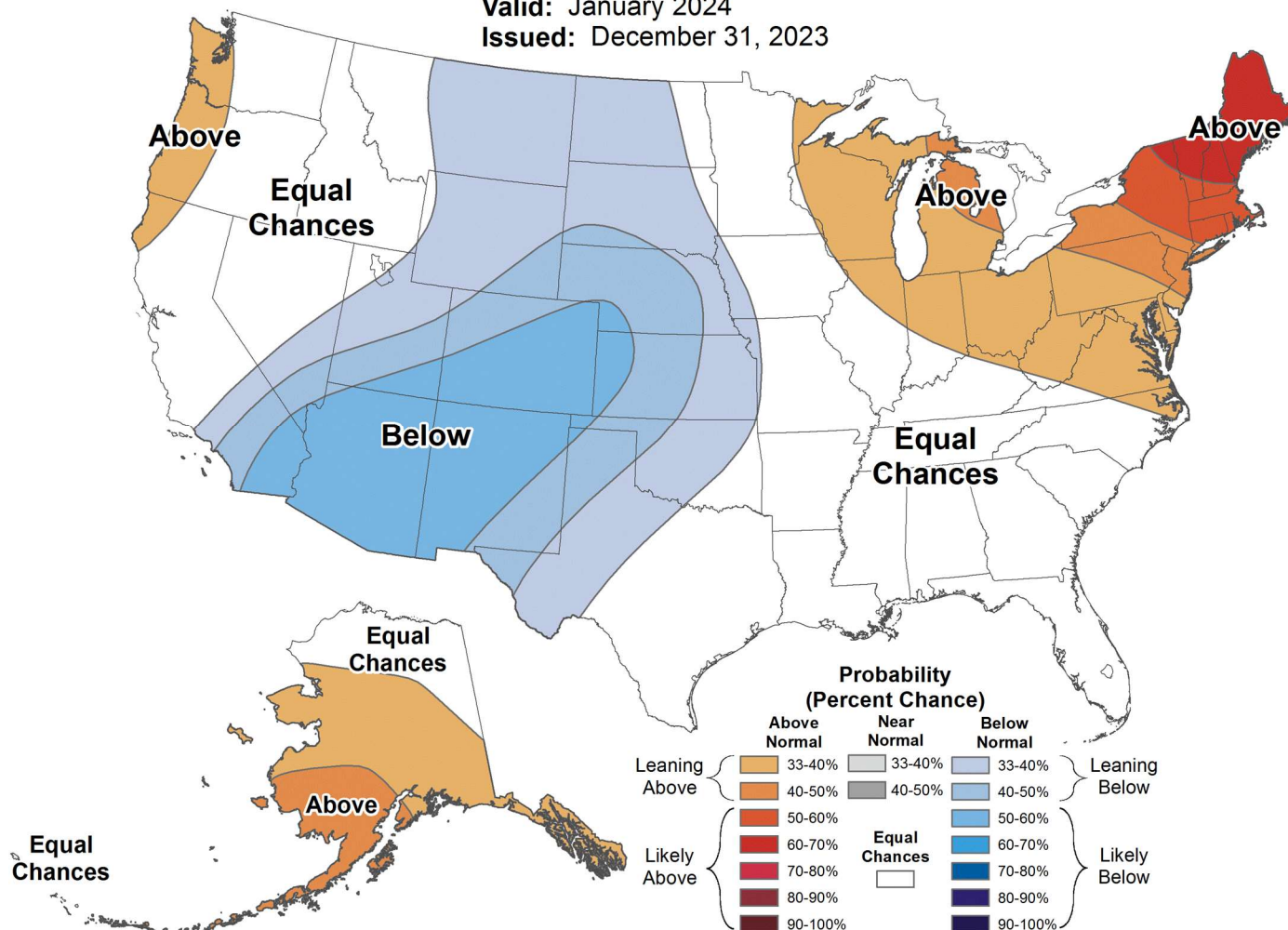


Monthly Temperature Outlook



Valid: January 2024

Issued: December 31, 2023



Temperatures are projected to be below average for the month of January. Based on the first week, this has not been entirely true as Denver has been above average temperature wise to start the month. Additional storm systems are expected to impact the region through the mid part of January. This could increase the likelihood of lower than average temperatures overall, although has yet to be seen so far.



Precipitation Anomaly Forecast

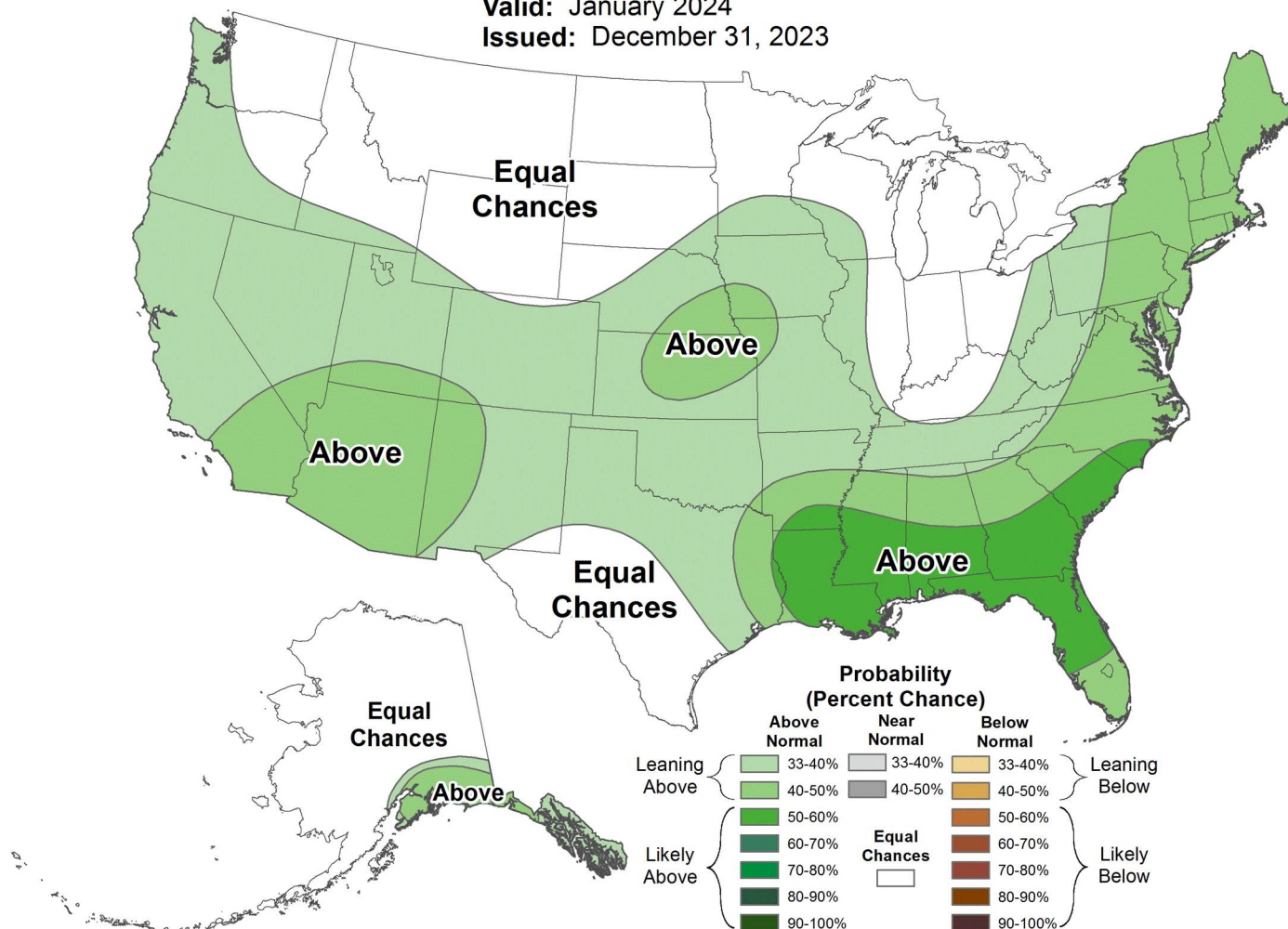


Monthly Precipitation Outlook



Valid: January 2024

Issued: December 31, 2023



Expect slightly above average precipitation for most of Colorado for the month. In January, increased storms doesn't necessarily mean more overall snowfall totals. With January's colder temperatures, the snowfall that does develop is generally light/fluffy with less overall liquid water equivalent.



December Summary

December 2023 provided well above average temperatures for the Denver metro area with some areas coming in with well below average precipitation for the month. Denver International Airport (DIA) reported an average daily high temperature of 50.5°F with a daily average low temperature of 24.3°F. Combined, this totaled 37.4°F, 6.2°F above the typical monthly average of 43.6°F. The warmest day occurred on December 6th when DIA reached 71°F. The coldest day, and only time DIA recorded single digits was on Christmas, December 25th, where temperatures dropped to 8°F.

Precipitation wise, DIA reported 0.12" of liquid precipitation, 0.23" below the average of 0.35" for the month of December. During the month of December, DIA missed out on several storms that impacted other areas in the Denver Metro and does not represent a good portion of the climatology for this month as seen in the map below.

Minimal storm systems would impact DIA during the month of December, with only two storms reporting over a trace. Those two events occurred on the 8th (0.4") and the 13th (1.0") and would account for the total snowfall at DIA for the month. However, the 8th storm ranged more in the 1.0-4.0" range across the Denver Metro area. An additional storm that impacted an isolated area from December 26th through December 27th would bring heavy snow for portions of Arapahoe County where areas along the I-225 corridor received between 6.0-8.0", whereas DIA reported only a trace from that same storm.

December 2023 provided well above average temperatures for southeastern Colorado with well above average precipitation in some spots. The Colorado Springs airport recorded an average daily high temperature of 50.2°F with an average daily low temperature of 24.6°F. Combined this totaled a monthly average of 37.4°F, 5.7°F above the typical 43.1°F monthly average. Precipitation wise, Colorado Springs airport reported 0.57" of liquid precipitation, 0.34" above the average of 0.23" for the month of December. The majority of this came down on the 13th where 0.29" fell in that 24-hour period.

Pueblo was similar, with above average temperatures and well above average precipitation for the month of December. Pueblo recorded an average daily high temperature of 51.1°F with an average daily low temperature of 20.6°F. Combined this totaled a monthly average of 35.9°F, 4.2°F above the typical 40.1°F monthly average. The warmest day was on the 6th where the airport reached 77°F, which set the daily record. The coldest day, and only single digit temperature was 6°F recorded on the 10th. Well above average precipitation for the Pueblo area throughout the month, with 1.31" of liquid precipitation recorded, a staggering 1.02" above the average of 0.29" December brings. Most of this occurred on the 23rd where a record breaking 0.57" fell during the 24-hour period. This resulted in the 2nd wettest month on record for the Pueblo area, however, only the 23rd snowiest as most precipitation fell as rainfall rather than snow.



December Statistics DIA

TEMPERATURE (IN DEGREES F)	OBSERVED VALUE	NORMAL VALUE		DEPARTURE FROM NORMAL
AVERAGE MAX	50.5°F	44.0°F		6.5°F
AVERAGE MIN	24.3°F	18.4°F		5.9°F
MONTHLY MEAN	37.4°F	31.2°F		6.2°F
DAYS WITH MAX 90 OR ABOVE	0	0		0
DAYS WITH MAX 32 OR BELOW	2	6.4		-4.4
DAYS WITH MIN 32 OR BELOW	28	29.2		-1.2
DAYS WITH MIN 0 OR BELOW	0	1.9		-1.9
	OBSERVED VALUE	DATE(S)	NORMAL VALUE	DEPARTURE FROM NORMAL
HIGHEST	71°F	12/6		
LOWEST	8°F	12/25		
HEATING DEGREE DAYS				
MONTHLY TOTAL	847		1048	-201
SEASONAL TOTAL	1924		2367	-443
COOLING DEGREE DAYS				
MONTHLY TOTAL	0		0	0
YEARLY TOTAL	791		849	-58
PRECIPITATION (IN INCHES)				
MONTHLY TOTAL	0.12"		0.35"	-0.23"
YEARLY TOTAL	18.94"		14.48"	-4.46"
GREATEST IN 24 HOURS	0.07"	12/13		
DAYS WITH MEASURABLE PRECIP.	3		4.4	-1.4
SNOWFALL (IN INCHES)				
MONTHLY TOTAL	2.2"		6.6"	-4.4"
SEASONAL TOTAL	12.6"		12.1"	-0.5"
GREATEST IN 24 HOURS	1.0"	12/13		
GREATEST DEPTH	1.0"			

Data for the table above can be found at

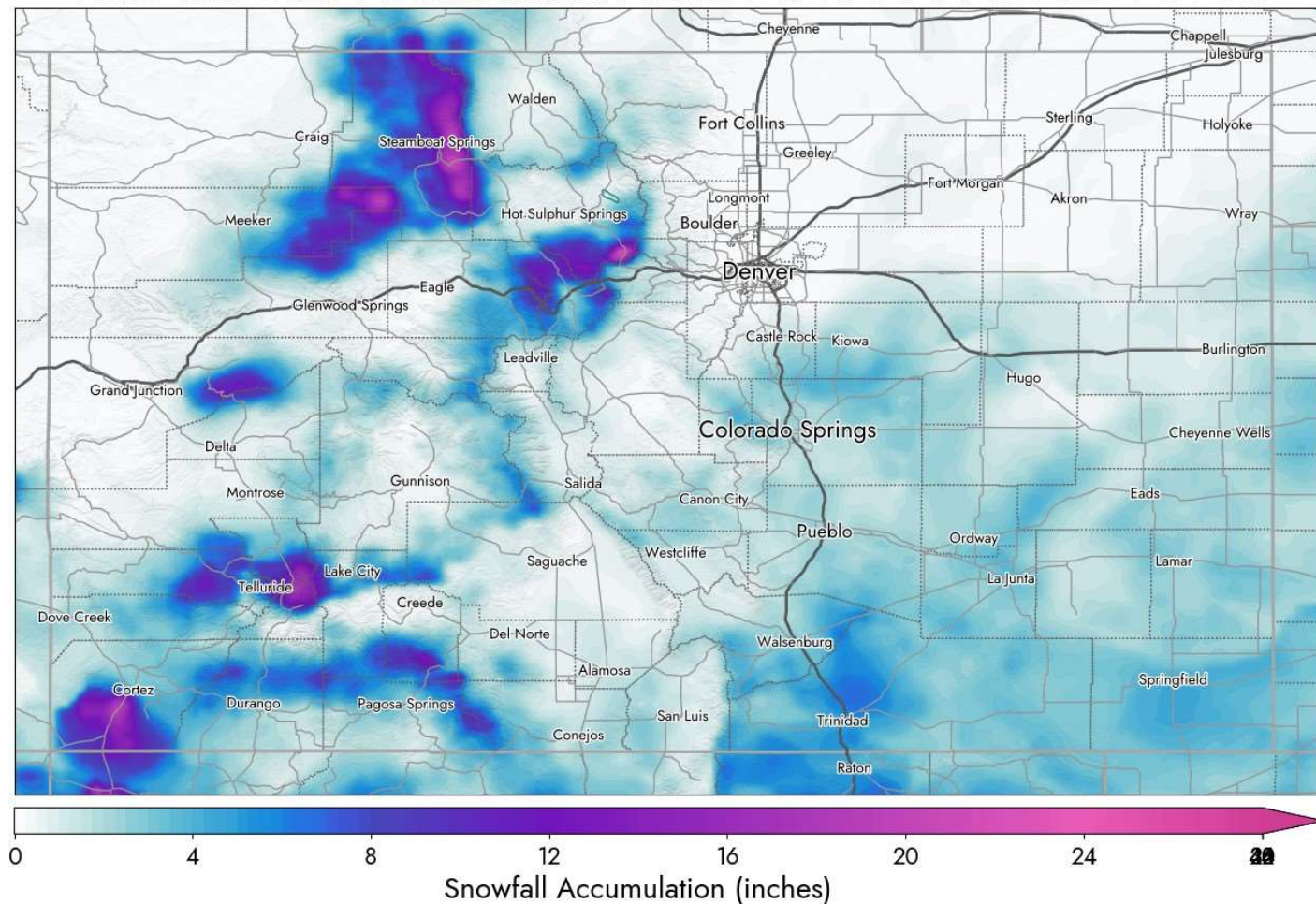
<https://forecast.weather.gov/product.php?site=BOU&product=CLM&issuedby=DEN>



January Preview

So far 2024 has been an uneventful year weather wise across the Denver Metro, with a little better snowfall for the Palmer Divide and into southeastern Colorado. Below is a map of the snowfall so far this month:

Total Snowfall Accumulation from 2024-01-01 to 2024-01-06



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Additional storm systems are expected to impact the Denver Metro and southeastern Colorado during the second week of the month. This will no doubt increase totals across portions of the state, hopefully filling in northeastern portions of the state where minimal snowfall continues to fall. So far, no precipitation has been recorded at Denver International Airport. If this continues, DIA will be well below some of the higher producing years. Below is a list of the top ten snowiest January's vs the least snowy recorded for Denver:

DENVER'S TOP 10 SNOWIEST JANUARYS:

24.3 INCHES 1992

22.2	1949
20.5	1883
19.2	1948
17.4	1959
17.2	1962
17.0	1987
17.0	1891
15.9	2007
15.7	1951

DENVER'S TOP 10 LEAST SNOWIEST JANUARYS:

T	2003
T	1934
0.1	1931
0.2	1933
0.3	1952
0.4	1914
0.8	1935
0.9	1970
1.0	1961
1.0	1893



January Statistics

DENVER'S JANUARY CLIMATOLOGICAL NORMAL	
(NORMAL PERIOD 1991-2020 DIA Data)	OBSERVED VALUE
TEMPERATURE	
AVERAGE HIGH	44.6°F
AVERAGE LOW	18.7°F
MONTHLY MEAN	31.7°F
DAYS WITH HIGH 90 OR ABOVE	0.0
DAYS WITH HIGH 32 OR BELOW	5.0
DAYS WITH LOW 32 OR BELOW	29.0
DAYS WITH LOWS ZERO OR BELOW	2.0
PRECIPITATION	
MONTHLY MEAN	0.38"
DAYS WITH MEASURABLE PRECIPITATION	4.4
AVERAGE SNOWFALL IN INCHES	6.4"
DAYS WITH 1.0 INCH OF SNOW OR MORE	2.0
MISCELLANEOUS AVERAGES	
HEATING DEGREE DAYS	1034
COOLING DEGREE DAYS	0
WIND SPEED (MPH)	8.6 mph
WIND DIRECTION	South
DAYS WITH THUNDERSTORMS	0
DAYS WITH DENSE FOG	1
PERCENT OF SUNSHINE POSSIBLE	71%
EXTREMES	
RECORD HIGH	76.0°F on 1/27/1888
RECORD LOW	-29.0°F on 1/9/1875
WARMEST	40.3°F in 1986
COLDEST	16.9°F in 1930
WETTEST	2.35" in 1883
DRIEST	0.01" in 1933
SNOWIEST	24.3" in 1992
LEAST SNOWY	TR in 2003/1994



Rainfall/Snowfall

2023/2024 Winter Snowfall								
City	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Aurora	6.6	2.3	10.4					19.3
Boulder	5.0	7.8	9.2					22.0
Brighton	4.7	4.0	1.1					9.8
Broomfield	4.3	5.3	3.2					12.8
Castle Rock	9.0	2.1	9.7					20.8
Colorado Springs Airport	0.0	1.1	8.4					9.5
Denver DIA	7.5	2.9	1.4					11.8
Denver Downtown	5.3	2.1	6.2					13.6
Golden	10.7	14.0	14.6					39.3
Fort Collins	5.7	9.6	0.0					15.3
Highlands Ranch	5.8	1.8	6.9					14.5
Lakewood	8.6	4.1	11.3					24.0
Littleton	10.0	1.6	6.0					17.6
Monument	6.5	1.5	14.8					22.8
Parker	7.4	1.0	8.8					17.2
Sedalia - Hwy 67	10.5	3.3	9.4					23.2
Thornton	4.0	4.4	4.4					12.8
Westminster	5.1	4.7	5.3					15.1
Wheat Ridge	6.0	3.4	6.9					16.3
Windsor	3.5	5.5	TR					9.0