# **Colorado Climate Summary** Water-Year Series

(October 1993-September 1994)

Nolan J. Doesken Thomas B. McKee

Climatology Report No. 94-4

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(October 1993-September 1994)

by

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### ACKNOWLEDGMENTS

As always we would like to take this opportunity to thank the many cooperative weather observers in Colorado and their National Weather Service supervisors, Jerry Sherlin and Michael Elias, for making it possible to monitor the climate in all parts of Colorado at a very low cost. Again, our sincere thanks are in order.

The authors also wish to express their appreciation to Odilia Bliss and Natalie Tourville for doing a fine job of preparing and processing each month's climate data and assembling this finished product. The work of John Kleist in database management has been very helpful.

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### **INTRODUCTION**

The 1994 Water Year marked the 20th year of existence of the Colorado Climate Center (CCC) and the 17th year of closely monitoring the climate of this diverse and interesting state. The first monthly climate summary prepared by the CCC was written in early 1977 in the midst of an unprecedented severe winter drought. Since that time Colorado has experienced a myriad of extremes – record winter cold, incredible snowstorms, disastrous hail storms and tornadoes, some of the snowiest years in the past 60 years and one of the wettest consecutive periods in the state as a whole, (1982-1986). More recently, dry weather has again become more frequent. Our monthly descriptions of Colorado climate have expanded to document and describe as much of this information as possible.

The monthly climate descriptions are intended to accomplish several purposes. They are a written historical record of what our climate has been which we hope will serve as a reference in the future. By tracking monthly departures of temperature and precipitation from long-term averages, these summaries also become tools for operations, planning and policy-making related to agriculture, water resources, recreation, land use and energy. Finally these summaries are used to educate the people of Colorado about our unique climate and its impact on our lives and livelihoods.

In Colorado, the Water Year (October 1 through September 30) is the most appropriate period for monitoring climate. This 12-month period is directly correlated with the state's water storage-water usage cycle. In October snow usually begins to accumulate in the high mountains. As winter progresses, the snowpack normally continues to build. This snow is the frozen reservoir which supports the huge ski and winter recreation industry. As it melts in the subsequent spring and summer, it supplies much of the water for human consumption, for extensive irrigation, for industry, for replenishing reservoirs, and to satisfy long-standing streamflow compacts with neighboring states. Colorado water use has been changing gradually, but irrigated agriculture still accounts for the majority of water used in this state. Therefore, demand for water peaks during the summer and tapers off as temperatures drop, crops are harvested, and autumn arrives. September marks an appropriate end to the water year.

Because of the crucial importance of water to Colorado, this publication emphasizes precipitation and water-year accumulated precipitation. Comparisons with long-term averages are made to help determine which parts of the state are wetter or drier than average. This makes it possible to document the availability of water resources and to assess potential drought situations.

In November 1991, we began a two-column layout for each monthly report. This format was continued throughout the 1994 Water Year. The first page of each monthly report begins with a brief synopsis of the month. A short paragraph and small map describe precipitation patterns for the month. A similar paragraph and map, showing temperature departures from normal, completes the front page. Normal climate, for both temperature and precipitation is defined as the 30-year average for the period 1961-1990.

The second page of each monthly summary gives a day-by-day narrative account of specific weather patterns, air masses and storm systems affecting Colorado. It includes

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selected examples of temperature values and precipitation totals. This page ends with a tabulation of temperature, precipitation and snowfall extremes for the state as reported by official National Weather Service Cooperative weather stations. This page is designed to give readers a good feel for the timing and location of significant weather events and general weather patterns without having to dig into detailed data tabulations or other references.

The third page is a graphical display of daily maximum and minimum temperatures for the month for nine selected locations in Colorado. The same nine cities are shown each month along with smoothed 30-year daily averages: Grand Lake, Denver, Akron, Grand Junction, Gunnison, Pueblo, Durango, Alamosa and Lamar. It is important to note that many stations do not use a midnight to midnight reporting period. The time of observation clearly has an impact on reported temperatures. For example, Durango, Gunnison and Lamar all take their observations at about 8 a.m. The maximum temperatures they report each day usually occurred the previous afternoon. It is important to take time of observation differences into consideration when comparing temperatures from different locations.

The fourth page of each monthly summary contains a map of monthly precipitation totals for the state, a brief narrative description of significant precipitation events and a bar graph showing daily precipitation amounts averaged spatially over the entire state of Colorado. This graph also shows the approximate percent area of the state receiving measurable (greater than or equal to 0.01 inches) precipitation each day. Again, it is important to realize that differences in observation time influence these results. A station with an 8 a.m. observation time will report yesterday afternoon's precipitation on today's date.

The fifth page of each monthly report shows a map with monthly precipitation plotted as a percent of the 1961-90 average. Beneath the map is a graph showing the number of

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stations in each of eleven precipitation categories ranging from less than 25% of average to more than 100% of average. This graphic, accompanied by a brief narrative, allows a quick evaluation of the frequency distribution of monthly precipitation. The lower right hand portion of the page contains monthly precipitation rankings and extremes for six Colorado weather stations with long data records. These rankings are intended to give readers a longterm perspective on how typical or unusual precipitation was during the month in different parts of the state.

Page six consists of a map, graph and narrative description of water-year accumulated precipitation with respect to average. This page is very helpful for evaluating the cumulative precipitation inputs into state water supplies. This page is omitted from the October summary since total water year precipitation after just one month is the same as the monthly data (fifth page).

Heating degree day data for 36 Colorado cities are published each month on the seventh page of each monthly report in a data table similar to previous years. A description of heating degree days and their use is given in Section II of this report.

The next two pages are tabular climate information for the month for selected Colorado stations. Stations are divided into 4 regions: the Eastern Plains, the Foothills/Adjacent Plains (includes the Front Range urban corridor), the Mountains and High Interior Valleys, and the Western Valleys (includes stations in western Colorado below 7,000 feet). Data presented for each station include the average high (Max), average low (Min) and mean temperature (Mean) for the month and the departure (Dep) from the 1961-1990 average all in degrees Fahrenheit. The extreme highest (High) and lowest (Low) temperature recorded during the month comes next followed by the monthly total of heating (Heat),

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cooling (Cool) and growing (Grow) degree days (see Section II for definitions), the monthly total precipitation (Total) in inches, the departure from the 1961-1990 average (Dep), the percent of the 1961-1990 average (% Norm) and the total number of days with measurable ( $\geq 0.01$ ") precipitation (# days).

Beneath the data tables is a comparative table of number of clear, partly cloudy and cloudy days and the percent of possible sunshine for several National Weather Service stations. This is followed by a graph of daily total solar radiation data measured at Fort Collins and a graph of daily soil temperatures at four selected depths (4", 12", 36", and 72"). Beneath the soil temperatures is a brief section, "Hats Off To: \_\_\_\_\_\_ ", which acknowledges an individual or an institution for their contribution to data collection and climate monitoring in Colorado.

The components of the monthly report described above are provided each and every month. However, there is some flexibility in the final few pages. Almost every month there is an in-depth analysis and discussion of some important aspect of Colorado's climate. These features vary in length from one to seven pages. Under special circumstances there may be two feature stories per month. The September issue always contains a wrap-up of the water year. Here is the index of the feature stories published during the 1994 Water Year:

- 1) How we differ from Denver, October 1993, page 9.
- Recent tendencies for above average temperatures, November 1993, page 21.
- The extraordinary Colorado snowstorm of December 1913, December 1993, page 32.
- 4) Fog in Colorado, January 1994, page 45.

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- 5) Drought in Colorado Part I, February 1994, page 58.
- 6) Colorado Climate Center Publications, February 1994, page 60.
- 7) Drought in Colorado Part II, March 1994, page 71.
- Hail, Hail, Hail Summertime Hazard of Eastern Colorado, April 1994, page 84.
- 9) No special feature for May 1994.
- 10) 200 and counting Who would have believed it?, June 1994, page 111.
- 11) Fire weather in Colorado, July 1994, page 122.
- 12) How many weather stations are there? The 10 August 1994Experiment, August 1994, page 134.
- 13) A review of the 1994 water year, September 1994, page 137.

The final components of each monthly report is a statewide data summary provided to the Colorado Climate Center by the Joint Center for Energy Management (JCEM) at the University of Colorado at Boulder. Back in 1988 they developed a small network of automated weather stations to help gather data useful for heating and cooling design and for energy conservation. A one-page table and graph provides a very compressed summary of statewide temperature, humidity, solar energy and wind based on hourly data. The actual raw data can be obtained on request from JCEM by calling (303) 449-4547.

Except for the JCEM data, temperature and precipitation data used in the monthly summaries were obtained from the National Weather Service cooperative observer network. Data from the major National Weather Service stations, such as Denver and Grand Junction, are also used extensively. A few volunteers who are not affiliated with the National Weather Service's networks are also included based on the Colorado Climate Center's judgement that the data are of good quality. Increasingly, data from automated electronic weather stations are being used. The Alamosa, Colorado Springs, and Pueblo NWS weather stations have all recently become primarily automated stations.

Please note that specific *daily* temperature and precipitation data are not listed here. Daily data can be obtained in digital and/or hard copy form from the Colorado Climate Center, the Western Regional Climate Center (Reno, NV) and the National Climatic Data Center (Asheville, NC). Much of the daily data are published in the government document, *Climatological Data*.

The averages which are used in this report for both temperature, heating degree days and precipitation were calculated using 1961-1990 data. Some adjustments have been applied to a few stations where station moves have resulted in significant differences between current observations and their historic data.

The written descriptions here give a good general accounting of each month's weather, but the majority of information is contained on the maps and tables which accompany each report. The accuracy of all of these maps and tables is quite good. However, these reports were initially prepared soon after the end of each month, and preliminary information was sometimes used. Therefore, some of the precipitation, temperature, and heating, cooling and growing degree day values may differ slightly from what is later published by the National Climatic Data Center.

### **EXPLANATION OF DEGREE DAYS**

Many climatic factors affect fuel consumption for heating and cooling. Wind, solar radiation and humidity all play a part, but temperature is by far the most important element. Very simply, the colder it gets; the more energy is needed to stay warm.

A simple index, given the name, *heating degree days*, was devised many years ago to relate air temperatures to energy consumption (for heating). The number of *heating degrees* for a given *day* is calculated by subtracting the mean daily temperature (the average of the daily high and low temperature) from  $65^{\circ}$ F. Sixty-five degrees is used as the base temperature because at that temperature a typical building will not require any heating to maintain comfortable indoor temperatures. That difference ( $65^{\circ}$ F minus the mean daily temperature) is the number of heating degrees for that day. For example, on a day with a maximum temperature of  $40^{\circ}$ F and a minimum of  $10^{\circ}$ F the mean daily temperature is  $25^{\circ}$  and the heating degree total is 40. When the mean daily temperature is  $65^{\circ}$  or greater, the heating degree day total is defined as 0. The daily values are accumulated throughout the heating season to give heating degree day totals. Different base temperatures can be used to calculate heating degree days, but  $65^{\circ}$  is the long-standing traditional base.

The heating degree day total for a month or for an entire heating season is approximately proportional to the quantity of fuel consumed for heating. Therefore, the

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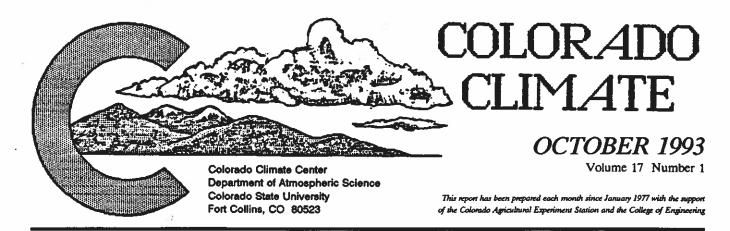
*colder* it gets and the *longer* it stays cold, the *more* heating degree days are accumulated and the more energy is required to heat buildings to a comfortable temperature.

So why is this important? Very simply, if you know how much energy you have used for heating your home or business during a certain period of time, and if you also know the heating degree day total for the same period, you can then establish an energy consumption ratio. With that information you can then make reasonable estimates of your future energy consumption and costs. Also, you can easily check the success and calculate the savings resulting from energy conservation measures such as new insulation, new windows or lowering the thermostat.

Cooling degree days are calculated in a similar fashion. *Cooling degrees* occur each day the daily mean temperature is *above* 65°F. They are accumulated each day throughout the cooling season and are roughly proportional to the amount of energy required to cool a building to a comfortable inside temperature. Cooling degree days are less useful than heating degree days here in Colorado where air conditioning requirements are minimal in many parts of the state. However, they still offer a means of making general comparisons from site to site, year to year or month to month.

*Growing degree days*, which are sometimes referred to as "heat units" or "crop growth units" are a measure of temperature which has been found to correlate with the rate of development and maturation of crops. Several methods exist for computing growing degree days. In this report the "corn" growing degree day definition was used. The optimum growth occurs at 86°F and essentially no growth occurs at temperatures below 50°F. Therefore, when computing the daily mean temperature any minimum temperature below 50° is set equal to 50° and any maximum above 86° is counted as 86°F. Growing degree day totals are obtained by subtracting the 50° base temperature from each adjusted mean daily temperature and the accumulating daily totals throughout the growing season.

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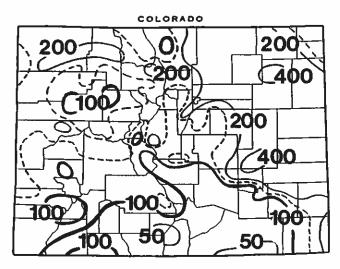


### October in Perspective - Stormy and Extreme

October continued the theme that September had established with stormy and extremely changeable weather affecting most of Colorado. Absolutely fantastic autumn days with near-record warmth were followed by snow and nearrecord cold. There were even a few thunderstorms tossed in for good measure. Overall, temperatures were cooler than average statewide for the fifth consecutive month. Precipitation totals varied greatly but were well above average over much of the State.

### Precipitation

Two strong storms and persistent unsettled weather in mid-October resulted in precipitation totals considerably greater than normal over much of Colorado. Totals exceeded



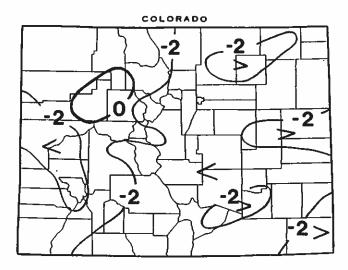
October 1993 precipitation as a percent of the 1961-1990 average.

200% of average over portions of northern Colorado and across wide areas of the Eastern Plains. The 3.71" total at Akron 4E was their wettest October on record this century.

Statewide, much of the precipitation fell as cold rain or melting snow, but some significant snowfall accumulations were reported. Meanwhile, south central Colorado missed the brunt of the autumn storms. Some areas received less than 50% of average precipitation.

### Temperatures

October delivered an interesting assortment of extremes. Temperatures soared into the 80s with even some 90s in the Arkansas Valley early in the month. But there were also some days later in October in and east of the mountains when the temperature stayed well below freezing. Overall, temperatures for the month ended up about two degrees Fahrenheit below average with a few areas close to 4° below average. For the fifth month in a row, temperatures were uniformly below average across almost all areas of the State. This uniformity is very unusual and is almost sure to change as we move into the winter season.



Departure of October 1993 temperatures from the 1961-90 averages.

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### **OCTOBER 1993 DAILY WEATHER**

- 1-6 October began with mild temperatures across western Colorado, but an upper air disturbance on the 1st brought cooler temperatures and gusty winds to the Eastern Plains. After a pleasant day on the 2nd, conditions became just plain toasty 3-5th with few clouds and low elevation temperatures well into the 80s with some 90s out on the Plains. Clouds increased on the 6th in advance of an approaching storm from California. Rain and cooler temperatures moved into western Colorado, but the heat continued for one final day east of the mountains. Las Animas and Holly each hit 95° on the 6th.
- 7-10 A push of cold Canadian air entered northern Colorado on the 7th as abundant moisture arrived from a slow-moving storm west of the State. Rain fell across all of western Colorado. Craig reported nearly one inch. Then thunderstorms erupted behind the cold front in northeastern Colorado giving way to steady, cold rain. Akron 4E received 1.88" by early on the 8th. Cloudy, chilly weather with some showers and higher elevation snow continued until early on the 10th when the upper level low began to move quickly to the east. Denver only reached a high of 39° on the 9th. Aspen got 7" of wet snow by early on the 10th. Fog and low clouds east of the mountains cleared quickly on the 10th as dry northwesterly winds developed.
- A chilly morning on the 11th (10° in Fraser) was 11-20 followed by a nice warmup and plenty of sunshine. Pueblo was back into the mid 70s by afternoon. But sunshine didn't last long as a new storm spread rain and high-elevation snow into western Colorado by evening. Most precipitation was light, but Crested Butte and Paonia reported close to 0.50" by early on the 12th. From the 12th through the 19th, westsouthwesterly winds aloft pumped moist subtropical Pacific air into Colorado. Cloudy weather kept daytime temperatures near or below average, but nights were milder than usual. Rain and highmountain snow fell each day across the western half of the State. Bonham Reservoir on the Grand Mesa totalled 3.50" of moisture for the period, much of it falling as wet snow. Several thundershowers were Hayden received a 0.80" reported 13-16th. downpour with hail on the 14th. A few nocturnal thunderstorms rumbled across eastern Colorado 15-16th. Some areas near the Kansas border picked up over 0.50" of rain. Precipitation (rain and mountain snow) spread over all of the State on the 17th, as a broad low pressure area formed west of the mountains. Precipitation ended in western Colorado

on the 18th but continued east of the mountains. 0.50-1.00" moisture totals were common over much of Colorado. The heaviest rains were along the North Front Range. Fort Collins totalled 1.51" for the 17-18th. Clouds finally exited the State on the 19th and daytime temperatures warmed, only to be followed by a fast-moving cold front that night that brought a burst of wind and a quick inch of mountain snow. High pressure then covered the region on the 20th with clearing skies but cool temperatures.

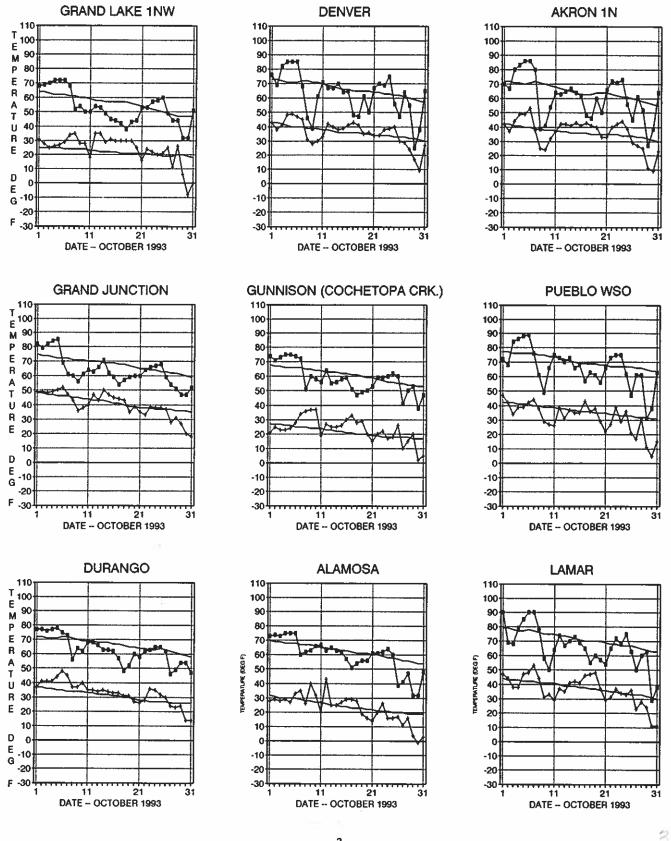
- 21-24 After all the unsettled weather, these four warm and sunny days were a true delight. Daytime temperatures rose into the 60s and 70s at lower elevations with very light winds.
- 25-26 Winds aloft increased and a cold front dropped down across Colorado from the northwest on the 25th. Western Colorado remained mild and dry, but the cooler air to the northeast, enhanced by a low pressure trough aloft, triggered rain and snow showers late on the 25th near the Front Range that moved across southeastern Colorado early on the 26th. Most precipitation was light, but Bailey received 4" of snow and the Mt. Evans Research Center measured 7".
- 27-31 After a chilly morning on the 27th (-1°F at Center), temperatures warmed and high clouds increased. Strong west-northwesterly winds gusting to 30-65 mph in wind-prone areas developed late in the day. An Arctic cold front then reached Colorado on the Along with much colder temperatures, 28th. precipitation began in and east of the mountains and soon turned to snow at all elevations. Precipitation diminished on the 29th. Most areas east of the mountains picked up 1-3" of snow while 6-8" totals were common in the mountains. The snow was heaviest along the Front Range where totals were close to a foot (10.5" at Boulder, 14" at Allenspark). Extremely cold air for this time of year (similar to the early cold wave of October 1991) kept daytime temperatures on the 29th only in the teens and 20s except on the Western Slope. Travel conditions were atrocious, and many serious traffic accidents occurred. Skies cleared late allowing temperatures early on the 30th to drop into the single digits on the plains with subzero values over much of the mountains. The low of -14° at Hohnholz Ranch was the lowest in the State. Warmer weather then returned to Colorado in time for Halloween.

	•	Weather Extremes	
Highest Temperature	95°F	October 6	Holly and Las Animas
Lowest Temperature	-14°F	October 30	Hohnholz Ranch
Greatest Total Precipitation	4.80"		Bonham Reservoir
Least Total Precipitation	0.12"		Wootton Ranch
Greatest Total Snowfall	31.5"		Allenspark
Greatest Snow Depth	18"	October 18	Bonham Reservoir

### **OCTOBER 1993 TEMPERATURE COMPARISON**

Observed daily high and low temperatures are shown below along with smoothed daily average highs and lows for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low tempera-

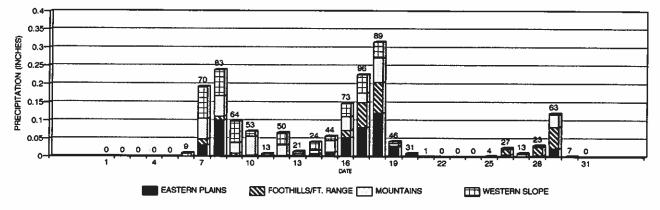
tures. Durango, Gunnison and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 4 p.m. The remaining stations shown below report at midnight.)



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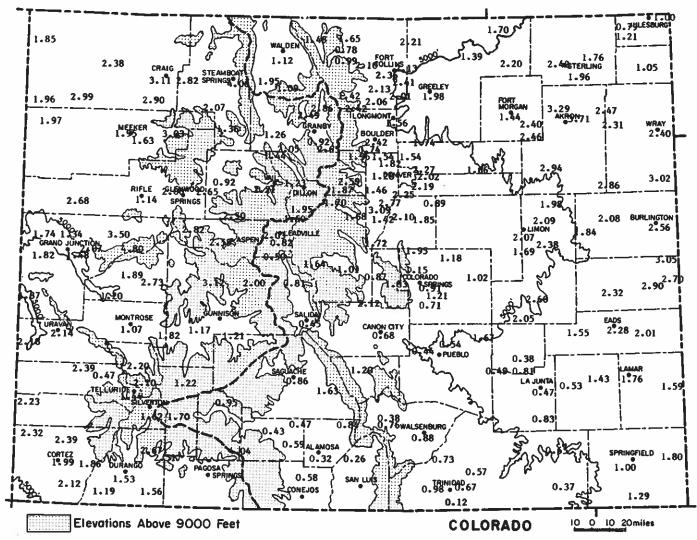
### **OCTOBER 1993 PRECIPITATION**

The bulk of October's precipitation fell from storm events 6-9th, 16-19th and 28-29th. Scattered rain and snow showers damped the mountains and Western Slope 10-15th as well. Steamboat Springs reported 14 consecutive days with measurable precipitation, October 7-20th – very unusual for Colorado at this time of year. Overall, statewide precipitation was approximately 1.70" which is considerably above average. Southern Colorado was south of the center of most storms and ended up with only 4-7 days with measurable precipitation.

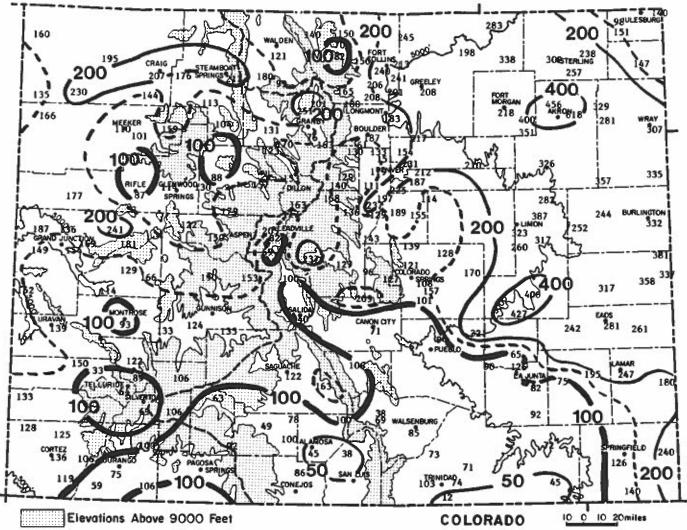


### COLORADO DAILY PRECIPITATION - OCT 1993

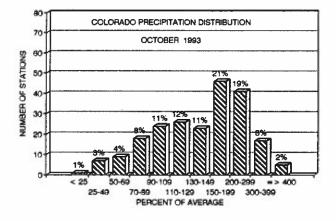
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



Precipitation Amounts (in inches) for October 1993.



October 1993 Precipitation as a Percent of the 1961-90 average.



There were both wet and dry areas in Colorado in October, but the wet areas far outnumbered those areas that were drier than average. 50% of Colorado's official weather stations reported 150% or more of their average monthly precipitation.

### OCTOBER 1993 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	2.27"	12th wettest in 122 years of record (wettest = $4.17^{\circ}$ in 1969)
Durango	1.53"	47th wettest in 101 years of record (wettest = 11.79" in 1972)
Grand Junction	1.34"	23rd wettest in 102 years of record (wettest 3.45" in 1972)
Las Animas	0.53*	56th wettest in 127 years of record (wettest 3.75" in 1870)
Pueblo	0.54*	59th wettest in 125 years of record (wettest = 4.91" in 1957)
Steamboat Springs	4.06*	3rd wettest in 89 years of record (wettest = 5.97" in 1908)

# COMPARATIVE HEATING DEGREE DAY DATA FOR OCTOBER 1993

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	STATION	ALAMOSA	ASPEN	BOULDER	BUENA VISTA	BURLINGTON	CANON	COLORADO SPRINGS	CORTEZ	CRAIG	DELTA	DENVER	NOTIIO	DURANGO	EAGLE	EVENGREEN	FORT	FORT MORQAN	GRAND
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\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

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\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

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### OCTOBER 1993 CLIMATIC DATA

### EASTERN PLAINS \_\_\_\_\_

			Tempera	ature			De	egree Da	ays		Precip	itation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep		
NEW RAYMER 21N	59.0	31.0	45.0	-3.0	86	5	613	2	185	1.70	1.10	283.3	11
STERLING	65.9	34.5	50.2	0.2	92	10	459	7	265	2.42	1.62	302.5	6
FORT MORGAN	62.7	35.5	49.1	-1.7	89	12	495	8	226	1.44	0.78	218.2	3
AKRON FAA AP	61.3	36.1	48.7	-2.0	86	9	506	9	214	3.29	2.57	456.9	9
AKRON 4E	61.7	32.7	47.2	-3.0	89	8	552	6	224	3.71	3.11	618.3	8
HOLYOKE	63.1	34.3	48.7	-2.8	90	3	502	6	237	1.05	0.34	147.9	8
JOES	63.3	35.3	49.3	-2.7	92	5	491	13	240	2.86	2.06	357.5	6
BURLINGTON	63.8	37.2	50.5	-1.5	91	8	460	19	244	2.57	1.80	333.8	9
LIMON WSMO	60.4	32.8	46.6	-1.7	85	1	564	2	200	2.07	1.43	323.4	9
CHEYENNE WELLS	64.8	37.3	51.1	-2.1	91	6	444	22	255	2.90	2.09	358.0	6
EADS	65.1	35.9	50.5	-3.3	90	10	457	14	256	2.28	1.47	281.5	6
ORDWAY 21N	66.1	32.1	49.1	-2.4	90	7	490	5	269	2.05	1.57	427.1	6
ROCKY FORD 2SE	70.5	35.9	53.2	-1.0	91	8	376	14	327	0.81	0.17	126.6	7
LAMAR	66.1	36.2	51.1	-3.6	90	11	437	16	268	1.76	1.05	247.9	7
LAS ANIMAS	68.3	36.9	52.6	-2.9	95	11	389	11	297	0.53	-0.17	75.7	6
HOLLY	67.4	37.1	52.3	-1.8	95	13	411	21	275	1.59	0.71	180.7	8
SPRINGFIELD 7WSW	69.1	37.2	53.2	-1.9	92	6	388	29	323	1.00	0.21	126.6	5

### FOOTHILLS/ADJACENT PLAINS

			Tempera	ature			De	egree Da	ays		Precip	itation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	t days
FORT COLLINS	60.6	34.5	47.5	-2.3	85	8	533	0	199	2.36	1.38	240.8	12
GREELEY UNC	62.0	35.9	49.0	-1.5	87	11	492	1	217	1.98	1.03	208.4	10
ESTES PARK	55.4	29.9	42.6	-2.3	74	3	685	0	113	1.42	0.56	165.1	12
LONGMONT ZESE	64.4	29.4	46.9	-3.0	89	5	557	3	246	1.56	0.71	183.5	8
BOULDER	61.6	35.7	48.6	-4.9	85	6	508	5	207	2.42	1.13	187.6	10
DENVER WSFO AP	62.5	35.8	49.1	-2.3	85	9	488	5	231	2.27	1.29	231.6	7
EVERGREEN	58.5	26.1	42.3	-2.3	80	-2	695	0	166	1.46	0.15	111.5	8
CHEESMAN	60.2	18.1	39.1	-7.6	79	2	797	0	196	1.72	0.52	143.3	8
LAKE GEORGE 8SW	55.2	23.8	39.5	-2.3	72	0	785	Q	107	1.01	0.22	127.8	7
ANTERO RESERVOIR	54.2	18.2	36.2	-1.7	73	- 13	886	0	107	0.64	-0.05	92.8	10
RUXTON PARK	46.1	23.4	34.7	-3.7	64	-5	929	0	38	1.83	0.40	128.0	11
COLORADO SPRINGS	60.5	35.3	47.9	-2.2	82	8	519	1	195	0.91	0.07	108.3	6
CANON CITY 2SE	66.0	35.8	50.9	-3.3	84	12	435	8	275	0.68	-0.27	71.6	7
PUEBLO WSO AP	66.2	31.7	49.0	-4.6	89	5	491	1	273	0.54	-0.03	94.7	5
WESTCLIFFE	58.2	22.5	40.4	-3.6	75	-12	757	0	163	1.20	0.07	106.2	7
WALSENBURG	67.3	36.2	51.7	-1.4	84	-1	406	1	279	0.88	-0.15	85.4	5
TRINIDAD FAA AP	66.1	33.6	49.9	-3.6	88	1	472	9	279	0.57	-0.23	71.2	4

### MOUNTAINS/INTERIOR VALLEYS

			Tempera	ature			De	egree Da	ays		Precip	itation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm a	# days
WALDEN	52.5	22.5	37.5	-1.2	73	-10	848	0	88	1.12	0.20	121.7	10
LEADVILLE 2SW	49.0	21.5	35.2	-1.6	65	-7	915	0	53	0.82	-0.18	82.0	11
SALIDA	61.5	26.6	44.0	-2.5	80	2	641	0	208	0.45	-0.65	40.9	7
BUENA VISTA	58.8	26.4	42.6	-2.8	76	0	687	0	168	0.81	-0.00	100.0	9
SAGUACHE	57.3	27.0	42.1	-2.5	73	0	702	0	159	0.86	0.16	122.9	12
HERMIT 7ESE	51.4	23.4	37.4	-1.1	71	6	847	0	96	0.00	-1.59	0.0	0
ALAMOSA WSO AP	59.3	22.9	41.1	-2.4	75	-1	735	0	181	0.32	-0.38	45.7	6
STEAMBOAT SPRINGS	57.6	26.1	41.9	-0.3	78	0	710	0	146	4.06	2.19	217.1	15
YAMPA	55.8	31.2	43.5	1.7	73	3	661	0	115	1.36	0.06	104.6	12
GRAND LAKE 1NW	53.0	24.1	38.5	-0.4	72	-8	813	0	96	2.86	1.44	201.4	15
GRAND LAKE 6SSW	52.0	25.6	38.8	-1.1	70	-3	805	0	84	2.49	1.50	251.5	12
DILLON 1E	50.4	21.7	36.1	-2.4	67	-2	889	0	78	1.23	0.43	153.7	12
CLIMAX	45.6	13.2	29.4	-4.0	62	-9	1096	0	43	1.60	0.24	117.6	13
ASPEN 1SW	55.0	28.2	41.6	-1.9	73	7	718	0	115	2.58	0.87	150.9	13
CRESTED BUTTE	51.5	22.3	36.9	-2.3	68	3	863	0	78	3.12	1.48	190.2	11
TAYLOR PARK	47.7	23.1	35.4	-2.4	66	3	912	0	43	2.00	0.70	153.8	12
TELLURIDE	55.2	24.9	40.0	-3.1	71	6	768	0	108	1.44	-0.78	64.9	9
SILVERTON	52.5	21.9	37.2	-1.7	69	5	854	0	85	1.62	-0.72	69.2	10
WOLF CREEK PASS 1	44.2	21.0	32.6	-3.6	58	1	997	0	26	4.04	-0.31	92.9	11

### WESTERN VALLEYS.

			Tempera	ature -			De	egree D	ays		Precip	itation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	XNorm #	# davs
CRAIG 4SW	57.9	30.3	44.1	-1.0	79	9	619	0	143	3.11	1.61	207.3	13
HAYDEN	58.2	30.6	44.4	-0.8	80	8	634	0	152	2.82	1.22	176.2	15
MEEKER 3W	60.9	30.5	45.7	-0.4	82	9	591	0	186	1.95	0.18	110.2	11
RANGELY 1E	60.9	34.2	47.5	-1.4	83	15	533	0	188	1.97	0.79	166.9	7
EAGLE FAA AP	62.9	27.9	45.4	0.5	79	4	603	0	204	0.92	-0.12	88.5	8
GLENWOOD SPRINGS	63.5	31.9	47.7	-0.8	84	13	529	0	222	2.00	0.25	114.3	12
RIFLE	64.6	33.6	49.3	0.3	84	12	464	0	232	1.14	-0.17	87.0	11
GRAND JUNCTION WS	63.5	39.9	51.7	-2.9	85	18	410	6	220	1.34	0.36	136.7	11
CEDAREDGE	63.1	30.7	46.9	-3.8	82	8	553	0	214	1.89	0.43	129.5	9
PAONIA 1SW	64.8	36.8	50.8	-0.7	85	13	432	1	238	2.73	1.09	166.5	10
DELTA	60.8	30.2	45.5	-6.4	80	11	598	0	180	1.20	0.15	114.3	8
COCHETOPA CREEK	58.4	23.2	40.8	0.0	75	2	742	0	150	1.21	0.32	136.0	10
MONTROSE NO. 2	60.9	35.2	48.0	-2.4	80	14	520	0	190	1.07	-0.07	93.9	9
URAVAN	68.5	36.5	52.5	-1.7	88	20	379	0	291	2.14	0.61	139.9	8
NORWOOD	59.3	31.6	45.4	-0.8	76	8	599	0	158	2.39	0.80	150.3	9
YELLOW JACKET 2W	61.7	35.3	48.5	-1.2	81	13	502	0	190	2.32	0.51	128.2	8
CORTEZ	64.3	32.5	48.4	-1.6	83	15	508	0	228	1.99	0.53	136.3	8
DURANGO	62.8	33.1	47.9	-0.9	78	14	522	0	209	1.53	-0.49	75.7	9
IGNACIO 1N	60.5	29.1	44.8	-3.0	77	13	621	0	174	1.56	0.10	106.8	12

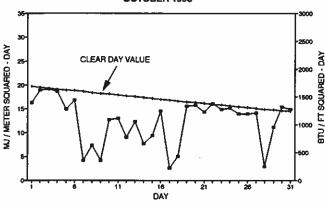
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

### OCTOBER 1993 SUNSHINE AND SOLAR RADIATION

	Numt	per of	Days	Percent Possible	Average % of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	Sunshine	Possible
Colorado Springs	10	11	10		
Denver	11	7	13	64%	72%
Fort Collins	11	8	12		
Grand Junction	11	8	12	82%	74%
Limon	11	6	14		
Puebio	NA	NA	NA	81%	78%

CLR = Clear PC = Partly Cloudy CLDY = Cloudy

The skies were predominantly sunny 1st-5th, 19th-26th, and 30th-31st. A lengthy partly cloudy to cloudy period persisted 6th-18th. Overall, Colorado was a bit cloudier than average during the month of October.



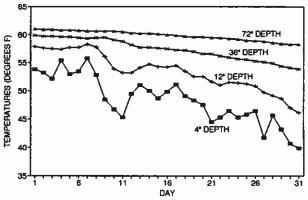
### FT. COLLINS TOTAL HEMISPHERIC RADIATION OCTOBER 1993

### **OCTOBER 1993 SOIL TEMPERATURES**

October soil temperatures showed the affects of the cooler and wetter than average weather above ground. Temperatures declined sharply with each storm system and ended up cooler than average at all depths.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

### FORT COLLINS 7 AM SOIL TEMPERATURES OCTOBER 1993



### HATS OFF TO: Robert Lund of Paonia, Colorado

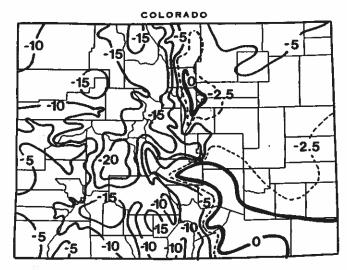
Just over 20 years ago, Mr. Lund volunteered to take the official weather observations for Paonia. (The Paonia weather observations date back to 1892.) Since then he has seen both flood and drought and everything in between. We thank you for you wonderful and reliable help!

### HOW WE DIFFER FROM DENVER

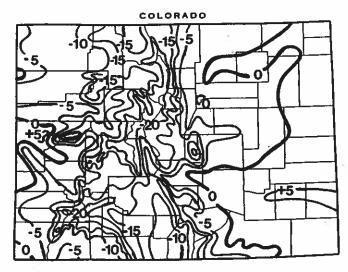
In case you haven't noticed (if you live in Colorado), Denver seems to be the center of the universe. As well as being the capital of Colorado and the largest city in the State, Denver is also the primary media market and the transportation hub of the region. Denver is also the source for most of Colorado's weather forecasts issued to the public. No matter where we live, we often must compare and contrast our locations to Denver.

In keeping with this idea, I thought you might be interested to see how temperatures compare between Denver and other parts of Colorado. Those of you who pay close attention to the weather have probably already formed your opinions about how temperatures where you live differ from Denver. Let's see if you are right.

First, we simply compared long-term climate normals (averages for the 1961-1990 period) for mean January and July



Mean Temperature Difference (°F) relative to Denver Stapleton Airport for January.



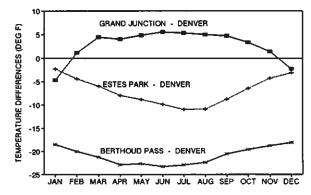
Mean Temperature Difference (\*F) relative to Denver Stapleton Airport for July.

temperatures. These maps show general temperature differences across Colorado. In January, nearly all of Colorado is colder than Denver. The Western Slope is generally 5 to 10 degrees cooler than Denver, but small areas near Grand Junction and in extreme southwest Colorado are only 3-5°F cooler. The high mountains are typically 15 to 20°F colder than Denver with the greatest differences observed between Denver and the upper Gunnison Valley. Areas where January mean temperatures are warmer than Denver are limited to the western suburbs and low foothills along the Front Range and areas in southern Colorado just east of the mountains extending out to extreme southeastern Colorado. Canon City and Boulder are the warmest areas in Colorado in January (with official data), 5° and 3°F warmer than Denver, respectively.

July temperature differences show quite a different pattern. In fact, during the summer, temperatures are predominantly controlled by elevation. The high mountains above 11,000 feet are typically at least 20 degrees cooler than Denver. Differences are still close to 10°F near 7500 feet. Areas that are warmer than Denver are much more expansive during the summer and include much of the Eastern Plains and a few areas of extreme western Colorado. The two warmest locations with respect to Denver are Palisade (near Grand Junction), +6.2°F, and La Junta, +5.8°F.

Many parts of Colorado show a systematic annual cycle in their relationship to Denver temperatures. But as the figure here shows, the cycle differs from one part of the State to another. In general, the high mountains and Front Range foothills become coolest with respect to Denver in the summer. The opposite is true on the Eastern Plains and Western Slope.

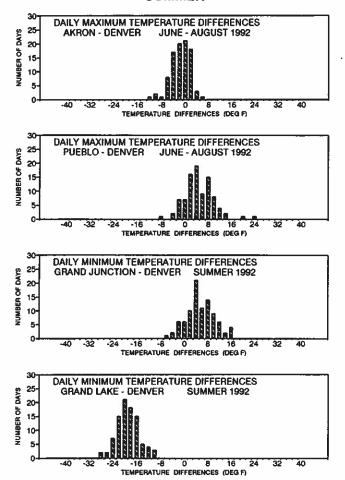
### MONTHLY TEMPERATURE COMPARISONS BASED ON 1961-1990 MONTHLY AVERAGES



Average differences are interesting, but we all know that conditions can vary dramatically from day to day. To examine daily differences, we took daily maximum and minimum temperatures for three recent seasons (summer (Jun-Aug 1992), winter (Dec 1992-Feb 1993) and spring (Mar-May 1993)) for Denver Stapleton Airport and for several other locations across Colorado. For each day, we subtracted Denver's temperatures from the temperature of the other points of interest. For example, if the high temperature at Pueblo was 92° while Denver only reached 87°F, we would show a difference of +5°F. Similarly, if the low at Grand Lake was -7°

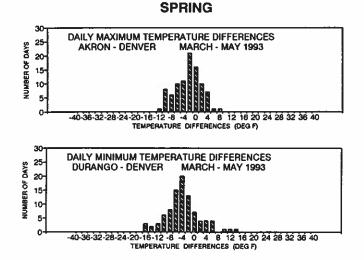
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

while Denver only dipped to 18°F, the difference would be -25°F. We then formed distributions of these daily differences and plotted histograms.



SUMMER

As you look at these graphs, you begin to see how wild our climate really is. The most consistent daily differences occur during the summer. In the summer examples you can see that Akron was usually a few degrees cooler than Denver during the chilly summer of 1992. Pueblo was typically a few degrees warmer.

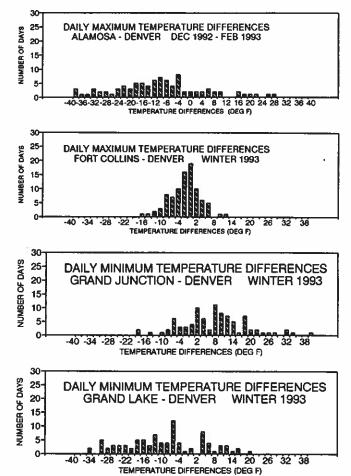


Overnight minimum temperatures show similar distributions. Grand Lake, for example, was typically 16° to 26° cooler than Denver at night but with some larger and smaller differences.

Two examples of springtime temperature differences are shown. Systematic relationships apply, but the distribution of differences are broader during the spring.

The final four figures are excellent demonstrations of why weather prediction (specifically for temperature) becomes most difficult during the winter. Huge daily differences are quite common. Even over the relatively short distance from Denver to Fort Collins, temperatures often differ by ten degrees. The comparisons with Alamosa, Grand Junction and Grand Lake are even more dramatic. Alamosa and Grand Lake are often 20° or more cooler than Denver, just as we might suspect. But there are also days when these locations are at least 20 degrees warmer than Denver.





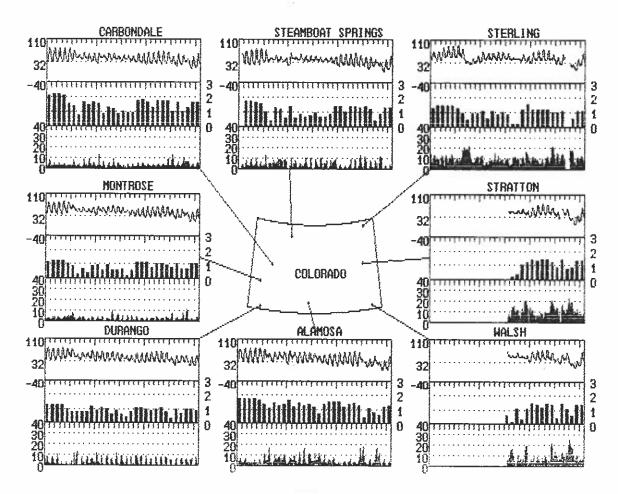
There are good reasons for all of these differences. Cloudiness, temperature inversions, air masses blocked by the mountains, upslope and downslope winds are all contributing factors. Colorado weather forecasters understand these factors and make good forecasts most of the time. Hopefully, you can now better appreciate how difficult it is to relate temperatures from one part of Colorado to another.

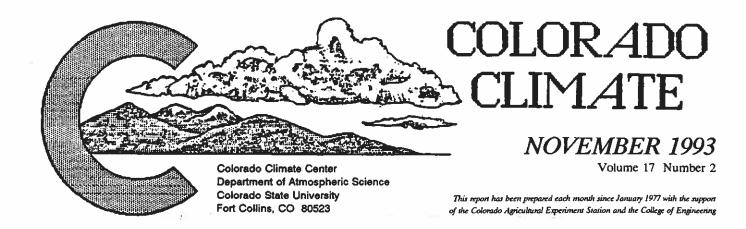
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NTHRNET NEATHER BATA 0010000 1003

		NTHRNET	WEATHER DATA	OCTOBER 1993				
Ala	nosa Durange	) Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh	
monthly avera 41	ge temperature ( ' .0 43.2	YF) 42.8	45,4	38.1	47.8	n/a	n/a	
махіюны: 75	rature extremes ar .7 4/15 74.8 .3 30/ 7 14.5	d time of occurent 1/16 80.1 4/ 30/5 9.5 30/	ce ( °F day/hou 14 79.5 4/1 7 11.7 30/ 1	6 77.4 5/14	90.0 6/1 7.3 30/		n/a n/a n/a n/a	n/a n/a
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The figure below shows monthly weather at WIHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



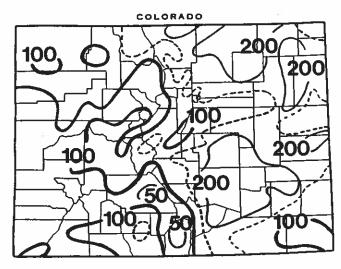


### November Climate in Perspective - Cold and Snowy

November was the sixth month in a row with colder than average temperatures across Colorado. Precipitation was above average over most of northern and eastern Colorado. The month featured a smattering of mild days and fairly typical amounts of sunshine. However, a powerful doubleheader rain and snowstorm 11-14th and a ferocious Thanksgiving coldwave and mountain snowstorm made front page news across the State.

### Precipitation

Several small snows whitened the Front Range and the Northern and Central mountains in November. Two large storms were responsible for nearly all significant precipitation



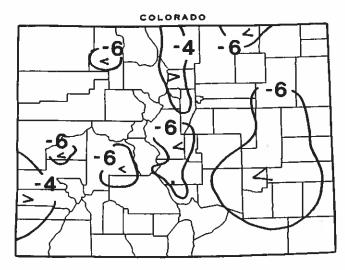
November 1993 precipitation as a percent of the 1961-1990 average.

accumulations. The storm episode from the 11th to the 14th affected the entire State and dropped more than 1" of rain and melted snow on several areas. The frigid storm system 23-24th

dropped most of it's moisture on the mountains and along the Front Range. Precipitation totals for the month ended up considerably above average across nearly all of the Front Range and Eastern Plains. Portions of the mountains and northwest valleys were also wet, but much of southwestern Colorado remained drier than average.

### Temperatures

Brief warm periods were interrupted by increasingly severe intrusions of cold air culminating in a severe Thanksgiving cold wave that set many new record low temperatures across Colorado. For the month as a whole, all of Colorado was colder than usual. Most areas ended up 4 to 6 degrees F below the 1961-1990 average, but portions of the Eastern Plains and several mountain valleys were more than 6 degrees below average. November continued the recent trend towards colder than average weather. For many locations in eastern Colorado, 14 of the past 18 months have been below average.



Departure of November 1993 temps. from the 1961-90 averages.

Inside This Issue									
November 1993 Daily Weather 13	Comparative Heating Degree Day Data								
November 1993 Temperature Comparison	November 1993 Climate Data 19								
November 1993 Precipitation									
November 1993 Precipitation Comparison	Above Average Temperatures								
1994 Water Year Precipitation 17	JCEM WTHRNET November 1993 Data 22								

**PLEASE NOTE:** Page numbering for the October 1993 summary should be pages 1-11. Consecutive page numbering for the 1994 Water Year (Vol. 17) began one month too early! Sorry for the confusion.

- 1-3 A Pacific cold front crossed Colorado on the 1st accompanied by a brief but locally intense burst of winds and wet snow during the evening, especially near the Front Range. Boulder reported 4" of snow. Skies cleared early on the 2nd. A cold morning was followed by a pleasant day. Winds aloft increased overnight. Westerly downslope winds helped temperatures on the 3rd climb well above average. Some 70s were observed in southeast Colorado. Winds gusted as high as 80 mph along portions of the Front Range as a deep low pressure center passed north of Colorado.
- 4-5 A strong cold front pushed across Colorado early on the 4th accompanied by mountain snow squalls. Snow developed again later in the day over the Northern and Central Mountains and the Front Range as a large, cold low pressure trough aloft moved southeastward. 1-3" of snow by early on the 5th made for icy roads. Winter Park totalled 8", and areas near Pikes Peak had as much as 12". The storm passed quickly, and skies cleared from the northwest later on the 5th.
- 6-10 Mostly clear but cold 6-9th as winds at mountain-top level blew steadily from the northwest. Temperatures each morning dropped to near zero in many mountain valleys. Temperatures then warmed abruptly on the 10th, and clouds drifted into western Colorado in advance of a storm system forming over California. Denver had its warmest temperature of the month on the 10th 67°F, and La Junta 1S reported 74°F.
- Mild weather continued on the 11th, but cooler air 11-14 and abundant Pacific moisture approached. Low elevation rain began during the afternoon. Wet snows developed later in the day over the mountains and along the Front Range. By morning on the 12th, a deep low pressure area was centered near Limon, and winds gusted to 40 mph. Snow continued in the mountains, and several inches fell on the Palmer Ridge and north of the Platte River. Walden got 10" of snow. Wolf Creek Pass reported 18 inches. Eastern Colorado just missed a blizzard as up to 0.75" of wind-blown precipitation fell as cold rain. Precipitation ended on the 12th but began again on the 13th and continued into the 14th as a second disturbance moved out of a large upper level low over the Southwest. Precipitation was widespread but fairly light in the mountains. The Front

Highest Temperature	74°F
Lowest Temperature	-25°F
Greatest Total Precipitation	5.37"
Least Total Precipitation	0.07"
Greatest Total Snowfall	58.1"
Greatest Snow Depth	30"

Range and Eastern Plains took the brunt of this storm with 4-12" of snow over many areas. More than 1" of water content was measured at Ordway, Rocky Ford and Walsenburg. As the snow ended, dense fog formed in many areas.

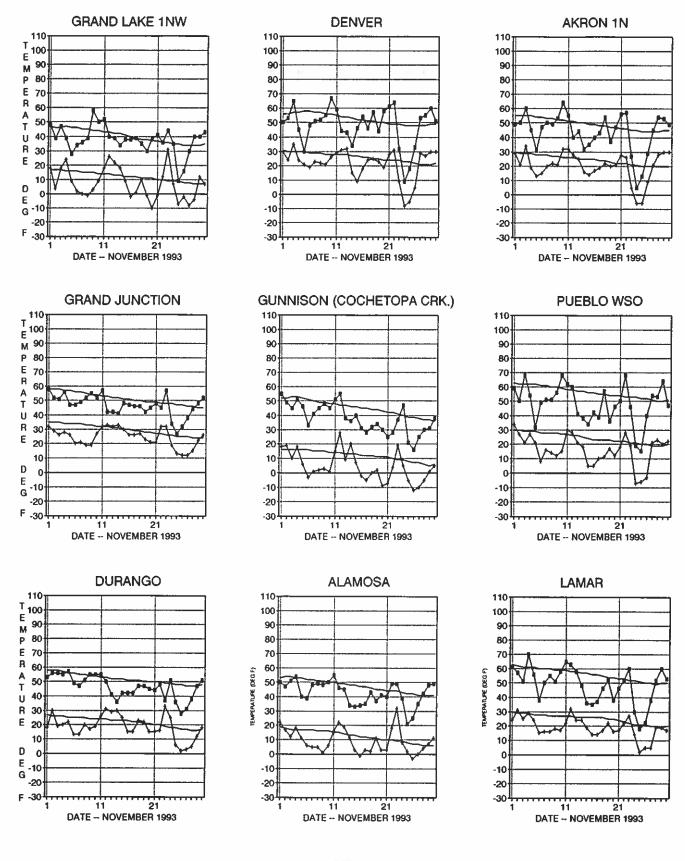
- 15-17 Clear and dry, but cold temperatures aloft 15-16th encouraged rapid nocturnal cooling, especially in mountain valleys. Antero Reservoir's -25° on the 16th was the coldest in the State. Dense fog also formed in many valleys. Westerly (zonal) winds returned on the 17th, accompanied by warmer temperatures and increasing high cloudiness.
- 18-20 A Pacific cold front raced across the region on the 18th. Several inches of snow fell in the mountains, and a burst of strong winds gusting as high as 60 mph moved out onto the Plains during the evening. It was sunny but quite chilly on the 19th. The 20th brought warmer temperatures but with increasing foothills winds.
- 21-26 Placid weather 21-22nd (68° at Pueblo on the 22nd) gave little clue to the extreme arctic cold that lurked just north of the State. Arctic air began slipping into eastern Colorado early on the 23rd accompanied by areas of freezing drizzle and light snow. Snow developed in western Colorado as a strong storm system approached from the northwest. Several areas in the mountains received close to a foot of snow by the 24th. Other nearby locations saw only flurries. Temperatures plummeted in the mountains, while east of the mountains daytime temperatures were at record levels in the teens and single digits. It was one of the coldest Thanksgiving Days (25th) in Colorado's history. Morning lows were far below zero over much of the State (-15° at Loveland), and highs only reached near zero in the high mountains with teens and single digits at lower elevations. A little more snow fell in the mountains. The frigid airmass began moving eastward on the 26th, but as it did, 30-70 mph northwest winds and blowing snow made for a painfully cold day east of the Continental Divide.
- 27-30 Temperatures continued to warm on the 27th, and winds gradually diminished. The month ended on a pleasant note with partly cloudy skies, mild temperatures and melting snow 28-30th. Some scant showers reached western Colorado on the 30th, but this final storm dissipated before reaching the mountains.

	Weather Extremes	
74°F	November 3	Las Animas, Springfield 7WSW
	November 10	La Junta 1S
-25°F	November 16	Antero Reservoir
5.37"		Wolf Creek Pass 1E
0.07"		Saguache
58.1"		Wolf Creek Pass 1E
30"	November 23	Wolf Creek Pass 1E

### NOVEMBER 1993 TEMPERATURE COMPARISON

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango,

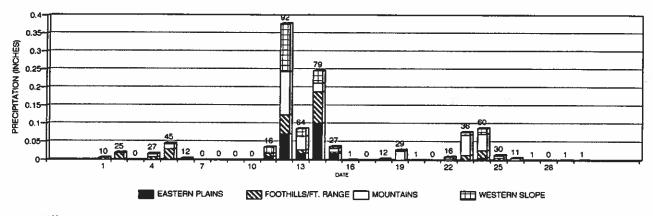
Gunnison and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



### **NOVEMBER 1993 PRECIPITATION**

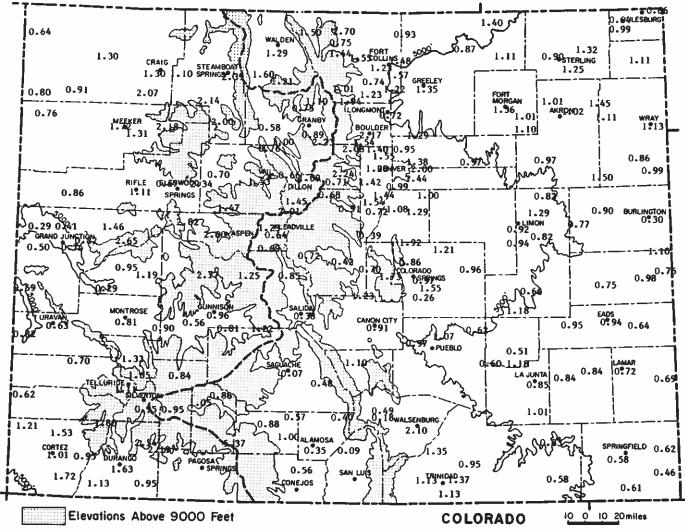
There were only a few days with precipitation in November in many lower elevation areas of Colorado, but when it did precipitate it meant business. The widespread storm system of November 11-14th (two precipitation episodes in quick succession) dropped an average of 0.75" of moisture

over the entire surface area of Colorado. The storm later in the month (November 22-25) was predominantly a mountain storm and dumped deep fluffy snow on most Colorado ski areas for the Thanksgiving weekend.

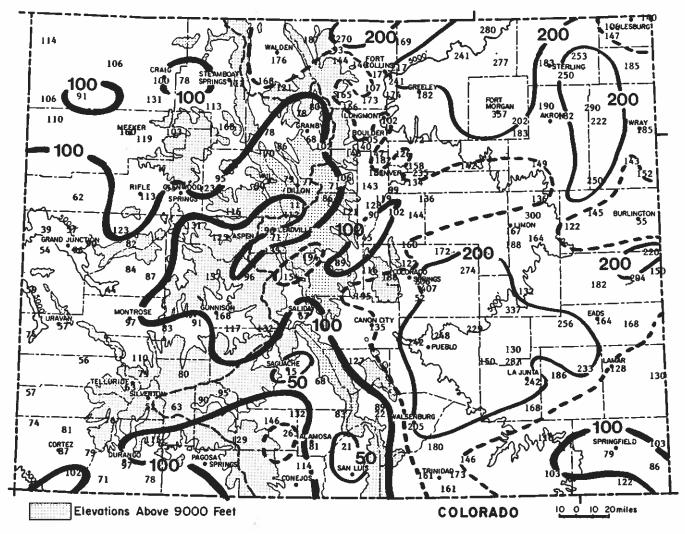


### COLORADO DAILY PRECIPITATION - NOV 1993

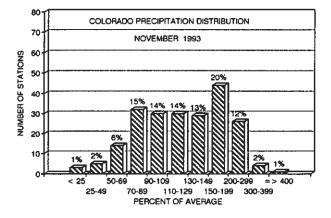
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



Precipitation Amounts (in inches) for November 1993.



November 1993 Precipitation as a Percent of the 1961-90 average.



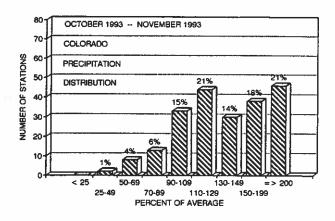
November precipitation ranged from less than 25% of average at Blanca and Saguache to close to 400% of average at a few locations east of the mountains. Overall, wetter than average reports outnumbered dry conditions by nearly 3 to 1. Thirty-five percent of Colorado's weather stations reported precipitation totals at least 150% of average.

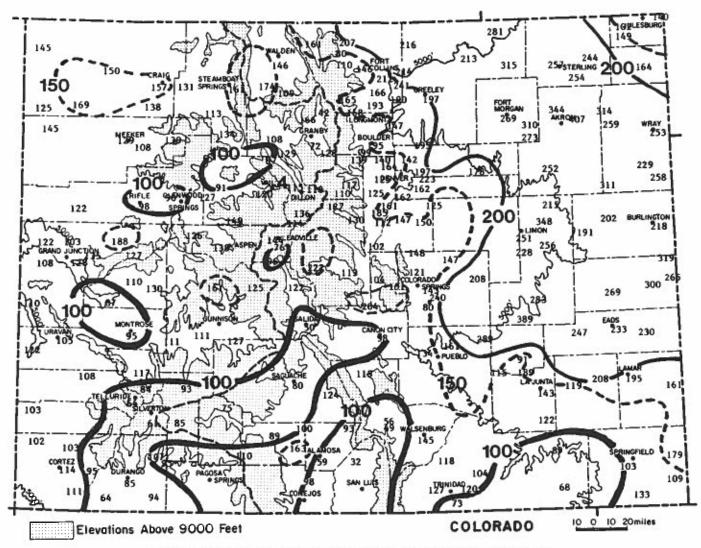
NOVEMBER	<b>1993</b> 2	PRECIPITATION	RANKING
FOR SE	LECT	ED COLORADO	CITIES

Station	Precip.	Rank
Denver	1.38"	15th wettest in 122 years of record (wettest = 3.21" in 1946)
Durango	1.63"	30th wettest in 101 years of record (wettest = 4.55" in 1982)
Grand Junction	0.41"	41st driest in 102 years of record (driest < 0.01" in 1904, 1932, & 1989)
Las Animas	0.84"	20th wettest in 127 years of record (wettest = 3.06" in 1946)
Pueblo	1.07"	12th wettest in 125 years of record (wettest = 2.48" in 1991)
Steamboat Springs	2.39"	23rd wettest in 89 years of record (wettest = 5.59" in 1985)

### **1994 WATER YEAR PRECIPITATION**

Two weeks of wet weather in mid October and a major mid-November storm system are responsible for most of the moisture thus far in the 1994 Water Year. That moisture has been sufficient to leave much of Colorado wetter than average. Large portions of eastern Colorado have received from 150% to 250% of the October-November average. A few locations have received more than three times their average. The mountains and Western Slope have received favorable moisture, but not extreme amounts. Most of those areas are near or above average. This has helped the winter recreation season in Colorado to get off to a good start. The only areas that are lagging behind average are in south central Colorado. Parts of the San Juan Mountains and San Luis Valley have received less than 75% of their average moisture.





October-November 1993 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR NOVEMBER 1993

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### NOVEMBER 1993 CLIMATE DATA

### EASTERN PLAINS

			Tempera	ature			D	egree D	ays	Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	# days
NEW RAYMER 21N	39.5	15.5	27.5	-7.3	63	-10	1117	0	20	1.40	0.90	280.0	5
STERLING	45.8	19.2	32.5	-4.1	65	-4	966	0	49	0.90	0.41	183.7	5
FORT MORGAN	42.9	19.6	31.2	-5.8	60	-4	1006	0	24	1.36	0.98	357.9	2
AKRON FAA AP	43.8	20.2	32.0	-5.1	64	-6	985	0	30	1.01	0.48	190.6	2
AKRON 4E	43.3	18.7	31.0	-5.6	64	-6	1014	0	35	1.02	0.46	182.1	4
HOLYOKE	48.5	19.9	34.2	-3.8	67	-1	886	0	61	1.11	0.51	185.0	3
JOES	45.4	19.1	32.3	-6.7	67	-4 55	975	0	49	1.50	0.90	250.0	4
BURLINGTON	45.6	20.5	33.0	-5.0	65	-3	953	0	45	0.30	-0.24	55.6	1
LIMON WSMO	41.7	16.7	29.2	-6.0	63	-6	1064	0	22	0.92	0.37	167.3	8
CHEYENNE WELLS	48.3	19.8	34.0	-5.5	67	-5	922	0	58	0.98	0.50	204.2	3
EADS	45.7	19.4	32.5	-7.3	67	1	966	0	47	0.94	0.37	164.9	2
ORDWAY 21N	44.1	14.5	29.3	-8.2	65	-4	1066	0	40	1.18	0.83	337.1	3
ROCKY FORD 2SE	47.9	17.1	32.5	-7.9	67	-1	967	0	55	1.18	0.77	287.8	4
LAMAR	48.5	18.5	33.5	-7.2	70	2	935	0	66	0.72	0.16	128.6	3
LAS ANIMAS	48.9	18.2	33.6	-7.8	74	-2	935	0	77	0.84	0.39	186.7	4
HOLLY	52.1	18.9	35.5	-4.4	70	-4	875	0	99	0.69	0.16	130.2	4
SPRINGFIELD 7WSW	54.1	23.6	38.8	-3.4	74	- 1	775	0	121	0.58	-0.15	79.5	2

### FOOTHILLS/ADJACENT PLAINS \_\_\_\_\_

			Tempera	ature			D	egree Da	ays		Precip	oitation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	days
FORT COLLINS	46.3	20.5	33.4	-4.1	62	-7	944	0	35	1.23	0.52	173.2	8
GREELEY UNC	44.2	21.6	32.9	-4.5	62	-7	955	0	29	1.35	0.61	182.4	5
ESTES PARK	41.7	20.7	31.2	-3.5	55	-12	1006	0	9	1.01	0.40	165.6	5
LONGMONT 2ESE	47.6	15.1	31.3	-5.9	64	-16	1005	0	53	0.72	0.02	102.9	4
BOULDER	48.1	23.1	35.6	-5.2	66	-8	875	0	53	2.17	1.11	204.7	9
DENVER WSFO AP	47.9	21.5	34.7	-4.3	67	-8	900	0	63	1.38	0.51	158.6	9
EVERGREEN	46.6	15.4	31.0	-3.4	63	-11	1011	0	48	1.42	0.43	143.4	8
CHEESMAN	48.5	8.8	28.6	-7.5	62	-9	1082	0	40	0.39	-0.47	45.3	6
LAKE GEORGE 8SW	35.9	8.7	22.3	-6.4	52	- 12	1275	0	2	0.42	-0.05	89.4	5
ANTERO RESERVOIR	35.2	1.3	18.2	-6.5	53	- 25	1393	0	2	0.72	0.35	194.6	6
RUXTON PARK	32.5	10.1	21.3	-6.5	44	-12	1305	0	0	1.73	0.81	188.0	7
COLORADO SPRINGS	44.2	20.4	32.3	-5.7	62	-4	972	0	38	0.97	0.50	206.4	9
CANON CITY 2SE	52.0	23.1	37.5	-4.7	68	-11	816	0	100	0.91	0.24	135.8	7
PUEBLO WSO AP	48.3	16.2	32.3	-8.2	69	-7	973	0	66	1.07	0.64	248.8	8
WESTCLIFFE	41.9	11.2	26.5	-6.1	57	-9	1145	0	10	1.10	0.24	127.9	4
WALSENBURG	51.2	25.5	38.4	-3.4	66	0	791	0	81	2.10	1.08	205.9	8
TRINIDAD FAA AP	51.7	20.7	36.2	-5.1	72	-2	857	0	92	0.95	0.30	146.2	7

### MOUNTAINS/INTERIOR VALLEYS

	Degree Days				Precipitation								
**	Maria	M.2	Tempera		117 - E			-	•	<b>T</b> - 4 - 4			
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	%Norm #	
WALDEN	34.4	7.4	20.9	-5.6	50	-20	1316	0	0	1.29	0.56	176.7	10
LEADVILLE 2SW	33.2	5.1	19.1	-5.7	48	-17	1368	0	0	0.64	-0.26	71.1	11
SALIDA	44.5	15.0	29.8	-6.2	61	2	1046	0	25	0.38	-0.18	67.9	4
BUENA VISTA	42.7	15.4	29.0	-4.9	57	2	1070	0	11	0.85	0.30	154.5	5
SAGUACHE	41.3	13.0	27.1	-4.2	52	1	1127	0	1	0.07	-0.39	15.2	2
HERMIT 7ESE	36.9	5.5	21.2	-3.8	50	-16	1305	0	0	1.05	-0.11	90.5	3
ALAMOSA WSO AP	42.5	9.1	25.8	-4.1	55	-3	1167	0	6	0.35	-0.08	81.4	3
STEAMBOAT SPRINGS	36.1	9.5	22.8	-6.3	53	-11	1260	0	3	2.39	0.27	112.7	9
YAMPA	38.4	14.0	26.2	-3.0	55	-4	1156	0	5	2.00	0.81	168.1	9
GRAND LAKE 1NW	37.9	7.5	22.7	-3.5	58	- 10	1264	0	5	1.10	-0.26	80.9	10
GRAND LAKE 6SSW	35.7	10.3	23.0	-4.9	48	-6	1250	0	0	0.75	-0.21	78.1	10
DILLON 1E	36.0	7.4	21.7	-5.1	54	-8	1291	0	2	0.66	-0.17	79.5	10
CLIMAX	30.9	2.5	16.7	-4.9	49	- 15	1440	Û	0	2.01	0.22	112.3	13
ASPEN 1SW	39.1	11.1	25.1	-5.4	57	-3	1188	0	7	2.00	0.40	125.0	9
CRESTED BUTTE	33.4	1.9	17.6	-7.7	53	- 16	1414	0	2	2.77	0.76	137.8	8
TAYLOR PARK	32.3	3.8	18.0	-6.3	48	-11	1402	0	0	1.25	-0.05	96.2	8
TELLURIDE	40.5	8.3	24.4	-7.1	57	-9	1210	0	7	1.11	-0.64	63.4	7
SILVERTON	39.4	5.0	22.2	-4.7	57	-14	1280	0	5	0.95	-0.87	52.2	8
WOLF CREEK PASS 1	31.8	9.7	20.7	-5.0	50	-12	1320	0	0	5.37	1.21	129.1	8

### WESTERN VALLEYS

WEGIERR VALLEIG														
		Temperature						egree D	ays		Precipitation			
Name	Max	Min	Mean	Dep	∦igh	Low	Heat	Cool	Grow	Total	Dep	%Norm #	# days	
CRAIG 4SW	38.4	13.2	25.8	-5.8	57	-8	1168	0	12	1.30	0.00	100.0	10	
HAYDEN	38.1	14.0	26.0	-6.1	55	-5	1161	0	5	1.10	-0.31	78.0	7	
MEEKER 3W	41.8	15.7	28.8	-4.9	61	-6	1077	0	19	1.72	0.65	160.7	10	
RANGELY 1E	41.8	17.4	29.6	-4.7	56	2	1059	0	6	0.76	0.07	110.1	5	
EAGLE FAA AP	42.6	12.3	27.5	-4.5	57	-6	1116	0	9	0.70	-0.03	95.9	6	
GLENWOOD SPRINGS	43.6	18.6	31.1	-4.8	61	2	1012	0	19	0.67	-0.53	55.8	12	
RIFLE	46.4	18.2	32.3	-4.4	58	2	975	0	24	1.11	0.13	113.3	6	
GRAND JUNCTION WS	46.7	24.5	35.6	-4.7	58	12	875	0	23	0.41	-0.30	57.7	7	
CEDAREDGE	45.6	17.1	31.3	-6.7	58	2	1002	0	15	0.95	-0.17	84.8	5	
PAONIA 1SW	47.4	21.7	34.6	-4.5	61	8	908	0	35	1.19	-0.17	87.5	7	
DELTA	43.5	15.8	29.6	-9.4	56	1	1052	0	8	0.29	-0.36	44.6	3	
GUNNISON	36.5	4.7	20.6	-7.8	53	-12	1323	0	- 4	0.96	0.39	168.4	8	
COCHETOPA CREEK	37.7	4.5	21.1	-6.9	55	- 12	1310	0	8	0.81	0.12	117.4	5	
MONTROSE NO. 2	45.3	20.5	32.9	-4.8	57	7	956	0	23	0.81	-0.02	97.6	3	
URAVAN	51.7	22.4	37.0	-3.9	61	8	832	0	66	0.63	-0.46	57.8	6	
NORWOOD	44.7	17.3	31.0	-3.2	55	-1	1011	0	13	0.70	-0.55	56.0	3	
YELLOW JACKET 2W	45.5	22.7	34.1	-3.1	55	5	921	0	16	1.21	-0.41	74.7	3	
CORTEZ	48.6	19.2	33.9	-4.4	59	3	926	0	41	1.01	-0.15	87.1	3	
DURANGO	46.4	18.6	32.5	-4.6	57	2	968	0	27	1.63	-0.05	97.0	5	
IGNACIO 1N	47.5	19.0	33.2	-2.8	55	7	504	0	11	0.95	-0.26	78.5	4	

Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

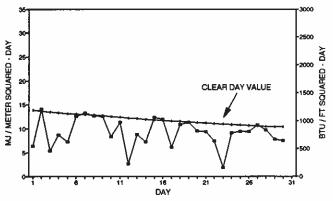
### NOVEMBER 1993 SUNSHINE AND SOLAR RADIATION

	Numt	ber of	Days	Percent Possible	Average % of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	Sunshine	Possible
Colorado Springs Denver Fort Collins Grand Junction	13 10 11 12	10 9 8 8	7 11 12 10	 64%  69%	65% 63%
Limon Pueblo	9 NA	9 NA	12 NA	65%	 73%

CLR = Clear	РС	= Partly Cloudy	CLDY= Cloudy
-------------	----	-----------------	--------------

There were several sunny days during November, but they were interspersed with some very cloudy days. Overall, Colorado ended up with a little less sunshine and solar energy than usual east of the mountains but with more sunshine than average on the Western Slope.

# FT. COLLINS TOTAL HEMISPHERIC RADIATION NOVEMBER 1993

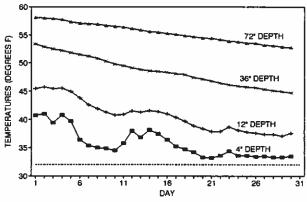


### NOVEMBER 1993 SOIL TEMPERATURES

November soil temperatures dropped steadily. Fresh snow before Thanksgiving helped to insulate the ground from the effects of the extreme holiday cold wave. Only the upper 3 inches of soil had frozen by the end of the month.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

### FORT COLLINS 7 AM SOIL TEMPERATURES NOVEMBER 1993



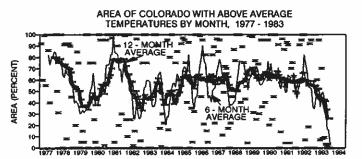
### HATS OFF TO: Public Service Company of Colorado, Shoshone Power Plant.

For more than 80 years, daily weather observations have been taken right at the bottom of Glenwood Canyon east of Glenwood Springs. John Davis currently oversees the station. It is a unique climate down in the canyon – much warmer and wetter than surrounding weather stations. Thanks to all of you at the Shoshone Power Plant, and keep those reports coming.

### **RECENT TENDENCIES FOR ABOVE AVERAGE TEMPERATURES**

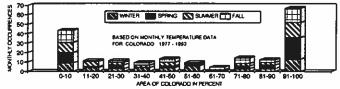
Since the early 1980s, above average temperatures have occurred in Colorado much more often than below average temperatures. However, during the past 18 months, this pattern has reversed. Only 3 of the past 18 months have been warmer than average over the majority of Colorado. Agricultural production, energy consumption, water supplies and even wildlife have been affected by this recent change.

To explore these tendencies, the Colorado Climate Center took a new approach to examining temperature records. Normally we look at how many degrees above or below average the temperature has been at individual stations. This is useful and important but can also be misleading. Sometimes just one or two extreme months (typically during the winter when anomalies are most dramatic) will skew the averages for an entire year. Instead, we decided to look at what percent of the State of Colorado was above average for a given month. To do this, we examined maps of monthly temperature departures from average that have been published in **Colorado Climate** since 1977. For each month, we graphically evaluated the fraction of the State with above average temperatures. Here are the results.



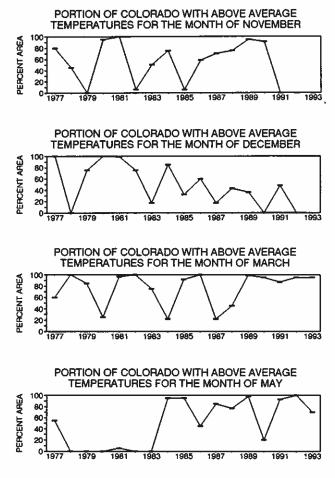
Colorado typically alternates, in what may appear to be a random pattern, from being entirely above average to entirely below average. Since 1977 there have been 44 months when no more than 10% of Colorado were above average. Sixty-seven months have been above average over more than 90% of the State. The remaining months had portions of the State that were above average at the same time that other areas were cooler than usual. The figure below shows the distribution of these months. Spring is the season when Colorado is most likely to be all warm or all cold. Winter is the season when Colorado is most often divided with parts of the State colder than average while other parts are warm.

### MONTHLY OCCURRENCES WITH SPECIFIED AREA WITH ABOVE AVERAGE TEMPERATURES



Six and 12 month averaging was used to smooth out monthly variations and show persisting features. A period of warm weather occurred in early 1981 when nearly the entire State remained above average for 6 months. No other warm period has persisted for more than 4 consecutive months. The recent cool episode, culminating in 6 consecutive cooler than average months is unprecedented during the 17-year period of investigation. Cool periods in 1979, 1982 and 1984 were not as widespread or as long lasting. Statistics would therefore suggest a strong likelihood that warmer than average temperatures will soon return to Colorado.

We also looked at temperature characteristics for individual months. All sorts of combinations appear. Selected examples are shown below. The last three Novembers have been cold statewide. December has shown a steady trend toward decreasing areas with warmer than average temperatures. January and February have been variable. March has been consistently warm. Seven of the past nine Aprils have been warm statewide. May had a long period with consecutive cool months but has been predominantly warm the past decade. June and August show no particular pattern, but July data suggest a cooling trend. September and October show no systematic patters. All of these data are extremely interesting to study, but have not proven useful on their own to help us predict future temperature patterns.



Volcanic activity, El Niño and sea surface temperatures may contribute to these temperature patterns, but the relationships are complex. In the future, we may extend these records farther back in history. It may not help us predict the future, but it may allow a better assessment of the probabilities of prolonged warm and cold episodes.

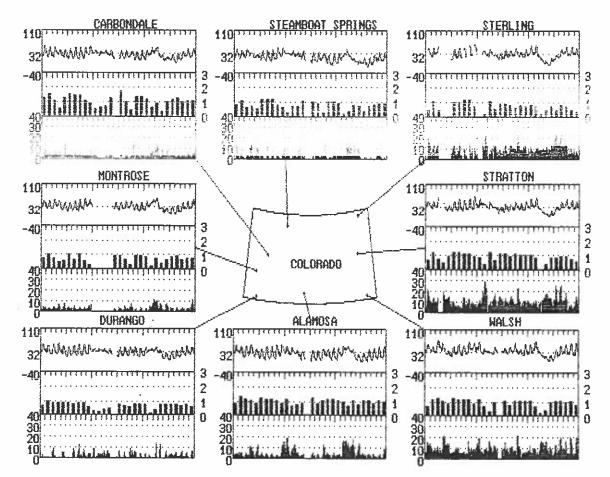
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

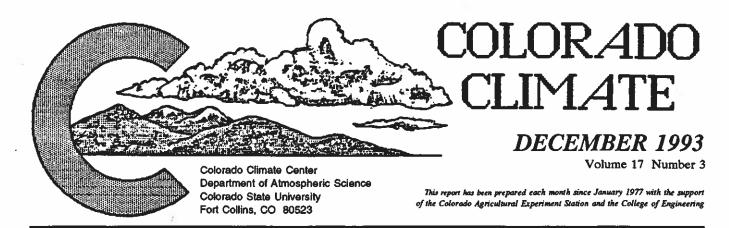
WTHRNET WEATHER DATA NOVEMBER 1993

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	¥alsh
monthly	average tempe 25.0	rature ( *F ) 29.0	26.9	29.4	19.2	29.9	30.6	35.8
aonthly maximum minimum	54.9 10/1	4 55.8 4/1		5 56.7 23/1	3 51.4 9/15			70.7 3/15 1.6 25/ 4
monthly 5 AM 11 AM 2 PM 5 PM 11 PM	average relat 73 / B 35 / 15 26 / 16 28 / 14 57 / 11	ive humidity / 74 / 15 43 / 22 38 / 22 40 / 20 69 / 17	' dewpoint { pr 86 / 16 53 / 21 39 / 22 46 / 20 75 / 18	rcent / 'F ) 73 / 15 42 / 21 32 / 22 35 / 20 70 / 18	89 / 10 73 / 19 60 / 22 65 / 19 85 / 13	76 / 17 54 / 25 44 / 25 51 / 21 71 / 19	35 / 6 24 / 14 21 / 16 24 / 11 31 / 7	76 / 22 48 / 29 40 / 30 48 / 27 69 / 24
monthly day day	average wind ( 190 175	direction ( c 163 82	legrees clockwi 215 173	se from north 211 156	) 165 125	234 248	177 219	188 251
	279 39	1.90	perhour) 2.21 rmonthforho 537 135 4 0	2,21 Burly average # 433 154 0 0	2.29 pph range ) 470 134 8 0	8.42 31 439 103 1	9.50 24 504 144 9	7.93 46 531 119 ()
monthly	average daily 988	total insolat 667	ion ( Btu/ft2+ 1035	day ) 723	759	683	901	923
"clearne 60-80% 40-60% 20-40% 0-20%	ss" distribut: 184 58 39 5	ion ( hours pe 0 175 58 57	r month in spe 45 55 50 18	cified clearne 32 53 59 75	55 index range ) 106 58 61 43	) 55 51 34	159 50 34 13	152 53 49 21

The State-Wide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



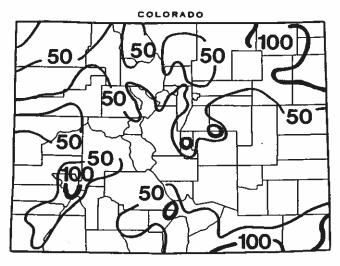


December Climate in Perspective - Dry and Windy

Several fast-moving storms moved across Colorado in December, but they brought more wind than snow. Westerly winds spilling over the Continental Divide, buffeted the Front Range on many days during the month with more than half of the days in the month experiencing strong winds in some foothills locations. Many small doses of snow sufficed to satisfy most December skiers, but precipitation for the month ended up well below average over most of the State.

### Precipitation

Eleven storm systems crossed Colorado in December. Usually this would be more than plenty to cover the mountains with deep snow. But this year the storms

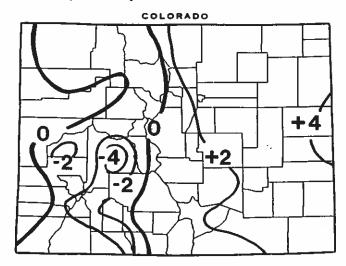


December 1993 precipitation as a percent of the 1961-1990 average.

passed very quickly. East of the mountains, all that was left from most of the storms were strong winds and evaporating clouds. As a result, almost the entire State ended up with less precipitation than normal. The only local exceptions were extreme southeast Colorado which got a nice rain from the Dec. 12-13 storm, extreme northeast Colorado that got the best of the Dec. 15-16 snow, and a small area in the mountains near Ouray. Precipitation was particularly meager (less than 25% of average) in the Arkansas Valley and south and east of the San Juan Mountains.

### Temperatures

The persisting strong west-northwesterly winds aloft over Colorado during December produced a temperature pattern with warmer than average temperatures from the Continental Divide eastward across the plains. Near average temperatures were observed in the mountains with locally below average temperatures in some snow-covered mountain valleys. There were no unusual temperature extremes over western Colorado with a fairly typical frequency of subzero readings in the mountains. Colorado was just on the edge of the polar outbreaks that sent bone-chilling cold into the Midwest for the Christmas holiday. The Eastern Plains escaped with no subzero readings for the entire month and several days with temperatures well above 50°F.



Departure of December 1993 temps. from the 1961-90 averages.

Inside This Issue										
	Comparative Heating Degree Day Data									
December 1993 Temperature Comparison 25	December 1993 Climate Data 30									
December 1993 Precipitation										
	Snowstorm of December 1913 32									
1994 Water Year Precipitation	JCEM WTHRNET December 1993 Data 35									

- 1-7 A series of four short waves (travelling disturbances in the winds aloft) raced across Colorado from west to east. Low elevation areas of Colorado remained dry, but the Northern and Central Mountains picked up a little snow from each of the systems (early on the 1st, late on the 2nd, overnight on the 4th to early on the 5th, and again late on the 6th). Temperatures fluctuated with each system but generally remained mild for this time of year. But the real story was the wind. Colorado's winter wind belt, from the crest of the high mountain ranges eastward to Interstate 25, was buffeted by several episodes of strong winds. Some areas reported wind gusts exceeding 50 mph each day. The most widespread strong winds occurred early on the 5th with gusts approached 90 mph along the northern Front Range causing some tree, roof and fence damage. Winds nearly as strong occurred on the 2nd, 4th and 7th.
- 8-11 Following another attack of strong Front Range winds 8-9th, a ridge of high pressure strengthened over the Rockies and held its position 10-11th. This brought the warmest weather of the month to the State. Temperatures climbed into the 40s in the mountains while at lower elevations, 50s and 60s were common. Kim 15NNE hit 74° on the 8th. Las Animas matched that reading on the 9th. Kassler (near Chatfield Reservoir) was surprised when they hit 71° on the 11th. Clouds increased on the 11th as a Pacific storm system pushed inland.
- 12-14 Barometer watchers awoke to very low pressure on the 12th as a strong storm developed over Colorado. Mild temperatures continued east of the mountains, but valley rains and mountain snows developed. The storm passed too quickly to deposit heavy precipitation, but Wolf Creek Pass 1E managed to get 15" of wet snow. The storm moved out onto the plains during the afternoon. Clouds darkened and winds increased, but only scattered rainshowers fell. The greatest rain report was 0.40" at Walsh. Snow ended in the mountains on the 13th, but northerly winds gusting over 40 mph howled across the Plains. Skies cleared and winds gradually diminished. Mountain temperatures early on the 14th dipped well below zero (e.g. -23°F at Fraser).
- 15-17 A similar storm developed rapidly over Utah on the 15th and pumped moisture into western Colorado from the south. The storm then slowed and moved right over the State on the 16th. This was the only storm of December that dropped moisture over most of Colorado. Only southeastern parts of the State were missed. Modest snowfall totals of 1-4" were the rule both east and west

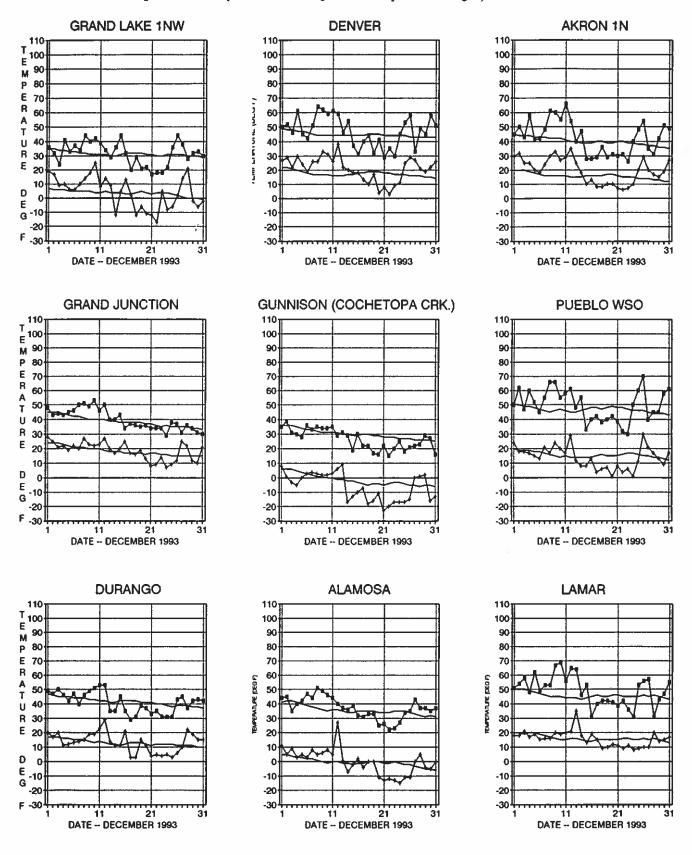
74°F
-28°F
2.44"
0.00"
41.1"
39"

of the mountains with up to 12" recorded in the mountains. Eight inches at Julesburg and 7" at Holyoke were the heaviest reports east of the mountains. Skies cleared but temperatures were cold statewide on the 17th.

- 18-23 A period of cold, wintry weather gripped Colorado with subzero temperatures each night in the mountains. Arctic air slid down from the north on the 19th bringing up to 3" of dry snow to the Front Range. Temperatures in the single digits were widespread at lower elevations early on the 20th, but the day was delightfully sunny and calm. On the 21st, cold air rushed down again from Canada with just enough light snow to make Front Range driving hazardous. Walsenburg totalled 5", but most reports were less. As skies cleared, mountain temperatures were far below zero again on the 22nd. Higher in the mountains north winds sent wind chill temperature below -40°F. Another blast of winds, cold and light snow on the 23rd chilled cattle and Christmas shoppers alike. Daytime temperatures in the mountains stayed in the teens.
- 24-26 The Christmas weekend was dry across all of Colorado. Westerly downslope winds along the Front Range, gusting to 40-60 mph on the 24th, sent temperatures rebounding back up above average. Christmas Day and the 26th were clear to partly cloudy statewide with seasonally cold temperatures in the mountains and Western Slope but very warm east of the mountains. Fort Collins hit 57° on the 25th. Pueblo soared to 70° on the 26th.
- 27-29 Moist air moved into western Colorado on the 27th bringing milder temperatures with light but widespread snows from Utah eastward to the Continental Divide. Vail reported 6" 27-28th. At the same time, a shallow layer of cold air slipped into eastern Colorado producing fog and a few flurries that lingered into the 28th. Skies cleared over much of Colorado on the 29th, but patches of morning fog remained. Taylor Park's -28°F early on the 29th was the coldest in Colorado for the month.
- 30-31 The 30th was dry and seasonal in western Colorado with mild temperatures east of the mountains. On the 31st, a storm system north of Colorado passed quickly eastward. Very strong westerly winds cascaded down the Front Range. 50 mph gusts were common from Fort Collins to Pueblo with local reports over 80 mph in wind-prone areas. The storm brought clouds to western Colorado and a few mountain flurries, but most of the State remained dry.

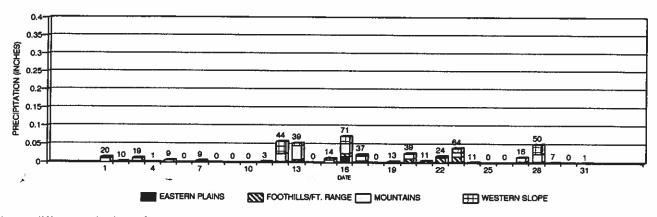
		Weather Extremes	
ture	74°F	December 8,	Kim 15 NNE
		December 9	Las Animas
ure	-28°F	December 29	Taylor Park Reservoir
recipitation	2.44"		Wolf Creek Pass 1E
pitation	0.00"		Eads
nowfall	41.1"		Wolf Creek Pass 1E
epth	39"	December 20	Wolf Creek Pass 1E
			10 m

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison (Cochetopa Creek), and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



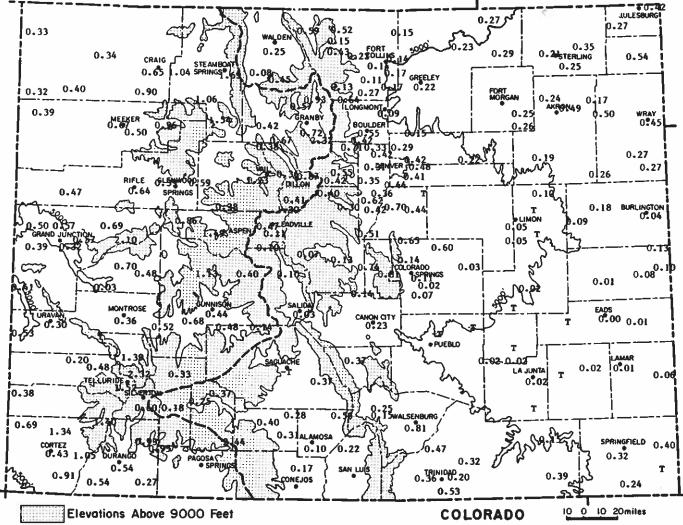
# **DECEMBER 1993 PRECIPITATION**

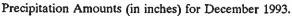
There were numerous brief storms during December, mostly affecting the higher mountains, but none bringing widespread heavy precipitation. The only precipitation that fell on the Eastern Plains occurred 12-13th and 15-16th. Most precipitation on the Front Range came from three small storms 19-23rd. The only storm that affected most of the State occurred 15-17th dropping an average of about 0.10" of moisture statewide. Total monthly precipitation statewide was less than 0.50" which was considerably below average.

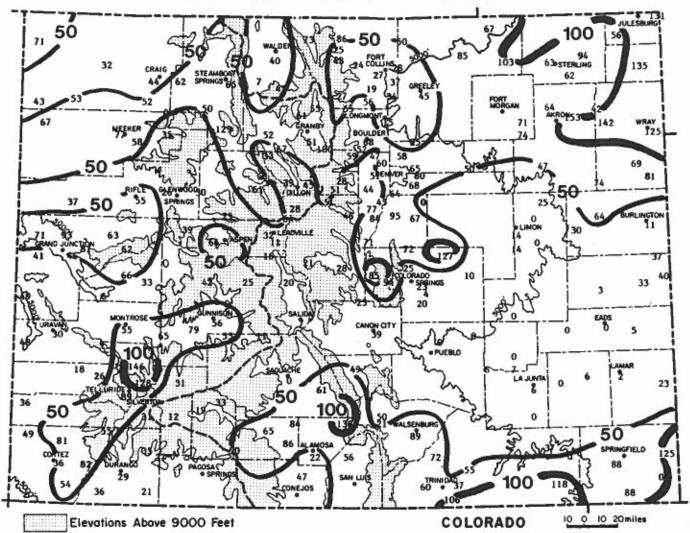


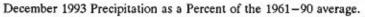
# COLORADO DAILY PRECIPITATION - DEC 1993

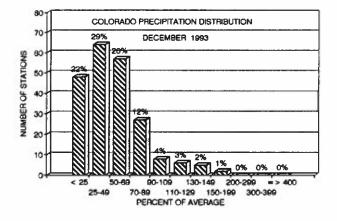
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)











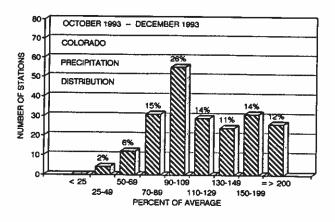
December precipitation totals were below average at more than 92% of Colorado's official weather stations. More than 50% of the State received less than half of the normal December moisture, and 22% received less than one-quarter of average.

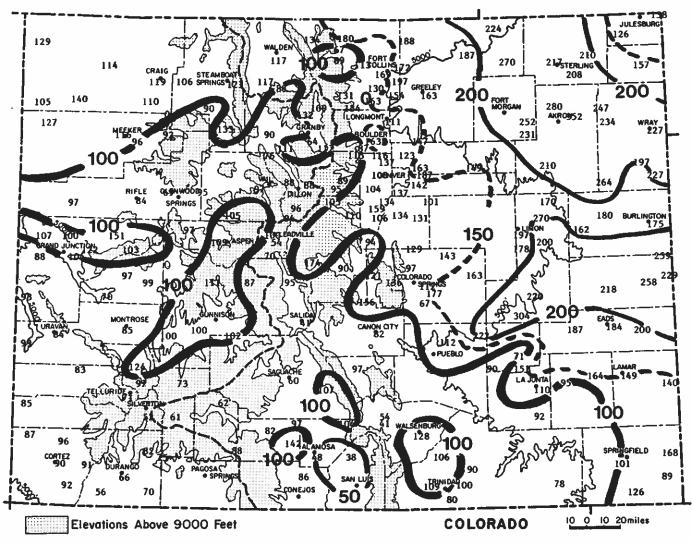
### DECEMBER 1993 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

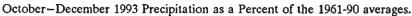
Station	Precip.	Rank
Denver	0.42"	55th driest in 122 years of record (driest < 0.01" in 1881 and 1905)
Durango	0.54"	22nd driest in 100 years of record (driest < 0.01" in 1900, 1917, 1950 & 1989)
Grand Junction	0.57"	43rd wettest in 102 years of record (wettest 1.89" in 1951)
Las Animas	Trace	One out of 24 years in 127 years of record with < 0.01" of precipitation
Pueblo	Trace	One out of 8 years in 126 years of record with < 0.01" of precipitation
Steamboat Springs	1.69"	30th driest in 89 years of record (driest = 0.05" in 1986)

# **1994 WATER YEAR PRECIPITATION**

Despite a very dry December, more than 60% of Colorado remains wetter than average for the first three months of the 1994 water year. Sizeable areas of eastern Colorado remain at 150-250% of average despite the meager December totals. The picture has been changing in western Colorado, however, where mid-winter precipitation plays a larger role in normal water-year accumulations. Northwestern Colorado, the Grand Junction area and parts of the Central Mountains are still slightly ahead of average. However, the remainder of the mountains and Western Slope are now falling behind. The southwestern mountains and valley areas are especially affected. Durango, for example, currently stands at just 66% of average following last year's record snows. Fortunately, it is still early in the season and there should be several more opportunities for winter storms.







COMPARATIVE HEATING DEGREE DAY DATA FOR DECEMBER 1993

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		STATION	ALAMOSA	ASPEN	BOULDER	BUENA VISTA	BURLINGTON	GITY	COLORADO SPRINGS	CORTEZ	CRAIG	DELTA	DENVER	DILLON	DURANGO	EAGLE	EVERGREEN	FORT COLLINS	FORT MORGAN	GRAND JUNCTION

\* = AVES AQJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

50

• # AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# **DECEMBER 1993 CLIMATE DATA**

# EASTERN PLAINS

			Tempera	ture			D	egree D	ays		Precip	itation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	days
NEW RAYMER 21N	39.0	17.6	28.3	1.8	56	3	1129	0	5	0.27	-0.13	67.5	- 4
STERLING	43.0	17.5	30.3	4.0	61	2	1066	0	28	0.21	-0.12	63.6	3
AKRON FAA AP	42.8	19.6	31.2	3.4	66	6	1038	0	31	0.24	-0.13	64.9	- 4
AKRON 4E	42.0	17.4	29.7	3.0	65	3	1086	0	32	0.49	0.17	153.1	5
HOLYOKE	45.1	19.5	32.3	3.6	67	7	1007	0	46	0.54	0.14	135.0	- 4
JOES	44.8	18.6	31.7	2.1	66	5	1022	0	45	0.26	-0.09	74.3	2
BURLINGTON	44.8	21.6	33.2	4.0	66	9	978	0	48	0.04	-0.30	11.8	1
LIMON WSMO	42.8	18.7	30.8	3.6	59	4	1054	0	24	0.05	-0.30	14.3	3
CHEYENNE WELLS	48.5	21.7	35.1	4.9	66	8	921	0	61	0.08	-0.16	33.3	2
EADS	46.6	20.0	33.3	3.0	64	11	975	0	43	0.00	-0.37	0.0	0
ORDWAY 21N	46.3	17.3	31.8	3.3	64	7	1020	0	40	0.00	-0.23	0.0	0
ROCKY FORD 2SE	51.5	18.1	34.8	3.9	66	6	926	0	74	0.02	-0.26	7.1	2
LAMAR	49.5	15.6	32.6	1.8	69	8	997	0	68	0.01	-0.39	2.5	1
LAS ANIMAS	52.2	17.6	34.9	3.5	74	8	925	0	88	0.00	-0.28	0.0	0
HOLLY	50.9	18.2	34.6	4.4	70	8	935	0	83	0.06	-0.20	23.1	3
SPRINGFIELD 7WSW	51.3	22.1	36.7	3.1	70	6	870	0	84	0.32	-0.04	88.9	2

# FOOTHILLS/ADJACENT PLAINS

	Temperature						D	egree D	ays	Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	t days
FORT COLLINS	44.3	20.3	32.3	3.2	57	3	1003	0	20	0.14	-0.37	27.5	4
GREELEY UNC	42.7	21.2	31.9	3.6	55	4	1021	0	15	0.22	-0.26	45.8	3
ESTES PARK	40.0	20.7	30.4	2.5	55	2	1065	0	5	0.13	-0.34	27.7	2
LONGMONT 2ESE	47.4	13.6	30.5	2.3	67	-2	1064	0	48	0.09	-0.49	15.5	3
BOULDER	47.0	24.1	35.6	2.1	63	2	905	0	44	0.55	-0.25	68.7	· 8
DENVER WSFO AP	47.2	21.1	34.1	3.1	64	3	948	0	50	0.42	-0.22	65.6	5
EVERGREEN	46.3	12.5	29.4	1.7	66	-9	1096	0	40	0.35	-0.44	44.3	7
CHEESMAN	45.3	3.8	24.5	-4.0	60	- 15	1246	0	27	0.51	-0.20	71.8	6
LAKE GEORGE 8SW	36.1	2.9	19.5	2.2	48	-17	1403	0	0	0.13	-0.33	28.3	4
ANTERO RESERVOIR	35.6	-1.5	17.0	1.8	49	-25	1478	0	0	0.07	-0.26	21.2	1
RUXTON PARK	31.0	9.2	20.1	-1.2	46	-9	1383	0	0	0.81	-0.05	94.2	8
COLORADO SPRINGS	44.6	19.9	32.3	2.5	61	5	1008	0	33	0.11	-0.35	23.9	4
CANON CITY 2SE	51.2	22.4	36.8	0.8	68	4	864	0	83	0.23	-0.35	39.7	- 4
PUEBLO WSO AP	49.8	13.8	31.8	0.8	70	1	1020	0	72	0.00	-0.43	0.0	0
WESTCLIFFE	41.5	8.0	24.7	0.5	55	- 16	1242	0	10	0.37	-0.38	49.3	3
WALSENBURG	49.3	24.4	36.9	2.9	67	-2	865	0	58	0.81	-0.10	89.0	5
TRINIDAD FAA AP	49.9	17.0	33.5	1.0	67	-3	968	0	72	0.32	-0.26	55.2	5

# MOUNTAINS/INTERIOR VALLEYS

	Temperature								ays		Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days	
WALDEN	30.1	4.8	17.5	-0.6	44	- 19	1469	0	0	0.25	-0.36	41.0	7	
LEADVILLE 2SW	30.6	3.4	17.0	-0.5	47	-16	1478	0	0	0.11	-0.89	11.0	5	
SALIDA	43.1	13.8	28.4	1.3	54	-4	1126	0	8	0.03	-0.37	7.5	1	
BUENA VISTA	39.8	11.9	25.9	0.3	53	-3	1208	0	3	0.10	-0.39	20.4	3	
SAGUACHE	37.6	6.8	22.2	1.5	50	-5	1317	0	0	0.00	-0.38	0.0	0	
HERMIT 7ESE	30.9	-6.7	12.1	-0.5	46	-21	1632	0	0	0.25	-1.03	19.5	2	
ALAMOSA WSO AP	37.1	-0.2	18.5	1.1	51	-15	1435	0	1	0.10	-0.35	22.2	5	
STEAMBOAT SPRINGS	29.4	4.2	16.8	-0.4	46	- 14	1486	0	0	1.69	-0.89	65.5	11	
YAMPA	35.1	11.0	23.1	2.9	46	- 10	1293	0	0	1.54	0.35	129.4	11	
GRAND LAKE 1NW	31.8	4.3	18.0	0.4	44	-17	1447	0	0	0.93	-0.76	55.0	14	
GRAND LAKE 6SSW	27.5	2.4	15.0	-2.4	44	-20	1543	0	0	0.57	-0.36	61.3	13	
DILLON 1E	31.8	2.0	16.9	-1.3	46	-16	1484	0	0	0.36	-0.56	39.1	9	
CLIMAX	29.5	-2.5	13.5	-1.1	42	-18	1586	0	0	1.30	-0.72	64.4	12	
ASPEN 1SW	36.6	5.7	21.1	-1.4	62	- 10	1351	0	6	1.49	-0.76	66.2	14	
CRESTED BUTTE	25.3	-11.3	7.0	-7.0	36	-27	1791	0	0	1.13	-1.50	43.0	9	
TAYLOR PARK	23.6	-11.4	6.1	-4.2	35	-28	1818	0	0	0.40	-1.18	25.3	3	
TELLURIDE	36.1	0.3	18.2	-5.2	52	- 15	1443	0	1	1.52	-0.18	89.4	7	
SILVERTON	33.4	-5.6	13.9	-3.3	47	-17	1578	0	0	0.60	-1.30	31.6	8	
WOLF CREEK PASS 1	30.0	3.8	16.9	-3.8	46	-10	1484	0	0	2.44	-2.41	50.3	7	

### WESTERN VALLEYS

	Temperature					De	egree D		Precipitation				
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm #	# days
CRAIG 4SW	31.8	9.3	20.6	-0.2	47	-9	1369	0	0	0.65	-0.80	44.8	7
HAYDEN	31.1	9.2	20.1	0.0	48	-11	1383	0	0	1.04	-0.62	62.7	11
MEEKER 3W	34.8	9.7	22.2	-2.6	52	-6	1317	0	2	0.67	-0.20	77.0	7
RANGELY 1E	34.6	9.7	22.2	2.0	47	-4	1319	0	0	0.39	-0.19	67.2	3
GLENWOOD SPRINGS	38.6	14.4	26.5	1.2	52	2	1187	0	1	0.39	-1.08	26.5	9
RIFLE	40.5	13.5	27.0	1.8	55	-1	1171	0	7	0.64	-0.51	55.7	9
GRAND JUNCTION WS	39.9	18.5	29.2	0.7	53	7	1102	0	3	0.57	-0.04	93.4	8
CEDAREDGE	39.1	13.4	26.3	-2.2	51	0	1192	0	3	0.70	-0.36	66.0	7
PAONIA 1SW	42.7	17.4	30.0	1.5	57	6	1076	0	15	0.48	-0.95	33.6	7
DELTA	37.8	11.4	24.6	-4.3	53	-3	1245	0	3	0.03	-0.44	6.4	2
GUNNISON	26.5	-6.3	10.1	-4.4	39	-23	1693	0	0	0.44	-0.34	56.4	9
COCHETOPA CREEK	29.2	-5.4	11.9	-3.1	39	-20	1638	0	0	0.48	-0.38	55.8	6
MONTROSE NO. 2	39.7	15.3	27.5	-0.1	58	1	1155	0	10	0.36	-0.29	55.4	3
URAVAN	45.6	16.3	31.0	0.6	60	8	1047	0	19	0.30	-0.70	30.0	6
NORWOOD	40.3	12.4	26.4	1.5	56	-2	1192	0	6	0.20	-0.89	18.3	4
YELLOW JACKET 2W	41.0	16.8	28.9	1.1	54	3	1112	0	5	0.69	-0.70	49.6	4
CORTEZ	43.3	12.2	27.8	-0.2	59	0	1148	0	14	0.43	-0.75	36.4	4
DURANGO	41.0	13.2	27.1	-0.3	53	3	1169	0	5	0.54	-1.29	29.5	5
IGNACIO 1N	39.6	9.5	24.6	-1.3	53	0	1247	Ó	3	0.27	-1.01	21.1	4
						-		•	-	5121			-

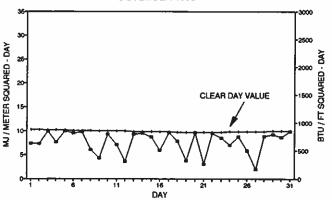
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

## DECEMBER 1993 SUNSHINE AND SOLAR RADIATION

	Numb	er of	Days	Percent Possible	Average % of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	NA	NA	NA		
Denver	14	8	9	72%	67%
Fort Collins	9	16	6		
Grand Junction	10	7	14	61%	61%
Limon	11	10	10		
Pueblo	NA	NA	NA	72%	71%

CLR = Clear	PC = Partly Cloudy	CLDY= Cloudy
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Sunny days were regular visitors to Colorado in December, and there were no prolonged periods of dark, cloudy weather. For most of the State, solar energy equalled or exceeded what is normal for December



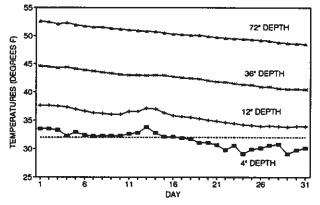
#### FT. COLLINS TOTAL HEMISPHERIC RADIATION DECEMBER 1993

# **DECEMBER 1993 SOIL TEMPERATURES**

A lack of snowcover compensated for the fairly mild air temperatures east of the mountains in December allowing frost penetration to proceed at or above the normal rates. By the end of December, the ground was frozen approximately one foot deep.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES DECEMBER 1993



### HATS OFF TO: Eric Wagner of Walden, Colorado

Eric is still a relative newcomer to weather observing compared to some of Colorado's faithful observers. Still, 161/2 years of excellent and dedicated observing in the middle of Colorado's windswept North Park more than qualifies him for our congratulations. Thanks for all of your special efforts, and keep up the good work.

## THE EXTRAORDINARY COLORADO SNOWSTORM OF DECEMBER 1913

If you are a structural engineer, a building code enforcer, a snow removal manager or a general climate trivia buff then you probably already know a great deal about the snowstorm of December 1913. If, however, you are one of the above and you don't know about the storm of December 1913 then I strongly suggest you sit up and take notice.

Colorado has had plenty of giant snowstorms during the past 100+ years of recorded history. Transportation and commerce have been slowed by many storms. Several dozen human lives have been lost and livestock by the thousands have been killed by the blizzards of Colorado's recorded history, but few storms hold a candle to the potent storm of December 4-5, 1913. Those of you who lived through the great Christmas Eve blizzard of 1982 probably thought you experienced the worst of the worst. That was a big storm by any standard, but it still was only modest when compared to the blizzard of 1913.

Here on the 80th anniversary of that giant storm I thought it might be interesting to dig into our files and try to reconstruct what happened. We may not see another storm of that magnitude in our lifetime - but then again we might.

### The Storm's Evolution

October 1913 had been cold. November followed with much warmer than average temperature and frequent precipitation from the mountains westward but with little snow accumulation. East of the mountains November was very dry. Although it was early in the winter, the farmers of the State were already nervous about having enough water for the upcoming growing season. During the final days of November a sizeable storm crossed the State but dropped only light precipitation mostly on the 28th. The storm slowed to a crawl over Texas on the 29th and then drew unseasonably mild and moist air from the Gulf of Mexico northward across Texas and Oklahoma into Kansas and Nebraska. This storm finally dissipated over the Great Lakes. Usually, cooler and much drier air moves in behind storms like this, but this time the mild, moist air lingered across the plains.

A new storm was over Seattle, WA, early on November 29 and dropped very quickly southward into northern Arizona by the morning of the 30th. It then slowed suddenly to a near standstill. This seemingly unusual behavior is consistent with the rapid formation of a closed or "cut-off" low pressure area in the atmosphere aloft. However, in 1913 meteorologists had to rely on surface weather conditions to deduce upper level winds and storm movements. As this storm slowed, clouds and precipitation began in western Colorado. At the same time, lower pressure west of the mountains caused the very moist air over the Central Plains to move westward into eastern Colorado. Clouds lowered and thickened along the Front Range.

The Arizona storm moved slowly southeastward on Dec. 1, producing modest mountain snows. Rains spread over parts of eastern Colorado with wet snows falling at elevations above 5,000 feet. Precipitation increased late in the day east of the mountains and continued on the 2nd, as a cooler high pressure area pushed southward and enhanced easterly upslope winds east of the mountains. By Dec. 3. precipitation stopped over much of northern Colorado, and precipitation over southern Colorado was light. This early phase of the storm was not exceptional. Denver totalled 8" of dense April-like snow. Mountain snows were also fairly typical for a Southern Rockies storm. Fremont Pass had 14" of new snow by December 3. Durango added 5" and Steamboat Springs only received 3". The one area of the State hit hard by this first phase of the storm was Larimer and Weld counties. Fifteen inches of snow fell in Fort Collins with 1.75" of water content. Kersey reported 14" of snow with 2.30" of water content. An article in the weekly paper, The Fort Collins Express, referring to the storm on Dec. 1, 1913 stated, "... the snow now covering the ground is one of the heaviest that has fallen here for years, For the first time in the history of the street car line the cars were unable to operate."

By this time the storm seemed to have skirted Colorado. The surface weather map early on Dec. 3 showed high pressure to be settling in over Colorado with just some light easterly winds keeping low clouds entrenched along the Front Range. The low pressure center was only slightly detectable on the weather maps near the Big Bend area of Texas. Most forecasters then and now probably would have assumed the storm would continue moving eastward away from Colorado, but cloud watchers on the 3rd were probably a little suspicious as thickening cloud bands began reaching northward, and snow began to fall again beginning first in southern Colorado and spreading northward.

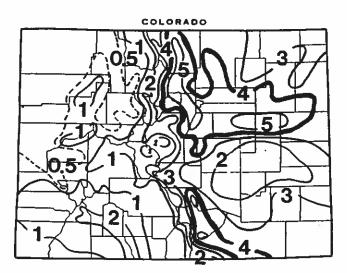
Thursday, December 4, was the day that "all hell broke loose." The weather map that morning looked much different as a deepening low pressure area was moving straight northward across eastern New Mexico. Heavy rains over Texas were causing devastating flooding. Meanwhile, high pressure held its ground over the Northern Plains. Pressure gradients tightened over Colorado, and strong northeasterly winds developed across the plains. Northwest Colorado was gusty but mostly dry, but precipitation increased over most of the rest of the State. Rains, accompanied by some lightning and thunder, poured down over eastern Colorado - the heaviest one-day rains (1-3") ever observed in a winter month. Frighteningly heavy snows developed along the Front Range accompanied by increasingly strong winds. By midafternoon the Denver U.S. Weather Bureau reported hourly wind speeds averaging as much as 35 mph with gusts well over 40 mph. By late afternoon, travel and commerce along the Front Range came to a halt. Many feared for their lives and the lives of their loved ones. Temperatures, instead of falling as they usually

do during storms, rose to near 32°F and stayed there until the storm ceased.

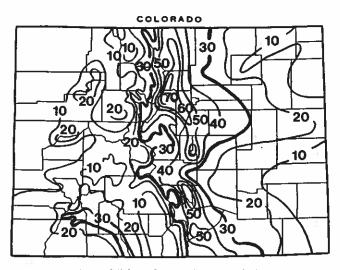
By the morning of the 5th, the low pressure center was still over southeastern Colorado, and the storm still raged. It finally turned toward the east and was centered over Topeka, Kansas, by Saturday morning (December 6). Snows ended in Colorado, but strong winds continued. The wind direction switched to the northwest, reshaping the huge drifts that had already formed. Finally, the winds abated and the "Colorado Storm of the Century" came to an end.

### **Storm Totals**

Using available weather observations still on file here at the Colorado Climate Center, we prepared the following analysis of total storm precipitation and snowfall. As one would expect, many observers struggled to take accurate measurements during the storm. Windblown, melting, settling snow is always hard to measure, and the deeper it gets, the harder it gets. Still I think this information gets the point across.



Total Precipitation (rain and melted snow) for 1-5 December 1913 (inches).



Total snowfall for 1-5 December 1913 (inches).

December 1-5, 1913 Daily Snowfall (inches) for selected Colorado locations

			Date	2		Maximum
	1	2	3	4	5	Reported Depth
Boulder	4.3	5.3	0.8	14.5	19.0	42"
Denver	5.7	2.0	0.4	22.8	14.8	33-36"
Durango	5.0	Т	1.5	8.0	2.0	11"
Georgetown	9.0	1.0	5.0	63.0	8.0	54*
Grand Lake	Т	0	9.0	36.0	1.0	
Greeley	8.0	6.5	4.0	8.0	6.3	18"
Lamar			All Ra	in		0"
Steamboat Springs	3.0	0	0	0	0	
Trinidad	0	2.0	2.0	22.0	16.0	18"

The heaviest snowfall totals occurred in the foothills and mountains west of Denver. Georgetown took the prize with 86 inches. To this day, December 1913 still stands alone atop the list of wettest winter (December - February) months on record for nearly all weather stations east of the Continental Divide. For example, Denver's December 1913 precipitation total was 5.21 inches. The next closest has been 2.84" in December 1973. December 1982 was a distant third place with 2.34 inches.

#### Storm Impacts

The impacts of this storm were many and varied. Here are a few notes and quotes that we uncovered to help us gain a 1913 perspective about the storm.

Before the storm really got rolling, a headline on 12/4/13 in the Rocky Mountain News read, "Denver Revels in 8-inch Snow – Sleighs and Skis Give Great Fun."

But the storm continued, and headlines became more serious.

"Snowstorm grips Denver for 24 hours, snowfall of 25.8" breaking all previous records for same duration." *RM News* 12/5/13 (and it wasn't over yet).

"Army of men to battle drifts today." RM News 12/5/13

"Auditorium and other public buildings shelter thousands of homeless men, women and children." RM News 12/5/13

"Broadway Building Caves [in]; Watchman Sleeps Soundly" RM News 12/5/13

"30 inches of snow has fallen [in Greeley by early on the 5th] ... street car service is completely crippled and telegraph and telephone is in bad condition. Here the wires are within touching distance of the ground. Farmers of Weld County ... say the snow is a blessing ...." *RM News* 12/5/13

By Saturday the 6th, the storm was ending and a more complete evaluation became possible. Here are some more quotes.

In Longmont, "The unprecedented snowstorm of the last 48hours ceased yesterday afternoon. A wet, sloppy snow of four feet covers the ground. Many roofs caved in during the day. The beet shed at the sugar factory gave in ...." RMNews 12/6/13

"The snow there [near base of Longs Peak] was seven feet deep and still falling" RM News 12/6/13

"A wind of about 60 mph sprang up last night. The snow in Cripple Creek was 5 feet deep on the level, and in many places drifted as high as 20 feet." *RM News* 12/6/13

"A rural mail carrier is missing [near Boulder] and fears are felt for his safety" *RM News* 12/6/13

"Marooned in a street car .... Mrs. Mary Frank, 60 years old, living at 1240 Twelfth St. contracted pneumonia yesterday and probably owes her life to the heroic work of Dr. E. L. Foster of Arvada and Miss A. E. Allen of Denver." *RM News* 12/6/13

"The streets of Sterling are flooded. Five inches of moisture (mostly rain with melting snow) has fallen this week." *RM* News 12/6/13

"Old Ladies Home in panic" RM News 12/6/13

"Mines [Colorado School of Mines] Men with Burros Tunnel Drifts Toward Buried Interurban Car Near Golden" RM News 12/6/13

"Hundreds of men and women spend second night in downtown hotels unable to reach dwellings." *RM News* 12/6/13

"State stormbound and all railroad traffic suspended" *RM News* 12/6/13. A map showed the location of 18 separate trains known to be stranded.

There was also some good news to report.

"The snow has provided work for many who were out of employment" RM News 12/4/13

"Bountiful Crops Assured by Enormous Increase in Moisture and Business Men Are Happy" RM News 12/5/13

"For the first time in the history of Fort Collins, no school will be held today on account of the storm" Fort Collins Express 12/11/13

"There is no suffering among the militia ... all soldiers at Ludlow military camp are well" *RM News* 12/5/13

These are but a small sample of the stories that were reported. I would love to have time to share more with you. Interestingly, except for a few more snows before Christmas, very little snow fell east of the mountains in the 12 weeks following the storm. The snow remained very deep on the ground through the end of December. Denver still reported 19" on the level on Christmas day. But gradually it melted and evaporated (there appear to have been numerous Chinook winds along the Front Range in January). Except for the drifts which remained until spring, most of the ground was bare by sometime in February. The moisture from the storm was indeed beneficial, and 1914 agricultural production over eastern Colorado was very good for most crops.

### What If It Happens Again

We haven't seen many storms behave like this (first dipping southward and then moving straight back to the north), but there have been some. The most recent example came Dec. 23-27, 1987. But the chances are a storm similar to the Great Blizzard of 1913 can and will happen again. We may like to think that our modern transportation and communication systems would survive, but I bet we would again come to a complete standstill for at least two days and perhaps longer. Residential, secondary and rural streets and highways would likely be blocked for several days. It would be a great test for the new Denver International Airport. The cost of clearing streets alone would far exceed anything the Front Range has ever experienced. I also think there would be greater loss of human life than in 1913. It appears that at most 5 or 6 people died from that storm, although record keeping was poor. People stayed closer to home then - and there weren't that many people to begin with. Those who had to travel significant distances travelled mostly by train where survival supplies were available.

How would our buildings fare today? Numerous roofs collapsed under the weight of that storm. It appears that 1993 building codes along the Front Range are adequate to survive a similar storm, but design and reality don't always match. Again, I would anticipate some building failures – older structures perhaps, but maybe even some of today's huge flat-roofed shopping centers and industrial structures.

Residents in 1913 were less dependent on public utilities than now. A similar snowstorm today would likely result in some losses of electrical service that could not be quickly restored due to transportation blockades. Consequences could be severe. Finally, due to the amazing changes in our State that have occurred since 1913, the economic losses today from lost business would probably far outweigh the benefits to agriculture of an increased water supply. In 1913, the reverse may have been true.

### Summary

I hope you enjoyed this feature as much as we enjoyed preparing it. I also hope you take it to heart. Historical data may make for interesting conversation, but it is also key information to help us plan and prepare for the future. Routine, consistent and reliable data collection was once the focus of many scientific endeavors. Now it often seems to take the back seat to applications of new technologies and other more exciting scientific pursuits. All of you who are data collectors today, I urge you to continue your efforts and pass on this message to those who follow in your footsteps. And for those of us using automated stations to monitor weather conditions – will that data still be retrievable and usable 80 years from now? Let's hope so.

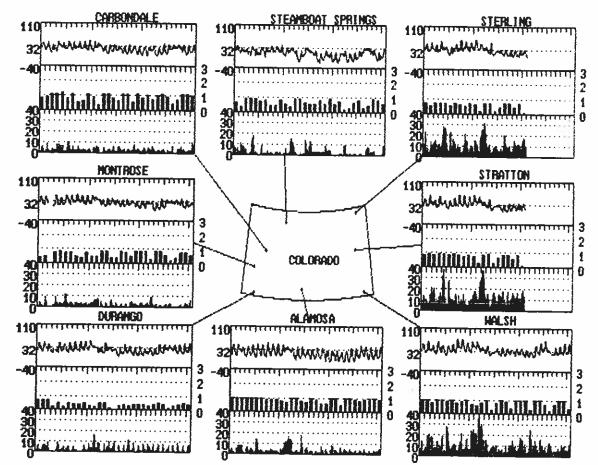
Acknowledgments: My thanks to Jim Harrington for his assistance in researching this remarkable historical event.

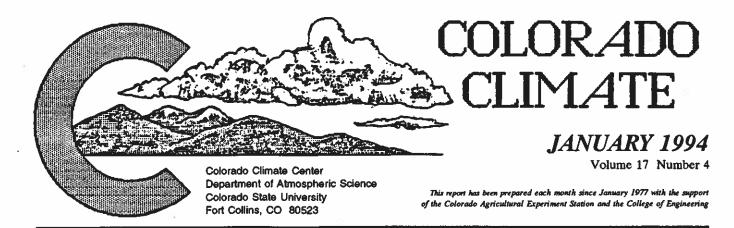
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

			WTHRNET WE	ATHER DATA	DECEMBER 1993			
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Wa]sh
monthly	average tempe 17.3	rature ( *F ) 23.2	22.6	24.9	13.2	31.2	31.5	34.1
eonthly maximum: minimum:	52.2 6/1	5 51.6 117	ime of occurence 12 48.7 10/15 8 -1.5 24/6	( *F day/hou 53.1 8/15 -2.7 24/ 5	41.5 10/14	66.0 11/14 9.5 19/ 2	64.2 11/14	70.0 9/14 10.6 24/ 1
monthly 5 AM 11 AM 2 PM 5 PM 11 PK	average relat: 72 7 -1 43 / 11 24 / 12 26 / 10 59 / 4	ive humidity 78 / 11 57 / 21 49 / 24 52 / 21 75 / 14	/ dewpoint { perc	cent / *F ) 82 / 14 64 / 23 52 / 25 55 / 22 77 / 16	87 / 6 79 / 13 66 / 19 73 / 15 87 / 8	67 / 18 47 / 23 39 / 24 48 / 20 67 / 18	31 / 5 22 / 15 21 / 17 23 / 10 28 / 5	71 / 19 49 / 29 40 / 28 43 / 24 65 / 20
monthly a day day day	average wind ( 200 176	direction ( e 171 66	legrees clockwise 220 174	from north ) 225 136	143 134	245 112	162 103	190 263
	average wind s 2.89 ed distributic 479 226 19 0	2.19	per hour ) 1.77 er month for hour 582 130 0 0	1.75 ly average mpi 525 135 0 0	1.91 h range } 517 96 15 0	6.22 268 368 88 17	7.44 251 329 132 31	8.83 43 552 127 22
monthly"a	average daily 861	total insolat 386	ion ( Btu/ft²•da 880	y ) 621	622	390	534	777
*c]earnes 60-80% 40-60% 20-40% 0-20%	55" distributi 206 58 31 5	on { hours pe 25 197 71	r month in speci 48 66 45 11	fied_clearness 99 59 88 33	index range ) 97 70 68 26	62 54 33 33	123 37 18 8	155 53 45 26

The State-Wide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft7/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



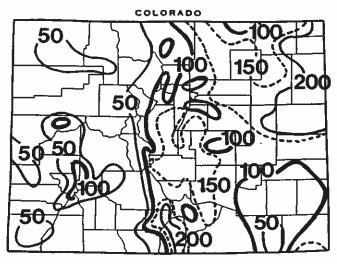


### January Climate in Perspective - Relatively Gentle

Some of the normal ingredients of January weather were present this year such as strong winds, periods of snow and subzero temperatures. However, most temperatures were much milder than normal, subzero episodes were few and brief, snows were mostly light, and the temperatures were usually warm when the winds were strong. Temperatures ended up warmer than average for the month. Precipitation was less than normal over the mountains and Western Slope.

### Precipitation

Seven storm systems crossed Colorado in January. Most of these only affected the higher elevations of the Northern and Central Mountains. The only storms that

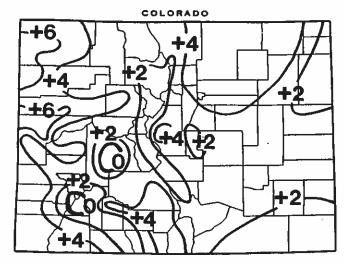


January 1994 precipitation as a percent of the 1961-1990 average.

brought significant snows to the mountains came early (5-6th) and late (25-27th) in the month. Most of the mountains and western valleys ended up dry with widespread areas below 50% of average. Most of January was dry and snow-free east of the mountains as well, but the late-month storm provided as much or more moisture than normally falls in the entire month (January is normally a dry month east of the mountains). Some areas in extreme eastern Colorado ended up with more than double their average January precipitation.

#### Temperatures

Extremely cold air froze much of the northern and eastern U.S. during January, but this arctic air only paid short visits to Colorado. Downslope winds east of the mountains and little snowcover also helped to raise temperatures. For the month as a whole, most of Colorado ended up several degrees warmer than average. Parts of western and northeastern Colorado were five or more degrees Fahrenheit above average. The Gunnison Valley and some high valleys in the southwestern mountains were the only locations where colder than normal temperatures persisted. Gunnison temperatures dipped below zero on 28 nights in January. In Denver, daytime temperatures exceeded 50°F on 16 days. Five days topped 60°F.



Departure of January 1994 temperatures from the 1961-90 averages.

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- 1-4 Strong northwesterly winds aloft, relatively mild temperatures and occasional periods of highelevation snow flurries characterized the first four days of January. Winds gusted to 64 mph in Colorado Springs on the 1st, 71 mph up the Poudre Canyon west of Fort Collins on the 2nd, 85 mph at Rocky Flats on the 3rd and 80 mph near Coal Creek Canyon on the 4th. Snow totals were very light, but some Northern and Central Mountain areas picked up a few inches early on the 2nd.
- 5-7 The 5th dawned unseasonably mild. Strong winds then developed across much of the State (gusting above 50 mph in some areas east of the mountains) as a deep low pressure area crossed the region. Mountain snows began with some sprinkles at lower elevations. Temperatures on the 5th soared into the 50s and 60s (40s in the mountains) but then dropped sharply later in the day. Mountain snows diminished on the 6th after leaving significant accumulations. Steamboat Springs got 9", 11" fell at Breckenridge but Wolf Creek Pass only reported 1 inch. The plains got a light dusting on the 6th. Some fog and flurries lingered east of the mountains early on the 7th. Then skies cleared, but mountain winds remained strong.
- 8-10 It was chilly in the mountains, especially near Gunnison, but warmer than average temperatures occurred at lower elevations. It was mostly dry across Colorado, but a weak storm produced a little snow over the Northern and Central Mountains late on the 9th.
- 11-13 Northwesterly winds brought dry, mild weather to Colorado, but frigid air filled some mountain valleys. Gunnison temperatures only climbed into the teens during the day with -20° at night. Another little storm whitened the Northern and Central Mountains on the 13th as upper winds strengthened.
- 14-17 Colorado found itself squeezed between intensely cold air over the Central U.S. and warm air over the West. Shallow arctic air slid into parts of eastern Colorado accompanied by fog 14-15th, but downslope winds kept temperatures warm along the Front Range. Then a disturbance from the NW late on the 15th brought some light snow to the mountains. Some convective snowshowers fell along the Front Range on the 16th. The arctic air pushed farther

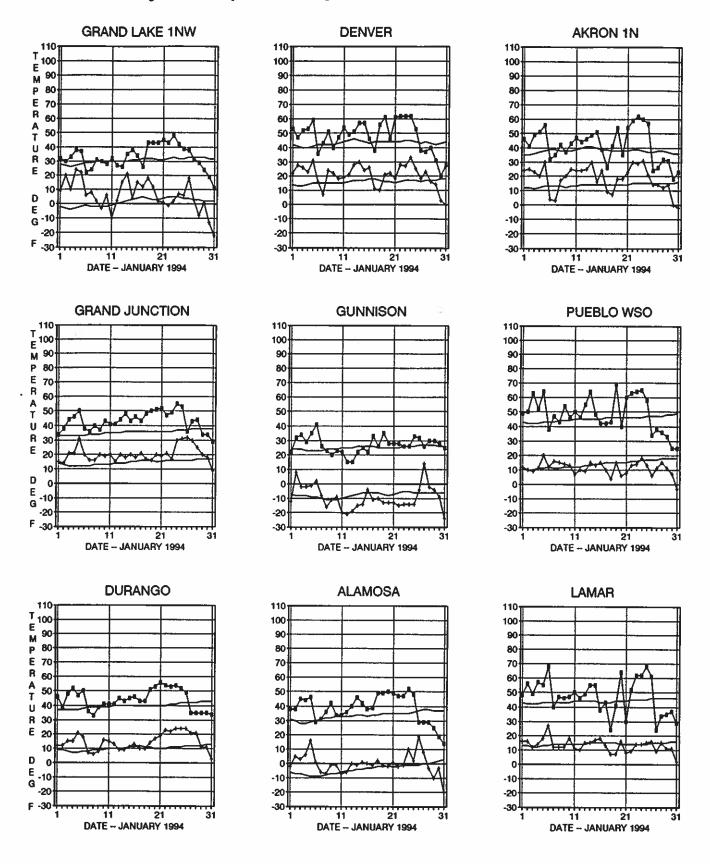
south on the 17th making some interesting contrasts. Daytime temperatures only made it up to 10° in extreme northeastern Colorado with much colder windchills, while down at Trinidad temperatures reached into the 60s.

- 18-24 The cold air retreated again on the 18th paving the way for a sunny and dry period for Colorado with very mild temperatures. Las Animas hit 72° on the 19th, the warmest in the State for the month. The arctic air made a brief return to eastern Colorado on the 20th along with some shallow fog, but warm weather bounced right back. 60s and even some low 70s were widespread across the plains 21-24th. Late in the period, winds aloft backed to the southwest, and clouds increased on the 24th. Some snow began late in the day over the San Juan Mountains.
- The first storm system in more than a month to bring 25-28 moisture to most of Colorado slowly approached from California on the 25th. Temperatures dropped sharply, especially east of the mountains, and precipitation (mostly snow) became widespread and locally heavy on the 26th. There were even some reports of lightning and thunder. Some of the heaviest precipitation reports from the storm included 14" of snow (1.12" water content) at Ouray and close to a foot of snow with 0.50-1.00" water content across east-central Colorado. 2-6" of snow covered many other areas of the State. This snow was much appreciated by most farmers and ranchers in the State as it ended a two-month dry spell across the plains. The main storm moved quickly eastward on the 27th, but a lingering upper level low left some clouds and snow flurries across southern and eastern Colorado 27-28th.
- 29-31 An area of snow and strong northerly winds moved down out of Wyoming on the 29th dropping just 1-3" along the Front Range but causing treacherous driving conditions and numerous accidents from Longmont southward to Raton Pass. Behind the snow, the coldest airmass since Thanksgiving chilled the entire State for the final two days of the month. Most of the State experienced subzero temperatures on the 31st. Durango only dropped to +3°F, but Estes Park dipped down to -21°F, and the -39°F reading at Antero Reservoir was the coldest in the State so far this winter.

		Weather Extremes	
Highest Temperature	72°F	January 19	Las Animas
Lowest Temperature	-39°F	January 31	Antero Reservoir
Greatest Total Precipitation	2.33"		Keystone 5E
Least Total Precipitation	0.03"		Rangely 1E
Greatest Total Snowfall	38"		Winter Park
Greatest Snow Depth	40"	January 30	Winter Park

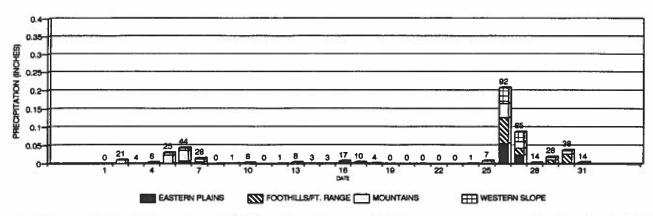
# **JANUARY 1994 TEMPERATURE COMPARISON**

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



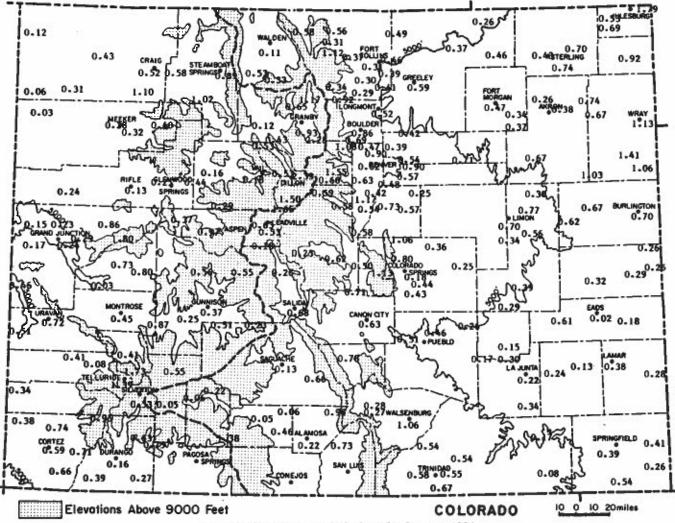
# **JANUARY 1994 PRECIPITATION**

A modest mountain snow January 5-6th, a major widespread storm 25-27th and a brief Front Range storm late on the 29th accounted for nearly all of the month's precipitation. The storm 25-27th averaged nearly 0.30" statewide which is a very wet storm for the mid-winter months in Colorado. All other storms combined only dropped an additional 0.20<sup>°</sup>, so the State-averaged January precipitation ended up close to 0.50<sup>°</sup>, significantly below average.

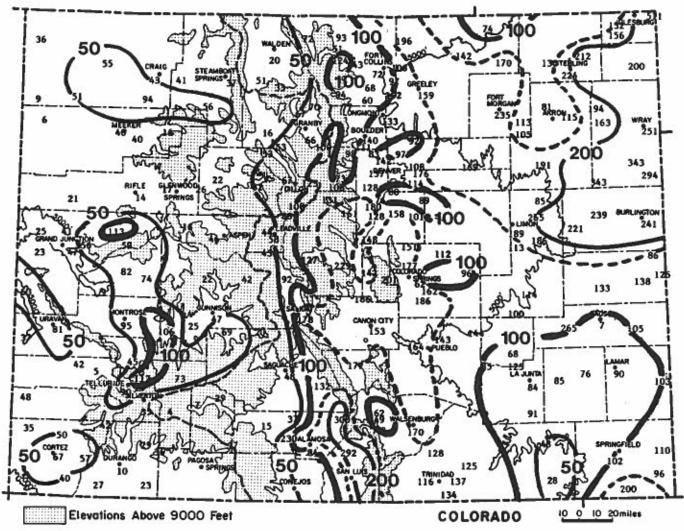


## COLORADO DAILY PRECIPITATION - JAN 1994

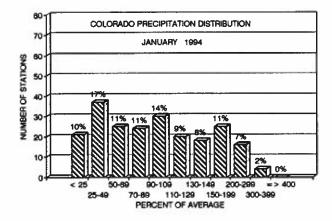
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



Precipitation Amounts (in inches) for January 1994.



January 1994 Precipitation as a Percent of the 1961-90 average.



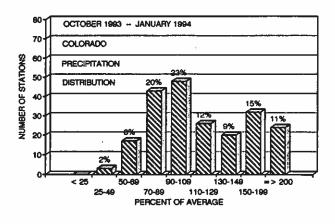
January precipitation ranged from below 25% of average across several areas of western Colorado to more than 300% of average in southern Yuma county. Overall the dry areas outnumbered the wet areas, and the wet areas were mostly locations that normally receive little January moisture.

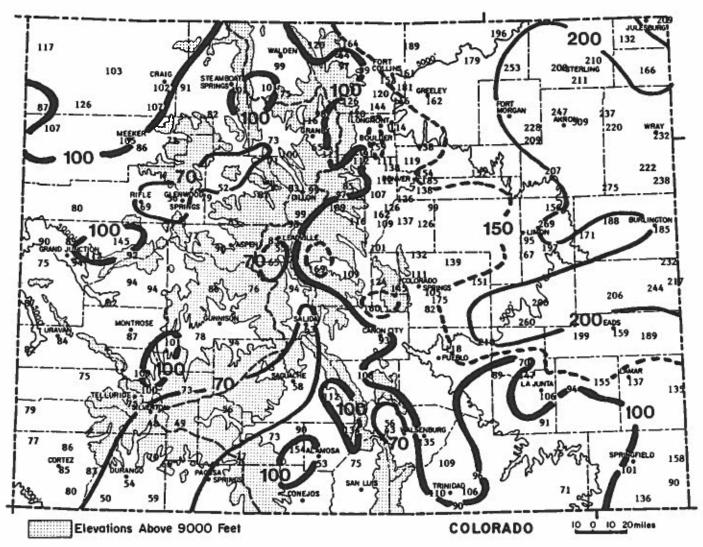
## JANUARY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.54"	41st wettest in 123 years of record (wettest = 2.35" in 1883)
Durango	0.16"	11th driest in 101 years of record (driest = 0.08" in 1934 and 1936)
Grand Junction	0.23"	16th driest in 103 years of record (driest < 0.01" in 1961)
Las Animas	0.24"	54th wettest in 128 years of record (wettest 1.60" in 1944)
Pueblo	0.46"	32nd wettest in 126 years of record (wettest = 1.48" in 1948)
Steamboat Springs	0.89"	9th driest in 88 years of record (driest = 0.23" in 1919)

# **1994 WATER YEAR PRECIPITATION**

After two consecutive mid-winter months with less snow than usual in Colorado's high country, water year precipitation totals have now fallen below average across most of the mountains and Western Slope. Parts of southwestern Colorado, which last year at this time were dealing with record-breaking wet snows, have only gotten about 50% of average this year. The Northern Mountains, by comparison, are fairly close to average and similar to last year. East of the mountains, most areas continue to show above average water year precipitation totals. Many stations near the Kansas and Nebraska borders are reporting more than 200% of average. It is important to note, however, that eastern Colorado receives only a small fraction of its annual average precipitation during the winter months. Farmers and ranchers are pleased to see these high totals, but conditions can change very rapidly when the wetter months of spring and early suumer arrive.





October 1993-January 1994 Precipitation as a Percent of the 1961-90 averages.

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		TATION			DULDER		BURLINGTON	CANON	COLORADO SPRINGS	CORTEZ	CRAIG	DELTA	Denver	DILLON	ODNWINGO	EAGLE	EVERGREEN	FORT	FORT MORGAN	GRAND	

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AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# JANUARY 1994 CLIMATE DATA

# EASTERN PLAINS

			_							-			
			Temper	ature			De	gree D	ays		Precip	oitatio	n
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	40.5	16.0	28.2	5.0	62	-3	1133	0	22	0.26	-0.09	74	5
STERLING	43.5	16.8	30.1	6.0	65	-2	1072	0	34	0.43	0.10	130	3
FORT MORGAN	Inco	omplete	e month,	tempe	rature da	ta not	available			0.47	0.27	235	2
AKRON 1N	42.3	18.5	30.4	4.4	62	-2	1066	0	29	0.26	-0.06	81	4
AKRON 4E	42.0	17.2	29.6	4.2	62	-3	1090	0	29	0.38	0.05	115	6
HOLYOKE	41.4	16.0	28.7	1.5	64	-1	1118	0	29	0.92	0.46	200	3
JOES 2SE	44.1	16.1	30.1	1.5	66	-9	1074	0	42	1.03	0.73	343	3
BURLINGTON	43.3	17.8	30.6	2.6	65	-3	1060	0	39	0.07	-0.22	24	2
LIMON WSMO	42.8	14.6	28.7	3.2	60	-7	1117	0	30	0.70	0.33	189	3
CHEYENNE WELLS	46.0	16.7	31.4	2.6	65	-4	1036	0	51	0.29	0.08	138	3
EADS	45.7	16.7	31.2	3.4	65	1	1040	0	53	0.02	-0.26	7	1
ORDWAY 21N	47.2	12.2	29.7	3.7	68	-4	1088	0	63	0.29	0.00	100	1
ROCKY FORD 2ESE	51.6	14.9	33.2	4.1	70	5	978	0	82	0.30	0.06	125	2
LAMAR	47.5	13.2	30.4	1.4	68	2	1067	0	60	0.38	-0.04	90	2
LAS ANIMAS 1N	51.0	14.4	32.7	3.2	72	-1	994	0	95	0.24	-0.04	86	2
HOLLY	48.0	14.2	31.1	3.3	70	2	1043	0	69	0.28	0.01	104	1
SPRINGFIELD 7WSW	47.2	18.8	33.0	1.2	68	0	985	0	64	0.39	0.01	103	2
					24			-	÷ •				

# FOOTHILLS/ADJACENT PLAINS \_\_\_\_\_

			Temper	ature			Deg	gree Da	ys		Precip	itation	٦
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	46.6	19.4	33.0	5.3	63	-2	985	0	41	0.31	-0.12	72	2
GREELEY UNC	44.6	19.9	32.3	5.1	64	-2	1005	0	40	0.59	0.22	159	2
ESTES PARK	39.0	19.5	29.3	1.9	54	-21	1100	0	4	0.34	-0.02	94	3
LONGMONT 2ESE	49.5	14.1	31.8	5.2	67	-10	1022	0	68	0.52	0.13	133	4
BOULDER	47.5	23.7	35.6	5.1	61	-3	905	0	42	0.86	0.25	141	6
DENVER WSFO AP	48.1	20.5	34.3	4.6	62	0	946	0	57	0.54	0.04	108	5
EVERGREEN	45.9	13.9	29.9	3.2	58	-16	1079	0	27	0.63	0.14	129	5
CHEESMAN	46.2	5.5	25.8	-0.8	58	-28	1205	0	36	0.58	0.19	149	4
LAKE GEORGE 8SW	35.6	0.3	18.0	3.5	48	-35	1453	0	0	0.62	0.35	230	4
ANTERO RESERVOIR	37.0	1.2	19.1	5.4	51	-39	1416	0	1	0.23	0.05	128	4
RUXTON PARK	28.0	7.1	17.5	-2.6	41	-23	1463	0	0	1.13	0.57	202	6
COLORADO SPRINGS WSO	44.8	18.2	31.5	2.7	62	-3	1032	0	37	0.18	-0.11	62	1
CANON CITY 2SE	51.4	20.8	36.1	2.6	68	-8	886	0	88	0.63	0.22	154	3
PUEBLO WSO AP	48.6	11.3	29.9	0.3	69	-3	1081	0	68	0.46	0.14	144	3
WESTCLIFFE	42.5	6.4	24.4	2.2	56	-23	1247	0	14	0.78	0.34	177	5
WALSENBURG	50.0	23.0	36.5	3.6	64	-5	877	0	68	1.06	0.44	171	4
TRINIDAD AP	49.7	15.5	32.6	1.4	66	-7	1000	0	74	0.54	0.11	126	5

# MOUNTAINS/INTERIOR VALLEYS

			Тепре	rature			De	gree Da	ays		Precip	itatio	n
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	31.4	6.9	19.1	3.2	43	- 19	1416	0	0	0.11	-0.42	21	5
LEADVILLE 2SW	30.7	2.0	16.4	1.5	48	-25	1499	0	0	0.53	-0.37	59	11
SALIDA	44.1	11.3	27.7	0.8	56	-17	1149	0	18	0.68	0.30	179	3
BUENA VISTA	42.2	11.7	27.0	1.4	55	- 18	1172	0	9	0.26	-0.02	93	3
SAGUACHE	40.0	7.7	23.8	5.7	51	0	1269	0	3	0.13	-0.14	48	5
HERMIT TESE	35.3	-4.6	15.3	5.5	44	-23	1533	0	0	0.06	-0.72	8	3
ALAMOSA WSO AP	38.5	0.0	19.3	4.6	52	-20	1412	0	1	0.22	-0.04	85	5
STEAMBOAT SPRINGS	31.6	5.7	18.7	3.8	45	-17	1427	0	0	0.89	-1,48	38	10
GRAND LAKE 1NW	33.0	6.1	19.5	3.6	48	-22	1401	0	0	1.17	-0.49	70	15
GRAND LAKE 6SSW	27.4	0.4	13.9	0.5	37	-24	1577	0	0	0.65	-0.31	68	8
DILLON 1E	31.2	2.5	16.8	1.1	44	-21	1486	0	0	0.53	-0.26	67	12
CLIMAX	27.2	0.0	13.6	0.7	43	-23	1588	0	0	1.65	-0.22	88	17
ASPEN 1SW	36.7	9.6	23.2	3.0	50	-11	1290	0	0	0.97	-1.23	44	9
CRESTED BUTTE	27.1	-10.0	8.5	-2.4	35	-34	1741	0	0	0.56	-1.94	22	5
TAYLOR PARK	29.0	-11.1	9.0	2.3	42	-36	1729	0	0	0.55	-0.73	43	7
TELLURIDE	35.7	-1.5	17.1	-4.8	50	-26	1476	0	0	1,39	-0.14	91	6
SILVERTON	35.2	-6.6	14.3	-0.8	46	-25	1563	0	0	0.53	-0.98	35	5
WOLF CREEK PASS 1E	30.8	5.6	18.2	0.9	44	-12	1444	0	0	1.38	-2.31	37	7

#### WESTERN VALLEYS

		Temperature				Degree Days				Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	XNorm #	# days
CRAIG 4SW	33.6	10.8	22.2	4.7	44	- 15	1317	0	0	0.52	-0.68	43	7
HAYDEN	30.2	9.7	19.9	2.9	39	- 18	1389	0	0	0.58	-0.81	42	8
MEEKER 3W	38.3	9.9	24.1	0.9	49	-16	1258	0	0	0.28	-0.41	41	5
RANGELY	39.7	11.6	25.6	9.2	49	-4	1216	0	0	0.03	-0.46	6	1
EAGLE FAA	40.6	7.6	24.1	5.6	51	- 14	1258	0	1	0.16	-0.58	22	5
GLENWOOD SPRINGS	41.3	15.4	28.3	4.8	52	-3	1129	0	3	0.25	-1.19	17	6
RIFLE	42.8	13.6	28.2	5.8	55	-7	1132	0	14	0.13	-0.77	14	2
GRAND JUNCTION WS	43.1	20.3	31.7	6.7	55	9	1025	0	7	0.23	-0.33	41	3
CEDAREDGE	42.1	13.5	27.8	1.4	55	-6	1147	0	5	0.73	-0.15	83	2
PAONIA 1SW	44.7	17.4	31.0	5.6	58	1	1045	0	22	0.80	-0.28	74	2
DELTA	39.6	10.5	25.0	-1.1	54	1	1231	0	2	0.03	-0.30	9	2
GUNN I SON	27.1	-9.4	8.9	-0.2	41	-24	1734	0	0	0.37	-0.41	47	5
COCHETOPA CREEK	30.5	-5,3	12.6	2.9	44	-19	1615	0	0	0.51	-0.22	70	5
MONTROSE NO 2	40.5	16.6	28.6	3.8	55	- 4	1120	0	6	0.45	-0.02	96	2
URAVAN	48.2	15.2	31.7	4.1	61	3	1024	0	29	0.72	-0.16	82	4
NORWOOD	42.2	14.3	28.3	5.7	56	-8	1128	0	9	0.41	-0.55	43	2
YELLOW JACKET 2W	41.9	17.4	29.7	4.5	56	-4	1089	0	5	0.38	-0.70	35	2
CORTEZ	45.0	14.6	29.8	5.3	63	-4	1086	0	21	0.59	-0.29	67	3
DURANGO	44.3	14.5	29.4	4.4	56	3	1094	0	14	0.16	-1.44	10	4
IGNACIO 1N	42.3	10.8	26.6	4.2	54	-4	1183	0	9	0.27	-0.90	23	3

Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

## JANUARY 1994 SUNSHINE AND SOLAR RADIATION

	Numt	er of	Davs	Percent Possible	Average % of
	<u>CLR</u>		<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	8	12	11		
Denver	10	9	12	61%	71%
Fort Collins	12	9	10		
Grand Junction	10	6	15	65%	61%
Limon	8	10	13		
Pueblo	NA	NA	NA	80%	74%

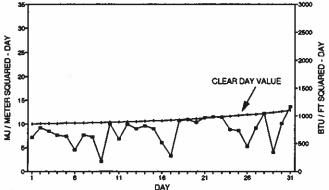
The mountains and Western Slope experienced more January sunshine than normal. East of the mountains, there were many days with mountain-induced standing wave clouds, especially early in the month. This kept solar energy near or a little less than average.

PC = Partly Cloudy

CLDY = Cloudy

CLR = Clear

# FT. COLLINS TOTAL HEMISPHERIC RADIATION JANUARY 1994

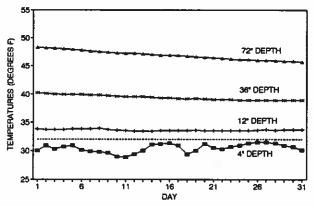


## **JANUARY 1994 SOIL TEMPERATURES**

Despite mild air temperatures in January, lack of snowcover allowed frost to penetrate to about one foot into the soil. Snowfall late in January helped warm the 4" soil temperatures and moderated the affects of subzero air temperatures on the 31st.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES JANUARY 1994



### HATS OFF TO: Gayle Kingery of Bailey, Colorado

Mrs. Kingery became the Bailey weather observer in 1977. Since then, we have received month after month of complete and carefully recorded weather observations. August of 1984 was probably Gayle's busiest month reading her raingage. 8.71" of rain fell that month. Thanks so much for your excellent work.

# FOG IN COLORADO

We all know what fog is. It is a cloud of condensed water vapor in contact with the ground that greatly reduces how far we can see. Various atmospheric processes can produce fog, but the bottom line is that air must be cooled or water vapor must be added such that the air becomes saturated (100% relative humidity) or gets moist enough that condensation can occur. Some of the common ways that fog forms include:

1) Advection (movement) of warm, moist air over cold or snow-covered ground. This mechanism often produces widespread, dense advection fogs during the winter over the central U.S. as mild, moist air from the Gulf of Mexico rides northward over colder surfaces.

2) Advection of warm, moist air over cold water. This mechanism often causes summer fog along coastal areas of the West Coast and over the Great Lakes.

3) Advection of cold air over warm water. This causes surface water to evaporate, producing local evaporation fogs. Examples of these would be local fogs near hot springs, power plant cooling lakes and cooling towers, and even the exhaust from cars.

4) Warm rain falling through and evaporating into colder air near the ground, usually near surface warm and cold fronts. The resulting fog is commonly called frontal fog.

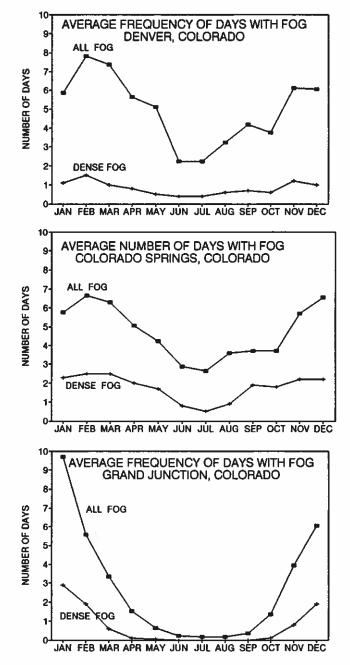
5) Movement of air up a sloped plain, hillside, valley or mountain where air is cooled by expansion as it rises. If the air is moist enough or rises far enough to cool to saturation, upslope fog can form. This type of fog occurs in Colorado and anywhere that moist air and sloping terrain meet. The coastal mountain ranges of the Pacific Northwest are especially prone to upslope fog.

6) Nighttime cooling of the ground by radiational heat loss is a very common mechanism for producing fogs. Since cold air is more dense it tends to drain downhill and collect in valley bottoms. Thus, radiation fog is also often called valley fog.

Here in Colorado we see almost no frontal fog. Advection fogs occur very infrequently – mostly near the Kansas border. Evaporation fogs occur but are highly localized. You will see them most often during cold winter weather by the big electric power generation plants near Craig, Brush, Pueblo and some of the other power plants in the State. Glenwood Hot Springs and some of the other larger hot springs/hot pool areas also make plenty of local evaporation fog. The most common types of fog in Colorado are upslope fogs and radiation fogs.

Our mountain topography is ideal for encouraging the formation of upslope fogs whenever sufficient moisture is present and the winds are blowing such that air has to rise up the mountain slopes. This type of fog most often occurs on mountain tops, mountain slopes and along the base of major mountain ranges. There are days in Colorado when moist winds are blowing gently from the east where almost the entire region along the base of the Front Range from Trinidad northward to the Wyoming border is shrouded in fog. Comparable widespread low-elevation upslope fogs on the Western Slope rarely occur since the air over the Great Basin is not normally moist enough. During dry weather periods, upslope fogs are rare. But all we need is a good soaking rain and some moist, upslope winds and suddenly localized upslope fogs can occur most anywhere.

Colorado is also prone to radiation fogs. The combination of frequently clear skies and the thin atmosphere above our high elevation land surfaces is ideal



for rapid radiational cooling of the air near the ground. Cold air, being denser, then collects in valleys and low spots. Even though the air over Colorado is often dry, the air can cool so much at night that local radiation fogs can still form. They are usually limited to the nighttime and early morning hours and tend to rapidly evaporate during the day. Weather conditions conducive to radiation fog formation nearby always leave surrounding hillsides and mountains in the clear. Radiation (valley) fogs occur most often just after a storm system has crossed Colorado and dropped precipitation.

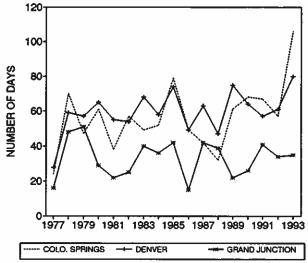
How often do we have fog here in Colorado and how much does it vary from place to place across the region? Since Colorado is so far away from the major atmospheric moisture sources (Pacific Ocean and Gulf of Mexico), we have many fewer occurrences of fog than in the more humid climates. Unfortunately, good consistent historic information on fog is very limited here in Colorado except from a few major cities across the State.

Our best sources for fog data come from National Weather Service hourly weather observations at major airport weather stations. Fog is reported anytime visibilities are reduced to less than 7 miles and temperature-dewpoint differences are less than 5 degrees F. Dense fog is reported when visibilities decrease to 1/4 mile or less.

The Front Range cities in Colorado are most likely to experience fog during the winter and early spring, but fog can occur at any time of year. Historically, Denver has reported fog more often than Colorado Springs. However, dense fogs are more likely in Colorado Springs. February and March are the foggiest months for both cities. On the Western Slope, fog is most common during mid winter with almost no fog observed during the summer months.

We don't have much data to prove it, but experience shows that fog frequencies are much greater in parts of Colorado than data from airports would suggest. That is good - airports shouldn't be located in foggy areas if possible. Portions of the lower Platte Valley and its tributaries, for example, may have twice as many fog days as Denver or Colorado Springs. Eastern and southern slopes of the Palmer Ridge near Limon also get a lot of fog. Valleys like the San Luis Valley, the upper Gunnison Valley and the Yampa Valley near Steamboat Springs may also be more prone to fog. In addition, fog frequencies are much higher on the peaks and high ridges of the Colorado Rockies that periodically are "up in the clouds." There are also some places in Colorado where fogs are rare. Certain hillsides and mesas are usually above the valley fogs but are beneath or on the downhill side of upslope fogs.

Fog frequencies vary a great deal from year to year as well. Denver and Colorado Springs typically total between 30 and 80 fog days per year. Grand Junction usually has between 15 and 50 days. Colorado Springs showed an unusually high number of fog days in 1993. At this point, we are unsure if this is real or a result of the new automated weather station installed there in late 1992. Records of dense fog have been kept in Denver for 100 years. No particular trends or cycles are apparent, but there have been some changes in the definition of dense fog that make valid comparisons impossible. Some people argue that fog frequencies have increased in Colorado. The data may not show it but it still might be true. Air pollution has definitely decreased the prevailing visibility in many areas and has potentially increased the number of condensation nuclei in the atmosphere (necessary for cloud droplet formation). Also, increased irrigation in parts of Colorado has locally increased surface humidity thus increasing opportunities for fog formation.



TIME SERIES OF ANNUAL DAYS WITH FOG

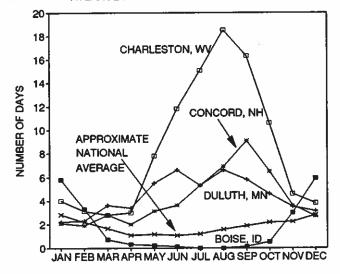
How does Colorado compare to other parts of the country? Obviously, a critical ingredient for fog formation is moisture. The areas of the country with the highest frequencies of fog are near the West Coast, near the Great Lakes and in the Appalachian Mountains. Fog frequencies are lowest in the desert Southwest, over southern coastal Florida and on lower slopes and table lands in the Great Basin. For most of the country, fog is most common during the winter months. But a variety of different annual cycles of fog frequencies can be found. Higher valleys in the Appalachian mountains have extremely high fog frequecies during the summer and early fall. Some areas near the Great Lakes see high frequencies of late spring and early summer fog.

What you can't tell from the statistics we have provided so far is timing and duration of fog. That ends up being highly variable and closely related to the local terrain. As all you commuters have undoubtedly come to realize, fog is much more common at night and early in the morning than at any other time of day. This is true not just in Colorado but throughout much of the world. Here in Colorado, the majority of all reported fog is radiation fog which occurs at night and just after sunrise. These fogs tend to last only a few hours but can, on occassion, linger for long periods of time in certain large valleys during mid winter. Upslope fogs occur less frequently and are most common on mountain peaks and ridges or along major mountain ranges. Upslope fogs can occur at any time of day and can last several days at a time.

# AVERAGE NUMBER OF DAYS WITH DENSE FOG

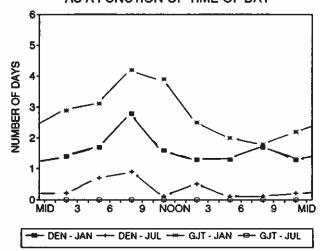
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ATLANTA, GA	
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	20
NUMBER OF DAYS	
NUMBER OF DATS	

AVERAGE NUMBER OF DAYS WITH DENSE FOG



While Colorado is not known for fog, we have had some memorable episodes. February of 1978 should still bring back memories of a remarkable bout with fog over eastern Colorado. Colorado Springs, Denver and Pueblo reported 19, 16 and 12 days with fog that month, respectively. East and south of Limon, dense fog along with sub-freezing temperatures persisted from February 5-15, 1978 and deposited tons of beautiful but damaging rime ice on trees, powerlines and anything else that stuck up into the air. Miles and miles of power lines broke and tumbled down under the weight of that ice. More recently, residents of Alamosa and the San Luis Valley won't soon forget the winter of 1991-92. Deep snow cover accumulated early in the winter followed by a long period of clear, dry weather. Radiational cooling allowed frigid air to fill the valley. Dense fog (visibilities of 1/4 mile or less) occurred on 65 days with moderate fog on another 33 days. At times, the dense fog persisted for days at a time while the surrounding mountains enjoyed bright sunshine.

AVERAGE NUMBER OF DAYS WITH FOG AS A FUNCTION OF TIME OF DAY



Fog is neat, once in a while. Everything that normally appears familiar and sharp becomes hidden and mysterious. Riming – white, glistening crystals of ice which form on objects protruding into foggy air when temperatures are below freezing, is one of nature's most beautiful art forms. But fog is also dangerous. Poor visibilities, along with damp or icy conditions on roads and runways, contribute to many traffic accidents each year and occasional aviation mishaps. Fog is to be enjoyed, especially here in Colorado where it doesn't occur too often, but please be careful if you have to travel.

#### **Reports Available:**

Back issues of "Colorado Climate" are available upon request. A fee for handling and shipping will be charged. Also, bound water-year volumes (Oct-Sept) are available for past years which include introduction, indexes, and explanations of maps and figures.

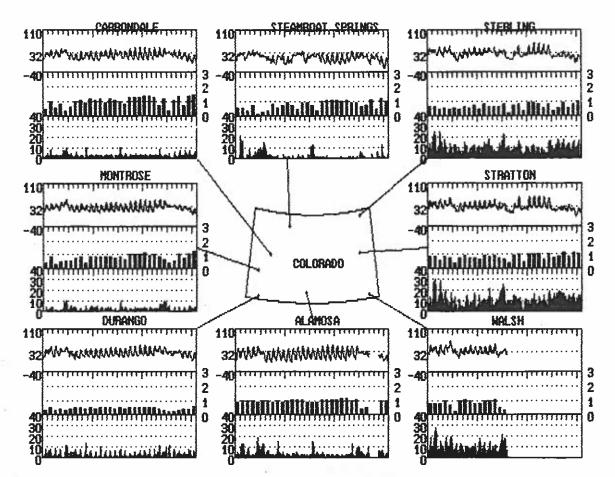
NTHRNET MEATHER NATA

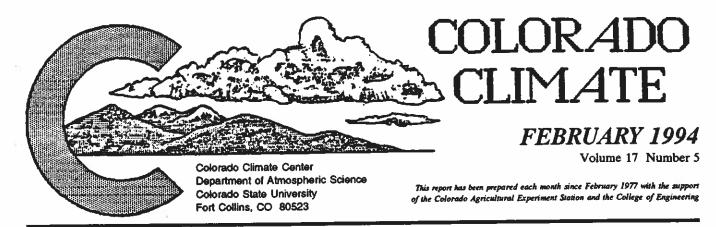
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			WINKNEI I	IEATHER DATA	JANUARY 1994				
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The State-Wide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind the states 0 and 40 miles one power or hourly average wind speed between 0 and 40 miles per hour.



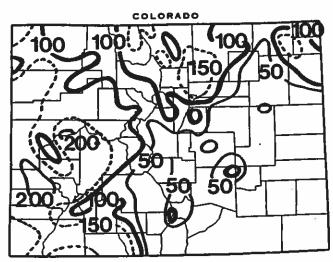


February Climate in Perspective - A Good Dose of Winter

A few episodes of heavy snow in the mountains helped reverse the recent dry weather pattern that began in late November over Colorado. This was also the first month since November with below average temperatures over most of the State. There was more cloudiness than usual, and a variety of changeable weather. Strong cold fronts, lightning and thunder, dense fog, freezing drizzle, and a few potent wind storms all made for an interesting month.

### Precipitation

Several strong storms struck Colorado in February, but most of the precipitation fell along and west of the Continental Divide. Northeastern Colorado received a few

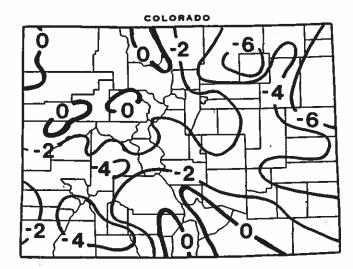


February 1994 precipitation as a percent of the 1961-1990 average.

small doses of precipitation, but wide areas of southeastern Colorado remained dry throughout the month. All the moisture in the high country fell as snow, but some rain fell at lower elevations both east and west of the mountains. Areas of west central and southwest Colorado ended up with 150% or more of their average for February. Uravan's 1.96" total was nearly 3 times their average. Northern Mountain precipitation was near average, but parts of the Front Range were snowier than usual. The 1.28" total at Estes Park was much above average.

#### Temperatures

Since Thanksgiving, Colorado had escaped much of the cold that often grips the Rockies in midwinter. But several attacks of moderately cold arctic air finally made its way into the State in February. There were no episodes of record or near-record cold, but temperatures did end up below average for the month over most of Colorado. The coldest area, compared to average, was the northeastern plains where temperatures ended up about 6 degrees below average. The San Juans and upper Gunnison Valley were also colder than usual. Near average temperatures were observed in the San Luis Valley (due to lack of snowcover), the southern Front Range, and in parts of northwest Colorado.



Departure of February 1994 temperatures from the 1961-90 averages.

	his Issue
February 1994 Daily Weather 50	Comparative Heating Degree Day Data 55
Eshnuary 1994 Temperature Comparison	February 1994 Climate Data
February 1994 Precipitation	Special Feature - Drought in Colorado - Part I
February 1994 Precipitation Comparison	- Colo Climate Center Publications
1994 Water Year Precipitation	JCEM WTHRNET February 1994 Data 61
1777 WHICH Feat A recipitution	

- 1-2 Sunshine was widespread, but temperatures were very cold. A few mountain flurries fell early on the 1st. Morning lows were far below zero each day in the mountains. Antero Reservoir reported -35° on the 1st. Northwesterly winds gusted over 50 mph in the high mountains and foothills. Winds diminished, and temperatures warmed a bit on the 2nd.
- 3-5 After another cold morning, clouds increased on the 3rd as a weak storm moved inland across California. Snow moved across parts of southern Colorado on the 4th depositing 4" at Durango but more than 12" on Wolf Creek Pass. Dense fog developed east of the mountains. Snow ended on the 5th. Fog dissipated and temperatures climbed to near-normal levels. Late on the 5th, strong winds developed again at high elevations along the Front Range.
- 6-9 Dry and seasonal weather on the 6th was shortlived as arctic air plunged south from Montana and a storm approached from the west. Cold air reached eastern Colorado early on the 7th. Freezing drizzle and light snow developed making driving dangerous near Fort Collins. Cloudy, windy and mild weather occured in the mountains. Alamosa experienced 45 mph wind gusts. Snow became widespread and locally heavy on the 8th over most of western Colorado (valley rains), while northeastern Colorado shivered with low clouds, fog and temperatures in the single digits and teens. The southern foothills escaped the snow and cold but got strong winds instead. Snow ended on the 9th, but 4-12" accumulations were common across the mountains. The heaviest totals included 16" at Aspen, 20" at Blue Mesa Reservoir and 31" at Crested Butte. Temperatures early on the 9th ranged from +26° at Gateway to -15° at Sterling.
- 10-12 Temperatures remained mild over western Colorado 10-11th and moderated east of the mountains. A period of light snow dusted parts of the mountains early on the 10th. Then a potent storm raced across Colorado on the 11th. Heavy snow fell in the mountains, winds howled across southern Colorado, and some thunder rumbled in northeast Colorado. A brief blizzard closed I-25 north of Fort Collins and made travel frightening. Estes Park got 11" of snow. Skies cleared on the 12th leaving cold but fantastic skiing conditions in the high country.
- 13-16 High pressure covered the Rockies. Sunshine was plentiful, but wave clouds formed along and east of the mountains on the 14th and 16th. A warming trend

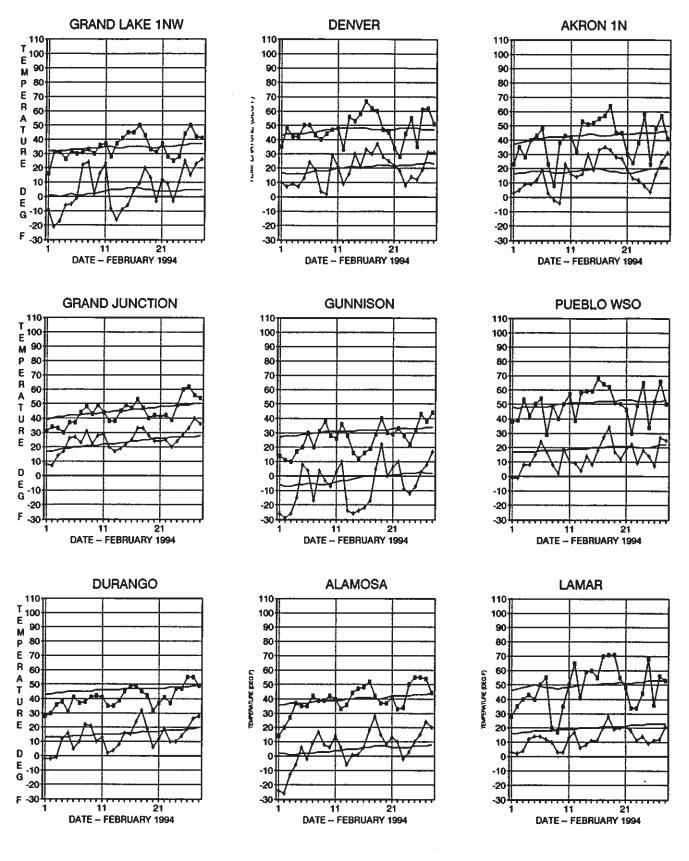
developed east of the mountains. Denver hit  $67^{\circ}$  by the 16th. But many mountain valleys filled with icy air. In Gunnison, daytime temperatures only made it into the teens, and nighttime readings were in the -20s. Taylor Park Dam reported -37° on the 13th, the coldest in the State.

- 17-18 Warmth continued east of the mountains. Campo reached 76° on the 17th. Thick clouds enveloped western Colorado, and precipitation became widespread late in the day. A deep low pressure area passed over Wyoming on the 18th and a cold front crossed Colorado. Little moisture fell east of the mountains, but thunder was reported near Greeley. Precipitation was moderate in the mountains. Ten inches of snow dumped on Hayden.
- 19-22 A trough of low pressure lingered over the Rockies bringing cold, unsettled weather with periods of mountain snow. A cold front dropped into eastern Colorado on the 19th triggering light rain changing to snow late over the northeast. Easterly winds continued through the period east of the mountains causing fog, low clouds and light snow. Wray and Boulder totalled 3". Locally heavy accumulations were reported in the mountains.
- 23-25 Dense fog early on the 23rd gave way to increasing northwestly winds. A strong surface low zipped north of Colorado on the 24th bringing several hours of roaring winds to the mountains and Front Range. Winds gusting 50-100 mph along the Front Range caused some damage in the metro area. A few inches of snow fell in the northern mountains. Temperatures during the evening plummeted as much as 30° in 30 minutes east of the mountains. A few flurries fell east of the mountains as the cold air arrived, but temperatures dropped to the teens and single digits by the morning of the 25th. The mountains enjoyed a mild day on the 25th, but it was very cold and breezy east of the mountains.
- 26-28 Springlike weather developed. It was warm in the mountains and on the Western Slope. Temperatures climbed to 54° in Alamosa on the 27th. Clouds increased as a new storm approached from the west. Meanwhile, high pressure and brisk southerly winds over the plains kept eastern Colorado very chilly. A storm system passed south of Colorado on the 28th. Convective precipitation developed over parts of the area, and some thunder and locally intense snow squalls fell. The foothills west of Boulder got 5-8".

		Weather Extremes	
Highest Temperature	76°F	February 16, 17	Campo 7S
Lowest Temperature	-37°F	February 13	Taylor Park Dam
Greatest Total Precipitation	7.05"		Wolf Creek Pass 1E
Least Total Precipitation	0.00"		8 stations in SE Colorado
Greatest Total Snowfall	9 <b>7</b> "		Wolf Creek Pass 1E
Greatest Snow Depth	72"	February 22	Bonham Reservoir

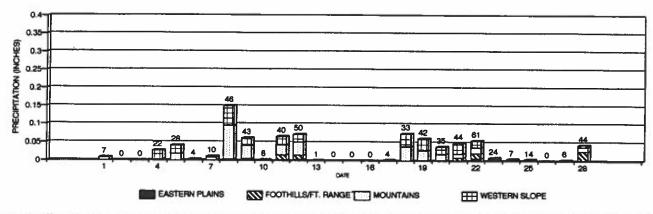
# **FEBRUARY 1994 TEMPERATURE COMPARISON**

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



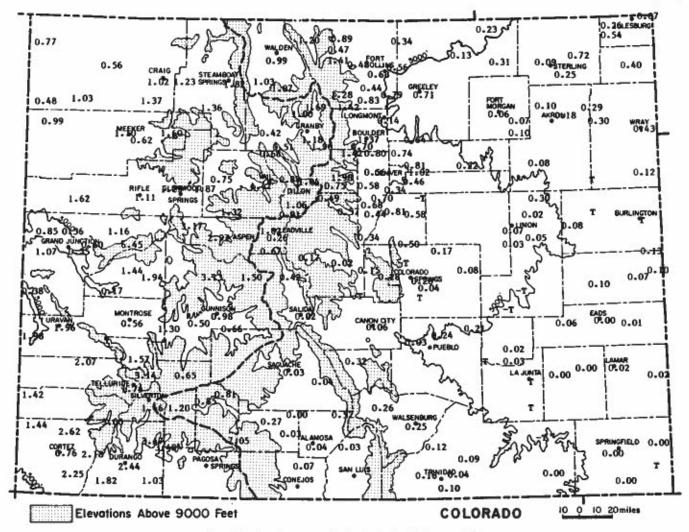
# **FEBRUARY 1994 PRECIPITATION**

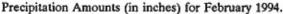
February precipitation east of the mountains wasn't much to shake a stick at, but a storm on the 11th, periods of snow 19th-22nd and rain changing to snow on the 28th provided some moisture to the Front Range and northeast plains. Mountain precipitation was more plentiful with significant storms 4-5th, 7-9th, 11th, 17-22nd and 28th. Only one day, the 22nd, had precipitation reported at more than half the weather stations in Colorado. Statewide precipitation for February average about 0.75". The 8th was the wettest day for the State as a whole.

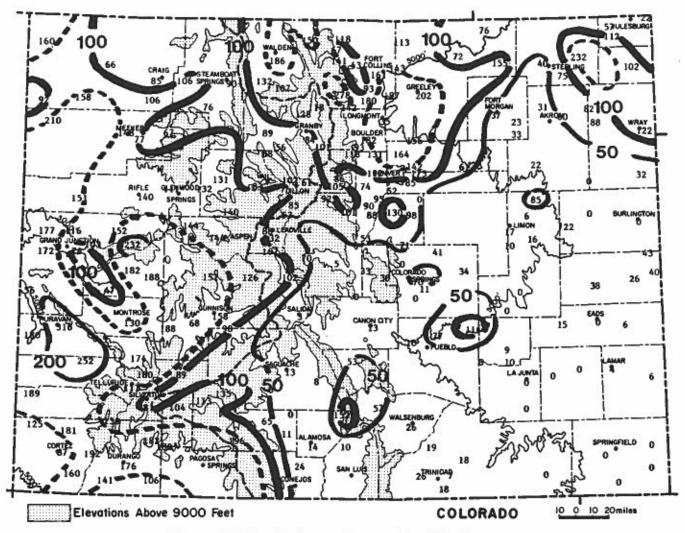


# COLORADO DAILY PRECIPITATION - FEB 1994

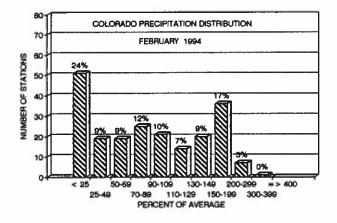
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)







February 1994 Precipitation as a Percent of the 1961-90 average.



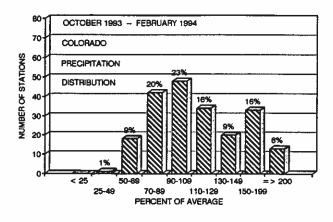
February precipitation ranged from zero over portions of southeast Colorado to more than 200% of average in a few locations in western Colorado. Dry areas slightly outnumbered the wet spots. 20% of the reporting stations reported 150% or more of average, but 33% had less than half the average precipitation.

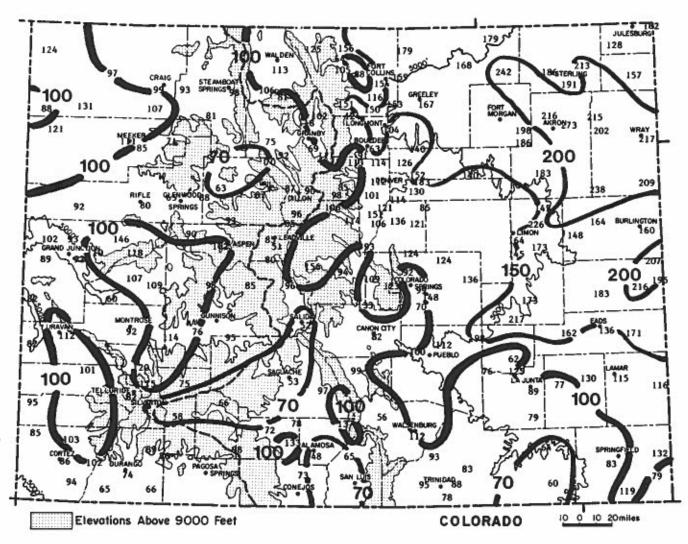
## FEBRUARY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.81"	29th wettest in 123 years of record (wettest = 2.01" in 1934)
Durango	2.44"	18th wettest in 100 years of record (wettest = 7.02" in 1911)
Grand Junction	0.56"	44th wettest in 103 years of record (wettest = 1.77" in 1893)
Las Animas	0.00"	One of 12 Februarys in 128 years of record with < 0.01"
Pueblo	0.24" (driest <	48th driest in 126 years of record 0.01" in 1880, 1916, 1952 + 1970)
Steamboat Springs	1.32"	13th driest in 89 years of record (driest = 0.30" in 1935)

## **1994 WATER YEAR PRECIPITATION**

The heavy snows of February across the Central and Southern Mountains helped raise hopes of a decent summer water supply on the Western Slope. There are still some areas in the Rio Grande Basin, the southern slopes of the San Juans and a few spots in the valleys of the Upper Colorado where precipitation totals since 1 October 1993 are less than 70% of average. Most areas in the mountains are in the 80-100% of average range, and a few spots like the Grand Mesa, the Ouray vicinity and the region west and north of Meeker are a little above average. East of the mountains, water year precipitation totals remain well above average nearly everywhere north of the Arkansas River. February didn't contribute much, but February is not known for providing much moisture to the Eastern Plains. This changes quickly though, and the next three months become very critical for both the winter wheat crop and range conditions.





October 1993-February 1994 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR FEBRUARY 1994

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COLOPADO CLIMATE CENTER (303) 481-8545	FEB MAR APR MAY JUN	1193 1014 717 453 174 1280 958 692 435 185 1179	1162 1116 796 524 262 1197 1039 901 557 363 1172	815 744 474 205 53 5 858 697 514 233 91 1 899	1047 992 729 477 197 1083 807 735 446 232 1124	846 859 519 254 34 1103 773 531 219 68 1068	756 688 408 1923 41 885 668 482 199 55 828	824 859 556 302 87 991 776 556 296 84 826	055 053 594 322 81 080 760 578 202 108 1008	1183 1094 087 419 183 1270 976 765 304 203 1237	066 719 435 186 38 783 649 469 151 52 1010	065 006 504 253 71 962 096 499 195 71 879	1355 1321 1008 747 459 1273 1220 1011 093 490 1307	852 853 564 363 127 966 768 569 302 136 1067	1106 058 875 422 164 1118 894 641 352 169 1060	1039 1011 741 512 234 1083 679 722 479 226 1029	913 828 525 272 77 1031 706 519 200 83 994	963 831 492 222 41 1202 789 500 156 64 1166	<b>B54</b> 670 389 132 13 799 567 446 144 33 853 .
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COLORADO CLIMATE CENTER (203)	NOV DEC JAN FEB MAR APR MAY JUN	1053 1473 1559 1193 1014 717 453 774 1281 1786 1637 1280 856 682 435 185 1187 1435 1412 1179	1029 1339 1376 1162 1116 790 524 262 1272 1458 1325 1197 1039 901 557 363 1188 1351 1290 1172	726 973 1004 915 744 474 235 53 5 821 1083 1130 856 697 514 233 91 1 875 905 905 899	060 1243 1250 1047 002 729 477 197 1119 1302 1211 1083 007 735 446 232 107 107 1206 1172 1124	622 1132 1175 946 659 519 254 34 828 1301 1331 1103 773 531 219 68 853 876 1060 1068	645 896 633 756 689 409 1\$3 41 682 876 1064 895 669 462 199 55 818 664 896 826	816 1091 1122 924 859 558 302 87 690 1101 1179 991 778 558 286 84 972 1006 1032 928	828 1163 1237 858 853 564 322 81 865 1276 1051 890 760 578 282 106 926 1146 1086 1036	886 1342 1479 1193 1094 087 419 193 1138 1453 1408 1270 976 765 364 203 1168 1369 1317 1227	774 1126 1221 066 719 435 186 30 919 1192 967 783 649 489 151 52 1052 1245 1231 1010	780 1054 1094 865 806 504 253 71 826 1218 1162 992 896 498 195 71 900 948 946 879	1203 1504 1587 1355 1321 1008 747 459 1346 1480 1435 1273 1220 1011 883 490 1301 1361 1494 1498 1307	B46         1172         1246         B62         B53         564         363         127           B66         1316         1152         B66         768         569         302         136           B68         1316         1152         B66         768         569         302         136           B68         1169         1054         1057         768         569         302         136	901 1376 1435 1106 938 675 422 161 1140 1389 1387 1118 894 641 332 169 1116 M 1239 1060	945 1194 1218 1039 1011 741 512 224 1074 1200 1177 1083 679 722 479 228 1011 1036 1079 1029	825 1113 1156 913 829 525 272 77 940 1222 1239 1031 706 519 209 83 944 1003 985 994	940 1197 1277 963 331 492 222 41 637 1472 1494 1202 789 509 156 64 1006 M M 1168	738 1125 1240 854 670 388 132 13 868 1245 1018 738 567 446 144 33 873 1102 1025 853
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COLORADO CLIMATE CENTER (203)	SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	306         667         1053         1473         1556         1183         1014         717         453         174           296         607         1281         1786         6637         1280         956         692         435         185           342         735         1167         1435         1412         1736         556         692         435         185	348         651         1029         1338         1376         1182         118         796         524         285         365	136         367         726         873         1004         815         744         474         235         53         17         71         337         821         1083         1130         858         6897         514         233         91         91         233         91         171         237         933         839         6897         514         233         91         91         202         503         839         689         6897         514         233         91         132         91 </td <td>318 620 660 1243 1259 1047 962 729 477 197 107 305 536 1119 1302 1211 1083 907 735 446 232 1357 687 1070 1208 1172 1124</td> <td>138 432 622 1132 1175 946 659 519 254 34 74 372 229 1301 1331 1103 773 531 219 68 189 450 853 878 1060 1069</td> <td>91 325 045 830 533 756 688 400 153 41 73 305 682 976 1064 885 669 402 199 55 153 435 818 664 809 826</td> <td>164 468 816 1091 1122 824 859 556 302 87 81 383 990 1101 1179 991 776 558 286 84 212 519 972 1006 1032 828</td> <td>148 474 828 1163 1237 858 653 564 322 81 122 373 865 1276 1051 880 780 578 282 108 165 506 926 1146 1086 1035</td> <td>273 006 006 1342 1479 1193 1004 007 419 193 234 408 1139 1453 1408 1270 978 765 304 203 206 619 1168 1369 1317 1237</td> <td>125 403 774 1128 1221 868 719 435 186 38 71 301 918 1182 967 783 649 469 151 52 232 588 1002 1245 1231 1010</td> <td>144 428 780 1054 1094 885 806 504 253 71 58 348 828 1219 1162 992 698 439 195 71 152 488 900 949 948 879</td> <td>555 856 1203 1504 1587 1355 1221 1008 747 459 555 744 1346 1480 1435 1273 1220 1011 083 480 579 889 1291 1484 1486 1307</td> <td>203         512         646         1172         1246         862         853         864         363         127           138         371         968         1316         1152         966         768         569         302         136           201         522         968         1169         1064         1067         768         569         302         136</td> <td>275         617         961         1376         4.435         1106         653         422         164           209         503         1140         1369         1367         1116         894         641         352         169           277         603         1116         M         1259         1060</td> <td>349         651         945         1134         7218         1039         1011         741         512         224           236         540         1074         1200         1177         1083         679         722         479         228           347         665         1011         1098         1079         1028         309         201</td> <td>176 471 825 1113 1156 913 829 525 272 77 87 377 940 1222 1239 1031 706 519 209 83 207 533 944 1003 985 894</td> <td>144 445 940 1197 1277 963 831 492 222 41 38 352 837 1472 1494 1202 789 509 156 64 188 485 1008 M M 1168</td> <td>55         332         738         1125         (240         854         670         368         132         13           25         222         689         1245         1018         798         567         446         144         33           56         410         675         1025         853         446         144         33</td>	318 620 660 1243 1259 1047 962 729 477 197 107 305 536 1119 1302 1211 1083 907 735 446 232 1357 687 1070 1208 1172 1124	138 432 622 1132 1175 946 659 519 254 34 74 372 229 1301 1331 1103 773 531 219 68 189 450 853 878 1060 1069	91 325 045 830 533 756 688 400 153 41 73 305 682 976 1064 885 669 402 199 55 153 435 818 664 809 826	164 468 816 1091 1122 824 859 556 302 87 81 383 990 1101 1179 991 776 558 286 84 212 519 972 1006 1032 828	148 474 828 1163 1237 858 653 564 322 81 122 373 865 1276 1051 880 780 578 282 108 165 506 926 1146 1086 1035	273 006 006 1342 1479 1193 1004 007 419 193 234 408 1139 1453 1408 1270 978 765 304 203 206 619 1168 1369 1317 1237	125 403 774 1128 1221 868 719 435 186 38 71 301 918 1182 967 783 649 469 151 52 232 588 1002 1245 1231 1010	144 428 780 1054 1094 885 806 504 253 71 58 348 828 1219 1162 992 698 439 195 71 152 488 900 949 948 879	555 856 1203 1504 1587 1355 1221 1008 747 459 555 744 1346 1480 1435 1273 1220 1011 083 480 579 889 1291 1484 1486 1307	203         512         646         1172         1246         862         853         864         363         127           138         371         968         1316         1152         966         768         569         302         136           201         522         968         1169         1064         1067         768         569         302         136	275         617         961         1376         4.435         1106         653         422         164           209         503         1140         1369         1367         1116         894         641         352         169           277         603         1116         M         1259         1060	349         651         945         1134         7218         1039         1011         741         512         224           236         540         1074         1200         1177         1083         679         722         479         228           347         665         1011         1098         1079         1028         309         201	176 471 825 1113 1156 913 829 525 272 77 87 377 940 1222 1239 1031 706 519 209 83 207 533 944 1003 985 894	144 445 940 1197 1277 963 831 492 222 41 38 352 837 1472 1494 1202 789 509 156 64 188 485 1008 M M 1168	55         332         738         1125         (240         854         670         368         132         13           25         222         689         1245         1018         798         567         446         144         33           56         410         675         1025         853         446         144         33
COLORADO CLIMATE CENTER (203)	AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	42 06 00 667 1053 1473 1556 1163 1014 717 453 174 97 131 296 607 1261 1786 1637 1260 956 692 435 165 51 116 342 735 1167 1435 1412 1179	85 150 348 651 1029 1339 1376 1162 1118 796 524 262 249 228 361 563 1272 1458 1325 1197 1039 901 557 363 232 221 425 716 1198 1351 1290 1172	0 7 138 387 728 973 1004 915 744 474 235 53 1 20 55 71 337 921 1083 1130 958 697 514 233 91 1 5 26 202 509 875 905 905 899	50 111 318 620 980 1243 1259 1047 962 729 477 197 107 107 148 305 539 1119 1302 1211 1083 907 735 448 232 183 144 357 687 1070 1208 1172 1124	0 9 138 432 622 1132 1175 946 659 519 254 34 5 39 74 372 828 1301 1331 1103 773 531 219 68 0 25 189 450 853 978 1060 1069	•         0         11         91         325         645         896         633         756         668         406         153         41           2         2         73         305         682         976         1064         885         669         402         190         55           0         22         153         435         816         664         806         825         569         402         190         55	6 18 164 468 816 1091 1122 224 859 596 302 87 21 53 91 383 990 1101 1179 991 778 556 286 84 0 40 212 519 972 1008 1032 828	* 0 11 148 474 828 1163 1237 868 853 564 322 81 18 42 122 373 865 1278 1051 860 760 576 282 106 14 165 506 926 1148 1066 1038	32 58 275 606 586 1342 1479 1153 1054 687 419 153 67 64 234 468 1138 1433 1408 1270 975 785 364 203 56 519 1169 1369 1317 1237	0 10 125 403 774 1128 1221 988 719 435 198 38 6 10 71 301 918 1182 967 783 649 469 151 52 13 33 232 598 1052 1245 1231 1010	0 0 144 429 780 1054 1084 885 806 504 253 71 10 35 58 346 826 1219 1182 902 888 498 195 71 1 20 152 488 900 948 946 979	282 341 553 856 1203 1504 1587 1355 1321 1008 747 456 384 381 525 744 1346 1450 1435 1273 1220 1011 683 480 327 350 579 869 1291 1484 1486 1307	6 37 203 512 546 1172 1246 552 553 564 363 127 34 49 139 371 566 1319 1152 566 768 569 302 136 6 43 201 522 568 1169 1064 1057	25         72         275         617         981         1376         6435         106         628         675         422         164           47         73         209         503         1140         1389         1387         1116         894         641         352         169           53         52         277         603         1116         M         1259         1090	76 122 349 651 945 1194 1219 1039 1011 741 512 234 103 167 236 540 1074 1200 1177 1063 679 722 479 228 85 140 347 685 1011 1096 1079 1029	0 12 176 471 825 1113 1156 913 828 825 272 77 22 55 87 377 940 1222 1239 1031 706 519 208 83 5 22 207 533 944 1003 965 994	0 8 144 445 940 1197 1277 963 831 492 222 41 12 40 38 352 837 1472 1494 1202 789 509 156 04 0 19 168 485 1000 M M 1168	0 0 55 322 738 1125 1240 854 670 388 132 13 0 6 25 222 888 1245 1018 799 567 446 144 33 4 0 56 410 675 1102 1025 853
	AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	06 300 607 1053 1473 1559 1193 1014 717 453 174 131 298 607 1281 1796 1637 1280 959 602 435 185 116 342 735 1167 1435 1412 1179	150 348 651 1029 1339 1376 1162 1116 796 524 262 228 361 363 1272 1438 1325 1197 1039 901 557 363 221 425 716 1198 1351 1290 1172	7 138 387 728 973 1004 915 744 474 235 53 1 55 71 337 921 1083 1130 958 697 514 233 91 1 26 202 509 875 905 905 899	111 318 620 660 1243 1259 1047 662 729 477 197 146 305 536 1119 1302 1211 1063 607 735 446 232 144 357 687 1070 1206 1172 1124	AVE 0 9 139 432 622 1132 1175 946 659 519 254 34 82.60 5 30 74 372 828 1301 1331 1103 773 531 219 68 94-94 0 25 189 450 853 878 1060 1069	11 91 325 645 896 833 756 669 406 163 41 29 73 305 642 876 1064 885 669 462 199 55 22 153 435 816 664 806 828	AVE         6         18         164         468         816         1091         1122         824         859         546         302         87           82.83         21         53         81         383         980         1101         1179         991         776         536         202         84           82.84         0         40         212         519         972         1006         1032         826         776         536         204         84	11 148 474 828 1163 1237 868 853 564 322 81 42 122 373 865 1278 1051 890 700 576 282 106 14 165 506 826 1148 1096 1038	56 275 606 586 1342 1479 1193 1054 687 419 163 64 234 468 1138 1453 1408 1270 976 765 364 203 60 286 619 1169 1369 1317 1237	10 125 403 774 1128 1221 888 719 435 186 38 10 71 301 918 1182 867 783 649 489 151 52 33 222 598 1052 1245 1231 1010	0 144 428 780 1054 1084 885 806 504 253 71 35 58 348 826 1219 1182 902 888 498 195 71 20 152 488 900 948 946 979	341         555         856         1201         1587         1355         1321         1008         747         456           381         525         744         1346         1480         1435         1273         1220         1011         683         490           381         525         744         1346         1430         1435         1273         1220         1011         683         490           350         579         968         1291         1484         1496         1307	AVE 6 37 203 512 846 1172 1246 852 553 564 363 127 62-54 34 49 139 371 866 1319 1152 866 768 569 302 136 82-64 6 43 201 522 868 1169 1094 1057	72 275 617 901 1376 4435 1106 658 675 422 164 73 209 503 1140 1369 1387 1116 894 641 352 169 52 277 603 1116 M 1259 1090	AVE 78 122 349 551 845 1194 7218 1039 1011 741 512 234 92.53 103 167 236 540 1074 1200 1177 1063 679 722 479 229 83-94 85 140 347 685 1011 1036 1079 1029	12 176 471 825 1113 1156 913 828 825 272 77 55 87 377 940 1222 1239 1031 706 519 208 83 22 207 533 944 1003 985 994	AVE 0 8 144 445 940 1197 1277 963 831 492 222 41 82.83 12 40 38 352 637 1472 1494 1202 789 509 156 04 82.94 0 19 108 405 1006 M M 1168	AVE         0         55         332         738         1125         1240         054         670         380         132         13           82.403         0         6         25         222         069         1245         1019         780         567         446         144         33           82.404         4         0         56         410         075         853         446         144         33           83.444         4         0         56         410         075         853         446         144         33
COLORADO CLIMATE CENTER (203)	AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	42 06 00 667 1053 1473 1556 1163 1014 717 453 174 97 131 296 607 1261 1786 1637 1260 956 692 435 165 51 116 342 735 1167 1435 1412 1179	85 150 348 651 1029 1339 1376 1162 1118 796 524 262 249 228 361 563 1272 1458 1325 1197 1039 901 557 363 232 221 425 716 1198 1351 1290 1172	0 7 138 387 728 973 1004 915 744 474 235 53 1 20 55 71 337 921 1083 1130 958 697 514 233 91 1 5 26 202 509 875 905 905 899	50 111 318 620 980 1243 1259 1047 962 729 477 197 107 107 148 305 539 1119 1302 1211 1083 907 735 448 232 183 144 357 687 1070 1208 1172 1124	0 9 138 432 622 1132 1175 946 659 519 254 34 5 39 74 372 828 1301 1331 1103 773 531 219 68 0 25 189 450 853 978 1060 1069	•         0         11         91         325         645         896         633         756         668         406         153         41           2         2         73         305         682         976         1064         885         669         402         190         55           0         22         153         435         816         664         806         825         569         402         190         55	6 18 164 468 816 1091 1122 224 859 596 302 87 21 53 91 383 990 1101 1179 991 778 556 286 84 0 40 212 519 972 1008 1032 828	* 0 11 148 474 828 1163 1237 868 853 564 322 81 18 42 122 373 865 1278 1051 860 760 576 282 106 14 165 506 926 1148 1066 1038	32 58 275 606 586 1342 1479 1153 1054 687 419 153 67 64 234 468 1138 1453 1408 1270 975 765 304 203 67 60 286 619 1169 1369 1317 1237	0 10 125 403 774 1128 1221 988 719 435 198 38 6 10 71 301 918 1182 967 783 649 469 151 52 13 33 232 588 1052 1245 1231 1010	0 0 144 429 780 1054 1084 885 806 504 253 71 10 35 58 346 826 1219 1182 902 888 498 195 71 1 20 152 488 900 948 946 979	282 341 553 856 1203 1504 1587 1355 1321 1008 747 456 384 381 525 744 1346 1450 1435 1273 1220 1011 683 480 327 350 579 869 1291 1484 1486 1307	6 37 203 512 546 1172 1246 552 553 564 363 127 34 49 139 371 566 1319 1152 566 768 569 302 136 6 43 201 522 568 1169 1064 1057	25         72         275         617         981         1376         6435         106         628         675         422         164           47         73         209         503         1140         1389         1387         1116         894         641         352         169           53         52         277         603         1116         M         7259         1090	76 122 349 651 945 1194 1219 1039 1011 741 512 234 103 167 236 540 1074 1200 1177 1063 679 722 479 228 85 140 347 685 1011 1096 1079 1029	0 12 176 471 825 1113 1156 913 828 825 272 77 22 55 87 377 940 1222 1239 1031 706 519 208 83 5 22 207 533 944 1003 965 994	0 8 144 445 940 1197 1277 963 831 492 222 41 12 40 38 352 837 1472 1494 1202 789 509 156 04 0 19 168 485 1000 M M 1168	0 0 55 322 738 1125 1240 854 670 388 132 13 0 6 25 222 888 1245 1018 799 567 446 144 33 4 0 56 410 675 1102 1025 853

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• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# FEBRUARY 1994 CLIMATE DATA

# EASTERN PLAINS \_\_\_\_\_\_

			Tompo	rature	_		Dev	ree Da	Ne		Procin	itation	
Nama	Mark	Min			и: _ь	1	-						
Name	Max		Mean	Dep	High	Low	Heat		Grow	Total		XNorm	# days
NEW RAYMER 21N	37.2	10.5	23.9	-5.6	61	-10	1144	0	13	0.23	-0.07	77	5
STERLING	40.2	13.9	27.0	-3.5	64	-15	1056	0	31	0.09	-0.13	41	1
FORT MORGAN	38.5	7.7	23.1	-7.5	64	- 13	1166	0	17	0.06	-0.10	38	2
AKRON 1N	40.9	16.3	28.6	-2.0	64	-4	1013	0	26	0.10	-0.22	31	2
AKRON 4E	39.0	13.6	26.3	-3.8	63	-5	1075	0	22	0.18	-0.12	60	4
HOLYOKE	38.9	11.4	25.1	-6.9	62	-14	1109	0	27	0.40	0.01	103	6
JOES 2SE	37.7	11.2	24.5	-9.1	62	-11	1128	0	18	0.00	-0.32	0	0
BURLINGTON	39.1	14.2	26.7	-6.3	63	-5	1068	0	26	0.00	-0.31	0	0
LIMON WSMO	40.4	13.8	27.1	-2.7	59	-5	1058	0	13	0.07	-0.34	17	3
CHEYENNE WELLS	46.8	15.2	31.0	-2.3	68	-4	945	0	48	0.07	-0.19	27	1
EADS	44.1	13.5	28.8	-5.4	68	0	1006	0	54	0.00	-0.34	0	0
ORDWAY 21N	43.3	11.6	27.4	-4.6	64	-5	1045	0	33	0.00	-0.27	0	0
ROCKY FORD 2ESE	53.2	16.9	35.1	-0.0	68	3	830	0	93	0.03	-0.26	10	1
LAMAR	47.6	12.4	30.0	-5.0	71	2	973	0	74	0.02	-0.40	5	1
LAS ANIMAS 1N	51.5	15.0	33.3	-2.2	72	0	882	0	97	0.00	-0.37	0	0
HOLLY	47.5	12.1	29.8	-3.6	73	-1	976	0	78	0.02	-0.31	6	1
SPRINGFIELD 7WSW	53.1	17.0	35.1	-0.6	72	2	829	0	97	0.00	-0.47	0	0

# FOOTHILLS/ADJACENT PLAINS

			Тепре	rature			Deg	Precipitation					
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	#days
FORT COLLINS	42.1	16.5	29.3	-3.1	60	-6	994	0	16	0.63	0.24	162	8
GREELEY UNC	38.4	15.5	27.0	-5.9	56	-6	1059	0	7	0.71	0.36	203	6
LONGMONT ZESE	44.0	10.2	27.1	-4.3	67	-9	1053	0	42	0.14	-0.25	36	3
BOULDER	46.0	19.3	32.7	-2.8	62	-1	899	0	27	1.37	0.62	183	8
DENVER WSFO AP	47.9	18.9	33.4	-0.0	67	2	879	0	45	0.81	0.24	142	6
EVERGREEN	45.1	10.9	28.0	-0.7	59	-13	1029	0	24	0.58	-0.20	74	2
CHEESMAN	44.9	2.4	23.6	-5.3	56	-28	1152	0	16	0.34	-0.30	53	3
LAKE GEORGE 8SW	35.0	-5.0	15.0	-3.9	50	-32	1393	0	0	0.02	-0.33	6	1
ANTERO RESERVOIR	34.4	-4.4	15.0	-2.1	48	-35	1392	0	0	0.17	-0.07	71	4
RUXTON PARK	29.1	5.6	17.4	-3.9	41	-19	1325	0	0	0.28	-0.64	30	6
COLORADO SPRINGS WSO	45.6	17.6	31.6	-0.4	62	1	926	0	33	0.28	-0.12	70	3
CANON CITY 2SE	49.9	20.4	35.1	-2.1	67	-2	828	0	61	0.06	-0.39	13	1
PUEBLO WSO AP	50.1	14.0	32.1	-2.9	68	-1	915	0	62	0.24	-0.07	77	2
WESTCLIFFE	41.4	10.9	26.1	0.5	54	-23	1080	0	4	0.32	-0.28	53	4
WALSENBURG	50.9	24.2	37.6	2.0	67	1	760	0	58	0.25	-0.71	26	4
TRINIDAD AP	52.4	18.0	35.2	0.3	65	· -4	826	0	78	0.09	-0,40	18	1

# MOUNTAINS/INTERIOR VALLEYS

			Temper	rature			Deg	ree Da	/S		Precipi	itation	ר
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	XNorm	#days
WALDEN	33.5	7.7	20.6	1.7	46	-17	1238	0	0	0.99	0.46	187	10
LEADVILLE 2SW	31.8	3.4	17.6	0.6	45	- 18	1321	0	0	0.26	-0.54	33	10
SALIDA	42.8	12.8	27.8	-1.9	58	-20	1033	0	18	0.02	-0.52	- 4	1
BUENA VISTA	39.2	9.9	24.5	-4.0	55	-8	1124	0	3	0.42	0.01	102	3
SAGUACHE	40.1	7.9	24.0	-0.5	56	- 14	1143	0	8	0.03	-0.20	13	1
HERMIT TESE	34.5	-5.1	14.7	0.5	51	-25	1403	0	1	0.85	0.10	113	2
ALAMOSA WSO AP	39.7	5.7	22.7	0.7	55	-26	1179	0	9	0.04	-0.24	14	2
STEAMBOAT SPRINGS	32.8	4.4	18.6	-0.9	52	-18	1294	0	1	1.82	-0.20	90	13
GRAND LAKE 1NW	35.0	5.3	20.2	1.1	50	-21	1247	0	0	1.69	0.26	118	16
GRAND LAKE 6SSW	30.4	-1.9	14.2	-2.1	44	-30	1415	0	0	1.00	0.22	128	12
DILLON 1E	33.0	3.1	18.1	-0.4	48	-17	1307	0	0	0.88	0.02	102	11
CLIMAX	26.0	-2.1	11.9	-3.0	40	-21	1481	0	0	0.91	-0.78	54	13
ASPEN 1SW	36.9	9.0	23.0	-0.0	51	-13	1172	0	1	2.97	0.92	145	13
CRESTED BUTTE	27.4	-4.7	11.3	-3.6	49	-32	1495	0	0	3.13	1.07	152	13
TAYLOR PARK	31.1	-8.0	11.5	0.9	43	-37	1491	0	0	1.50	0.31	126	8
TELLURIDE	34.3	4.0	19.1	-5.7	50	-22	1276	0	0	1.74	0.26	118	12
SILVERTON	32.6	-6.1	13.2	-5.2	49	-26	1444	Ó	Ó	1.46	-0.34	81	11
WOLF CREEK PASS 1E	24.5	4.0	14.2	-4.2	40	-17	1415	Ó	Ó	7.05	3.46	196	12

### WESTERN VALLEYS

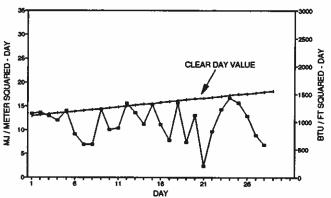
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			Tempe	rature			Degree Days				Ргесір	itation	า
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	#days
CRAIG 4SW	32.7	8.5	20.6	-0.9	52	-9	1237	0	1	1.02	-0.18	85	9
HAYDEN	33.2	9.1	21.2	-0.5	51	-13	1220	0	1	1.23	0.07	106	9
MEEKER 3W	39.0	12.4	25.7	-1.8	56	-10	1096	0	6	1.10	0.36	149	8
RANGELY	40.9	13.1	27.0	2.7	59	-4	1057	0	15	0.99	0.52	211	5
EAGLE FAA	40.7	11.6	26.1	0.8	56	-13	1080	0	8	0.75	0.18	132	7
GLENWOOD SPRINGS	41.7	18.2	30.0	-0.1	57	-2	973	0	8	1.23	0.13	112	8
RIFLE	44.4	19.2	31.8	1.7	61	-3	921	0	17	1.11	0.32	141	11
GRAND JUNCTION WS	44.0	24.4	34.2	0.0	62	7	853	0	18	0.56	0.08	117	8
CEDAREDGE	43.5	15.2	29.3	-3.1	59	-7	992	0	9	1.44	0.65	182	7
PAONIA 1SW	41.8	19.2	30.5	-1.6	62	1	959	0	11	1.94	0.91	188	11
DELTA	39.7	17.8	28.7	-5.2	60	-2	1010	0	9	0.17	-0.19	47	4
GUNN I SON	26.4	-5.9	10.3	-4.4	44	-29	1527	0	0	0.98	0.36	158	7
COCHETOPA CREEK	31.0	-2.8	14.1	-1.4	51	-26	1418	0	1	0.66	-0.01	99	7
MONTROSE NO 2	40.4	18.4	29.4	-2.2	61	0	992	0	11	0.56	0.13	130	4
URAVAN	46.6	19.9	33.2	-2.4	63	2	881	0	27	1.96	1.34	316	11
NORWOOD	38.9	12.4	25.7	-2.2	53	-7	1094	0	3	2.07	1.25	252	10
YELLOW JACKET 2W	40.4	17.4	28.9	-0.9	55	-2	1005	0	5	1.44	0.29	125	8
CORTEZ	41.9	13.4	27.6	-2.4	57	-7	1038	0	9	0.76	-0.11	87	10
DURANGO	40.8	13.1	27.0	-4.2	55	-2	1057	0	6	2.44	1.06	177	10
IGNACIO 1N	39.3	12.8	26.0	-2.8	54	-6	1083	0	3	1.03	0.06	106	7

Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

# FEBRUARY 1994 SUNSHINE AND SOLAR RADIATION

				Percent	Average
	Numb	er of	Days	Possible	% of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	Sunshine	Possible [
Colorado Springs	7	12	9		
Denver	9	7	12	56%	70%
Fort Collins	7	11	10		
Grand Junction	6	8	14	47%	65%
Limon	9	7	12		
Pueblo	NA	NA	NA	74%	73%

Cloudier than normal weather prevailed in February over the mountains and Western Slope. The Front Range and northeast plains also had several very cloudy days. Only southeast Colorado ended up with more sunshine and solar energy than usual.



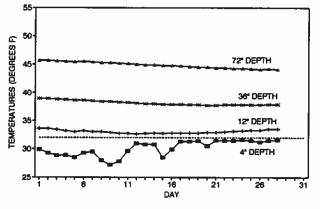
#### FT. COLLINS TOTAL HEMISPHERIC RADIATION FEBRUARY 1994

# **FEBRUARY 1994 SOIL TEMPERATURES**

With the help of some very cold temperatures in early February, soil temperatures reached their lowest values for the winter. Frost penetration was near or a little deeper than average, but not extreme. Near-surface soil temperatures began warming late in the month in preparation for the normal March thaw.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES FEBRUARY 1994



HATS OFF TO: Floyd Montgomery of Yampa, Colo.

Floyd Montgomery retired at the end of December 1993 after 30 years of observing the weather in Yampa. During those years, temperatures ranged from -36° to 90°F. 60" of snow fell in December 1983. By comparison, the driest year was 1966 when only 69" of snow fell all year. Thanks for all you have done, and please enjoy your retirement.

### **Background Perspective**

I have been planning to write a history of drought in Colorado for a long, long time. It is a topic of critical importance. Yet it is surprisingly difficult to write about. Those of us who work routinely with climate and water in Colorado are very comfortable discussing drought – among ourselves. But when we step out of our offices and try to answer simple questions like, "When was our last drought?" or "How often does Colorado experience drought?" that's when we start to stammer. Let me give some background information about drought. Then I think it will be easier to provide some specific answers.

I started work here at the Colorado Climate Center in 1977. Does that ring any bells? Yes, the 1976-77 drought still stands out as the driest, least snowy winter for Colorado's mountains and one of the only really lousy years for what has otherwise been a remarkably steady growth industry – Colorado skiing. I should have known I was in trouble when I applied for the job here. There was an essay question on the job application that read something like this, "Briefly explain the current drought situation in Colorado to someone in the media?" I should have kept a copy of my reply since I must have answered reasonably well.

Back then, I thought drought was pretty straight forward. Where I grew up in the Midwest you didn't need a bunch of scientists to tell you there was a drought. All you did was look outside. If the grass was brown, it was dry. If you didn't have to mow the yard for a month, the drought was getting bad. If you could walk in a corn field in August and see where you were going, you were in serious trouble. What could be more simple - dry meant drought. Then I came to Colorado, and things got a lot more complicated. To me, it seemed like Colorado was constantly in drought. If you have to water your grass to get it to grow, you're in a drought, and everyone seemed to watering their grass like crazy. It was no big surprise to me when I learned that back in the mid 19th century this area was widely known as the Great American Desert. Then I learned the "theory of relativity." It's not how dry it is that matters. It's how dry it is compared to how dry it usually is. I also learned that ditches and pumps could be used for something other than draining excess water away (which is what they did in central Illinois).

And so, in my first years in Colorado, I carefully kept my mouth shut about drought and listened. In some of my earliest dealings with the Colorado media I was specifically advised not to mention the "D" word. Gradually I came to appreciate what so many people like about Colorado and other western states. Let those Midwesterners suffer in their sweat. Let the snow fall in the mountains. Let gravity bring the water to me when I need it the most (i.e. during the growing season). I'll water the crops and the grass when it needs it, just let me enjoy the sunshine.

This approach to life does make some sense, doesn't it. It worked great for the Egyptians thousands of years ago, and it still works today. But this is also where the confusion begins. No longer is drought a here and now question. Build a few reservoirs and divert some water across the Continental Divide from one river basin to another and things get even more interesting. Instead of praying for rain when the field is dry, farmers here pray for sunshine and warm temperatures - and snow on the other side of the mountains. Meanwhile, the neighboring dryland wheat grower is praying for rain (hold the hail, please). The skier wants snow, but the traveller wants clear weather - and the skier is also the traveller. The people in the city want water, but they don't want rain. When it does rain, it seems to cause a lot of flooding. No snow in November and December and the ski areas are hurting. But if there is water in the reservoirs and the spring snows fall on schedule, summer water supplies are fine. Likewise, ski conditions can be just great and still end up with only 60% of our normal water supply. I'm not even including forest fires, wildlife, white-water rafting and many other facets of life in Colorado. The simple fact is that in a diverse economy and a diverse topography like we find here in Colorado, someone's perfect weather is bound to be someone else's drought.

### **Definitions of Drought**

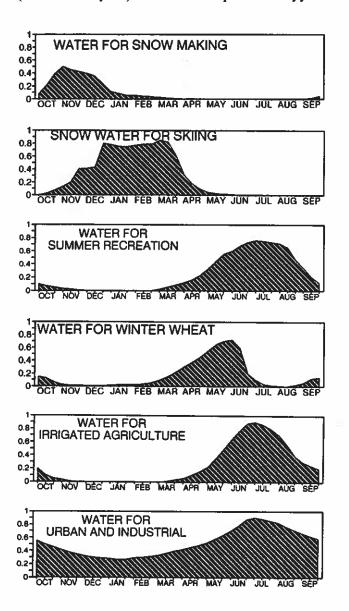
Anything that we can clearly define we are usually able to discuss and analyze quite well. So let us define drought. Drought has a very simple dictionary definition -"A prolonged period of dry weather." That sounds easy enough, but it doesn't quite answer the question. How dry does it have to be to be a drought? How long does it have to be dry to be considered a drought? How wet does it have to be and how long does it have to stay wet before a drought is over? These are some of the questions we constantly face. The answers depends on who you are, where you are and what you are doing. The World Meteorological Organization, in an effort to help countries around the world more effectively monitor and respond to drought, put together an inventory of specific drought definitions. They ended up with an entire book on the subject and no perfect answer. Likewise, here in Colorado a lot of time and energy have been put into trying to appropriately define drought. To date, no one definition satisfies everyone.

#### **Supply and Demand**

Many definitions of drought are based on comparing how much precipitation has fallen in some time period compared to how much usually falls. But for many applications, drought only becomes an issue when it disrupts "normal" activities. Three years without rain in an unpopulated, unvegetated region of the Sahara Desert may not be a problem. Six weeks with no rain in the Midwest from late May through June and problems are major.

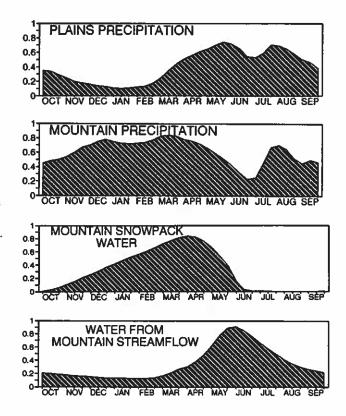
In function, drought occurs when there is insufficient water to meet demands. If you have no demands, perhaps you have no drought. If you make unreasonable demands, you will experience drought often. Colorado homesteaders learned quickly that drought was very common here if they tried to continue to raise the kinds of crops that grew back East. But if they changed their practices and lowered their expectations, things weren't so bad. They also learned that if they could increase their supply by providing irrigation water, drought impacts could be averted.

A good way to evaluate vulnerability to drought is by identifying the primary water users and determining their water demands. The following graph may be helpful for visualizing water demand in Colorado. The numbers are not precise, but it gives a general idea of the timing of various demands for water in Colorado. Please note that an important set of demands are not shown here. The deliveries of surface water to downstream states on each major river leaving Colorado are governed by long-standing agreements (Interstate Compacts) that have been in place for many years.



A great deal of monitoring, regulation and occasional legal action are required to meet this water demand.

Activities in Colorado have evolved over time such that supplies roughly meet demands most years. The development of ground water resources and the use of stored water in many reservoirs statewide have greatly helped to maintain a reliable supply depite the vagaries of the climate. The following graphs depict the typical water supply available from precipitation, snowpack and streamflow. Snowpack accumulation and streamflow have very similar patterns throughout the state. However, seasonal patterns of average monthly precipitation vary considerably from one region of the State to another.



Those sectors where demand and supply are not always in balance are the areas where Colorado remains most susceptible to drought. For example, the precipitation needed to germinate the fall-planted winter wheat is not reliable. Spring rains are more plentiful, but are not always sufficient to guarantee large yields. Snow for early season and Christmas holiday skiing is not a sure bet. Surface water for both early and late irrigation is not always available while in early June there is usually adequate supplies, even in a dry year. White water rafters find plenty of fast water from late May through June, but rafters later in the summer can find it very slow going.

Next month, we will discuss and demonstrate many of the methods for monitoring drought that are currently used in Colorado.

# COLORADO CLIMATE CENTER PUBLICATIONS

We try to summarize much of the research conducted here at the Colorado Climate Center in feature stories in "Colorado Climate." Unfortunately, we don't always find the space or time to summarize all of our work. The following is a listing, in chronological order, of publications of the Colorado Climate Center from the last few years. Sometime in the future, we will also provide a listing of our work that appears in published proceedings from scientific conferences. Most of the publications listed below are available from the Colorado Climate Center.

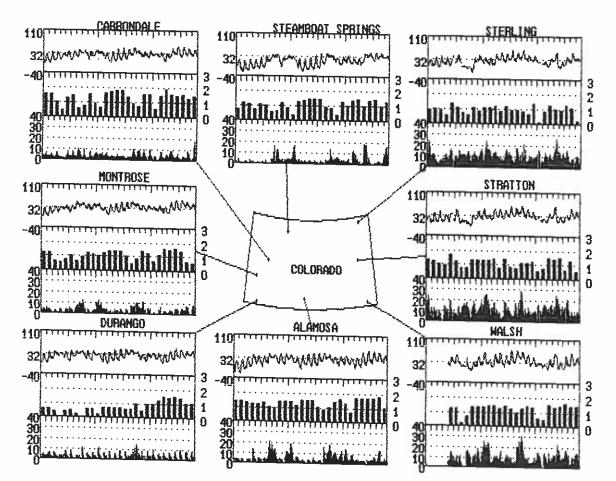
YEAR	AUTHOR(S)	TITLE	SOURCE
		Refereed Journal Articles	
1990	Weaver, Doesken	Recurrence probability-A difference approach.	Weather, 45, 9 (Sept), pp. 333-338.
1990	Weaver, Doesken	High plains severe weather-Ten years after.	Weather and Forecasting, 6, pp. 411-414.
1991	McKee, Doesken, Kleist	Drought monitoring in Colorado.	Drought Mngmt and Planning, Univ of Nebraska-Lincoln, pp. 73-80.
1991	Changnon, McKee	Climate variability of mountain snowpack in the Central Rocky Mountains.	15th Climatic Diagnostics Workshop, NCDC, Asheville, NC, pp. 384-389.
1991	Doesken, McKee	Observed variations in seasonal temperatures at selected High Plains locations during the past century.	Great Plains Research, Univ. of Nebr Lincoln, August, pp. 302-323.
1991	Changnon, McKee, Doesken	Hydroclimatic variability in the Rocky Mountains.	Water Resources Bulletin, 27, October, pp. 733-743.
1992	Bader, McKee	Mesoscale boundary layer evolution over complex terrain. Part II. Factors controlling nocturnal boundary layer structure.	Monthly Weather Review, 120, May, pp. 802-816.
1992	Doesken	The 1992 Alamosa anomaly.	Weatherwise, 45, Oct/Nov., pp. 19-22.
1993	Changnon, McKee, Doesken	Annual snowpack patterns across the Rockies: Long-term trends and associated 500 mb synoptic patterns.	Monthly Weather Review, 121, March, pp. 633-647.
		Climatology Reports	×
1990	Doesken, McKee, Kleist	Climatic data representativeness in Western Colorado.	Climo Report 90-1, Atmos Sci Dept, June, 43 pp.
1990	Changnon, McKee, Doesken	Hydroclimatic variability in the Rocky Mountain region.	Climo Report 90-3, Atmos Sci Dept, December, 225 pp.
1991	Doesken, McKee, Hersh	Cooperative weather observations in Colorado.	Colorado Centennial 1891-1991, Colo State Univ, June, 39 pp.
1991	Kleist, Doesken, McKee	A snapshot of Colorado's climate during the 20th century.	Climo Report 91-2, Atmos Sci Dept, June, 42 pp.
1991	Doesken, McKee, Kleist	Development of a surface water supply index for the Western United States.	Climo Report 91-3, Atmos Sci Dept, November, 80 pp.
1992	Wolyn, McKee	Modeling and observational study of the daytime evolution east of the crest of the Colorado Rockies.	Climo Report 92-1, Atmos Sci Dept, April, 225 pp.
1992	Doesken, McKee	The climate of Fort Collins, CO. The Year in Review-1992 water-year (1 Oct 1991-30 Sept 92)	Climo Rept 92-3, Atmos Sci Dept, December, 64 pp.
1992	McKee, Doesken, Kleist	Climate data continuity with ASOS-1992 Final Report (A Precommissioning Comparison).	Climo Rept 92-4, Atmos Sci Dept, December, 79 pp.

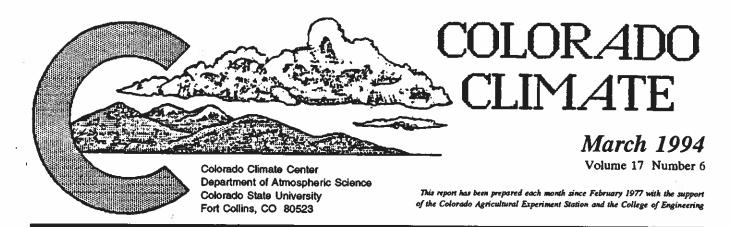
WTHRNET	WEATHER	DATA	FEBRUARY	1994

			WTHRNET W	EATHER DATA	FEBRUARY 1994			
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The State-Wide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



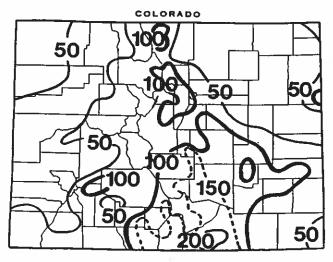


March Climate in Perspective - Warm and Fairly Dry

March can be wild and stormy, but this year was pretty gentle. Temperatures were more consistent than usual with many warm days and only a few large day-to-day changes. There were fewer and smaller storms than usual and little disruption to travel. Little snow fell in the mountains until the last week of March. Temperatures ended up well above average, and precipitation was below average except for an area just east of the Continental Divide.

## Precipitation

Seven storm systems crossed Colorado in March, but none of them brought precipitation to the entire State. The storm of March 6-8th delivered beneficial moisture to

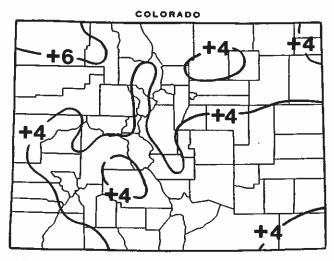


March 1994 precipitation as a percent of the 1961-1990 average.

the Eastern Plains, but it ended up being the only precipitation of the month for many areas. The mountains received frequent snows in late March, but by then it was too late to catch up with normal. Much of western and northeastern Colorado ended up with less than 50% of the normal March moisture. The exception to the dry pattern was the eastern foothills of the Front Range and parts of the southeastern Plains. A band from Pikes Peak south to Trinidad ended up with more than 150% of average. The 3.06" total at Trinidad Lake was three times their average.

## Temperatures

Except for two brief interruptions of colder weather, the first three weeks of March were remarkably warm with many days in the 60s and 70s at lower elevations. Colorado was on track for one of the warmest March's on record. For example, of the first 22 days of March in Grand Junction, only 3 days had high temperatures less than 60°F. Western Slope fruit orchard development was much ahead of schedule greatly increasing the likelihood of later frost damage. Fortunately, the last few days of March turned cold. Still, March ended up 3-6 degrees above average over the entire State both east and west of the mountains.



Departure of March 1994 temperatures from the 1961-90 averages.

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1994 Water Year Precipitation												

- 1-5 March came in lamb-like. The Feb. 28 storm moved southeast on the 1st. Brisk northerly winds with seasonal temperatures blew across the Eastern Plains. A high pressure ridge aloft then took command bringing sunny and very warm weather statewide 2-4th. Denver hit 71° on the 3rd. It remained mild on the 5th, but clouds increased and a little rain developed late evening along the Front Range.
- 6-9 Clouds were widespread on the 6th with rain and snow showers near the mountains. Temperatures east of the mountains turned sharply colder. Fog developed over the Plains, and 0.26" of cold rain fell at Colorado Springs. Easterly winds strengthened on the 7th as low pressure over Arizona coupled with high pressure over the Great Plains. Dense fog east of the mountains turned to freezing drizzle late in the day. Showers and mountain snows moved into western Colorado late. The upper-level storm system tracked across New Mexico on the 8th. Snow fell across southern Colorado but became especially heavy over the Plains. Most areas east of the mountains got some snow, but 6-12" snows were common in the Arkansas Valley. Las Animas totalled 12". It was cold statewide, but much of eastern Colorado stayed in the 20s. Skies cleared on the 9th. Morning temperatures ranged from single digits on the plains to below zero in some mountain valleys. Morning fog east of the mountains gave way to cold but drier northerly winds.
- 10-12 Warmer weather returned along with increasing cloudiness 10-11th. A new storm system over Arizona on the 11th began spreading light rain and snow into the mountains late. Most mountain areas only got 1-4" of snow, but heavier snow continued into the morning of the 12th along the Front Range (8-12" near Mount Evans) and in the southern foothills from Pikes Peak south to New Mexico (4-8"). Cool and hazy weather lingered east of the mountains on the 12th while northwestern Colorado enjoyed a very mild spring day.
- 13-18 Dry, unseasonally warm weather covered Colorado. Some grass fires got out of control on the plains. Daytime temperatures reached into the 60s and 70s at lower elevations with some 80s in the southeast. Melting snow was the rule in the mountain valleys where some 50s were reported. A deep low pressure center crossed Wyoming on the 17th and brought cooler weather and a few mountain snow showers along with strong winds. Gusts reaching 40-70 mph from the Front Range across the northeast plains

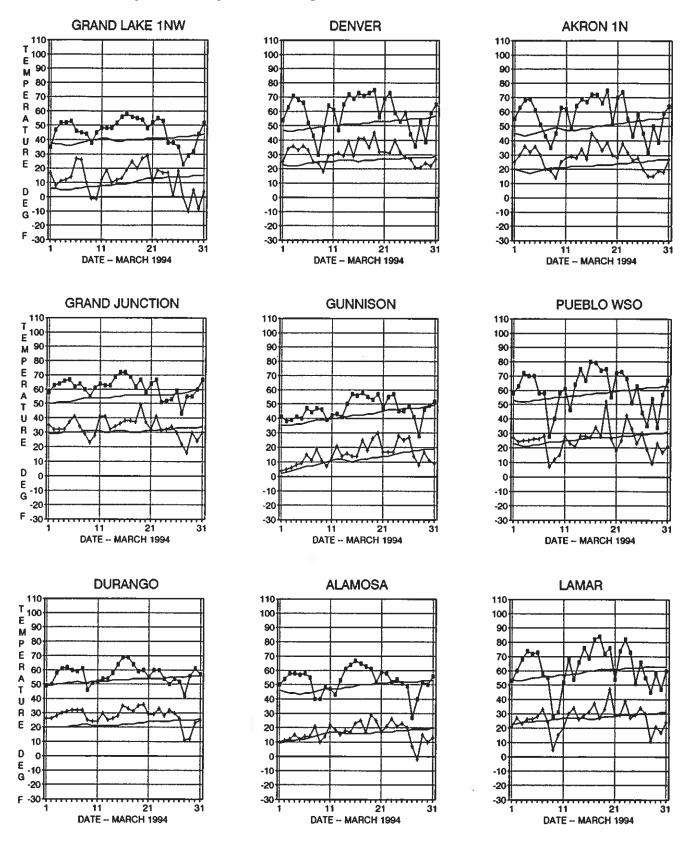
caused blowing dust in many areas. Las Animas reported 86°, the warmest temperature in the State. Winds diminished on the 18th, but the warm and very low-humidity air remained.

- 19-21 The warm weather continued on the 19th, but a moist Pacific airmass and cold front approached. Temperatures dropped sharply overnight, and a good dose of snow fell on parts of the mountains. Craig reported 4" of wet snow, and Wolf Creek Pass picked up 12". A few flurries fell east of the mountains early on the 20th, moving southward down the Front Range. Mostly it was just windy and cold over the plains. Temperatures then rebounded quickly back into the 60s and 70s at low elevations on the 21st.
- 22-23 While eastern Colorado enjoyed a warm spring day on the 22nd, clouds thickened on the Western Slope and light rain began late. A strong, fast-moving storm then dropped 2-6" of wind-driven snow over the Northern and Central Mountains overnight. Winds became very strong along the Front Range early on the 23rd as the low pressure center moved rapidly out onto the Plains. For example, wind gusts of 70-80 mph were reported in Fort Collins.
- 24-29 Cool Canadian air covered eastern Colorado, while' another Pacific storm spread snow into western Colorado late on the 24th. 2-7" snows fell overnight over much of the mountains. Then snowshowers became widespread again on the 25th in the cold, unstable air. Westcliffe totalled 11". Heavy snowshowers developed again on the 26th, especially near the Front Range. Only a trace to 3" fell over the Front Range cities, but up in the foothills 3-12" totals were common. Snow showers tapered off and moved south on the 27th, but daytime temperatures were very cold. Highs only reached into the teens and 20s in the mountains. Climax dropped to -19°, the coldest in the State. Temperatures moderated on the 28th, but then another cold front moved straight down from Canada. Late day snow squalls moved down the Front Range. Snow became especially heavy near Denver and continued overnight with 3-8" in the metro area. Dry, sunny weather returned on the 29th, but cold north winds continued much of the day.
- 30-31 After a chilly morning on the 30th (subzero readings in parts of the mountains), sunny springlike weather returned for the rest of the month.

		Weather Extremes	
Highest Temperature	86°F	March 17	Las Animas
Lowest Temperature	-19°F	March 27	Climax
Greatest Total Precipitation	3.75"		Wolf Creek Pass 1E
Least Total Precipitation	0.01"		Brush, Yuma
Greatest Total Snowfall	59"		Ruxton Park
Greatest Snow Depth	52"	March 1, 22	Wolf Creek Pass 1E

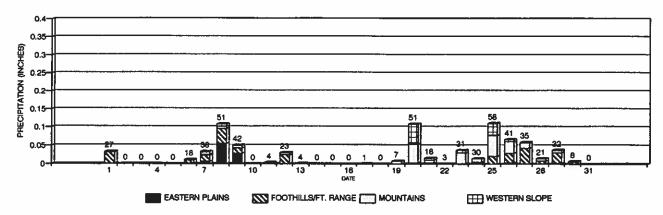
# MARCH 1994 TEMPERATURE COMPARISON

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



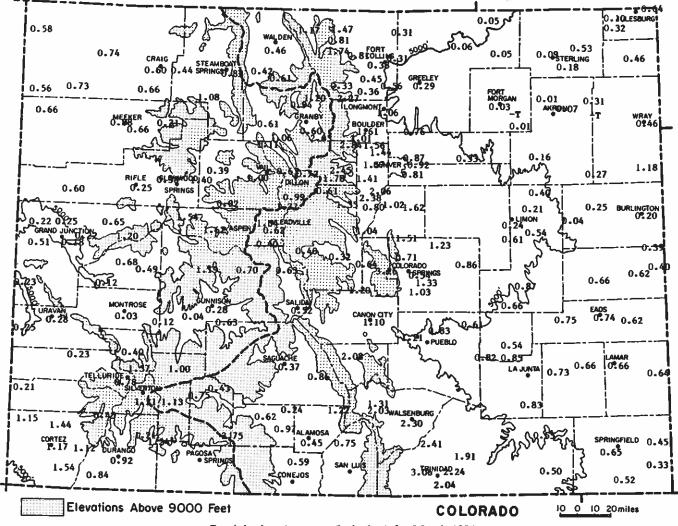
# **MARCH 1994 PRECIPITATION**

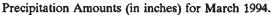
A significant storm dropped precipitation across eastern Colorado 6-8th. Little or no precipitation fell across the mountains and Western Slope the first 18 days of March. Then a series of storms brought frequent precipitation in and near the mountains later in the month. Heaviest amounts fell on the 20th and 25th. Overall, statewide March precipitation only averaged 0.72", which is well below average for this time of year. While some locally heavy precipitation fell, there were no widespread heavy storms.

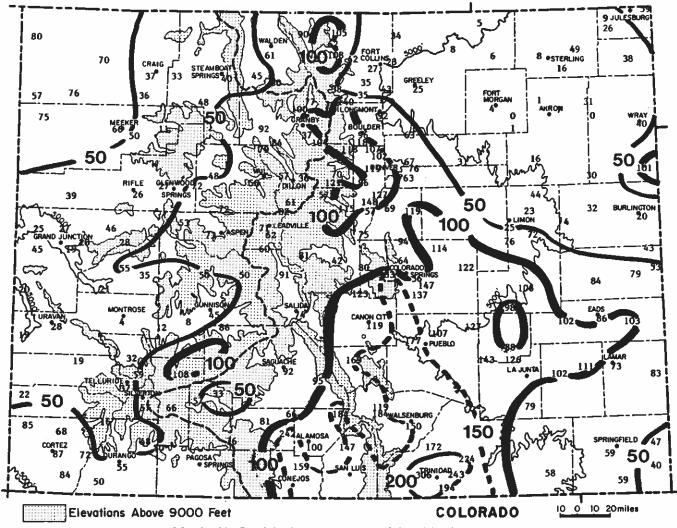


# **COLORADO DAILY PRECIPITATION - MAR 1994**

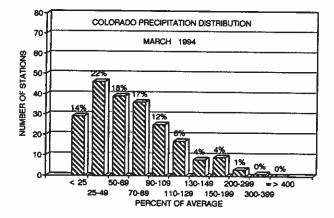
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)







March 1994 Precipitation as a Percent of the 1961-90 average.



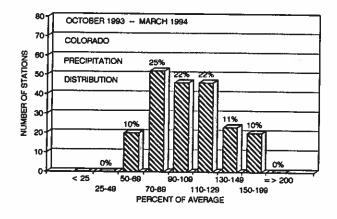
March precipitation ranged from just a trace in parts of northeastern Colorado to more than 200% of average near Trinidad. Dry areas outnumbered the limited wet spots nearly 4 to 1. 36% of the reporting stations reported less than 50% of the average March precipitation. 5% got more than 150% of average.

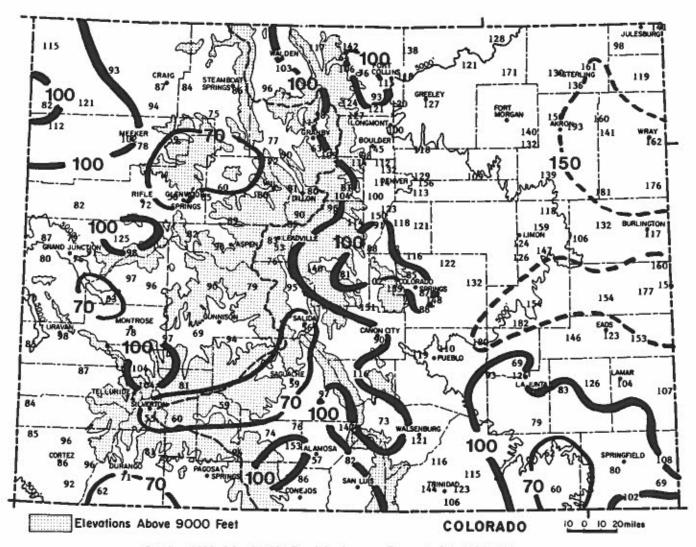
# MARCH 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.87"	45th driest in 123 years of record (driest = 0.11" in 1908)
Durango	0.92" (d	34th driest in 100 years of record riest < 0.01" in 1895, 1934 and 1955)
Grand Junction	0.25" (d	14th driest in 103 years of record riest = $0.02^{"}$ in 1909, 1971 and 1972)
Las Animas	0.73"	43rd wettest in 128 years (wettest = $3.06^{\circ}$ in 1973)
Pueblo	0.83"	42nd wettest in 126 years of record (wettest = 3.06" in 1905)
Steamboat Springs	0.83"	5th driest in 89 years of record (driest = 0.49" in 1910)

# **1994 WATER YEAR PRECIPITATION**

It seems that Colorado is often flirting with drought. After a wet February in the High Country, the snow took another vacation. By March 20, mountain snowpack was deteriorating quickly. Fortunately, weather patterns shifted and snows began again, helping to improve summer water supply projections. With 6 months of the 1994 Water Year now complete, precipitation totals are generally below average over nearly all of the western half of Colorado. Most areas are not significantly below average, but some areas near Glenwood Springs, Eagle, Silverton and Durango have received less than 70% of average. East of the mountains, conditions are better. Except for a few areas in the eastern foothills and a dry area in southeastern Colorado, most of eastern Colorado continues to show above average moisture. The storm of March 6-8 was extremely helpful in settling the dry topsoil that had been developing over parts of the plains. But other areas near Akron have received very little moisture the past 2-3 months. Some local blowing soil problems have developed.





October 1993-March 1994 Precipitation as a Percent of the 1961-90 averages.

# **COMPARATIVE HEATING DEGREE DAY DATA FOR MARCH 1994**

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	STATION	ALAMOSA	ASPEN	BOULDER	BUENA VISTA	BURLINGTON	CANON	COLORADO SPRINGS	CORTEZ	CRAIG	DELTA	DENVER	DILLON	DURANGO	EAGLE	EVERGREEN	FORT	FORT MORGAN	GRAND

8

\* # AVES ADJUSTED FOR STATION MOVES M # MISSING E = ESTIMATED

\* = AVES ADULSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# MARCH 1994 CLIMATE DATA

# EASTERN PLAINS

			Тепре	rature			Deg	gree Da	ays		Ргесір	itation	1
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	XNorm:	# days
NEW RAYMER 21N	54.6	22.8	38.7	5.1	71	9	806	0	129	0.05	-0.85	6	4
STERLING	60.0	27.2	43.6	6.0	79	11	653	0	195	0.09	-0.92	9	2
FORT MORGAN	60.5	23.7	42.1	3.9	75	9	704	0	190	0.03	-0.67	4	3
AKRON 1N	57.7	27.9	42.8	5.9	75	14	679	0	160	0.01	-0.99	1	1
AKRON 4E	57.3	25.4	41.3	4.9	76	10	727	0	157	0.07	-0.84	8	3
HOLYOKE	57.7	27.3	42.5	3.4	79	8	690	0	172	0.46	-0.74	38	2
JOES 2SE	58.5	26.5	42.5	4.0	79	6	689	0	178	0.27	-0.63	30	4
BURLINGTON	59.5	27.7	43.6	4.1	80	11	654	0	188	0.20	-0.78	20	2
LIMON WSMO	55.4	24.9	40.1	3.6	73	8	766	0	137	0.24	-0.70	26	5
CHEYENNE WELLS	61.8	29.4	45.6	5.4	83	10	594	0	213	0.62	-0.16	79	2
EADS	60.4	28.4	44.4	2.7	81	9	632	0	198	0.74	-0.12	86	3
ORDWAY 21N	59.4	24.1	41.7	3.2	79	0	711	0	185	0.66	-0.01	99	5
ROCKY FORD 2ESE	66.1	27.6	46.8	3.9	83	5	553	0	267	0.85	0.18	127	5
LAMAR	62.5	26.8	44.6	1.5	84	5	623	0	221	0.66	-0.24	73	3
LAS ANIMAS 1N	65.0	28.6	46.8	3.1	86	12	555	0	262	0.73	0.02	103	3
HOLLY	63.1	24.4	43.7	2.2	83	7	651	0	234	0.64	-0.13	83	4
SPRINGFIELD 7WSW	65.9	30.4	48.1	5.7	84	7	516	1	261	0.65	-0.29	69	2

# FOOTHILLS/ADJACENT PLAINS \_\_\_\_\_

			Тепр	erature			Deg	gree Da	iys		Precip	itatio	n
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	%Norm	#days
FORT COLLINS	58.7	27.7	43.2	4.9	73	8	669	0	169	0.38	-0.98	28	7
GREELEY UNC	58.9	29.1	44.0	3.7	75	12	643	0	173	0.29	-0.84	26	2
ESTES PARK	50.6	25.7	38.1	5.1	64	-1	826	0	73	0.33	-0.53	38	8
LONGMONT 2ESE	59.6	23.6	41.6	3.7	78	5	718	0	183	1.06	-0.09	92	5
BOULDER	57.5	30.1	43.8	4.3	76	12	651	0	159	1.61	-0.05	97	10
DENVER WSFO AP	59.0	30.6	44.8	5.8	75	18	618	0	180	0.87	-0.41	68	8
EVERGREEN	54.1	20.1	37.1	4.1	72	0	859	0	105	1.41	-0.05	97	10
CHEESMAN	53.1	13.5	33.3	-0.8	69	-7	973	0	107	1.04	-0.33	76	8
LAKE GEORGE 8SW	48.1	16.5	32.3	5.6	61	-3	1007	0	48	0.32	-0.44	42	5
ANTERO RESERVOIR	45.6	13.0	29.3	5.4	60	-12	1099	0	34	0.40	-0.09	82	8
RUXTON PARK	36.7	13.7	25.2	-0.3	50	-7	1225	0	0	3.26	1.48	183	14
COLORADO SPRINGS WSO	54.5	26.7	40.6	3.4	73	7	749	0	127	0.54	-0.41	57	6
CANON CITY 2SE	58.6	31.5	45.1	4.4	76	3	609	0	178	1.10	0.18	120	7
PUEBLO WSO AP	60.3	24.8	42.6	0.9	80	7	687	0	203	0.83	0.06	108	4
WESTCLIFFE	49.9	18.5	34.2	2.1	65	-11	946	0	77	2.08	0.85	169	7
WALSENBURG	59.5	29.8	44.7	3.9	73	5	623	0	174	2.30	0.77	150	9
TRINIDAD AP	59.4	26.9	43.2	2.2	75	3	668	Ō	191	1.91	1.06	225	8

# MOUNTAINS/INTERIOR VALLEYS

			Temp	erature			Deg	gree Da	ys		Precip	itatio	n
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	XNorm	#days
WALDEN	45.3	15.3	30.3	4.9	59	-1	1068	0	22	0.46	-0.29	61	7
LEADVILLE 2SW	41.8	10.7	26.2	4.2	53	-12	1196	0	6	0.62	-0.38	62	8
SALIDA	54.2	23.0	38.6	2.1	69	6	813	0	115	0.52	-0.18	74	2
BUENA VISTA	51.1	21.4	36.3	2.3	65	0	882	0	81	0.63	-0.06	91	4
SAGUACHE	53.5	21.3	37.4	4.2	66	9	849	0	87	0.37	-0.03	92	5
HERMIT 7ESE	48.2	12.7	30.5	10.8	67	-4	1064	0	41	0.75	-0.56	57	2
ALAMOSA WSO AP	53.0	16.6	34.8	2.5	67	-2	930	0	84	0.45	0.00	100	6
STEAMBOAT SPRINGS	48.4	18.9	33.7	5.4	66	7	965	0	47	0.83	-1.21	41	6
GRAND LAKE 1NW	46.2	12.3	29.2	4.0	58	-10	1099	0	27	1.20	-0.34	78	13
GRAND LAKE 6SSW	42.5	9.6	26.1	2.5	52	-10	1200	0	3	0.94	0.00	100	10
DILLON 1E	42.0	13.3	27.6	3.5	57	-5	1152	0	14	0.63	-0.46	58	9
CLIMAX	34.9	1.2	18.1	-0.9	46	-19	1447	0	0	1.77	-0.37	83	11
ASPEN 1SW	47.3	19.2	33.2	4.7	59	0	979	0	31	1.62	-0.58	74	8
CRESTED BUTTE	41.3	7.2	24.2	1.5	54	-7	1256	0	3	1.19	-1.15	51	5
TAYLOR PARK	40.3	3.1	21.7	3.8	49	-15	1335	0	0	0.70	-0.69	50	4
TELLURIDE	45.1	16.6	30.9	1.4	58	1	1049	0	14	0.78	-1.29	38	6
SILVERTON	44.7	9.9	27.3	3.3	56	-5	1164	0	13	1.21	-0.90	57	9
WOLF CREEK PASS 1E	38.3	11.2	24.7	2.8	51	-8	1241	0	1	3.75	-1.17	76	10

# WESTERN VALLEYS

			Temp	erature	9		De	gree D	ays		Preci	pitatio	>n
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	XNorm	#days
CRAIG 4SW	51.8	23.7	37.8	6.4	67	12	837	0	73	0.60	-1.00	38	4
HAYDEN	51.9	23.8	37.9	7.5	67	11	834	0	71	0.44	-0.87	34	4
MEEKER 3W	54.5	24.5	39.5	4.3	70	13	785	0	106	0.88	-0.45	66	5
RANGELY	56.4	26.9	41.6	5.1	72	18	718	0	117	0.66	-0.21	76	3
EAGLE FAA	56.5	22.6	39.6	5.7	69	9	779	0	115	0.49	-0.31	61	4
GLENWOOD SPRINGS	58.3	27.4	42.8	5.2	70	15	680	0	142	0.38	-1.02	27	6
RIFLE	60.1	25.5	42.8	4.1	73	14	682	0	171	0.25	-0.69	27	3
GRAND JUNCTION WS	61.5	33.2	47.3	4.2	72	16	540	0	189	0.25	-0.66	27	~ 4
CEDAREDGE	60.1	25.4	42.8	3.2	73	11	679	0	167	0.68	-0.54	56	5
PAONIA 1SW	60.0	31.4	45.7	5.9	74	16	590	0	167	0.49	-0.89	36	6
DELTA	57.1	23.4	40.2	-1.6	69	11	758	0	122	0.12	-0.44	21	2
GUNN I SON	46.7	15.4	31.0	4.0	58	4	1044	0	28	0.28	-0.34	45	5
COCHETOPA CREEK	49.2	15.4	32.3	5.6	62	5	1005	0	36	0.63	-0.10	86	7
MONTROSE NO 2	58.0	28.6	43.3	3.8	69	14	664	0	136	0.03	-0.62	5	2
URAVAN	64.0	30.2	47.1	3.8	78	19	548	0	228	0.28	-0.72	28	4
NORWOOD	54.5	25.3	39.9	5.1	67	13	769	0	87	0.23	-0.94	20	2
YELLOW JACKET 2W	56.2	29.0	42.6	6.8	67	15	688	0	108	1.15	-0.20	85	3
CORTEZ	57.7	26.8	42.3	5.0	69	13	695	0	132	1.17	-0.17	87	5
DURANGO	56.7	28.0	42.4	4.7	69	11	695	0	116	0.92	-0.73	56	11

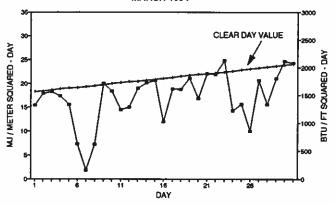
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

# MARCH 1994 SUNSHINE AND SOLAR RADIATION

	Numb	per of	Days	Percent Possible	Average % of
	<u>CLR</u>		<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	10	6	15		
Denver	10	9	12	68%	69%
Fort Collins	10	13	8		
Grand Junction	10	10	11	75%	64%
Limon	11	7	13		
Pueblo	NA	NA	NA	85%	74%

CLR = Clear	PC = Partly Cloudy	CLDY= Cloudy
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There were a few dark and cloudy days in March, but they were more than balanced by many days with bright sunshine. Most of the State ended up with a little more sunshine and solar energy than usual.



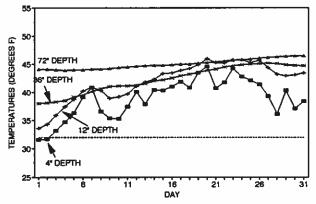
#### FT. COLLINS TOTAL HEMISPHERIC RADIATION MARCH 1994

# MARCH 1994 SOIL TEMPERATURES

There was still frost in the ground in early March, but the spring thaw came quickly. By mid-March, soil temperatures were already warmer than average. Then cloudier, cooler weather later in the month kept soil temperatures cool and slowed early plant growth.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES MARCH 1994



HATS OFF TO: Mesa Verde National Park, Colorado

Weather observations have been taken daily at Mesa Verde National Park since February 1922. Literally dozens of different park rangers have shared the observing duties, but they all know the importance of the their climate – both now and throughout the history of Mesa Verde. Thanks to all of you, and keep up the good work.

# **Monitoring and Evaluating Drought**

Many aspects of climate are direct and to the point. Heavy rains or snows and extremes of heat and cold are obvious. Drought, however, is secretive and sneaky. Nearly all of us like sunshine and warm temperatures. If the dictionary defines drought as "a prolonged period of dry weather" and if we admit that dry weather is nice weather, then logic would lead us to say that drought is a prolonged period of nice weather. It sneaks up on us while we are out enjoying ourselves. The termination of drought is similarly elusive. Just because it rains does not mean a drought is over. It has to rain or snow enough to restore depleted soil moisture, lakes and streams and perhaps even ground water. In some cases it may take months or years of average or wet weather to end drought.

It is very important that we recognize these sneaky properties of drought. It is also important to have a good historic perspective on drought characteristics in our type of climate. Long dry periods are a normal part of climate in semi-arid regions like Colorado. We need not get unduly concerned if we go a few weeks without precipitation. It is normal, for example, for entire winters to be very dry east of the mountains and for early summers to be bone dry on the Western Slope. But if the mid-winter snows fail to fall in the mountains, the spring rains don't fall on the plains and Front Range or the summer monsoon showers don't materialize, then we can get into trouble.

Routine monitoring of water supply conditions is a sensible way to avoid being surprised by drought. Here in Colorado, drought monitoring has been a part of water resource management throughout the 20th Century. We have an advantage over many parts of the country. We can look up at the mountains and see how white they are in winter and spring. Immediately we have some idea of what our water supplies will be for several months to come. With the help of routine climate measurements interpretted with respect to historic data, we can do even better.

Comparing supply to demand would be the ideal way to monitor and document drought. Unfortunately, statistics on water demand have not been gathered or stored as objectively as data about supply. Likewise, demands change over time. For example, there is much more urban and recreational water use in Colorado than there was 30 years ago. The demand for pre-Christmas natural snow for skiing is not as urgent now as it was pre-1981 due to the great expansion in artificial snowmaking at major ski resorts. Water-conserving agricultural practices in combination with more drought tolerant varieties has help Colorado farmers achieve higher yields with less water. Changes in reservoir management to meet a wider set of water demands (ecological minimum flow requirements, recreational requirements, dam safety regulations, power generation, etc.) has also perturbed the picture. Therefore, time after time we

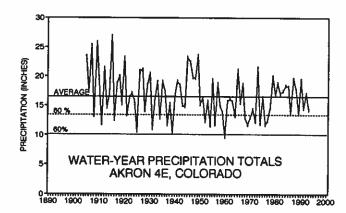
find ourselves coming back to using the basic supply-side data: precipitation, snowpack, and streamflow.

Various methods are used in Colorado for studying past drought and evaluating current conditions. Methods range from very simple to quite complex. The common ingredient in all drought monitoring methods is many years (the more the better) of accurate, consistent water resources data from many representative locations.

# Use of precipitation data for drought monitoring

# 1) Precipitation amounts and percents of averages on monthly, seasonal and annual time scales.

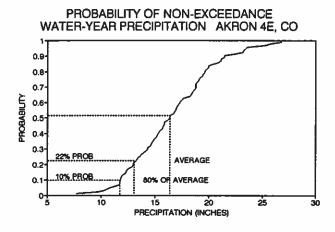
This is the original and traditional approach to climate monitoring utilizing data primarily collected by the National Weather Service's Cooperative Network. We continue to use this information in our monthly reports. It is possible to define drought based on receiving less than a certain amount or percent of average within a given time period. This type of presentation is easy to understand and communicate but has limitations for defining drought. Averages change with time so the same amount of precipitation becomes a different percent of average depending on what base period you compare with. Water users often need to interpret the information for their own applications. The graph below shows water-year precipitation totals for Akron, Colorado, and shows possible drought thresholds at 60% at 80% of the period-of-record average.



#### 2) Precipitation probabilities.

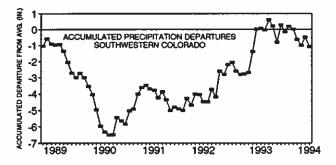
Where historic records are available, it is useful to establish how likely or unlikely a certain amount of precipitation is. The same data for Akron are displayed below in a non-exceedance probability distribution. Based on historic records, Akron can expect less than 11.80" of precipitation in 10% of the years. Thus, a given probability can be defined as a threshold for drought. Similarly, you can determine the probability of receiving less than a certain percent of average. There is a 22% percent chance (probability = 0.22) of receiving less than 80% of the period-

of-record average at Akron. Since the variability of precipitation is greater in some areas than others, the same percent of average does not equate directly with a precipitation probability. Durango receives less than 80% of their average water-year precipitation totals 27% of the years. Steamboat Springs, by comparison, has received less than 80% of average only 9 times this century. The definition thus has a significant effect on the outcome.



3) Accumulated precipitation departures from average

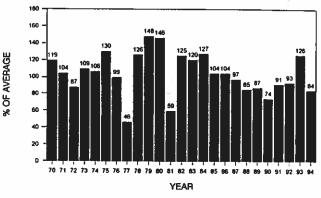
Another useful way of using precipitation data in historical perspective is to keep a running total of daily, monthly, seasonal or annual departures from average. When precipitation is above average, departures from average are positive. Below average precipitation produces deficits. Large and long-lasting deficits are the signature for major droughts.



Use of Mountain Snowpack for drought monitoring

Early settlers in Colorado learned that most of the water in Colorado's rivers and streams first appeared as snow in the mountains. Already 100 years ago, monthly climate reports included subjective evaluations of mountain snow accumulation compared to "normal." The drought of the 1930s stimulated the U.S. Department of Agriculture Soil Conservation Service to systematically monitor mountain snowpack to anticipate water supplies for agriculture. Monthly readings of snow depth and snow water equivalent from mid winter through spring began in the late 1930s at several places in the Rockies. This has now been upgraded to include about 60 remote sites in Colorado where data on precipitation and snow water content are transmitted automatically every day of the year. These data have become invaluable for anticipitating surface water supplies. Simple percents of average are most often used, although many other statistics could be generated from the available data. The graph below shows an example time series of Colorado statewide-averaged April 1 snowpack as a percent of a 30year average.





Graph prepared by SCS Snow Survey Staff, Colorado.

## Use of streamflow for drought monitoring

Streamflow is the net result of all the natural processes of precipitation, snowmelt, evapotranspiration, infiltration and ground water recharge and also direct manmade influences such as irrigation diversions and reservoir storage. As such, it may be the best overall indicator of drought on time scales of several months to several years. Streamflow is not used as much as precipitation or snowpack for operational drought monitoring simply because precipitation and snowpack give a little more advance warning of what is to come. For historic documentation of drought and water supply, streamflow is ideal.

## **Drought Indexes**

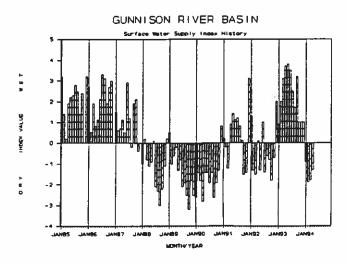
There have been many efforts to combine hydroclimatic data into single numbers for a region or local area that can be used to identify the severity of drought. There are endless possibilities for computing indexes, and simplification always has some disadvantages. But simplified indexes can help managers and administrators quickly identify and respond to drought. For many years the federal government has computed two related indexes for nationwide drought monitoring, the Palmer Drought Index (long-term drought) and the Crop-Moisture Index (short-term drought). These indexes consist of a simplified water balance equation and require temperature and precipitation data as inputs. Both models were the results of many years of work by Wayne Palmer of the U.S. Weather Bureau. His paper, "Meteorological Drought" published in 1965 continues to be widely read and referenced.

Indexes have become popular due to their ease in communicating complex information quickly and effectively. Increasingly negative index values are associated with drought

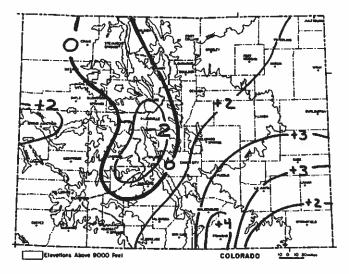
while positive numbers relate to moisture surplus. Indexes identify extremely wet and dry periods and are well suited for graphical display. However, they sometimes are not consistent with other water supply information, especially during those all-important periods when drought is emerging or retreating.

Nationally, Colorado has been one of the most active states in terms of drought monitoring and response planning. The Colorado Drought Response Plan first went into effect in 1981 with revisions made in 1988. The Plan calls for using preset values of acceptable drought indexes to trigger government actions and response. Perhaps for this reason, Colorado has put a great deal of effort into testing and understanding indexes. Colorado currently uses three additional indexes for in-state water supply monitoring:

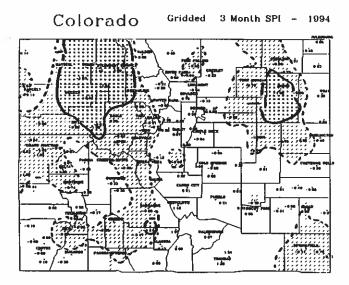
1) Surface Water Supply Index (SWSI). This index was developed jointly by the USDA Soil Conservation Service and the Colorado Division of Water Resources in 1981 to help monitor water supplies in areas where mountain snowpack contributes the majority of surface water. This index combined precipitation, accumulated snowpack, streamflow and reservoir storage into a single value updated each month for 7 major watersheds in Colorado. This index is published in reports from the State Engineers Office and the Soil Conservation Service.



2) Colorado Modified Palmer Drought Index. Experience with the Federally-computed Palmer Index led officials in Colorado to question its value for application to large basins in Colorado. In 1982, the Colorado Climate Center undertook a project to better adapt the Palmer Index for use in Colorado. The structure of the Index itself was not changed, but regional boundaries were set and input parameters controlled so that index values were only computed for relatively homogeneous climatic regions. These index values are computed monthly for 25 sub-regions in Colorado. An example map showing index values at the end of March 1994 is provided here.



3) Standardized Precipitation Index (SPI). The SPI has been developed at the Colorado Climate Center over the past four years and is the newest member of the family of indexes used to monitor drought in Colorado. The SPI is an easily computed statistical index that requires only precipitation data. Its advantage is that it can be computed for any specified time period. Currently, index values are being computed for 3, 6, 12 and 24-month time periods. The SPI, calculated for 12-month periods, correlates very well with the Palmer Drought index in Colorado suggesting that it has an inherent time scale close to 12 months. Historic SPI time series have been computed for all of Colorado's best long-term weather stations. An example map of the SPI for a 3-month time scale ending 31 March is shown below.



Next month, we will describe Colorado's drought history since the late 1800s using several of these drought monitoring tools.

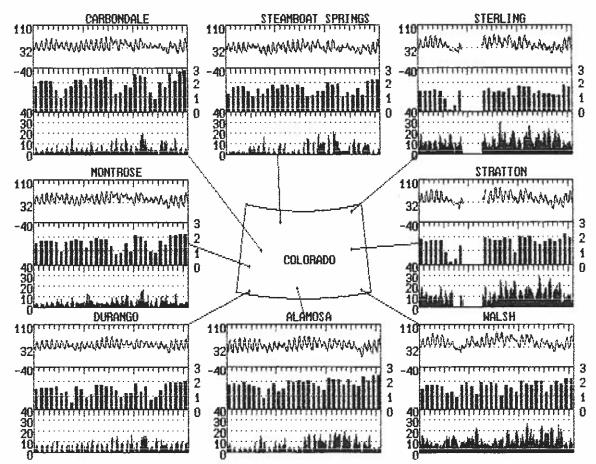
WTHRNET NEATHER DATA

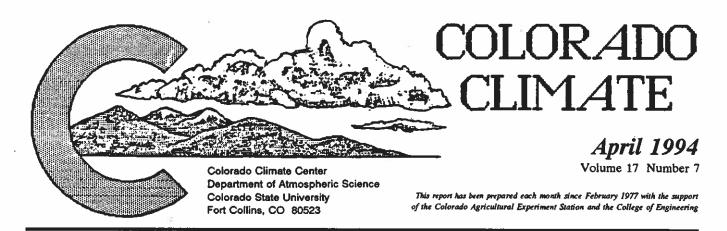
MARCH 1994

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The State-Nide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



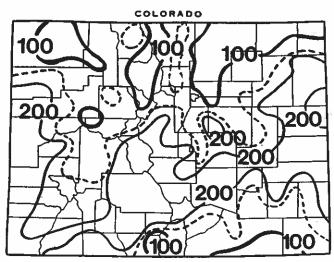


# April Climate in Perspective - Beneficial Moisture

April lived up to its reputation, delivering a wide variety of lively weather to Colorado. Widespread cold rains and snows early and late in the month were separated by several days of summerlike weather. A week of cold and snowy weather at the end of April added substantially to the mountain snowpack and improved soil moisture conditions at lower elevations. Overall, most of Colorado received above average precipitation for in April, and temperatures ended up a little above average statewide.

#### Precipitation

Six storm systems crossed Colorado during April, the last of which contained at least three separate disturbances during the last week of the month. The heaviest

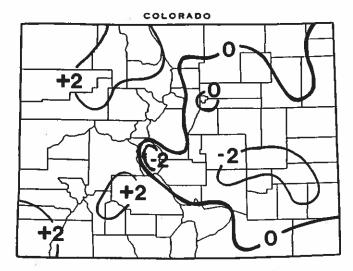


April 1994 precipitation as a percent of the 1961-1990 average.

and most widespread precipitation fell April 9-11. However, it was the snows that fell April 24-29 in and near the mountains that may have added the most to statewide surface water supplies for the coming summer. For the month as a whole, precipitation was above average over most of the State. Many areas received 150% to 350% of average from the western and southwestern valleys eastward across the San Juan mountains, the San Luis Valley, the Arkansas Valley and on to the east-central Plains. Drier than normal conditions were limited to parts of northern Colorado and a few areas near the New Mexico border.

# Temperatures

Changeable weather early in the month was followed by nearly two weeks of persistent warm temperatures April 13-24. This was followed by a week of much below average temperatures at the end of April. Near record cold temperatures April 27 over northeastern Colorado caused widespread damage to the recently planted sugar beet crop. Still, temperatures for the entire month ended up near or a little above average over much of the State. The only pocket of cooler than normal temperatures occurred over the Arkansas Valley and east-central plains where snowfall had been substantial.



Departure of April 1994 temperatures from the 1961-90 averages.

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- 1-2 April came in like a lamb with mild temperatures and sunshine. However, clouds and precipitation increased late on the 1st from the west. Rifle totalled 0.47" by evening. A few inches of snow fell overnight in the mountains. Then rain and snow moved down the Front Range early on the 2nd and became quite heavy south of Colorado Springs. Canon City measured 0.77" of moisture, and more than a foot of snow fell near Pikes Peak.
- 3-6 Dry and warmer weather on the 3rd was followed by increasing winds. Deep low pressure swept across Colorado on the 4th along with plumetting temperatures, very strong winds (mostly east of the mountains) and snow. Wind-driven snow was falling in Denver as the first Rockies baseball game of the year ended. Temperatures on the 5th remained very cold (high of only 25°F at Colorado Springs), and clouds and light snow lingered across eastern Colorado. Parts of the State received significant snowfall totals (3" at Denver, 6" at Pueblo and 9" at Climax and Monument). Skies cleared by early on the 6th, and morning temperatures were very chilly. Leadville had a low of 4° and Pueblo recorded 18°F.
- 7-8 Clouds increased again on the 7th as a fast-moving storm system approached from the west. Hardly any moisture spilled across to eastern Colorado, but significant moisture fell in the mountains. Craig reported 0.38" of rain and melted snow by early on the 8th. 10" of snow was reported in both Vail and Breckenridge with 5" at Aspen. Winds gusted to 40-60 mph along the Front Range as the storm passed. Weather conditions improved on the 8th.
- 9-12 Another storm reached Colorado on the 9th. Rain changing to snow developed over southwest Colorado early in the day and quickly expanded northeastward. Yellow Jacket reported 0.83" of moisture on the 9th. Showers fell over southeast Colorado, but several inches of wet snow accumulated along the Front Range and northeast plains. An upper-level low pressure area formed over Utah and drifted slowly eastward 10-11th. Temperatures stayed far below average. Daytime highs only reached into the 20s in the mountains on the 10th, and Taylor Park Dam reported a low of -11° on the 11th. Significant precipitation fell over all except northwest Colorado. Totals were greatest on the southern slopes of the San Juan Mountains and across the southeast and eastcentral plains. Durango got 1.47" (8" snow) in 3 days.

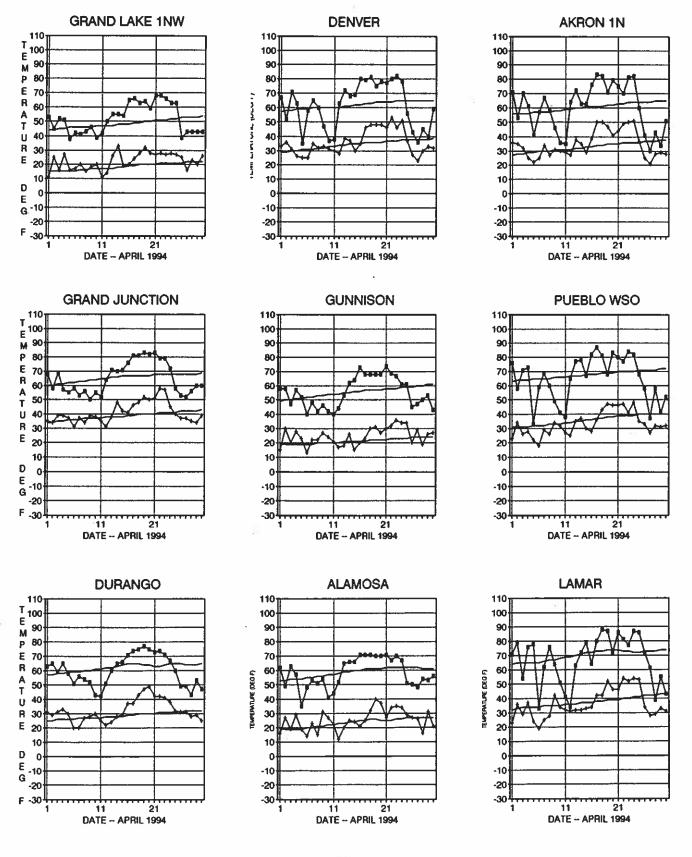
More than 10" of wet snow with at least 2" of water content soaked an area from Haswell north to Burlington and Bonny Reservoir. Several highways and schools were closed on the 11th. Skies cleared and temperatures rebounded rapidly on the 12th.

- 13-15 The 13th was windy, warm and dry with many lowelevation temperatures climbing into the 70s. Then a cold front quickly passed Colorado on the 14th triggering a few light showers and Northern Mountain snows. The 15th started off cool, but sunshine and mild temperatures returned.
- 16-18 A large ridge of high pressure dominated the Rocky Mountain region. Skies were perfectly clear statewide on the 16th, and temperatures shot into the 80s with 60s high into the mountains. Afternoon cloudiness developed 17-18th, but temperatures remained very warm. Holly and Las Animas each hit 91° on the 18th, the warmest in the State for April. Mountain snowmelt accelerated. A few gusty thundersprinkles developed on the 18th.
- 19-23 Unseasonably warm weather continued statewide, but cooler and moister air slipped into eastern Colorado on the 19th and again on the 22nd. Afternoon convection became more active, and a few local showers were reported (e.g. 0.46" at Cheesman Lake late on the 21st), but most areas remained dry.
- Clouds and winds increased on the 24th as a large 24-30 storm system moved across California. Rains and mountain snows reached southwest Colorado late on the 24th and spread eastward overnight. Lively thunderstorms erupted along the Front Range early on the 25th. Lots of small hail fell in parts of Arvada, Loveland, and other Front Range locations. Some locations got more than 1" of rain. The remainder of the week was marked by cold, cloudy weather, periods of mountain snow and occasional intense snow squalls, even at lower elevations. Snowfall totals of 1-3 feet for the week were common in the mountains. Most snow melted on highways. The worst problem was the extreme cold temperatures for this late in the spring. Over northeastern Colorado, temperatures plummetted to near 20° early on the 27th and daytime highs stayed below freezing. Young sugarbeet plants were badly damaged, and thousands of acres had to be replanted. The storm finally moved east on the 30th, but temperatures remained below average.

		Weather Extremes	
Highest Temperature	91°F	April 18	Holly, Las Animas
Lowest Temperature	-11°F	April 11	Taylor Park Dam
Greatest Total Precipitation	7.67"	-	Wolf Creek Pass 1E
Least Total Precipitation	0.35"		Blue Mesa Lake
Greatest Total Snowfall	84"		Wolf Creek Pass 1E
Greatest Snow Depth	59"	April 10	Climax

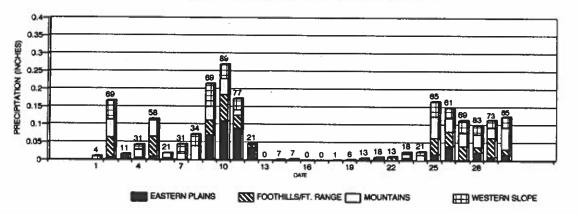
Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango,

Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



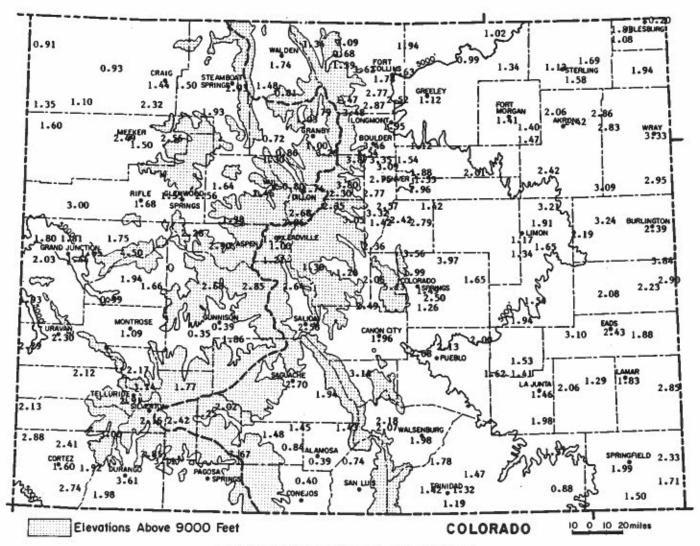
# **APRIL 1994 PRECIPITATION**

Several April storms contributed significant precipitation. The heaviest precipitation statewide and especially on the Eastern Plains fell April 9-11. Stateaveraged precipitation for this period totalled nearly 0.70". After a lengthy mid-month dry spell, the last week of April was also very wet. April 24-30 contributed about 0.80" to the statewide total. For the month as a whole, statewide precipitation averaged nearly 2.00".

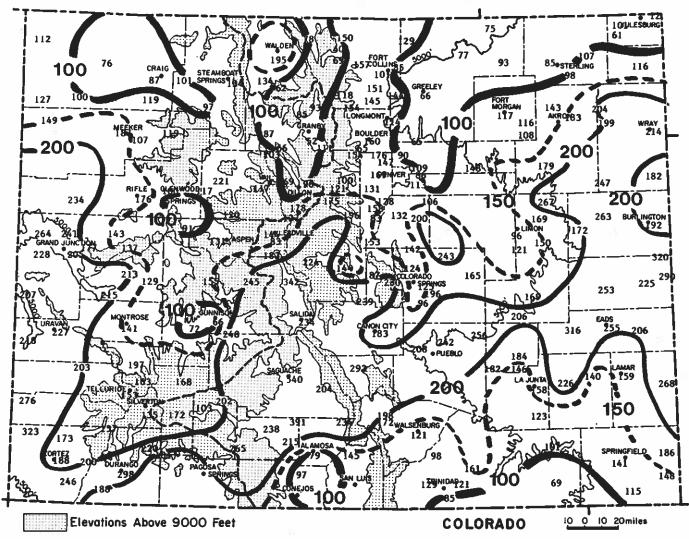


COLORADO DAILY PRECIPITATION - APR 1994

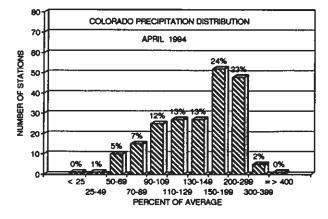
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



Precipitation Amounts (in inches) for April 1994.



April 1994 Precipitation as a Percent of the 1961-90 average.

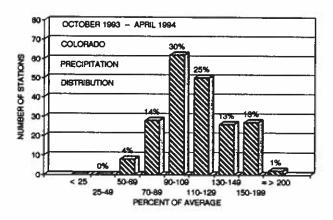


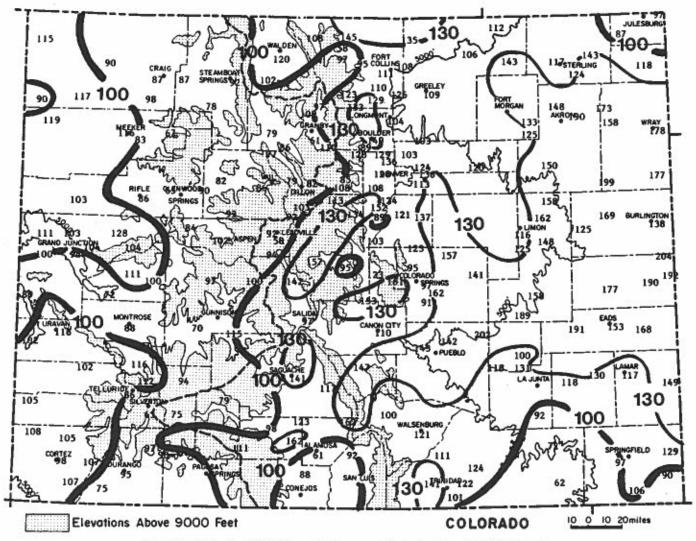
April precipitation ranged from less than 70% of average over portions of northeastern Colorado to more than 300% at Buena Vista, Center, Haswell, and Yellow Jacket. Wet areas greatly outnumbered the drier regions. Nearly half of Colorado's official reporting stations reported more than 150% of the average April precipitation.

# APRIL 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	1.88"	55th wettest in 123 years of record (wettest = 8.24" in 1900)
Durango	3.61"	5th wettest in 100 years of record (wettest = 5.54" in 1926)
Grand Junction	1.81"	2nd wettest in 103 years of record (wettest = 1.95" in 1965)
Las Animas	2.06"	23rd wettest in 128 years (wettest = 7.54" in 1900)
Pueblo	2.13"	19th wettest in 125 years of record (wettest = 8.13" in 1900)
Steamboat Springs	2.93"	19th wettest in 89 years of record (wettest = 5.13" in 1920)

All winter, Colorado's high country has been limping by with just enough storms to keep the snowpack above the critical level. Water supplies were beginning to look meager again at the end of March. Several widespread April storms came along just in time to again lift water supplies closer to average. Areas east of the mountains had also been drying out. Above average temperatures through the end of March had quickened evapotranspiration rates, and soil moisture had begun to deplete. The April storms restored these supplies, in many areas. As of the end of April, accumulated precipitation since 1 October 1993 was above average in most areas east of the Continental Divide. Some areas near the Kansas border have received more than 150% of average. The only drier areas east of the mountains are in extreme northeast and southeast Colorado. Western Slope areas are near average, while most areas in the mountains remain drier than average.





October 1993-April 1994 Precipitation as a Percent of the 1961-90 averages.

**COMPARATIVE HEATING DEGREE DAY DATA FOR APRIL 1994** 

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DEOREE DATA	AUG SEP OCT NOV	306 667 1053 265 607 1281 342 735 1167	348 651 1026 361 563 1272 425 718 1188	7 136 387 728 55 71 337 921 28 202 509 875	318 620 980 205 536 119 337 687 1070	138 432 822 74 372 828 190 450 953	11 01 325 645 20 73 305 602 22 153 435 816	18 164 468 816 53 91 383 980 40 212 519 972	11 146 474 526 42 122 373 965 14 165 506 828	56 275 508 896 64 234 498 1139 90 286 619 1168	125 403 774 71 301 919 232 598 1052	144 429 780 58 346 926 152 486 900	555 656 1200 525 744 1346 576 880 1291	203 512 846 130 371 988 201 522 908	275 617 961 209 503 1140 1277 603 1116	122 349 651 945 167 236 540 1074 140 347 685 1011	176 471 625 87 377 940 207 533 944	144 445 840 38 352 937 158 495 1006	232 235 235 235 235 235 235 235 235 235
HEATING DEGREE DATA	AUG SEP OCT NOV	96 306 667 1063 131 265 607 1281 116 342 735 1167	150 348 651 1029 1 228 361 563 1272 1 221 425 718 1188	0 7 136 387 728 20 55 71 337 821 5 28 202 509 875	111 316 620 960 148 305 536 1119 144 357 667 1070	9 134 432 622 39 74 372 628 25 199 450 663	• 0 11 01 225 645 2 20 73 305 642 0 22 153 435 816	6 18 164 468 816 21 53 91 383 980 0 40 212 519 972	0 11 146 474 829     18 42 122 373 965     10 14 165 508 828	56 275 508 896 64 234 498 1139 90 286 619 1168	10 125 403 774 10 71 301 919 33 232 598 1052	0 144 429 760 35 58 346 926 20 152 488 900	341         555         656         1200           381         525         744         1346           350         579         986         1291	37 203 512 846 49 136 371 968 43 201 522 968	72 275 617 981 73 208 563 1140 52 277 663 1116	122 349 651 945 167 236 540 1074 140 347 685 1011	12 178 471 825 55 87 377 940 22 207 533 944	B 144 445 840 40 38 352 937 19 158 495 1006	0 55 332 739 6 23 232 969 10 675 0 50 410 675

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

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• # AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTMATED

# APRIL 1994 CLIMATE DATA

# EASTERN PLAINS

		Ī	Tempera	ature			D	egree	Days	Precipitation
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
NEW RAYMER	58.4	29.8	44.1	0.1	82	18	619	0	194	1.02 -0.33 76 11
STERLING	63.9	35.3	49.6	1.5	88	19	464	8	247	1.13 -0.19 86 4
FORT MORGAN	61.2	31.7	46.4	-2.2	83	17	550	0	213	1.41 0.21 118 7
AKRON 1N	60.5	34.9	47.7	0.9	83	21	516	6	212	2.06 0.62 143 7
AKRON 4E	60.7	33.1	46.9	0.5	83	19	535	0	216	2.42 1.10 183 6
HOLYOKE	62.4	35.7	49.0	-0.4	87	18	474	5	231	1.94 0.27 116 7
JOES 2SE	62.6	33.5	48.0	1.0	85	19	503	2	240	3.09 1.84 247 9
BURLINGTON	62.5	34.1	48.3	-1.5	86	18	499	6	240	2.39 1.15 193 7
LIMON WSMO	58.0	29.8	43.9	-1.1	80	17	628	0	180	1.17 -0.04 97 8
CHEYENNE WELLS	64.5	35.2	49.9	-0.4	89	21	454	9	251	2.23 1.24 225 6
EADS	63.9	34.1	49.0	-2.6	86	20	478	5	254	2.43 1.48 256 8
ORDWAY 21N	62.8	30.6	46.7	-2.8	85	18	541	0	241	1.94 1.00 206 10
ROCKY FORD 2ESE	70.6	36.3	53.5	0.5	88	22	350	10	325	1.41 0.45 147 8
LAMAR	67.1	36.2	51.6	-2.2	88	19	414	20	296	1.83 0.68 159 8
LAS ANIMAS 1N	67.9	36.6	52.3	-1.9	91	22	400	27	305	2.06 1.15 226 8
HOLLY	68.6	33.8	51.2	-1.6	91	19	425	18	304	2.85 1.79 269 7
SPRINGFIELD 7WSW	72.6	35.8	54.2	2.2	90	15	327	10	349	1.99 0.58 141 6

# FOOTHILLS/ADJACENT PLAINS\_\_\_\_\_

		1	lempera	ture			De	gree D	ays	Precipitation
Station	Max	Min	Áve	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
FORT COLLINS	61.6	35.1	48.3	0.8	79	22	493	0	214	1.78 0.02 101 10
GREELEY UNC	62.2	35.8	49.0	-0.1	83	22	473	0	224	1.12 -0.56 67 7
ESTES PARK	53.0	27.0	40.0	-0.2	70	7	744	0	106	1.47 0.23 119 10
LONGMONT 2ESE	63.6	30.3	47.0	-0.5	85	14	533	0	247	1.95 0.25 115 7
BOULDER	61.5	33.7	47.6	-0.2	87	21	514	1	224	3.46 1.30 160 14
DENVER WSFO AP	61.4	35.8	48.6	0.4	82	23	485	2	222	1.88 0.17 110 10
EVERGREEN	55.4	26.9	41.1	0.0	75	12	710	0	153	2.77 0.67 132 14
CHEESMAN	57.1	17.5	37.3	-4.9	78	2	823	0	160	2.36 0.82 153 11
LAKE GEORGE 8SW	50.2	22.9	36.6	0.2	67	4	847	0	83	1.26 0.39 145 7
ANTERO RESERVOIR	48.5	20.5	34.5	1.1	67	-4	909	0	64	1.30 0.72 224 12
RUXTON PARK	39.2	18.6	28.9	-4.7	54	5	1075	0	5	5.13 2.83 223 14
COLORADO SPRINGS WSO	58.0	33.0	45.5	-1.1	80	17	576	0	180	1.49 0.30 125 12
CANON CITY 2SE	62.4	36.1	49.2	-0.6	81	15	468	3	226	1.96 0.89 183 9
PUEBLO WSO AP	65.1	33.3	49.2	-2.6	87	18	467	0	261	2.13 1.25 242 11
WESTCLIFFE	54.0	25.1	39.6	-1.2	70	4	756	0	108	3.14 2.07 293 13
WALSENBURG	64.8	36.0	50.4	1.4	80	21	433	0	241	1.98 0.35 121 8
TRINIDAD AP	63.5	33.9	48.7	-1.4	83	20	481	0	236	1.47 0.56 162 11

# MOUNTAINS/INTERIOR VALLEYS\_\_\_\_\_

		1	Тетрега	ature			De	gree D	ays	Precipitation
Station	Max	Min	Áve	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
WALDEN	52.5	22.8	37.6	2.6	71	11	814	0	90	1.74 0.85 196 10
LEADVILLE 2SW	45.5	17.7	31.6	1.2	61	4	994	0	33	1.00 -0.20 83 13
SALIDA	56.0	26.9	41.4	-3.3	75	6	700	Ó	145	2.58 1.48 235 12
BUENA VISTA	53.5	25.1	39.3	-2.1	73	10	762	0	115	2.64 1.87 343 9
SAGUACHE	56.8	26.8	41.8	0.4	72	17	690	0	133	2.70 2.20 540 13
HERMIT 7ESE	47.7	21.6	34.6	4.4	65	1	903	0	42	1.25 0.04 103 6
ALAMOSA WSO AP	57.8	25.3	41.5	0.1	71	12	699	0	141	0.39 -0.10 80 6
STEAMBOAT SPRINGS	56.9	27.3	42.1	3.3	76	18	678	0	139	2.93 0.75 134 15
GRAND LAKE 1NW	52.1	22.2	37.1	3.5	68	11	828	0	87	1.79 -0.12 94 17
GRAND LAKE 6SSW	50.0	21.5	35.8	2.2	65	7	868	0	67	1.03 -0.17 86 14
DILLON TE	47.9	19.9	33.9	1.1	65	6	925	0	58	0.80 -0.35 70 8
CLIMAX	39.4	7.3	23.3	-2.7	55	-5	1242	0	10	2.86 0.62 128 14
ASPEN 1SW	52.2	26.0	39.1	0.6	72	11	771	0	91	2.90 0.70 132 11
CRESTED BUTTE	46.0	19.1	32.5	0.0	62	5	967	0	36	2.68 0.96 156 14
TAYLOR PARK	44.6	14.1	29.4	0.6	58	-11	1059	0	26	2.85 1.69 246 13
TELLURIDE	50.1	21.9	36.0	-1.7	68	7	860	0	73	2.91 1.02 154 14
SILVERTON	47.3	19.0	33.2	0.2	64	5	946	Ō	45	2.16 0.56 135 12
WOLF CREEK PASS 1E	38.4	18.4	28.4	-1.0	55	3	1091	Ó	12	7.67 4.78 265 18

#### WESTERN VALLEYS

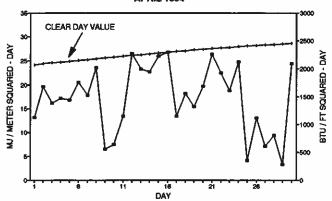
			Tempera	ature				De	gree Da	ays	Pi	recip	itation	
Station	Max	Min	Ave	Dep	Highest	Lowest	H	eat	Cool	Grow	Tot		%Norm #	
CRAIG 4SW	58.4	29.8	44.1	1.9	76	21	(	621	0	151	1.44 -	0.21	87	9
HAYDEN	59.0	30.9	45.0	2.7	77	18		592	0	161	1.50	0.02	101 1	4
NEEKER 3W	59.2	30.8	45.0	2.1	77	22		594	0	165	2.49	1.16	187 1	5
RANGELY	63.1	34.4	48.8	1.1	80	25	4	480	0	206	1.60	0.53	150 1	0
EAGLE FAA	58.4	28.5	43.4	1.1	73	13		539	0	146	1.64	0.90	222 1	0
GLENWOOD SPRINGS	62.5	33.5	48.0	2.1	82	23		500	0	197	1.55	0.00	100 1	5
RIFLE	64.0	32.9	48.5	1.5	83	3	4	488	0	219	1.68	0.73	177 1	1
GRAND JUNCTION WS	65.4	40.9	53.1	1.1	83	31		360	13	246	1.81	1.06	241 1	2
CEDAREDGE	64.8	31.7	48.3	0.8	81	21	4	495	0	229	1.94	1.03	213 1	1
PAONIA 1SW	64.2	37.2	50.7	2.6	85	26	4	423	0	226	1.66	0.38	130 1	3
DELTA	61.8	32.2	47.0	-3.6	79	20		533	0	183	0.99	0.53	215	9
GUNNISON	55.6	24.6	40.1	1.8	74	13		736	0	121	0.39 -	0.20	66 1	2
COCHETOPA CREEK	55.6	23.9	39.8	2.8	74	13	7	752	0	118	1.86	1.11	248 1	1
MONTROSE NO 2	62.0	35.0	48.5	0.5	79	25	4	487	0	191	1.09	0.32	142	9
URAVAN	67.9	37.8	52.9	1.2	85	29	3	359	2	276	2.30	1.29	228 1	1
NORWOOD	57.2	30.9	44.0	1.5	74	16	6	521	0	138	2.12	1.08	204 1	0
YELLOW JACKET 2W	59.9	33.6	46.8	2.4	75	22	5	540	0	163	2.88	1.99	324	7
CORTEZ	61.6	32.6	47.1	2.7	79	22	5	528	0	195	1.60	0.75	188	8
DURANGO	60.3	32.0	46.1	0.6	77	20	5	561	0	175	3.61	2.40	298 1	4

Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

# APRIL 1994 SUNSHINE AND SOLAR RADIATION

	Numt	er of	Davs	Percent Possible	Average % of
	<u>CLR</u>		<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	4	10	16		
Denver	5	9	16	48%	67%
Fort Collins	4	11	15		
Grand Junction	7	5	18	64%	69%
Limon	4	7	19		
Pueblo	NA	NA	NA	71%	74%
CLR = Clear	PC	= Pa	rtly Clo	udy CLI	OY= Cloudy

April is a relatively cloudy month for Colorado most years, but 1994 was even cloudier than normal. More than half the days in April were cloudy across much of Colorado, and all areas ended up with less sunshine and solar energy than usual.



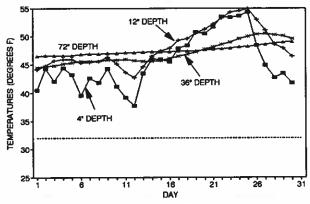
# FT. COLLINS TOTAL HEMISPHERIC RADIATION

# **APRIL 1994 SOIL TEMPERATURES**

Soil temperatures remained cool in early April but shot up dramatically during the hot, dry period April 13-24. The cloudy, snowy weather the last week of April then brought a sharp decline again even as deep as three feet.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES APRIL 1994



## HATS OFF TO: Louis Johnson of Castle Rock

A few of Colorado's loyal cooperative weather observers do not belong to the National Weather Service Network (often due to proximity to long-term official stations). Mr. Johnson has been providing detailed daily weather observations near Castle Rock for over 11 years. They are now moving to Idaho to be closer to their grandchildren. We sure will miss you.

# HAIL, HAIL, HAIL – THE SUMMERTIME HAZARD OF EASTERN COLORADO

#### INTRODUCTION

Hail – the word itself sends feelings of frustration through Colorado farmers. Each year, millions of dollars of agricultural losses occur when hailstorms sweep across the Eastern Plains. Hundreds of Colorado wheat farmers can tell tales of disappointment about years when their crop had survived drought, windstorms, winter cold, and insects only to be wiped out by hail the day before harvest. If it wasn't last year or the year before, then it might be this year or the next.

Hail is a pain, but it's also an unavoidable part of life east of the Rockies. All the way from Alberta, Canada, south to eastern New Mexico, hundreds (maybe thousands) of hailstorms develop each year. There is no other place in North America with more numerous or more severe hailstorms, and Colorado is right in the middle of it. There are areas in Wyoming, Montana, South Dakota, Nebraska and New Mexico that may challenge Colorado as the hail capital of the U.S., but more often than not, Colorado takes that honor.

Hail used to be viewed as primarily an agricultural problem. The past 20 years, however, has brought one catastrophic hailstorm after another to Front Range population centers. The culmination came July 11, 1990 when Denver took a direct hit by a prolific hail-making thunderstorm. When it was all over, damage totals close to \$600 million were reported - the greatest property losses from hail ever reported from one storm up to that time. Property damage in Colorado has exceeded \$50 million in 5 of the last 7 years. Front Range car dealers tremble every time the summer skies turn dark. Insurance agents have nightmares about being buried alive beneath piles of claim forms.

Colorado hail can also be life threatening. A child was killed in Fort Collins in 1979 when struck in the head by a large hailstone. There have been many instances of lesser injuries. Livestock fatalities from hail are fairly common.

### HAIL INFORMATION

We receive literally hundreds of questions each year about hail in Colorado. Questions like, "Where can I set up greenhouses where the risk of hail won't be too great?" or "How often will stones larger than one inch fall at such-and-such location?" are common. We also find ourselves on both sides of insurance claims. Individuals who are filing claims but can't remember when the hail fell will call us. Likewise, insurance investigators routinely call or write to verify if hail did indeed occur at a particular time and place.

As I have attempted to answer these many questions, I have always been frustrated by the lack of information about hail. Systematic observations of hail are taken at only a handful of stations in Colorado. The National Weather Service offices at Denver, Colorado Springs, Pueblo, Grand Junction and Alamosa have gathered hail information for many years – but only right at their offices. Some of the 200+ cooperative weather stations in Colorado also report their hailstorms. The Fort Collins weather station, for example, has more than 100 years of local hail reports.

The data from these few locations are very useful. Unfortunely, if you ask for information from Boulder, Lamar, Breckenridge or most any other location in Colorado, we probably won't have much data to refer to. Since hail occurs only briefly (typically, just a few minutes per year even at the most hail prone locations) and tends to be very localized (Colorado hailstorms are at most a few miles wide), many storms go undetected by the "official" weather stations. For example, Denver Stapleton Airport, the source of Denver's hail data since 1950, only had a few hail stones on 11 July 1990 – the day that much of the city was pulverized.

The National Weather Service (NWS), as a part of their duty to warn citizens of the threat of severe weather, obtains reports of severe weather from pilots, law enforcement officers, news media, local civil defense organizations, volunteer storm "spotters," private citizens and any other credible source. These data are used in real time to help issue and verify severe thunderstorm and tornado warnings. At the end of each month, severe weather reports are assembled, checked and then transmitted to the National Climatic Data Center. Several months later, the publication "Storm Data" is published for the country providing historical documentation of significant storms.

Another source of information is the insurance industry. In densely or uniformly populated regions of the country, property and crop insurance claims give a detailed picture of the locations and frequency of hail that greatly compliments weather station data. Here in Colorado, population is far from uniformly distributed, and farmland is not uniformly distributed. Thus, insurance data are not much help in improving hail information. Also, many farmers choose not to insure their crops against hail since the cost of insurance is so high. Some farmers try to self insure their crops by spreading their fields several miles apart so the likelihood is small that all their crops will be hit at the same time.

Weather radar can be used to detect hail. It is difficult, time consuming and expensive to go through years of past radar data to try to reconstruct storm locations, frequencies and intensities, so few such radar climatologies have been completed. New NWS radars now being deployed may make this task easier.

#### PAST STUDIES

Our hail problem here in Colorado shouldn't be a surprise to us. Long before the 20th Century, Native Americans living on the High Plains were familiar with hail. Native American folklore referred to "Ice balls from the sky when summer winds blow from the east." Early European settlers knew about hail, but surprisingly little was written about it. Climate summaries written prior to the late 1930s contained almost nothing about hail. A very small number of scientists embarked on descriptive hail climatologies around 1940. After World War II, Air Force and commercial airline studies of hail began. A special network of volunteer weather observers was established in the Denver area in 1949 and operated for at least 10 years. Several fascinating papers were written in the 1950s and 1960s by W. Boynton Beckwith of United Airlines using this data set.

Interest in hail research in Colorado expanded rapidly in the 1960s, and a number of published references can be found. Much of the interest centered around the possibility of reducing hail damage by seeding clouds with silver iodide. This interest culminated in a large scientific experiment, the National Hail Research Experiment (NHRE), to learn more about hailstorms. This early 1970s project attracted scientists from around the world to places like Grover and Keota, Colorado. Cloud seeding aspects of this project attracted much controversy. The project came to a premature end, and much climatological information gathered on eastern Colorado hail was never analyzed.

Since the 1970s, most research has turned toward modelling and predicting severe storms. Studies of Colorado severe weather and tornadoes have brought noticeable improvements in forecasting severe storms, but little information to better define the risks of hail has been assembled. In the past few years, new meteorological radars in Colorado are paving the way for expanded studies of storm characteristics.

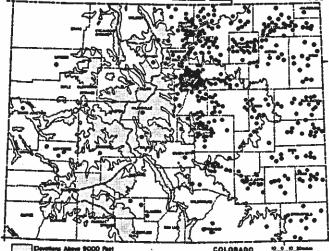
## **CCC HAIL PROJECT**

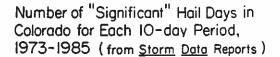
The Colorado Climate Center has been working to improve climatological information about hail for Colorado decision makers. Back in the March 1988 issue of Colorado Climate we compiled some information about hail in Colorado. All significant hail reports for Colorado for a 13 year period, 1973-1985 were reviewed. The following map and graph show some of the features of Colorado hail patterns derived from those data.

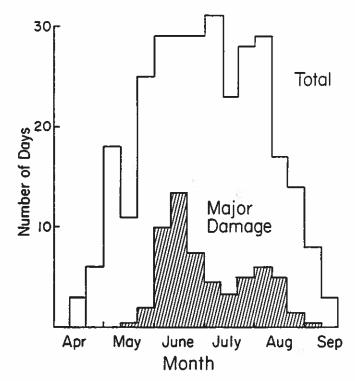
In recent months, with the help of part time assistance from Natalie Tourville (High School intern) and Jim Harrington, we have now updated our Colorado hail statistics. Based on more than 1,200 hailstorm reports, 1986-1993, more detail can now be offered to better describe the characteristics of hail in Colorado.

The data used for this study included point weather station data from a small number of sites in and near Colorado

HAIL STORM LOCATIONS FROM STORM DATA REPORTS 1973-1985







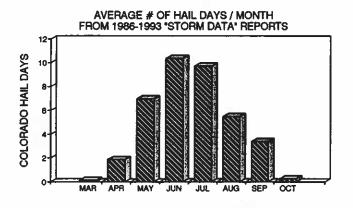
along with statewide data on severe hailstorms obtained from the national publication, "Storm Data." It is important to note that to be reported as a severe storm, maximum hailstone diameter must be at least 3/4 inch. Therefore, the numerous storms that produce smaller stones were usually not included in the statewide data unless they caused significant crop damage or accumulated to significant depths. Some of the larger hailstorms reported during this 8-year period included several storm data reports. In some of the analyses that follow, multiple reports were combined to define a single storm.

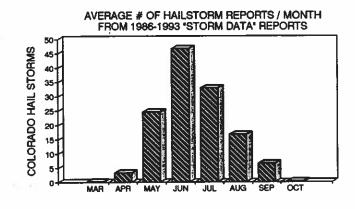
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

# MONTHLY HAIL FREQUENCIES

The hail season in Colorado begins in March and ends in October. Average monthly distributions of hail (all sizes included) for selected locations show that overall, June has the highest frequency of days with hail. However, some individual sites, such as Fort Collins and Grand Junction, have more frequent hail in May. May-August accounts for the vast majority of Colorado hail events. It would be very interesting to have mountain stations to add to this comparison. July-August thunderstorms are common throughout the Colorado high country, and many of these storms are accompanied by small and usually soft hail or graupel. This type of hail rarely does damage and is sometimes even reported as snow.

Statewide severe hail-day statistics show a similar monthly distribution. Out of an average of 37 days per year with large hail, June is the peak month with slightly more than 10 days. July has almost as many hail days. However, if you look at the actual number of hailstorm reports, June is clearly the leader with an average of 46 storms. This means that the number of severe hailstorms per hail day is larger in June than any other month. There have been an average of more than 130 <u>reported</u> severe hailstorms each year since 1986.



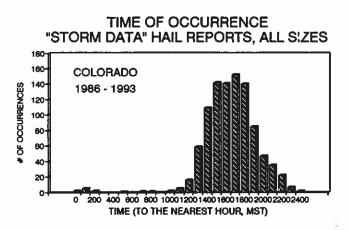


#### TIME OF DAY

Hail is primarily an afternoon or evening phenomenon here in Colorado. 90% of all severe hailstorms reported 1986-1993 occurred between 1:00 p.m. and 9:00 p.m. MST. Previous studies of hail at Fort Collins and in the Denver area, including both large and small hail, showed about 80% of all hail fell during those same hours. The least likely hours for hail in Colorado are between 2:00 a.m. and 10:00 a.m. Less than 2% of the reported severe hailstorms occurred between 11:00 p.m. and 10:00 a.m. with most of those occurring before 2:00 a.m.

There are some variations in the preferred times for hail at different times of the year and in different parts of the State. Nearly all reports of morning (5:00 a.m.-10:00 a.m.) hailstorms have been in April and May with a few in September. Some of these storms, including one in the Denver area on April 25, 1994, have dropped large quantities of hail, but stones are typically small. There is a detectable shift in preferred times of day for hail as you move eastward across Colorado. Most hail (including small stones) in and near the mountains occurs between 11:00 a.m. and 6:00 p.m. Out near the eastern border of Colorado, storms are most likely from 3:00 p.m. to midnight. The large majority of severe hailstorms reported after 9:00 p.m. in Colorado have occurred over the eastern quarter of the State.

					Averag	e Num	ber of	Days w	ith Ha	il				
							Month	L						
Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Period-of-record
Alamosa	0	0	0.1	0.1	0.6	0.8	0.4	0.4	0.3	0.3	0	0	3.0	1984-1993
Cheyenne, WY	0	0	0.1	0.4	2.0	2.5	1.6	1.2	0.6	0.2	-	0	8.6	1892-1993
Colorado Springs	0	0	0.2	0.5	1.2	1.9	0.9	0.9	0.4	0	0	0	5.8	1974-1993
Denver	0	0	0.1	0.2	1.2	1.2	1.0	0.8	0.1	0.1	0.1	0	4.8	1974-1993
Fort Collins	0	0	0.1	0.5	1.4	1.2	0.7	0.5	0.3	0.1	0	0	4.8	1979-1993
Goodland, KS	0	0	0.1	0.3	1.5	1.4	0.8	0.3	0.1	0.1	0	0	4.6	1982-1993
Grand Junction	0	0	0.1	0.1	0.4	0.1	0.1	0.2	0.2	0.1	0.1	0	1.2	1974-1993
Limon	0	••	0.2	0.4	1.6	1.8	1.3	1.3	0.4	0.1	0	0	7.1	1989-1993 Est.
Pueblo	0	0	0.1	0.1	1.1	1.0	0.7	0.7	0.3	0.1	0	0	4.1	1974-1993 (except 1979-83)



# HAILSTORM DURATIONS

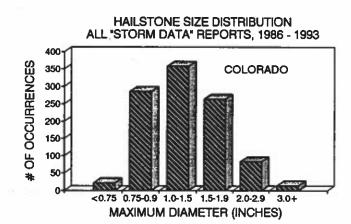
At any given point, hail usually only falls for a few minutes. Hail that continues for more than 15 minutes is unusual. A study of 60 Fort Collins hail events showed the median duration to be 6 minutes. Just over 10% of the storms lasted for more than 20 minutes, but these included most of the severe storms that included large stones. An awesome hailstorm that hit parts of the Denver area on 13 June 1984 dropped stones as large as baseballs for up to 40 minutes straight.

While hail at a given point is usually short-lived, the storm complexes that produce hail may last for for several hours. The 11 July 1990 storm that crossed the Denver area began near Estes Park and continued southward to El Paso County. This system lasted for more than 3 hours and dropped hail for most of that time. Severe thunderstorm systems out on the Eastern Plains have produced severe weather for 6 hours or longer.

# HAILSTONE SIZES

The distribution of hailstone size is of critical importance for evaluating hail damage potential. Crops can be damaged by almost any size of hail. Even pea-sized stones can damage tender crops, especially if propelled by strong winds. Windblown marble-sized hail has been known to effectively strip paint from buildings. To damage vehicles and roofs requires larger stones. The NWS hail criteria for severe thunderstorms equalling or exceeding 3/4" diameter is consistent with the size of stones that begin to be capable of more extensive property damage. Since this study was primarily limited to severe storm reports, most reports are at least 3/4".

If we somehow could count, measure and weigh <u>all</u> the hailstones that fall from the sky, we would surely find that the vast majority of stones that fall here on Colorado are  $1/2^n$  diameter or smaller. Local studies elsewhere in North America have suggested that at least 95% of all hailstones are less than  $1/2^n$  diameter. But just east of the Rockies, the percentage of larger stones appears to increase. Each year, Colorado gets more than its fair share of larger stones as well. The high frequency of larger stone sizes here contributes directly to the excessive property damage that occurs.



The most common size range for damaging hail in Colorado is 1 to 1.5" in diameter. This size range, which includes the classic "golfball" size, accounts for more than 1/3 of the severe hailstorm reports during this study. Slightly more than 1/3 of the storm reports included maximum stone diameters greater than 1.5 inches. These are truly large stones by any definition. Six percent of the reported severe hailstorms had maximum stone diameters of 2.5" of greater. Huge hailstones 3 inches in diameter or greater are not common, but they have been reported in 7 of the last 8 years and probably occur briefly and over limited areas every summer somewhere in eastern Colorado. These stones are commonly classified as "baseball-sized" or larger.

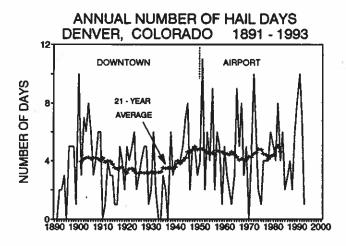
The maximum stone size reported in this study was 4.5 inches. Such stones may fall at speeds of close to 90 miles per hour and can do incredible damage. Not only do these stones dent cars and break windshields, they can penetrate corrogated metal as well as asphalt shingle/plywood roofs. Very few stones ever exceed this size, but the largest documented hailstone anywhere in the U.S. was found in Kansas. It was 5.5 inches in diameter and weighed nearly 2 pounds. (Note to all readers: If you ever become aware of a Colorado hailstone of a comparable size, please contact us immediately. Be ready to provide witnesses and photographic documentation.)

The largest hailstones reported in Colorado have a different monthly distribution than storms in general. Their season is limited to the period from late June through August, and they are most likely in July.

We have also performed a single-station analysis of hail size distribution using all reported hail of any size (see below). Based on hail data collected 1962-1993 at the Colorado State University campus weather station, we found that only 11% of the reported hail events included stones sizes of 3/4 inch or greater. Hail in excess of 1 inch diameter has occurred only twice in the past 32 years. While large hail may be common somewhere within a large area, this suggests that at a point the risk of severely damaging hail may not be quite as great as we think. It may be possible for some of our roofs to grow old naturally.

# MONTHLY AND INTERANNUAL VARIABILITY

One of the big challenges of trying to deal with hail is its variability. An area can go decades without a severe hailstorm and then be hit three years in a row. The graph below gives an indication of year-to-year variations in hail frequencies at a point. More than 100 years of hail observations have been gathered by the National Weather Service in Denver. The annual number of hail days (including stones of any size) has ranged from 0 to 11.



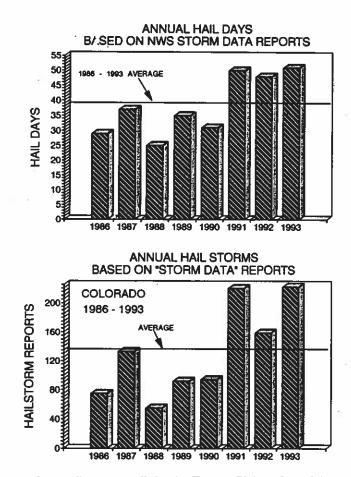
Even over the entire area of Colorado, the number of hailstorms and hail days varies considerably. For example, there were only 25 severe hail days in 1988 compared to 51 in 1993. The number of storms varies even more. There were 55 reported severe hailstorms in 1988 compared to 222 in 1993. Within a given month, the magnitude of variation is greater yet. The number of severe hailstorm reports in June has ranged from 12 to 96 during the past 8 years. If we had more years of data to study, I'm sure the observed variations would be even greater.

The numbers seem to suggest an upward trend in Colorado hailstorms. We predict this trend will continue, but not because hail is actually increasing. Rather, we believe that growing population, more cellular phones and greater awareness will mean that more storms will be reported in the years ahead.

#### SPATIAL DISTRIBUTION

Each of the approximately 1,200 reported severe hailstorms was plotted as a single dot on the map below. This is not a totally appropriate method for displaying hail occurrences. Some storms were only severe in a very small area, but some storms produced long hail swaths. The point method is clearly inadequate for presenting spatial characteristics of hail, but we have no better data sources at this time.

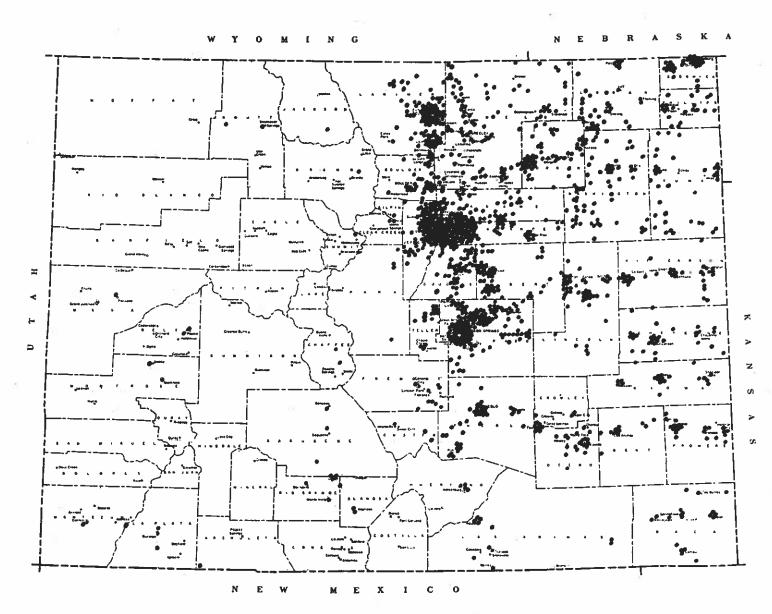
Two features of Colorado hail are evident here. 1) Severe hail is not a problem statewide. Rather it is clearly limited to eastern Colorado beginning in the eastern foothills



and extending across all the the Eastern Plains. Out of the more than 1,200 severe hail reports statewide in the past 8 years, only about 50 were in the mountains or on the Western Slope. Of these western Colorado hailstorms, few produced significant property damage and only a handful included stone diameters in excess of 1 inch. 2) Local details of storm concentrations east of the mountains are probably (and unfortunately) not realistic. Using the type of data available to us, hail patterns are strongly influenced by population density. The more people and personal property there are, the more severe hail reports we receive. Not only do towns and cities show up clearly on the map, so do highways. U.S. Highway 24 from Colorado Springs to Limon shows up clearly on the map even though few people live along that road.

To try to more accurately define the distribution of damaging hail in Colorado, the number of severe hailstorms per county were mapped. These values were then divided by the population (1990 Census) and expressed as hailstorms per 1,000 people. This paints quite a different picture of the spatial distribution of Colorado hail. While El Paso and Weld Counties were the leaders in reported storms, the greatest frequency of per capita severe hail occurs in eastern Colorado near the Kansas and Nebraska borders. But this, too, may be misleading.

Meteorological evidence (radar, satellite, historic weather observations) points to the Palmer Ridge (high ground between Denver and Colorado Springs that extends



eastward beyond Limon) and the Cheyenne Ridge (high ground that extends eastward along the Colorado-Wyoming-Nebraska borders) as the most hail-prone regions of Colorado. Our study does not show these areas to be unusually stormy with respect to adjacent areas. However, except for U.S. Highway 24, these areas have little population, little transportation, and not much agriculture. Our experience with hail reporting also suggests that where people are most accustomed to hail, they are likely to only report extremely severe storms, so it remains very possible that these areas are indeed more hail prone.

Results of mapping hail, although somewhat dissappointing, still contain helpful information. For example, there appears to be a distinctly lower hail risk in Boulder and Longmont than in other Front Range cities. Also, despite relatively dense population and intense agricultural activities along the South Platte River from Denver north to Greeley, the number of hail reports there are relatively low. By comparison, the Lafayette area east of Boulder has had many hail reports. A relatively large number of severe hailstorms have also been reported north of Greeley along U.S. Highway 85. The Wiggins area along with Sedgwick-Julesburg have been especially active during the 1986-93 period.

There is considerable anecdotal evidence of preferred "hail paths" in eastern Colorado and along the Front Range. This might very well be true. At this point, we do not have the enough information to prove it one way or the other. Even when the results of the 1973-1985 study are combined, consistent patterns do not emerge.

## **MEMORABLE HAILSTORMS**

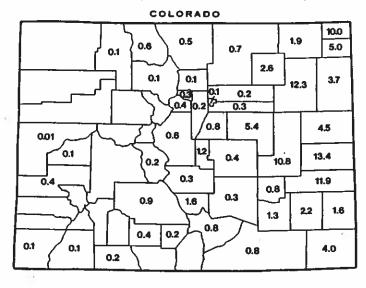
The storms we remember most are the storms that get the most attention in the media. Many of Colorado's largest hailstorms plaster the Eastern Plains, flatten wheat fields, bruise cattle but pass unnoticed by most of us. I will list a few dates, locations and impacts of some relatively recent storms below, but there are many other storms that could just as easily be mentioned.

Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

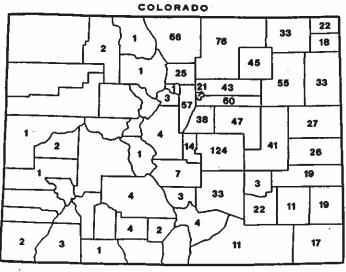
89

Memorable Colorado Hailstorms					
Date	Location	Remarks			
7/30/1979	Fort Collins	3-4" diameter stones, baby killed.			
6/4/1983	Greeley	Millions in damage.			
6/13/1984	NW-W Denver	1-3" inch stones, long duration, \$200 M damage.			
8/2/1986	Front Range	Widespread damage, Fort Collins to Denver.			
6/23/1987	Pueblo/La Junta	1-4" hail, \$70 M damage.			
7/11/1990	Denver area	\$625 M property damage.			

# 1986-93 County Hail Reports per 1,000 People



# 1986-93 Number of Hail Storms per County (multiple reports removed)



# WHY COLORADO?

There are some very good reasons why Colorado and similar locations just east of the tall Rocky Mountain barrier are so prone to hail. Contrasting dry continental air masses and humid subtropical air from the Gulf of Mexico often clash just east of the Rockies in late spring and summer. This is a key ingredient for severe thunderstorm development. The nearby mountains serve as preferred initiation points for thunderstorm formation.

The high elevations of the western Great Plains also enhances hail potential in two ways. First, the high ground warms quickly under the intense western sunshine and provides an elevated heat source that intensifies convective updrafts. The greater the vertical speed of air within a cloud, the greater the hail potential. The cumulonimbus clouds (thunderheads) associated with Colorado's severe hailstorms frequently climb to heights of 45,000 feet or more above ground. Secondly, the high elevation means that hail does not have as far to travel to reach the ground. Thus, the chances of it melting are reduced. This is further supported by the dry air that typically lies just west of the Great Plains storms. Precipitation evaporating into the nearby dry air cools the air further, increases downdrafts and increases the likelihood that the hail will hit the ground before it melts. Many spring and summer thunderstorms across the eastern and southern U.S. also contain hail, but that hail usually melts before it reaches the ground.

# **FUTURE WORK**

We know a lot about seasonal distributions, time of day, duration and stone size distributions for Colorado hailstorms. Additional data may not result in much new information. What is clearly needed, is better definition of spatial patterns. Some of this may be accomplished using improved radar technology to remotely sense hailstorms. It may be difficult to separate storms based on maximum stone size, but radar identification of hail shafts is often possible. A more systematic method for ground detection of hail would also help. Networks of passive hail detectors (foil-covered styrofoam pads) have proven extremely useful in analyzing hail patterns in other parts of the country.

Better knowledge of year-to-year variability in hail frequency and severity is also needed. By associating past occurrences of hail with larger scale atmospheric processes, same long-range predictability of hail frequencies might be realized.

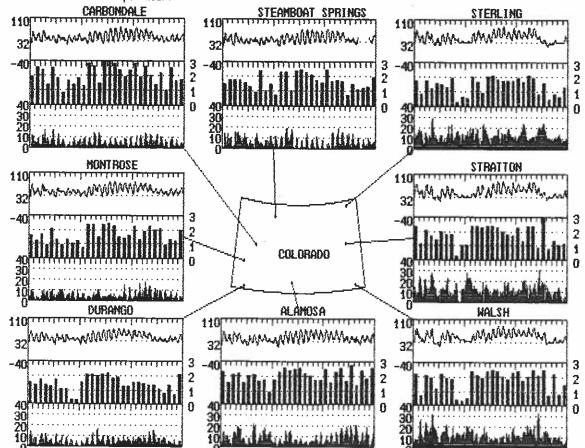
Many other graphs and data summaries were developed during the course of this research which cannot be shown in the compressed report. If you have more detailed questions or additional information about Colorado hail, please contact the Colorado Climate Center.

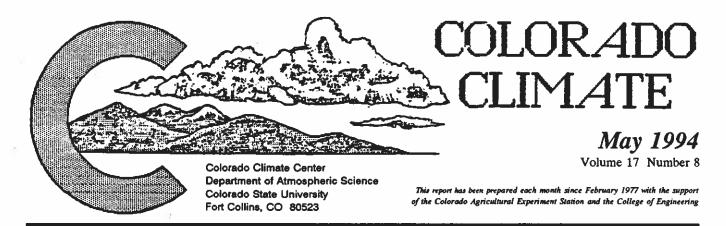
Note to Readers: We far exceeded our editorial page limit for this feature on hail, but we thought it best not to break this topic into sections. We will return to our feature on Drought in the months ahead.

			WTHRNET	WEATHER DATA	APRIL 1994			
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
<pre>monthly</pre>	average tempe 42.8	rature ( 'F ) 42.5	44.1	47,4	40.7	46.9	46.8	50.7
monthly maximum minimum		5 71.6 18/)	15 78.4 21/3	15 77.5 21/15	5 74.8 21/16	86.5 18/13 19.0 27/ 4		86.2 17/15 17.8 6/3
monthly 5 AN 11 AM 2 PM 5 PM 11 PM	average relat 82 / 26 43 / 33 31 / 31 33 / 30 62 / 29	ive humidity . 80 / 28 53 / 35 45 / 35 40 / 33 70 / 31	/ dewpoint ( pr 85 / 28 43 / 32 31 / 31 35 / 30 62 / 30	ercent / *F ) 69 / 29 44 / 36 35 / 35 34 / 34 57 / 31	94 / 27 51 / 34 45 / 34 -42-/ 33 76 / 31	69 / 29 42 / 33 36 / 33 36 / 31 54 / 29	37 / 17 24 / 25 20 / 25 20 / 24 32 / 20	73 / 33 47 / 38 40 / 38 40 / 38 66 / 36
monthly day day day	average wind ( 201 164	direction { ( 185 91	legrees clockwi 236 183	ise from north ) 224 147	215 138	179 185	157 173	183 202
	2 412 105			4.09 ourly average mp 308 381 19 0	3.89 bh range ) 371 261 44 0	10.20 24 469 220 3	10.21 62 421 213 12	10,33 20 463 223 14
monthly	average daily 2009	total insolat 1423	ion ( Btu/ft²) 2068	day ) 1639	1640	1385	1732	1749
"clearne 60-80% 40-60% 20-40% 0-20%	955" distribut: 136 56 61 26	ion { hours pe 117 86 110 75	r month in spe 69 76 64 33	citied clearnes 105 101 102 44	5 index range 121 77 79 49	122 82 71 95	154 78 73 42	165 63 49 64

The State-Wide Picture

The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



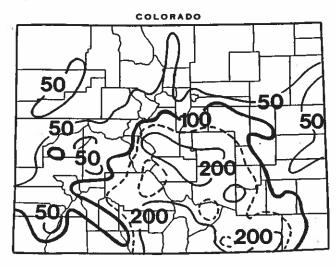


## May Climate in Perspective - Warm and Fairly Dry

A few significant storms took aim on Colorado in May. Most locations heard thunder on 5 to 10 days during the month but many storms produced little moisture. Humidity was fairly low for May, and significant rains were limited to south-central Colorado. Warmer than average temperatures persisted most of the month statewide, and several daily record highs were broken May 30. A week of very windy weather mid-month contributed to greater than normal evaporation rates.

#### Precipitation

Seven storm systems crossed Colorado in May. Low pressure lingered much of the month south of Colorado and kept weather conditions threatening. Despite many

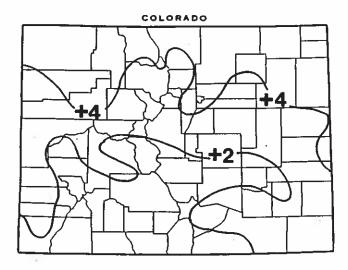


May 1994 precipitation as a percent of the 1961-1990 average.

opportunities, most precipitation totals were light. Fort Collins had 9 days with measurable precipitation but still ended up with just 38% of the normal May rainfall. Most of the northern half of the State got less than 50% of average. Warmer than average temperatures also meant that most precipitation fell as rain even at high elevations. The Mount Evans Research Center reported 6 inches of snowfall compared to an average of nearly 30 inches. It was a different story in south-central Colorado. More than 200% of the average May precipitation fell, and heavy snows fell in the Pikes Peak region.

# Temperatures

Warmer than average temperatures were the rule across all of Colorado in May. There were only a handful of cooler than average days scattered throughout the month. Temperatures for the month as a whole ended up 1 to 3 degrees F above average across the southern half of Colorado. The northwest quarter of the State was about 4 degrees above average. The warmest region, compared to average, was northeast Colorado. Denver and Sterling, for example, each ended up 6 degrees above average.



Departure of May 1994 temperatures from the 1961-90 averages.

Inside This Issue					
May 1994 Daily Weather	1994 Water Year Precipitation				
May 1994 Temperature Comparison	Comparative Heating Degree Day Data				
May 1994 Precipitation	May 1994 Climate Data				
May 1994 Precipitation Comparison	JCEM WTHRNET May 1994 Data 101				

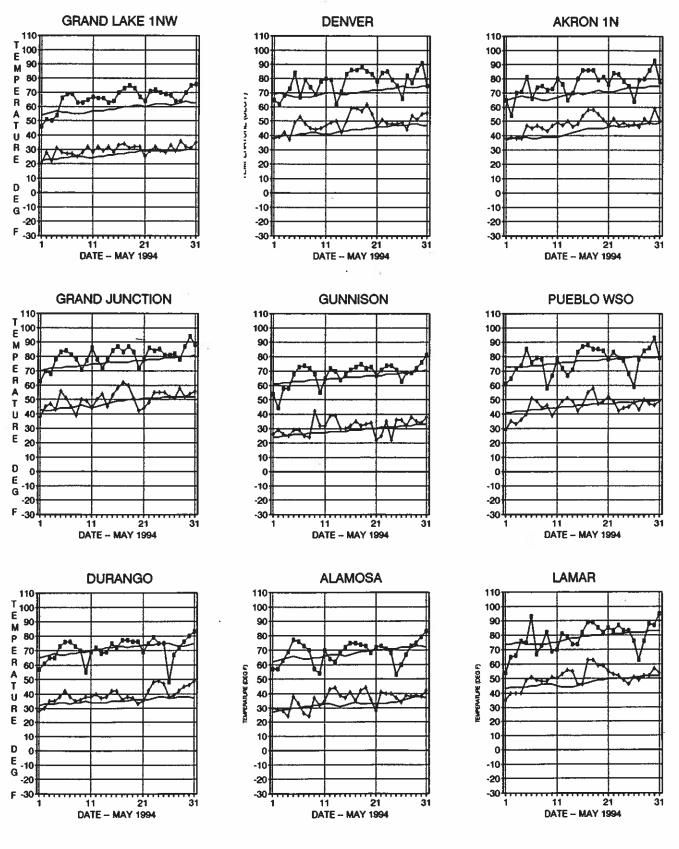
- 1-3 A lingering low pressure trough aloft brought the coolest weather of the month to much of Colorado. Climax recorded 8° on the 1st and 6° on the 2nd, the coldest readings of the month. Some low elevation areas had their last spring frost. Morning fog was common, and thundershowers popped up each afternoon. Some hail fell, and some light mountain snow was reported, but most precipitation totals were light. Eagle reported 0.27" on the 2nd.
- 4-5 A ridge of high pressure brought drier and very warm weather to Colorado. Denver hit 84°F on the 5th, and Lamar reached 93°F. Widely scattered late-day thundershowers were reported but with little rain.
- 6-9 The warm, dry weather continued over western Colorado, but much cooler, damper air pushed across the Eastern Plains and spawned a few strong thunderstorms. Hail fell at Colorado Springs on the 6th. Then a large storm system approached from the west on the 7th. A large thunderstorm complex erupted along the Front Range that evening with awesome lightning, very strong winds but not much rain. The upper level storm system then slowed on the 8th. While northern Colorado enjoyed a lovely day on the 9th, rains, mountain snows and local thunderstorms spread northward from New Mexico as far north as Denver and Limon. Precipitation totals across southern Colorado were impressive ranging from 0.71" at Alamosa to around 3.00" near Pikes Peak. Ruxton Park weather station added 18" of new, wet snow.
- 10-12 Skies cleared over much of Colorado in time for the solar eclipse on the 10th. The Sargents weather observer (east of Gunnison) recorded an amazing drop of 18° during the eclipse. Most of Colorado then enjoyed warm, dry weather 10-12th, but remnants of the upper level storm remained over New Mexico and continued to pump moisture into southern Colorado. There were some showers on the 10th, and Durango received 0.49" late on the 11th. A few big storms shot up late on the 12th mostly east of the mountains. Akron got 0.71" of moisture.
- 13-14 A Pacific cold front crossed Colorado and combined with the disturbance over New Mexico to trigger showers over much of the State and some mountain snow. Fort Collins got 0.62", while 1.04" fell at Joes. Skies cleared on the 14th leaving seasonal temperatures and brisk northerly winds.

- 15-21 A deep trough of low pressure stalled west of Colorado producing strong southwesterly winds aloft. Unseasonably warm and very windy weather resulted with high evaporation rates. Wind gusts reached 47 mph at Grand Junction on the 16th and 52 mph at Denver on the 19th. Some thunderstorms developed each day but produced little rain. The Limon area was an exception – receiving more than 0.50" late on the 18th. Cooler than normal temperatures returned briefly on the 20th as a portion of the storm system finally advanced eastward. Winds finally abated on the 21st, much to the relief of farmers and ranchers.
- 22-23 Above average temperatures prevailed again. Durango hit 79° on the 22nd. A few thundershowers developed but failed to produce much rain.
- 24-27 Colorado rested between a warm high pressure ridge to the north and a nearly stationary upper level low pressure system to the south. A weak cold front crossed Colorado on the 24th bringing some noisy thundershowers with some hail. Rains increased on the 25th as a surge of moisture moved up from the south. Thunderstorms became numerous except over northwest Colorado. Precipitation of 0.50" or more became widespread over southern and eastern Colorado and continued into the 26th. Limon and Colorado Springs each totalled more than 1.00", and 1.61" fell near Kim. The 26th was one of just a handful of cooler than normal days as highs only reached into the 50s and 60s. Morning fog and low clouds on the 27th gave way to warm and dry weather again with just a few light thundershowers.
- 28-30 A surprisingly strong upper level disturbance crossed northern Colorado on the 28th kicking up winds and thundershowers. Some hail fell in southeast Colorado. Then dryer, warmer weather moved in 29-30. Descending westerly winds helped elevate temperatures to near record levels on the 30th. Grand Junction reached 94°F, but the 100° reading at Julesburg was the warmest in the State this May.
- 31 Cool, moist air pushed down from the north, while an upper disturbance moved up out of Arizona. Scattered but vigorous thunderstorms erupted late, especially over northeast Colorado. Fort Collins reported 0.45" in a short time.

Weather Extremes								
Highest Temperature	100°F	May 30	Julesburg					
Lowest Temperature	6°F	May 2	Climax					
Greatest Total Precipitation	6.44"	-	Ruxton Park					
Least Total Precipitation	0.09"		Grand Junction 6ESE					
Greatest Total Snowfall	34"		Ruxton Park					
Greatest Snow Depth	49"	May 1	Climax					

# **MAY 1994 TEMPERATURE COMPARISON**

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)

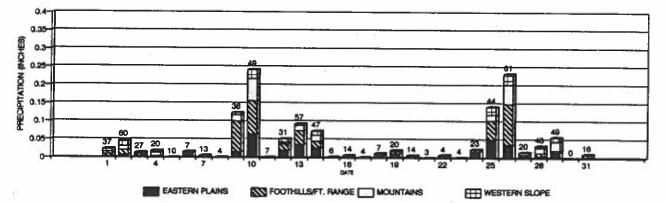


# MAY 1994 PRECIPITATION

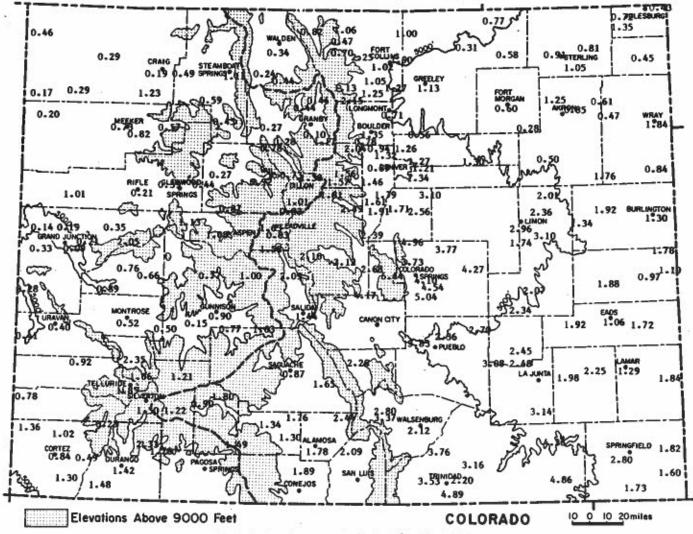
There were many days with precipitation in May, but widespread heavy storms were few and were limited to southern Colorado. The heaviest precipitation fell May 9-10th, 12-13th and 24-26th. The statewide average precipitation May 9-10 was 0.36", but near Colorado Springs

and along the southern Front Range many locations exceeded 2.00<sup>n</sup>. The storm May 24-26 affected the same areas but was not as intense. Statewide precipitation for the month as a whole was 1.24<sup>n</sup>, which was somewhat less than average.

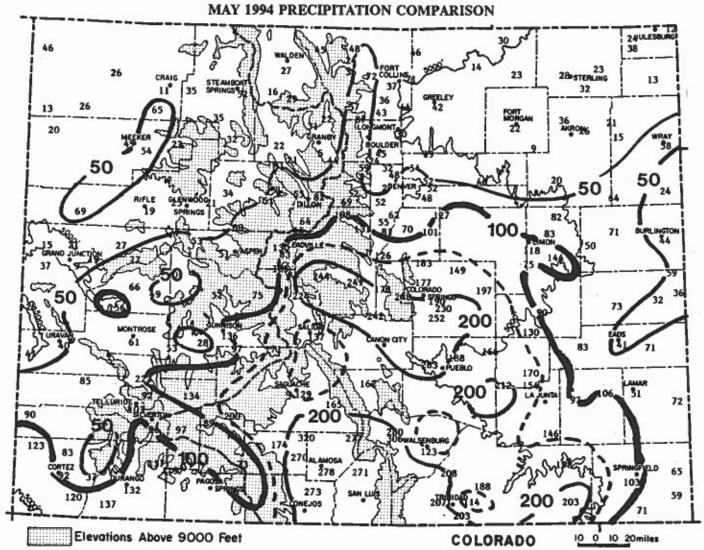
# COLORADO DAILY PRECIPITATION - MAY 1994



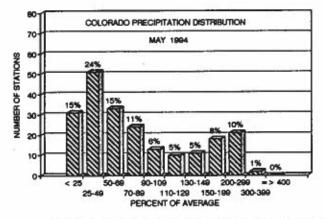
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



Precipitation Amounts (in inches) for May 1994.



May 1994 Precipitation as a Percent of the 1961-90 average.



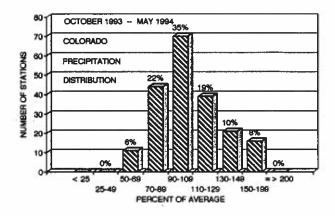
May precipitation ranged from less than 25% of average over portions of northern Colorado to more than 200% of average across south-central Colorado. Most locations were either very wet or very dry. 39% of Colorado's weather stations reported less than half of average while 19% of the stations received at least 150% of average.

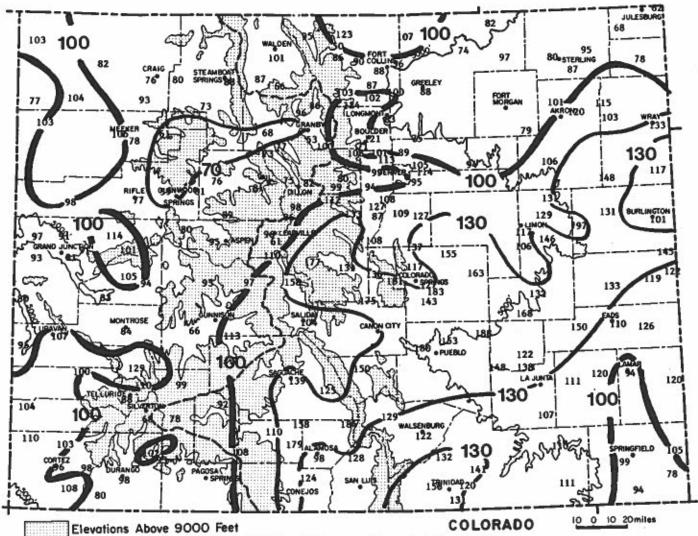
#### MAY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	1.27"	29th driest in 123 years of record (driest = 0.06" in 1974)
Durango	1.42"	33rd wettest in 100 years of record (wettest = 3.72" in 1947)
Grand Junction	0.19"	14th driest in 103 years of record (driest $< 0.01$ " in 1940 and 1970)
Las Animas	1.98"	56th wettest in 129 years (wettest = $5.63^{\circ}$ in 1944)
Pueblo	2.36"	24th wettest in 126 years of record (wettest = 5.43" in 1957)
Steamboat Springs	1.11"	12th driest in 88 years of record (driest = 0.07" in 1948)

# **1994 WATER YEAR PRECIPITATION**

Drier than average conditions for the 1994 water year spread across northern and western Colorado as a result of dry May weather. Much of the South Platte watershed north and east of Denver is now drier than normal for this time of year. After the beneficial moisture from April, dry conditions expanded again over the Northern and Central Mountains and many western valleys. Glenwood Springs has only measured 59% of their normal October through May precipitation. Most mountain areas now stand at 80-95% of average. Moisture conditions are much better over southcentral Colorado and much of the southeastern plains. Accumulated precipitation since October 1, 1993 stands at 158% of average at Buena Vista, and Center, 156% of average at Trinidad Lake, 153% of average at Pueblo and 150% of average at Haswell. Predominantly warmer than average temperatures have resulted in earlier mountain snowmelt than average and increased evapotranspiration rates. Dry Mays often result in a reduction in available summer water supplies compared to earlier projections.







**COMPARATIVE HEATING DEGREE DAY DATA FOR MAY 1994** 

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IMATE CENTER (303)	FEB MAR APR MAY JUN	1180 1014 717 453 174 1280 858 882 435 185 1179 820 880 387	1162 1116 798 524 262 1116 1116 798 524 262 11167 1039 901 557 363 11172 979 771 443	815 744 474 205 50 856 697 514 203 91 896 651 514 148	1047 902 729 477 197 1000 907 735 446 232 1124 802 702 415	946 859 519 254 34 1103 773 531 219 54 1068 654 489 144	756 665 406 182 41 825 666 482 199 55 829 609 466 M	824 850 558 302 87 901 778 558 206 84 826 749 578 223	e5e e53 504 322 B1 800 760 578 262 106 1038 805 528 272	1183 1004 687 419 183 1270 976 765 304 203 1237 637 621 295	004 719 435 106 38 733 049 409 161 52 1010 758 533 238	865 806 504 253 71 862 686 489 195 71 879 616 485 104	1355 1321 1008 747 459 1273 1220 1011 660 480 1307 1152 825 630	962 853 564 363 127 966 768 569 302 138 1057 986 561 300	1106 858 875 422 164 1116 864 641 352 169 1080 778 638 330	1033 1011 741 512 234 1083 879 722 479 226 1028 859 710 343	913 826 525 272 77 1001 706 519 200 83 804 669 483 141	963 531 492 222 41 1202 769 509 156 64 1108 704 550 126	EG4 6/70 396 132 13 5548 796 597 448 144 33 5403 ES3 540 360 66 4863
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	DEC JAN FEB MAR APR MAY JUN	1473 1556 1150 1014 717 453 174 1786 174 1796 1537 1260 656 652 435 185 1455 1455 1412 1179 650 669 367	1339 1378 1182 1116 788 524 282 282 185 11458 1325 1197 1038 801 557 383 1151 1351 1351 1351 1351 1351 1351	973 1004 815 744 474 235 53 1003 1130 859 807 514 233 91 905 905 809 651 514 148	1243 1256 1047 942 729 477 197 1302 1211 1060 907 735 448 222 1206 1172 1124 882 762 415	1132 1175 948 859 519 254 34 1301 1331 1103 773 531 219 68 978 1000 1008 654 489 144	14         0.01         40.05         6.03         7.54         6.00         6.00         7.00          7.00 <th< td=""><td>1001 1122 024 850 556 302 67 1101 1179 901 776 558 302 64 1008 1022 626 748 578 223</td><td>13         12.37         95.48         55.3         56.4         55.1         10.52         2.72         2.72         10.51<!--</td--><td>1342 1476 1160 1004 667 419 160 1455 1408 1270 976 765 364 203 1306 1317 1237 637 821 280</td><td>1126 1221 008 719 435 106 39 1182 987 783 649 469 161 52 1245 1231 1010 756 533 238</td><td>1054 1094 885 806 504 253 71 1219 1162 892 686 489 185 71 846 846 879 616 465 104</td><td>1504 1567 1355 1321 1008 747 459 1480 1435 1273 1220 1011 663 480 1484 1488 1307 1152 825 630</td><td>1172 1246 962 853 564 363 127 1319 1152 906 768 569 302 136 1169 1004 1057 985 561 300</td><td>1376 1435 1105 856 675 422 164 1366 1387 1118 864 541 352 169 M 1256 1060 776 639 330</td><td>1184 1218 1038 1011 741 512 234 1200 1177 1083 879 722 479 228 1086 1079 1028 659 710 343</td><td>1113 1156 913 826 525 272 77 1222 1239 1001 706 519 209 83 1003 965 994 609 483 141</td><td>1197 1277 963 831 482 222 41 1472 1494 1202 769 509 156 64 1472 1494 1202 769 500 156 64 1472 1496 744 550 126</td><td>1125 12-40 654 670 389 132 13 5548 1245 1018 799 597 446 144 33 5403 1102 1025 853 340 360 69 4968</td></td></th<>	1001 1122 024 850 556 302 67 1101 1179 901 776 558 302 64 1008 1022 626 748 578 223	13         12.37         95.48         55.3         56.4         55.1         10.52         2.72         2.72         10.51 </td <td>1342 1476 1160 1004 667 419 160 1455 1408 1270 976 765 364 203 1306 1317 1237 637 821 280</td> <td>1126 1221 008 719 435 106 39 1182 987 783 649 469 161 52 1245 1231 1010 756 533 238</td> <td>1054 1094 885 806 504 253 71 1219 1162 892 686 489 185 71 846 846 879 616 465 104</td> <td>1504 1567 1355 1321 1008 747 459 1480 1435 1273 1220 1011 663 480 1484 1488 1307 1152 825 630</td> <td>1172 1246 962 853 564 363 127 1319 1152 906 768 569 302 136 1169 1004 1057 985 561 300</td> <td>1376 1435 1105 856 675 422 164 1366 1387 1118 864 541 352 169 M 1256 1060 776 639 330</td> <td>1184 1218 1038 1011 741 512 234 1200 1177 1083 879 722 479 228 1086 1079 1028 659 710 343</td> <td>1113 1156 913 826 525 272 77 1222 1239 1001 706 519 209 83 1003 965 994 609 483 141</td> <td>1197 1277 963 831 482 222 41 1472 1494 1202 769 509 156 64 1472 1494 1202 769 500 156 64 1472 1496 744 550 126</td> <td>1125 12-40 654 670 389 132 13 5548 1245 1018 799 597 446 144 33 5403 1102 1025 853 340 360 69 4968</td>	1342 1476 1160 1004 667 419 160 1455 1408 1270 976 765 364 203 1306 1317 1237 637 821 280	1126 1221 008 719 435 106 39 1182 987 783 649 469 161 52 1245 1231 1010 756 533 238	1054 1094 885 806 504 253 71 1219 1162 892 686 489 185 71 846 846 879 616 465 104	1504 1567 1355 1321 1008 747 459 1480 1435 1273 1220 1011 663 480 1484 1488 1307 1152 825 630	1172 1246 962 853 564 363 127 1319 1152 906 768 569 302 136 1169 1004 1057 985 561 300	1376 1435 1105 856 675 422 164 1366 1387 1118 864 541 352 169 M 1256 1060 776 639 330	1184 1218 1038 1011 741 512 234 1200 1177 1083 879 722 479 228 1086 1079 1028 659 710 343	1113 1156 913 826 525 272 77 1222 1239 1001 706 519 209 83 1003 965 994 609 483 141	1197 1277 963 831 482 222 41 1472 1494 1202 769 509 156 64 1472 1494 1202 769 500 156 64 1472 1496 744 550 126	1125 12-40 654 670 389 132 13 5548 1245 1018 799 597 446 144 33 5403 1102 1025 853 340 360 69 4968
IMATE CENTER (303)	NOV DEC JAN FEB MAR APR MAY JUN	1053 1473 1559 1369 1014 717 453 174 1281 1281 1281 1281 1396 1637 1280 658 662 435 185 1167 1435 1412 1179 620 669 367	1026 1330 1376 1162 1116 788 524 262 263 263 263 1272 1438 1325 1197 1038 601 537 363 1108 1361 1280 1172 978 771 443	726 973 1004 815 744 474 235 53 1021 1020 1120 056 607 514 233 91 61 635 615 605 656 651 514 146	000         1243         1256         1047         002         729         417         187           1116         1302         1211         1003         007         735         446         222           1070         1206         1172         1124         882         745         415	822 1132 1175 948 859 519 254 34 828 1301 1331 1103 773 531 219 68 853 978 1090 1098 654 489 144	045         906         633         756         668         406         183         41           082         976         1004         835         668         406         183         41           082         976         1004         835         668         406         180         55           016         846         629         620         486         190         55	016         1031         1122         024         656         556         302         67           900         1101         1179         901         776         558         206         64           972         1006         1022         626         749         5716         223	628 1163 1237 958 653 564 322 81 965 1276 1051 960 760 578 282 106 826 1148 1066 1036 965 528 272	C01 011 700 1401 0411 0711 0711 040 C01 011 040 040 040 040 040 040 040 040 0	774         1128         1221         888         719         435         186         39           918         1182         967         753         649         469         181         52           1062         1245         1271         1010         758         533         238	780 1054 1094 885 806 504 253 71 226 1219 1162 882 888 488 185 71 200 848 846 879 618 485 104	1200 1504 1567 1355 1321 1008 747 459 1346 1480 1435 1273 1220 1011 683 480 1281 1484 1488 1307 1152 625 630	846         1172         1246         962         853         564         363         127           646         1319         1152         846         785         569         302         126           646         1316         1152         846         765         569         302         126           646         1164         1057         846         765         509         302         136	901 1376 1435 1106 959 673 422 164 1140 1308 1387 1118 864 641 332 169 1116 M 1258 1000 778 639 330	945 1184 1218 1039 1011 741 512 234 1074 1200 1177 1083 879 722 479 238 1011 1086 1079 1029 659 710 343	825 1113 1156 913 826 525 272 77 940 1222 1239 1031 706 519 209 83 944 1003 985 984 669 433 141	B40 1197 1277 963 631 482 222 41 627 1472 1404 1202 768 509 156 64 10006 M M 1198 704 550 126	736 1125 1240 864 6/0 386 122 13 5548 868 1245 1018 790 587 448 144 33 5403 8/3 1102 1025 853 540 360 66 4663
IMATE CENTER (303)	OCT NOV DEC JAN FEB MAR APR MAY JUN	067         1053         1473         1556         1183         1014         717         450         174           067         1281         1786         1637         1260         556         656         652         435         185           735         1167         1435         1412         1179         600         656         662         435         185	651 1020 1330 1376 1162 1116 788 524 262 563 1272 1436 1325 1187 1038 601 557 363 177 144 7716 1168 1351 1260 1172 978 771 445	387         726         973         1004         815         744         474         235         53           337         821         1006         815         744         474         235         53           337         821         1006         815         814         233         91           508         873         905         905         908         651         144         148	620         960         1243         1256         1047         962         729         477         187           536         1118         1302         1211         1083         907         735         446         222           536         1118         1302         1211         1083         907         735         446         222           687         1070         1206         1172         1124         882         742         415	422 822 1132 1175 948 859 519 254 34 372 828 1301 1331 1103 773 531 219 88 450 853 978 1080 1089 854 489 144	325 645 866 633 756 869 406 183 41 306 882 978 1064 885 668 482 196 55 435 818 864 889 829 609 488 M	468 616 1091 1122 824 659 556 302 67 353 990 1101 1179 991 776 559 296 64 519 972 1006 1022 829 749 576 223	474 826 1163 1237 658 653 564 322 81 373 865 1276 1051 860 760 578 262 106 506 825 1148 1066 1038 865 528 272	C61         018         780         9001         C611         6714         1.942         600         60	403 774 1126 1221 048 719 435 166 30 301 919 1192 067 783 049 459 181 52 306 1052 1245 1231 1010 758 533 238	428 780 1054 1094 885 808 504 253 71 346 826 1219 1162 882 888 489 185 71 488 800 848 848 879 518 455 104	656         1200         1567         1355         1251         1008         747         456           744         1346         1480         1435         1273         1220         1011         660         480           868         1294         1480         1435         1273         1220         1011         660         480           808         1294         1480         1430         1452         650         650	512 846 1172 1246 952 553 564 363 127 371 868 1319 1152 966 763 569 302 136 522 968 1169 1064 1057 665 561 300	617 961 1375 1435 1105 569 675 422 164 500 1140 1386 1387 1115 664 541 332 169 600 1116 M (256 1060 779 639 330	651 945 1194 1218 1038 1011 741 512 234 540 1074 1200 1177 1083 679 722 479 226 586 1011 1086 1079 1029 659 710 343	471 8c5 1113 1156 913 826 525 272 77 37 940 1222 1239 1031 706 519 209 83 533 944 1003 985 984 999 443 141	445 840 1197 1277 963 531 492 222 41 0 352 807 1472 1464 1202 766 569 156 64 1 495 1006 M M 1196 704 550 126	1125 12-40 654 670 389 132 13 5548 1245 1018 799 597 446 144 33 5403 1102 1025 853 340 360 69 4968
COLORADO CLIMATE CENTER (303)	SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	306         667         1053         1473         1554         1103         1104         717         453         174           206         607         1281         1706         1637         1280         646         652         435         185           312         735         1167         4435         1412         1179         820         646         682         435         185	348 651 1029 1378 1378 1162 1116 738 524 262 061 061 1272 1438 1325 1187 1039 001 557 363 1467 1272 1187 1039 001 557 363 145	136         387         726         973         1004         815         7.4         474         235         55           71         337         121         1003         1130         56         667         514         233         91           702         506         673         905         696         651         514         144	318         620         040         1243         1256         1047         982         729         477         187           305         536         1116         1302         1211         1080         907         735         445         222           307         687         1071         1204         112         1124         882         745         415	136         432         822         1132         1175         948         856         519         254         34           74         372         826         1301         1310         1100         773         531         218         68	81         325         645         806         533         756         665         403         41           73         305         802         976         1004         805         606         53         756           73         305         802         976         1004         805         606         402         160         55           153         435         616         806         823         606         405         40         55	164         468         610         1001         1122         824         856         556         302         67           01         363         360         1001         1179         301         76         556         200         61           212         519         372         1006         1002         828         746         576         201         64	146         474         828         1163         1237         968         853         864         322         81           122         373         965         1276         1051         960         760         578         282         106           125         506         820         1148         1066         1038         969         578         282         106           165         506         820         1148         1066         1038         969         578         272         106	C61         614         714         7601         1601         1611         4741         2441         906         800         72           C61         614         714         702         1041         714         1041         2141	125 403 774 1126 1221 048 719 435 166 30 71 301 919 1182 047 753 649 469 161 52 232 548 1062 1245 1231 1010 736 533 238	144         429         780         1064         885         806         504         253         71           58         346         826         1084         805         606         489         185         71           58         346         826         1162         802         688         489         185         71           152         438         800         646         879         616         455         104	555         656         1200         1504         1355         1321         1008         747         456           525         744         1346         1480         1355         1220         1011         660         480           579         966         1284         1464         1466         1307         1152         625         630	203         512         846         1172         1246         662         853         564         863         127           136         371         868         1316         1152         866         788         560         302         136           136         1316         1152         866         788         560         302         136           201         522         868         1064         1064         1065         663         501         300	901 1376 1435 1106 959 673 422 164 1140 1308 1387 1118 864 641 332 169 1116 M 1258 1000 778 639 330	348         651         945         1104         1216         1003         1011         741         512         234           238         540         1074         1200         1177         1063         879         722         479         226           347         965         1011         1046         1079         1020         659         710         343	825 1113 1156 913 826 525 272 77 940 1222 1239 1031 706 519 209 83 944 1003 985 984 669 433 141	B40 1197 1277 963 631 482 222 41 627 1472 1404 1202 768 509 156 64 10006 M M 1198 704 550 126	332 738 1125 1240 854 870 389 132 13 5548 222 888 1245 1018 798 597 446 144 33 5403 410 873 1102 1025 853 540 380 68 4868
COLORADO CLIMATE CENTER (303)	AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	86         306         667         1053         1473         1556         1833         1014         717         453         174           131         286         607         1281         1796         1637         1280         666         662         453         156           116         342         736         1637         1379         600         668         662         435         165	150 348 651 1026 1330 1376 1162 1116 788 524 262 268 361 663 1272 14.98 1325 1197 1039 601 557 363 1228 1127 117 443 771 443	387         726         973         1004         815         744         474         235         53           337         821         1006         815         744         474         235         53           337         821         1006         815         814         233         91           508         873         905         905         908         651         144         148	111         318         620         960         1243         1256         1047         962         729         477         187           148         305         538         1118         1302         2211         1080         807         735         448         222           148         305         538         1118         1302         1211         1080         807         735         448         222           144         357         667         1070         1206         112         1124         882         745         415	136         432         822         1132         1175         948         856         519         254         34           74         372         826         1301         1310         1100         773         531         218         68	11         91         325         945         896         633         756         686         406         183         41           20         73         305         842         976         1064         835         666         433         41           20         73         305         842         976         1064         835         666         432         190         55           22         153         435         616         804         8056         820         600         55	10 104 409 016 1001 1122 024 050 556 302 07 53 01 353 900 1101 1179 901 776 556 302 04 40 212 519 972 1008 1032 029 749 576 223	11 146 474 828 1163 1237 958 853 954 322 8 42 122 333 965 1278 1051 960 760 578 282 106 14 165 506 826 1148 1066 1038 963 528 272	58         275         608         906         1472         1479         1604         607         419         403           64         234         486         1356         1455         1406         1270         207         205         204         203           64         289         1406         1350         1455         1400         1270         207         205         204         203           60         289         619         1106         1306         1317         1237         621         280	403 774 1126 1221 048 719 435 166 30 301 919 1192 067 783 049 459 181 52 306 1052 1245 1231 1010 758 533 238	0 144 429 780 1064 1094 885 806 504 253 71 35 54 344 226 129 1162 802 898 439 195 71 20 152 438 000 848 946 879 616 495 104	341         555         856         1203         1564         1561         1355         1221         1006         747         456           381         525         744         1346         1480         1435         1323         1220         1011         663         480           350         579         868         1284         1484         1486         1486         500         480	512 846 1172 1246 952 553 564 363 127 371 868 1319 1152 966 763 569 302 136 522 968 1169 1064 1057 665 561 300	275         617         801         1376         1435         1106         856         673         422         164           206         500         1140         1366         1347         1118         864         641         352         169           277         600         1116         M         1254         1060         776         630         300	122 349 651 945 1184 1216 1039 1011 741 512 234 167 238 540 1074 1200 1177 1083 879 722 479 238 140 347 685 1011 1086 1079 1029 659 710 343	176 471 825 1113 1156 813 826 525 272 77 8 377 940 1222 1236 1031 706 519 209 83 207 537 944 1003 885 894 899 493 141	144 445 840 1197 1277 863 831 482 222 41 6 38 38 382 827 1472 1494 1202 789 509 156 64 316 483 1006 M M 1198 704 550 126	55 332 736 1125 1240 854 670 389 132 13 5548 25 222 868 1245 1018 790 307 446 144 33 5403 56 410 873 1102 1025 853 540 360 66 4868
COLORADO CLIMATE CENTER (303)	SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	42 86 308 667 1053 1473 1556 1193 1014 717 453 174 67 174 101 206 607 1281 1796 1537 1260 656 662 435 165 51 116 342 735 1167 1435 1412 1179 620 690 387	85 150 348 551 1029 1330 1376 1162 1116 788 524 262 263 248 288 301 563 1272 1458 1325 1197 1039 601 557 363 1230 232 221 425 718 1108 1351 1290 1172 979 771 443	0 7 136 367 726 973 1004 915 744 474 235 53 20 55 71 337 921 1003 1130 859 907 514 233 91 5 5 205 208 673 905 905 899 651 514 148	50         111         318         620         860         1243         1256         1047         862         729         477         187           107         148         305         536         1116         1302         2211         1080         807         735         446         222           83         144         357         667         1070         1206         1112         1124         882         745         415           83         144         357         667         1070         1206         1122         1124         882         745         415	0 9 138 422 822 1132 1175 948 856 519 254 34 5 30 74 372 828 1301 1331 1100 773 531 219 88 0 25 188 450 853 978 1080 1088 654 488 144	•         0         11         91         325         945         806         633         756         666         405         180         41           2         2         73         305         802         976         1064         823         166         833         41           0         22         153         435         616         804         826         606         53	6 18 164 468 616 1061 1122 624 656 556 302 67 21 53 61 353 960 1161 1179 961 776 556 266 64 0 40 212 519 972 1006 1032 626 749 576 223	•         0         11         146         474         828         1103         1237         964         853         804         322         81           18         42         122         373         965         1278         1051         960         760         570         252         106           18         42         122         373         965         1278         1051         960         700         700         570         252         106           10         14         165         506         826         1148         1006         1034         903         528         272	32 58 2/5 606 986 1342 1476 1160 1004 687 419 160 67 64 234 486 1139 1453 1408 1270 976 785 384 203 67 00 288 619 1166 1308 1317 1237 621 280	0 10 125 403 774 1128 1221 008 719 435 106 30 6 10 71 301 919 1182 067 753 649 460 161 52 13 33 232 508 1052 1245 1231 1010 756 533 238	0 0 144 429 780 1054 1094 885 806 504 253 71 10 35 58 346 826 1219 1162 892 898 489 195 71 1 20 152 488 600 848 846 879 616 495 104	282 341 555 559 1203 1564 1567 1355 1321 1008 747 459 304 301 325 744 1346 1480 435 1273 1220 1011 663 480 327 350 579 689 1281 4484 1488 1307 1152 825 630	6         37         203         512         846         1172         1246         962         853         564         963         127           34         40         138         319         685         1515         866         703         127           34         40         138         119         1152         866         703         736           6         43         201         552         868         1666         1064         1057         660         561         300	25 72 273 617 961 1376 1435 1106 956 675 422 164 47 73 209 503 1140 1369 1387 1118 864 641 352 169 53 52 277 603 1116 M 1256 1060 776 639 330	78         122         349         651         945         1104         1216         1033         1011         741         512         234           103         167         238         540         1074         1200         1177         1083         879         722         479         226           85         140         347         686         1011         1086         1076         1076         236	0 12 176 471 825 1113 1156 813 828 825 272 77 22 55 87 377 840 1222 1238 1001 706 519 209 83 5 5 22 207 533 844 1003 885 884 889 443 141 5	0 b 144 445 b40 1197 1277 963 531 482 222 41 122 40 38 352 537 1472 1494 1202 798 509 156 64 126 19 168 485 1006 M M 1198 704 550 126	0 0 55 332 736 1125 1240 854 6/0 386 132 13 5548 0 6 25 222 868 1245 1018 790 567 446 144 33 5403 4 0 56 410 8/75 1102 1025 853 540 360 66 4668
IMATE CENTER (303)	AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN	86         306         667         1053         1473         1556         1833         1014         717         453         174           131         286         607         1281         1796         1637         1280         666         662         453         156           116         342         736         1637         1379         600         668         662         435         165	150 348 651 1026 1330 1376 1162 1116 788 524 262 268 361 663 1272 14.98 1325 1197 1039 601 557 363 1228 1127 117 443 771 443	7 136 387 726 973 1004 915 744 474 235 53 55 71 337 921 1008 31130 859 967 514 233 91 258 202 508 873 903 905 869 651 514 148	AVE 50 111 318 620 990 1243 1256 1047 992 729 477 197 82.441 232 445 235 445 232 445 235 445 445 235 445 235 445 235 445 445 235 445 235 445 445 445 445 445 445 445 445 445 4	9 138 422 822 1132 1175 948 856 519 254 34 30 74 372 828 1301 1331 1100 773 531 219 88 25 188 430 853 978 1080 1088 654 488 144	AVE * 0 11 61 325 645 666 633 756 669 406 163 41 62-80 2 29 73 305 682 978 1064 855 666 482 169 55 63-94 0 22 153 435 616 864 886 829 608 468 16	6 18 164 468 616 1061 1122 624 656 556 302 67 21 53 61 353 960 1161 1179 961 776 556 266 64 0 40 212 519 972 1006 1032 626 749 576 223	•         0         11         146         474         828         1103         1237         964         853         804         322         81           18         42         122         373         965         1278         1051         960         760         570         252         106           18         42         122         373         965         1278         1051         960         700         700         570         252         106           10         14         165         506         826         1148         1006         1034         903         528         272	58         275         608         906         1472         1479         1604         607         419         403           64         234         486         1356         1455         1406         1270         207         205         204         203           64         289         1406         1350         1455         1400         1270         207         205         204         203           60         289         619         1106         1306         1317         1237         621         280	10 125 403 774 1128 1221 888 719 435 186 38 10 71 301 919 1182 867 753 649 488 181 52 33 222 588 1052 1245 1251 1010 758 533 238	0 144 429 780 1064 1094 885 806 504 253 71 35 54 344 226 129 1162 802 898 439 195 71 20 152 438 000 848 946 879 616 495 104	282 341 555 559 1203 1564 1567 1355 1321 1008 747 459 304 301 325 744 1346 1480 435 1273 1220 1011 663 480 327 350 579 689 1281 4484 1488 1307 1152 825 630	37         203         512         846         1172         1246         962         853         564         963         127           40         138         319         6152         816         1316         1152         806         302         136           40         138         1152         806         168         560         302         136           43         201         522         808         1064         1057         860         561         300	72         273         617         961         1376         1435         1106         856         675         422         164           73         209         500         1140         1366         1387         1118         864         641         352         169           82         277         600         1116         M         1256         1060         776         630         330	122 349 651 945 1104 1216 1039 1011 741 512 234 167 238 540 1074 1200 1177 1083 879 722 479 238 140 347 965 1011 1086 1079 1029 659 710 343	12 176 471 825 1113 1156 813 826 825 272 77 55 87 377 840 1222 1238 1031 706 519 209 83 22 207 533 844 1003 885 884 889 443 141	B         144         445         B40         137         1277         963         531         482         222         41           40         38         352         837         1472         1464         1202         786         500         156         64           10         168         485         1006         M         M         1168         704         550         126         64	0 55 332 736 1125 1240 854 670 386 132 13 5548 6 25 222 868 1245 1018 790 597 446 144 33 5403 0 56 410 573 1102 1025 853 540 360 66 4863

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

## EASTERN PLAINS

		Т	emperati	ure			De	gree D	ays	F	recipi	tation	
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm a	# days
NEW RAYMER 21N	73.4	42.2	57.8	4.3	<b>9</b> 0	27	225	12	369	0.77	-1.73	31	5
STERLING	79.7	48.0	63.9	6.0	98	33	112	84	481	0.91	-2.26	29	6
FORT MORGAN	78.0	46.8	62.4	4.0	93	35	126	52	456	0.60	-2.04	23	8
AKRON 1N	76.3	48.0	62.2	5.7	93	38	121	40	429	1.25	-2.18	36	4
AKRON 4E	76.0	45.6	60.8	4.4	95	30	160	39	418	0.85	-2.40	26	5
HOLYOKE	77.5	49.0	63.2	4.2	96	30	116	70	457	0.45	-2.91	13	4
JOES 2SE	76.8	47.6	62.2	4.2	94	30	129	51	445	1.76	-0.99	64	6
BURLINGTON	75.9	46.7	61.3	2.1	95	30	144	37	415	1.30	-1.61	45	6
LINON WSMO	71.6	42.9	57.3	3.7	88	29	238	5	343	2.96	0.46	118	13
CHEYENNE WELLS	78.8	48.6	63.7	4.1	96	36	90	55	465	0.97	-2.06	32	4
EADS	78.1	49.5	63.8	3.1	94	32	110	78	470	1.06	-1.51	41	7
ORDWAY 21N	76.0	45.4	60.7	1.7	93	30	154	29	418	2.34	0.55	131	9
ROCKY FORD 2ESE	80.7	48.6	64.7	2.6	94	34	84	80	490	2.48	0.87	154	14
LAMAR	78.4	50.7	64.5	2.0	95	35	92	83	478	1.29	-1.21	52	8
LAS ANIMAS 1N	80.1	50.6	65.4	1.9	98	35	78	96	497	1.98	-0.06	97	12
HOLLY	78.8	50.5	64.7	2.7	99	34	91	86	479	1,89	-0.64	75	9
SPRINGFIELD 7WSW	79.4	48.6	64.0	3.4	94	34	93	70	479	2.80	0.10	104	10

# FOOTHILLS/ADJACENT PLAINS

			Тетре	rature				Degree	Days		Precip	itation	l
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	XNorm	#days
FORT COLLINS	75.4	46.5	60.9	4.5	92	35	141	22	407	1.02	-1.67	38	9
GREELEY UNC	78.2	47.4	62.8	4.9	95	34	109	48	450	1.13	-1.53	42	7
ESTES PARK	67.5	36.3	51.9	3.7	80	28	400	0	276	1.13	-0.85	57	8
LONGMONT 2ESE	77.8	41.3	59.6	2.5	96	32	182	22	428	0.71	-1.63	30	4
BOULDER	77.0	44.6	60.8	3.8	91	31	146	23	429	1.35	-1.65	45	12
DENVER WSFO AP	77.4	49.0	63.2	6.0	91	37	104	60	462	1.27	-1.13	53	8
EVERGREEN	69.7	37.6	53.6	4.7	83	28	343	0	316	1.46	-1.32	53	10
CHEESMAN	70.9	29.9	50.4	-0.1	87	20	444	0	331	2.39	0.50	126	7
LAKE GEORGE 8SW	62.5	34.5	48.5	2.6	79	23	505	0	208	3.12	1.83	242	5
ANTERO RESERVOIR	60.7	30.6	45.7	2.7	74	22	591	0	181	2.50	1.64	291	10
RUXTON PARK	51.1	28.7	39.9	-2.6	66	15	772	0	59	6.44	3.85	249	16
COLORADO SPRINGS WSO	70.0	45.4	57.7	2.3	83	32	223	5	323	4,10	1.95	191	12
PUEBLO WSO AP	76.7	45.4	61.1	0.1	93	29	143	29	426	2.36	1.11	189	11
WESTCLIFFE	65.6	34.8	50.2	0.9	77	24	451	0	251	2.26	0.87	163	11
WALSENBURG	74.0	46.3	60.1	2.4	87	32	170	27	395	2.12	0.41	124	14
TRINIDAD AP	74.5	45.8	60.2	1.3	88	35	161	17	393	3.16	1.48	188	13

# MOUNTAINS/INTERIOR VALLEYS

			Tempe	rature			De	gree Da	iys		Precipi	tation	
Name	Max	Min	Mean	Dep	High	LOW	Heat	Cool	Grow	Total	Dep	%Norm	#days
WALDEN	66.9	29.4	48.2	4.1	80	22	514	0	270	0.34	-0.88	28	4
LEADVILLE 2SW	58.5	28.2	43.4	3.6	71	17	662	0	149	0.83	-0.17	83	8
SALIDA	69.1	38.0	53.5	1.5	83	26	345	0	309	1.44	0.39	137	3
BUENA VISTA	66.4	36.3	51.3	1.3	80	14	415	0	265	2.09	1.16	225	6
SAGUACHE	67.4	35.8	51.6	1.6	77	21	409	0	278	0.84	0.17	125	3
HERMIT TESE	61.7	28.8	45.3	3.8	74	17	603	0	187	0.90	-0.11	89	3
ALAMOSA WSO AP	68.6	35.9	52.3	1.9	83	24	387	0	298	1.78	1.14	278	9
STEAMBOAT SPRINGS	70.5	33.6	52.0	4.2	84	27	392	0	322	1.11	-1.00	53	7
GRAND LAKE 1NW	65.9	29.6	47.8	5.0	76	20	526	0	256	0.44	-1.49	23	9
GRAND LAKE 6SSW	64.1	30.1	47.1	3.4	75	22	545	0	230	0.44	-0.94	32	9
DILLON 1E	60.1	28.8	44.5	2.4	71	18	630	0	170	0.73	-0.58	56	4
CLIMAX	48.8	20.9	34.8	-0.4	65	6	927	0	30	0.83	-1.05	44	5
ASPEN 1SW	65.3	35.6	50.4	3.4	77	25	443	0	247	1.08	-1.02	51	9
CRESTED BUTTE	60.3	28.7	44.5	1.3	72	21	627	0	177	0.77	-0.69	53	6
TAYLOR PARK	56.7	26.9	41.8	1.6	69	15	710	0	123	1.00	-0.32	76	7
TELLURIDE	60.0	28.8	44.4	-2.1	76	13	627	0	169	1.85	0.07	104	11
SILVERTON	58.3	28.7	43.5	0.9	72	22	657	0	148	1.50	-0.06	96	11
WOLF CREEK PASS 1E	49.3	28.5	38.9	-0.3	62	11	803	0	42	1.49	-0.54	73	12

#### WESTERN VALLEYS

			Tempe	rature				Degre	e Days		Preci	pitatio	n —
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	#days
CRAIG 4SW	72.2	38.4	55.3	4.8	84	30	295	0	350	0.19	-1.46	12	4
HAYDEN	73.9	38.8	56.3	4.6	85	29	260	1	379	0.49	-0.91	35	6
MEEKER 3W	73.7	37.8	55.8	4.3	86	29	280	2	378	0.73	-0.74	50	3
RANGELY	76.8	44.3	60.6	3.9	90	32	153	23	430	0.20	-0.80	20	3
EAGLE FAA	72.5	35.6	54.1	2.9	82	26	330	0	357	0.27	-0.52	34	1
GLENWOOD SPRINGS	77.8	40.9	59.4	4.8	93	30	173	4	433	0.39	-1.14	25	5
RIFLE	77.4	40.3	58.8	3.2	89	31	194	10	432	0.21	-0.85	20	3
GRAND JUNCTION WS	79.9	50.4	65.1	3.1	94	38	69	82	504	0.19	-0.68	22	4
CEDAREDGE	78.1	38.9	58.5	1.9	90	30	202	9	441	0.76	-0.38	67	9
PAONIA 1SW	77.5	45.1	61.3	4.2	93	38	131	24	431	0.66	-0.67	50	8
DELTA	73.8	40.6	57.2	-2.2	88	33	238	3	374	0.89	0.32	156	6
GUNNISON	68.2	31.5	49.8	2.4	81	22	460	0	292	0.90	0.24	136	8
COCHETOPA CREEK	68.6	31.0	49.8	3.4	80	21	463	0	299	0.77	-0.02	97	8
MONTROSE NO 2	73.8	43.0	58.4	1.2	87	35	203	7	380	0.52	-0.33	61	5
URAVAN	80.7	46.8	63.8	2.6	96	38	84	55	486	0.40	-0.60	40	6
NORWOOD	70.3	37.7	54.0	2.7	83	30	334	2	326	0.92	-0.15	86	4
YELLOW JACKET 2W	71.5	40.5	56.0	1.9	85	34	273	2	341	1.36	0.26	124	9
CORTEZ	72.9	39.1	56.0	2.6	86	25	272	1	363	0.84	-0.07	92	7
DURANGO	71.0	39.2	55.1	1.6	83	28	300	1	336	1.42	0.35	133	5

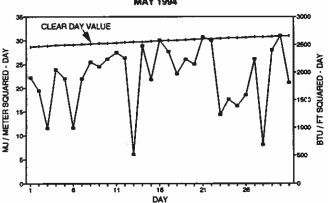
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

### MAY 1994 SUNSHINE AND SOLAR RADIATION

	Numb <u>CLR</u>		Days <u>CLDY</u>	Percent Possible <u>Sunshine</u>	Average % of <u>Possible</u>
Colorado Springs	6	8	17		
Denver	11	5	15	68%	65%
Fort Collins	7	15	9		••
Grand Junction	14	7	10	79%	73%
Limon	9	9	13		
Pueblo	NA	NA	NA	73%	74%

CLR = Clear	PC = Partly Cloudy	CLDY= Cloudy
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May often brings considerable cloudiness, especially during afternoon hours, to northern and northeastern Colorado. This year, clouds were more numerous over southern Colorado while northern areas had more sunshine than normal.



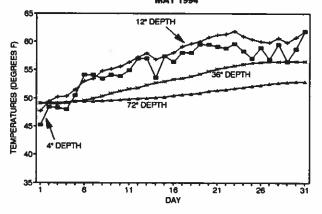
# FT. COLLINS TOTAL HEMISPHERIC RADIATION

#### MAY 1994 SOIL TEMPERATURES

Soil temperatures rose rapidly in May until finally leveling off late in the month. Overall, soil temperatures by the end of May (similar to air temperatures) were warmer than usual for this time of the year.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES MAY 1994



#### HATS OFF TO: Howard Ohl of Canon City, Colorado

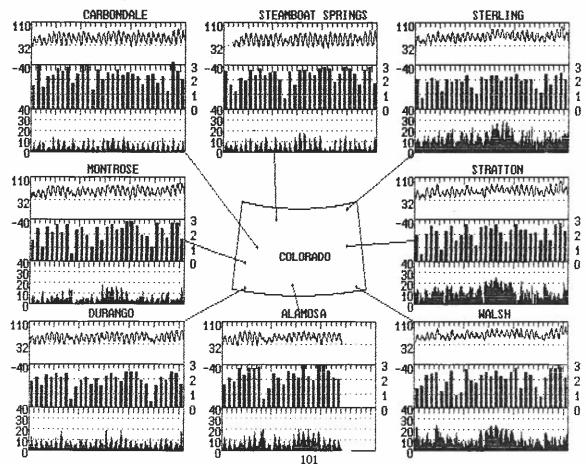
At age 85, Howard Ohl has retired as the cooperative weather observer for Canon City. His stint as official observer was just 9 years-relatively short for Colorado observers-but his observing was top notch and his efforts helped make Canon City one of only a few locations in Colorado to have maintained weather observations continuously for more than 100 years. Thanks, Howard, for your great work.

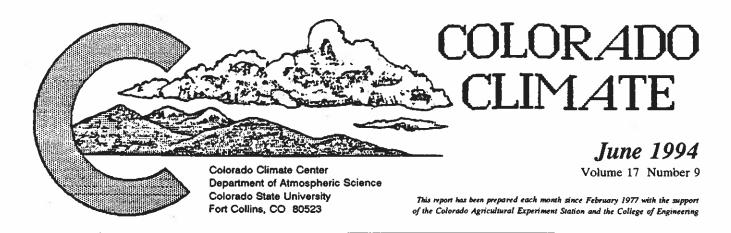
## NO SPECIAL FEATURE THIS MONTH.

			WTHRNET W	EATHER DATA	MAY 1994			
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly	average tempe 48.6	rature ( 'F ) 52.5	55.3	59.1	51.1	61.9	60.9	63.7
monthly maximum minimum	: 75.4 5/1			6 86.7 30/15	83.5 31/13			94.1 30/16 34.3 1/1
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The State-Nide Picture

The figure below shows monthly weather at WIHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



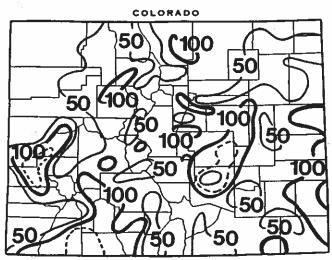


#### June Climate in Perspective - Dry and Very Hot

A combination of abnormally hot and dry weather in June accompanied by periods of strong winds rapidly dried out forests and rangeland, quickly melted the remaining mountain snowpack and drove irrigation requirements up. A period of wet weather statewide after the middle of June brought only temporary relief. On the plus side, hail and tornado occurrences were relatively few in number. Temperatures for June ended up well above average with most areas also drier than average.

#### Precipitation

The number of days with precipitation in June was less than average over most of Colorado ranging from only 2 days with measurable precipitation over much of the

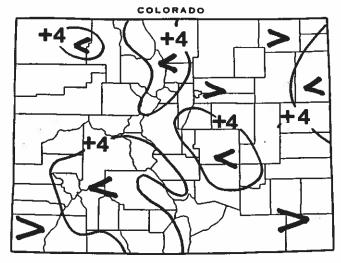


June 1994 precipitation as a percent of the 1961-1990 average.

Western Slope to as many as 8 days along parts of the Front Range. Some locally heavy storms 1-3rd along the Front Range, 8-9th on the Eastern Plains, and 18-22nd statewide helped to bring monthly totals above the long-term June average over parts of southwest Colorado, some of the Front Range and in a few locations in extreme eastern Colorado. For the rest of Colorado, June ended up considerably drier than normal. June precipitation was less than 25% of average over parts of northwestern and northeastern Colorado, with just 0.03" reported at Yuma.

#### Temperatures

The trend toward warmer than average temperatures that has been present in recent months continued into June. Daily temperatures were above the 30year averages on almost every day of the month in nearly all areas of the State. Low humidity accompanied most of the hot weather. Individual daily record high temperatures were set at many stations on the 13th, 14th and 26th. The 104°F reading at Denver and the 95° at Alamosa on the 26th each came within 1 degree of the all time record high temperatures for those sites. June temperatures ended up 3-6° above average across the entire State. It was Denver's all time warmest June on record while at Fort Collins, it was 3rd warmest June in 106 years.



Departure of June 1994 temperatures from the 1961-90 averages.

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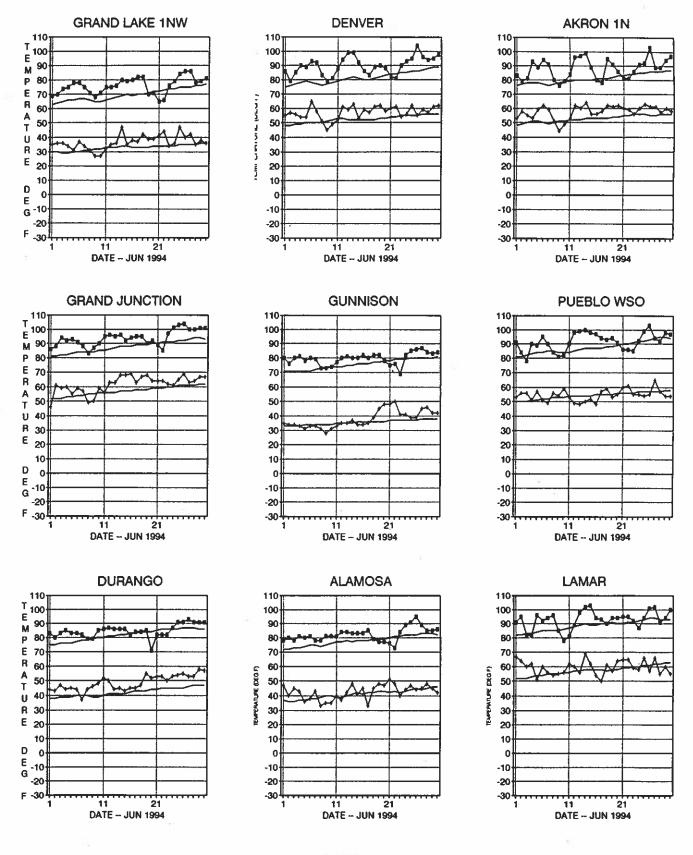
#### **JUNE 1994 DAILY WEATHER**

- 1-3 June got off to a warm start, but moist easterly breezes and a stationary front near the Palmer Ridge helped spawn a few big thunderstorms 1-2nd. Colorado Springs totalled 2.97" of rain in two days. Some large hail was reported. A midnight storm in Pueblo on the 2nd may have locally dropped more than 3" of rain which caused considerable flooding early on the 3rd. More showers developed later on the 3rd, but drier air pushed in from the west.
- 4-6 Hot and dry weather covered Colorado but with slightly cooler readings on the 5th. High temperatures at lower elevation locations climbed into the upper 80s and 90s. Mountain snows continued to melt rapidly. Some convective clouds developed on the 6th dropping little or no rain but producing locally strong and damaging downburst winds (Fort Morgan, for example).
- 7-9 Temperatures remained hot on the 7th (94° at Sterling and 102° at Las Animas) until a Pacific cold front crossed much of the State. Thunderstorms with ferocious lightning but little rain erupted over northcentral Colorado during the evening. Temperatures then dropped to more seasonal levels 8-9th, especially across northern Colorado. Very chilly morning temperatures were observed on the 9th. Nunn dropped to 38°, but many mountain locations were in the 20s. Spicer (near Walden) recorded 22°, the coldest in the State. Most of the State remained dry with very low humidity air. However, severe thunderstorms developed in far eastern Colorado out near the boundary of much moister air to the east. There were several reports of severe hail and tornadoes late on the 8th from Yuma County south to Baca County. Local rains exceeded 1 inch. Powerful storms developed again late on the 9th but were not as widespread.
- 10-14 After a chilly morning on the 10th, hot air with very low humidities again covered most of Colorado. By the 12th, temperatures were in the 90s across most low-elevation areas. With the help of increasing southwesterly winds, many record highs were set 13-14th including 99° readings at Denver both days. Las Animas hit 107° on the 14th. A surprising amount of cloudiness accompanied the hot weather over northern Colorado. Some dry convective downbursts were reported on the 12th. Winds gusted over 50 mph at Denver and other locations. More widespread winds on the 14th again gusted over 50 mph as deep low pressure passed north of the State.

- 15-17 Very cool air over the northern Rockies approached Colorado, but the heat to the south held its ground. Very moist surface air north of a stationary front across central Colorado produced morning fog and low clouds over northeast counties 16-17th. Dry southwesterly winds aloft suppressed any storm development until a few evening storms finally got going on the 17th.
- 18-23 Winds aloft diminished and at last a surge of damp and unstable air made its way into all parts of Colorado. A few large slow-moving storms developed along the Front Range on the 18th. Activity increased in the mountains on the 19th with close to 1" of rain falling near Estes Park and 1.06" at the Great Sand Dunes. Most areas of Colorado saw shower activity 20-22nd with some locally heavy amounts. Northwest Fort Collins received close to 3" in two hours on the 20th. Norwood, Uravan, Wolf Creek Pass and Bonham Reservoir also got more than 1 inch. Kremmling reported 0.81" and 1.58" fell at the Pueblo airport on the 21st. Storms were still numerous but moved more quickly on the 22nd, so rainfall totals were less. Finally, drier air moved in on the 23rd, but a few very fast moving storms still developed over the northern mountains and raced out onto the plains dropping little rain but producing wind gusts of 30-60 mph.
- 24-26 Sunny, low humidity and very hot a fairly typical late June heatwave except for the brief surge of record heat on the afternoon of the 26th. Alamosa reached 95°F, just short of the hottest temperature ever measured there. Denver's 104° was also one degree short of their 123 year record for any date. The La Junta 20S weather station hit 109°F, the hottest in the State in June. Temperatures in the mountains climbed into the 70s and 80s, even at very high elevations.
- 27-30 A dry Pacific cool front crossed most of Colorado early on the 27th. Temperatures cooled over northern and eastern Colorado but still remained well above average for the rest of June. Over southwest Colorado, no change in temperatures was felt. Afternoon readings continued to exceed 100° each day at Grand Junction and Uravan. Some afternoon convective clouds tried to develop each day but mostly only produced virga. Boulder's high of 99 and low of 65° on the 30th made fans and air conditioners a popular item.

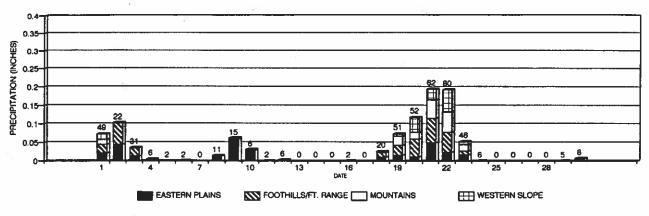
		Weather Extremes	
Highest Temperature	109°F	June 14	LaJunta 20S
Lowest Temperature	22°F	June 9	Spicer
Greatest Total Precipitation	4.32"	2	Colorado Springs NWS
Least Total Precipitation	0.03"		Yuma
Greatest Total Snowfall	0"		No snow – some 1" hail accumulations
Greatest Snow Depth	0"		None reported

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



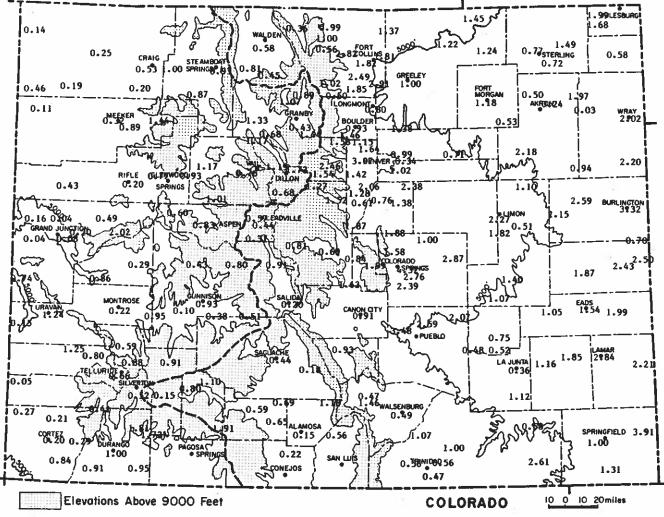
## **JUNE 1994 PRECIPITATION**

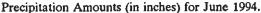
Three episodes, 1-3rd, 8-10th and 18-23rd, accounted for nearly all of Colorado's June precipitation. The only widespread episode affecting most of the State occurred June 19-22nd. This latter episode temporarily retarded the rapidly deteriorating wildfire potential. Overall, statewide precipitation in June averaged about 0.97", which is considerably less than normal.

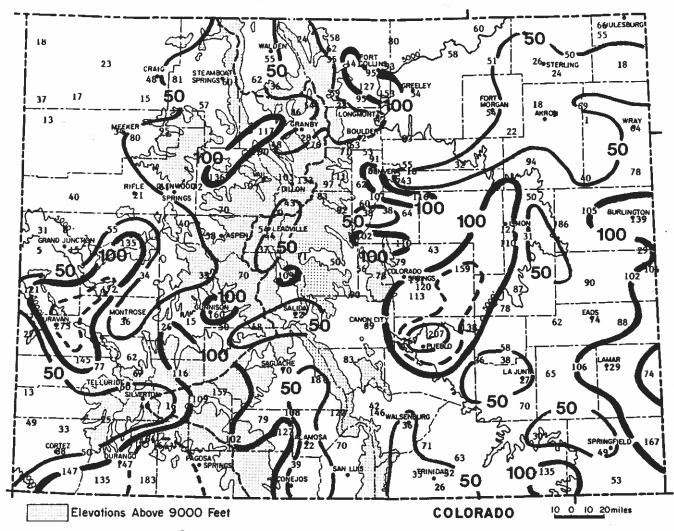


COLORADO DAILY PRECIPITATION - JUN 1993

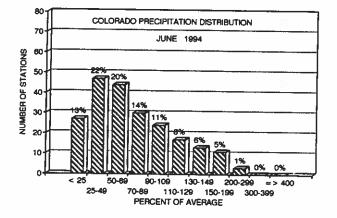
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)







June 1994 Precipitation as a Percent of the 1961-90 average.



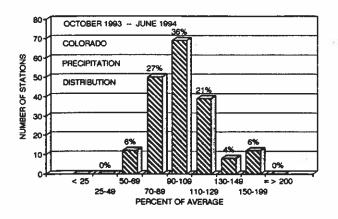
June precipitation ranged from less than 25% of average over portions of western and northeastern Colorado to more than 200% of average around Pueblo and Uravan. Despite some good rains in a few locations, the majority of Colorado was much drier than average. 13% of the official weather stations received less than 25% of the normal June rainfall.

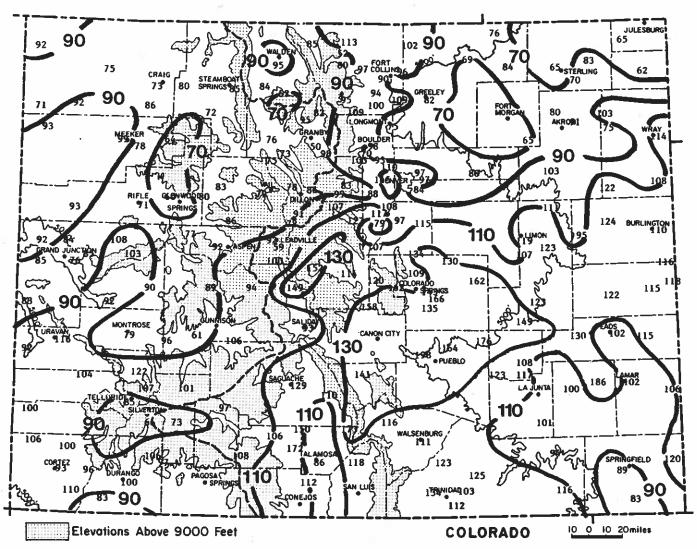
#### JUNE 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.99"	49th driest in 123 years of record (driest < 0.01" in 1890)
Durango	1.00"	32nd wettest in 100 years of record (wettest = 5.53" in 1927)
Grand Junction	0.04"	13th driest in 103 years of record (driest < 0.01" in 1916, 1961 and 1980)
Las Animas	1.16"	53rd driest in 129 years (driest < 0.01" in 1879, 1952 and 1954)
Pueblo 2.59"		15th wettest in 125 years of record (wettest = $7.14$ " in 1921)
Steamboat Springs	0.93"	32nd driest in 88 years of record (driest < 0.01" in 1919)

# **1994 WATER YEAR PRECIPITATION**

An overall deterioration in statewide accumulated precipitation with respect to average was observed in June. Water year totals still remain above average over portions of southwestern Colorado and over most of the southeastern quarter of the State. Drier than average conditions continue to expand across the northern half of Colorado. Parts of Weld County and much of Morgan, Logan, Phillips and Sedgwick counties in northeastern Colorado have reported less than 70% of average since October 1993. Noticeable agricultural drought conditions have become apparent in many of those areas. Similarly, northwestern Colorado including higher elevation areas of the Northern and Central Mountains now have considerable moisture deficits. Only about 60% of the average precipitation has fallen near Glenwood Springs. Dry Junes are typical across the mountains and Western Slope but are uncommon over northeastern Colorado. The onset of the Southwest Monsoon weather pattern will now be carefully watched to see if relief from emerging drought conditions will occur.







**COMPARATIVE HEATING DEGREE DAY DATA FOR JUNE 1994** 

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ORADO CLIMATE CENTER (30	JAN FEB MAR	1559 1193 1014 717 1637 1280 958 692 1412 1179 930 699	1376 1162 1116 798 1325 1197 1039 901 1290 1172 979 771	1004 815 744 474 235 1130 958 697 514 233 805 899 651 514 146	1259 1047 992 729 477 1211 1093 907 735 446 1172 1124 882 762 415	1175 946 059 519 254 1331 1103 773 531 219 1060 1068 054 499 144	833 756 688 400 193 1064 885 668 482 199 886 828 609 468 M	1122 924 859 558 302 1179 991 776 558 286 1032 926 749 576 223	(237 <b>956</b> 853 594 322 81 (051 880 760 578 282 106 1096 1038 895 528 272 14	1479 1193 1094 687 419 193 1408 1270 976 765 364 203 1317 1237 837 621 295 63	1221 888 719 4.35 186 36 967 783 649 469 181 52 1231 1010 756 533 238 0	1094         885         806         504         253         71           1162         992         686         483         195         71           946         873         618         485         104         3	1587         1355         1321         1008         747         459           1435         1273         1220         1011         693         480           1436         1307         1152         925         630         312	1246 952 853 594 363 127 1152 866 768 569 302 136 1084 1057 -895 561 300 20	1435 1106 958 675 422 164 1367 1118 894 641 352 189 1258 1080 779 639 330 64	1218 1039 1011 741 512 234 1177 1083 879 722 479 226 1079 1029 859 710 343 89	1156 813 828 525 272 77 1239 1031 706 519 209 83 985 994 669 493 141 6	1277 963 831 492 222 14 1494 1202 789 509 156 54 M 1106 704 550 126	1240 854 670 339 122 13 1018 799 587 446 144 33 1025 853 540 360 69 0
COLORADO CLIMATE CENTER (303)	DEC JAN FEB MAR	1473 1559 1193 1014 717 1796 1637 1280 958 692 1475 1412 1179 930 699	1339 1376 1162 1116 798 1456 1325 1197 1039 901 1351 1290 1172 979 771	973 1004 815 744 474 235 1083 1130 958 697 514 233 905 905 899 651 514 146	1243 1259 1047 392 729 477 1302 1211 1093 907 735 446 1208 1172 1124 882 762 415	1132 1175 946 <b>85</b> 9 519 254 1301 1103 773 531 219 878 1060 1068 854 499 144	896 \$33 756 688 408 193 976 1064 885 668 482 199 884 886 828 609 468 M	1091 1122 924 859 558 302 1101 1179 991 776 558 286 1008 1032 926 749 576 223	1163         1237         956         853         594         322         81           1276         1051         880         760         578         282         106           1148         1086         1036         695         528         272         14	1342 1479 1193 1094 687 419 193 1453 1408 1270 976 765 364 203 1369 1317 1237 637 621 265 53	1126 1221 888 719 435 186 38 1182 967 783 649 469 181 52 1245 1231 1010 756 533 238 0	1054         1094         885         806         504         253         17           17         151         1162         992         686         483         195         17           17         164         895         696         592         696         483         195         17           18         191         819         619         619         39         946         31	1504 1587 1355 1321 1008 747 459 1480 1435 1273 1220 1011 553 400 1484 1486 1307 1152 925 530 312	1172 1246 952 853 594 363 127 1319 1152 966 768 569 302 136 1169 1094 1057 -695 561 300 20	1376 14.35 1106 958 675 422 164 1369 1367 1118 694 641 352 189 M 1258 1060 779 639 330 64	1194 1218 1039 1011 741 512 234 1200 1177 1083 879 722 479 226 1098 1079 1029 859 710 343 89	1113         1156         913         828         525         272         77           1222         1239         1031         706         519         209         63           1003         985         994         669         433         141         6	1197 1277 963 831 492 222 41 1472 1494 1202 783 509 156 54 M M 1166 704 550 126 6	1125 1240 854 870 389 122 13 1245 1018 799 547 446 144 33 1102 1025 853 540 360 69 0
COLORADO CLIMATE CENTER (30	JAN FEB MAR	1053 1473 1559 1193 1014 717 1281 1796 1637 1280 956 692 1167 1435 1412 1179 930 699	967 911 591 976 959 650 650 151 650 151 650 151 151 956 1521 155 1551 1551 1551 1551 1561 1561 1561 1551 1561 1561 1551 1561 1561 1561 1551 1561 1	1004 815 744 474 235 1130 958 697 514 233 805 899 651 514 146	960 1243 1259 1047 992 729 477 1119 1302 1211 1093 907 735 446 1070 1208 1172 1124 982 762 415	822 1132 1175 946 859 519 254 828 1301 1331 1103 773 531 219 853 976 1060 1068 654 499 144	833 756 688 400 193 1064 885 668 482 199 886 828 609 468 M	816 1091 1122 924 859 558 302 990 1101 1179 991 776 558 286 972 1008 1032 926 749 576 223	(237 <b>956</b> 853 594 322 81 (051 880 760 578 282 106 1096 1038 895 528 272 14	936         1342         1479         1193         1034         687         419         193           1139         1453         1408         1270         976         765         364         203           1169         1363         1317         1237         637         621         285         63	774         1126         1221         888         719         435         186         36           918         1182         967         783         649         469         181         52           9052         1245         1231         1010         736         533         238         0	1094         885         806         504         253         71           1162         992         686         483         195         71           946         873         618         485         104         3	1587         1355         1321         1008         747         459           1435         1273         1220         1011         693         480           1436         1307         1152         925         630         312	1246 952 853 594 363 127 1152 866 768 569 302 136 1084 1057 -895 561 300 20	1435 1106 958 675 422 164 1367 1118 894 641 352 189 1258 1080 779 639 330 64	1218 1039 1011 741 512 234 1177 1083 879 722 479 226 1079 1029 839 710 343 89	1156 813 828 525 272 77 1239 1031 706 519 209 83 985 994 669 493 141 6	1277 963 831 492 222 14 1494 1202 789 509 156 54 M 1106 704 550 126	1240 854 670 339 122 13 1018 799 587 446 144 33 1025 853 540 360 69 0
COLORADO CLIMATE CENTER (30	DEC JAN FEB MAR	667 1053 1473 1559 1193 1014 717 607 1281 1796 1537 1280 956 692 735 1167 1435 1412 1179 930 699	651 1029 1330 1376 1162 1116 798 583 1272 1458 1325 1197 1039 901 718 1188 1351 1280 1172 979 771	973 1004 815 744 474 235 1083 1130 958 697 514 233 905 905 899 651 514 146	1243 1259 1047 392 729 477 1302 1211 1093 907 735 446 1208 1172 1124 882 762 415	1132 1175 946 <b>85</b> 9 519 254 1301 1103 773 531 219 878 1060 1068 <b>854 499 144</b>	896 \$33 756 688 408 193 976 1064 885 668 482 199 884 886 828 609 468 M	1091 1122 924 859 558 302 1101 1179 991 776 558 286 1008 1032 926 749 576 223	1163         1237         956         853         594         322         81           1276         1051         880         760         578         282         106           1148         1086         1036         695         528         272         14	1342 1479 1193 1094 687 419 193 1453 1408 1270 976 765 364 203 1369 1317 1237 637 621 265 53	1126 1221 888 719 435 186 38 1192 967 783 649 469 181 52 1245 1231 1010 756 533 238 0	1054         1094         885         806         504         253         17           17         151         1162         992         686         483         195         17           17         164         895         696         592         696         483         195         17           18         191         819         619         619         3         946         3	1504         1587         1355         1321         1001         1346         1355         1321         1001         1011         101         <	1172 1246 952 853 594 363 127 1319 1152 966 768 569 302 136 1169 1094 1057 -695 561 300 20	1376 14.35 1106 958 675 422 164 1369 1367 1118 694 641 352 189 M 1258 1060 779 639 330 64	1194 1218 1039 1011 741 512 234 1200 1177 1083 879 722 479 226 1098 1079 1029 859 710 343 89	1113         1156         913         828         525         272         77           1222         1239         1031         706         519         209         63           1003         985         994         669         433         141         6	1197 1277 963 831 492 222 41 1472 1494 1202 783 509 156 54 M M 1166 704 550 126 6	1125 1240 854 870 389 122 13 1245 1018 799 547 446 144 33 1102 1025 853 540 360 69 0
	SEP OCT NOV DEC JAN FEB MAR	1053 1473 1559 1193 1014 717 1281 1796 1637 1280 956 692 1167 1435 1412 1179 930 699	967 911 591 976 959 650 650 151 650 151 650 151 151 956 1521 155 1551 1551 1551 1551 1561 1561 1561 1551 1561 1561 1551 1561 1561 1561 1551 1561 1	726 973 1004 815 744 474 235 921 1093 1130 956 697 514 233 875 905 905 999 651 514 146	960 1243 1259 1047 992 729 477 1119 1302 1211 1093 907 735 446 1070 1208 1172 1124 982 762 415	822 1132 1175 946 859 519 254 828 1301 1331 1103 773 531 219 853 976 1060 1068 654 499 144	645 896 933 756 698 408 193 882 976 1064 885 668 482 199 816 864 896 828 609 468 M	816 1091 1122 924 859 558 302 990 1101 1179 991 776 558 286 972 1008 1032 926 749 576 223	0.20         1163         1237         956         853         594         322         81           065         1276         1051         880         760         576         282         106           926         1148         1086         1038         685         528         272         14	936         1342         1479         1193         1034         687         419         193           1139         1453         1408         1270         976         765         364         203           1139         1453         1408         1270         976         765         364         203           1168         1317         1237         637         621         285         63	774         1126         1221         888         719         435         186         36           918         1182         967         783         649         469         181         52           9052         1245         1231         1010         736         533         238         0	780 1054 1094 885 806 504 253 71 826 1219 1162 992 686 489 195 71 800 948 946 879 618 485 104 3	1504         1561         1355         1321         1001         1341 <td< td=""><td>846         1172         1246         952         853         594         363         12           960         1319         1152         966         768         569         302         13           961         1319         1152         966         768         561         302         302         36           968         1169         1094         1057         685         561         300         20</td><td>961         1376         1425         1106         5456         675         422         164           1140         1389         1387         1118         894         641         352         169           1116         M         1258         1080         779         639         330         64</td><td>945 1194 1218 1029 1011 741 512 224 1074 1200 1177 1083 879 722 479 226 1011 1098 1079 1029 859 710 343 89</td><td>625 1113 1156 913 828 525 272 77 940 1222 1239 1031 706 519 209 63 944 1003 985 994 669 493 141 6</td><td>840 1197 1277 963 831 492 222 41 837 1472 1494 1202 789 509 156 64 1006 M M 1168 704 550 126 6</td><td>738 1125 1240 854 870 389 132 13 868 1245 1018 799 597 446 144 33 875 1102 1025 853 540 360 69 0</td></td<>	846         1172         1246         952         853         594         363         12           960         1319         1152         966         768         569         302         13           961         1319         1152         966         768         561         302         302         36           968         1169         1094         1057         685         561         300         20	961         1376         1425         1106         5456         675         422         164           1140         1389         1387         1118         894         641         352         169           1116         M         1258         1080         779         639         330         64	945 1194 1218 1029 1011 741 512 224 1074 1200 1177 1083 879 722 479 226 1011 1098 1079 1029 859 710 343 89	625 1113 1156 913 828 525 272 77 940 1222 1239 1031 706 519 209 63 944 1003 985 994 669 493 141 6	840 1197 1277 963 831 492 222 41 837 1472 1494 1202 789 509 156 64 1006 M M 1168 704 550 126 6	738 1125 1240 854 870 389 132 13 868 1245 1018 799 597 446 144 33 875 1102 1025 853 540 360 69 0
	OCT NOV DEC JAN FEB MAR	667 1053 1473 1559 1193 1014 717 607 1281 1796 1537 1280 956 692 735 1167 1435 1412 1179 930 699	651 1029 1330 1376 1162 1116 798 583 1272 1458 1325 1197 1039 901 718 1188 1351 1280 1172 979 771	387         728         973         1004         815         744         474         235           337         821         1083         1(30         956         687         514         233           308         875         903         9130         956         691         514         233           308         875         905         805         899         651         514         146	620 960 1243 1259 1047 992 729 477 536 1119 1302 1211 1093 907 735 446 687 1070 1208 1172 1124 982 762 415	432 822 1132 1175 946 859 519 254 372 828 1301 1331 1103 773 531 219 450 853 878 1060 1068 654 498 144	325 645 896 933 756 649 406 193 305 882 976 1064 885 668 482 199 435 818 864 886 828 609 468 M	468 818 1091 1122 924 859 558 302 383 980 1101 1179 991 776 558 286 519 972 1008 1032 826 749 576 223	474 620 1163 1237 956 653 594 322 61 373 665 1276 1051 880 760 576 282 106 508 826 1149 1096 1038 655 528 272 14	608         996         1342         1479         1193         1034         687         419         153           408         1130         1453         1408         1270         978         765         364         203           408         1305         1317         1237         937         621         285         63	403 774 1126 1221 888 719 435 186 38 301 919 1192 367 783 649 469 181 52 598 1052 1245 1231 1010 758 533 239 0	429 780 7054 1094 885 806 504 253 71 346 826 2319 1162 992 686 489 195 71 488 900 946 946 879 618 485 104 3	\$56         1203         1504         1587         1355         1321         1008         747         459           744         1346         1480         1435         2273         1220         1011         683         480           889         1291         1486         1307         1152         925         530         312	512 846 1172 1246 952 853 954 365 127 371 969 1319 1152 966 768 569 302 136 522 968 1169 1034 1057 465 561 300 20	617         961         1376         1435         1106         958         675         422         164           503         1140         1389         1367         1118         894         641         352         169           503         1116         1389         1367         1118         894         641         352         169           603         1116         M         1258         1080         779         639         300         64	651 945 1194 1218 1039 1011 741 512 224 540 1074 1200 1177 1083 879 722 479 226 685 1011 1098 1079 1029 859 710 343 89	471 825 1113 1156 913 828 525 272 77 377 940 1222 1239 1031 706 519 209 83 533 944 1003 985 994 669 493 141 6	445 840 1197 1277 963 831 492 222 41 352 837 1472 1494 1202 788 509 156 64 495 1006 M M 1166 704 550 126 6	332 738 1125 1240 854 670 339 132 13 222 868 1245 1018 799 597 445 144 33 410 875 1102 1025 853 540 360 69 0
	SEP OCT NOV DEC JAN FEB MAR	306         667         1053         1473         1559         1133         1014         717           295         607         1281         1796         1637         1280         958         692           342         735         1167         1435         1412         1139         930         699	348 651 1029 1339 1376 1162 1116 796 361 363 1272 1456 1325 1197 1039 901 425 718 1198 1351 1290 1172 979 771	136 387 726 973 1004 815 744 474 235 71 337 921 1093 1130 958 697 514 233 202 508 875 903 905 899 651 514 146	318         620         960         1243         1259         1047         392         729         477           305         536         119         302         1211         1033         907         735         446           357         687         1070         1208         1172         1124         882         762         415	138 432 822 1132 1175 946 659 519 254 74 372 828 1301 1331 1103 773 531 219 188 450 953 976 1060 1068 654 499 144	91 325 645 896 \$33 756 698 409 133 73 305 982 976 1064 985 668 482 199 153 435 816 964 895 628 609 455 M	164 468 818 1091 1122 924 859 558 302 91 383 980 1101 1179 991 776 558 286 212 519 972 1008 1032 926 749 576 223	146 474 629 1163 1237 959 853 594 322 61 122 373 965 1276 1051 880 750 575 282 106 165 508 926 1149 1096 1035 955 528 272 14	275         608         996         1342         1479         1193         1034         687         419         150           234         408         1130         1453         1408         1270         876         765         364         203           204         608         1130         1453         1408         1270         876         765         364         203           206         619         1168         1369         1317         1237         637         621         285         63	125         403         774         1126         1221         888         719         435         186         26           71         301         919         1192         967         783         649         459         181         52           212         588         1022         1245         1231         1010         758         533         60         533         20         0	144 429 780 1054 1094 885 806 504 253 71 56 346 926 1219 1162 992 686 489 195 71 152 488 900 948 946 879 618 485 104 3	555         856         1201         1504         1597         1355         1321         1008         747         459           525         744         1346         1480         1435         1273         1220         1011         693         480           579         889         1291         1484         1486         1401         1152         925         630         312	203         512         846         1172         1246         952         853         543         363         127           139         371         660         1319         1152         866         768         568         302         136           130         371         660         1319         1152         866         768         569         302         136           201         522         968         1169         1064         1657         685         561         300         20	275         617         961         1376         1435         1706         958         673         164           208         503         1140         1369         1367         1116         894         641         352         169           277         603         1116         M         1256         1080         779         639         300         641         353         169	Jug         651         945         1154         1218         1039         1011         741         512         224           238         540         1074         1200         1177         1083         879         722         479         226           347         685         1011         1098         1079         1029         959         710         343         89	176 471 625 1113 1156 813 628 525 272 77 81 31 31 31 31 31 31 31 31 31 31 31 31 31	144 445 840 1197 1277 963 631 492 222 41 30 332 837 1472 1494 1202 789 509 156 64 168 495 1006 M M 1166 704 550 126 6	55 332 738 1125 1240 854 670 389 132 13 25 222 868 1245 1018 799 587 446 144 33 39 410 875 1102 1025 853 540 360 89 0
HI ATING DEGHLE DATA COLORADO CUMATE CENTER (20	AUG SEP OCT NOV DEC JAN FEB MAR	90 300 667 1053 1473 1559 1193 1014 717 131 295 607 1281 1796 1537 1280 956 692 118 342 735 1167 1435 1412 1179 930 699	150 348 651 1029 1330 1376 1162 1176 796 228 361 363 1272 1458 1325 151 1039 901 221 425 718 1186 1351 1290 177 979 771	7 136 387 726 973 1001 815 74 725 72 135 235 65 23 233 233 241 233 25 25 202 508 875 905 905 959 659 51 51 51	111 318 620 960 1243 1259 1047 992 729 477 148 305 536 1119 1302 1211 1093 907 735 446 144 357 697 1070 1209 1172 1124 982 762 415	8 138 432 822 1132 1175 946 859 519 254 30 74 372 828 1301 1331 1103 773 531 219 25 188 450 953 978 1060 1068 654 499 144	11 91 225 645 896 533 756 698 408 133 28 73 305 882 978 1064 885 668 482 199 22 153 435 818 864 866 828 609 468 M	10 164 469 816 1031 1122 824 859 558 302 53 91 383 990 1101 1179 991 776 558 286 40 212 519 972 1008 1022 826 749 576 223	18         252         968         628         964         7121         6311         952         874         911         11           801         595         876         085         086         1201         8721         838         671         53         54	58         275         608         996         1342         1479         1193         1034         687         419         193           64         234         498         1306         1453         1408         1270         978         765         364         203           64         234         498         1306         1453         1408         1270         978         765         364         203           60         296         619         1168         1363         1317         1237         621         285         63	10         125         403         774         1126         1221         888         719         435         186         36           10         71         301         919         1192         961         783         649         469         181         52           33         232         588         1052         1245         731         1010         736         533         208         0	0 144 429 780 1054 1094 885 806 504 253 71 35 58 346 826 1219 1152 992 686 489 195 71 20 152 488 900 948 946 879 618 485 104 3	341         555         856         1201         1504         1587         1355         1321         1008         747         459           381         523         744         1346         1430         1435         1231         1220         1011         683         480           381         523         744         1346         1430         1435         1233         1220         1011         683         480           350         579         889         1291         1484         1496         1307         1152         925         630         312	37         203         512         846         1172         1246         952         853         564         363         127           49         139         371         960         1319         1152         966         768         569         302         136         136           49         139         371         960         1319         1152         966         768         560         302         136           43         201         522         968         1064         1057         965         561         300         20	72 275 617 961 1376 1435 1106 956 675 422 164 73 209 503 1140 1369 1387 1118 864 641 352 169 52 277 603 1116 M 1256 1060 779 639 300 64	122 349 651 945 1194 1218 1039 1011 741 512 234 167 238 540 1074 1200 1177 1083 879 722 479 226 140 347 685 1011 1098 1079 1029 659 710 343 89	12 176 471 625 1113 1156 913 828 525 272 77 55 87 377 940 1222 1239 1031 706 519 209 83 22 207 533 944 1003 985 994 669 433 141 6	6 144 445 840 1197 1277 963 831 492 222 41 40 38 382 837 1472 1494 1202 788 509 156 64 19 168 455 1006 M M 1166 704 530 126 6	0 55 332 738 1125 1240 854 670 389 132 13 6 25 222 868 1245 1018 789 587 446 144 33 0 59 410 875 1102 1025 853 540 360 89 0
	AUG SEP OCT NOV DEC JAN FEB MAR	42 99 306 667 1053 1473 1559 1193 1014 717 97 131 295 607 1281 1796 1537 1280 956 692 51 118 342 735 1167 1435 1412 1179 930 699	85 150 348 651 1029 1330 1376 115 348 249 228 361 383 1272 1450 1325 120 029 232 231 425 119 186 1351 1290 232	0 7 136 387 726 973 1004 815 744 474 235 20 55 71 337 921 1093 1130 958 697 514 233 5 26 202 508 875 905 905 699 651 514 146	50         111         318         620         960         1243         1259         1047         382         729         477           107         140         305         536         1119         1302         1211         1033         907         735         446           83         144         357         687         1070         1208         1112         1124         982         762         415	0 9 139 432 822 1132 1175 946 659 519 254 5 39 74 372 828 1301 1331 1103 773 531 219 0 25 189 450 853 878 1060 1058 654 499 144	C 11 91 325 645 886 933 756 688 400 133     2 28 73 305 842 978 1064 885 668 482 199     22 153 435 816 864 885 828 609 468 M	6 19 164 469 816 1031 1122 824 859 558 302 21 53 91 383 990 1101 1179 991 776 558 286 0 40 212 519 972 1008 1032 826 749 576 223	•         0         11         148         474         629         1163         1237         959         853         594         322         81           18         42         1237         1065         1237         959         853         536         322         81           18         42         1237         965         1276         1051         880         760         578         282         106           10         14         165         508         826         1148         1086         1036         685         528         272         14	32 59 275 608 996 1342 1479 1193 1094 687 419 193 65 66 234 498 1399 1453 1408 1270 978 765 364 203 87 60 296 619 1168 1368 1317 1237 637 621 295 63	0 10 125 403 774 1126 1221 888 719 435 186 36 8 10 71 301 919 1192 967 783 649 469 181 52 13 23 239 1052 1248 1231 1010 736 533 238 0	0 0 144 429 780 1054 1094 885 806 504 253 71 10 35 58 346 926 1219 1162 992 686 489 195 71 1 20 152 488 900 948 946 879 618 485 104 3	282         341         555         856         7203         1504         1587         1355         1321         1008         747         459           364         381         525         744         1346         1480         1435         1221         1008         747         459           364         381         525         744         1346         1480         1435         1220         1011         683         480           327         350         539         889         1291         1484         1496         1307         1152         925         630         312	6         37         203         512         846         1172         1246         952         853         564         363         127           34         49         139         319         1960         1319         1152         866         768         569         302         136           34         49         139         319         1152         866         768         569         302         136           6         43         201         522         968         1064         1057         865         561         300         20	25         72         275         617         961         1376         1435         1106         956         673         422         164           47         73         209         503         1140         1389         1387         1118         894         641         352         169           53         322         277         603         1116         M         1256         1090         779         639         300         641         533         300         641         535         169	78 122 349 651 945 1194 1218 1039 1011 741 512 234 103 167 238 540 1074 1200 1177 1083 879 722 479 226 85 140 347 685 1011 1098 1079 1029 659 710 343 89	0 12 176 471 625 1113 1156 913 828 525 272 77 22 55 97 377 940 1222 1239 1031 706 519 209 63 5 22 207 533 944 1003 985 994 669 433 141 6	0 6 144 445 840 1197 1277 963 831 492 222 41 12 40 30 302 837 1472 1484 1202 788 509 156 64 0 19 168 485 1006 M M 1166 704 550 126 6	0 0 5 53 72 738 1125 1240 854 870 389 132 13 0 6 25 222 968 1245 1018 789 597 446 144 33 4 0 59 410 675 1102 1025 853 540 360 69 0

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

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# JUNE 1994 CLIMATE DATA

# EASTERN PLAINS \_\_\_\_\_

		Т	empera	ture			D	egree	Days	Precipi	itation	1
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep	XNorm	#days
NEW RAYMER 21N	83.5	51.3	67.4	5.0	100	38	33	111	519	1.45 -0.95	60	6
STERLING	89.9	58.0	73.9	5.5	104	49	3	279	645	0.77 -2.14	26	4
FORT MORGAN	87.0	55.6	71.3	2.7	99	44	6	203	597	1.18 -0.97	55	8
AKRON 1N	88.1	57.7	72.9	6.0	103	44	6	249	634	0.50 -2.21	18	4
AKRON 4E	89.0	54.3	71.7	5.1	105	40	10	217	594	0.24 -2.38	9	4
HOLYOKE	85.0	59.4	72.2	3.4	101	51	2	225	628	0.58 -2.60	18	6
JOES 2SE	86.7	58.2	72.4	3.9	100	48	4	234	628	0.94 -1.36	41	4
BURLINGTON	88.2	58.3	73.2	3.4	100	50	1	255	640	3.32 0.94	139	8
LIMON WSMO	85.0	53.9	69.5	4.7	97	44	16	155	552	2.27 0.49	128	7
CHEYENNE WELLS	90.8	56.6	73.7	4.2	102	47	0	270	634	2.43 0.05	102	5
EADS	91.4	59.1	75.3	4.5	102	54	0	315	665	1.54 -0.53	74	6
ORDWAY 21N	90.9	54.6	72.8	3.2	104	47	3. 1	241	606	1.07 -0.30	78	6
ROCKY FORD 2ESE	95.2	58.1	76.7	4.8	103	51	0	358	667	0.52 -0.84	38	4
LAMAR	92.7	59.5	76.1	4.1	103	50	0	339	678	2.84 0.65	130	9
LAS ANIMAS 1N	95.7	59.9	77.8	4.4	107	51	0	392	694	1.16 -0.61	66	4
HOLLY	94.9	59.6	77.3	4.8	105	54	0	377	685	2.21 -0.77	74	7
SPRINGFIELD 7WSW	95.9	59.3	77.6	7.1	105	53	0	386	684	1.00 -1.02	50	8

# FOOTHILLS/ADJACENT PLAINS \_\_\_\_\_

			Temp	eratu	ге		De	gree D	ays	Precip	itation	
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep	%Norm #	days
FORT COLLINS	84.9	54.8	69.8	4.1	97	44	6	159	573	1.82 -0.08	96	6
GREELEY UNC	89.0	56.7	72.9	4.9	103	46	3	246	632	1.00 -0.83	55	5
ESTES PARK	74.2	44.5	59.3	2.4	80	34	168	5	377	1.02 -0.69	60	6
LONGMONT 2ESE	89.3	50.1	69.7	3.3	106	41	8	156	549	0.80 -1.07	43	4
BOULDER	86.8	53.1	70.0	4.5	101	43	10	168	573	0.93 -1.30	42	8
DENVER WSFO AP	89.8	57.2	73.5	6.6	104	45	3	263	641	0.99 -0.81	55	6
EVERGREEN	80.4	44.6	62.5	4.5	96	36	89	22	452	1.42 -0.85	63	6
CHEESMAN	84.7	37.3	61.0	1.0	99	30	125	12	499	1.87 0.04	102	8
LAKE GEORGE 8SW	75.7	43.1	59.4	4.3	86	38	164	2	390	0.69 -0.69	50	4
ANTERO RESERVOIR	75.6	37.9	56.7	4.8	85	27	245	2	393	0.81 -0.33	71	4
RUXTON PARK	65.4	40.1	52.8	1.6	77	31	358	0	241	1.99 -0.56	78	8
COLORADO SPRINGS WSO	83.4	54.7	69.0	3.8	98	47	14	143	559	4.32 2.06	191	6
CANON CITY 2SE	89.6	56.7	73.2	5.5	103	50	0	253	632	0.91 -0.40	69	4
PUEBLO WSO AP	91.7	54.5	73.1	2.1	103	48	0	251	608	2.59 1.34	207	7
WESTCLIFFE	80.0	42.7	61.4	3.3	90	32	116	14	463	0.93 -0.19	83	5
WALSENBURG	87.9	56.5	72.2	5.4	100	49	0	222	621	0.49 -0.85	37	4
TRINIDAD AP	90.3	55.5	72.9	4.3	103	47	0	243	615	1.00 -0.58	63	7

# MOUNTAINS/INTERIOR VALLEYS

			Тепр	eratu	ге		Deg	јгее Да	ys	Pre	ipitati	on
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot 👘 I	ер %Мог	n #days
WALDEN	76.5	37.1	56.8	3.2	85	25	239	0	405	0.58 -0	.46 50	5 4
LEADVILLE 2SW	71.8	35.2	53.5	4.7	81	26	338	0	336	0.44 -0	.56 44	45
SALIDA	84.5	43.8	64.1	3.3	94	34	55	36	506	0.20 -0	.70 22	2 2
BUENA VISTA	80.5	45.0	62.7	3.5	90	38	77	17	468	0.91 0	.03 103	36
SAGUACHE	82.1	43.8	62.9	4.4	93	36	87	31	476	0.44 -0	.18 7	14
HERMIT 7ESE	76.2	32.2	54.2	4.2	85	26	316	0	401	0.80 0	.07 = 110	0 2
ALAMOSA WSO AP	82.2	42.5	62.3	2.9	95	33	89	16	481	0.15 -0	.52 23	2 3
STEAMBOAT SPRINGS	82.0	39.2	60.6	5.2	91	29	133	10	481	0.93 -0	.62 6	04
GRAND LAKE 1NW	76.0	36.7	56.3	5.0	86	27	254	1	396	0.89 -0	.74 5!	57
GRAND LAKE 6SSW	74.0	37.6	55.8	3.5	82	28	269	0	367	1.07 -0	.16 8	7 8
DILLON 1E	72.7	36.1	54.4	3.7	82	26	312	0	348	1.19 0	.04 103	38
CLIMAX	63.7	33.9	48.8	3.3	72	26	477	0	211	0.00 -1	.46 1	0 0
ASPEN 1SW	76.8	43.0	59.9	4.4	85	33	149	3	409	0.83 -0	.58 59	95
CRESTED BUTTE	74.1	33.8	53.9	2.4	84	26	324	0	368	0.43 -0	.77 30	54
TAYLOR PARK	70.2	35.3	52.8	2.8	79	28	359	0	311	0.80 -0	.34 70	) 4
TELLURIDE	75.8	38.0	56.9	2.0	84	28	234	Ø	392	0.66 -0	.64 51	15
SILVERTON	72.8	35.2	54.0	3.8	82	29	324	0	351	0.52 -0	.77 4(	) 4
WOLF CREEK PASS TE	64.4	39.0	51.7	3.9	- 75	33	391	0	222	1.91 0	.04 102	2 5

#### WESTERN VALLEYS

			Temp	eratu	re		Deg	ree Da	ys	Precipitation
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
CRAIG 4SW	83.2	44.8	64.0	3.4	94	36	63	43	494	0.53 -0.57 48 5
HAYDEN	83.4	44.3	63.8	3.3	94	31	67	39	501	1.00 -0.22 82 6
MEEKER 3W	86.1	44.7	65.4	4.4	98	33	52	70	522	0.32 -0.62 34 4
RANGELY	89.3	54.0	71.7	4.9	101	43	10	219	604	0.11 -0.71 13 2
EAGLE FAA	83.7	44.9	64.3	4.3	93	33	64	49	513	1.17 0.31 136 6
GLENWOOD SPRINGS	88.5	48.2	68.3	4.7	100	37	17	125	545	0.77 -0.49 61 2
GRAND JUNCTION WS	93.8	61.7	77.7	5.3	104	46	0	388	725	0.04 -0.46 8 2
PAONIA 1SW	90.3	53.5	71.9	5.5	100	45	0	212	603	0.29 -0.55 35 3
DELTA	91.9	53.4	72.6	4.3	103	44	Ō	237	603	0.86 0.36 172 2
GUNNISON	79.6	37.7	58.6	2.8	87	28	185	1	448	0.93 0.35 160 3
COCHETOPA CREEK	81.5	36.4	58.9	3.8	90	27	179	5	474	0.38 -0.38 50 3
MONTROSE NO 2	86.7	52.6	69.7	3.1	97	43	9	156	580	0.22 -0.39 36 3
URAVAN	94.9	56.4	75.7	5.0	105	47	Ó	327	644	1.24 0.79 276 3
NORWOOD	83.1	48.4	65.7	5.1	93	38	39	67	510	1.25 0.39 145 3
YELLOW JACKET 2W	86.2	52.2	69.2	5.2	96	44	10	143	570	0.27 -0.28 49 4
CORTEZ	87.9	48.8	68.3	6.2	96	41	14	124	555	0.20 -0.32 38 3
DURANGO	84.7	48.6	66.7	4.6	93	37	20	79	535	1.00 0.32 147 4
RAILURAA	Q-4 - 1	40.0	00.1	4.0	75	31	20	17	ل ہے کہ	1.00 0.32 147 4

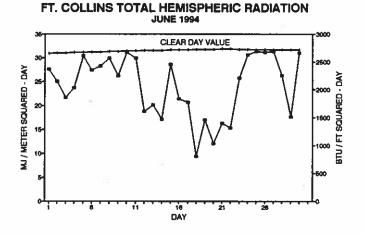
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

#### JUNE 1994 SUNSHINE AND SOLAR RADIATION

	Numb	per of	Days	Percent Possible	Average % of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	10	15	5		
Denver	15	10	5	69%	71%
Fort Collins	10	12	8	••	
Grand Junction	17	9	4	92%	80%
Limon	12	15	3		
Pueblo	NA	NA	NA	90%	79%

CLR = Clear	PC	Ξ	Partly	Cloudy	CLDY= Cloudy
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June delivered large quantities of intense sunshine to southern and western Colorado. Northeastern Colorado had the greatest amounts of cloudiness, but still not as much as in many Junes. There were very few totally overcast days.

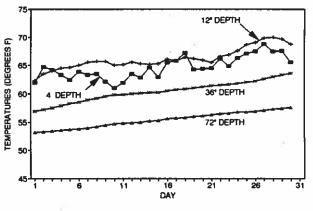


#### **JUNE 1994 SOIL TEMPERATURES**

Soil temperatures climbed throughout the month and reached typical mid-summer values in the top one foot of soil near the end of June.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.





HATS OFF TO: Frankie St

Frankie Stoker of Haswell, Colorado

It's been more than 21 years since Frankie Stoker became the official weather observer in Haswell, Colorado. His precipitation and temperature reports have included some huge storms and some bad droughts – but that is what the climate of southeastern Colorado is all about. Thanks for your diligent help, and keep up the fine work. 200 degrees?? 200 days without precipitation? 200 inches of snow? What is that CSU climatologist talking about?

I know I should be writing something important. I still owe you Colorado Drought Part 3, and I've promised you many other educational features about Colorado's amazing climate. But the fact is I've been gone on vacation and I just haven't felt like it. I'd rather be out enjoying the climate instead of sitting in my office analyzing data, answering requests, writing reports and sending out proposals.

One evening on vacation, while rocking in an old wicker rocking chair after losing an evening game of Scrabble, my mind wandered. For some reason I had a flashback to my first month as a Colorado climatologist. My very first duty was to compile the statistics and write the November 1977 issue of "Colorado Climate" before Christmas vacation. It took me the better part of a week just to find the Colorado weather stations on a map. Figuring out the difference between Two Buttes and Twin Lakes was a tough task.

My mind then brought me back to the present. The shadow of another climate summary needing to be written the minute vacation ended darkened my thoughts. Don't get me wrong - I really do love writing these reports. It's just that I'm always behind. "How many monthly climate summaries have I written?" I asked myself. I counted 6 times, just to make sure. This issue - June 1994 - is my 200th consecutive monthly summary. 200 reports - all the same yet all totally different. No wonder I find myself forgetting which was the 2nd wettest spring and which was the fourth windiest winter.

Any self respecting climatologist knows that 200 months is no big deal. It barely makes a useable climate record. 30 years (360 months) is often the lower limit for defining average temperatures and precipitation. 100 years is hardly enough to understand the fluctuations and extremes of climate. For drought analysis, 300 years is preferred. 16 and 2/3 years (200 months) is just a tiny segment of history. It's just a blip on the global climate record.

Then I noticed a sparkle of light reflecting on the water outside the cabin. The moon was rising over the calm lake. I got up from the rocker and quietly stepped outside. Surrounded by stillness, I could detect the flicker of distant lightning. It was so quiet that I could hear the splash of a hungry fish at least 400 yards away. My attitude softened. I still didn't feel like rushing home to write the June summary, but I realized what an honor it is each month to get to report the never-ending parade of nature's awesome work. The cycle of chilly autumn mornings giving way to winter snows, then spring winds leading on to summer thunder and back to fall again – every year the same cycle yet every year unique and special. It really has been a joy to write every one of these reports. It has made me appreciate each day and has given me a special platform from which to gauge the passage of time.

I hope I can write another 200 climate summaries – 400 would be super. Even better, I hope that people read them and that newcomers find out about "Colorado Climate." I hope many will learn to love our climate as I do. While we rely increasingly on technology to observe our weather and communicate our information. I hope that the human element will remain an essential part of observing and describing our climate. Finally, I hope that I can be a friend to as many of you as possible who earnestly want to understand and enjoy the endless progression of weather events that we call climate.

To this end, I am going to do something that I never dreamed I would do. I am going to ask for money. I have three goals for the future that are difficult to fund through the organizations that normally support climatology. Maybe you could help.

1) Provide part-time employment for high school students to help work on climate research projects (for example, the snow summary we published a few months ago).

2) Expand the distribution of "Colorado Climate" to schools in Colorado (currently we are limited to one subscription per school district).

3) Provide opportunities for weather observers in Colorado to meet, get updated training, and learn more about the many ways that their weather observations are used. (The 1991 Centennial Celebration Program was the first activity like this that we organized.)

If you, a friend, a family member, the company you work for, an organization you are familiar with (or any combination of the above) is supportive of these goals, please consider making a donation. I am not going to send out any brochures or envelopes but I will make sure that you get an appropriate receipt for tax purposes. We are a non-profit organization, as you know.

To give you an idea of what you would get for your money. \$40 would put a high school student to work for about 8 hours - and it's amazing how much they can accomplish in that much time. For a few thousand dollars we could put on a top notch workshop for weather observers and data users.

Give this some thought. If we work together on this, we might do something really useful.

Make checks payable to:

Colorado State University Foundation c/o Colorado Climate Center, Atmospheric Science Department, Colorado State University, Fort Collins, Colorado 80523.

Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

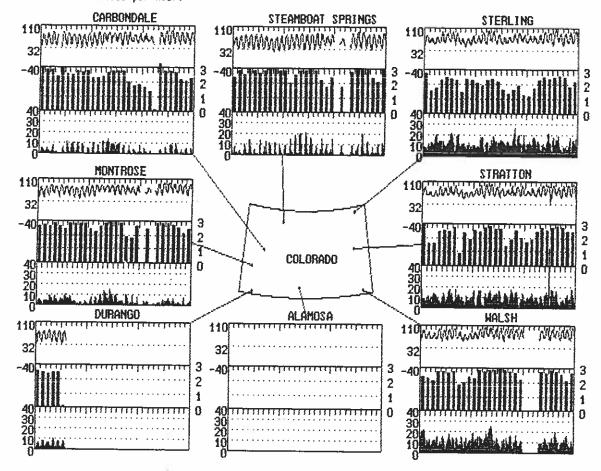
NTHRNET MEATHER DATA

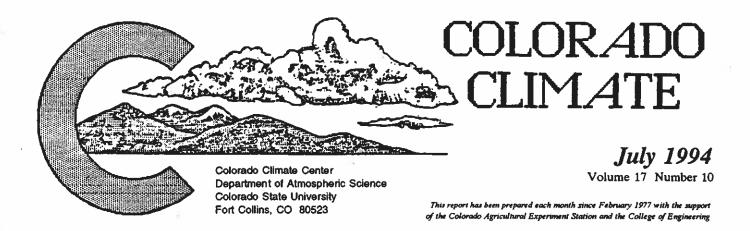
THME 1004

			WIGNNET W	LAIMER VAIA	JUNE 1994			
	A]amosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
month)y	average temp	erature ( 'F )	65.7	70.8	59.5	72.5	72.7	77.5
monthly maximum minimum:	;	extremes and t	ime of occurenc 92.7 26/1 33.1 9/	6 95.5 26/15	92.7 25/16	103.6 26/18 32.0 29/ (		101.7 25/14 53.6 5/ 5
monthly 5 AM 11 AM 2 PM 5 PM 11 PM	average rela n/a /n/a n/a /n/a n/a /n/a n/a /n/a n/a /n/a	tive humidity , n/a /n/a n/a /n/a n/a /n/a n/a /n/a n/a /n/a n/a /n/a	/ dewpoint ( pe: 68 / 36 18 / 38 15 / 38 14 / 38 32 / 34	rcent / *F ) 44 / 35 20 / 43 17 / 41 16 / 40 24 / 35	96 / 34 23 / 41 17 / 39 16 / 38 65 / 41	64 / 47 29 / 47 21 / 46 21 / 45 44 / 45	51 / 43 14 / 37 12 / 38 13 / 38 25 / 35	70 / 54 28 / 53 20 / 50 20 / 48 49 / 53
monthly day day	average wind N/a	direction ( c n/a	legrees clockwis 228 134	se from north ) 242 138	240 111	155 161	130 172	150 198
	ed distribut: O	speed ( miles ion ( hours pe 0 0	2.35	2.95 srly average mp 407 259 5 0	3.29 h range ) 406 157 45 0	9.28 26 522 171 1	8.19 88 502 129 1	9.25 33 456 156 3
monthly	average daily	y total insolat	ion ( Btu/ft²•d 2448	lay ) 2582	2607	2052	2321	2527
clearne 10-80% 10-60% 20-40% 0-20%	ss" distribut	tion ( hours pe	r month in spec 238 84 33 20	ified clearnes 222 65 22 11	s index range ) 175 50 33 7	200 95 78 60	254 69 52 32	231 63 29 16

The State-Nide Picture

The figure below shows monthly weather at WIKRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft\*/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



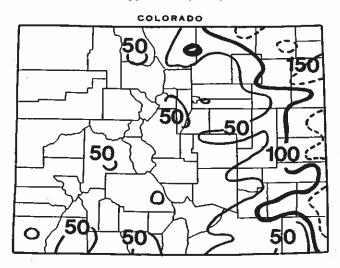


July Climate in Perspective - Hot and Very Dry

July is typically the wettest month of the year for many areas in southern and western Colorado. For the second year in a row, however, persisting westerly and northwesterly winds aloft during July delayed the onset of the Southwest Monsoon weather pattern. Most of Colorado ended up much drier than average. Hotter than average temperatures prevailed west of the mountains, while temperatures were a bit cooler than average over the Eastern Plains. The hot, dry weather with sporadic lightning resulted in numerous forest fires.

#### Precipitation

July is traditionally remembered, by the many campers and vacationers who visit Colorado, as the month when thunderstorms appear nearly every afternoon over the

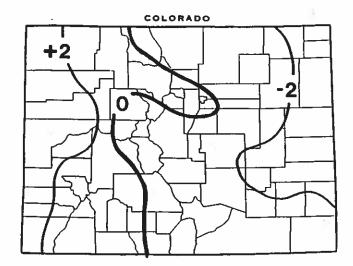


July 1994 precipitation as a percent of the 1961-1990 average.

High Country. For the second straight year, however, most of July's storms developed over eastern Colorado. There were only one to seven days with measurable rainfall at most locations from the mountains to the Utah border. East of the mountains, most areas had at least 8 days with rain, and Holly recorded precipitation on 14 days in July. Rainfall totals ended up much below average over the western 3/4 of Colorado. Only 0.01" was measured at Craig and Grand Junction, while Rangely, Rifle and Alamosa reported just 0.02 inches. Above average totals were limited to extreme eastern Colorado. 6.38" fell at Holly, 296% of average.

#### Temperatures

Hot weather persisted in July over western Colorado. Daily maximum temperatures climbed to 95° or higher at Grand Junction on 27 days during the month. Temperatures for the month as a whole ended up one to three degrees F above average. There were many hot days east of the mountains as well, but several significant summer cold fronts interrupted the heat. Eastern Colorado temperatures ended up one to three degrees cooler than average except in the immediate Denver area where readings continued slightly above normal.



Departure of July 1994 temperatures from the 1961-90 averages.

Inside T	his Issue
July 1994 Daily Weather 114	
July 1994 Temperature Comparison	
July 1994 Precipitation	
July 1994 Precipitation Comparison	
1994 Water Year Precipitation	
1 1994 water rear recipitation 110	

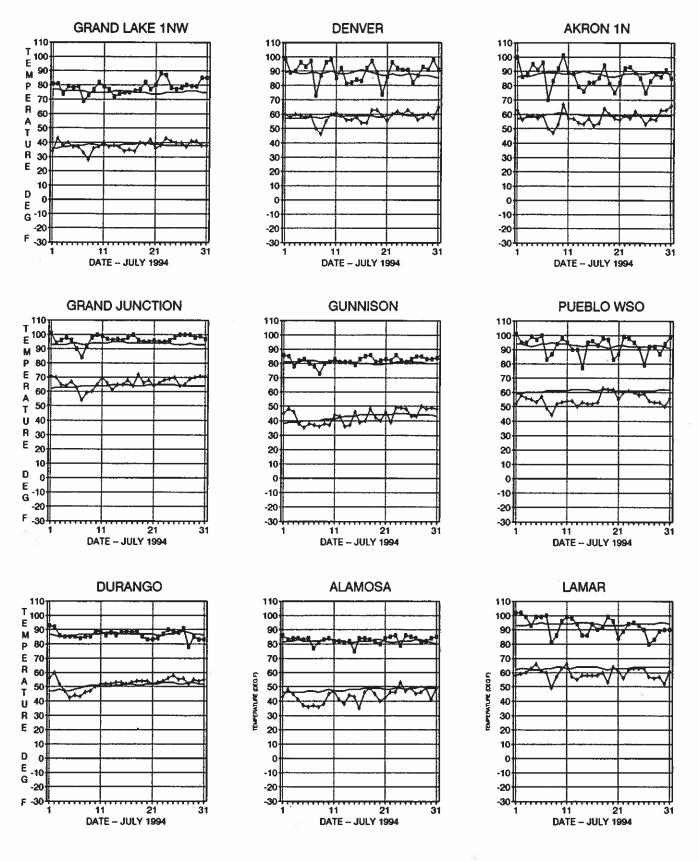
- 1 July began with extreme heat and a few dry thunderstorms with gusty winds. Las Animas and Springfield 7WSW each hit 109° – the hottest in the State. Denver's 99° reading was their highest for the month. A lightning-caused forest fire raced through Colorado State University's Pingree Park mountain campus, destroying many buildings and giving dozens of camp participants a hair-raising scare.
- 2-3 Cooler and more humid air reached Colorado. An upper disturbance triggerred scattered thundershowers over the mountains. The modest 0.18" rain at Crested Butte turned out to be their heaviest storm of the entire month. A few storms also erupted over the Eastern Plains. 1.97" of rain fell at Eads, and damaging hail was reported near Burlington. Temperatures were seasonal on the 3rd with some scattered late-day convective showers.
- 4-6 Colorado enjoyed a typical hot, dry 4th of July. Denver reached 96°F. Similar conditions continued on the 5th. Then a deep low pressure area for this time of year crossed Wyoming on the 6th and dragged a sharp cold front across Colorado. Little precipitation accompanied the front, but strong winds from the southwest shifted to northwesterly during the afternoon. Winds at Grand Junction, for example, averaged 16 mph for a 24-hour period – very strong and sustained for a summer day. These winds, gusting to over 40 mph at times, contributed directly to the devastating wildfire near Glenwood Springs that killed 14 firefighters.
- 7-10 Winds diminished overnight and temperatures dipped below freezing in the mountains on the 7th and 8th. The lowest temperature for the month was 24° on the 7th at Climax and at Fraser on the 8th. Near record cold extended out onto the plains early on the 8th with 41° at Limon and 44° at Pueblo. Some lively storms developed late on the 6th over northeastern Colorado and dropped as much as 1" of very welcome rains. More showers fell near Sterling later on the 7th. Then hot, dry weather returned statewide 9-10th.
- 11-17 Wildfires continued out of control in parts of western Colorado as west northwest winds aloft reinforced the hot, dry weather pattern. Temperatures approached 100° each day from Uravan to Dinosaur. But east of

the mountains cooler air slipped southward and helped trigger several episodes of storms. 1.57" of rain fell at Wray late on the 11th. Storms soaked extreme southeast Colorado daily 12-16th. Holly totalled 3.73" of moisture from 5 successive storms. Fleming measured 1.30" early on the 14th and then got an additional 2.72" later that day, helping to relieve local drought concerns. Spotty fog and low clouds developed overnight on the plains. Finally, there were numerous reports of hail and even some tornado sitings on the 16th. Showers decreased on the 17th.

- 18-20 It was hot and dry over most of Colorado 18-19th, but some much appreciated showers dampened southwestern Colorado. Cool air again moved down over eastern Colorado 19-20th accompanied by lots of clouds and a few storms. 1.03" of rain fell north of New Raymer, and Fort Collins daytime temperature on the 20th only reached 72°F.
- 21-22 Some widely scattered light late-day thunderstorms developed each day. The hottest temperatures of the summer toasted some mountain locations on the 22nd as a high pressure ridge aloft covered the region. Grand Lake hit 88° while Steamboat Springs reached 92°F.
- 23-26 Seasonally hot weather continued over the State. Weak winds aloft combined with a touch of monsoon moisture from the south and some humidity from the Central Plains, resulted in some fairly vigorous and widespread daily thunderstorm activity. Fort Collins measured nearly 1.8" of rain in 40 minutes late on the 23rd. Stratton was pounded by hail and 80 mph winds on the 24th. 3" diameter hailstones were reported in a portion of Morgan County on the 25th. Durango enjoyed 0.67" of rain that same day. Much cooler and drier weather then covered eastern Colorado on the 26th with daytime temperatures staying mostly in the comfortable 70s – while temperatures on the Western Slope were again near 100°F.
- 27-31 July ended with hot daytime temperatures and warm nights. Lows in Grand Junction stayed in the low 70s. There was enough moisture to support daily thundershower development, particularly over southwestern Colorado. Rainfall totals, however, were light.

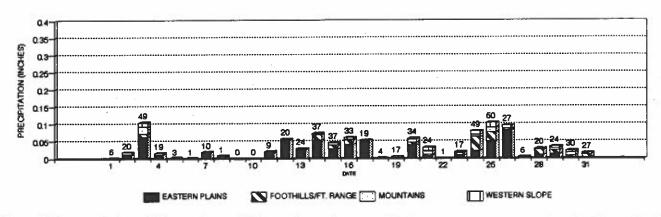
			Weather Extremes	
Highest Temperature		10 <b>9°F</b>	July 1	Las Animas and Springfield 7WSW
Lowest Temperature	2	24°F	July 7 and	Climax and
• 240			July 8	Fraser
Greatest Total Precipitation		6.38"	-	Holly
Least Total Precipitation		0.00"		Cimarron, Colo. National Monument,
				Gateway 1SW, and Uravan
Greatest Total Snowfall		0"		No snow - Some hail accumulations
Greatest Snow Depth		0 <b>"</b>		None reported

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



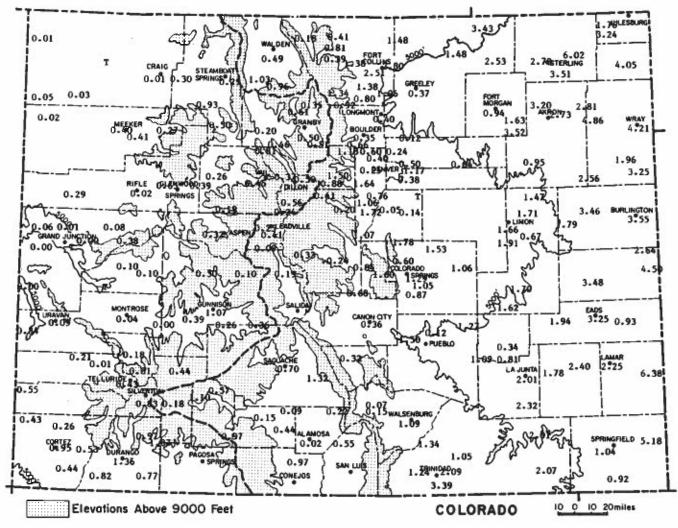
# **JULY 1994 PRECIPITATION**

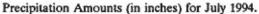
Precipitation fell somewhere in Colorado on most days during July – typical for mid summer. However, widespread showers were limited to the 2-3rd and 24-25th. The Eastern Plains enjoyed frequent storms July 11-17, but little rain fell in the mountains during that period. There were a few heavy storms during the month, but most heavy rains were isolated. Overall, statewide precipitation for July averaged 1.05" which is less than 50% of normal.



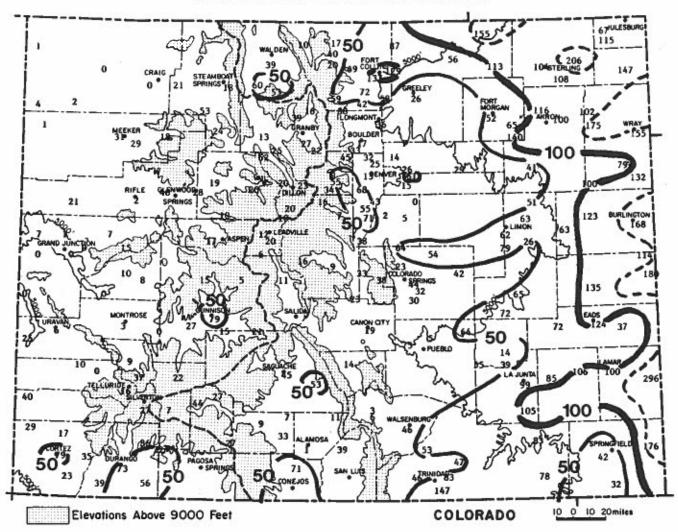
COLORADO DAILY PRECIPITATION - JUL 1994

(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

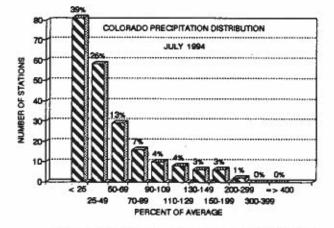




**JULY 1994 PRECIPITATION COMPARISON** 



July 1994 Precipitation as a Percent of the 1961-90 average.



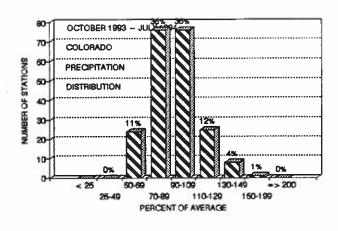
July precipitation was below average at 88% of the official reporting stations in Colorado. 65% of the stations received less than 50% of the average July rainfall and 39% of the stations got less than 25% of average. The eight stations that reported more than 150% of average were all located in extreme eastern Colorado.

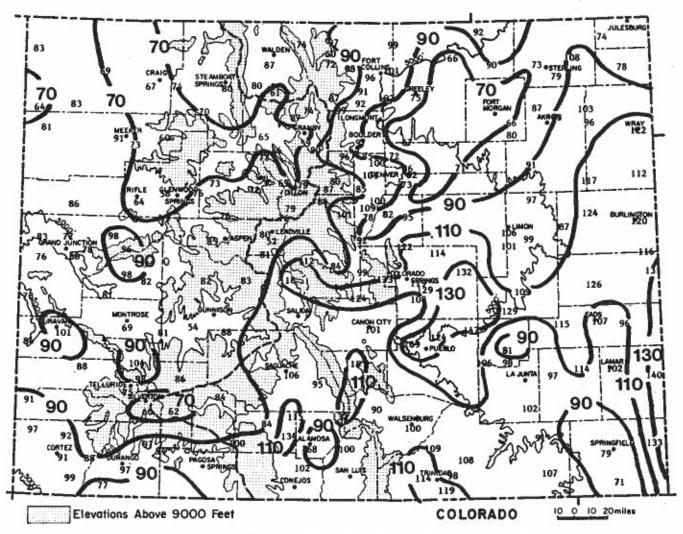
#### JULY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.50"	9th driest in 123 years of record (driest = 0.01" in 1901)
Durango	1.36"	33rd driest in 100 years of record (driest = 0.02" in 1900)
Grand Junction	0.01"	2nd driest in 103 years of record (driest < 0.01" in 1898)
Las Animas	1.78"	62rd driest in 129 years (driest < 0.01" in 1901)
Pueblo	0.12"	2nd driest in 125 years of record (driest = 0.09" in 1987)
Steamboat Springs	0.29"	4th driest in 88 years of record (driest < 0.01" in 1898)

# **1994 WATER YEAR PRECIPITATION**

Statewide water supplies continued to deteriorate as a result of the very dry weather of July. The driest portions of Colorado are the northwest quarter of the State and much of the lower Platte drainage from Denver downstream to Julesburg. Several weather stations in these areas have received less than 2/3 the normal precipitation since 1 October 1993. The shortage of precipitation has been exacerbated by high evaporation rates caused by above average temperatures, plentiful solar radiation, lower humidity and stronger winds than usual so far this summer. Furthermore, unusually warm temperatures in May and June brought an early peak to the runoff from mountain snowmelt. Many rivers had already dropped to their typical late summer levels by early July. Seven of the past 8 years have now produced less runoff than normal for rivers and streams across northern Colorado. Reservoir levels remain near average due to careful management and plentiful summer rains in previous years. However, many lower elevation reservoirs used primarily for agricultural irrigation are being drained quickly this summer. With only two months remaining in the 1994 water year, little improvement is likely before October.





October 1993-July 1994 Precipitation as a Percent of the 1961-90 averages.

**COMPARATIVE HEATING DEGREE DAY DATA FOR JULY 1994** 

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HEATING DEGREE DATA	STATION	GRAND LAKE	GREELEY	GUNNISON	LAS ANIMAS	LEADVILLE	IIMON	LONGMONT	MEEKER	MONTROSE	PAGOSA SPRINGS	PUEBLO	RIFLE	STEAMBOAT SPRINGS	STERLING	TELLURIDE	TRINICAD	WALDEN	WALSENBURG
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• = AVES ADJUSTED FOR STATION MOVES M & MISSING E = ESTIMATED

• = AVES ADUUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# JULY 1994 CLIMATE DATA

### EASTERN PLAINS

	Temperature						Degree Days			Precipitation
			•					-		
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
NEW RAYMER 21N	83.0	52.9	67.9	-1.8	96	42	25	123	545	3.43 1.23 156 8
STERLING	90.6	58.7	74.6	-0.1	102	47	6	311	681	2.73 0.11 104 11
FORT MORGAN	85.6	55.5	70.6	-4.6	97	45	9	189	618	0.94 -0.86 52 8
AKRON 1N	86.5	57.6	72.1	-1.5	101	47	6-	232	647	3.20 0.45 116 8
AKRON 4E	88.1	54.9	71.5	-1.9	102	42	9	218	613	2.73 0.00 100 10
HOLYOKE	84.2	57.4	70.8	-3.9	95	48	6	195	627	4.05 1.30 147 11
JOES 2SE	86.3	55.6	71.0	-4.0	103	45	8	198	610	2.56 0.01 100 8
BURLINGTON	88.0	57.2	72.6	-3.0	98	48	4	249	662	3.55 1.44 168 10
LIMON WSMO	86.8	52.6	69.7	-0.8	98	41	12	168	589	1.66 -1.00 62 7
CHEYENNE WELLS	90.2	56.7	73.5	-1.8	105	45	5	274	656	3.17 0.64 125 7
EADS	90.1	58.3	74.2	-2.5	105	49	2	295	677	3.25 0.63 124 7
ORDWAY 21N	91.5	54.1	72.8	-3.1	100	42	5	255	621	1.62 -0.60 73 9
ROCKY FORD 2ESE	94.2	57.5	75.8	-1.0	103	47	0	342	682	0.81 -1.23 40 6
LAMAR	92.5	58.8	75.7	-1.9	102	48	0	337	696	2.25 0.02 101 10
LAS ANIMAS 1N	93.4	59.7	76.5	-2.6	109	47	0	364	709	1.78 -0.30 86 9
HOLLY	92.6	59.3	76.0	-2.4	108	49	0	345	702	6.38 4.23 297 14
SPRINGFIELD 7WSW	96.4	57.0	76.7	1.0	109	44	0	369	678	1.04 -1.41 42 10

# FOOTHILLS/ADJACENT PLAINS\_\_\_\_\_

			Temp	eratu	re		Degree Days			Precipitation				
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot	Dep	%Norm	#days	
FORT COLLINS	84.8	56.2	70.5	-1.0	93	45	3	182	623	2.51	86.0	137	9	
GREELEY UNC	87.9	56.8	72.4	-1.0	97	47	1	236	649	0.37 -	1.04	26	6	
ESTES PARK	74.5	46.2	60.3	-2.3	82	34	142	5	398	1.34 -	0.90	60	9	
LONGMONT 2ESE	89.1	50.5	69.8	-2.6	100	38	13	170	568	0.40 -	0.71	- 36	5	
BOULDER	86.3	56.0	71.1	0.1	98	45	4	201	626	0.35 -	1.62	18	8	
DENVER WSFO AP	89.5	58.2	73.9	0.4	99	46	3	286	672	0.50 -	1.41	26	7	
EVERGREEN	80.9	47.1	64.0	0.2	88	38	59	- 38	487	1.64 -	0.77	68	11	
CHEESMAN	84.5	38.0	61.3	-4.2	94	29	120	12	515	1.07 -	1.71	- 38	11	
LAKE GEORGE 8SW	76.8	44.6	60.7	-0.3	83	38	126	2	423	0.24 -	2.34	9	6	
ANTERO RESERVOIR	77.4	37.6	57.5	-0.4	85	28	227	2	433	0.33 -	1.70	16	7	
RUXTON PARK	65.5	39.3	52.4	-3.7	72	33	384	0	248	1.60 -	2.55	39	16	
COLORADO SPRINGS WSO	84.4	55.2	69.8	-1.2	93	46	10	165	600	1.29 -	1.61	- 44	12	
CANON CITY 2SE	90.3	58.6	74.4	0.8	97	48	0	301	685	0.36 -	1.52	19	5	
PUEBLO WSO AP	92.8	54.9	73.9	-3.1	101	44	0	283	633	0.12 -	1.98	6	2	
WESTCLIFFE	80.5	40.8	60.7	-2.5	85	32	126	1	483	0.32 -	1.93	14	- 4	
WALSENBURG	87.9	55.3	71.6	-0.7	95	44	1	214	637	1.09 -	1.23	47	5	
TRINIDAD AP	90.1	55.5	72.8	-1.2	98	43	2	250	640	1.05 -	1.14	48	10	

# MOUNTAINS/INTERIOR VALLEYS\_\_\_\_\_

			Temp	eratu	re		Deg	gree Da	iys		Precipitation			
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow		Tot	Dep	%Norm	#days
WALDEN	79.3	37.7	58.5	-0.5	- 88	28	193	0	459		0.49	-0.74	40	7
LEADVILLE 2SW	73.3	36.2	54.7	0.4	78	26	310	0	368		0.41	-1.59	20	6
SALIDA	85.3	45.6	65.5	-0.1	92	37	25	45	543		0.30	-1.35	18	5
BUENA VISTA	82.1	45.9	64.0	-0.7	88	39	50	28	508		0.19	-1.50	11	3
SAGUACHE	80.5	45.8	63.1	-0.6	87	38	76	25	480		0.70	-0.85	45	8
HERMIT TESE	78.5	35.4	57.0	1.0	85	· 29	241	0	451			-1.38	- 44	6
ALAMOSA WSO AP	82.7	43.5	63.1	-1.8	86	35	62	12	515		0.02	-1.17	2	1
STEAMBOAT SPRINGS	85.4	41.8	63.6	1.7	92	33	67	- 31	534		0.29	-1.24	19	5
GRAND LAKE 1NW	78.6	37.8	58.2	1.4	89	28	202	0	449		0.35	-1.78	16	5
GRAND LAKE 6SSW	76.5	39.8	58.1	0.0	82	29	205	0	415		0.61	-0.92	40	10
DILLON 1E	74.7	37.7	56.2	-0.4	80	26	265	0	392	20	0.37	-1.42	21	5
CLIMAX	66.0	36.0	51.0	-0.7	73	24	430	0	255		0.24	-2.12	10	4
ASPEN 1SW	77.7	45.1	61.4	-0.6	83	32	106	2	438		0.32	-1.53	17	3
CRESTED BUTTE	77.4	36.3	56.8	-0.3	82	29	246	0	433	2.0	0.30	-1.66	15	5
TAYLOR PARK	71.6	38.4	55.0	-1.0	77	31	304	2	346		0.10	-1.66	6	2
TELLURIDE	78.6	39.8	59.2	-1.0	84	31	175	2	451		0.43	-2.17	17	5
SILVERTON	75.1	37.4	56.2	0.7	81	31	265	0	397		0.83	-2.15	28	6
WOLF CREEK PASS 1E	67.2	40.8	54.0	0.8	73	35	332	0	276		0 <b>.97</b>	-2.57	27	10

#### WESTERN VALLEYS .

			Temp	eratu	re		Deg	jree Da	iys	Preci	pitati	n
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Deg	XNorm	#days
CRAIG 4SW	86.7	50.0	68.4	1.2	92	40	13	125	564	0.01 -1.29	) 1	1
HAYDEN	85.9	48.5	67.2	0.3	93	36	23	99	556	0.30 -1.11	21	4
MEEKER 3W	89.4	49.1	69.2	2.0	96	38	13	151	574	0.40 -0.88	31	3
RANGELY	93.1	59.0	76.1	2.7	98	48	0	341	679	0.02 -1.04	2	1
EAGLE FAA	85.6	45.6	65.6	-0.8	91	37	16	35	373	0.26 -1.05	20	1
GLENWOOD SPRINGS	92.1	53.1	72.6	2.6	97	44	0	244	619	0.65 -0.70	48	3
RIFLE	93.2	52.2	72.7	2.1	98	42	3	249	609	0.02 -0.98	2	1
GRAND JUNCTION WS	96.5	66.1	81.3	2.5	101	54	0	514	814	0.01 -0.64	2	1
PAONIA 1SW	93.6	57.5	75.6	2.8	101	46	0	335	683	0.10 -1.05	9	1
DELTA	93.8	55.9	74.9	1.2	99	50	0	314	656	0.00 -0.69	0	0
GUNN I SON	82.1	42.7	62.4	0.8	86	35	87	15	507	1.07 -0.28	79	4
COCHETOPA CREEK	84.1	41.2	62.6	1.3	89	33	84	19	531	0.26 -1.44	15	6
MONTROSE NO 2	89.2	54.4	71.8	-0.7	95	45	4	223	635	0.04 -0.97	' 4	1
URAVAN	98.8	61.1	79.9	2.9	103	54	0	471	739	0.09 -1.22	7	2
NORWOOD	85.6	52.5	69.1	2.7	90	35	11	145	600	0.21 -1.76	11	3
YELLOW JACKET 2W 🔅	90.3	54.6	72.4	2.0	95	44	3	238	640	0.43 -1.02	30	4
CORTEZ	90.8	53.4	72.1	4.1	96	41	4	230	629	0.95 -0.25	79	5
DURANGO	86.5	52.1	69.3	0.6	93	42	2	146	598	1.36 -0.49	74	5
IGNACIO 1N	87.5	49.5	68.5	-0.1	93	38	8	125	578	0.77 -0.59	57	5

Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

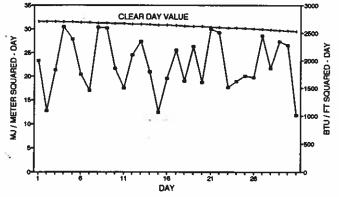
#### JULY 1994 SUNSHINE AND SOLAR RADIATION

	Numb	per of	Days	Percent Possible	Average % of
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	<u>Sunshine</u>	Possible
Colorado Springs	6	17	8		
Denver	9	18	4	64%	71%
Fort Collins	9	13	9		
Grand Junction	14	311	6	86%	78%
Limon	11	13	7		
Pueblo	NA	NA	NA	90%	78%

CLR = Clear Po	C =	Partly Cloudy	CLDY=	Cloudy
----------------	-----	---------------	-------	--------

Convective clouds developed most days, as is typical for July weather. However, the clouds were not as numerous or as thick as usual, especially over western and southern Colorado. As a result, more solar radiation than usual reached much of Colorado.



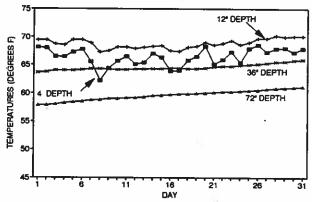


#### **JULY 1994 SOIL TEMPERATURES**

Deep soil temperatures continued to climb steadily during July, while nearer the surface, values began to level off by late in the month.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES JULY 1994





The weather station at Cheyenne Wells has been reporting weather conditions there since 1889. Mr. Lovell took over as the official observer 33 years ago. Since Carl became the observer, Cheyenne Wells has escaped the extreme droughts that plagued the area in the 1930s and 1950s, but local precipitation has still been lower than it was from 1893-1930. Carl, thanks so much for your work, and keep up the fine job.

## FIRE WEATHER IN COLORADO

I had planned on continuing my discussions on drought this month. Fire weather would not have been my chosen topic, but it forced its way into all of our minds during this past month with the help of visible smoke plumes, terrible front page headlines, and vivid news photography.

Colorado took a severe beating from fast-spreading wildfires during July 1994. It will be a year not soon forgotten. The loss of lives of 14 firefighters July 6 near Glenwood Springs and the sudden devastation of parts of Colorado State University's beloved Pingree Park mountain campus west of Fort Collins on July 1 got most of the headlines. But several other fires consumed much larger areas.

We are not fire experts here at the Colorado Climate Center, but our many years of statewide drought monitoring have certainly shown us that climate and wildfires are closely related. Wildfire is often the most dramatic and severe impact that we experience from drought. Unlike other impacts that are tied to specific time scales of drought, wildfires can occur both during short term and long term drought.

#### **Climate Factors Related to Wild Fire**

Wildfires are possible at almost any time of year, but there are some very definite seasonal patterns in fire frequency and severity that are related to our climate. The timing of this year's fires was no fluke. In fact, many of Colorado's severe fires have occurred in early July.

#### 1) Lightning, the great ignitor

The majority of wildfires are ignited by lightning. We don't have wood-burning steam locomotives bellowing out sparks all over the State like we used to. Campers have such neat (and safe) little portable stoves that many don't bother making campfires now. Also, years of Smokey the Bear indoctrination have successfully made most of us fire conscious. As a result, human-caused fires have been reduced in this part of the country despite the increase in population. This year, Governor Romer's summer ban on open fires helped reduce fire ignitions even more.

Lightning, however, is still alive and well. Any cloudto-ground lightning bolt is a potential fire starter. Lightning frequency has a very clear annual cycle here in Colorado. There are almost no lightning strikes in Colorado from November through February. A few strikes begin in March. The number increases dramatically from April to June, especially east of the mountains. By summertime, there can be hundreds or even thousands of cloud to ground strikes in a single day. July is the biggest month for lightning statewide and becomes especially active in and near the mountains. Lightning activity usually remains lively in western and southern Colorado in August but begins to taper off elsewhere. There are some storms in September, but by October the heavens become still again, and we're left to our own devices for starting fires.

#### 2) Fuel to burn

You can't have a fire unless there is something to burn. Fuel consists of grasses, herbs, shrubs, leaves, needles, dead trees, live trees, buildings, and anything else that's flammable. Many folks think you need a thick forest to have a wildfire, but that is not true. It is amazing how little fuel is needed if other conditions are right. Even a sparse overgrazed pasture can burn.

The type and availability of fuel is closely related to our climate's seasonal cycles and episodic variations. For example, the growth of grasses, herbs and certain shrubs are greatly affected by climate. Most growth here occurs during spring and early summer. Then, just a few weeks of hot, dry weather can turn lovely green growth into dry, easily ignited fuel. This is especially true for Southern California where nearly all their precipitation falls during the winter, and almost no rain falls in the summer. There, wet winters are often followed by bad fire seasons.

Colorado's sequences are more complex since we have several different wet and dry seasons. Elevation also plays a role. Precipitation generally increases with elevation and temperatures decrease. The result is varying vegetation regimes and varying fuel sources. The greatest overall fuel sources are found where vegetative growth is greatest. Since these areas are cooler and moister, they are less likely to get dry enough to burn than some of the sparser vegetation. However, under long-tern drought conditions, these denser forests produce some ot the hottest and longest lasting fires like the Yellowstone fires of 1988.

#### 3) Dry enough to fry

When the forests and rangelands are moist, it's hard to start a fire even when you're trying to. Lightning may singe some pine needles and char a tree trunk, but during moist weather, the fires rarely spread. But after the snow is melted, summer temperatures have arrived and we've gone a few weeks without rain, conditions change quickly. In June and July, it may take less than a week of hot, dry weather to change moist grasses, herbs, shrubs and pine needles into dry, brittle fuel that burns almost as easily as dry paper. These fuels dry out quickly but they also moisten quickly. A single rain may suppress the fire danger for a few days.

Long-term fuels such as tree trunks and large branches, the type required to support really large and intense fires, require many weeks and months of dry weather to become dry enough to burn. But once dry, it may take an entire season to be moistened again. The drier it is and the longer it stays dry, the more likely it becomes that larger fuels will burn. Hence, long-term drought affects the potential for very intense large fires. In hindsight, for example, the driest area (compared to average) of westerm Colorado since June 1993 just so happened to have been Glenwood Springs.

Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

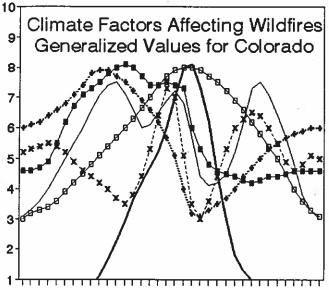
#### 4) Whipped by the wind

A six-year old can tell you that if you want a fire to burn hotter and faster, you have to blow on it. Without some wind, fires rarely get out of control. Wind is truly the biggest and most challenging factor in wildfires. In a matter of minutes, a hot, dry wind can whip a small fire into a raging, racing inferno. In each of Colorado's major 1994 fires, wind played a large role.

While winds may seem whimsical and independent, from a climatic perspective they are fairly predictable. Winds in Colorado exhibit distinct diurnal and seasonal behaviors in and near the mountains. Light winds at night typically become brisk and gusty from late morning until late afternoon on many days from spring on into early autumn. Beginning in the fall and continuing through the winter and spring, strong winds come in episodes that may last for many hours at a time and can continue day and night, especially east of the mountains. The lightest winds of the year are often observed from mid summer into the autumn.

#### Put It In a Pot

The factors described above and shown schematically below all work in combination with available fuel supplies to produce distinct fire seasons in Colorado.





- Wind Gustiness		- B- Temperature
Low Humidity	-X- No Precipitation	

1) A spring fire season typically runs from March into early May and is limited to low elevation range and crop lands primarily east of the mountains. The fuel source is last year's grasses and herbs. This season ends as spring rains arrive, winds diminish and new green vegetation emerges.

2) A rangeland fire hazard emerges west of the mountains beginning in April, May or June depending on when the winter moisture is depleted. This season ends as winds subside and/or when monsoon moisture arrives. During dry summers, this fire season can continue throughout the summer and into the fall.

3) The early July fire maximum is a combination of factors. Summer heat and sunshine are at a maximum. Humidities remain very low and often fall below 20% during the afternoon. Despite low humidity and little rain, lightning strikes become very common. The rapidly drying spring growth of small plants provides plentiful quick fuels while the larger fuels are also drying. Afternoon wind gusts can be very strong in early July, and a few organized large-scale storms can still cross the region (this was the case with the July 6 Glenwood Springs fire).

There is normally a lull in fire activity from late July into August. While lightning activity is very high, humidities normally increase markedly, winds decrease and precipitation becomes more frequently widespread.

4) A final fire season appears after the summer monsoon as humidities decrease again and wind episodes become more likely. Reduced lightning activity minimizes the number of opportunities, and cooler temperatures tend to make this season less troublesome than in July. However, winds can be more persistent and can even continue throughout the night, especially near the Front Range. In years with little monsoon moisture, this season is simply a continuation of (3).

#### **Reducing Our Risks**

We have greatly simplified the subject of fire weather, but we want you to know that we do have high fire risk here in Colorado and it's not just a random process. Risk is a topic which deserves plenty of attention as population in Colorado continues to expand into the forests and interface zones where forest and range meet the developing urban areas. This is not solely a climate question, but understanding our climate helps us appreciate the risks that we face. For more information, contact your local county emergency management personnel, U.S. Forest Service office or Colorado State Forest Service officials.

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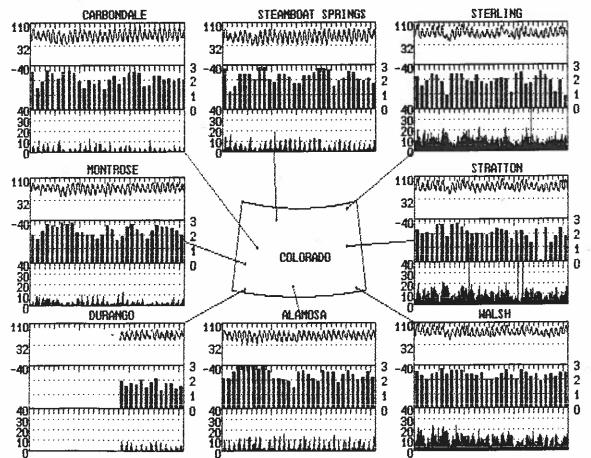
WTHRNET WEATHER DATA

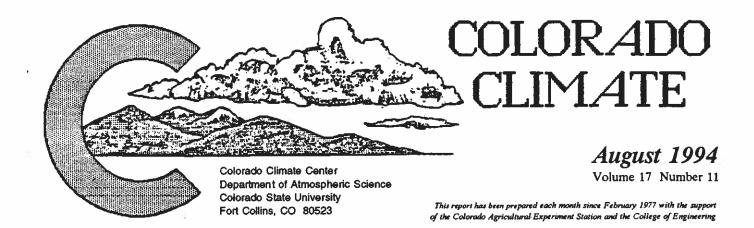
JULY 1994

			WINKRE I W	ENTHER DATE	JUL1 1774			
	Alanosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
<b>e</b> onthly	average tempi 63.0	erature ( *F )	67.1	70.9	61.7	71.8	72.8	75.1
monthly maximum: minimum:	85.1 23/1	15 26/	17 95.5 22/1	te ( *F day/hou 6 92.1 28/16 5 41.4 7/5	r } 89.4 22/16 30.7 8/5			104.5 1/14 46.8 8/ 5
monthly 5 AN 11 AN 2 PM 5 PM 11 PM	average re}at 86 / 42 37 / 51 23 / 45 26 / 43 51 / 43	tive humidity	/ dewppint ( pe 67 / 39 15 / 38 14 / 39 12 / 38 27 / 34	ercent / *F ) 57 / 41 25 / 48 16 / 44 17 / 43 37 / 43	93 / 39 24 / 44 18 / 40 19 / 40 58 / 42	64 / 48 29 / 50 20 / 46 24 / 46 47 / 48	70 / 50 13 / 37 13 / 40 17 / 42 42 / 43	83 / 56 37 / 58 23 / 53 24 / 51 61 / 56
monthly day day day	average wind 198 132	direction (	degrees clockwi 191 n/a	ise from north ) 245 140	212 106	150 181	141 191	134 194
	2.76 ed distribut: 508 215 215 21	speed ( miles ion ( hours p	1.26	1.92 burly average mp 583 160 1 0	2.58 h range } 464 201 11 0	8.49 32 595 116 3	8.47 76 528 137 3	9.04 508 194 2
monthly	average daily 2370	y total insola	tion { Btu/ft <sup>2</sup> 2090	day ) 2275	2201	1924	2061	2333
"clearne 60-80% 40-60% 20-40% 0-20%	955° distribut 146 81 54 26	tion ( hours p	er month in spe 220 96 93 20	cified clearnes 211 102 66 18	5 index range 185 100 57 30	) 177 104 77 60	231 78 44 29	253 83 50 35

The State-Wide Picture

The figure below shows monthly weather at WIKRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



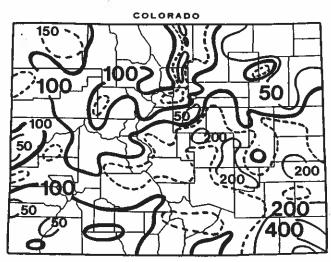


August Climate in Perspective - Wetter but Still Hot

The extreme dryness that Colorado has experienced in recent months ended, at least temporarily, in August as monsoon moisture and humidity from the east encouraged daily afternoon and evening thunderstorm development. The month was especially wet in southeastern Colorado. Precipitation patterns were more spotty elsewhere in the State. The recent tendency toward above average temperatures continued in August as practically all of Colorado was warmer than normal.

#### Precipitation

Thunderstorm activity was frequent in August, especially near the mountains. Several stations had measurable rainfall on at least half of the days in August.

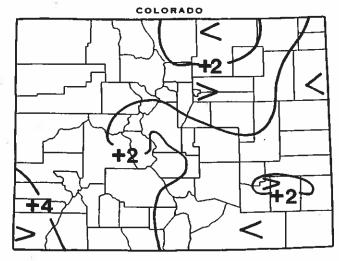


August 1994 precipitation as a percent of the 1961-1990 average.

There were also several torrential downpours during the month. The Springfield 7WSW station had more than 1" of rain on four separate days and ended up with a whopping 9.62" monthly total. Overall, August ended up wetter than average across almost all of southeastern Colorado, much of the Front Range from Denver northward and across scattered portions of western and central Colorado. Northeastern Colorado unfortunately missed most of the storms and ended up much drier than average. Joes reported just 0.29", 15% of average. There were also dry spots in southwestern Colorado and several areas were a little drier than average in the Northern and Central Mountains.

#### Temperatures

Hot temperatures persisted throughout August with only a few brief cooler than average episodes. This was the 6th consecutive month with above average temperatures for the western two-thirds of Colorado. The mercury climbed to 100° or higher ten times during August at Lamar. Denver hit 90° or higher on 20 days. Even Steamboat Springs reached the 90° mark six times. Almost all of Colorado's weather stations ended up 1 to 4°F warmer than average for the month with the greatest anomalies in western Colorado.



Departure of August 1994 temperatures from the 1961-90 averages.

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- 1-2 Locally heavy thunderstorms dropped significant rainfall over scattered portions of Colorado. Most areas along the Front Range reported thundershowers both days. Heavier rain reports includied 1.24" at Gunnison on the afternoon of the 1st (very heavy for that area of Colorado), 2.13" at Akron 1N late on the 1st, 2" at Castle Rock on the 2nd and 2.66" at Sheep Mountain west of Walsenburg.
- 3-7 A ridge of high pressure with very warm temperatures aloft remained centered near the Four Corners area throughout the period. Temperatures soared to near 100° at many low-elevation locations on the Western Slope each day while 80s were common in the mountains. Uravan hit 107° on both the 3rd and 6th. East of the mountains, temperatures were quite comfortable 3-5th, but then heated up quickly 6-7th. La Junta 20S also hit 107° on the 7th to tie for the State's hot spot. Little precipitation fell during the period, although a few thunderstorms developed each afternoon. A few of the storms dropped more than 0.40° of rain.
- 8-9 A surge of moisture into western Colorado brought temporary relief from the heat. With cloudy skies, Grand Junction only hit a high of 82° on the 9th, their coolest day since May. Light to moderate rains were widepread over western Colorado, especially on the 8th. Craig enjoyed 0.85" of cool rain. The Shoshone Power Plant in the Glenwood Canyon measured 1.08". Temperatures east of the mountains stayed hot, especially in the Arkansas Valley. Scattered thunderstorms were locally severe. Greeley had hail and 68 mph winds on the 8th. A tornado was spotted near the new Denver airport.
- 10-14 Humid air from the Midwest covered much of eastern Colorado on the 10th. As a cool front dropped southward from Wyoming during the evening, huge thunderstorms exploded along the base of the northern foothills. These storms continued late into the night and dropped as much as 5" of rain in a narrow band from the Wyoming border south to Denver (see special feature). High humidity lingered, especially east of the mountains, 11-13th. Scattered storms developed 11-12th. Flash flooding was reported around Canon City on the 11th. Most storms on the 12th were light, but Brush and Burlington each reported 1.72". Then, with weak winds aloft, numerous large, slow-moving storms

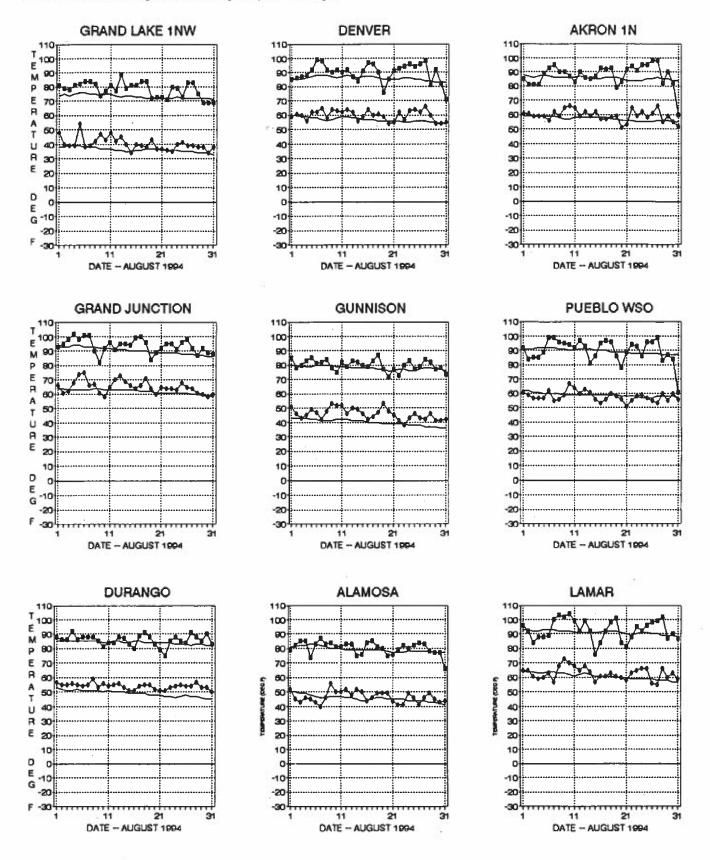
erupted on the 13th from the Front Range eastward. Some of these storms continued late into the night out on the plains. Numerous rainfall totals exceeded 1". The heaviest rains soaked southeastern Colorado where Walsh reported 3.20", Holly got 3.27", Stonington 3.93" and Eads 4.81". It then dried out a bit on the 14th with cool temperatures east of the mountains (only 76° at Lamar) and more hot weather on the Western Slope. Scattered afternoon storms were most vigorous over southern Colorado.

- 15-17 Winds aloft strengthened a bit from the northwest helping to dry out but heat up the atmosphere. Scattered convective showers developed each day, especially near the mountains and over southern Colorado. Grand Junction hit 100° on the 17th.
- 18-21 Another monsoonal surge of moisture moved into western Colorado on the 18th and set off showers 18-19th that dampened nearly all areas in and west of the mountains. Aspen reported 0.64" of rain. Canon City got 1.09". Scattered showers continued 20-21st mostly near the mountains.
- 22-26 Another fling with hot weather for Colorado as temperatures climbed into the 90s each day at lower elevations with a few hundreds. Some thunderstorms developed daily, and evening lightning displays were awesome, but very little rain fell from these storms.
- 27-30 It was still very hot east of the mountains on the 27th, but cooler and moister air moved into westerm Colorado. Denver 98° set a new record. Then cooler temperatures moved into eastern Colorado on the 28th and numerous showers fell statewide. Most rains were light, but several areas in southeastern Colorado got close to 1" of rain. Fountain measured 1.30". High humidity persisted 29-30th helping to fuel many scattered showers and thundershowers.
- 31 The first surge of fallish Canadian air reached northern and eastern Colorado. High temperatures only reached 60° in northeastern Colorado accompanied by low clouds, fog and drizzle. A little snow was seen at high elevations in the northern mountains. Big storms erupted behind the cold front in southeastern Colorado. Springfield 7WSW recorded 2.48" while Stonington added 2.52". Western Colorado remained mild with only some scattered showers.

		Weather Extremes	
Highest Temperature	107°F	August 7	LaJunta 20S
• 63		August 3, 6, 25	Uravan
Lowest Temperature	29°F	August 29	Fraser
Greatest Total Precipitation	9.62"		Springfield 7WSW
Least Total Precipitation	0.29"		Joes
Greatest Total Snowfall	O"		No snow – A few hail accumulations
Greatest Snow Depth	0"		None reported

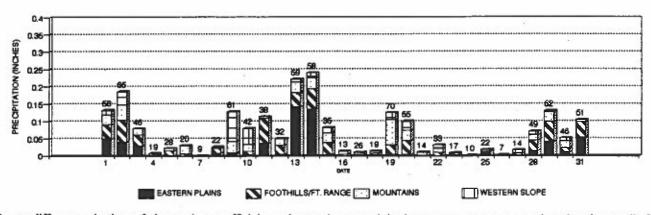
# **AUSGUST 1994 TEMPERATURE COMPARISON**

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



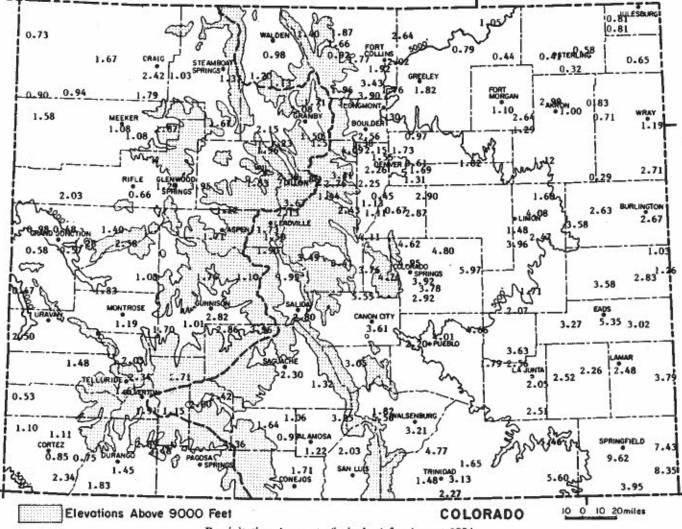
# **AUGUST 1994 PRECIPITATION**

As usual for a summer month, precipitation fell somewhere in Colorado on most days during August. Rainfall was fairly widespread over the mountains and western Slope 8-9th and 19-20th. August 1-3, 10-14, and 28-31st accounted for most of the month's rainfall from the mountains eastward. The combined rainfall, 13-14th averaged 0.45" over the area of Colorado -- the heaviest event since early April. For the month as a whole, statewide precipitation averaged 2.18" which is significantly more than normal.

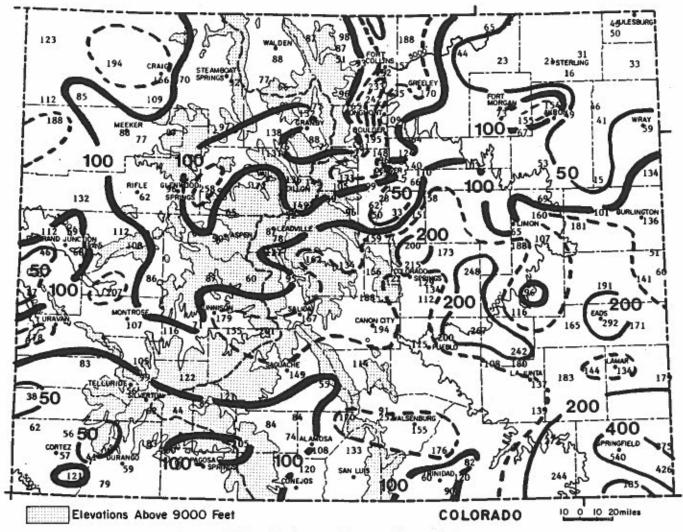


#### COLORADO DAILY PRECIPITATION - AUG 1994

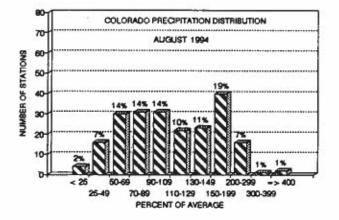
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)



# AUGUST 1994 PRECIPITATION COMPARISON



August 1994 Precipitation as a Percent of the 1961-90 average.



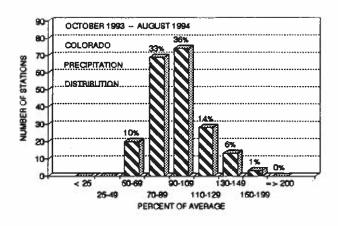
There was a broad distribution of precipitation in August with totals ranging from less than 25% of average in parts of northeastern Colorado to more than 400% of average in Baca County. Overall, the number of wetter than average stations outnumbered drier than average locations modestly.

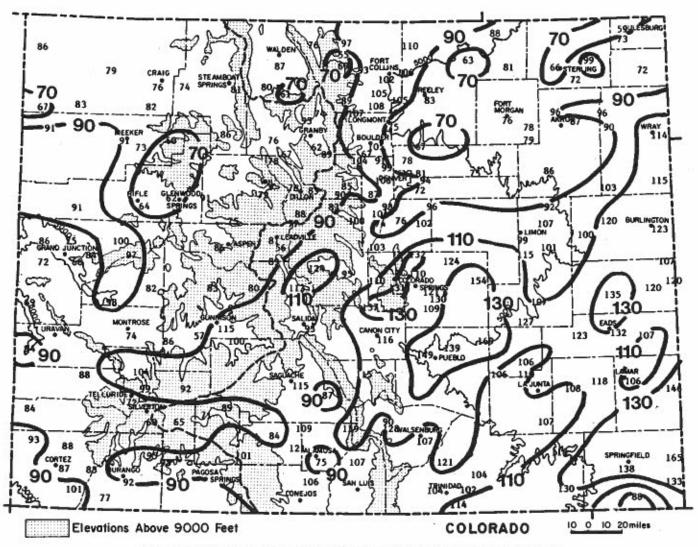
#### AUGUST 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank			
Denver	0.61"	25th driest in 123 years of record (driest = 0.02" in 1924)			
Durango	1.45"	30th driest in 100 years of record (driest = 0.24" in 1985)			
Grand Junction	0.48"	23rd driest in 103 years of record (driest = 0.02" in 1903)			
Las Animas	2.52"	28th wettest in 129 years (wettest = 5.96" in 1916)			
Pueblo	4.01"	9th wettest in 125 years of record (wettest = 5.85" in 1955)			
Steamboat 1.37" Springs		39th driest in 88 years of record (driest = 0.17" in 1944)			

#### **1994 WATER YEAR PRECIPITATION**

Episodes of high humidity helped reduce evaporation rates in August. Days with widespread and locally heavy rains also calmed some of the concerns over drought. However, temperatures remained high, streamflows were still low and reservoir levels continued to decline reflecting the dry conditions that have now prevailed for several months. Also, some parts of Colorado missed out on the August storms. Several counties in northeast Colorado received less than 50% of their normal August rainfall. Portions of central and southwestern Colorado were also quite dry, while areas of southeastern Colorado continued wet as has been the rule throughout the year. Through 11 months of the 1994 water year, 43% of Colorado's official weather stations have accumulated less than 90% of average precipitation. 21% of the stations, nearly all in southeastern Colorado, have received more than 110% of average. The driest areas of Colorado, compared to average, are in the South Platte drainage from Denver to Julesburg. Briggsdale, Sterling and Brighton have received just 63%, 66% and 67% of average, respectively. Almost all stations west of the Continental Divide have reported less precipitation than average with the driest area near Glenwood Springs (62% of average).





October 1993-August 1994 Precipitation as a Percent of the 1961-90 averages.

**COMPARATIVE HEATING DEGREE DAY DATA FOR AUGUST 1994** 

	NNA	10542 10462 393	6306 5957	10516 M 161	5455 5260 3	10670 11106 624	6797 25	6443 6430 13	7714 7373 18	6383 6296 6296	9540 M M	5413 5950 6	6881 M 3	9779 9050 118	6541 6058 6	8986 9875 336	5339 5583 6	10378 10000 353	5438 5052 2
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EB (30)	APR	845 828	492	867 736	370	<b>8</b> 80 80	628	83 F	651 594	510	356 M	396 467	488	678	20 20 20 20	819	44	606 718	E4 84
CENT	MAR		806	1237	707 555	1320 1196	924 766	840 718	998 785	791 664	1029 M	722	825 682	1169 965	653 653	1101 1049	722	1237 1068	744
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MEATING DEGREE DATA	SIATION	GRAND LAKE	GREELEY	NOSINND	LAS ANIMAS	LEADVILLE	NOWI	LONGMONT	MEEKER	MONTROSE	PAGOSA SPRINGS	PUEBLO	RIFLE	STEAMBOAT SPRINGS	STERLING	TELLURIDE	TRINIDAD	WALDEN	WALSENBURG
	ANN	8749 8544 115	8850 8939 191	5554 5646 4	8003 7981 115	6320 6021 4	4987 M 0	6415 6271 24	6667 6404 4	6376 7959 27	5927 6943 0	6020 5544 5	11218 10732 512	6911 6636 \$	8106 M M	8094 7483 107	6368 6002 8	6460 M 17	5548 5297 6
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HEATING DEGREE DATA	STATION	ALAMOSA	ASPEN	BOULDER	BUENA VISTA	BURLINGTON	CITY	COLORADO SPRINGS	CORIEZ	CRAIG	DELTA	DENVER	DILLON	DURANGO	EAGLE	EVERGREEN	FORT	FORT MORGAN	GRAND JUNCTION

\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

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\* = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

# AUGUST 1994 CLIMATE DATA

### EASTERN PLAINS

	Temperature									Precipitation
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days
NEW RAYMER 21N	84.9	52.8	68.9	1.7	95	42	15	143	577	1.05 -0.55 66 3
STERLING	93.1	60.2	76.6	4.5	101	53	0	369	724	0.41 -1.47 22 5
FORT MORGAN	87.7	56.2	72.0	-0.5	96	51	8	228	632	1.10 -0.39 74 7
AKRON 1N	87.7	59.4	73.6	2.2	98	51	9	283	678	2.99 1.06 155 8
AKRON 4E	90.5	56.3	73.4	1.9	100	48	1	267	653	1.00 -1.04 49 8
HOLYOKE	86.6	59.2	72.9	0.4	96	44	3	255	681	0.65 -1.30 33 6
JOES 2SE	89.8	58.7	74.3	1.4	100	48	0	296	688	0.29 -1.71 15 4
BURLINGTON	89.7	59.6	74.6	1.5	100	55	0	308	700	2.67 0.72 137 9
LIMON WSMO	86.5	55.3	70.9	2.4	98	49	13	204	601	1.48 -0.79 65 10
CHEYENNE WELLS	89.8	59.0	74.4	1.3	101	52	4	303	682	2.83 0.83 142 9
EADS	89.7	60.5	75.1	1.2	101	54	7	328	700	5.35 3.52 292 4
ORDWAY 21N	91.6	57.7	74.7	1.6	101	52	0	308	675	2.07 0.30 117 9
ROCKY FORD 2ESE	93.3	59.2	76.3	2.2	103	54	0	358	706	2.56 1.14 180 10
LAMAR	92.8	62.8	77.8	2.7	104	55	0	406	755	2.48 0.63 134 6
LAS ANIMAS 1N	93.6	62.7	78.2	1.9	106	56	3	416	749	2.52 1.15 184 8
HOLLY	91.7	61.5	76.6	1.1	103	55	0	368	730	3.79 1.68 180 5
SPRINGFIELD 7WSW	89.4	59.5	74.4	0.9	100	52	1	300	695	9.62 7.84 540 11

### FOOTHILLS/ADJACENT PLAINS\_\_\_\_\_

	Temperature					Degree Days					Precipitation				
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow		Tot	Dep	%Norm	#days	
FORT COLLINS	84.2	56.4	70.3	1.1	93	51	3	174	614		1.92	0.66	152	11	
GREELEY UNC	88.1	58.0	73.0	1.8	98	53	3	260	666		1.82	0.75	170	8	
ESTES PARK	74.5	47.8	61.1	0.6	84	42	121	10	399		1.96	-0.08	96	14	
LONGMONT 2ESE	90.4	55.0	72.8	2.8	100	50	0	242	612		1.30	0.11	109	7	
BOULDER	85.0	56.7	70.9	1.4	96	50	0	191	633		2.56	1.25	195	16	
DENVER WSFO AP	89.8	60.1	75.0	3.6	99	54	2	318	701		0.61	-0.91	40	9	
EVERGREEN	81.7	47.3	64.5	2.6	90	42	48	40	496		2.25	-0.01	100	12	
CHEESMAN	83.8	39.8	61.8	-1.7	92	32	105	15	513		4.11	1.53	159	17	
LAKE GEORGE 8SW	74.9	46.5	60.7	1.7	81	41	126	1	396		3.41	0.87	134	16	
ANTERO RESERVOIR	74.9	42.1	58.5	2.7	81	34	193	0	395		3.49	1.34	162	17	
RUXTON PARK	64.4	41.8	53.1	-0.8	70	37	362	0	230		4.74	0.86	122	18	
COLORADO SPRINGS WSO	83.3	57.0	70.2	1.6	93	50	14	182	608		3.92	0.89	129	14	
CANON CITY 2SE	90.0	60.9	75.4	4.3	96	53	0	331	724		3.61	1.75	194	17	
PUEBLO WSO AP	89.9	57.9	73.9	-0.4	99	51	6	289	666		4.01	2.01	200	14	
WESTCLIFFE	78.3	43.5	60.9	-0.1	84	35	123	2	445		3.05	0.39	115	16	
WALSENBURG	85.6	57.6	71.6	1.8	93	50	1	215	647		3.21	1.15	156	17	
TRINIDAD AP	88.5	58.2	73.3	1.7	97	53	4	271	666		1.65	-0.36	82	11	

# MOUNTAINS/INTERIOR VALLEYS\_\_\_\_\_

			Temp	eratu	re		Deg	gree Da	iys	F	Precipitation				
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot	Dep	%Norm	#days		
WALDEN	79.2	39.8	59.5	3.0	89	33	160	1	459	0.98	-0.13	88	11		
LEADVILLE 2SW	71.4	37.7	54.6	2.0	76	31	314	0	339	1.50	-0.40	79	17		
SALIDA	83.2	49.0	66.1	2.4	90	43	17	58	540	2.80	1.13	168	18		
BUENA VISTA	79.6	46.4	63.0	0.7	86	43	65	8	469	1.95	-0.10	95	14		
SAGUACHE	79.9	48.5	64.2	2.7	86	43	43	27	482	2.30	0.76	149	11		
HERMIT 7ESE	75.1	39.4	57.2	2.9	81	33	234	0	397	2.00	-0.34	85	9		
ALAMOSA WSO AP	80.3	46.6	63.5	1.1	87	40	53	14	484	1.22	0.10	109	12		
STEAMBOAT SPRINGS	84.6	44.3	64.4	4.2	92	38	49	41	526	1.37	-0.11	93	8		
YAMPA	77.0	47.6	62.3	2.9	85	40	83	10	434	1.67	-0.05	97	12		
GRAND LAKE 1NW	78.3	40.3	59.3	4.4	89	34	172	5	449	1.71	-0.49	78	13		
GRAND LAKE 6SSW	75.4	42.0	58.7	2.1	82	37	188	0	401	2.08	0.51	132	16		
DILLON 1E	73.4	40.1	56.8	2.0	79	34	247	0	371	2.38	0.63	136	18		
CLIMAX	64.0	35.3	49.6	-0.2	77	30	469	0	224		-0.18	92	14		
ASPEN 1SW	77.6	46.9	62.3	1.8	85	40	85	6	440	1.71	-0.19	90	14		
CRESTED BUTTE	75.6	39.8	57.7	2.0	82	32	219	0	405	1.74	-0.26	87	12		
TAYLOR PARK	69.8	40.4	55.1	1.0	77	35	298	0	313	1.10	-0.71	61	7		
TELLURIDE	76.5	42.9	59.7	1.2	84	34	161	2	420	1.61	-1.24	56	14		
SILVERTON	73.6	40.7	57.2	3.5	80	36	235	0	371		-1.13	63	13		
WOLF CREEK PASS 1E	65.9	41.1	53.5	2.2	70	36	348	0	255	4.36	0.23	106	22		

#### WESTERN VALLEYS

			Temp	eratu	re		Deg		Precipitation					
Station	Max	Mîn	Ave	Dep	Highest	Lowest	Heat	Cool	Grow		Tot	Dep	%Norm	#days
CRAIG 4SW	84.8	50.5	67.6	2.2	93	44	14	103	549		2.42	0.97	167	12
HAYDEN	84.4	50.9	67.6	2.8	91	41	12	102	559		1.03	-0.43	71	9
MEEKER 3W	87.4	50.8	69.1	3.8	95	44	5	138	570		1.08	-0.14	89	11
RANGELY	90.4	57.8	74.1	3.4	99	50	2	291	678		1.58	0.74	188	6
GLENWOOD SPRINGS	89.8	54.1	71.9	3.9	97	47	0	222	621		1.29	-0.04	97	7
RIFLE	90.2	53.8	72.0	3.3	98	46	0	227	616		0.66	-0.39	63	6
GRAND JUNCTION WS	93.7	65.1	79.4	3.2	102	58	0	454	795		0.48	-0.33	59	10
PAONIA 1SW	90.9	58.0	74.4	3.7	99	53	0	300	683		1.05	-0.17	86	8
GUNNISON	80.0	45.8	62.9	3.7	87	38	74	14	477		2.82	1.25	180	12
COCHETOPA CREEK	80.8	45.6	63.2	3.6	88	38	66	17	484		2.86	1.02	155	11
MONTROSE NO 2	86.7	55.8	71.3	1.3	93	49	2	204	634		1.19	0.08	107	7
NORWOOD	84.1	52.3	68.2	3.8	92	41	7	114	567		1.48	-0.30	83	9
YELLOW JACKET 2W	87.9	56.8	72.4	4.2	98	52	0	236	659			-0.65	63	10
CORTEZ	89.1	56.4	72.7	5.7	96	51	0	246	662		0.85	-0.63	57	8
DURANGO	85.7	54.1	69.9	3.4	92	50	2	162	605	-	1.45	-0.97	60	15

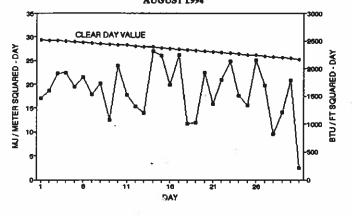
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

### AUGUST 1994 SUNSHINE AND SOLAR RADIATION

	Numb	er of	Days	Percent Possible	Average % of	
	<u>CLR</u>	<u>PC</u>	<u>CLDY</u>	<u>Sunshine</u>	Possible	
Colorado Springs	7	15	9			
Denver	11	10	10	62%	72%	
Fort Collins	8	15	8		**	
Grand Junction	12	10	9	80%	77%	
Limon	11	10	10			
Pueblo	NA	NA	NA	84%	78%	

CLR = Clear PC = Partly Cloudy CLDY = Cloudy

Convective clouds developed most days in August, especially near the mountains. Cloudcover ended up a little more than usual near the mountains but a little less than average in western Colorado. Overall, solar energy reaching the State was about average.

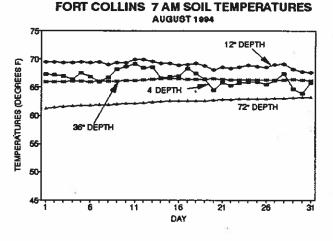


#### FT. COLLINS TOTAL HEMISPHERIC RADIATION AUGUST 1994

### AUGUST 1994 SOIL TEMPERATURES

Despite above average air temperatures, the decreasing daylength and solar energy in August was sufficient to allow soil temperatures near the surface to begin their downward turn annoucing the approach of autumn.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.



### HATS OFF TO: The Federal Aviation Administration at Eagle, Colorado

For nearly 50 years, FAA Flight Service Station personnel at the Eagle County airport have provided us with climate information. This activity ceased this summer. Thanks for the many years of service and the fine long-term climate record. We hope a new Eagle weather observer will soon be found to carry on this important tradition.

## HOW MANY RAIN GAGES ARE THERE? -THE 10 AUGUST 1994 EXPERIMENT

The 10th of August dawned partly cloudy, warm and reasonably humid across northern Colorado. Weather forecasters anticipated an excellent chance for afternoon thunderstorms as a cold front moved slowly southward from Wyoming. One of our graduate students here at the Colorado Climate Center, Captain Pete Clement, got to work early. His research project had targetted the June - August period for collecting data on Front Range intense summer rainfalls and how well new weather radar technology can estimate rainfall amounts reaching the ground. The hot, dry weather so far this summer had slowed his research, so he was anxious for a day with lively storms.

CSU radar specialists hustled to the research facility near Greeley to get the CHILL radar system up and running before storms began to develop. As it turned out, however, there was no rush. Despite humid air, hot sunshine and an approaching cold front, the anticipated storms failed to materialize. Dewpoint temperatures across northeast Colorado climbed to near 60° (usually a sure sign of imminent storm development), but only scattered flat cumulus formed across the region. By about 6 p.m. that evening, Pete made his last call out to the CSU CHILL radar facility. No storms had developed and everyone was disappointed. They decided to call it quits. The radar was turned off for the night, and everyone headed home – outwitted once again by the weather.

That evening, my wife and I attended a parent meeting for our daughter's 3rd grade class. I wasn't close to a window, but as usual, my eyes drifted as often as possible to the outdoor sky. It seemed to get dark unusually fast after the sun neared the horizon, but I wasn't paying that much attention. The meeting dragged on and on, it seemed. Then I began to notice distant but surprisingly frequent lightning on the northwest horizon. I glanced at my watch - 9 p.m. Suddenly I remembered I was responsible for the 10 p.m. weather observation at the Fort Collins weather station. When there was finally a break in the meeting, I informed my wife of my weather station obligation. Reluctantly, she said farewell to the other parents and blamed my weather station duties for interfering once again in our lives. But as we drove toward the CSU campus, she became more forgiving. The storm was obviously more than just another Colorado evening light show. Nearly continuous lightning north-northwest was often nearly obscured by a wall of approaching low clouds and a distant curtain of heavy rain. Intense lightning also appeared over the foothills southwest of Fort Collins. We noticed that a brisk east wind had developed, and the air was as humid as I had ever felt it here.

I could continue with this literary approach to describing the storm. It might make good reading for a few of us. Needless to say (or I wouldn't be writing about it), we ended up having a spectacular storm. By the time we got home at 11 pm, I already had 2.50" of rain in my raingage. Lightning was still flashing in all directions. Sometime well after midnight the thunder finally stilled and I fell asleep. When I awoke the next morning (Thursday, Aug. 11), the newspaper had several stories about the storm. Parts of northwest Fort Collins had been clobbered by an unusual nocturnal hail storm. Farther north near Livermore, reports of washed out roads and flooded homes had been filed. Street flooding as far south as the Denver area had been reported with heavy rains continuing until nearly 4 am in some areas.

Even though the CSU research radar had been shut down, Pete and I decided to undertake a special study of this storm. The National Weather Service radar east of Denver was operating, so we would have plenty to study. We knew it wasn't the worst storm in the world, but it had been unusual and exciting. A close examination would probably help Pete earn his Master's degree.

When we got to work Thursday morning, we developed a strategy. Our plan was to see how many actual rainfall reports we could obtain in order to document the location and evolution of this nocturnal storm event. We didn't have a lot of extra time on our hands, so we decided we would give ourselves 48 hours to dig up all the data we could. Then we would say, "Enough is enough" and analyze what we had. As it turned out, this study took on a life of its own and ended up occupying more than a week of my time. It is late September as I write this, and Pete is still working non-stop on the project. The effort is paying off.

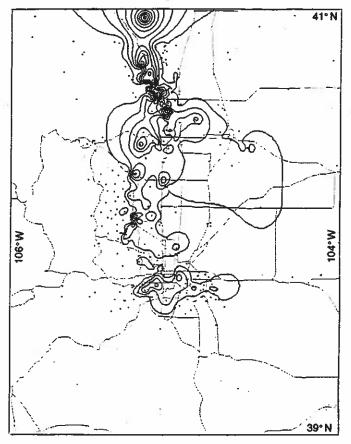
Our little data search turned up some amazing results. What amazed me the most is how much information we could obtain without ever leaving our office. Pete used Internet to let our students and faculty know about our data search. I called Jim Wirshborn of Mountain States Weather Services to get some help and also asked the Fort Collins daily newspaper if they would mention in print that we were looking for rainfall measurements from the storm. Within a few days we had received more than 300 rainfall reports, mostly from Larimer and Boulder counties. My ear got really sore talking on the phone so much, but the enthusiastic assistance of private citizens across the region was truly impressive. We know that people love to talk about the weather, but hundreds of folks in northern Colorado also do a pretty good job observing the weather, too. If we would have enlisted the help of TV, radio and other Front Range newspapers, we would still be tabulating the data. While we have about 220 official National Weather Service weather stations in Colorado to base our monthly climate reports on, I am now convinced that there are potentially thousands of unofficial weather observers in our State that are ready to help at the drop of a pin (or a raindrop).

Let me show you what we have learned so far. The map below shows total storm precipitation for the evening of 10 August 1994 into the early morning hours of 11 August. The storm system initiated near Virginia Dale where more

Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

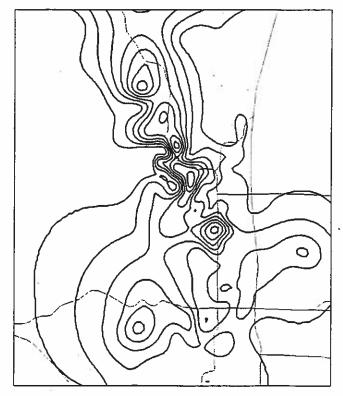
than 5" of rain was reported. As this storm intensified, very moist easterly winds with dewpoints rising into the low 60s created "upslope" conditions along much of the Front Range. Outflow from the Virginia Dale storm enhanced the vertical motions, and storms erupted almost spontaneously throughout the late evening from Livermore southward to Denver.

The heaviest rainfalls were reported right along the lowest foothills and hogbacks from Lyons northward. Several locations received 3" rainfall totals. There was also a pocket of very heavy rain that extended from southeast Fort Collins to Windsor. The community of Laporte, just northwest of Fort Collins, was especially hard hit. A very localized area, not much more than one square mile, was pounded by wind-driven hail. Longtime residents reported to me that they had never seen severe hail so late at night (10-11 pm MDT). Precipitation totals here were measured to be as much as 3.5", but several residents reported that hail had bounced out of their raingages or just plain broken them. Some trash can and paint bucket "unofficial" measurements gave me a pretty strong feeling that actual precipitation may have been closer to 4.5".



Regional storm totals for 10 August 1994 in 0.5 inch increments.

As we analyzed this data an awful thing happened. The more data we received, the less satisfied we became. With only a handful of measurements like we normally have from "official" stations, we rarely see much detail about a storm. We draw smooth contours, and then we move on. But with more than 300 reports, and in some cases several measurements per square mile, the detail was phenomenal. Coffeeshop conversational wisdom has long purported that it can rain heavily on one side of the street while it is dry on the other. Indeed, that is almost what our analysis shows. Near Bellyue and Laporte for example (see Fort Collins-Loveland enlargement below), we found some locations where rainfall increased from just a few tenths to nearly 3" over distances of one mile or less. After seeing these patterns and sharp gradients, we quickly began to loose faith in our analysis where our data resources were sparser. Indeed, for intense local convective storms like this, traditional data networks composed of just a few weather stations per county will never show what actually happened. Even with another 600 reports, we would still be uncertain. (Note: we are assuming that the precipitation measurements we received were all totally accurate and representative - you and I both know that is not a great assumption).



Fort Collins-Loveland area enlargement of the 10 August 1994 storm in 0.5 inch increments.

In the weeks ahead Pete will be analyzing the radar data. With the improved radar and greatly improved radar data processing that we now have, many scientists are hopeful that accurate and very detailed rainfall patterns will be determined even while the storm is still raging (instead of 6 weeks later like what we are doing). We will be anxious to see how our rainfall patterns compare to what the National Weather Service WSR-88D radar detected.

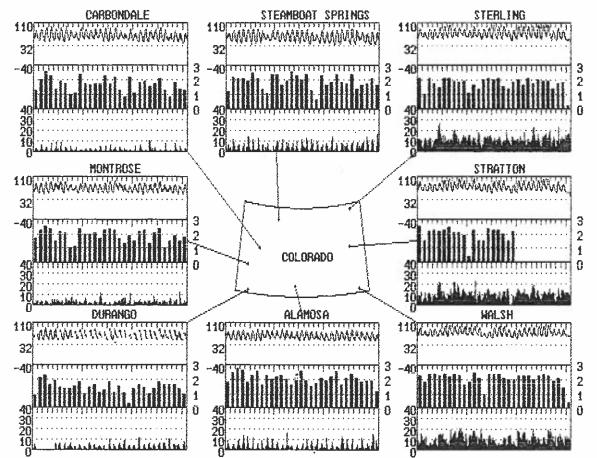
P.S. Many thanks to all who made the effort to contact us with your rainfall reports. I hope you keep your raingages even after radar-derived precipitation maps become commonplace.

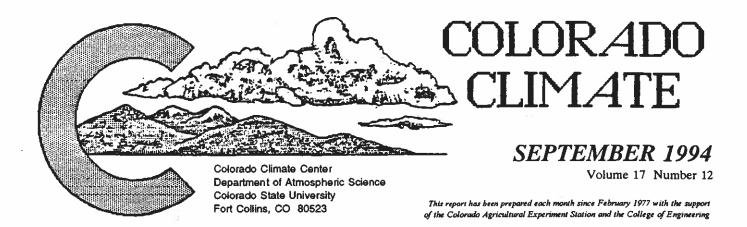
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA AUGUST 1994

Alamosa	Durango	Carbondale	Nontrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average te 62.7	emperature ( 'F ) 64.9	65.7	68.8	61.4	73.5	73.5	75.0
monthly temperatur maximum: 86.5 minimum: 42.4	e extremes and t 7/15 - 88.7 - 3/ 7/4 - 47.1 - 29/	16 96.1 4/1	5 92.7 17/17	89.2 7/14 34.7 23/6			99.9 7/14 55.4 21/ 3
monthly average re 5 AN 92 / 47 11 AM 47 / 55 2 PM 31 / 50 5 PM 37 / 48 11 PM 71 / 50	elative humidity : 80 / 47 n/a /n/a 33 / 52 38 / 51 71 / 50	/ dewpoint ( pe 86 / 47 46 / 50 39 / 57 41 / 56 68 / 51	rcent / *F ) 80 / 50 44 / 57 31 / 52 34 / 52 58 / 51	74 / 43 34 / 48 26 / 45 26 / 44 71 / 46	59 / 47 21 / 44 15 / 42 16 / 41 36 / 43	64 / 50 24 / 45 19 / 45 18 / 43 46 / 47	82 / 59 45 / 61 34 / 58 34 / 57 67 / 59
monthly average wi day 166 day 148	nd direction ( ) 167 85	legrees clockwi 190 n/a	se from north ) 212 144	150 86	165 184	135 183	137 206
monthly average wi 2.16 wind speed distrib 0 to 3 562 3 to 12 168 12 to 24 6 > 24 0	1.59	0.78	1.68 ourly average mpt 619 122 3 0	2.44 (range) 453 193 10 0	8.82 56 549 138 1	8.55 75 541 128 0	8.52 68 513 163 0
monthly average da 2048	ily total insola 1414	tion ( Btu/ft²• 1646	day ) 1865	1871	1710	1470	2057
"clearness" distri 60-80% 135 40-60% 74 20-40% 72 0-20% 37	bution ( hours po 106 78 81 96	er month in spe 157 100 95 57	cified clearness 177 89 84 39	index range 189 79 65 41	) 180 102 54 69	152 59 30 17	247 85 45 36

The State-Wide Picture The figure below shows monthly weather at WTHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft<sup>2</sup>/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



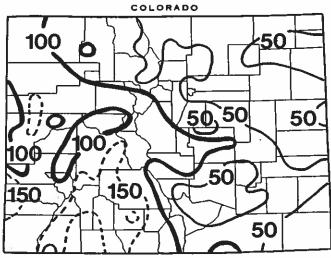


September Climate in Perspective – Varied Moisture But Still Warm

Four significant storm systems brought significant rainfall to western Colorado, but little moisture fell east of the mountains. A compact storm system with very cold arctic air brought the first snow of the season to Denver and parts of the Front Range on the 21st. Between the storms unseasonably warm temperatures were again the rule across Colorado for the 5th month in a row. Temperatures climbed into the 90s on several days during September east of the mountains.

#### Precipitation

The month began with a three-day episode of high humidity and widespread rains. Isolated very light showers fell 4-10th. Thundershowers, some quite lively, developed

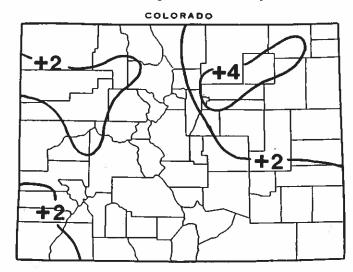


September 1994 precipitation as a percent of the 1961-1990 ave.

daily 11-14th over most of western Colorado. Rains moved into western Colorado 18-20th and 29-30th and then spread eastward. The storm on the 21st brought rain and snow along the Front Range and over portions of the Eastern Plains. Overall, September precipitation totals were near or above average over most of western Colorado. Wolf Creek Pass had a hefty 8.00" total for the month. Rainfall was much lighter across eastern Colorado and the Northern Mountains. Many areas there received less than 50% of average.

#### Temperatures

Colorado's string of consecutive warmer than average months extended to 5 as September temperatures were above average statewide. The warmest areas, compared to average, were found in northeastern Colorado. From Denver to Sterling, September temperatures were nearly 5°F above average. Near record daily high temperatures were reported on several days. Western Colorado was generally 1-3 degrees above average, while southern and southeastern counties were only slightly warmer than usual. Despite these warm monthly temperatures, the 1994 growing season ended one to two weeks earlier than usual east of the mountains with a hard regional freeze on September 22nd.



Departure of September 1994 temps. from the 1961-90 average.

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September 1994 Temperature Comparison	September 1994 Climate Data 144
September 1994 Precipitation	Special Feature – A Review of the 1994
September 1994 Precipitation Comparison	Water Year 146
1994 Water Year Precipitation	JCEM WTHRNET September 1994 Data 149

### **SEPTEMBER 1994 DAILY WEATHER**

- 1-3 September got off to a nice, wet start as monsoon moisture covered western Colorado and upslope breezes helped generate morning fog and low clouds and afternoon thunderstorms east of the mountains. Hail pounded Walden and other locations on the 1st. Rains that continued late into the night from Glenwood Springs to Dillon dropped more than 1" and were responsible for a large mudslide across I-70 at the site of the July Storm King Mountain forest fire. A horrendous storm on the 2nd buried parts of Colorado Springs under several inches of hail. Cloudy, humid weather continued on the 3rd with scattered showers. Wolf Creek Pass received more than 4" of rain from this episode.
- 4-5 Most of the State was warmer and drier on the 4th, but scattered showers continued over portions of southern Colorado. A cold front then crossed the State. Skies cleared and temperatures were cooler on the 5th, especially east of the mountains.
- Summerlike temperatures continued with partly cloudy 6-10 skies. Widely scattered afternoon sprinkles developed each day, and locally strong wind gusts were reported near these clouds. Little or no rain fell in most areas, but Rocky Ford did pick up 0.50" on the 9th. Some westerly downslope winds elevated temperatures to near-record levels 9-10th over northeast Colorado. Denver hit 94° on the 9th. Sterling and Leroy 5WSW both hit 98° on the 10th.
- 11-15 An upper level low pressure area approached California on the 11th and moved gradually towards Colorado. Southwesterly winds aloft strengthened. Temperatures remained warm over eastern Colorado but turned cooler west of the mountains. Wind gusts exceeded 40 mph on the Western Slope each day 11-13th. Evening showers reached southwestern Colorado on the 11th and became more numerous 12-13th. A few spilled across to the Front Range. Storms on the 13th lasted through the night on the Western Slope as the low pressure area and associated cold front pushed eastward. Rainfall measured early on the 14th totalled 0.60" at Grand Junction 6 ESE. Masadona 3E got 0.84". Silverton totalled 2.20" for the 3-day period. Storms diminished on the 14th, but some light snows fell in the high mountains. By the morning of the 15th, it was very fallish in the mountains with lows in the 20s. The rest of the day was cool with northwesterly winds and stratocumulus clouds.

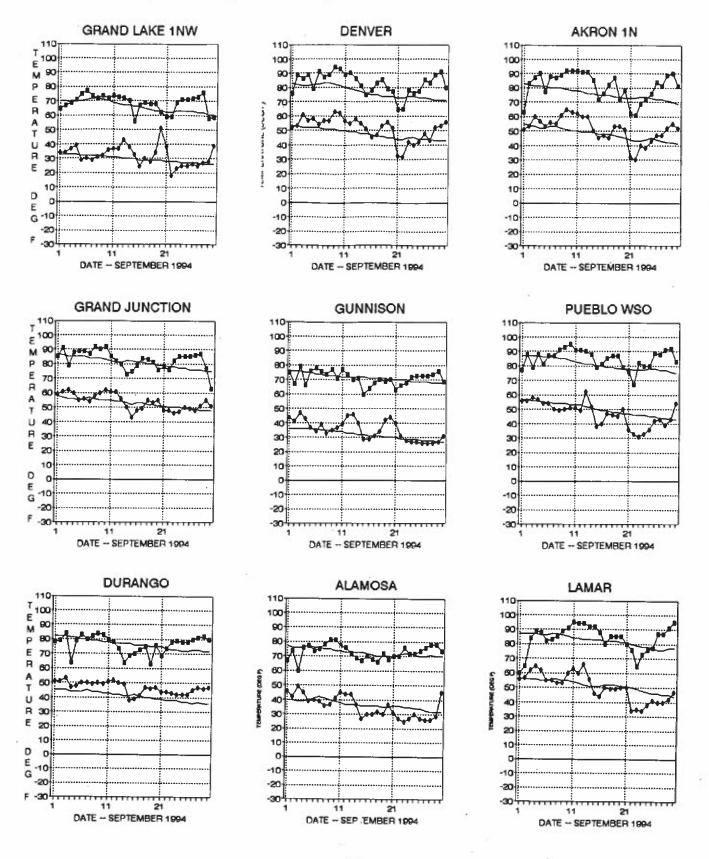
Highest Temperature	98°F
Lowest Temperature	6°F
Greatest Total Precipitation	8.00"
Least Total Precipitation	Trace
Greatest Total Snowfall	5"
Greatest Snow Depth	2"

- 16-17 High pressure returned to Colorado. Morning temperatures were cold on the 16th. Climax registered 10°F. Daytime temperatures rebounded nicely accompanied by plenty of sunshine.
- Clouds and humidity increased on the 18th from the 18-20 southwest. Gusty winds accompanied some late day thunderstorms. It remained cloudy and mild overnight into the 19th. An area of steady rains then moved across western Colorado continuing into the early morning hours on the 20th. More showers developed later on the 20th and spread to the Front Range. Rainfall totals over western Colorado were typically 0.25 to 0.50" with locally heavier totals such as 0.82" at Norwood.
- An early blast of winter plummeted southward from 21-22 Canada and reached Colorado on the 21st. Showers and thunderstorms developed just behind the cold front in eastern Colorado and later turned to snow in many areas. Precipitation totals east of the mountains were typically around 0.30" but Burlington reported 0.92", and 1.66" was measured near Parker. 1-3" snowfall totals were observed by evening along the Front Range north of Monument. The greatest report was 5" at Rocky Flats. Skies then cleared, and the first freeze of the season was widespread across eastern Colorado on the 22nd. Fort Collins dipped to 28°F. Walden reported 11°F. Spicer, southwest of Walden, was the State's cold spot with a 6° reading. The 22nd was sunny but cool with nippy northwest winds.
- 23-28 Eastern Colorado remained cool and breezy on the 23rd, but warmer weather returned quickly elsewhere. The next several days were clear and dry statewide with cool nights but warm days - ideal for enjoying Colorado's autumn colors. Forty to fifty degree daynight temperature swings were common. By the 28th, daytime temperatures were well up into the 80s at lower elevations with some 90s east of the mountains.
- Clouds increased on the 29th and temperatures cooled 29-30 in Western Colorado as a low pressure area approached from California. Very hot temperatures continued east of the mountains with several new record highs. Holly and Campo 7S each climbed to 98°F. Light showers began late on the 29th on the Western Slope and moved eastward on the 30th. Locations near the Utah border such as Rangely and Uravan received more than 0.50", but rains decreased to the east.

		weather Extremes	
Temperature	98°F	September 10	Sterling, Leroy 5WSW
-		September 29	Holly, Campo 7S
Temperature	6°F	September 22	Spicer
t Total Precipitation	8.00"	-	Wolf Creek Pass 1E
otal Precipitation	Trace		Kit Carson 6S, Shaw
t Total Snowfall	5"		Rocky Flats
Snow Depth	2"	Сһетту С	reek Reservoir, Coal Creek Canyon,
-		Gross Reserv	oir, Inter Canyon, Ralston Reservoir

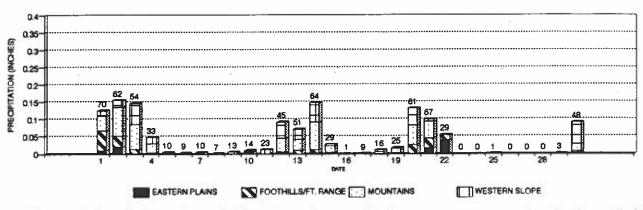
TREATE AN INCOME.

Observed daily high and low temperatures are shown along with smoothed daily averages for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison, and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 5 p.m. The remaining stations shown below report at midnight.)



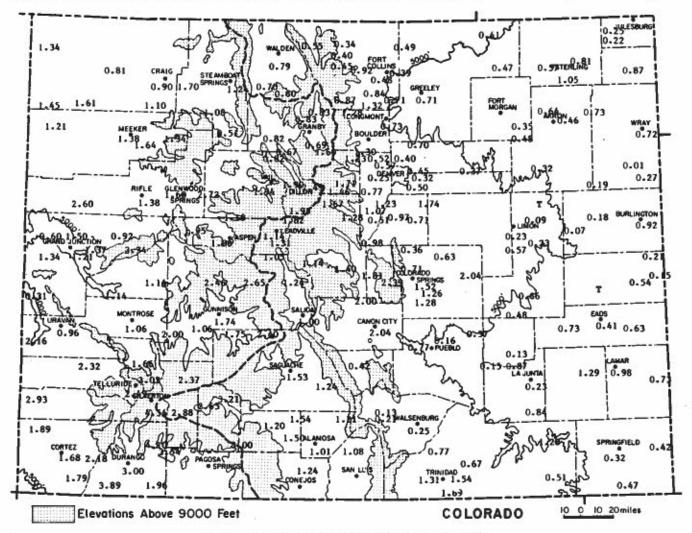
### SEPTEMBER 1994 PRECIPITATION

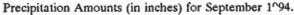
Five precipitation episodes, 1-4th, 11-14th, 18-20th, 21st, and 29-30th provided nearly all of Colorado's moisture in September. Except for the 21st, these storm systems all brought the majority of their moisture to western Colorado. For the month as a whole, precipitation averaged over the entire area of the State totalled 1.30" of which 0.47" fell 1-4th. Western Colorado received considerably more September precipitation than normal, while eastern Colorado was very dry.

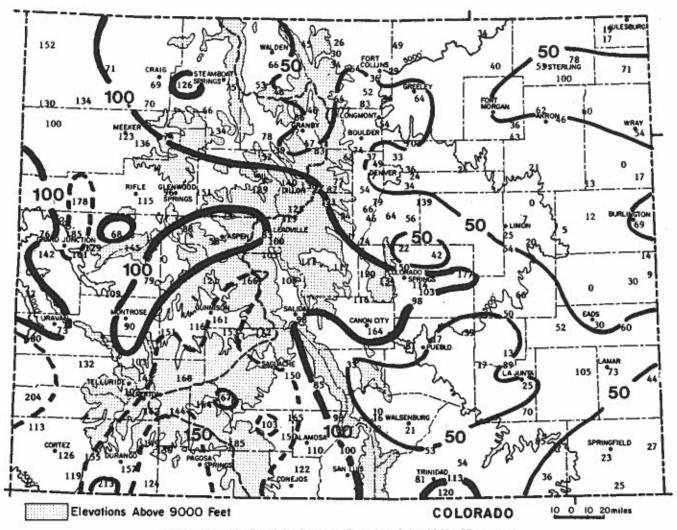


#### COLORADO DAILY PRECIPITATION - SEP 1994

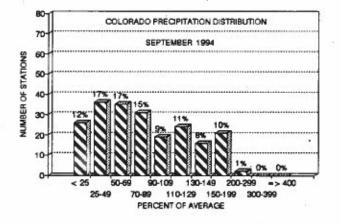
(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)











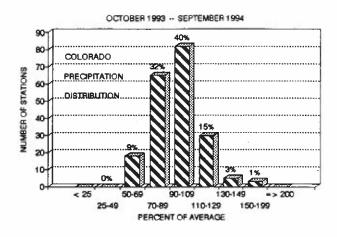
September precipitation totals ranged from less than 25% of average at many weather stations in eastern Colorado to more than 150% of average over portions of southwestern Colorado. Overall, drier than average locations outnumbered wetter than average areas.

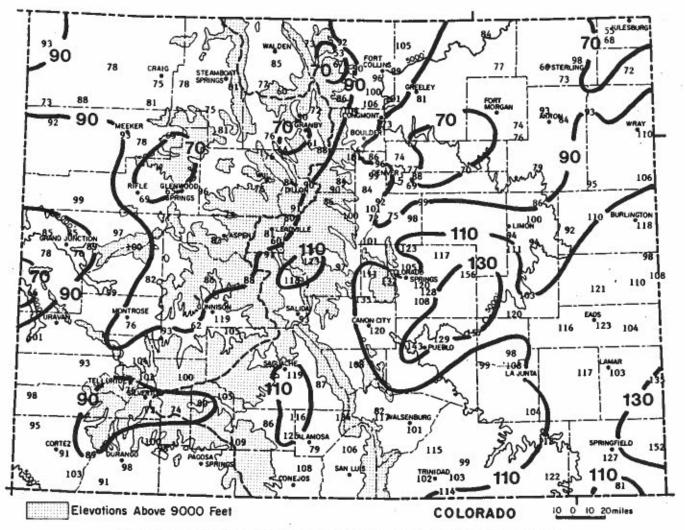
#### SEPTEMBER 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.45"	39th driest in 123 years of record (driest < 0.01" in 1892 and 1944)
Durango	3.00"	18th wettest in 101 years of record (wettest = 7.36" in 1927)
Grand Junction	1.50"	20th wettest in 103 years of record (wettest = 3.78" in 1896)
Las Animas	1.19"	44th wettest in 129 years (wettest = 4.87" in 1941)
Pueblo	0.16*	22nd driest in 126 years of record (driest < 0.01" in 1882, 1892, 1916, 1956)
Steamboat Springs	1.24"	34th driest in 90 years of record (driest = 0.07" in 1953)

#### **1994 WATER YEAR PRECIPITATION**

Our special feature this month (pages 146-148) provides a detailed summary description of the 1994 Water September brought continued Year in Colorado. improvement to moisture conditions in Western Colorado, but brought more dryness east of the mountains. For the year as a whole, accumulated precipitation totals ended up below average across all of western Colorado and northeastern Colorado. More than 40% of the weather stations recorded less than 90% of the water year average. The driest portions of the State were found in the South Platte Basin from Denver to Julesburg. Most of this region received 75% or less of average. There were also very dry areas in western Colorado. The Glenwood Springs weather station recorded just 65% of average. At the same time, parts of southeastern Colorado enjoyed a wet year. For Lamar, Pueblo, and other parts of the Arkansas Valley this was the 5th consecutive wetter than average water year.





October 1993-September 1994 Precipitation as a Percent of the 1961-90 averages.

**COMPARATIVE HEATING DEGREE DAY DATA FOR SEPTEMBER 1994** 

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i¥ (soc)	APR N	828	492	867 736	370 400	904 964	603	525 533	651 514	510 487	756 M	396 467	549	801 678	50t 46t	819 860	444 481	908 814	477
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IATE CI		1361 1404	\$24 1059	1456 1	062 082	1318	981 1058	941 1053	1086	935 982	1011 M	837 815	980 921	1 916 1294	963 1056	1126 1	815 826	1236	620 780
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	G SEP	894 5 894 5 895 8	7 158 15 178 3 68	204 435 M M M 74 343	000	337 522 390 591 314 538	21 189 48 237 13 124	10 171 30 246 0 62	56 261 42 253 5 170	11 143 15 161 2 113	115 324 143 357 M M	0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	23 194 7 199 0 105	156 14 18 285 285 285	9 149 14 193 0 78	204 390 249 455 161 395	7 87 27 123 4 66	510 42 42 42 42	8 105 17 110 1 62
	ILAUG	214 260 297 274 205 188	- • • •	8 M 30	-	225 354 36 36 36 36	8 r ū	0 <u>7</u> 0	835	 • <u>*</u> *	223	• • • •	050	113 168 14 15 14 15 15 15 15		152 20 228 24 175 16	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	189 273 286 262 193 160	- 00
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HEATING DEGREE DATA	STATION	GRAND LAKE	GREELEY	GUNNISON	LAS ANIMAS	LEADVILLE	LIMON	LONGMONT	MEEKER	MONTROSE	PAGOSA SPHINGS	PUEBLO	RIFLE	STEAMBOAT SPRINGS	STERLING	TELLURIDE	TRINIDAD	WALDEN	WALSENBURG
											2								
	NNK	8749 8544 434	8850 8939 526	5554 5646 81	9003 7981 401	6320 6021 64	4967 M 4.2	6415 6271 122	6667 6404 115	6376 7959 223	5827 6943 67	6020 5544 62	11218 10732 1017	6911 6636 108	8106 M M	8094 7483 383	6369 8002 86	6460 M 17	5546 5297 24
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(303) 491-8545	A R	717	771	514 5	128	6 6 6 7 6 6	408	576 2	528 3	681	533	485	008 952	26 19 192	675	12.02	<b>625</b> <b>493</b>	550 550	- 86 96
	MAR A	1014 830	1116 979	744 651	982 882	92 F3	689 603	859 749	853	1094 837	718 758	618 618	1321 1	85.3 695	958 779	1011 859	828 669	831 704	670 540
COLORADO CLIMATE CENTER	FEB M	1153	1162 1	815	1047	946 1068	756	824 826	858	1193 1	888	873	1355 1	962 1057	1080	1039	884 213	1166 1166	12 SS 2 SS 2 SS
IO CLIN		1412 1	1376 1	905	1250 1	1175	888	11 22 10 22	1237	1479 1	1221	1094	1587 10	1246	1435 1	1218 11 1079 11	1156 985 1	1277 M 1	1240 1
ILORAE	C JAN	1473 1:	1330 15	973 10 905 5	1243 12	1132 11 978 10	969	1091	1163 12	1342 14 1369 13	1128 13 1245 13	01, 14501 1976	11484 11	1172 12	1376 14 M 12	1194 12	1113 11	1197 12 M	1125 12
0	V DEC		10 C	726 9 875 9	960 1070 12	្ក ° ស្នួ ឆ្ល	645 B 816 B	<b>816</b> 10 972 10	828 11 926 11			780 10 900 9		546 566			822 944 10		736 11
at i	T NOV	7 1053	1 1029							8 996 9 1168	3 774 8 1052		6 1203 1291		7 981 0 1116	1 945 5 1011		5 500 800	
	P OCT	306 667 342 735 319 319	348 651 425 718 335	136 387 202 508 77	318 620 357 687 266 687	138 181 182 182 182 182 182	91 325 153 435 42	164 468 212 519 98	146 474 165 508 111	275 006 286 619 196	125 403 232 598 67	144 429 152 488 57 488	555 856 579 889 505	203 512 201 522 104	275 617 277 603 M	349 651 347 695 266	176 471 207 533 89	144 445 168 495 M	55 332 59 410 24
	AUG SEP	852	85 22 85 28 96 45 38	~ % 0	5 8 3 5 8 3	a 8 a	= 8 °	80 <b>1</b> 12 2 12 2	2 2 0	2 8 2 2 8 2	0 20 0	5 0 0 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1 7 1	241 55 247 55 247 55	~ ~ % %	2 2 3 M	5 <del>6</del> 8 8 4 3	5 X 5 5 X 5	ອ 00 ອ  1 0	000
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GREE		AVE 93-94	AVE 83-94 94-95	AVE 83.94 94-95	AVE 83.94 94.95	AVE 83-84 84-95	AVE 80:94 94:95	AVE 80-94 94-95	AVE 80-94 94-95	AVE 00-94	AVE 93-94 94-95	AVE 93.94 94.95	AVE 83-94 84-85	AVE 83.94 94.95	AVE 93-94 94-95	AVE 83-94 94-95	AVE 93-94 94-95	AVE 83-94	AVE 93:94 94:95
HEATING DEGREE DATA	STATION	ALAMOSA	ASPEN	BOULDER	BUENA	BURUNGTON	CANON	COLORADO SPRINGS	CORTEZ	CRAIG	DELTA	DENVER	DILLON	DURANGO	EAGLE	EVERGREEN	FORT COLLINS	FORT MORGAN	GRAND JUNCTION

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• = AVES ADJUSTED FOR STATION MOVES M = MISSING E = ESTIMATED

• = AVES ADJUSTED FOR STATION MOVES M = MISSING E & ESTIMATED

# SEPTEMBER 1994 CLIMATE DATA

### EASTERN PLAINS\_\_\_\_\_

		1	empera	ture			D	egree	Days	E F	Precip	itatio	n	
Station	Max	Min	Äve	Dep	Highest	Lowest	Heat	Cool	Grow	Tot	Dep	%Norm	#days	
STERLING	83.8	49.7	66.8	5.0	98	35	78	137	517	0.57	-0.46	55	4	
AKRON 1N	81.3	51.2	66.2	4.4	92	30	83	130	514	0.64	-0.39	62	3	
AKRON 4E	81.0	47.9	64.5	2.2	94	30	109	98	469	0.46	-0.52	47	4	
HOLYOKE	78.9	50.2	64.5	1.8	94	35	99	91	465	0.87	-0.34	72	4	
JOES 2SE	81.5	48.6	65.0	1.8	96	31	95	103	485	0.19	-1.21	14	2	
BURLINGTON	82.1	50.9	66.5	3.0	95	33	80	132	501	0.92	-0.41	69	1	
LIMON WSMO	78.4	45.8	62.1	2.2	90	26	124	44	442	0.23	-0.67	26	7	
CHEYENNE WELLS	84.3	49.1	66.7	2.4	97	31	70	128	530	0.54	-1.21	31	4	
EADS	83.1	50.6	66.8	1.5	94	33	61	124	527	0.41	-0.95	30	3	
ORDWAY 21N	78.8	42.9	60.9	-2.7	89	26	138	25	441	0.48	-0.47	51	4	
ROCKY FORD 2ESE	86.1	48.0	67.1	1.1	95	31	50	120	549	0.87	-0.10	90	5	
LAMAR	83.8	50.4	67.1	0.6	95	34	63	130	540	0.98	-0.35	74	5	
HOLLY	84.8	51.2	68.0	2.2	98	35	51	150	559	0.73	-0.91	45	5	
SPRINGFIELD 7WSW	80.8	50.5	65.7	-0.1	93	31	72	99	512	0.32	-1.05	23	4	

### FOOTHILLS/ADJACENT PLAINS

			Temp	eratu	re		De	egree D	ays	F	recip	itation	1
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot	Dep	%Norm	#days
FORT COLLINS	79.4	47.1	63.2	3.0	88	28	89	42	471	0.48	-0.82	37	4
GREELEY UNC	82.4	48.3	65.3	3.1	93	32	68	84	503	0.71	-0.39	65	3
ESTES PARK	68.4	37.9	53.1	-0.4	76	22	346	0	283	0.87	-0.47	65	5
LONGMONT 2ESE	84.3	46.4	65.4	4.6	96	30	62	83	494	0.73	-0.61	54	- 4
BOULDER	79.7	50.2	64.9	3.9	90	29	77	82	494	0.54	-1.36	28	9
DENVER WSFO AP	82.8	51.5	67.2	4.9	94	32	57	128	540	0.45	-0.80	36	4
EVERGREEN	72.5	38.4	55.4	1.3	87	23	286	6	350	0.76	-0.65	54	7
CHEESMAN	75.8	28.6	52.2	-4.3	84	17	376	Ð	392	0.98	-0.33	75	9
LAKE GEORGE 8SW	67.6	37.2	52.4	0.6	75	22	370	0	273	1.40	0.21	118	10
ANTERO RESERVOIR	67.1	32.4	49.8	1.0	75	22	448	0	262	1.14	0.12	112	13
RUXTON PARK	58.5	34.7	46.6	-0.9	67	26	545	0	137	2.39	0.61	134	9
COLORADO SPRINGS WSO	76.7	48.6	62.6	2.0	85	29	98	33	436	1.52	0.19	114	8
CANON CITY 2SE	81.8	52.4	67.1	4.4	91	38	42	112	536	2.04	0.80	165	8
PUEBLO WSO AP	85.1	46.8	66.0	0.4	95	31	57	94	529	0.16	-0.74	18	3
WESTCLIFFE	72.5	35.0	53.8	-0.3	80	22	332	0	346	0.42	-0.85	33	4
WALSENBURG	80.0	50.2	65.1	2.3	88	31	62	72	498	0.25	-0.94	21	3
TRINIDAD AP	81.7	48.6	65.1	1.2	91	30	66	76	511	0.67	-0.56	54	9

### MOUNTAINS/INTERIOR VALLEYS

	A LUMP													
		Тепр	eratu	re		Deg	ree Da	iys		1	recipi	itation	n	
Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow						
69.7	30.3	50.0	1.4	79	11	442	0	306		0.79	-0.40	66	7	
62.9	30.8	46.9	0.5	71	24	539	0	202		1.31	0.01	101	10	
76.0	38.5	57.2	0.6	83	28	227	2	400		1.00	-0.02	98	8	
72.5	38.0	55.2	0.1	80	27	286	0	347		1.24	0.11	110	9	
71.1	39.4	55.2	1.0	79	31	286	0	323		1.53	0.51	150	10	
67.4	32.1	49.8	2.1	77		449	0	270		2.65	1.04	165	4	
72.9	35.4	54.2	-0.5	81		319	0	348		1.01	0.10	111	6	
	*	55.1				289	0	393		1.24	-0.41	75	8	
		54.0	2.2			324	0	300		0.51	-0.95		6	
			2.6				0				-0.95		. –	
							0							
				• =			0			1.90	0.55	141	12	
							0			1.82	0.30	120	10	
							0			1.01	-0.79	56	9	
							0			2.46	0.43	121	11	
			-0.2			537	0			2.65	1.06	167	10	
			-0.4	• •		395	0			2.49	0.07	103	11	
64.0			1.1	74		491	0	219		4.54	1.75	163	12	
56.5	33.9	45.2	0.1	63	25	587	0	113		8.00	3.68	185	14	
	Max 69.7 62.9 76.0 72.5 71.1 67.4 72.9 75.8 69.5 69.3 68.1 64.7 55.3 69.4 64.7 55.3 69.4 64.7 55.3 69.4 64.7	Max Min 69.7 30.3 62.9 30.8 76.0 38.5 72.5 38.0 71.1 39.4 67.4 32.1 72.9 35.4 69.5 38.5 69.3 32.0 68.1 33.1 64.7 31.3 55.3 26.9 69.4 37.8 66.3 31.7 61.6 32.0 67.9 35.3 64.0 32.6	Max         Min         Ave           69.7         30.3         50.0           62.9         30.8         46.9           76.0         38.5         57.2           72.5         38.0         55.2           71.1         39.4         55.2           67.4         32.1         49.8           72.9         35.4         54.2           75.8         34.5         55.1           69.5         38.5         54.0           69.3         32.0         50.7           68.1         33.1         50.6           64.7         31.3         48.0           55.3         26.9         41.1           69.4         37.8         53.6           66.3         31.7         49.0           61.6         32.0         46.8           67.9         35.3         51.6           64.0         32.6         48.3	Temperatu           Max         Min         Ave         Dep           69.7         30.3         50.0         1.4           62.9         30.8         46.9         0.5           76.0         38.5         57.2         0.6           72.5         38.0         55.2         0.1           71.1         39.4         55.2         1.0           67.4         32.1         49.8         2.1           72.9         35.4         54.2         -0.5           75.8         34.5         55.1         2.9           69.5         38.5         54.0         2.2           69.3         32.0         50.7         2.6           68.1         33.1         50.6         1.2           64.7         31.3         48.0         0.2           55.3         26.9         41.1         -2.2           69.4         37.8         53.6         0.6           66.3         31.7         49.0         0.7           61.6         32.0         46.8         -0.2           67.9         35.3         51.6         -0.4           64.0         32.6         48.3         1.	TemperatureMaxMinAveDep Highest69.730.350.01.47962.930.846.90.57176.038.557.20.68372.538.055.20.18071.139.455.21.07967.432.149.82.17772.935.454.2-0.58175.834.555.12.98669.538.554.02.27869.332.050.72.67768.133.150.61.27464.731.348.00.27255.326.941.1-2.26369.437.853.60.67766.331.749.00.77461.632.046.8-0.27067.935.351.6-0.47764.032.648.31.174	Temperature           Max         Min         Ave         Dep Highest         Lowest           69.7         30.3         50.0         1.4         79         11           62.9         30.8         46.9         0.5         71         24           76.0         38.5         57.2         0.6         83         28           72.5         38.0         55.2         0.1         80         27           71.1         39.4         55.2         1.0         79         31           67.4         32.1         49.8         2.1         77         22           72.9         35.4         54.2         -0.5         81         25           75.8         34.5         55.1         2.9         86         20           69.5         38.5         54.0         2.2         78         20           69.3         32.0         50.7         2.6         77         18           68.1         33.1         50.6         1.2         74         20           64.7         31.3         48.0         0.2         72         21           55.3         26.9         41.1         -2.2 <td< td=""><td>TemperatureDegMaxMinAveDep HighestLowestHeat<math>69.7</math><math>30.3</math><math>50.0</math><math>1.4</math><math>79</math><math>11</math><math>442</math><math>62.9</math><math>30.8</math><math>46.9</math><math>0.5</math><math>71</math><math>24</math><math>539</math><math>76.0</math><math>38.5</math><math>57.2</math><math>0.6</math><math>83</math><math>28</math><math>227</math><math>72.5</math><math>38.0</math><math>55.2</math><math>0.1</math><math>80</math><math>27</math><math>286</math><math>71.1</math><math>39.4</math><math>55.2</math><math>1.0</math><math>79</math><math>31</math><math>286</math><math>67.4</math><math>32.1</math><math>49.8</math><math>2.1</math><math>77</math><math>22</math><math>449</math><math>72.9</math><math>35.4</math><math>54.2</math><math>-0.5</math><math>81</math><math>25</math><math>319</math><math>75.8</math><math>34.5</math><math>55.1</math><math>2.9</math><math>86</math><math>20</math><math>289</math><math>69.5</math><math>38.5</math><math>54.0</math><math>2.2</math><math>78</math><math>20</math><math>324</math><math>69.3</math><math>32.0</math><math>50.7</math><math>2.6</math><math>77</math><math>18</math><math>423</math><math>68.1</math><math>33.1</math><math>50.6</math><math>1.2</math><math>74</math><math>20</math><math>423</math><math>64.7</math><math>31.3</math><math>48.0</math><math>0.2</math><math>72</math><math>21</math><math>505</math><math>55.3</math><math>26.9</math><math>41.1</math><math>-2.2</math><math>63</math><math>10</math><math>710</math><math>69.4</math><math>37.8</math><math>53.6</math><math>0.6</math><math>77</math><math>29</math><math>335</math><math>66.3</math><math>31.7</math><math>49.0</math><math>0.7</math><math>74</math><math>22</math><math>470</math><math>61.6</math><math>32.0</math><math>46.8</math><math>-0.2</math><math>70</math><math>23</math><math>537</math><math>67.9</math><math>35.3</math><math>51.6</math><math>-0.4</math><math>77</math><math>26</math><math>395</math><math>64.0</math><math>32.6</math><math>48.3</math><math>1.1</math></td><td>TemperatureDegree DaMaxMinAveDep HighestLowestHeatCool<math>69.7</math><math>30.3</math><math>50.0</math><math>1.4</math><math>79</math><math>11</math><math>442</math><math>0</math><math>62.9</math><math>30.8</math><math>46.9</math><math>0.5</math><math>71</math><math>24</math><math>539</math><math>0</math><math>76.0</math><math>38.5</math><math>57.2</math><math>0.6</math><math>83</math><math>28</math><math>227</math><math>2</math><math>72.5</math><math>38.0</math><math>55.2</math><math>0.1</math><math>80</math><math>27</math><math>286</math><math>0</math><math>71.1</math><math>39.4</math><math>55.2</math><math>1.0</math><math>79</math><math>31</math><math>286</math><math>0</math><math>67.4</math><math>32.1</math><math>49.8</math><math>2.1</math><math>77</math><math>22</math><math>449</math><math>0</math><math>72.9</math><math>35.4</math><math>54.2</math><math>-0.5</math><math>81</math><math>25</math><math>319</math><math>0</math><math>75.8</math><math>34.5</math><math>55.1</math><math>2.9</math><math>86</math><math>20</math><math>289</math><math>0</math><math>69.5</math><math>38.5</math><math>54.0</math><math>2.2</math><math>78</math><math>20</math><math>324</math><math>0</math><math>69.3</math><math>32.0</math><math>50.7</math><math>2.6</math><math>77</math><math>18</math><math>423</math><math>0</math><math>68.1</math><math>33.1</math><math>50.6</math><math>1.2</math><math>74</math><math>20</math><math>423</math><math>0</math><math>64.7</math><math>31.3</math><math>48.0</math><math>0.2</math><math>72</math><math>21</math><math>505</math><math>0</math><math>55.3</math><math>26.9</math><math>41.1</math><math>-2.2</math><math>63</math><math>10</math><math>710</math><math>0</math><math>64.3</math><math>31.7</math><math>49.0</math><math>0.7</math><math>74</math><math>22</math><math>470</math><math>0</math><math>64.3</math><math>31.6</math><math>-0.4</math><math>77</math><math>26</math><math>395</math><math>0</math><math>64.0</math><math>32.6</math><math>48.3</math><math>1.1</math><math>74</math>&lt;</td><td>MaxMinAveDep 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#### WESTERN VALLEYS

			Тепр	eratur	re		Deg	ree Da	iys	Precipitation	
Station	Max	Mín	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot Dep %Norm #days	
CRAIG 4SW	76.5	40.2	58.4	1.6	85	26	196	1	404	0.90 -0.40 69 10	
HAYDEN	76.3	39.8	58.0	1.9	84	23	203	2	402	1.70 0.36 127 10	
MEEKER 3W	78.1	41.1	59.6	2.4	87	27	170	16	435	1.38 0.26 123 9	
RANGELY	80.6	46.2	63.4	2.3	89	36	88	46	474	1.21 0.00 100 6	
GLENWOOD SPRINGS	80.3	44.0	62.2	2.9	88	34	97	22	467	1.60 -0.06 96 12	
RIFLE	81.4	43.4	62.4	2.3	92	30	105	38	478	1.38 0.18 115 9	
GRAND JUNCTION WS	82.8	53.7	68.2	1.5	92	43	24	126	550	1.50 0.69 185 10	
PAONIA 1SW	80.7	48.5	64.6	2.3	88	40	61	57	486	1.14 -0.30 79 10	
DELTA	82.2	46.2	64.2	1.5	91	36	67	51	497	1.14 0.10 110 5	
GUNNISON	71.3	35.3	53.3	1.6	79	26	343	0	326	1.74 0.66 161 14	
COCHETOPA CREEK	73.5	34.9	54.2	2.6	82	25	318	0	360	1.75 0.61 154 10	
MONTROSE NO 2	77.4	46.2	61.8	0.3	86	39	113	22	430	1.06 -0.11 91 8	
URAVAN	85.5	48.6	67.0	1.2	97	40	27	94	526	0.96 -0.34 74 10	
NORWOOD	74.8	43.9	59.4	2.5	83	33	164	3	380	2.32 0.57 133 9	
YELLOW JACKET 2W	78.6	47.6	63.1	2.5	86	ं 38	78	28	446	1.89 0.22 113 10	
CORTEZ	79.7	45.0	62.4	2.9	86	36	111	41	474	1.68 0.35 126 10	
DURANGO	76.6	46.7	61.6	2.7	84	38	104	11	409	3.00 1.09 157 12	
IGNACIO 1N	74.9	41.5	58.2	0.0	83	31	197	1	387	1.96 0.38 124 12	

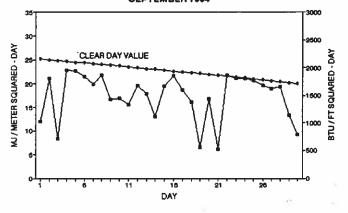
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

#### SEPTEMBER 1994 SUNSHINE AND SOLAR RADIATION

	Numt	her of	Dave	Percent Possible	Average % of
	CLR		CLDY	Sunshine	
		—			
Colorado Springs	8	13	9		
Denver	12	13	5	72%	74%
Fort Collins	12	8	10		
Grand Junction	13	11	6	77%	<b>7</b> 9%
Limon	11	12	7		
Pueblo	NA	NA	NA	88%	80%

CLR = Clear	PC = Partly Cloudy	CLDY= Cloudy
-------------	--------------------	--------------

Partly cloudy weather interspersed with a few very cloudy days in the first half of September gave way to a lengthy period of statewide sunshine later in the month. Overall cloudiness and solar energy for the month were fairly close to average.



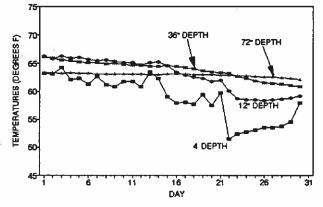
#### FT. COLLINS TOTAL HEMISPHERIC RADIATION SEPTEMBER 1994

### SEPTEMBER 1994 SOIL TEMPERATURES

September 1994 soil temperatures dropped more gradually than normal until the cold front and subsequent killing freeze September 21-22 hastened the cooling.

These soil temperature measurements were taken at Colorado State University beneath sparse unirrigated sod with a flat, open exposure. These data are not representative of all Colorado locations.

#### FORT COLLINS 7 AM SOIL TEMPERATURES SEPTEMBER 1994



# HATS OFF TO:

### Kenneth Thompson at New Raymer, Colorado

Mr. Thompson became the weather observer in New Raymer in April 1965. He is also the Postmaster. His observations have always been thorough, precise and punctual. He has seen temperatures as high as 105° and as low as -32°F. He has also experienced many hailstorms and some truly awful blizzards. Thanks for all you have done and keep up the great work.

#### **Significant Features**

The 1994 water year will be remembered for its warmth, for its dryness and for its fires. The figure below outlines some of the most significant features of the year.

# 1994 WATER YEAR HIGHLIGHTS EVENTS PATTERNS

ОСТ	Statewide Storm	Cold and Snowy
NOV	Record Cold Thanksgiv	
DEC	Mild and Sunny Christn	Windy Little Snow
JAN	Beneficial Snow at Last	Mild for Midwinter
FEB	Brief Coldwave East	Good Mountain Snow
MAR	Big Snowstorm Southea	ast Unusually Warm and Dry
APR	Statewide Storm Hard Freeze – Snow	Changeable
MAY	Wet Storm Southcentral	Warm Early Snowmelt
JUN	Some Heavy Storms Record Heat	Unusually Windy
JUL	Many Forest Fires Stormy East	Hot, Dry Summer
AUG	Heavy Rains Southeast	Monsoon at Last
SEP	Dry East - Wet West	Still Unusually Warm
Ť		

#### 1993 Winter Season

The water year got off to a cold and stormy start with several big storms and many chilly days in both October and November. Widespread heavy precipitation in mid October, heavy precipitation November 11-14 and finally extreme subzero cold on Thanksgiving Day seemed to warn us that we were in for a long, cold winter. But the weather pattern quickly changed. From then until late January heavy storms were nonexistent. There were some cold days but no more serious outbreaks of Arctic air. Many small doses of mountain snow kept skiers content, but the snowpack accumulation began to lag behind average.

A nice widespread snow in late January calmed the nerves of skiers and Colorado farmers and ranchers concerned with drought. Then February brought plentiful mountain snowfall and some cold weather out on the plains. Just as things were looking up, March came along with very warm temperature and little moisture. Only one storm all month whitened the Eastern Plains (March 8th). Temperatures continued to climb in April. Fortunately, several major storm systems early and late in the month improved statewide water supply outlooks considerably. Very cold and snowy weather the last week of April brought beneficial moisture but also brought a severe damaging freeze that affected several crops, especially east of the mountains. For the seven "winter" months combined, October-April, precipitation totals ended up below average over most of the mountains but above average over most of eastern Colorado. As it turned out, this cool-season moisture proved to be valuable for Colorado farmers and ranchers since summer rains were downright stingy.

#### **1994 Growing Season**

After two consecutive cool summers (especially east of the mountains) the pendulum swung completely in the other direction during 1994. Warmer than average temperatures persisted with only a few brief interruptions for the entire May-September period across all of Colorado. For several areas including Denver and Grand Junction, this was the warmest or close to the warmest growing season on record for the past 100+ years. Denver accumulated a total of 60 days with temperatures climbing to 90° or above. Several days scattered throughout the growing season saw record or near record high temperatures. The 104° at Denver and 95° at Alamosa June 26 came within one degree of each city's all time highest recorded temperature. An early freeze ended the growing season September 22 most everywhere east of the mountains. This did not cause much of a problem since hot temperatures all summer had already caused full maturation of most crops.

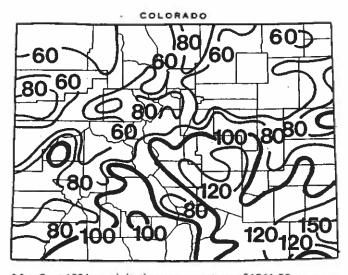
As is often the case, hot weather was accompanied by less precipitation than normal. There were some heavy storms each month, and even some significant localized flooding (for example, Pueblo 6/3, Fort Collins 6/20, Kremmling 6/21, near Sterling 7/14, Canon City 8/11, southeast Colorado 8/13 and 8/31, Colorado Springs 9/2). But for the majority of Colorado it was a very dry growing season. Much of Colorado was drier than average each month except in August when beneficial rains were more widespread. For the second year in a row, the afternoon thundershowers that typically occur daily in July over the mountains were nearly nonexistent.

The hot and dry weather was exacerbated by frequent strong winds from May into July. The inevitable result of this combination was very high evapotranspiration rates, rapid water consumption and an extremely ferocious wildfire season. The summer will be long remembered for the fire that raced through Colorado State University's Pingree Park mountain campus on July 1 followed on July 6th by the Storm King Mountain fire near Glenwood Springs that claimed the lives of 14 firefighters. There were numerous other fires many of which were larger in area.

Another direct impact of the 1994 weather pattern was a very early peak in streamflow from snowmelt runoff. Most rivers peaked in May and by late June had already declined to their normal late summer flows. Summer water temperatures were unusually high in several of Colorado's rivers and streams which may have adversely impacted the fisheries of the State.

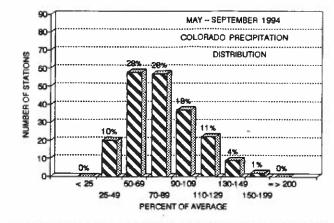
Unless noted otherwise, the special features contained in Colorado Climate are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

On the bright side, there were not as many hailstorms or tornadoes as in some recent summers. Still there were combined losses totalling millions of dollars to crops and property from several of the hailstorms. Also, Colorado's water supplies stored in reservoirs were above average before this summer so many areas had adequate water supplies despite low streamflows and high consumption rates.



May-Sept 1994 precipitation as percentage of 1961-90 average.

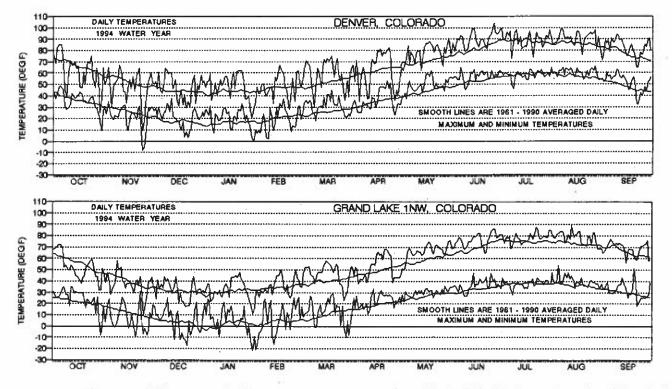
Overall, the 1994 growing season was one of the driest in recent memory for portions of northeastern and western Colorado. Approximately 2/3 of Colorado received less than 90% of the growing season average precipitation. Denver, Byers, Brighton, Sedalia, Sedgwick and other locations in northeastern Colorado totalled less than 50% of their normal growing season precipitation. In these areas, the 1994 growing



season now ranks as one of the 5 driest growing season this century. Areas of northwestern Colorado were comparably dry. Grand Lake 1N received only 4.22" (43% of average) and Rifle just 2.47" (46%) during the growing season. At the same time, southeastern Colorado enjoyed average to above average rainfall for the season. A few stations reported more than 130% of average.

#### **Temperature Summary**

The graph below gives an indication of how temperatures varied through the year on a daily basis. There were severe, but fairly brief, blasts of colder than normal air in October and November. During midwinter, there were only a couple of 1-2 week episodes with colder than average temperatures, and many days were mild. Some episodes of cold air occurred from late March through April. Then practically the entire growing season was near or above average until the quick freeze struck in late September. There were very few temperatures all year near record low

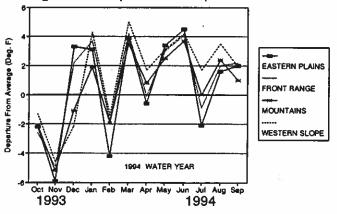


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levels, while several days during the growing season approached new record highs.

An interesting feature of the 1994 Water Year was that temperature anomalies tended to affect nearly all areas of the State at the same time. This is often not the case in Colorado. The autumn was much cooler than average statewide. The persistent above average temperatures in spring and summer also occurred statewide (except in July when eastern Colorado got some relief). Even midwinter temperature patterns, which often differ greatly, were fairly uniform across Colorado. December was the only month with large differences (with respect to average).

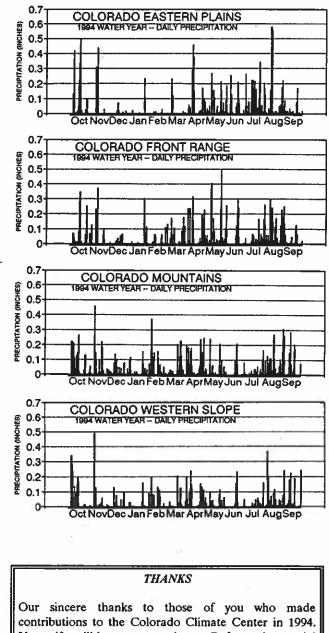




#### **Precipitation Summary**

The 1994 Water Year brought less precipitation than normal to the majority of Colorado. Over the entire area of the State, precipitation for the year ended up 95% of the longterm average and 11% less than last year. Portions of northern Colorado were especially dry with several areas totalling less than 70% of average. Southeastern Colorado was the only region that avoided the dryness. As usual, there was a great deal of spatial variability in precipitation throughout the year. In all 12 months both drier and wetter than average conditions occurred within the State borders. In 10 out of 12 months, precipitation totals at individual Colorado weather stations ranged from less than 25% to more than 200% of average. In 9 out of 12 months, weather stations reporting below average precipitation outnumbered those reporting more moisture than average. The wettest location in Colorado for the year, based on data from official National Weather Service raingages only, was 48.43" at Wolf Creek Pass 1E. The driest location was Alamosa with just 6.05".

Daily precipitation events through the year are shown in the graphs that follow. In general, there were fewer precipitation days than usual across Colorado during the past year. A few large storms accounted for a large percentage of the year's precipitation. This is a normal part of climate in semiarid regions. Especially noteworthy on these graphs was the lack of midwinter precipitation, especially east of the mountains, and the small amounts of May-July precipitation particularly in the mountains. Streamflow and surface water supplies were below average in 1994. Winter snow accumulation was somewhat less than normal, but the lack of heavy March-May precipitation in combination with the extremely warm and dry summer resulted in less runoff than would normally occur from the winter snowpack. Fortunately, there are signs that water conservation policies and practices that have been deployed over the past decade in Colorado may be paying dividends. Overall water consumption was less than might previously have been projected for a year like this. Reservoir storage was depleted somewhat, but carryover storage for 1995 is still in fairly good shape for much of the State.



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#### WTHRNET WEATHER DATA SEPTEMBER 1994

	Alamosa	Durango	Carbondale	Nontrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly	average tempi 54.4	erature ( *F ) 56.4	55.9	59.3	51.7	65.0	65.3	67.1
monthly maximum; minimum;	79.9 10/1	15 79.2 2/3	ime of occurence 15 86.0 8/15 7 28.4 23/6	5 84.6 9/15	r) 83.5 8/15 17.1 22/6	97.5 10/15 31.8 22/6		95.0 29/14 34.7 22/6
aonthly 5 AM 11 AM 2 PM 5 PM 11 PM	average relat 88 / 36 38 / 43 27 / 41 31 / 40 63 / 38	tive humidity ; n/a /n/a n/a /n/a 30 / 44 28 / 41 64 / 40	/ dewpoint ( per 92 / 39 47 / 48 35 / 48 38 / 47 65 / 42	rcent / °F } 77 / 40 40 / 46 29 / 43 27 / 41 55 / 41	93 / 32 33 / 39 22 / 38 25 / 36 67 / 36	47 / 36 19 / 37 16 / 37 16 / 36 32 / 32	74 / 46 36 / 51 27 / 49 28 / 48 56 / 46	74 / 47 38 / 52 28 / 50 27 / 47 55 / 47
monthly day day	average wind 202 147	direction ( a 194 82	legrees clockwis 206 n/a	se from north ) 234: 145	218 106	187 220	189 1216	176 227
	average wind 2.26 ed distributi 519 186 7 0	speed ( miles 1.72 on ( hours pr 513 167 0 0	per hour ) - 0,79 er month for hou 489 45 0 0	1.82 sr]y average mpi 575 144 1 0	3.13 ) range ) 389 221 10 0	8.62 57 530 131 2	8.82 24 546 150 0	9.17 55 455 207 3
monthly a	average daily 1835	total insolat 1344	ion ( Btu/ft2+d 1501	lay ) 1685	1663	656	n/a	1825
*clearne: 60-80% 40-60% 20-40% 0-20%	55" distribut 130 42 47 20	ion ( hours pe 143 67 48 71	r month in spec 181 86 59 32	ified clearnes: 177 70 48 19	5 index range ) 151 48 45 32	69 25 13 23	n/a n/a n/a n/a	238 57 31 15

The State-Wide Picture

The figure below shows monthly weather at WIHRNET sites around the state. Three graphs are given for each location: the top graph displays the hourly ambient air temperature, ranging from -40°F to 110°F, the middle one gives the daily total solar radiation on a horizontal surface, up to 4000 Btu/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.

