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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Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

December 1994

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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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TABLE OF CONTENTS

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 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 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 long-term 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), 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 (≥ 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:

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.

8) 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 1994 Experiment, 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°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°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°F and a minimum of 10°F the mean daily temperature is 25° and the heating degree total is 40. When the mean daily temperature is 65° 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° 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 *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.

COLORADO CLIMATE

OCTOBER 1993

Volume 17 Number 1

Colorado Climate Center
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Fort Collins, CO 80523

This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

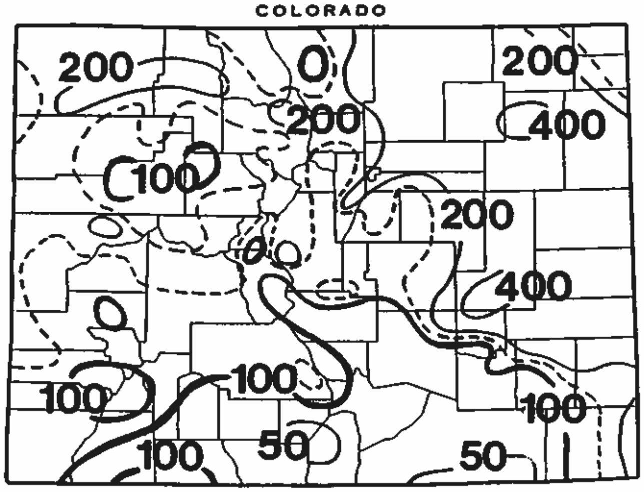
October in Perspective – Stormy and Extreme

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 near-record 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

COLORADO



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

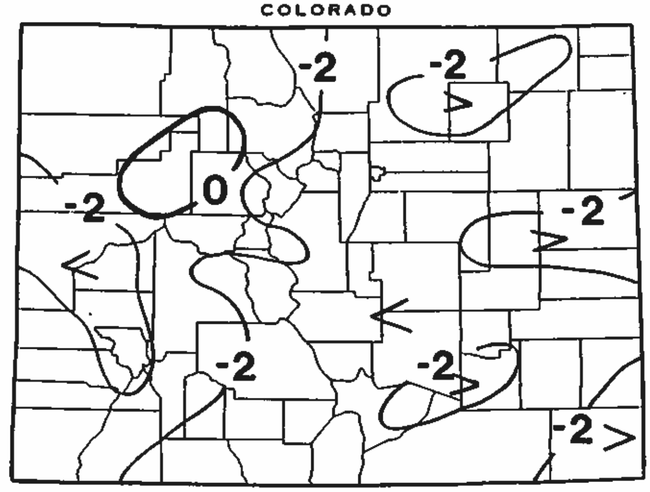
200% of average over portions of northern Colorado and across wide areas of the Eastern Plains. The 3.71" total at Akron 4E was their wettest October on record this century.

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.

COLORADO



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

Inside This Issue

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.

11-20 A chilly morning on the 11th (10° in Fraser) was 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, west-southwesterly 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 high-mountain 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 reported 13-16th. Hayden received a 0.80" 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".

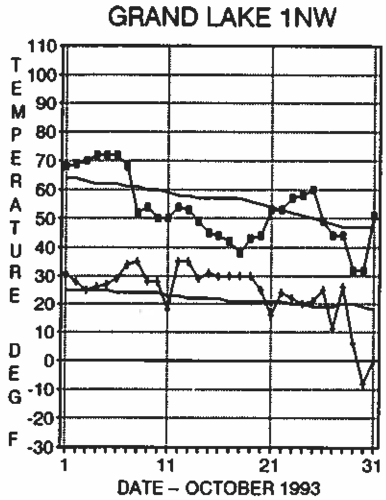
27-31 After a chilly morning on the 27th (-1°F at Center), temperatures warmed and high clouds increased. Strong west-northwesterly winds gusting to 30-65 mph in wind-prone areas developed late in the day. An Arctic cold front then reached Colorado on the 28th. Along with much colder temperatures, precipitation 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.

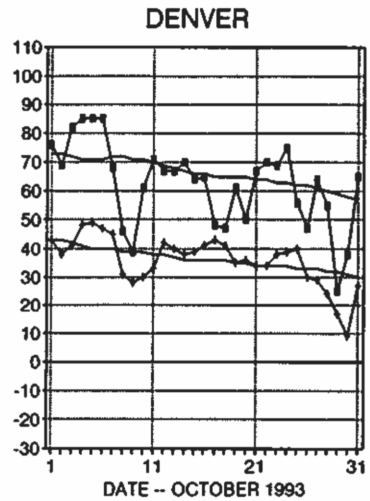
Weather Extremes

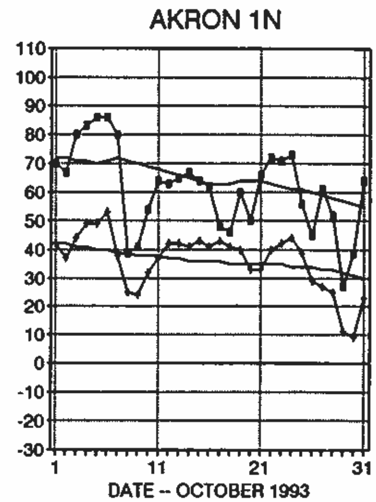
Highest Temperature	95°F	October 6	Holly and Las Animas
Lowest Temperature	-14°F	October 30	Hohnholz Ranch
Greatest Total Precipitation	4.80"		Bonham Reservoir
Least Total Precipitation	0.12"		Wootton Ranch
Greatest Total Snowfall	31.5"		Allenspark
Greatest Snow Depth	18"	October 18	Bonham Reservoir

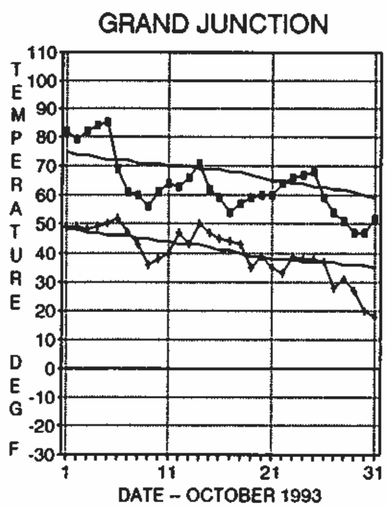
OCTOBER 1993 TEMPERATURE COMPARISON

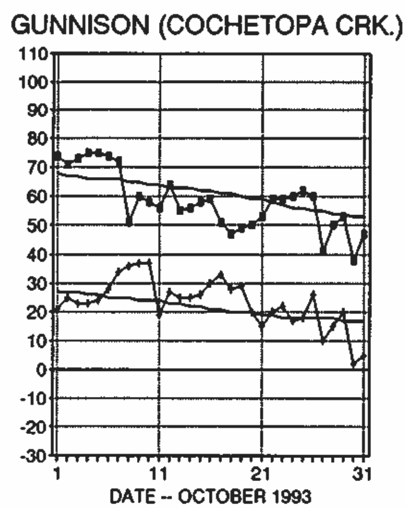
Observed daily high and low temperatures are shown below along with smoothed daily average highs and lows for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison and Lamar each take their observations at 8 a.m. Grand Lake takes their daily measurement at 4 p.m. The remaining stations shown below report at midnight.)

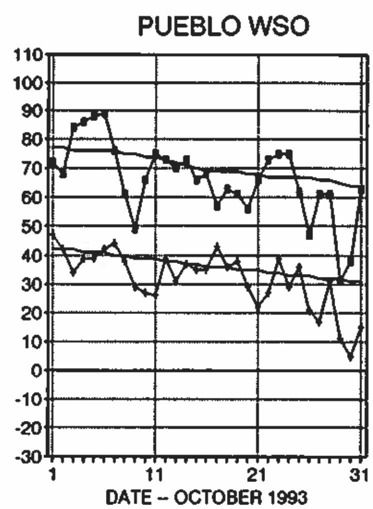


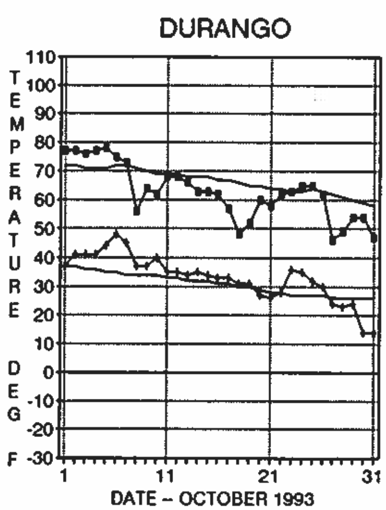


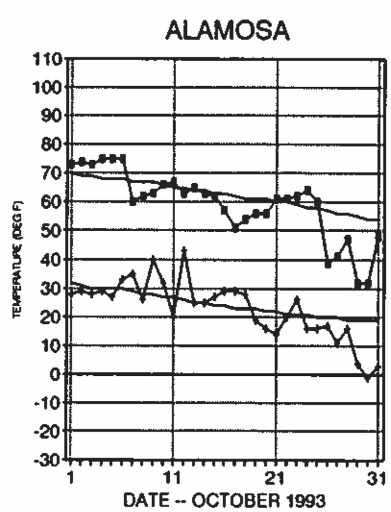


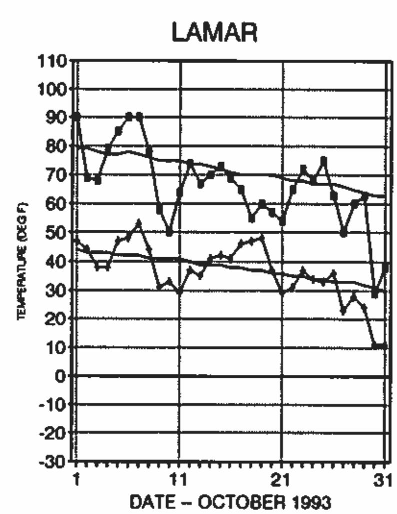








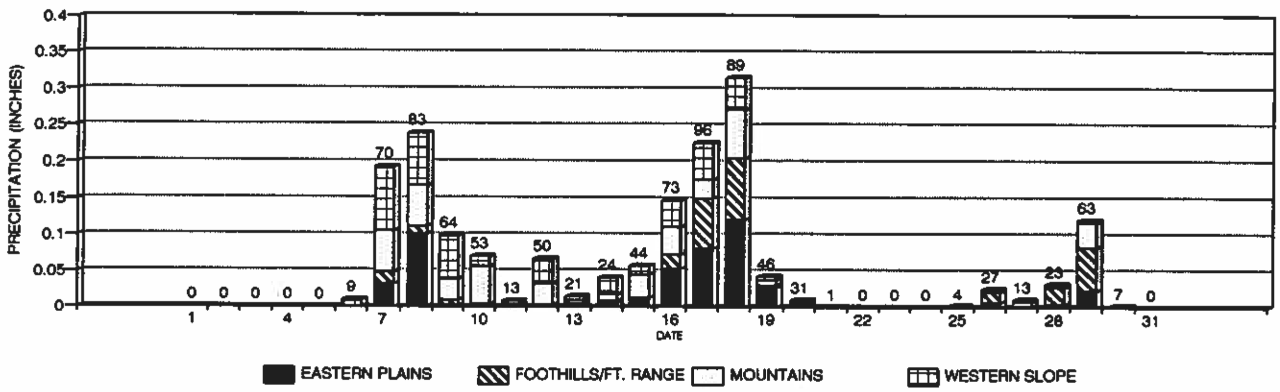




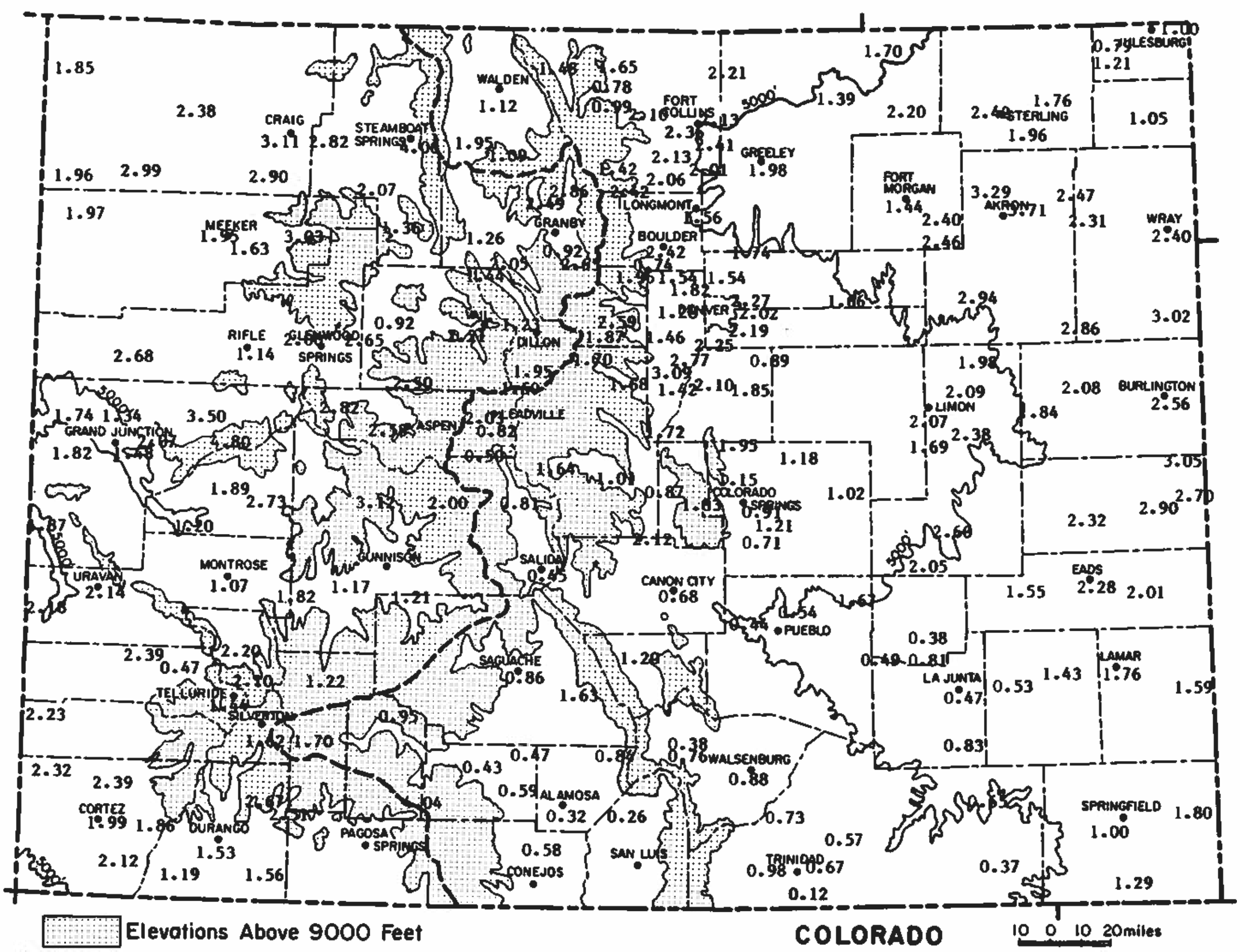
OCTOBER 1993 PRECIPITATION

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

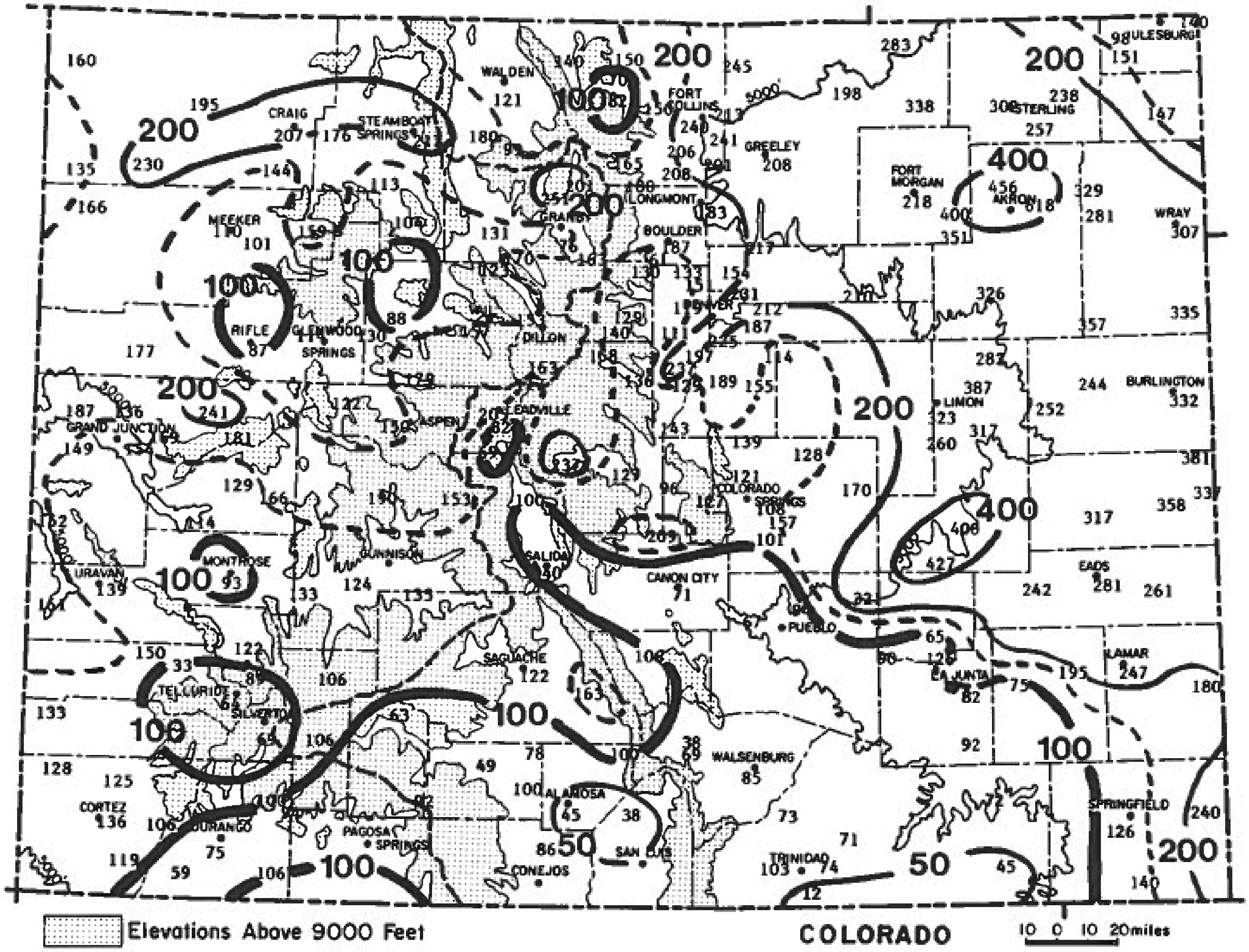


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

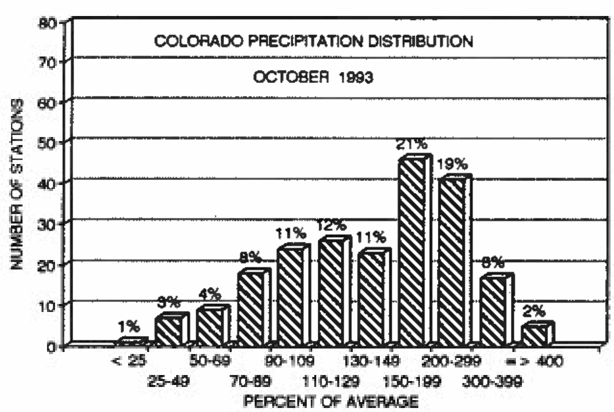


Precipitation Amounts (in inches) for October 1993.

OCTOBER 1993 PRECIPITATION COMPARISON



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" 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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1063	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	296	607	1281	1796	1637	1280	956	692	436	165	9394
	93-94	51	118	342	735									
														511
ASPEN	AVE	95	160	348	661	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1456	1325	1197	1039	901	657	363	9533
	93-94	232	221	425	718									
														876
BOULDER	AVE	0	7	138	387	726	973	1004	815	744	474	236	53	5554
	92-93	20	55	71	337	921	1093	1130	968	897	514	233	91	6120
	93-94	6	26	202	509									
														233
BUENA VISTA	AVE	60	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	736	446	232	8141
	93-94	83	144	357	687									
														584
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	169	450									
														214
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4967
	92-93	2	29	73	306	862	976	1064	885	888	482	199	55	5620
	93-94	0	22	153	435									
														175
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	778	558	286	84	6513
	93-94	0	40	212	519									
														252
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	780	578	282	108	6453
	93-94	10	14	165	506									
														169
CRAIG	AVE	32	58	276	606	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	496	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	288	619									
														433
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	436	186	38	5927
	92-93	6	10	71	301	919	1192	967	783	649	469	181	52	5600
	93-94	13	33	232	598									
														278
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	348	928	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488									
														173
DILLON	AVE	282	341	556	658	1203	1504	1587	1356	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	360	579	889									
														1258
DURANGO	AVE	8	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	589	302	136	6793
	93-94	8	43	201	522									
														250
EAGLE	AVE	25	72	276	617	981	1376	1436	1106	968	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603									
														382
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1063	879	722	479	226	7888
	93-94	85	140	347	696									
														572
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	67	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533									
														234
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	983	831	492	222	41	6480
	92-93	12	40	38	352	837	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495									
														187
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410									
														63

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	761	1113	1476	1600	1361	1283	945	660	381	10542
	92-93	277	311	442	685	1301	1563	1683	1340	1197	949	648	380	10676
	93-94	297	274	496	813									
														1067
GREELEY	AVE	0	7	158	446	831	1153	1208	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492									
														197
GUNNISON	AVE	130	204	435	763	1143	1609	1788	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1279	M	M	M	M	M	M	M	M
	93-94	M	M	M	M									
														M
LAS ANIMAS	AVE	0	0	69	338	750	1068	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	380	128	9	5896
	93-94	0	12	90	389									
														102
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	536	785	1401	1502	1462	1306	1209	1033	736	489	11276
	93-94	354	390	591	915									
														1335
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564									
														292
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557									
														288
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	428	1123	1308	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565									
														349
MONTROSE	AVE	0	11	143	453	819	1159	1246	936	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	16	161	520									
														190
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	758	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1098	915	714	422	261	8365
	93-94	94	143	357	M									
														594
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	398	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	195	30	6105
	93-94	0	18	155	491									
														173
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464									
														219
STEAMBOAT SPRINGS	AVE *	113	168	398	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	160	119	318	570	1247	1563	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710									
														705
STERLING	AVE	0	9	149	462	852	1200	1265	983	843	504	238	58	6541
	92-93	14	36	70	400	949	1473	1401	1168	739	501	162	66	6999
	93-94	0	14	193	459									
														207
TELLURIDE	AVE	152	204	390	679	1006	1290	1336	1128	1101	819	574	310	8988
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	560	380	8566
	93-94	228	249	455	766									
														932
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	891	1137	1013	904	699	450	206	39	5838
	93-94	0	27	123	472									
														150
WALDEN	AVE	189	273	498	825	1161	1457	1528	1298	1237	909	667	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	282	510	848									
														1078
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	64	271	894	961	947	875	684	461	210	42	5423
	93-94	0	17	110	406									
														127

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

OCTOBER 1993 CLIMATIC DATA

EASTERN PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# 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 2ESE	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	0	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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
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.

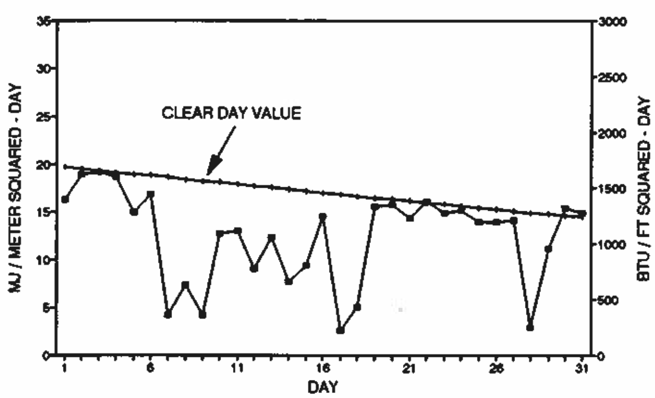
OCTOBER 1993 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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	--	--
Pueblo	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

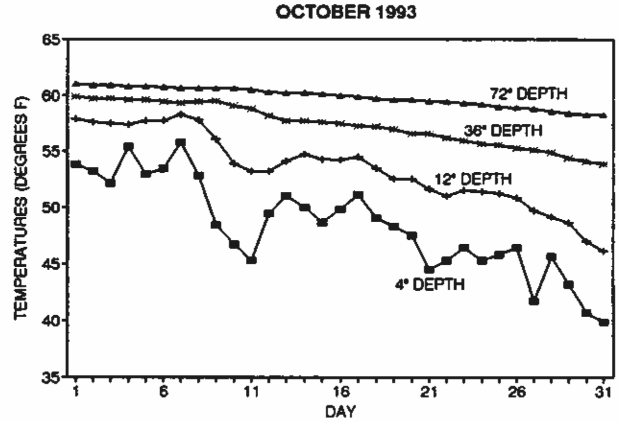


OCTOBER 1993 SOIL TEMPERATURES

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

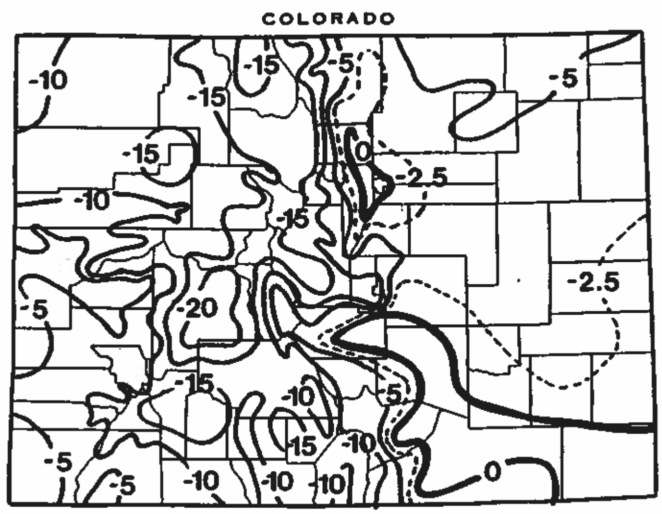
Just over 20 years ago, Mr. Lund volunteered to take the official weather observations for Paonia. (The Paonia weather observations date back to 1892.) Since then he has seen both flood and drought and everything in between. We thank you for you wonderful and reliable help!

HOW WE DIFFER FROM DENVER

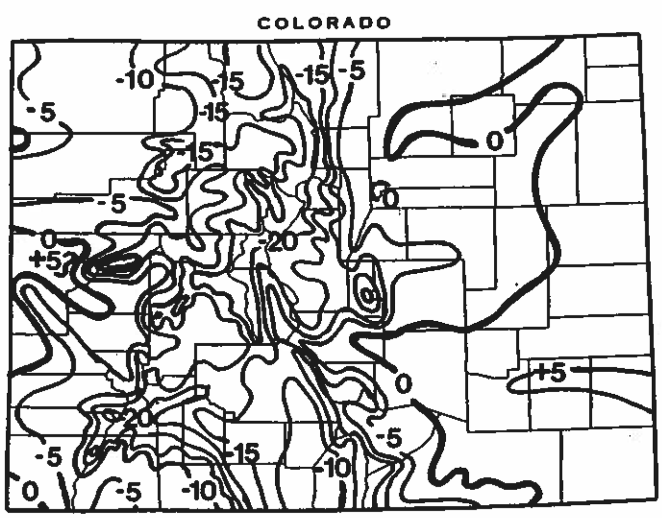
In case you haven't noticed (if you live in Colorado), Denver seems to be the center of the universe. As well as being the capital of Colorado and the largest city in the State, Denver is also the primary media market and the transportation hub of the region. Denver is also the source for most of Colorado's 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 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.



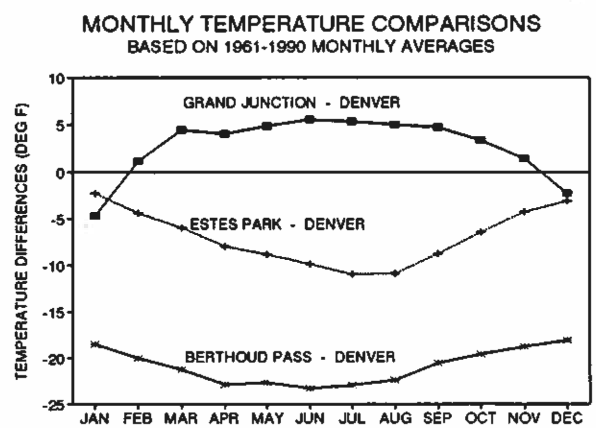
Mean Temperature Difference (°F) relative to Denver Stapleton Airport for January.



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

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.

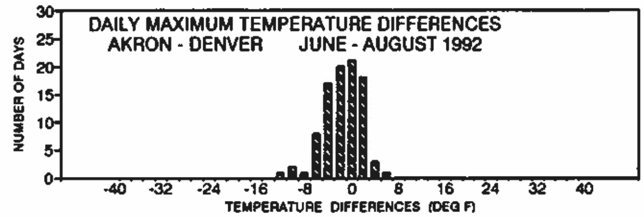


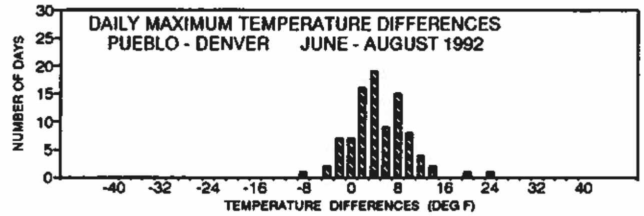
Average differences are interesting, but we all know that conditions can vary dramatically from day to day. To examine daily differences, we took daily maximum and minimum temperatures for three recent seasons (summer (Jun-Aug 1992), winter (Dec 1992-Feb 1993) and spring (Mar-May 1993)) for Denver Stapleton 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°

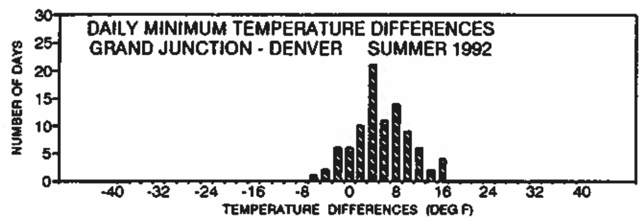
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

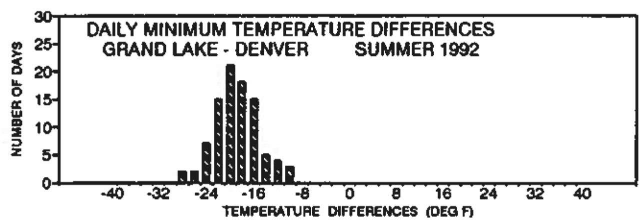
while Denver only dipped to 18°F, the difference would be -25°F. We then formed distributions of these daily differences and plotted histograms.

SUMMER



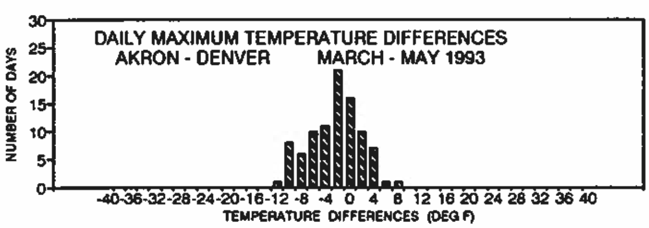


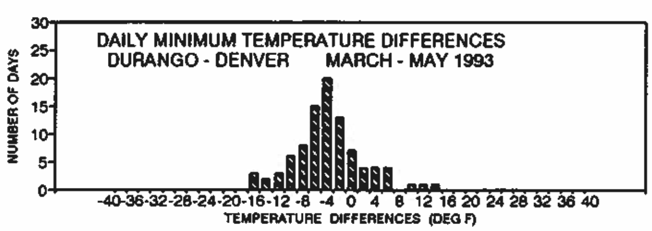




As you look at these graphs, you begin to see how wild our climate really is. The most consistent daily differences occur during the summer. In the summer examples you can see that Akron was usually a few degrees cooler than Denver during the chilly summer of 1992. Pueblo was typically a few degrees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

SPRING



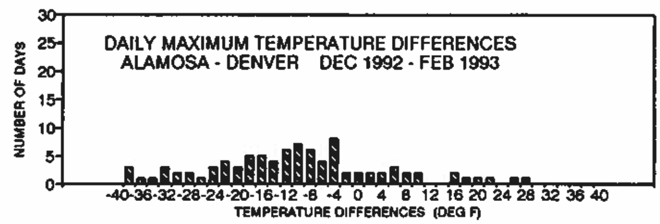


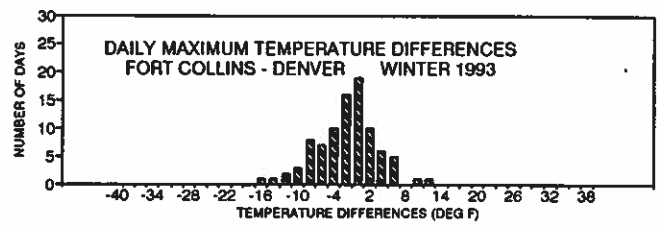
Overnight minimum temperatures show similar distributions. Grand Lake, for example, was typically 16° to 26° cooler than Denver at night but with some larger and smaller differences.

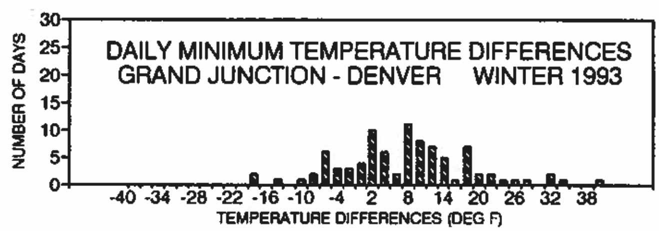
Two examples of springtime temperature differences are shown. Systematic relationships apply, but the distribution of differences are broader during the spring.

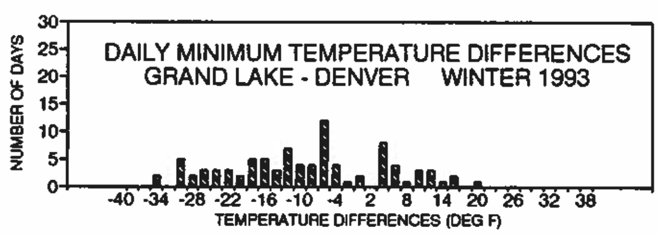
The final four figures are excellent demonstrations of why weather prediction (specifically for temperature) becomes most difficult during the winter. Huge daily differences are quite common. Even over the relatively short distance from Denver to Fort Collins, temperatures often differ by ten degrees. 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.

WINTER









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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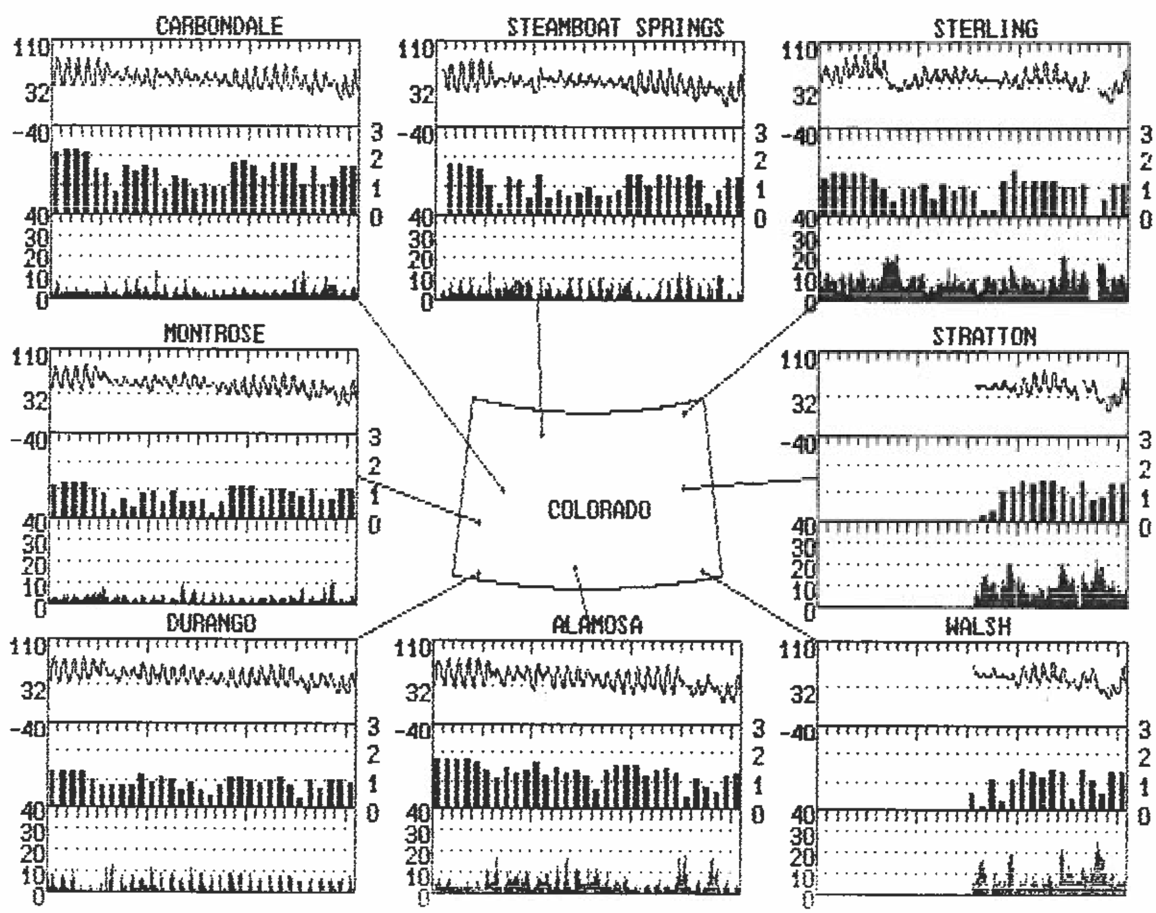
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	41.0	43.2	42.8	45.4	38.1	47.8	n/a	n/a
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	75.7 4/15	74.8 1/16	80.1 4/14	79.5 4/15	77.4 5/14	90.0 6/13	n/a n/a	n/a n/a
minimum:	0.3 30/ 7	14.5 30/ 5	9.5 30/ 7	11.7 30/ 7	-1.1 30/ 6	7.3 30/ 6	n/a n/a	n/a n/a
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	70 / 21	81 / 28	91 / 29	82 / 31	94 / 26	75 / 33	n/a /n/a	n/a /n/a
11 AM	30 / 26	45 / 36	47 / 35	49 / 37	63 / 37	43 / 36	n/a /n/a	n/a /n/a
2 PM	23 / 26	34 / 34	33 / 34	38 / 36	49 / 37	34 / 36	n/a /n/a	n/a /n/a
5 PM	23 / 25	36 / 32	36 / 32	37 / 34	56 / 36	39 / 34	n/a /n/a	n/a /n/a
11 PM	45 / 21	71 / 30	73 / 31	70 / 33	85 / 29	66 / 33	n/a /n/a	n/a /n/a
monthly average wind direction (degrees clockwise from north)								
day	182	189	242	264	196	216	n/a	n/a
day	163	85	179	136	124	225	n/a	n/a
monthly average wind speed (miles per hour)								
	3.89	2.53	1.88	1.79	2.27	7.45	n/a	n/a
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	358	450	620	543	470	76	n/a	n/a
3 to 12	355	224	111	161	180	542	n/a	n/a
12 to 24	23	1	1	0	1	92	n/a	n/a
> 24	0	0	0	0	0	0	n/a	n/a
monthly average daily total insolation (Btu/ft²·day) * ≡ incorrect calibration								
	1271	882 *	1450	849 *	1042	996	n/a	n/a
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	200	0	62	40	136	121	n/a	n/a
40-60%	71	196	48	54	57	87	n/a	n/a
20-40%	48	88	48	84	62	51	n/a	n/a
0-20%	13	54	25	108	51	63	n/a	n/a

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.



COLORADO CLIMATE

NOVEMBER 1993

Volume 17 Number 2

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

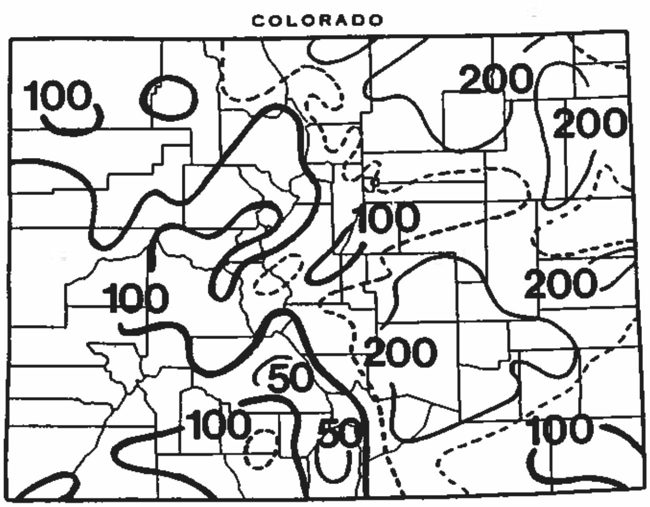
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

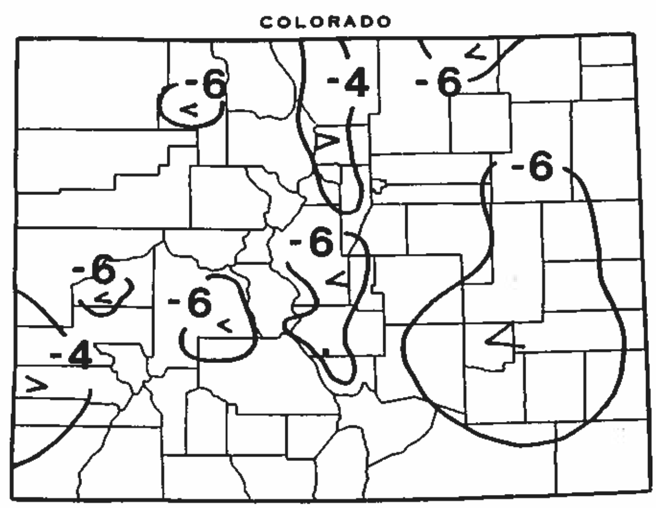
Several small snows whitened the Front Range and the Northern and Central mountains in November. Two large storms were responsible for nearly all significant precipitation accumulations. The storm episode from the 11th to the 14th affected the entire State and dropped more than 1" of rain and melted 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.



November 1993 precipitation as a percent of the 1961-1990 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

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.

NOVEMBER 1993 DAILY WEATHER

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.

11-14 Mild weather continued on the 11th, but cooler air 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 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.

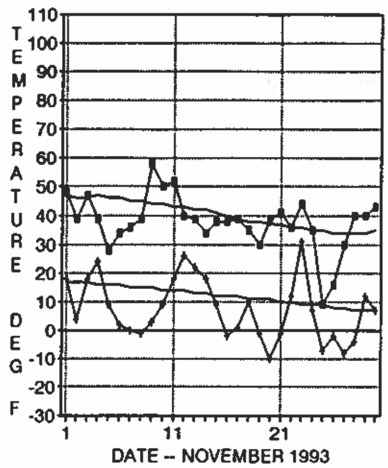
Weather Extremes

Highest Temperature	74°F	November 3	Las Animas, Springfield 7WSW
		November 10	La Junta 1S
Lowest Temperature	-25°F	November 16	Antero Reservoir
Greatest Total Precipitation	5.37"		Wolf Creek Pass 1E
Least Total Precipitation	0.07"		Saguache
Greatest Total Snowfall	58.1"		Wolf Creek Pass 1E
Greatest Snow Depth	30"	November 23	Wolf Creek Pass 1E

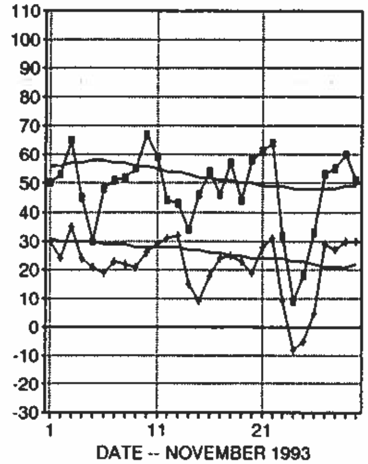
NOVEMBER 1993 TEMPERATURE COMPARISON

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.)

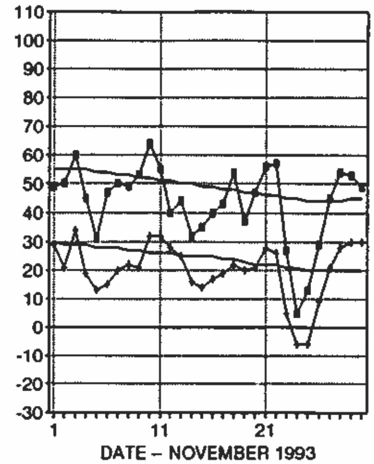
GRAND LAKE 1NW



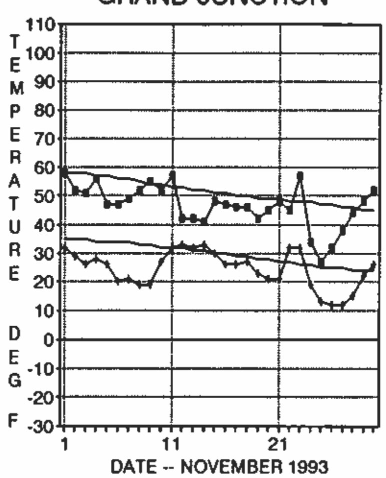
DENVER



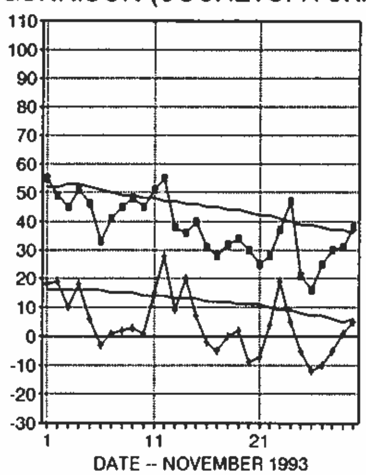
AKRON 1N



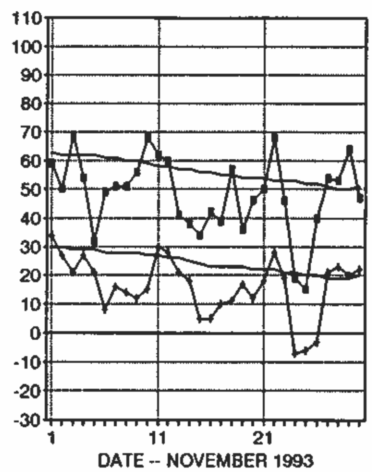
GRAND JUNCTION



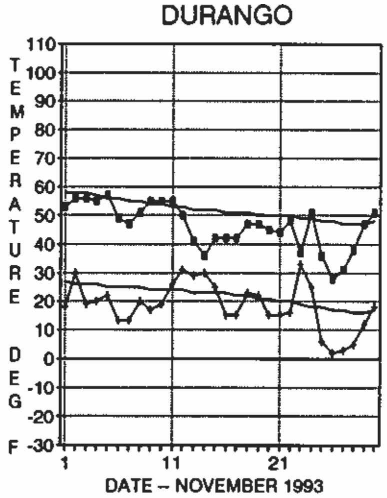
GUNNISON (COCHETOPA CRK.)



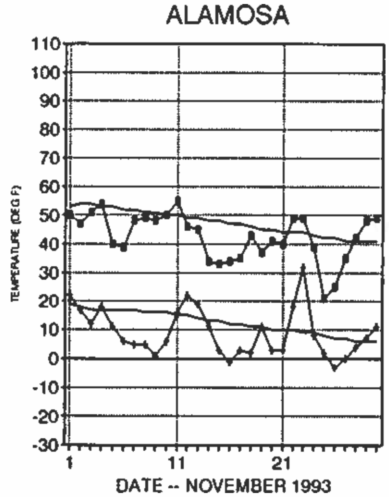
PUEBLO WSO



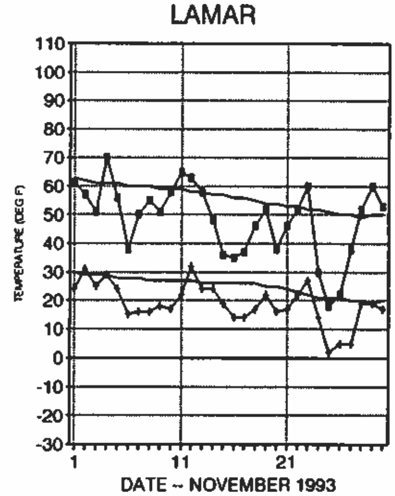
DURANGO



ALAMOSA



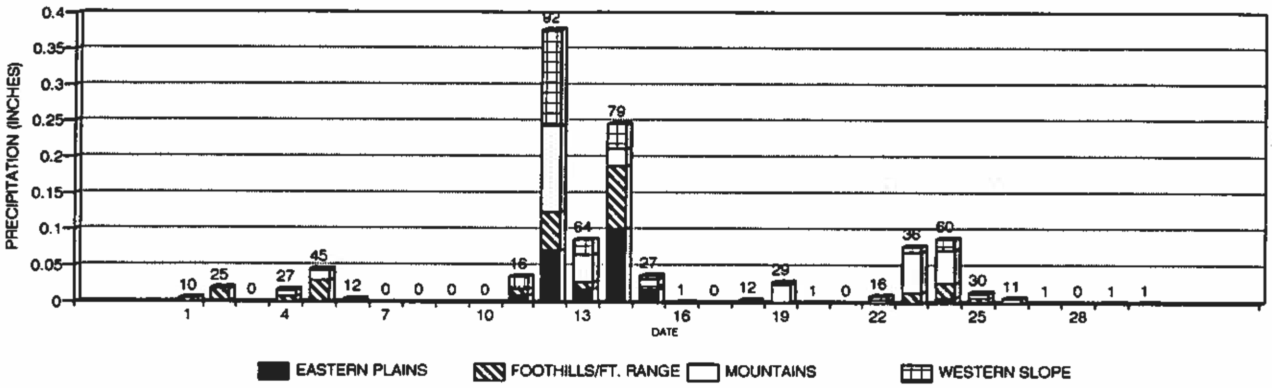
LAMAR



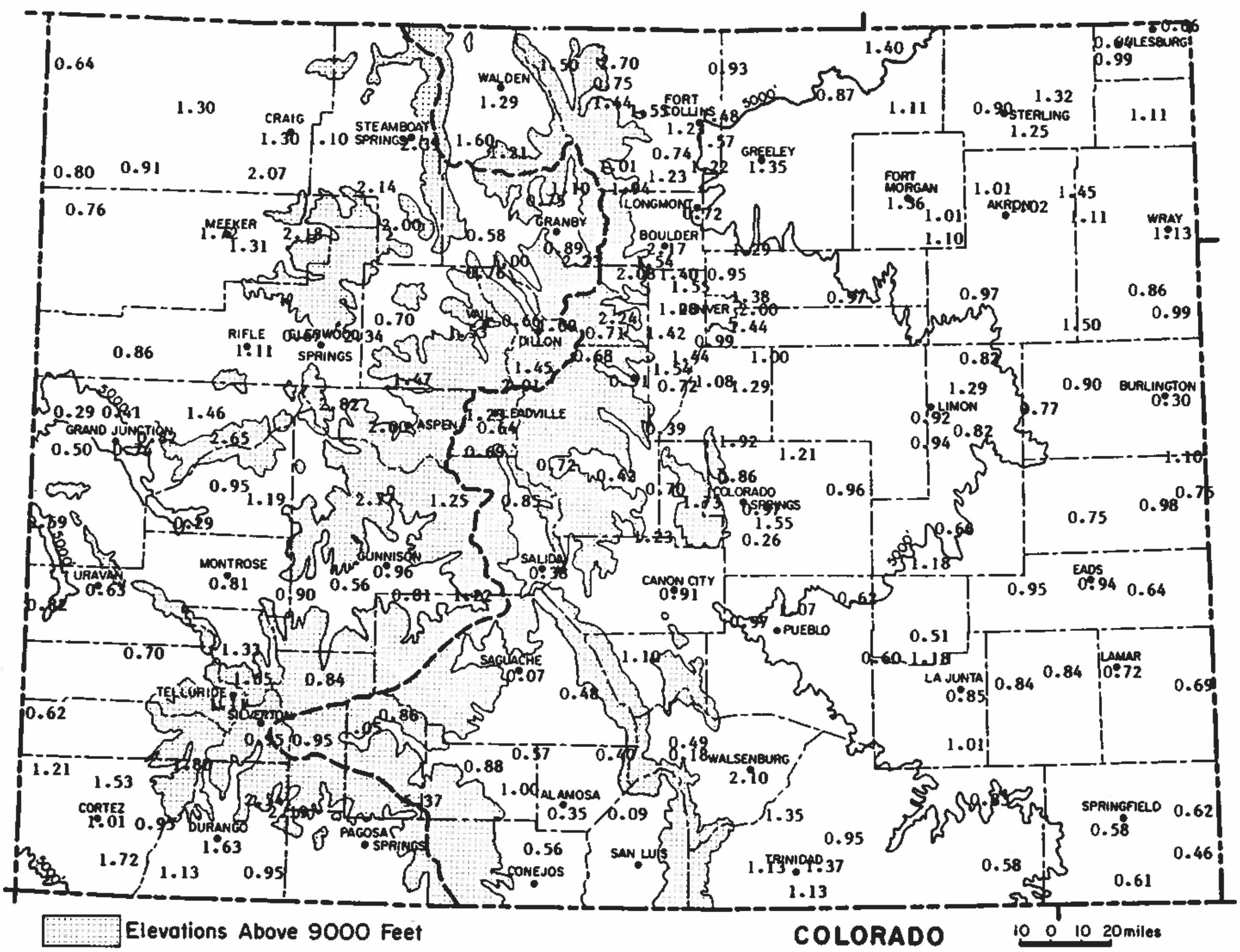
NOVEMBER 1993 PRECIPITATION

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

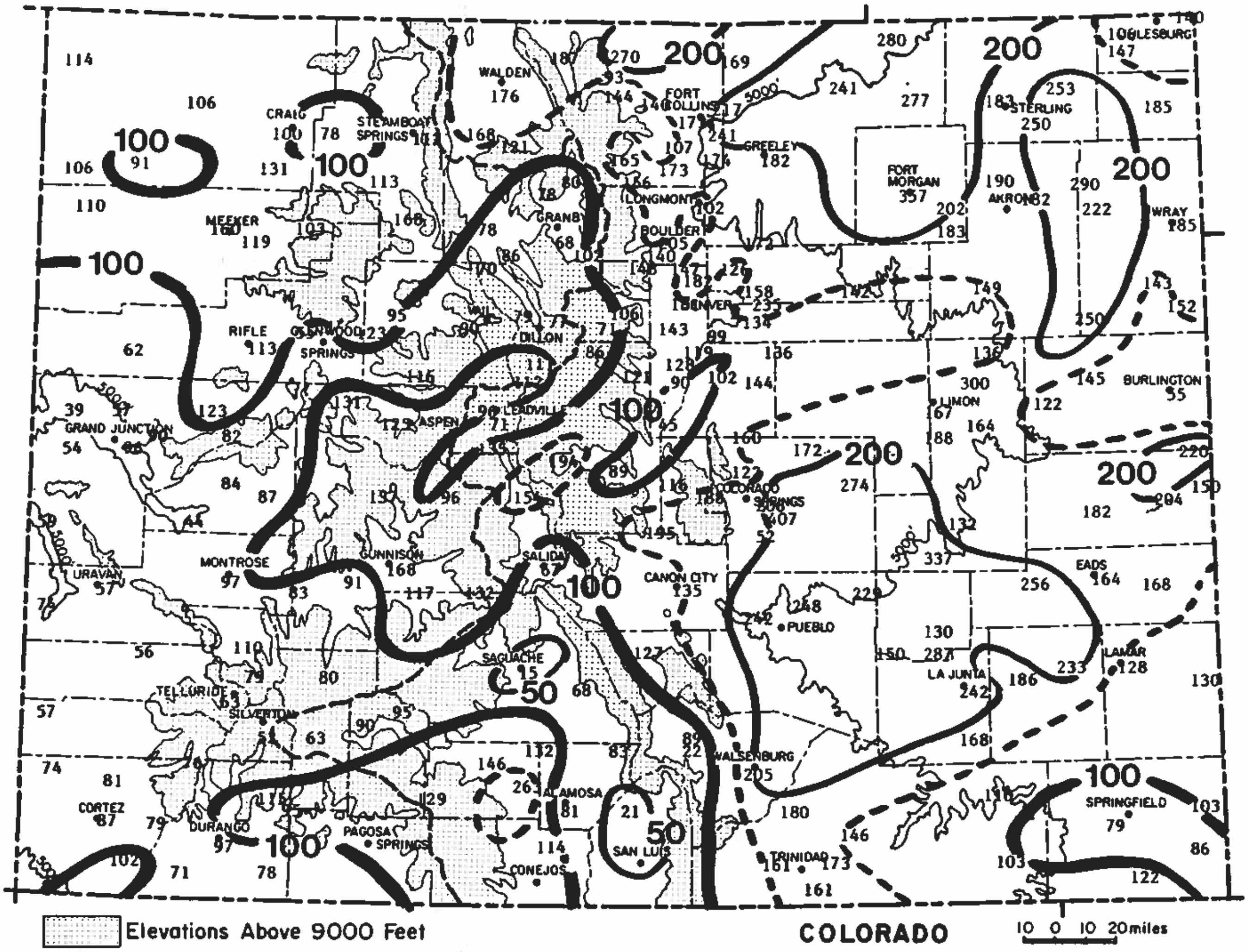


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

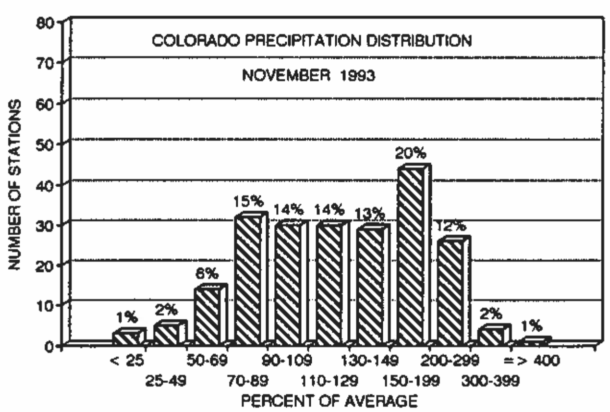


Precipitation Amounts (in inches) for November 1993.

NOVEMBER 1993 PRECIPITATION COMPARISON



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



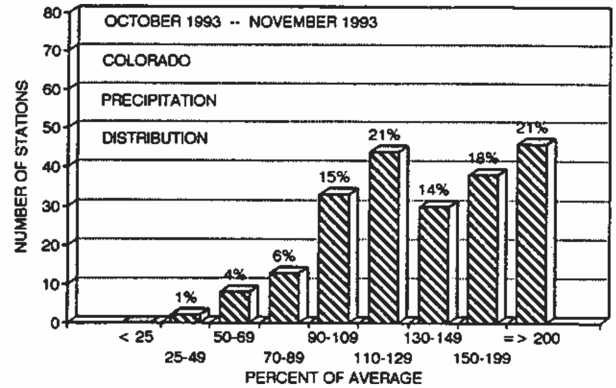
November precipitation ranged from less than 25% of average at Blanca and Saguache to close to 400% of average at a few locations east of the mountains. Overall, wetter than average reports outnumbered dry conditions by nearly 3 to 1. Thirty-five percent of Colorado's weather stations reported precipitation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

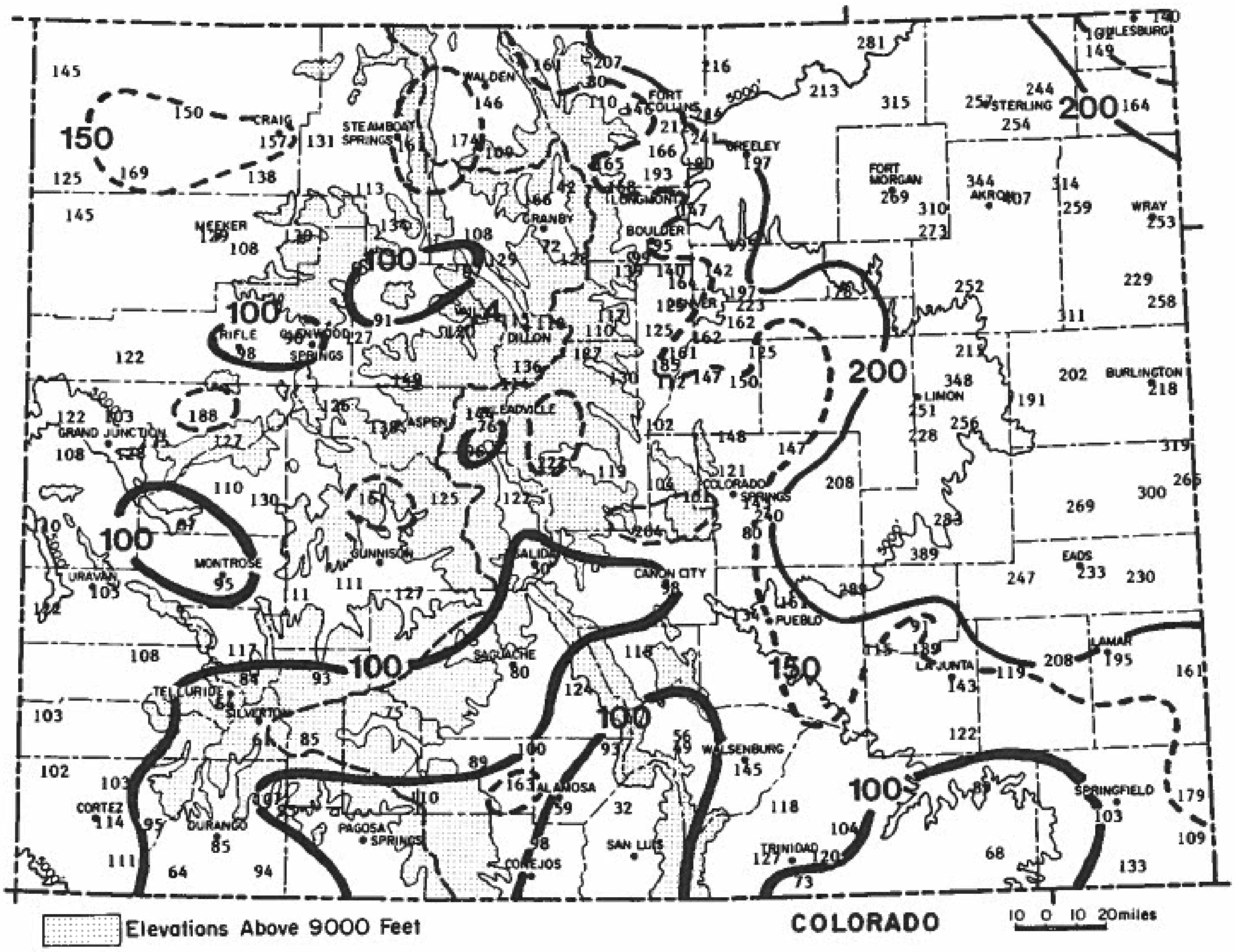
NOVEMBER 1993 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1063	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1260	958	692	435	185	9394
	93-94	51	118	342	735	1167								2413
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	6850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188								2784
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	506	875								1616
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070								2341
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953								1617
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	482	199	55	5620
	93-94	0	22	153	435	816								1426
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972								1743
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	760	578	282	106	6453
	93-94	10	14	165	508	926								1623
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	286	619	1168								2220
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	763	649	469	181	52	5800
	93-94	13	33	232	598	1052								1928
DENVER	AVE	0	0	144	429	780	1054	1094	865	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900								1561
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291								3436
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968								1740
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1116	894	641	352	169	7922
	93-94	53	52	277	603	1116								2101
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	228	7888
	93-94	85	140	347	695	1011								2278
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944								1711
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1006								1688
GRAND JUNCTION	AVE	0	0	55	332	736	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875								1348

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1263	945	880	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	813	1250								3130
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6864
	93-94	4	15	178	492	955								1644
GUNNISON	AVE	130	204	435	763	1143	1809	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323								M
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	380	128	9	5895
	93-94	0	12	90	389	935								1426
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	536	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368								3618
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064								1920
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557	1005								1850
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077								1991
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	956								1666
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1098	915	714	422	261	8365
	93-94	94	143	357	M	M								594
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	398	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	196	30	6105
	93-94	0	18	155	491	973								1637
RIFLE	AVE	0	23	184	502	958	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94	E 13	7	199	464	975								1658
STEAMBOAT SPRINGS	AVE *	113	186	386	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	160	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260								2675
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	966								1632
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210								2910
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5838
	93-94	0	27	123	472	857								1479
WALDEN	AVE	169	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	266	282	510	848	1316								3242
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	6423
	93-94	0	17	110	406	791								1324

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

NOVEMBER 1993 CLIMATE DATA

EASTERN PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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	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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
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	0	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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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.

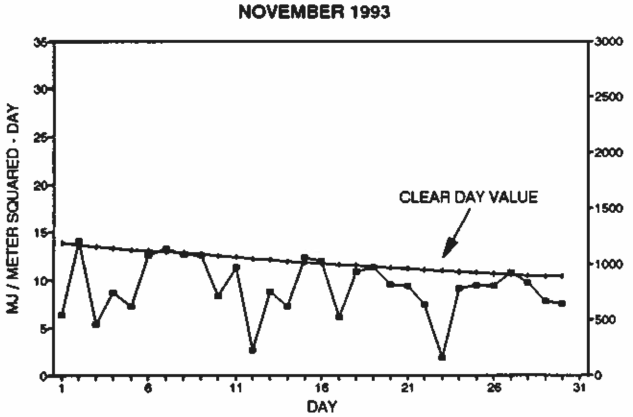
NOVEMBER 1993 SUNSHINE AND SOLAR RADIATION

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

CLR = Clear PC = 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

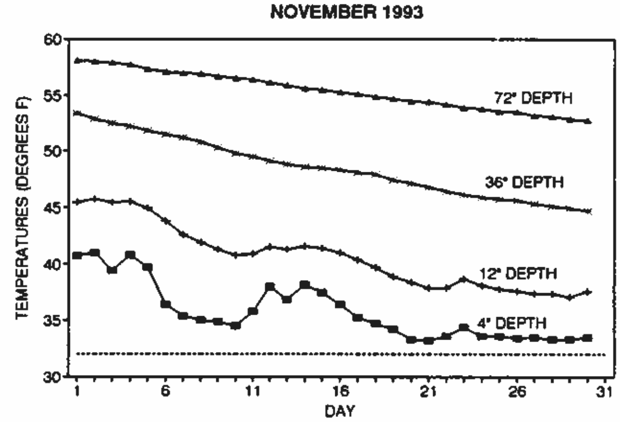


NOVEMBER 1993 SOIL TEMPERATURES

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.

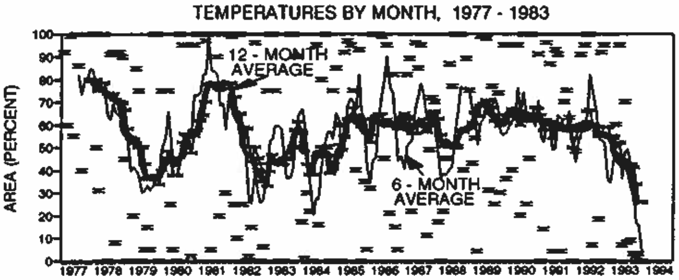
For more than 80 years, daily weather observations have been taken right at the bottom of Glenwood Canyon east of Glenwood Springs. John Davis currently oversees the station. It is a unique climate down in the canyon – much warmer and wetter than surrounding weather stations. Thanks to all of you at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

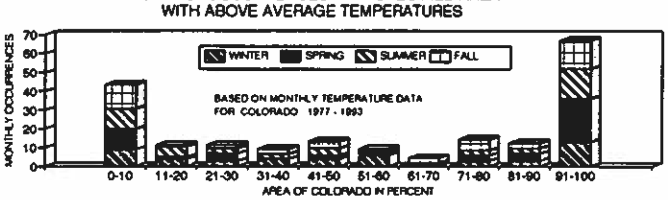
To explore these tendencies, the Colorado Climate Center took a new approach to examining temperature records. Normally we look at how many degrees above or below average the temperature has been at individual stations. This is useful and important but can also be misleading. Sometimes just one or two 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.

AREA OF COLORADO WITH ABOVE AVERAGE TEMPERATURES BY MONTH, 1977 - 1983



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.

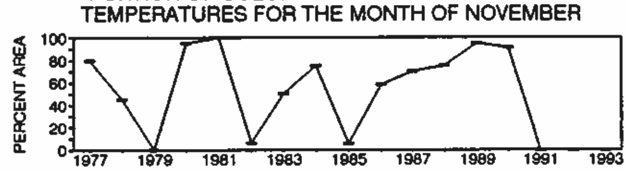
MONTHLY OCCURRENCES WITH SPECIFIED AREA WITH ABOVE AVERAGE TEMPERATURES



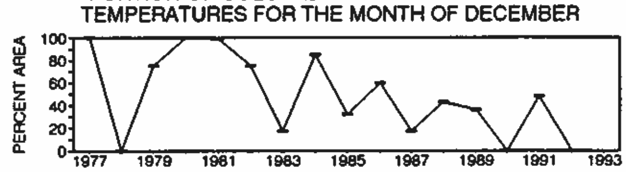
Six and 12 month averaging was used to smooth out monthly variations and show persisting features. A period of warm weather occurred in early 1981 when nearly the entire State remained above average for 6 months. No other warm period has persisted for more than 4 consecutive months. The recent cool episode, 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.

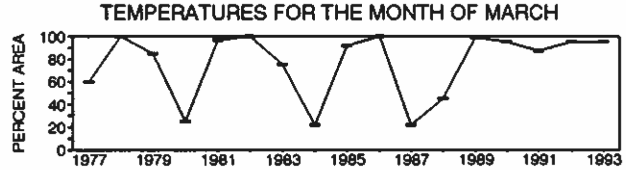
PORTION OF COLORADO WITH ABOVE AVERAGE TEMPERATURES FOR THE MONTH OF NOVEMBER



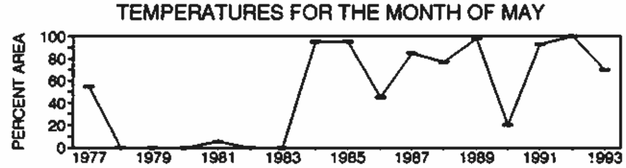
PORTION OF COLORADO WITH ABOVE AVERAGE TEMPERATURES FOR THE MONTH OF DECEMBER



PORTION OF COLORADO WITH ABOVE AVERAGE TEMPERATURES FOR THE MONTH OF MARCH



PORTION OF COLORADO WITH ABOVE AVERAGE TEMPERATURES FOR THE MONTH OF MAY



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.

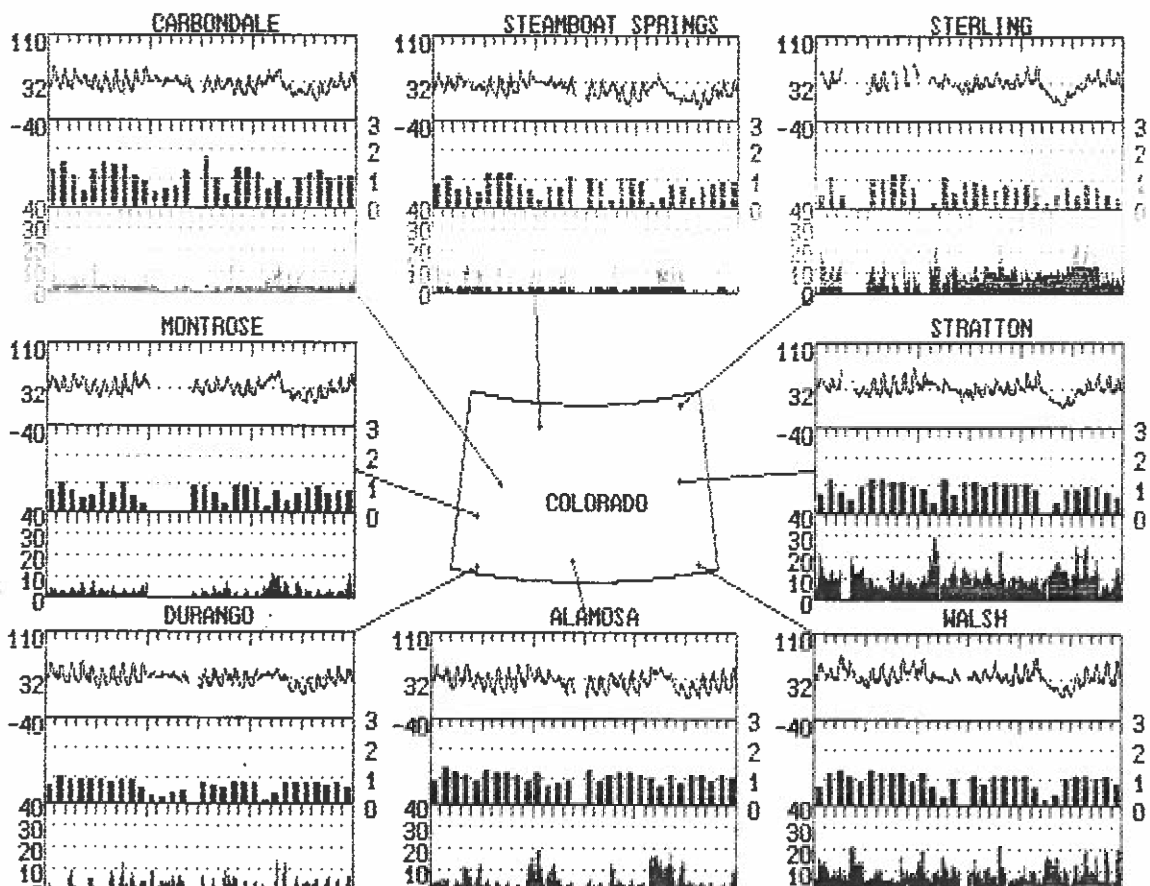
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA   NOVEMBER 1993

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	25.0	29.0	26.9	29.4	19.2	29.9	30.6	35.8
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	54.9 10/14	55.8 4/14	56.1 1/15	56.7 23/13	51.4 9/15	62.2 10/13	65.7 10/13	70.7 3/15
minimum:	-4.2 26/ 7	0.5 26/ 7	-0.8 27/ 7	3.7 27/ 5	-15.9 27/ 8	-6.5 24/21	-2.9 25/ 3	1.6 25/ 4
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	73 / 8	74 / 15	86 / 16	73 / 15	89 / 10	76 / 17	35 / 6	76 / 22
11 AM	35 / 15	43 / 22	53 / 21	42 / 21	73 / 19	54 / 25	24 / 14	48 / 29
2 PM	26 / 16	38 / 22	39 / 22	32 / 22	60 / 22	44 / 25	21 / 16	40 / 30
5 PM	28 / 14	40 / 20	46 / 20	35 / 20	65 / 19	51 / 21	24 / 11	48 / 27
11 PM	57 / 11	69 / 17	75 / 18	70 / 18	85 / 13	71 / 19	31 / 7	69 / 24
monthly average wind direction (degrees clockwise from north)								
day	190	163	215	211	165	234	177	188
day	175	82	173	156	125	248	219	251
monthly average wind speed (miles per hour)								
	3.78	1.90	2.21	2.21	2.29	8.42	9.50	7.93
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	373	441	537	433	470	31	24	46
3 to 12	279	139	135	154	134	439	504	531
12 to 24	39	4	4	0	8	103	144	119
> 24	0	0	0	0	0	1	9	0
monthly average daily total insolation ($Btu/ft^2 \cdot day$)								
	988	667	1035	723	759	683	901	923
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	184	0	45	32	106	81	159	152
40-60%	58	175	55	53	58	55	50	53
20-40%	39	58	50	59	61	51	34	49
0-20%	5	57	18	75	43	34	13	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 $Btu/ft^2/day$, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



COLORADO CLIMATE

DECEMBER 1993

Volume 17 Number 3

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

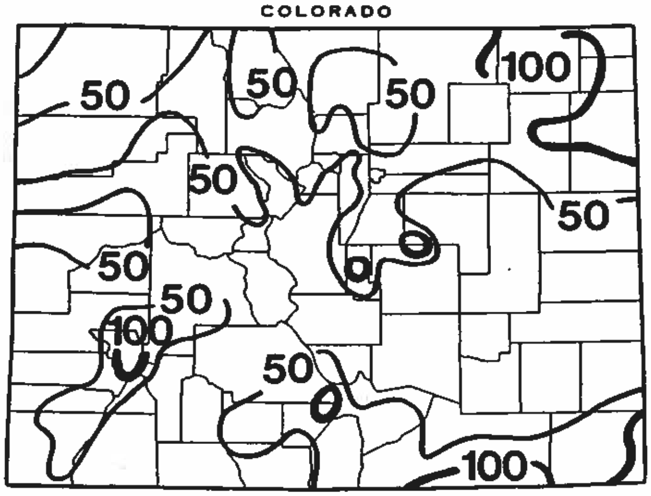
December Climate in Perspective – Dry and Windy

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

COLORADO



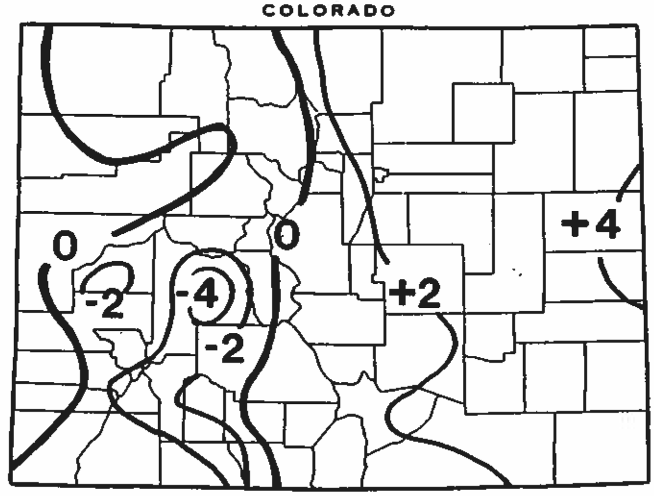
December 1993 precipitation as a percent of the 1961-1990 average.

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.

COLORADO



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

Inside This Issue

DECEMBER 1993 DAILY WEATHER

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 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.

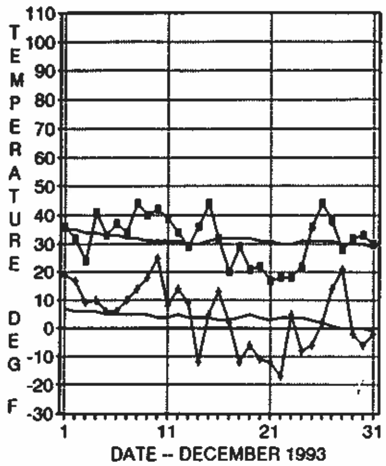
Weather Extremes

Highest Temperature	74°F	December 8,	Kim 15 NNE
		December 9	Las Animas
Lowest Temperature	-28°F	December 29	Taylor Park Reservoir
Greatest Total Precipitation	2.44"		Wolf Creek Pass 1E
Least Total Precipitation	0.00"		Eads
Greatest Total Snowfall	41.1"		Wolf Creek Pass 1E
Greatest Snow Depth	39"	December 20	Wolf Creek Pass 1E

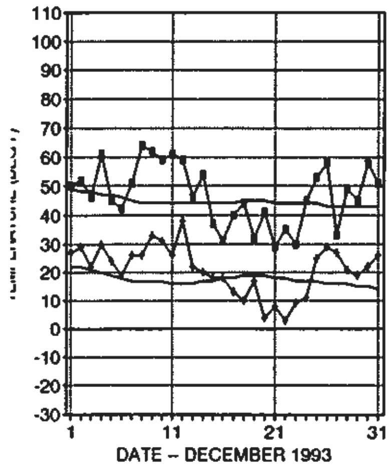
DECEMBER 1993 TEMPERATURE COMPARISON

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 (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.)

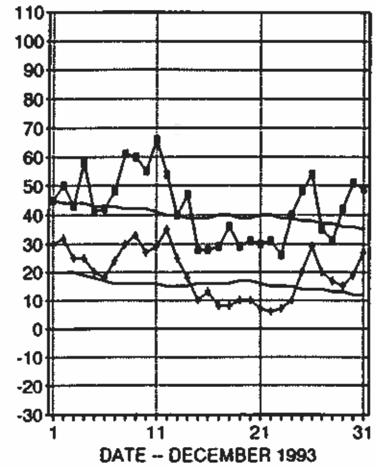
GRAND LAKE 1NW



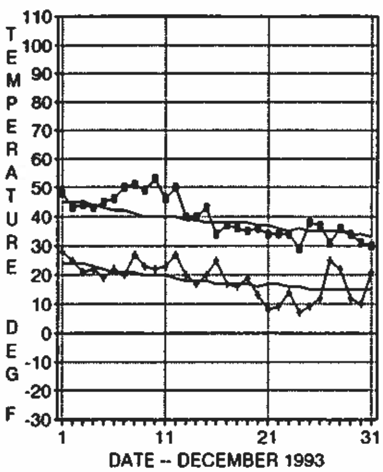
DENVER



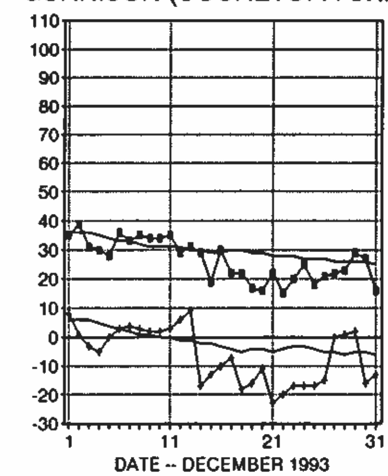
AKRON 1N



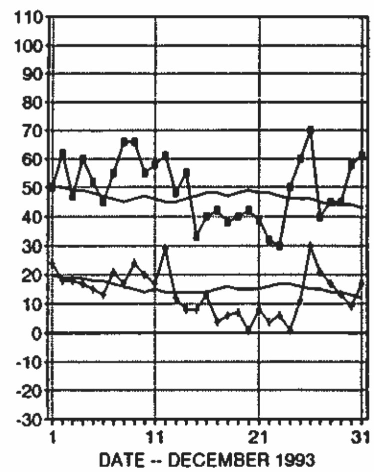
GRAND JUNCTION



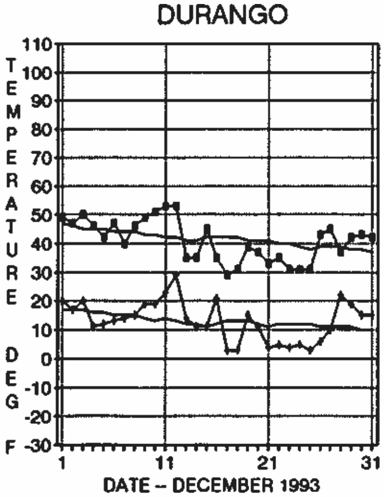
GUNNISON (COCHETOPA CRK.)



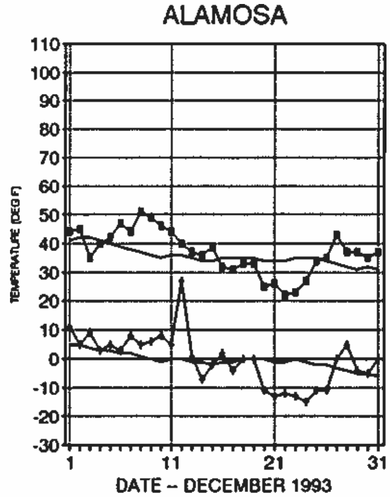
PUEBLO WSO



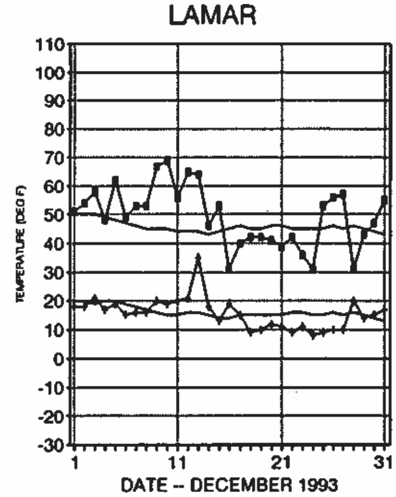
DURANGO



ALAMOSA



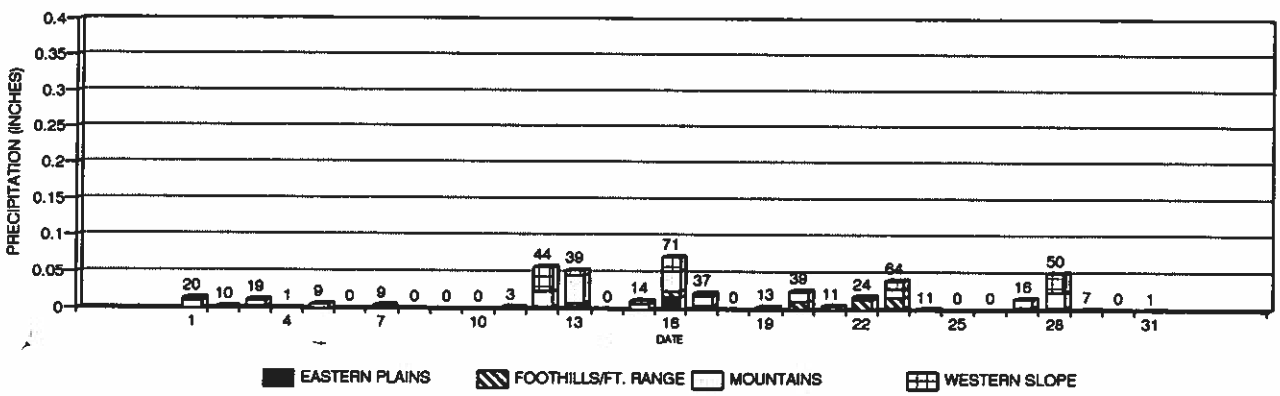
LAMAR



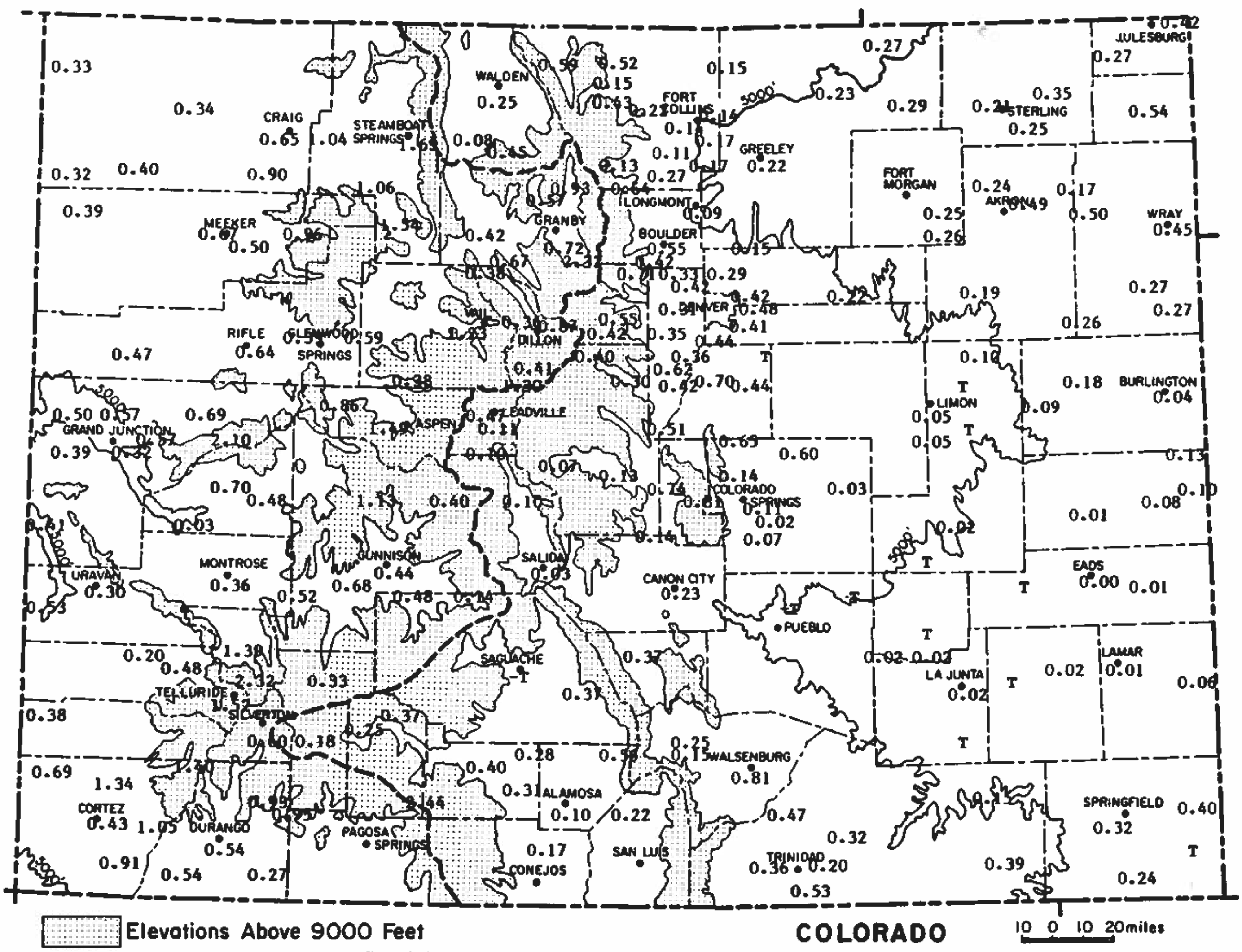
DECEMBER 1993 PRECIPITATION

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

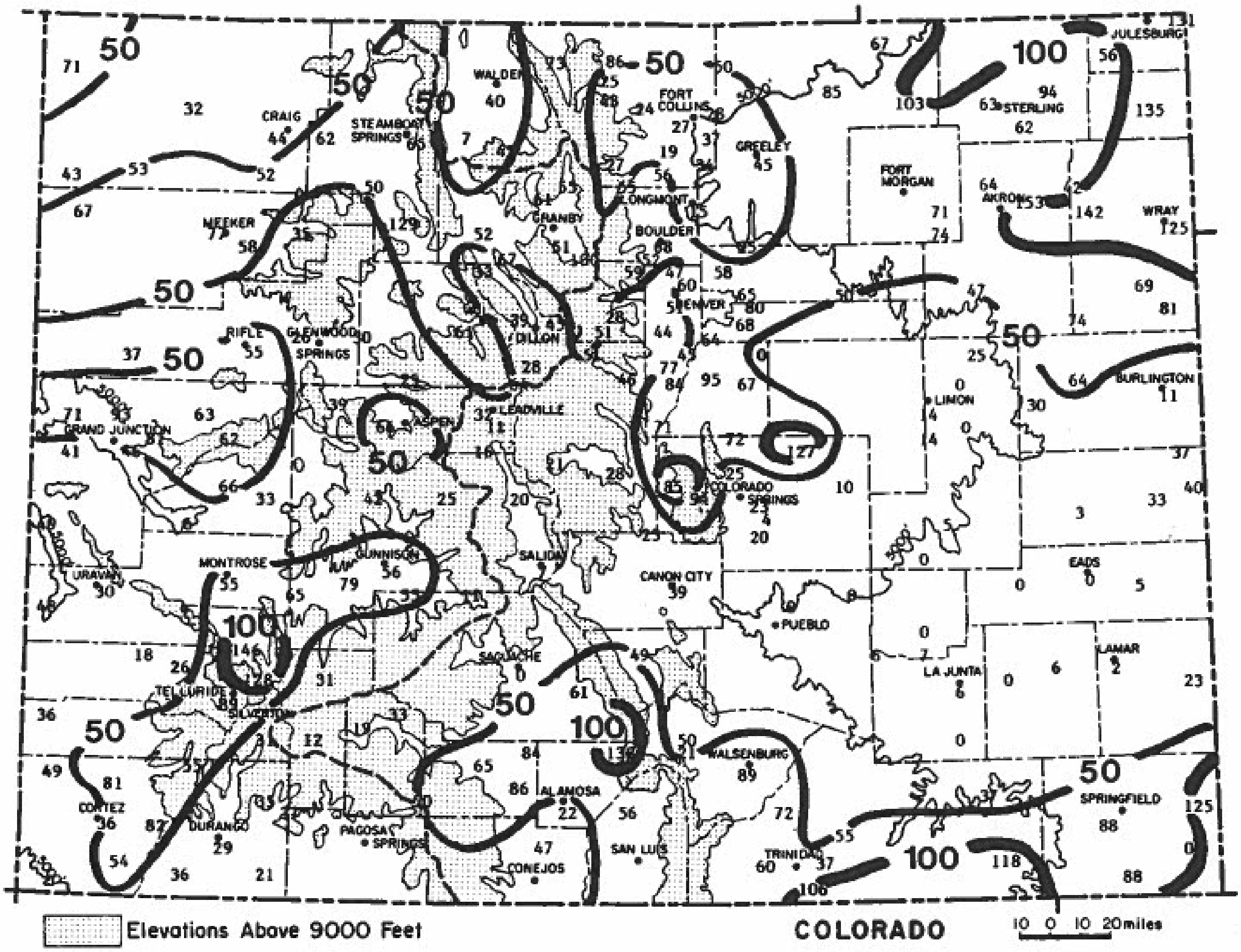


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

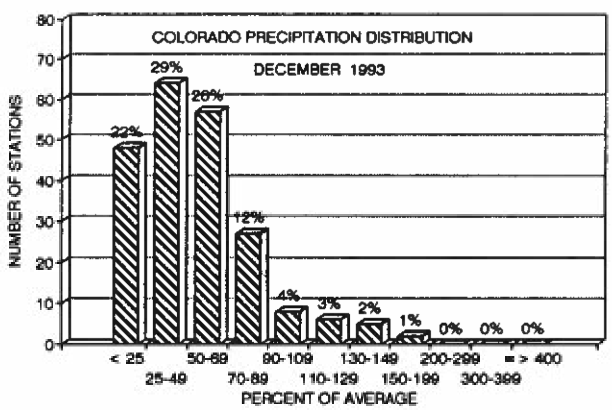


Precipitation Amounts (in inches) for December 1993.

DECEMBER 1993 PRECIPITATION COMPARISON



December 1993 Precipitation as a Percent of the 1961–90 average.



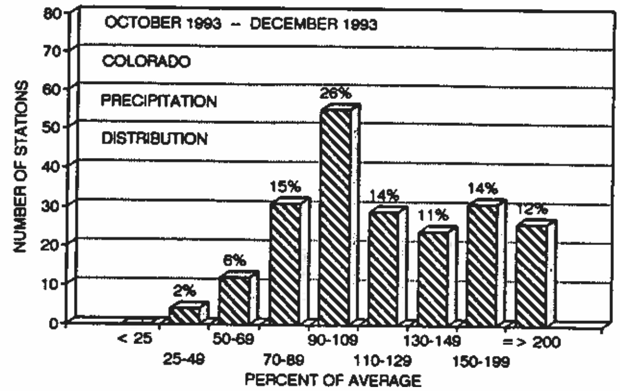
December precipitation totals were below average at more than 92% of Colorado's official weather stations. More than 50% of the State received less than half of the normal December moisture, and 22% received less than one-quarter of average.

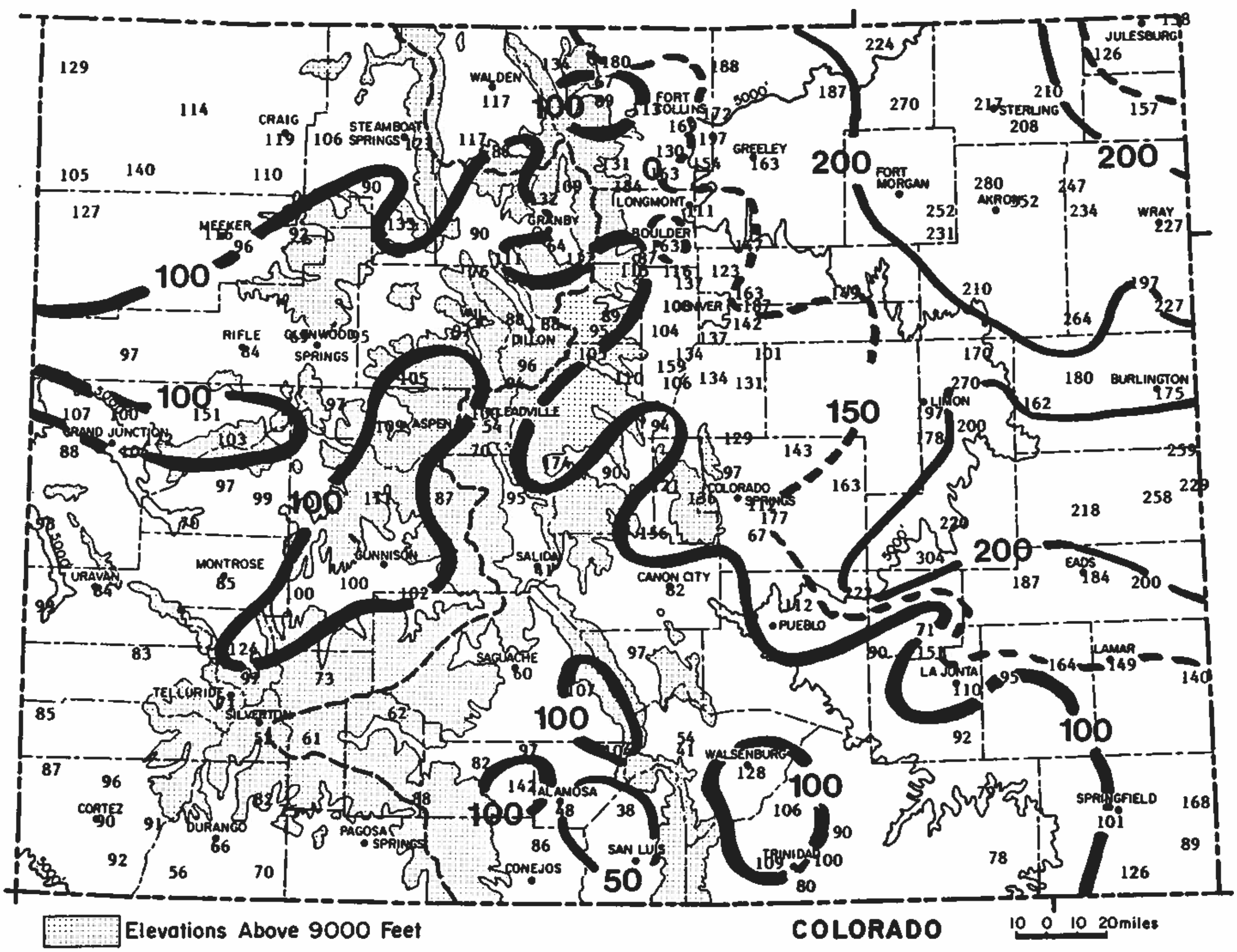
DECEMBER 1993 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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.





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

COMPARATIVE HEATING DEGREE DAY DATA FOR DECEMBER 1993

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1280	958	692	435	185	9394
	93-94	51	118	342	735	1167	1435							2413
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351							2784
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	506	875	905							1616
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1206							2341
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	853	978							1617
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	482	199	55	5620
	93-94	0	22	153	435	816	864							1426
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972	1008							1743
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	760	578	282	106	6453
	93-94	10	14	165	508	926	1148							1623
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	286	619	1168	1369							2220
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	783	849	469	181	52	5600
	93-94	13	33	232	598	1052	1245							1928
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948							1561
DILLON	AVE	262	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1464							3436
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968	1169							1740
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M							2101
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1096							2278
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	826	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003							1711
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1006	M							1688
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102							1348

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	660	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	813	1250	1543							3130
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	176	492	955	1021							1644
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693							M
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	360	128	9	5695
	93-94	0	12	90	389	935	925							1426
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	538	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478							3618
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054							1920
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557	1005	1064							1850
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317							1991
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	246	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	956	1155							1666
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M							594
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	92-93	0	15	56	390	1009	1132	1166	959	703	428	195	30	6105
	93-94	0	18	155	491	973	1020							1637
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464	975	1171							1658
STEAMBOAT SPRINGS	AVE *	113	166	398	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	160	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260	1486							2675
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	966	1066							1632
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8966
	92-93	180	189	313	529	1194	1268	1193	1046	961	743	550	380	8566
	93-94	228	249	455	768	1210	1443							2910
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5836
	93-94	0	27	123	472	857	968							1479
WALDEN	AVE	189	273	496	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	263	433	709	1310	1471	1426	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1469							3242
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	694	951	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865							1324

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

DECEMBER 1993 CLIMATE DATA

EASTERN PLAINS

Name	Max	Min	Temperature Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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

Name	Max	Min	Temperature Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# 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

Name	Max	Min	Temperature Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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	0	3	0.27	-1.01	21.1	4

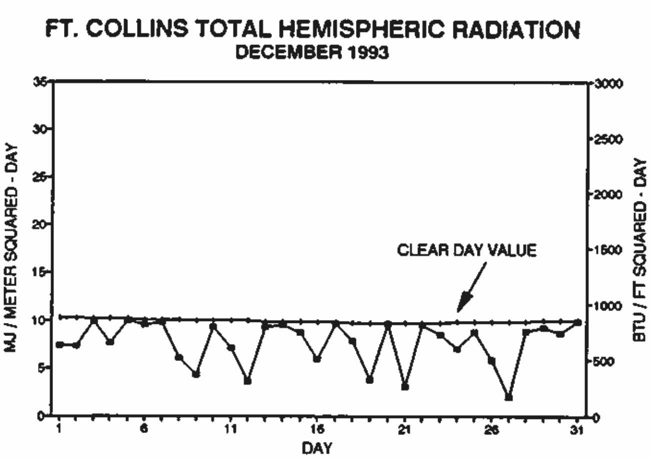
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

DECEMBER 1993 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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

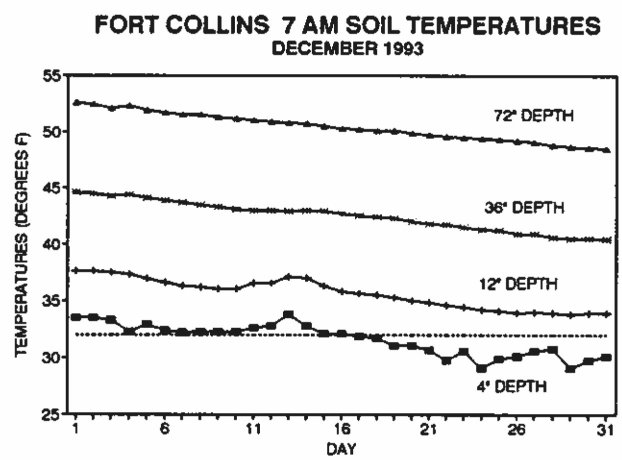
Sunny days were regular visitors to Colorado in December, and there were no prolonged periods of dark, cloudy weather. For most of the State, solar energy equalled or exceeded what is normal for December



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.



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, 16½ 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

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.

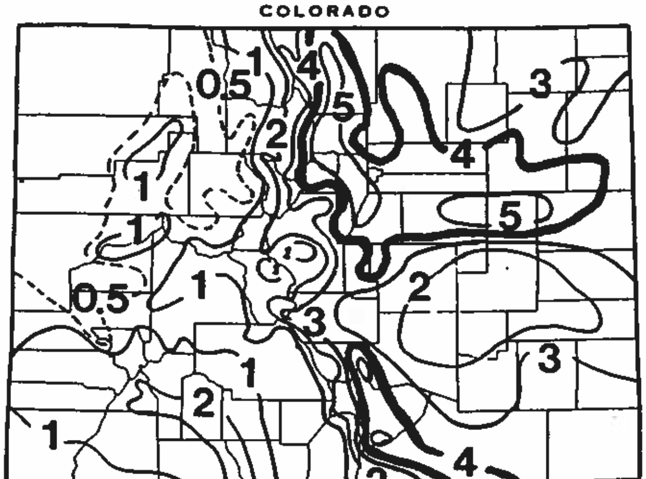
do during storms, rose to near 32°F and stayed there until the storm ceased.

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

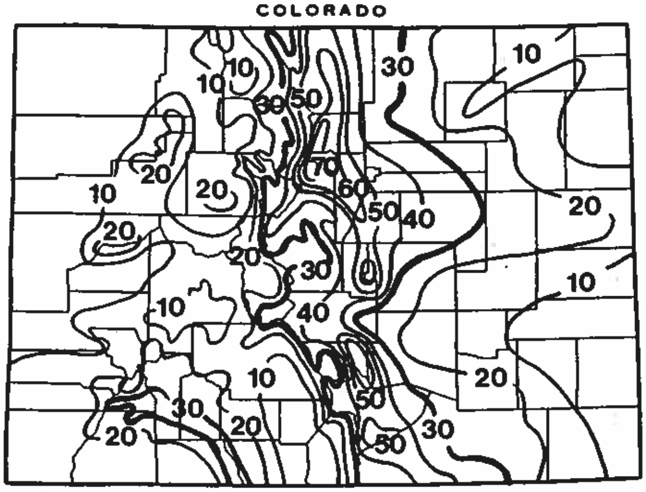
Using available weather observations still on file here at the Colorado Climate Center, we prepared the following analysis of total storm precipitation and snowfall. As one would expect, many observers struggled to take accurate measurements during the storm. Windblown, melting, settling snow is always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

COLORADO



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

COLORADO



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

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

	Date 1	2	3	4	5	Maximum 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	T	1.5	8.0	2.0	11"
Georgetown	9.0	1.0	5.0	63.0	8.0	54"
Grand Lake	T	0	9.0	36.0	1.0	--
Greeley	8.0	6.5	4.0	8.0	6.3	18"
Lamar			All Rain			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.

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.

In Longmont, "The unprecedented snowstorm of the last 48-hours 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 ...." *RM News* 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.

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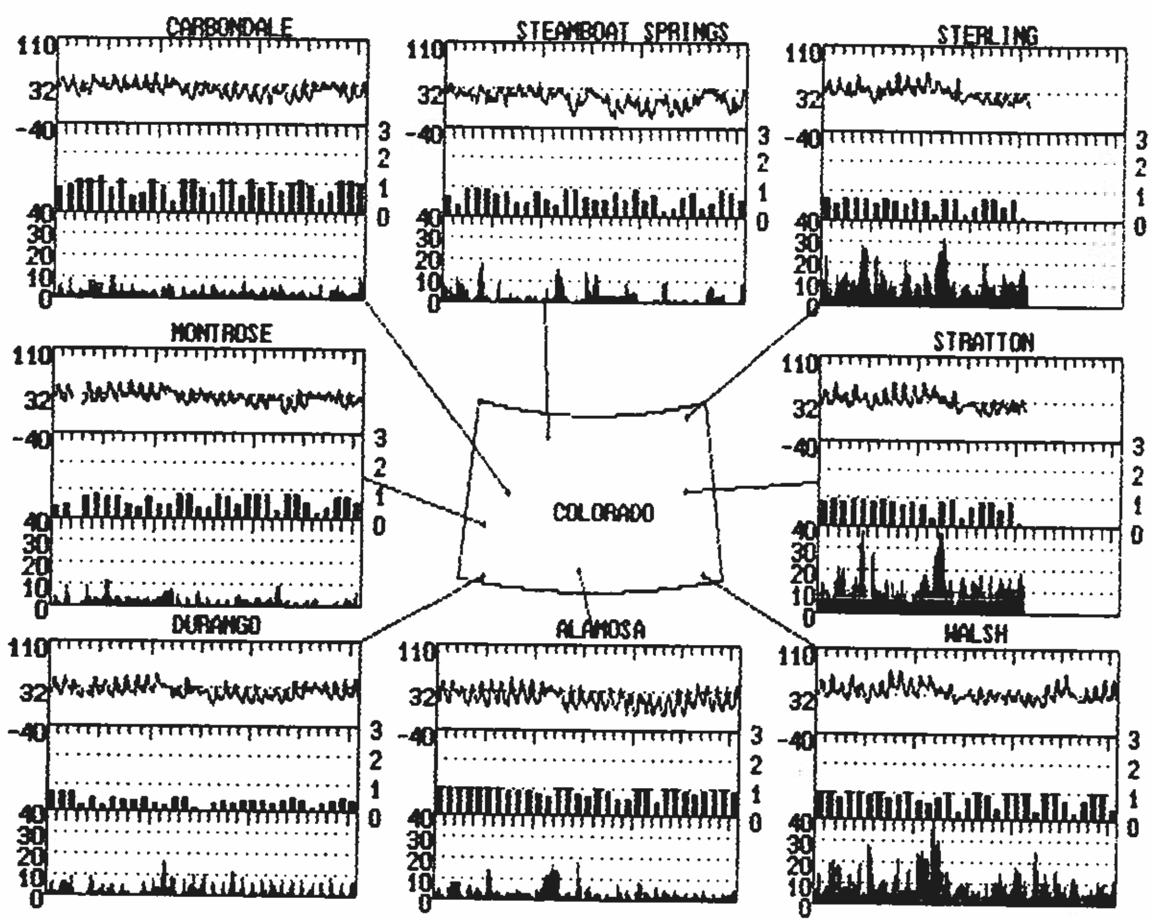
WTHRNET WEATHER DATA DECEMBER 1993

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)	17.3	23.2	22.6	24.9	13.2	31.2	31.5	34.1
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	52.2 8/15	51.6 11/12	48.7 10/15	53.1 8/15	41.5 10/14	66.0 11/14	64.2 11/14	70.0 9/14
minimum:	-13.5 21/ 8	-1.1 17/ 8	-1.5 24/ 6	-2.7 24/ 5	-18.9 22/ 3	9.5 19/ 2	5.4 18/ 6	10.6 24/ 1
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	72 / -1	78 / 11	87 / 13	82 / 14	87 / 6	67 / 18	31 / 5	71 / 19
11 AM	43 / 11	57 / 21	61 / 18	64 / 23	79 / 13	47 / 23	22 / 15	49 / 29
2 PM	24 / 12	49 / 24	43 / 20	52 / 25	66 / 19	39 / 24	21 / 17	40 / 28
5 PM	26 / 10	52 / 21	50 / 18	55 / 22	73 / 15	48 / 20	23 / 10	43 / 24
11 PM	59 / 4	75 / 14	75 / 15	77 / 16	87 / 8	67 / 18	28 / 5	65 / 20
monthly average wind direction (degrees clockwise from north)								
day	200	171	220	225	143	245	162	190
day	176	66	174	136	134	112	103	263
monthly average wind speed (miles per hour)	2.89	2.19	1.77	1.75	1.91	6.22	7.44	8.83
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	479	525	582	525	517	268	251	43
3 to 12	226	183	130	135	96	368	329	552
12 to 24	19	5	0	0	15	88	132	127
> 24	0	0	0	0	0	17	31	22
monthly average daily total insolation (Btu/ft²·day)	861	386	880	621	622	390	534	777
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	206	2	48	99	97	62	123	155
40-60%	58	25	66	59	70	54	37	53
20-40%	31	197	45	88	68	33	18	45
0-20%	5	71	11	33	26	33	8	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/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



COLORADO CLIMATE

JANUARY 1994

Volume 17 Number 4

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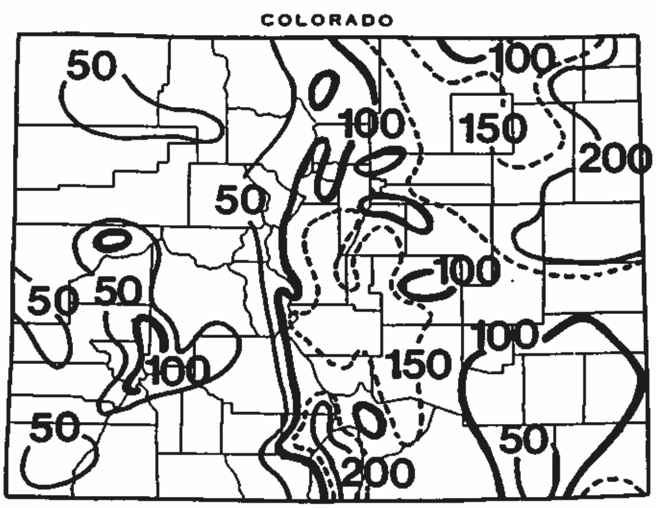
Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

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

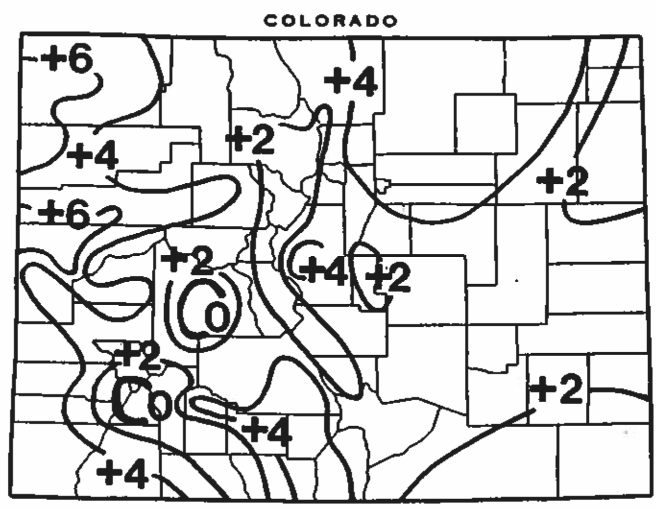
Seven storm systems crossed Colorado in January. Most of these only affected the higher elevations of the Northern and Central Mountains. The only storms that brought significant snows to the mountains came early (5-6th) and late (25-27th) in the month. Most of the mountains and western valleys ended 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.



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

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.

Inside This Issue

JANUARY 1994 DAILY WEATHER

1-4 Strong northwesterly winds aloft, relatively mild temperatures and occasional periods of high-elevation 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.

25-28 The first storm system in more than a month to bring 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.

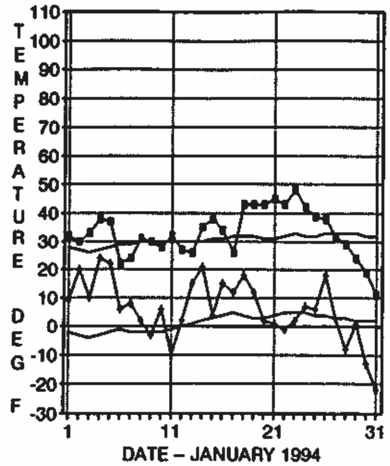
Weather Extremes

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

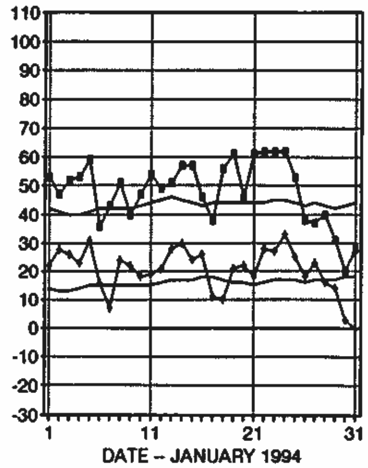
JANUARY 1994 TEMPERATURE COMPARISON

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.)

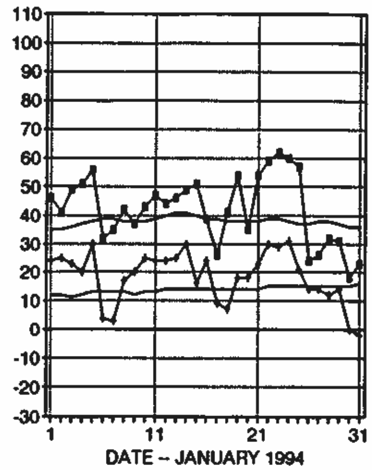
GRAND LAKE 1NW



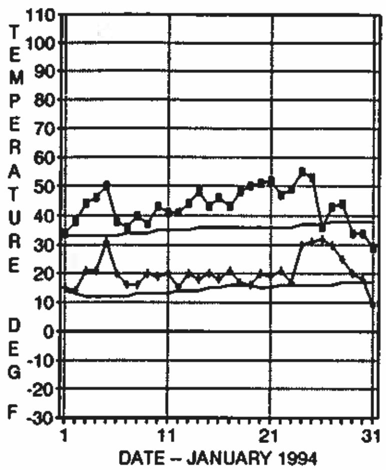
DENVER



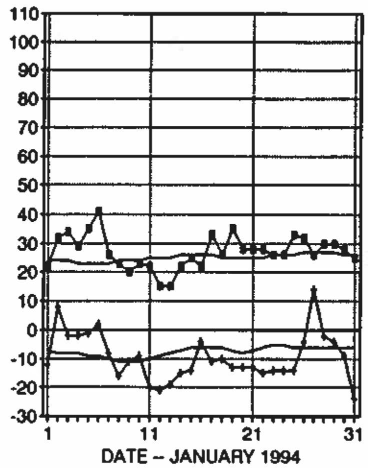
AKRON 1N



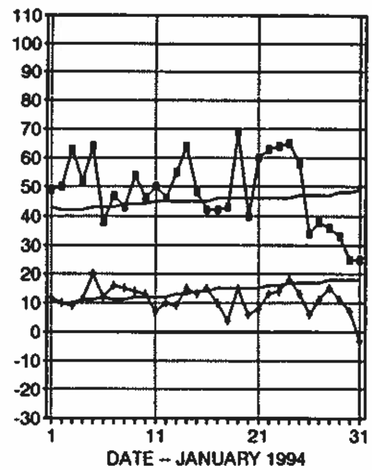
GRAND JUNCTION



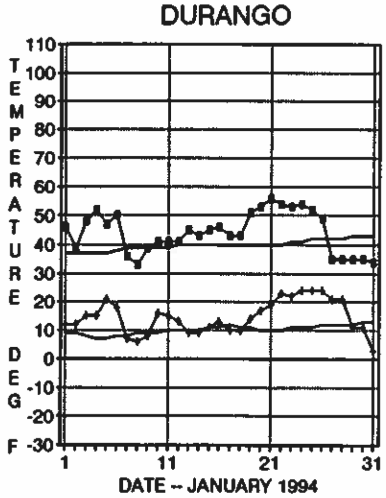
GUNNISON



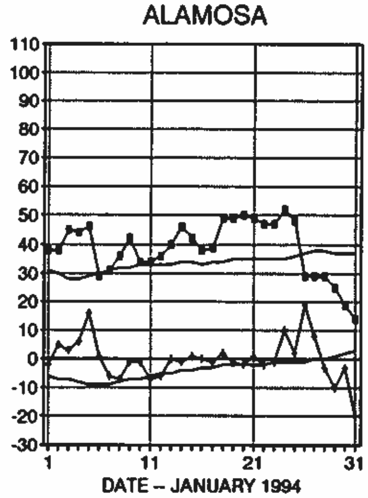
PUEBLO WSO



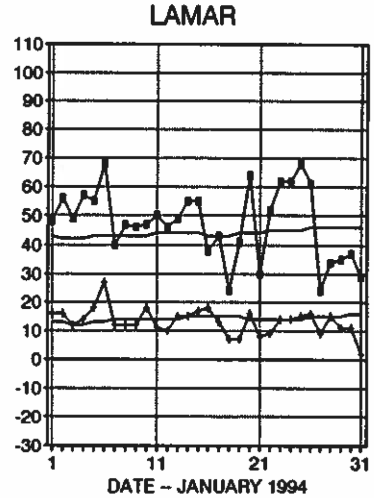
DURANGO



ALAMOSA



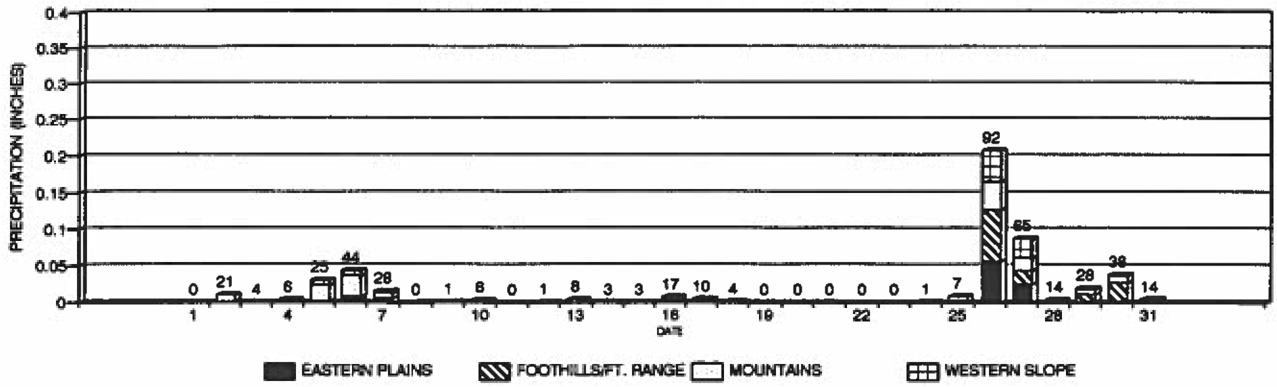
LAMAR



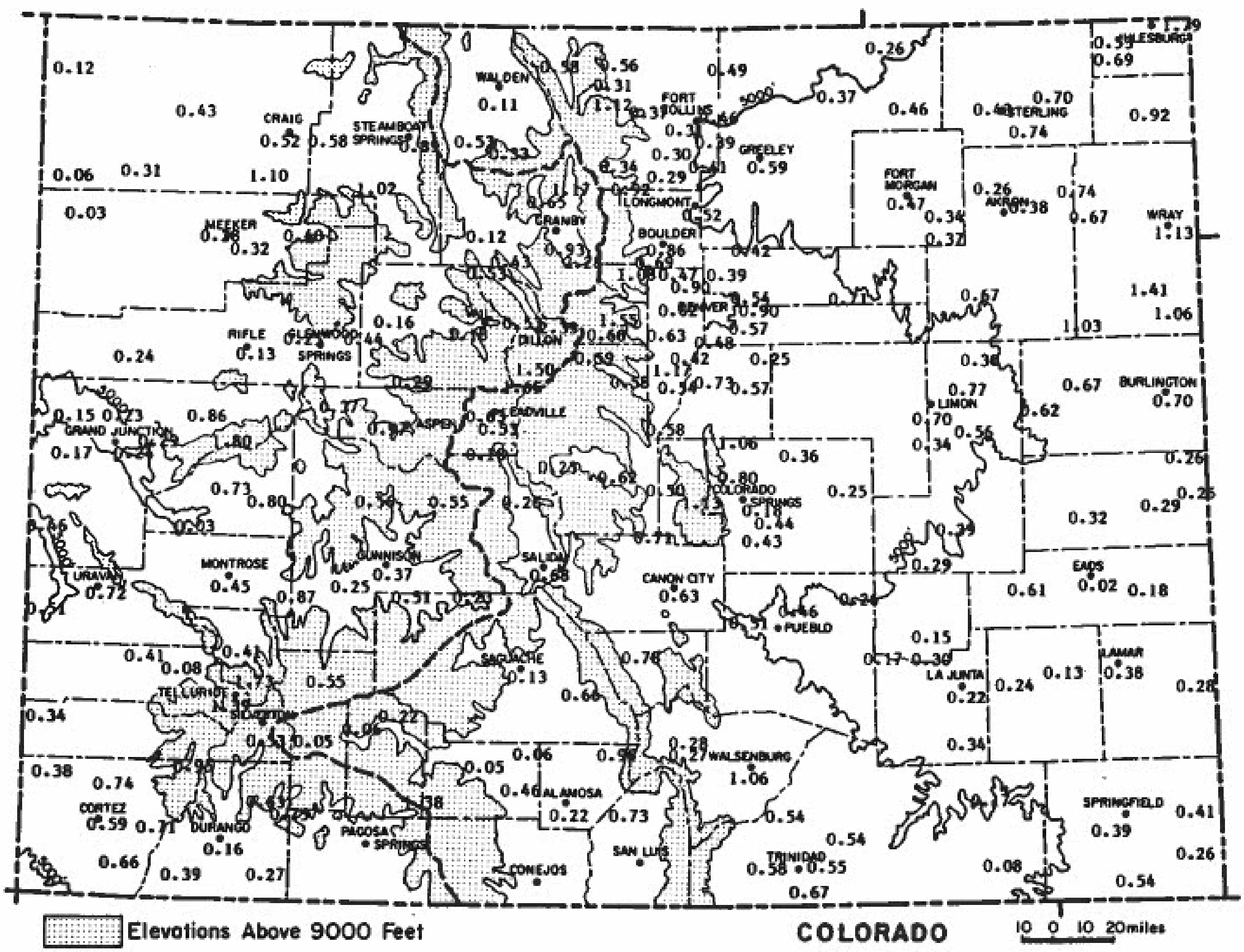
JANUARY 1994 PRECIPITATION

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", so the State-averaged January precipitation ended up close to 0.50", significantly below average.

COLORADO DAILY PRECIPITATION - JAN 1994

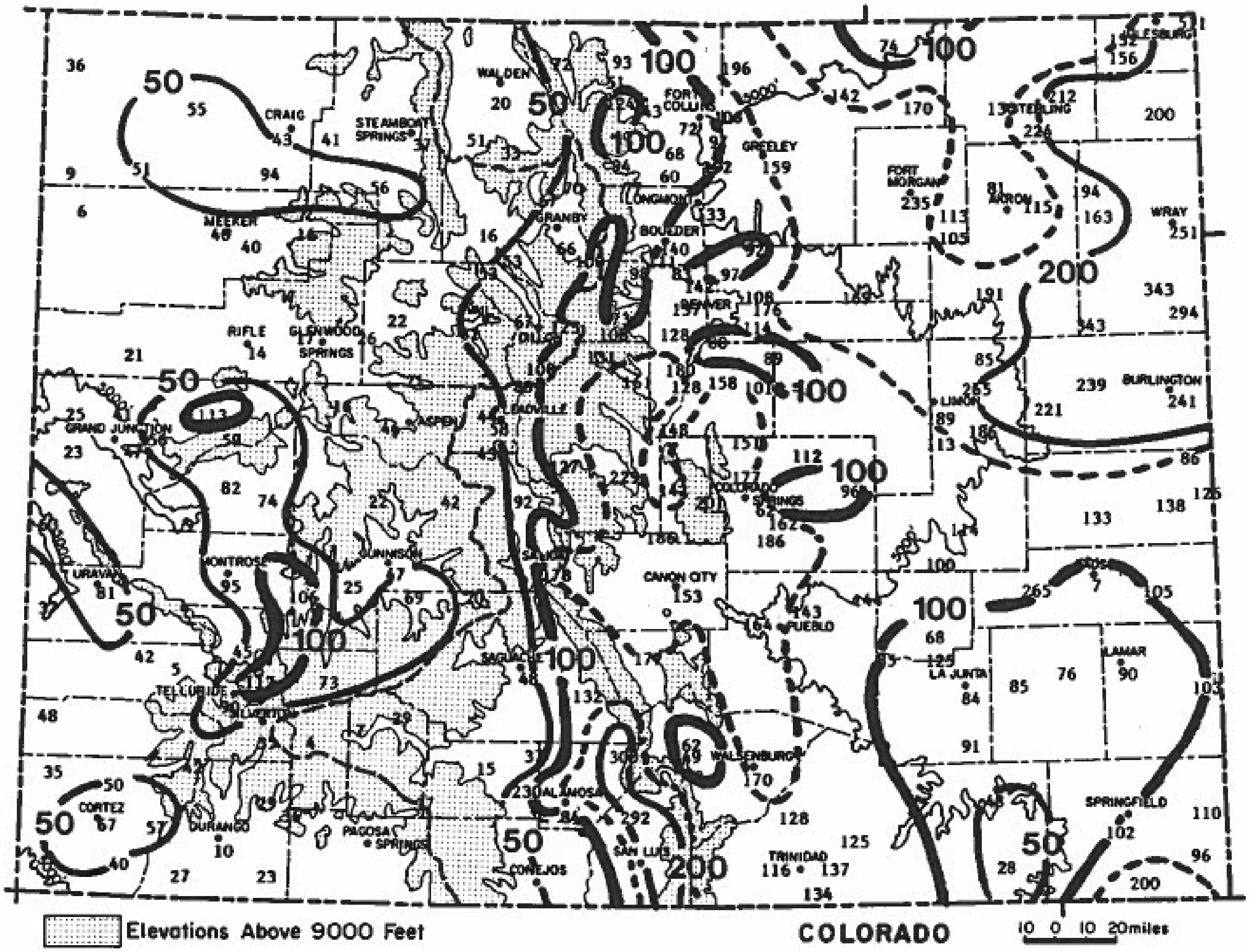


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

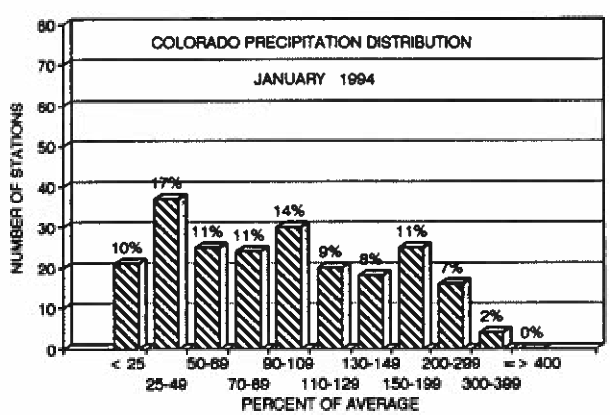


Precipitation Amounts (in inches) for January 1994.

JANUARY 1994 PRECIPITATION COMPARISON



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

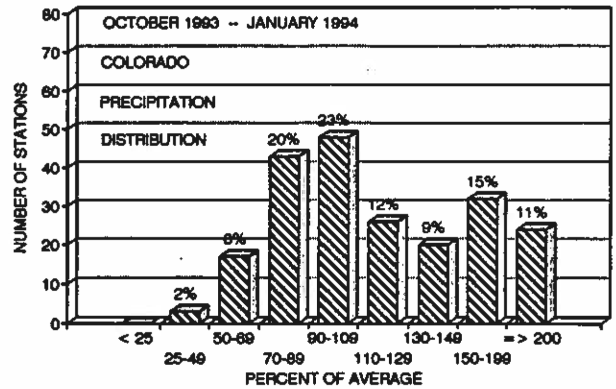


January precipitation ranged from below 25% of average across several areas of western Colorado to more than 300% of average in southern Yuma county. Overall the dry areas outnumbered the wet areas, and the wet areas were mostly locations that normally receive little January moisture.

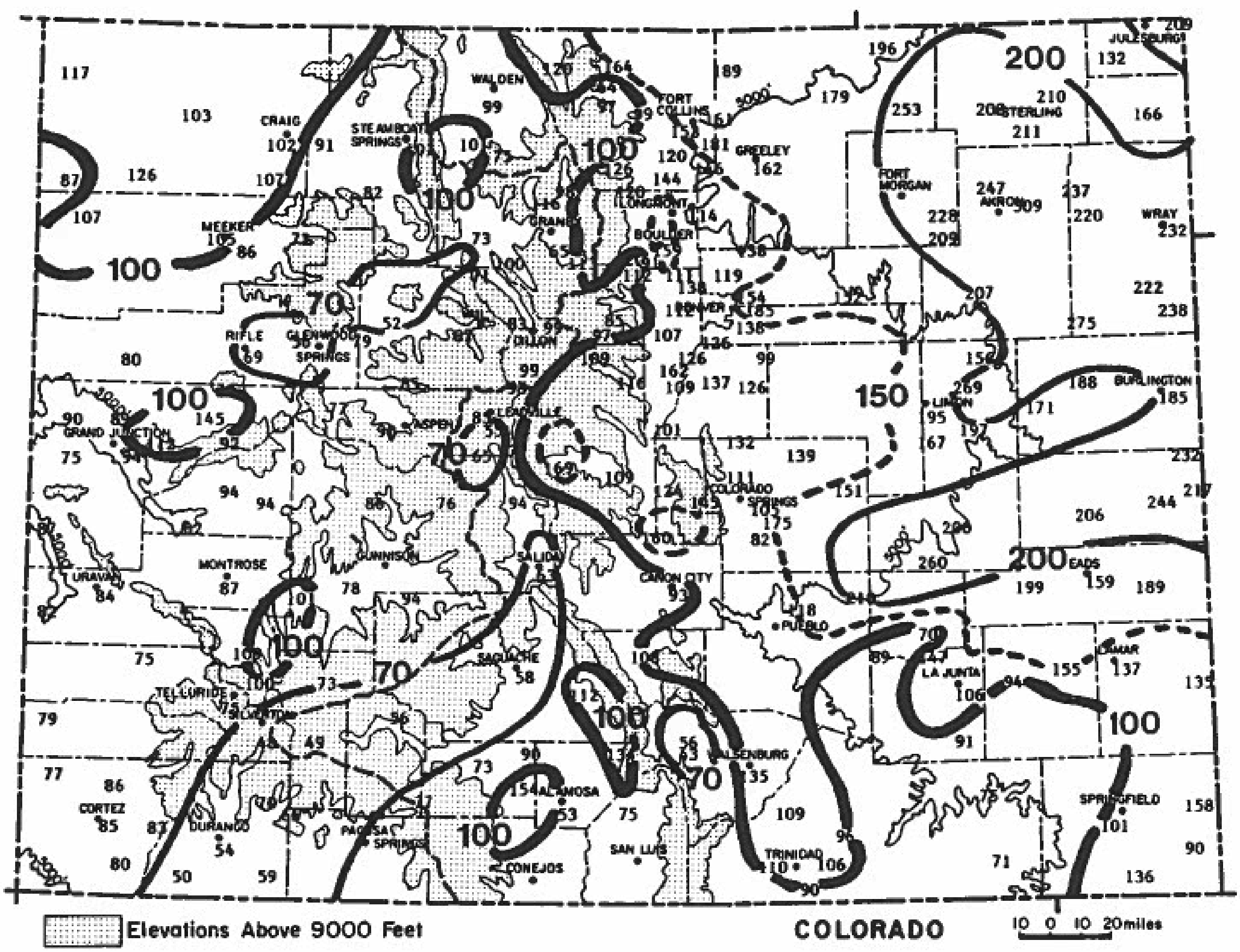
JANUARY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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.

COMPARATIVE HEATING DEGREE DAY DATA FOR JANUARY 1994

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	308	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1280	956	692	435	185	9394
	93-94	51	118	342	735	1167	1435	1412						5260
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351	1290						5425
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	897	514	233	91	6120
	93-94	5	26	202	508	875	905	905						3428
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1206	1172						4721
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953	978	1060						3655
CANON CITY	AVE *	0	11	91	325	645	898	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	482	199	55	5620
	93-94	0	22	153	435	816	864	886						3176
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	778	558	286	84	6513
	93-94	0	40	212	519	972	1008	1032						3783
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	760	578	282	106	6453
	93-94	10	14	165	508	926	1148	1088						3857
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	887	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	286	619	1168	1369	1317						4906
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	8	10	71	301	919	1192	967	783	849	489	181	52	5600
	93-94	13	33	232	598	1052	1245	1231						4404
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948	948						3455
DILLON	AVE	282	341	555	858	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1484	1486						6406
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968	1169	1094						4003
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M	1258						M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1098	1079						4453
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003	985						3699
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1006	M	M						M
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	8	25	222	868	1245	1018	799	597	448	144	33	5403
	93-94	4	0	59	410	875	1102	1025						3475

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	680	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	813	1250	1543	1577						6250
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6308
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492	955	1021	1005						3670
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734						M
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	360	128	9	5895
	93-94	0	12	90	389	935	925	994						3345
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	536	785	1401	1502	1462	1305	1209	1033	738	489	11276
	93-94	354	390	591	915	1368	1478	1499						6595
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117						4091
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557	1005	1064	1022						3936
MEEKER	AVE	26	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317	1258						4568
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	958	1155	1120						3941
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8546
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M						M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	195	30	6105
	93-94	0	18	155	491	973	1020	1081						3738
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	978	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464	975	1171	1132						3961
STEAMBOAT SPRINGS	AVE *	113	168	398	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	180	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260	1486	1427						5588
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	968	1066	1072						3770
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210	1443	1476						5829
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5838
	93-94	0	27	123	472	857	968	1000						3447
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1469	1416						6127
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865	877						3068

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

JANUARY 1994 CLIMATE DATA

EASTERN PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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	Incomplete month, temperature data 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

FOOTHILLS/ADJACENT PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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 7ESE	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	%Norm	# 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
GUNNISON	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.

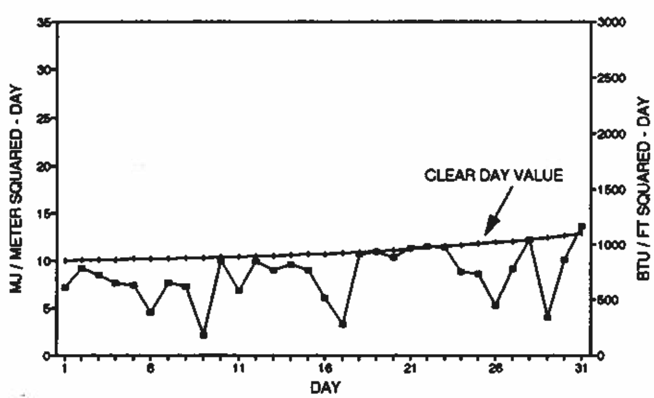
JANUARY 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days			Percent Possible	Average % of
	CLR	PC	CLDY	Sunshine	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%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

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.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
JANUARY 1994

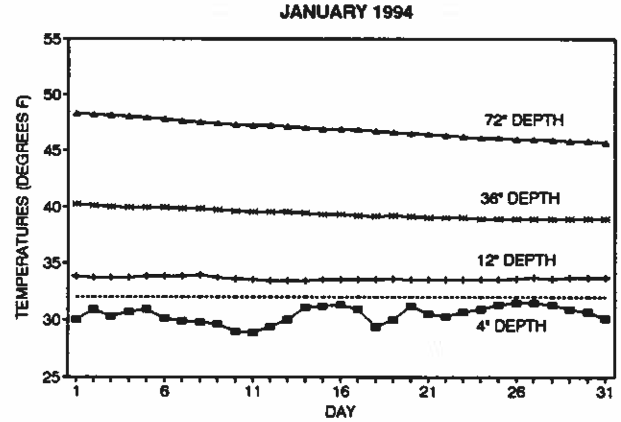


JANUARY 1994 SOIL TEMPERATURES

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.

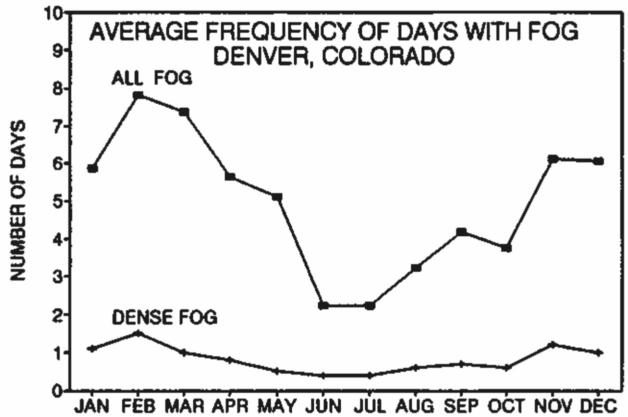
5) Movement of air up a sloped plain, hillside, valley or mountain where air is cooled by expansion as it rises. If the air is moist enough or rises far enough to cool to saturation, **upslope** fog can form. This type of fog occurs in Colorado and anywhere that moist air and sloping terrain meet. The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

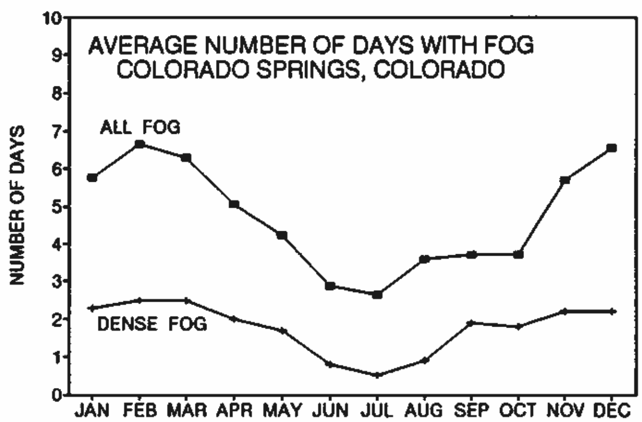
6) Nighttime cooling of the ground by radiational heat loss is a very common mechanism for producing fogs. Since cold air is more dense it tends to drain downhill and collect in valley bottoms. Thus, **radiation** fog is also often called **valley** fog.

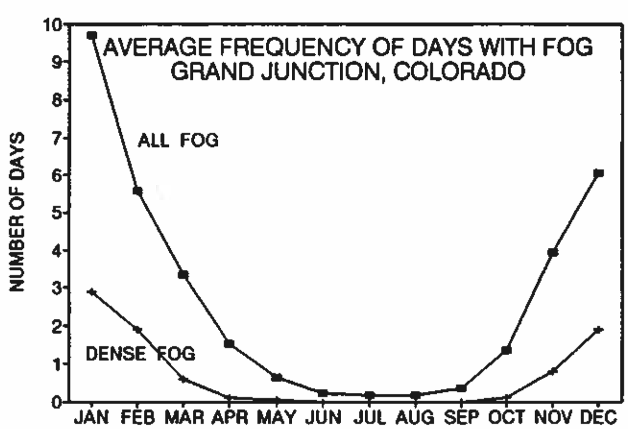
Here in Colorado we see almost no frontal fog. Advection fogs occur very infrequently – mostly near the Kansas border. Evaporation fogs occur but are highly localized. You will see them most often during cold winter weather by the big electric power generation plants near Craig, Brush, Pueblo and some 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







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.

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.

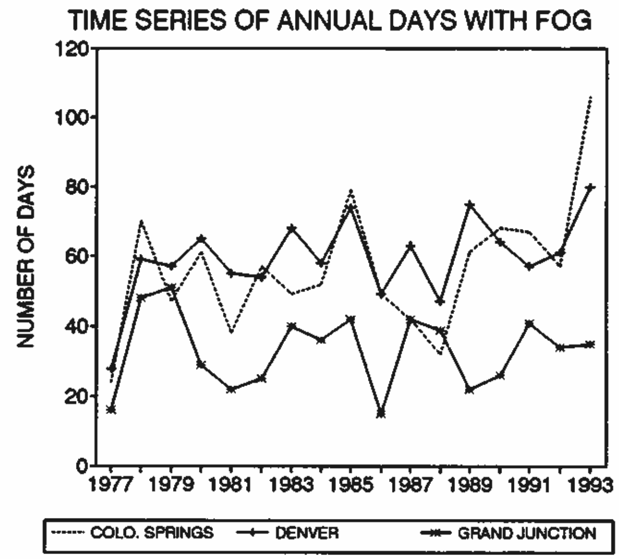
How often do we have fog here in Colorado and how much does it vary from place to place across the region? Since Colorado is so far away from the major atmospheric moisture sources (Pacific Ocean and Gulf of Mexico), we have many fewer occurrences of fog than in the more humid climates. Unfortunately,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



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.

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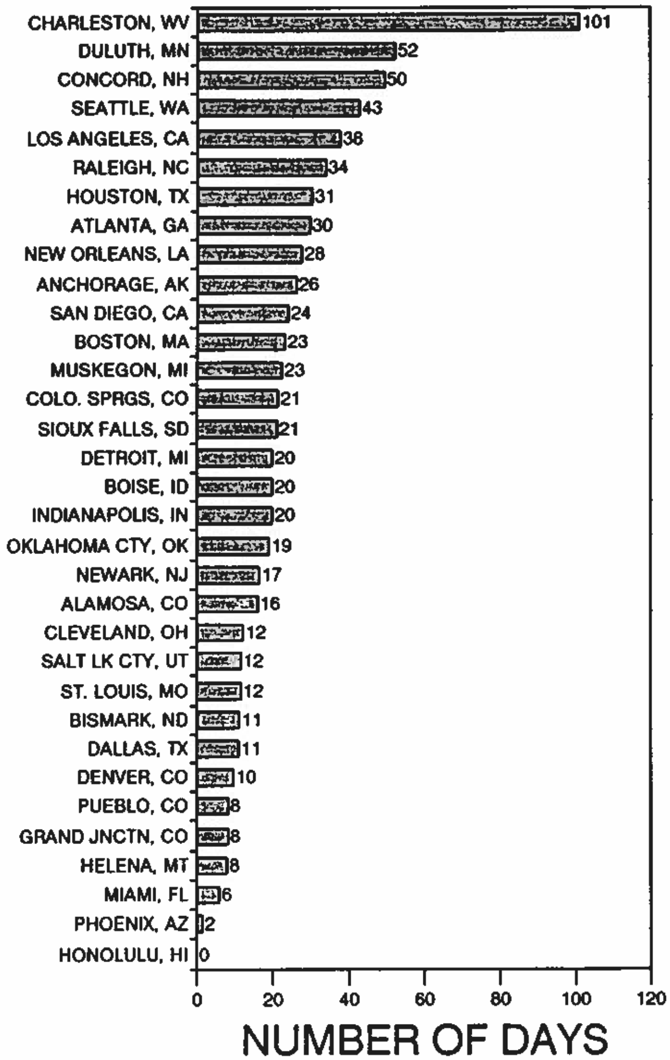
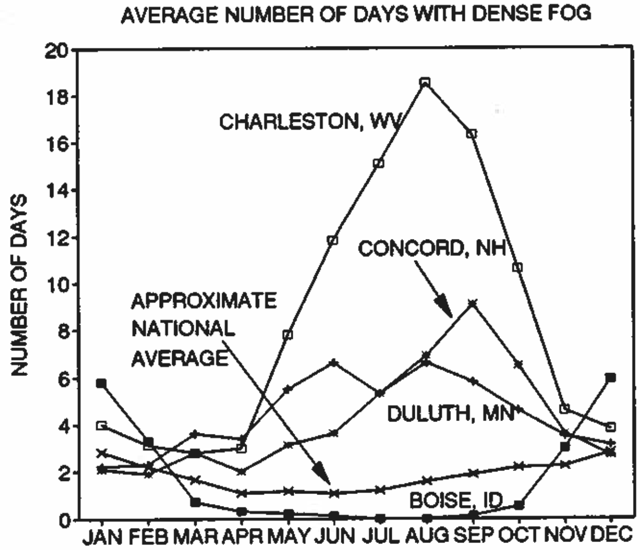
AVERAGE NUMBER OF DAYS WITH DENSE FOG

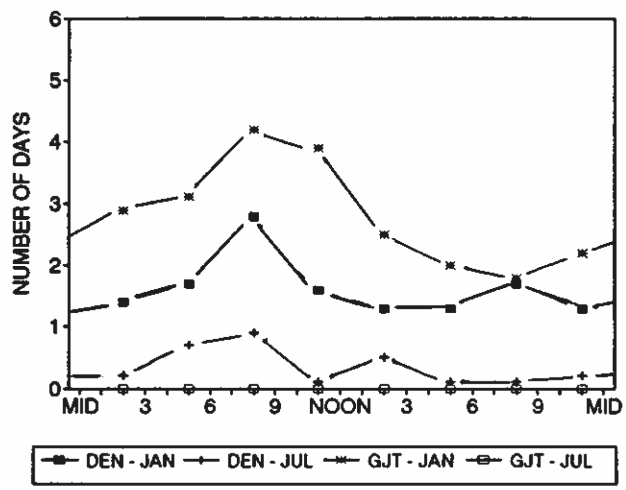


AVERAGE NUMBER OF DAYS WITH DENSE FOG



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 and12 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.

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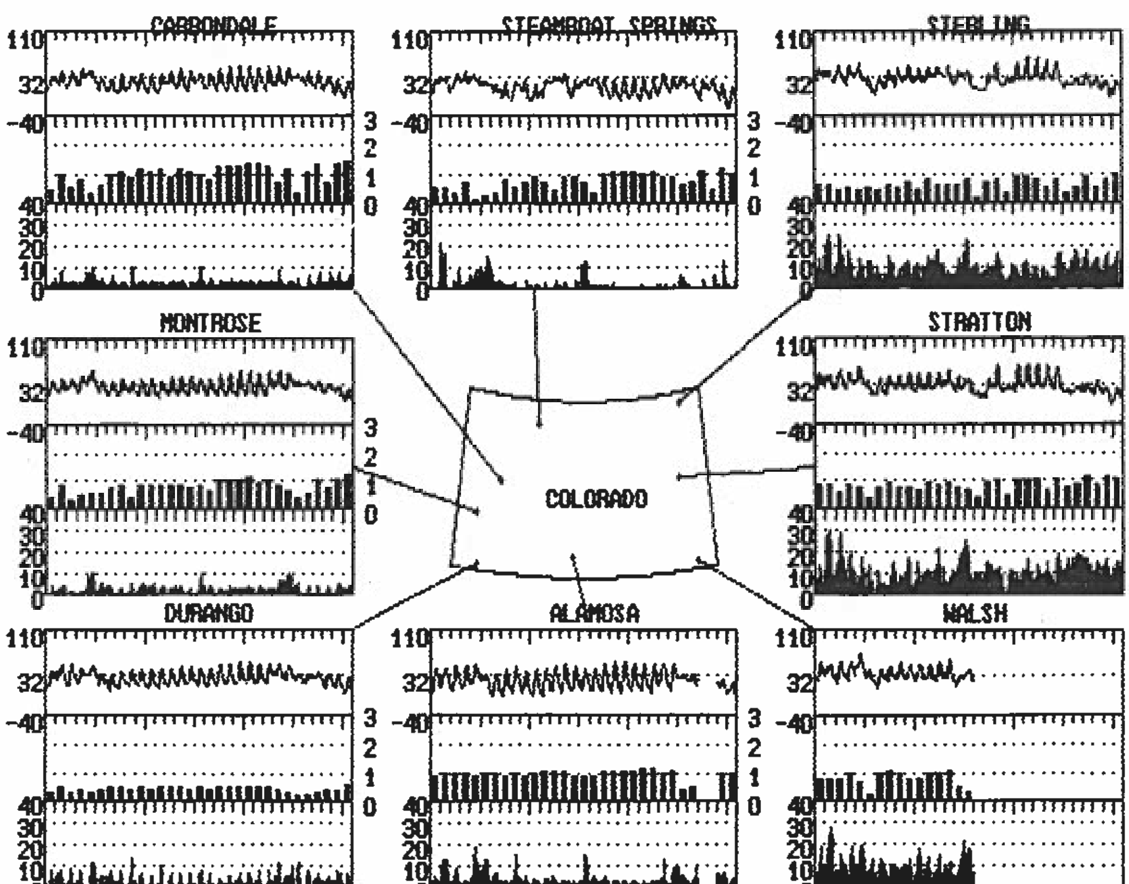
WTHRNET WEATHER DATA   JANUARY 1994

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	19.7	25.1	22.9	26.0	13.7	28.3	27.9	n/a
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	52.2 19/16	53.1 20/15	49.5 21/16	55.0 24/15	39.9 4/14	65.1 22/15	64.2 23/14	n/a n/a
minimum:	-15.5 31/22	-4.9 31/ 8	-6.5 31/ 8	0.7 31/ 7	-25.6 31/ 5	-4.0 30/22	-5.6 30/23	n/a n/a
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	68 / 1	72 / 11	89 / 12	78 / 13	88 / 5	75 / 17	32 / 3	n/a /n/a
11 AM	34 / 10	51 / 22	59 / 18	58 / 23	83 / 14	58 / 22	25 / 12	n/a /n/a
2 PM	25 / 14	45 / 24	40 / 20	45 / 25	70 / 20	47 / 24	22 / 15	n/a /n/a
5 PM	26 / 13	43 / 22	43 / 19	46 / 23	74 / 17	53 / 22	23 / 10	n/a /n/a
11 PM	48 / 2	68 / 15	75 / 15	73 / 16	87 / 9	72 / 18	31 / 3	n/a /n/a
monthly average wind direction (degrees clockwise from north)								
day	197	178	191	227	138	225	127	n/a
day	176	67	174	141	116	254	234	n/a
monthly average wind speed (miles per hour)								
	3.05	2.56	1.77	1.94	1.59	8.19	9.59	n/a
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	459	495	610	497	469	46	60	n/a
3 to 12	210	235	98	155	87	581	478	n/a
12 to 24	22	2	0	0	12	108	193	n/a
> 24	0	0	0	0	0	3	12	n/a
monthly average daily total insolation (Btu/ft²·day)								
	925	423	1002	802	726	616	834	n/a
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	198	2	51	131	108	78	161	n/a
40-60%	49	1	51	72	65	92	71	n/a
20-40%	25	234	41	57	62	60	59	n/a
0-20%	13	58	11	20	31	57	10	n/a

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.



COLORADO CLIMATE

FEBRUARY 1994

Volume 17 Number 5

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

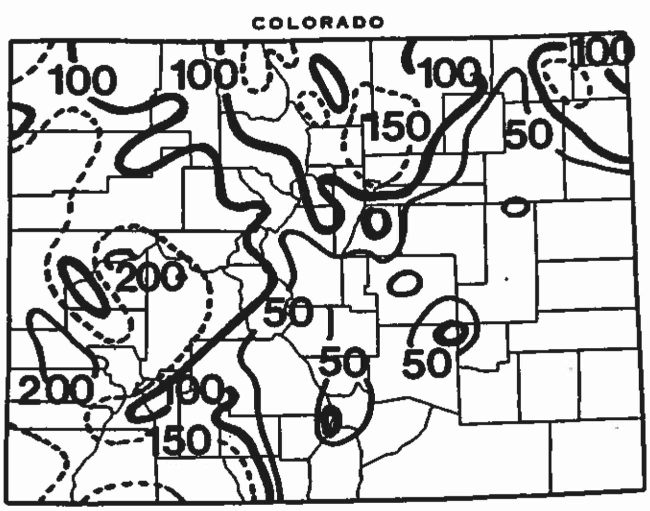
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

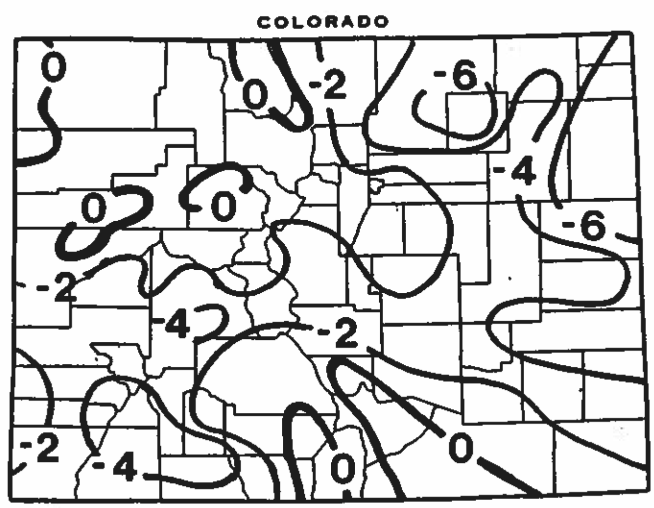
Several strong storms struck Colorado in February, but most of the precipitation fell along and west of the Continental Divide. Northeastern Colorado received a few small doses of precipitation, but wide areas of southeastern Colorado remained dry throughout the month. All the moisture in the high country 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.



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

Inside This Issue

FEBRUARY 1994 DAILY WEATHER

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° 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".

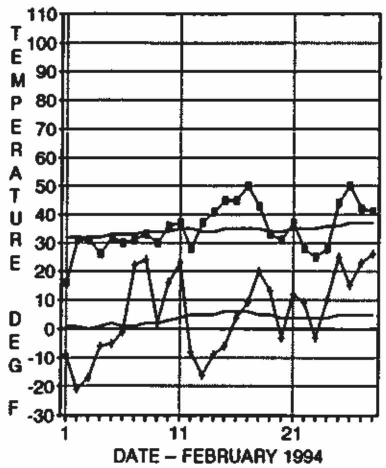
Weather Extremes

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	97"		Wolf Creek Pass 1E
Greatest Snow Depth	72"	February 22	Bonham Reservoir

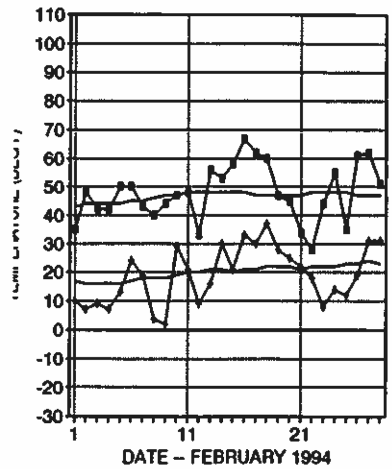
FEBRUARY 1994 TEMPERATURE COMPARISON

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.)

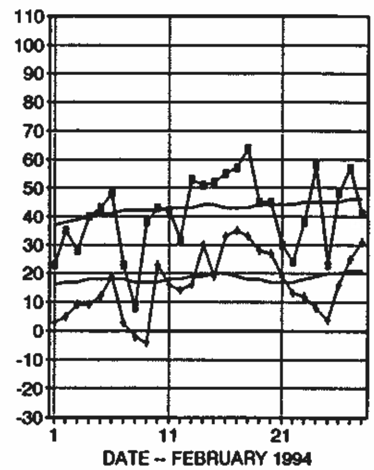
GRAND LAKE 1NW



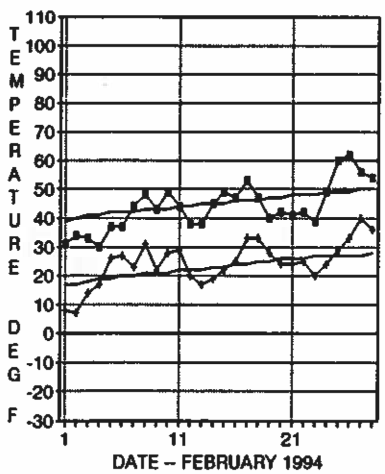
DENVER



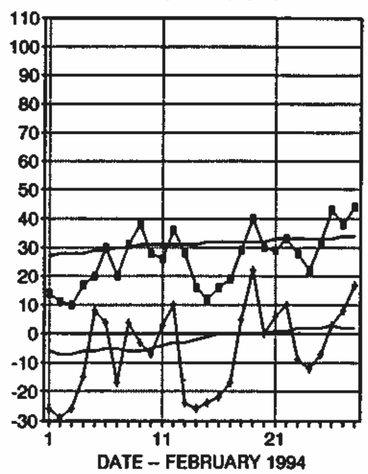
AKRON 1N



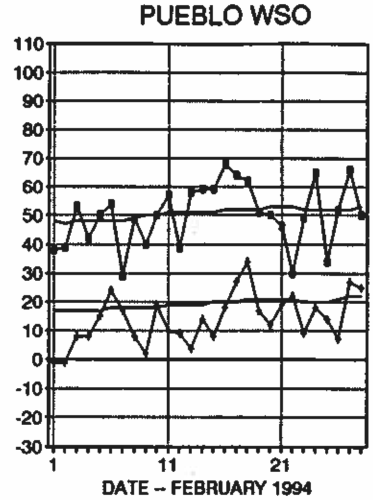
GRAND JUNCTION



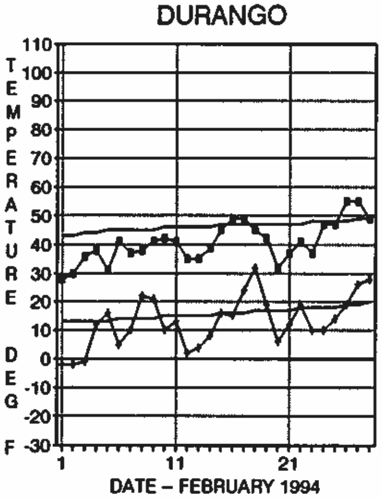
GUNNISON



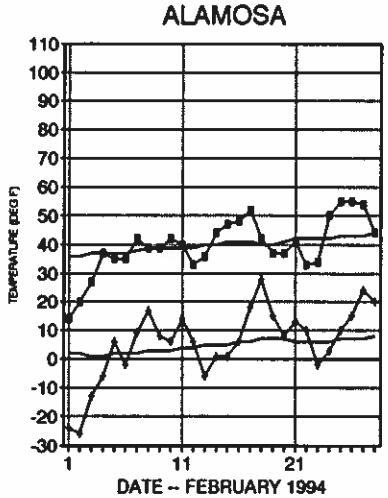
PUEBLO WSO



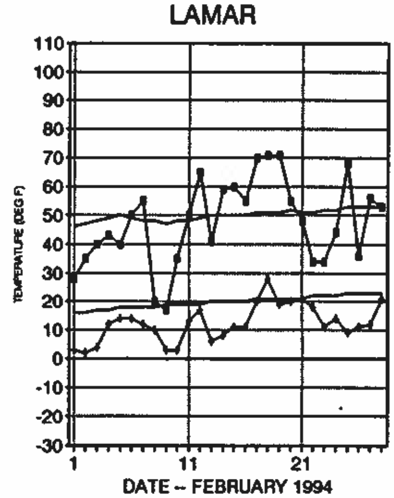
DURANGO



ALAMOSA



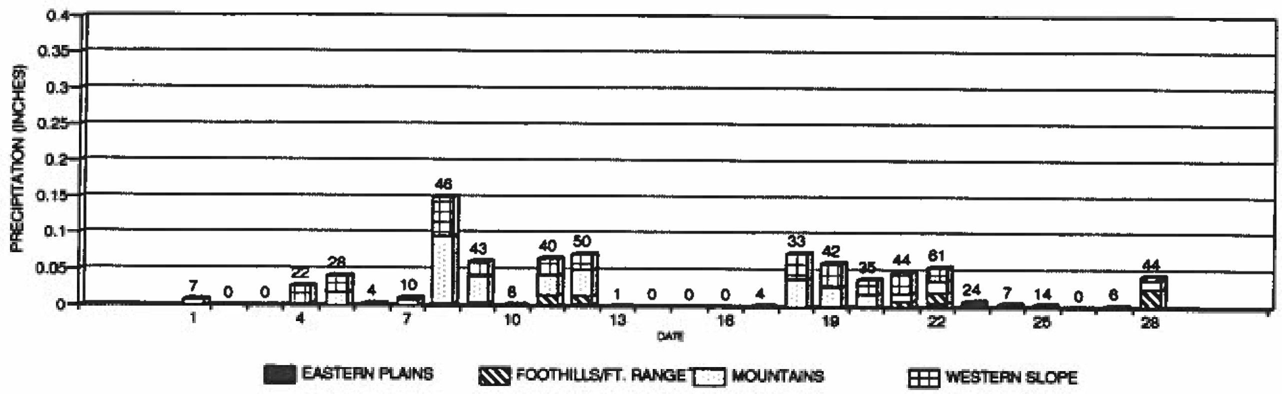
LAMAR



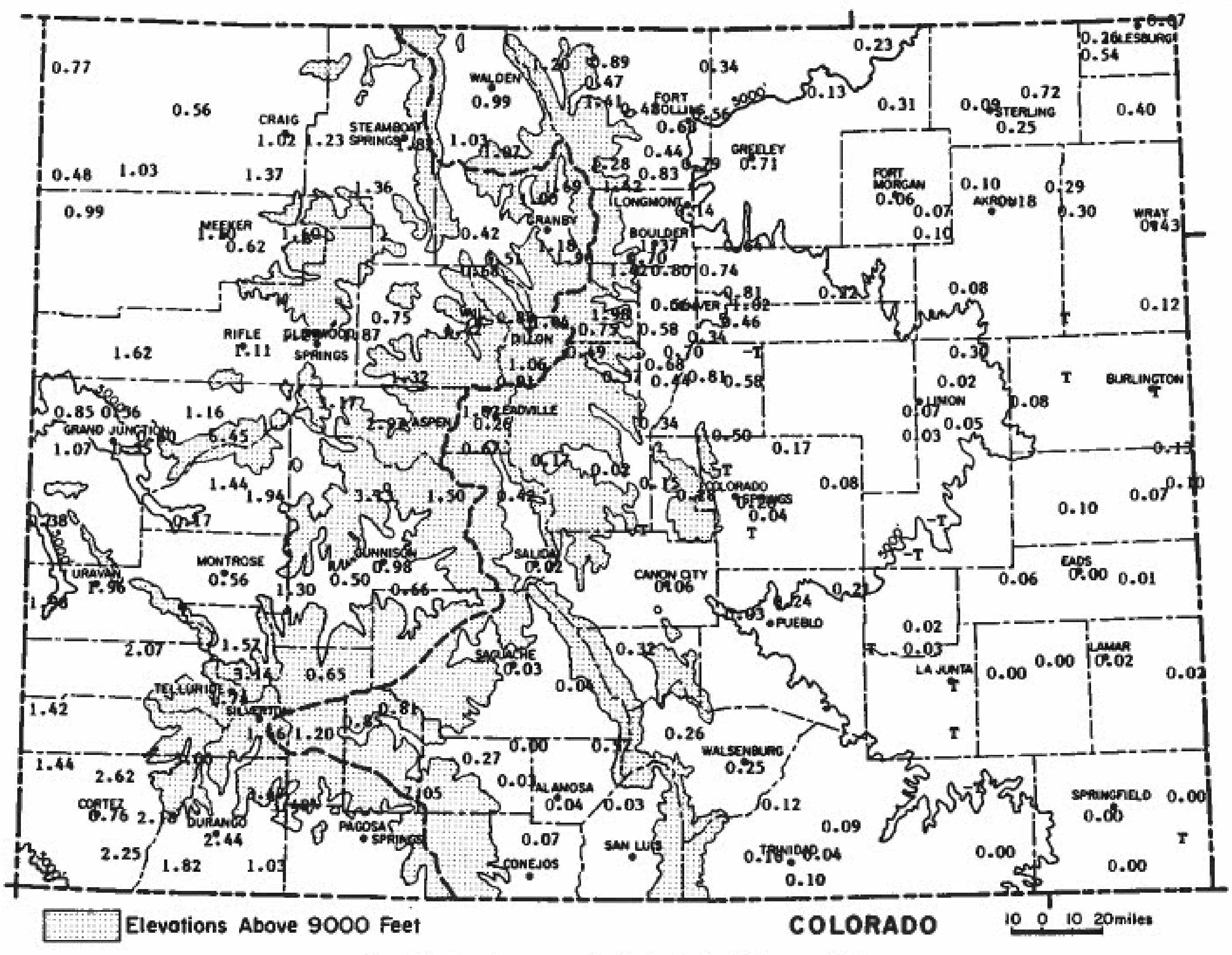
FEBRUARY 1994 PRECIPITATION

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

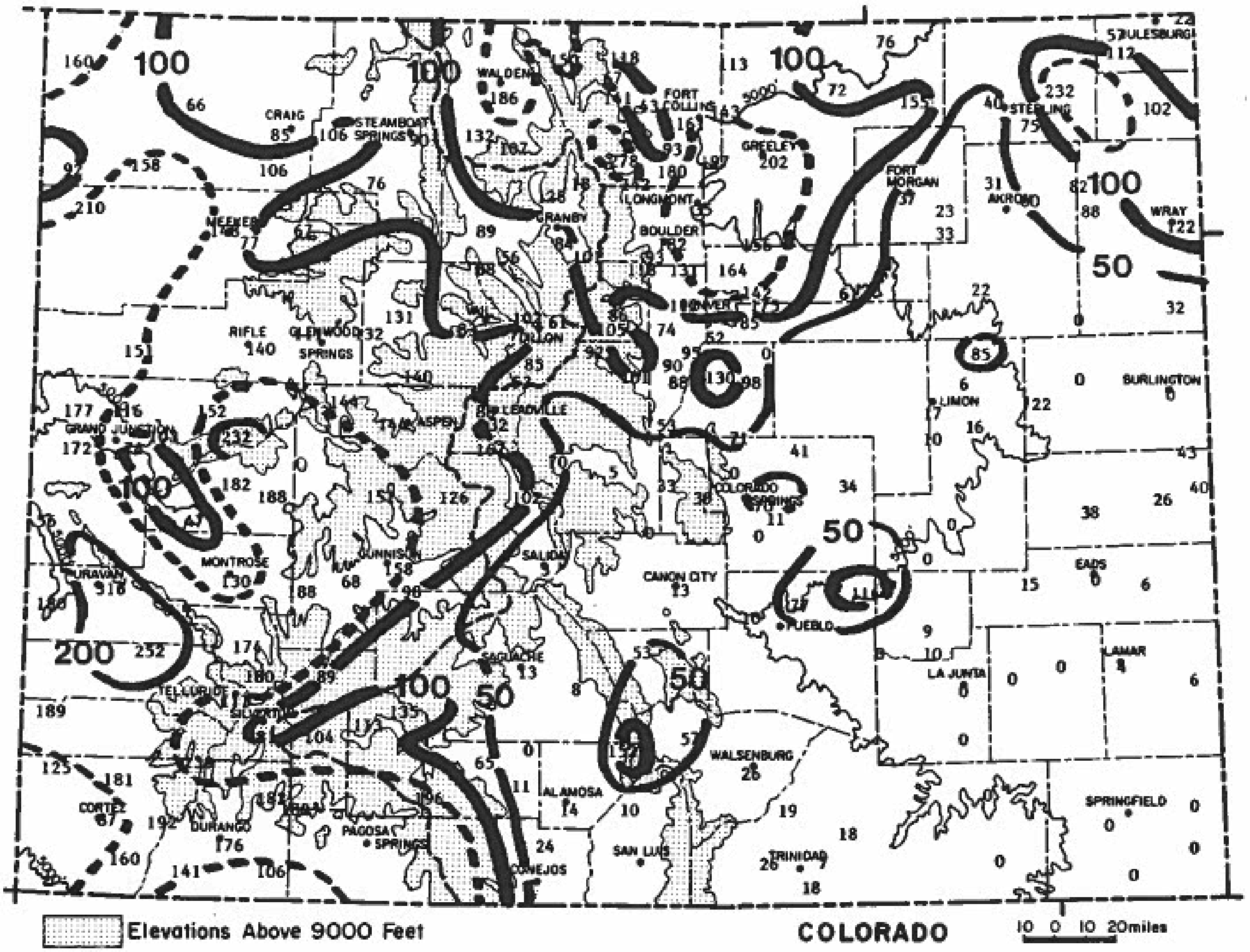


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

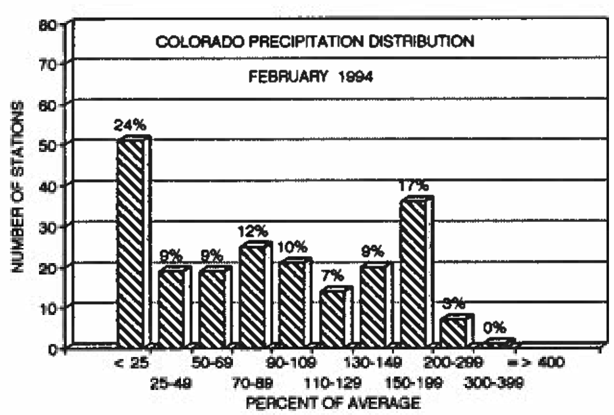


Precipitation Amounts (in inches) for February 1994.

FEBRUARY 1994 PRECIPITATION COMPARISON



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



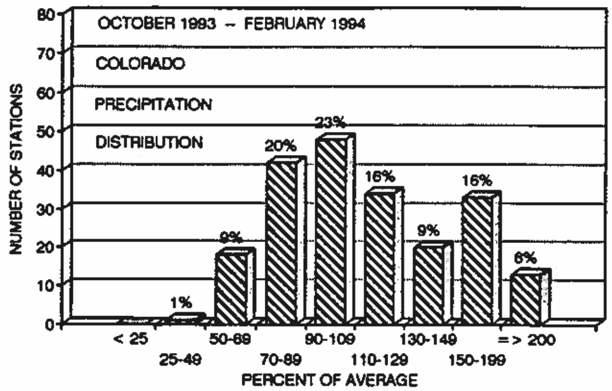
February precipitation ranged from zero over portions of southeast Colorado to more than 200% of average in a few locations in western Colorado. Dry areas slightly outnumbered the wet spots. 20% of the reporting stations reported 150% or more of average, but 33% had less than half the average precipitation.

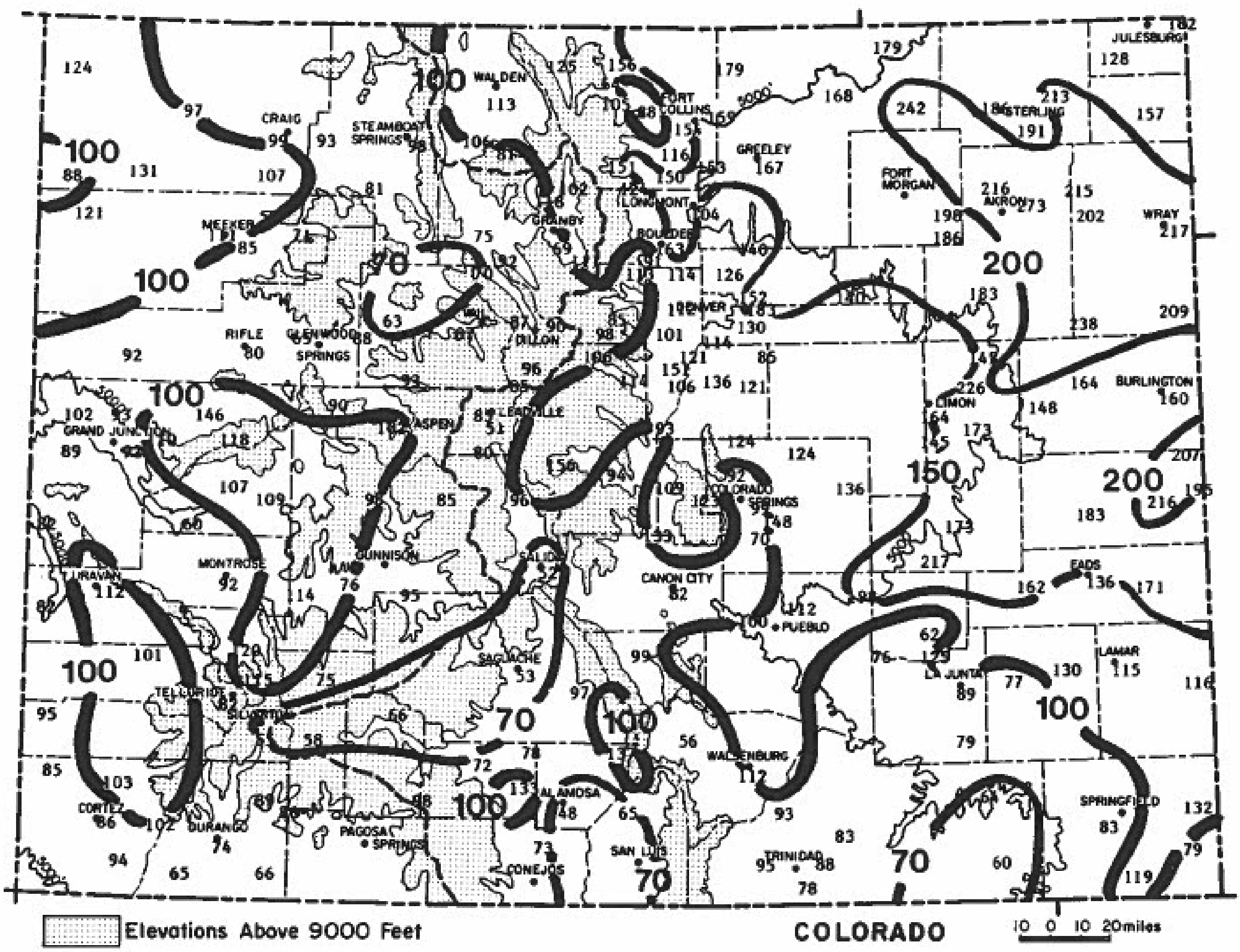
FEBRUARY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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"	48th driest in 126 years of record (driest < 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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1280	958	692	435	185	9394
	93-94	51	118	342	735	1167	1435	1412	1179					5260
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351	1290	1172					5425
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	508	875	905	905	899					3426
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1206	1172	1124					4721
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953	978	1060	1068					3655
CANON CITY	AVE *	0	11	91	325	645	898	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	462	199	55	5620
	93-94	0	22	153	435	816	864	886	828					3176
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972	1008	1032	926					3783
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	760	578	282	108	6453
	93-94	10	14	165	506	926	1148	1086	1038					3857
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	887	419	193	8378
	92-93	87	64	234	498	1139	1453	1408	1270	978	765	384	203	8441
	93-94	87	60	286	619	1168	1369	1317	1237					4906
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	783	649	469	181	52	5600
	93-94	13	33	232	598	1052	1245	1231	1010					4404
DENVER	AVE	0	0	144	429	780	1054	1094	885	808	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948	946	879					3455
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1484	1486	1307					6406
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	589	302	136	6793
	93-94	6	43	201	522	968	1169	1094	1057					4003
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M	1258	1080					M
EVERGREEN	AVE	76	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1098	1079	1029					4453
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003	985	994					3699
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	158	64	7065
	93-94	0	19	168	495	1008	M	M	1166					M
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102	1025	853					3475

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1263	945	660	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	613	1250	1543	1577	1404					6250
GREELEY	AVE	0	7	158	446	831	1153	1208	924	808	492	231	52	6308
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492	955	1021	1005	1059					3670
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734	1527					M
LAS ANIMAS	AVE	0	0	69	338	750	1068	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	360	128	9	5895
	93-94	0	12	90	389	935	925	994	882					3345
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	728	439	10870
	92-93	383	435	536	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478	1499	1321					6595
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117	1058					4091
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557	1005	1064	1022	1053					3936
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1308	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317	1258	1098					4566
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	956	1155	1120	992					3941
PAGOSA SPRINGS	AVE	64	115	324	636	964	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M	M					M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	195	30	6105
	93-94	0	18	155	491	973	1020	1081	915					3738
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94	E 13	7	199	464	975	1171	1132	921					3961
STEAMBOAT SPRINGS	AVE *	113	166	396	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	160	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260	1486	1427	1294					5588
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	966	1066	1072	1056					3770
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210	1443	1476	1276					5829
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5838
	93-94	0	27	123	472	857	968	1000	826					3447
WALDEN	AVE	189	273	498	825	1161	1457	1528	1298	1237	909	657	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1469	1416	1238					6127
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865	877	780					3066

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

FEBRUARY 1994 CLIMATE DATA

EASTERN PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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 2ESE	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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	#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 7ESE	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	0	0	1.46	-0.34	81	11
WOLF CREEK PASS 1E	24.5	4.0	14.2	-4.2	40	-17	1415	0	0	7.05	3.46	196	12

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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
GUNNISON	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.

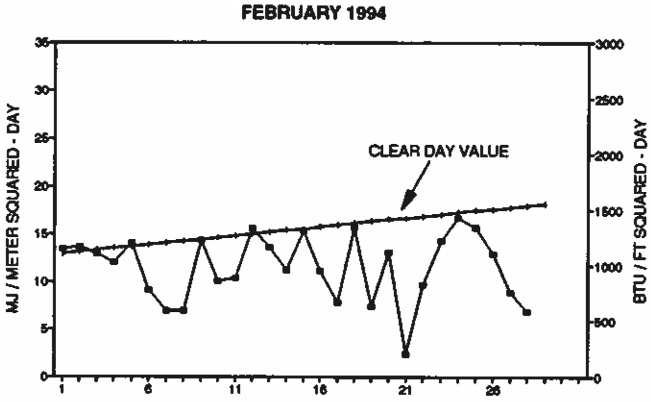
FEBRUARY 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

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

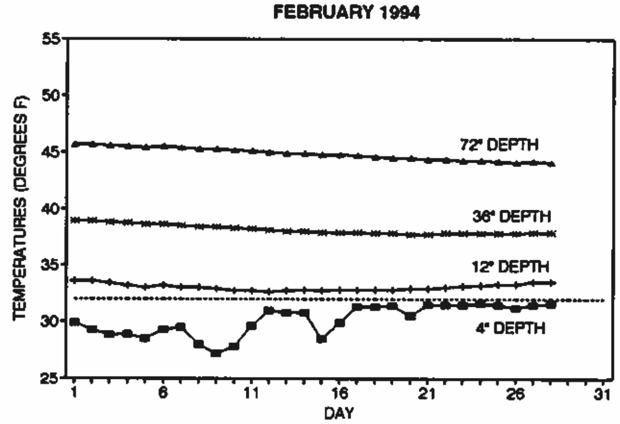


FEBRUARY 1994 SOIL TEMPERATURES

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.

DROUGHT IN COLORADO – PART I

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.

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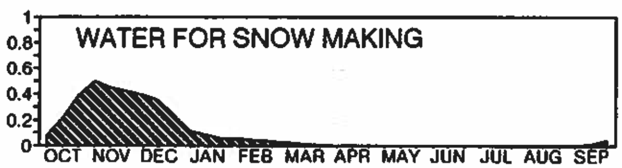
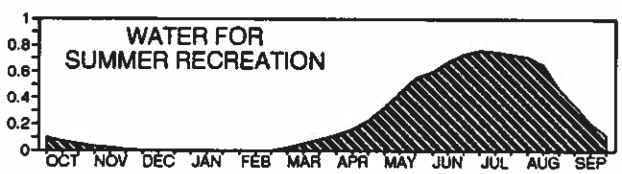
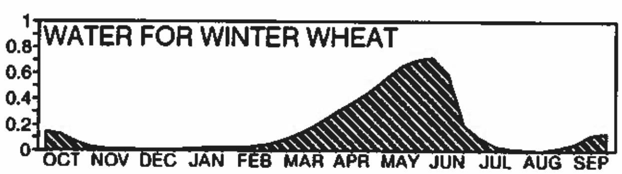
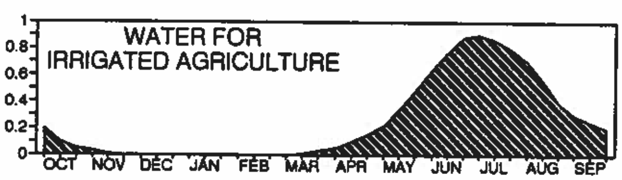
In function, drought occurs when there is insufficient water to meet demands. If you have no demands, perhaps you have no drought. If you make unreasonable demands, you will experience drought often. Colorado homesteaders learned quickly that drought was very common here if they tried to continue to 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.

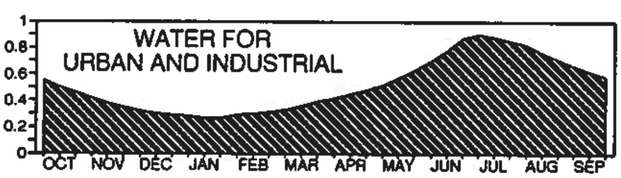
A good way to evaluate vulnerability to drought is by identifying the primary water users and determining their water demands. The following graph may be helpful for visualizing water demand in Colorado. The numbers are not precise, but it gives a general idea of the timing of various demands for water 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.





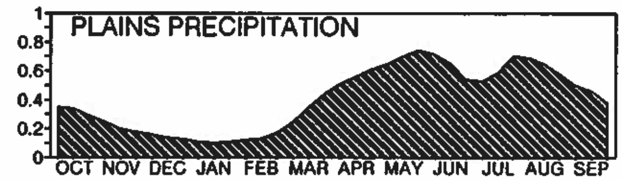


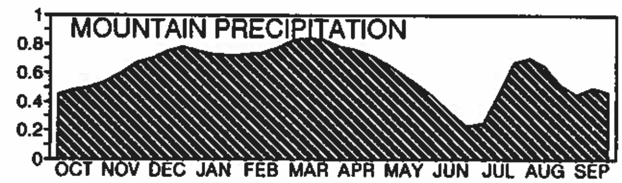


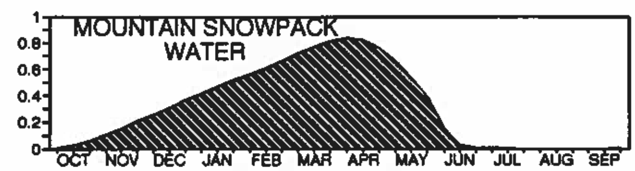


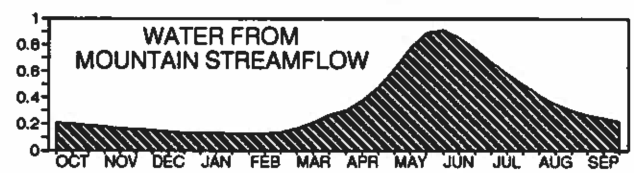
A great deal of monitoring, regulation and occasional legal action are required to meet this water demand.

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.

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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.

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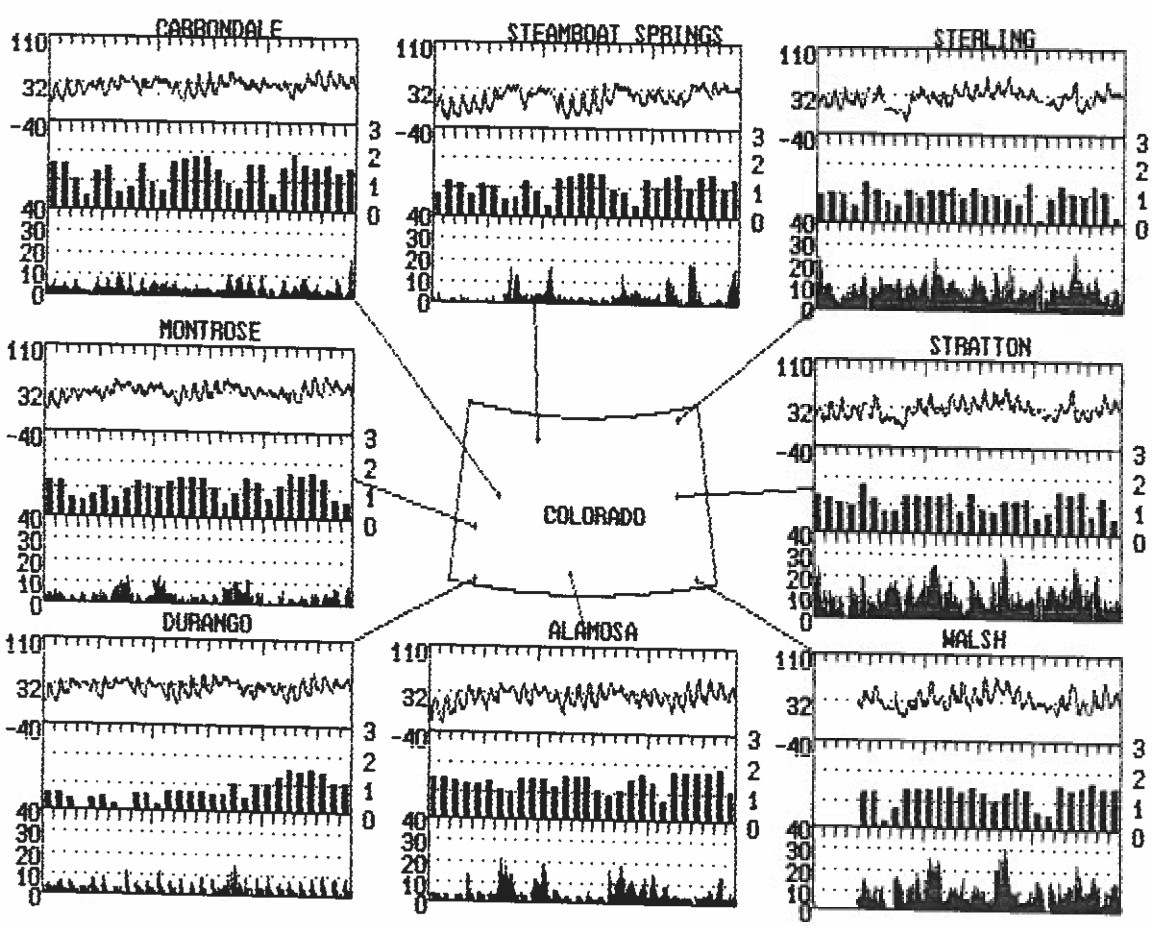
WTHRNET WEATHER DATA FEBRUARY 1994

	Alamosa		Durango		Carbondale		Montrose		Steamboat Springs		Sterling		Stratton		Walsh	
monthly average temperature (°F)																
	23.3		25.0		26.4		29.9		15.5		26.2		26.7		33.0	
monthly temperature extremes and time of occurence (°F day/hour)																
maximum:	57.6	26/15	51.6	25/16	55.9	26/15	59.4	26/15	45.7	26/14	62.4	16/15	62.6	18/12	71.1	17/16
minimum:	-24.2	2/ 5	-3.8	1/ 5	-5.3	2/ 8	-2.9	2/ 7	-24.7	2/ 7	-13.9	9/ 2	-6.0	9/ 3	0.3	9/ 7
monthly average relative humidity / dewpoint (percent / °F)																
5 AM	81 / 8		84 / 13		87 / 16		83 / 20		87 / 5		71 / 14		32 / 0		71 / 16	
11 AM	54 / 20		60 / 24		58 / 21		59 / 25		80 / 16		57 / 21		24 / 10		44 / 24	
2 PM	43 / 23		55 / 25		46 / 22		53 / 27		64 / 21		46 / 22		21 / 13		36 / 25	
5 PM	40 / 21		51 / 24		47 / 22		51 / 26		66 / 19		50 / 21		22 / 11		36 / 23	
11 PM	72 / 14		78 / 18		74 / 19		79 / 23		86 / 10		75 / 17		30 / 4		58 / 17	
monthly average wind direction (degrees clockwise from north)																
day	176		188		234		195		152		199		160		175	
day	150		86		191		152		132		223		186		233	
monthly average wind speed (miles per hour)																
	4.60		2.42		2.50		2.62		2.29		8.40		9.72		9.42	
wind speed distribution (hours per month for hourly average mph range)																
0 to 3	298		457		465		397		450		34		91		32	
3 to 12	293		191		184		221		100		491		344		379	
12 to 24	57		4		3		2		26		118		199		137	
> 24	0		0		0		0		0		1		13		8	
monthly average daily total insolation (Btu/ft²·day)																
	1345		731		1264		1083		1039		901		1125		1200	
"clearness" distribution (hours per month in specified clearness index range)																
60-80%	109		48		32		110		76		99		143		139	
40-60%	51		36		51		60		76		75		61		49	
20-40%	29		134		68		66		59		55		47		25	
0-20%	4		85		24		31		25		45		10		23	

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.



COLORADO CLIMATE

March 1994

Volume 17 Number 6

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

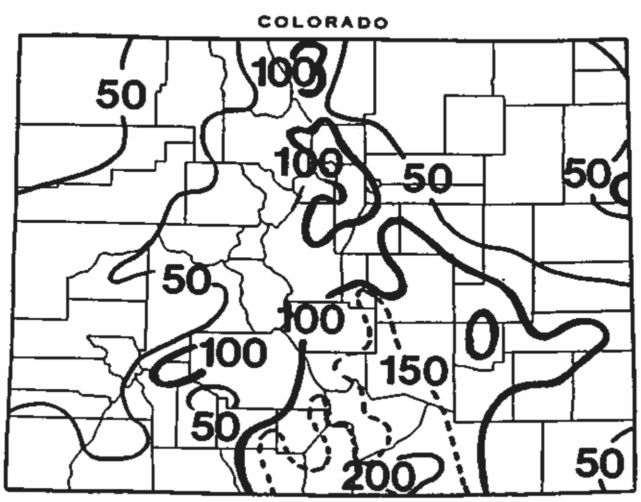
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

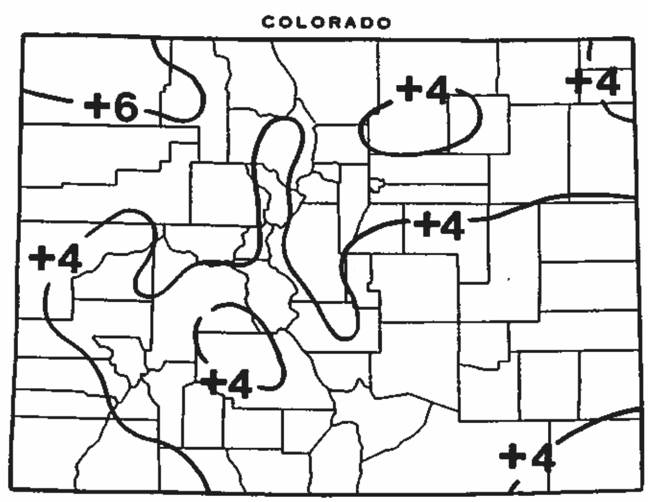
Seven storm systems crossed Colorado in March, but none of them brought precipitation to the entire State. The storm of March 6-8th delivered beneficial moisture to the Eastern Plains, but it ended up being the only precipitation of the month for many areas. The mountains received frequent snows in late 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.



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

Inside This Issue

MARCH 1994 DAILY WEATHER

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.

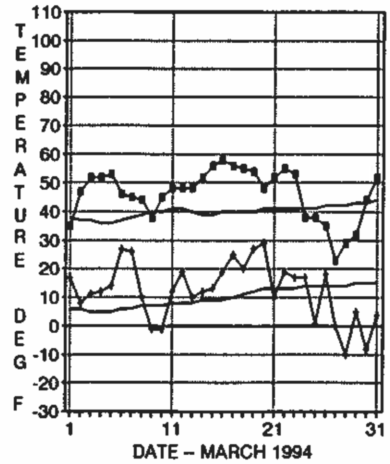
Weather Extremes

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

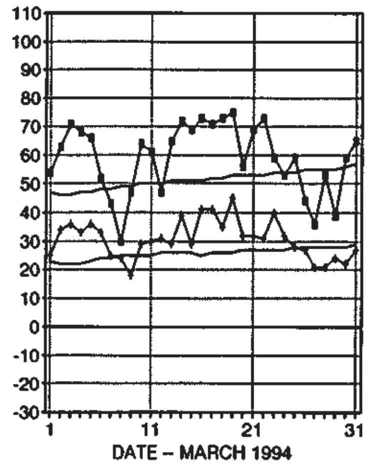
MARCH 1994 TEMPERATURE COMPARISON

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.)

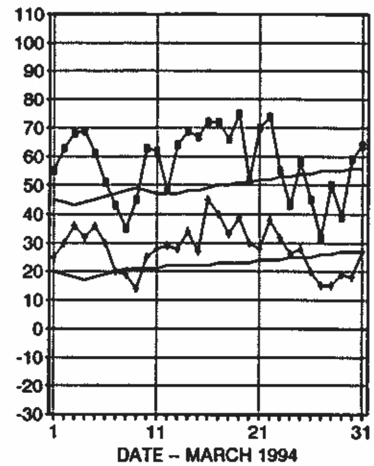
GRAND LAKE 1NW



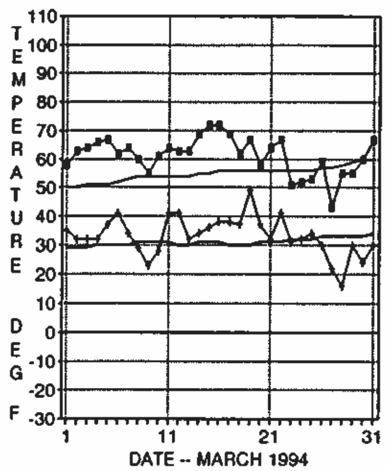
DENVER



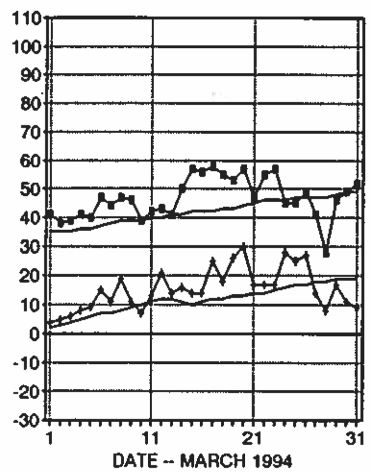
AKRON 1N



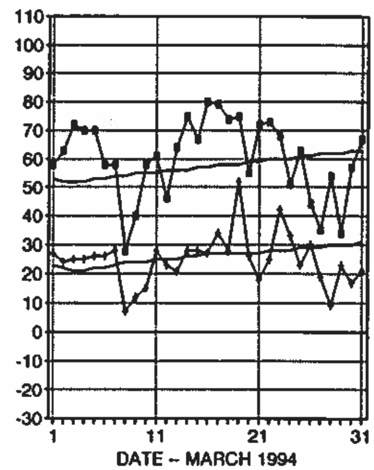
GRAND JUNCTION



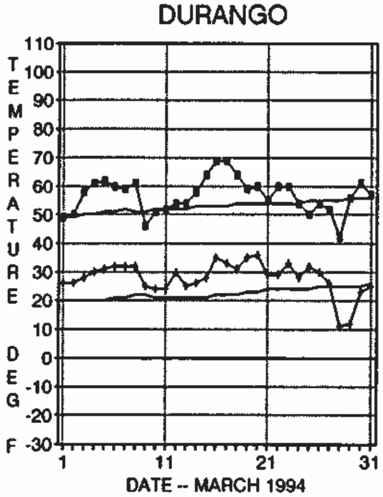
GUNNISON



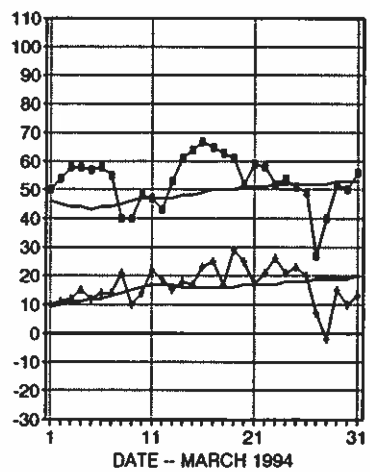
PUEBLO WSO



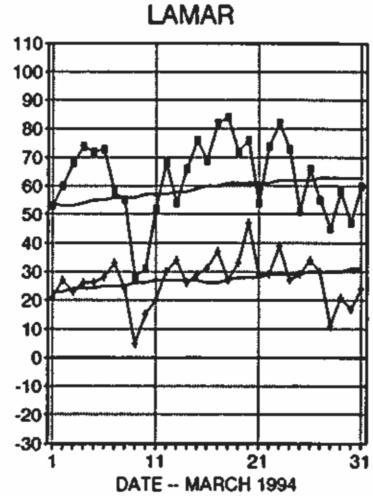
DURANGO



ALAMOSA



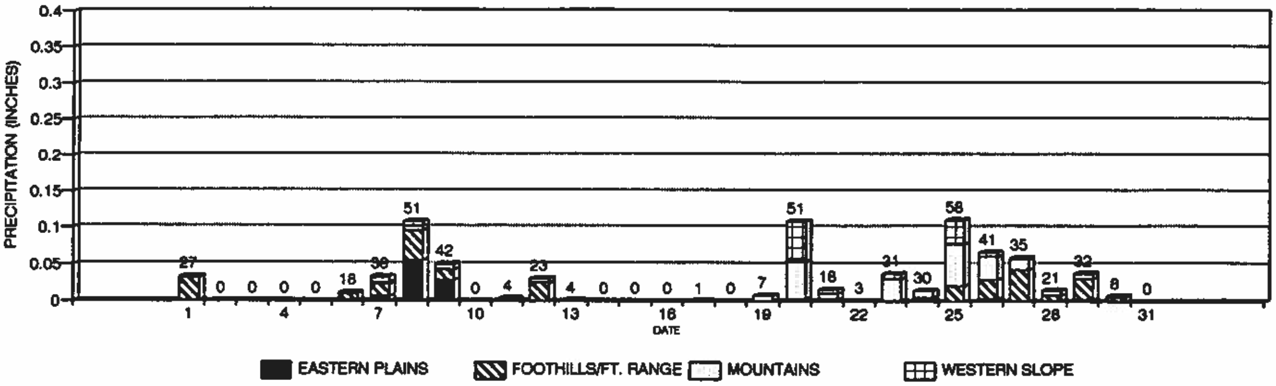
LAMAR



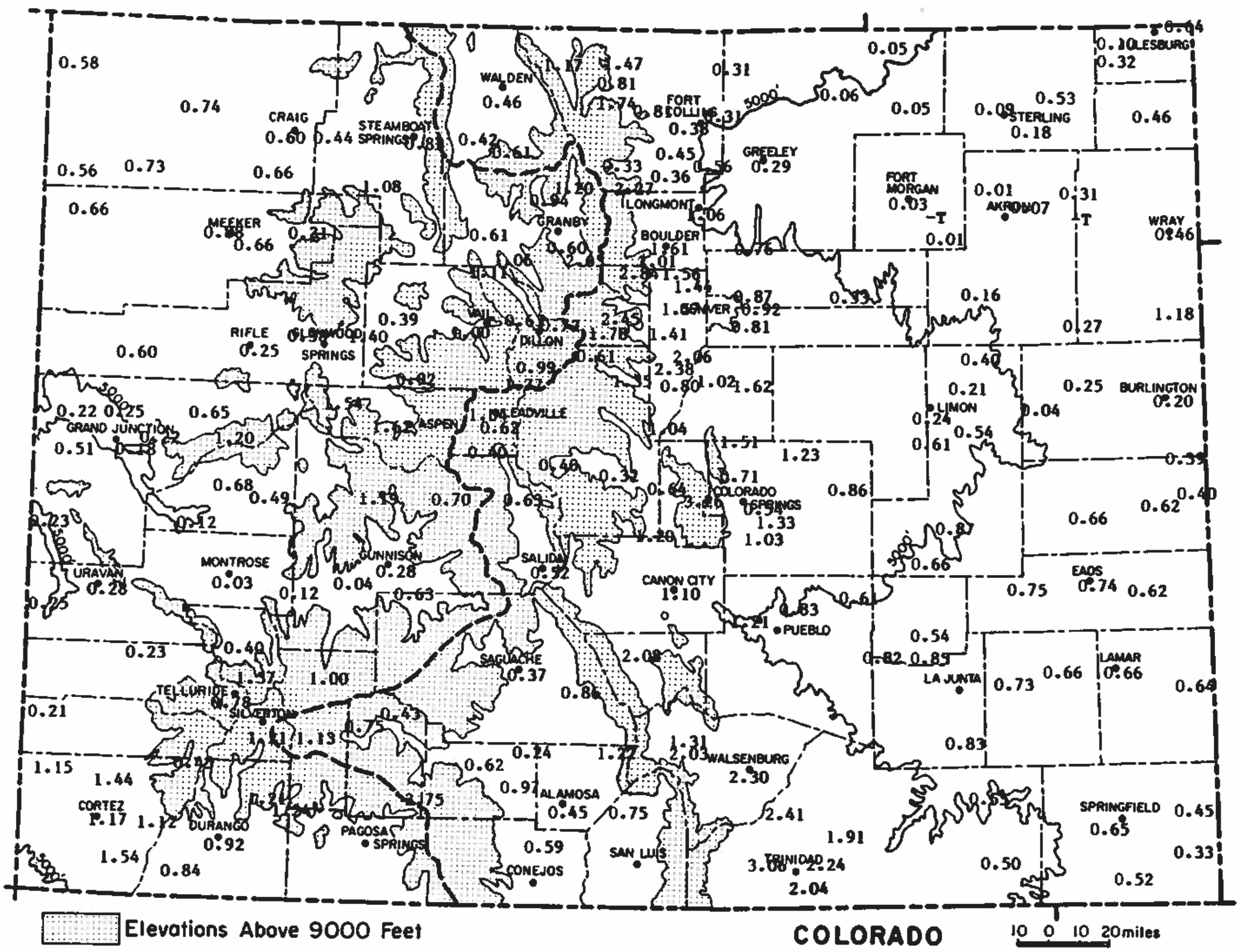
MARCH 1994 PRECIPITATION

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

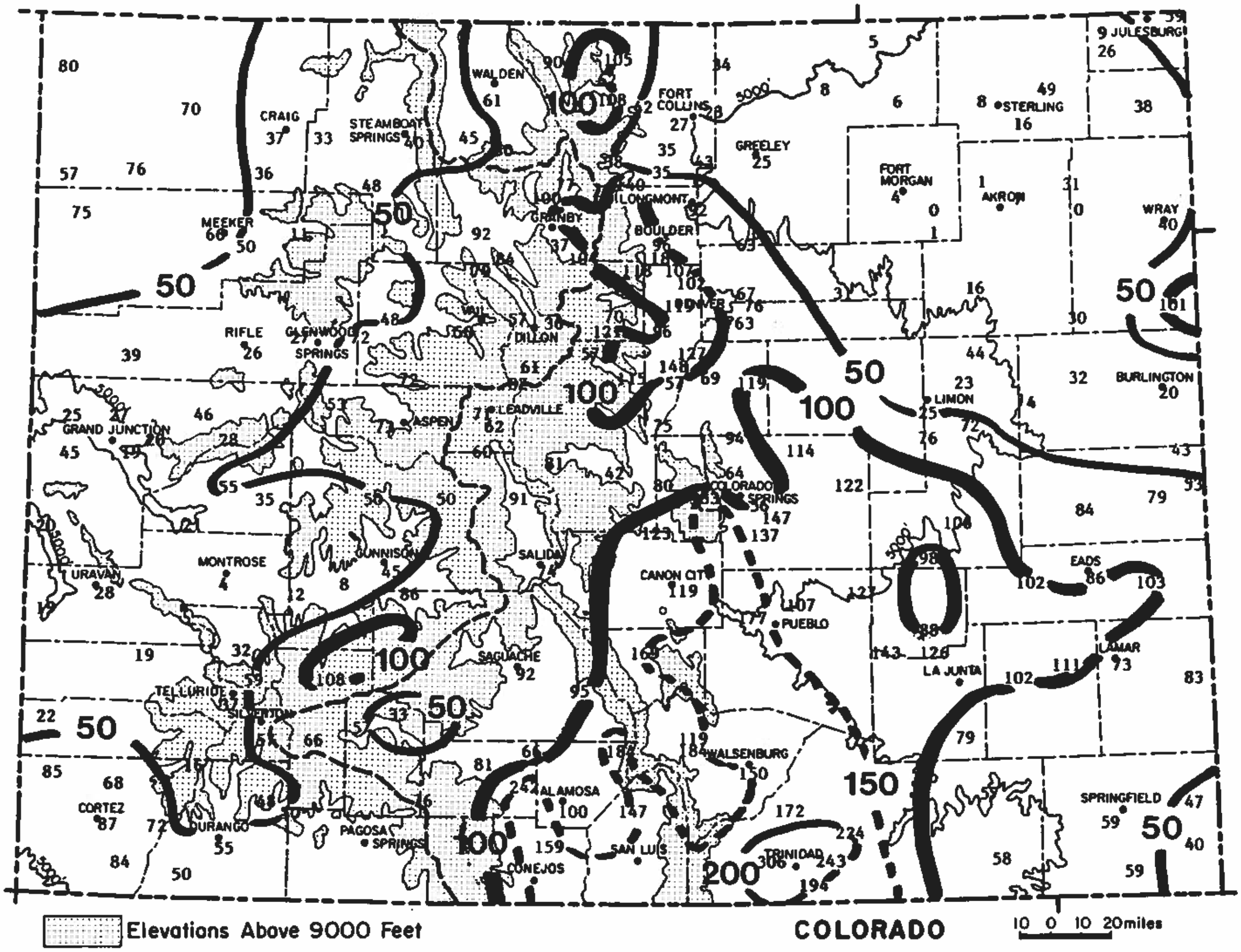


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

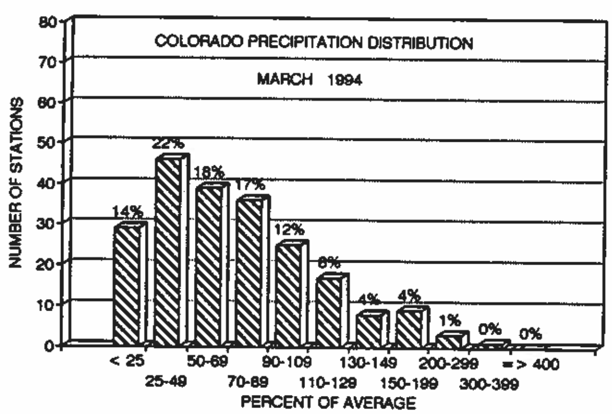


Precipitation Amounts (in inches) for March 1994.

MARCH 1994 PRECIPITATION COMPARISON



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



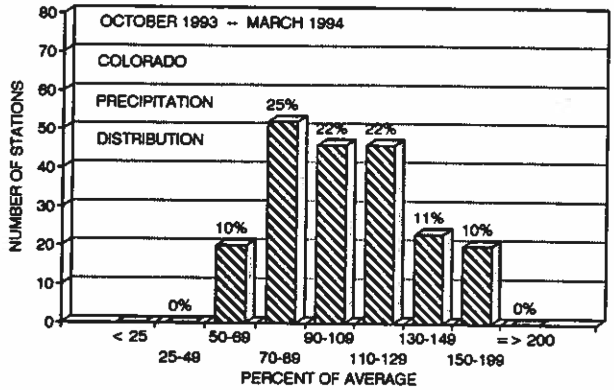
March precipitation ranged from just a trace in parts of northeastern Colorado to more than 200% of average near Trinidad. Dry areas outnumbered the limited wet spots nearly 4 to 1. 36% of the reporting stations reported less than 50% of the average March precipitation. 5% got more than 150% of average.

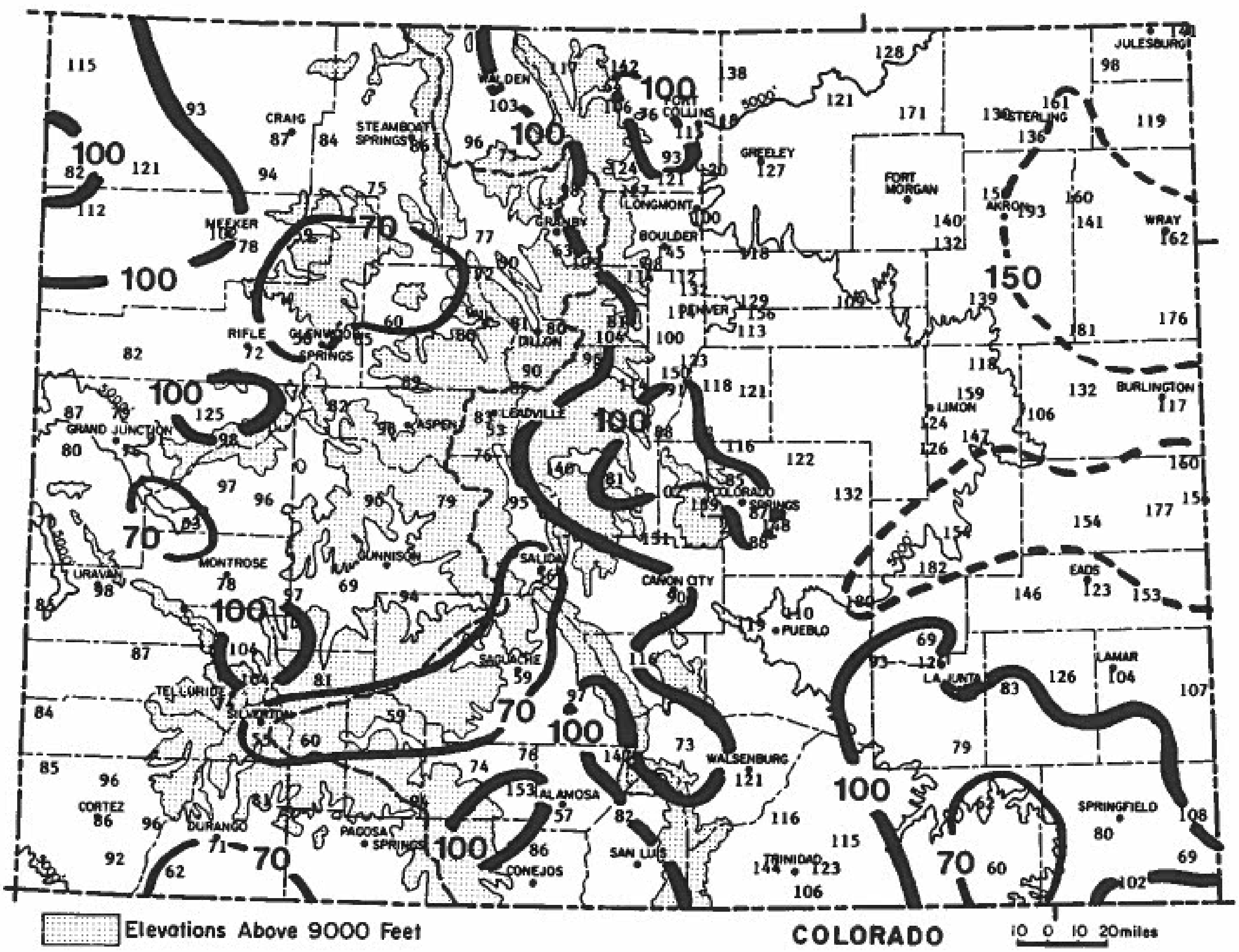
MARCH 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.87"	45th driest in 123 years of record (driest = 0.11" in 1908)
Durango	0.92"	34th driest in 100 years of record (driest < 0.01" in 1895, 1934 and 1955)
Grand Junction	0.25"	14th driest in 103 years of record (driest = 0.02" in 1909, 1971 and 1972)
Las Animas	0.73"	43rd wettest in 128 years (wettest = 3.06" 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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1261	1796	1637	1280	958	692	435	185	9394
	93-94	51	118	342	735	1167	1435	1412	1179	930				7369
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351	1290	1172	979				7576
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	956	697	514	233	91	6120
	93-94	5	26	202	508	875	905	905	899	651				4976
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1208	1172	1124	882				6727
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953	978	1060	1068	654				5377
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	688	482	199	55	5620
	93-94	0	22	153	435	816	864	886	826	609				4813
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972	1008	1032	926	749				5458
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6867
	92-93	18	42	122	373	965	1276	1051	880	760	578	262	106	6453
	93-94	10	14	165	508	926	1148	1086	1038	695				5590
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	266	619	1168	1369	1317	1237	837				6960
DELTA	AVE	0	10	125	403	774	1126	1221	888	719	435	186	38	5927
	92-93	8	10	71	301	919	1192	967	783	649	469	161	52	5600
	93-94	13	33	232	598	1052	1245	1231	1010	758				6172
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948	946	879	618				4952
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1484	1486	1307	1152				8865
DURANGO	AVE	6	37	203	512	846	1172	1248	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968	1169	1094	1057	695				5755
EAGLE	AVE	25	72	275	617	981	1376	1435	1108	958	675	422	164	8108
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1118	M	1258	1080	779				M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1063	879	722	479	226	7888
	93-94	85	140	347	695	1011	1096	1079	1029	859				6341
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003	985	994	669				5362
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	983	831	492	222	41	6480
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	496	1006	M	M	1166	704				M
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102	1025	853	540				4868

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1263	945	660	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	813	1250	1543	1577	1404	1200				8854
GREELEY	AVE	0	7	158	448	831	1153	1206	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	162	82	6664
	93-94	4	15	178	492	955	1021	1005	1059	643				5372
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734	1527	1044				M
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	958	848	360	128	9	5895
	93-94	0	12	90	389	935	925	994	882	555				4782
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	536	785	1401	1502	1482	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478	1499	1321	1198				9112
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	98	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117	1058	766				5915
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	248	557	1005	1064	1022	1053	718				5707
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317	1258	1098	765				6447
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	958	1155	1120	992	664				5597
PAGOSA SPRINGS	AVE	84	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M	M	M				M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	398	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	195	30	6105
	93-94	0	18	155	491	973	1020	1081	915	687				5340
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464	975	1171	1132	921	682				5564
STEAMBOAT SPRINGS	AVE *	113	166	398	725	1122	1525	1608	1316	1169	801	543	297	9779
	92-93	180	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	188	144	395	710	1260	1486	1427	1294	965				7847
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	38	70	400	949	1473	1401	1188	739	501	182	66	6999
	93-94	0	14	193	459	968	1068	1072	1056	653				5479
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210	1443	1476	1276	1049				8154
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5636
	93-94	0	27	123	472	857	968	1000	826	668				4941
WALDEN	AVE	189	273	498	825	1161	1457	1526	1298	1237	909	657	348	10378
	92-93	270	263	433	709	1310	1471	1426	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1489	1416	1238	1068				8433
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865	877	780	623				4449

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

MARCH 1994 CLIMATE DATA

EASTERN PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# 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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation 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	0	191	1.91	1.06	225	8

MOUNTAINS/INTERIOR VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	#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

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	#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
GUNNISON	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.

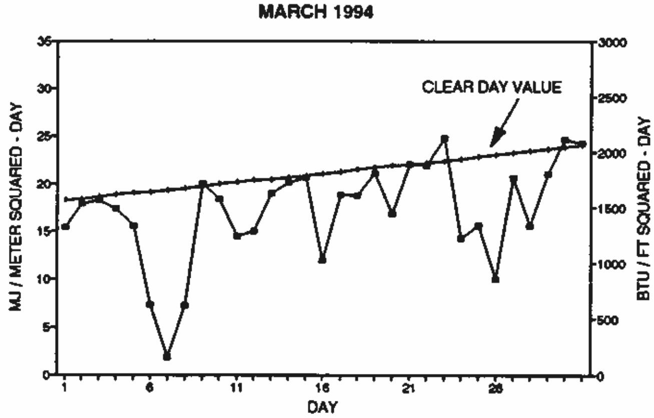
MARCH 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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

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

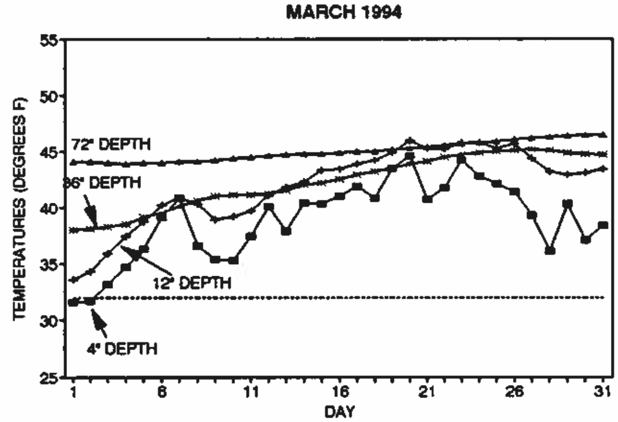


MARCH 1994 SOIL TEMPERATURES

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.

DROUGHT IN COLORADO – PART II

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.

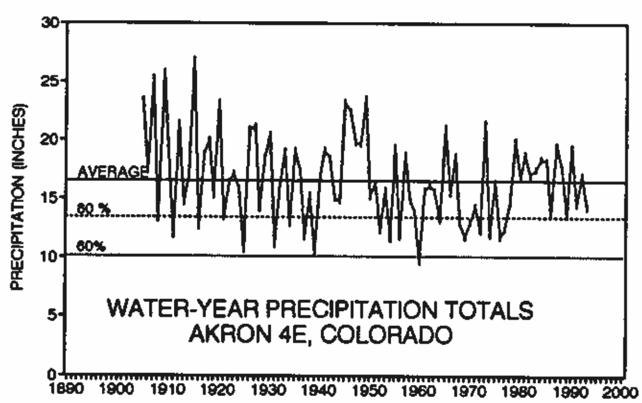
Comparing supply to demand would be the ideal way to monitor and document drought. Unfortunately, statistics on water demand have not been gathered or stored as objectively as data about supply. Likewise, demands change over time. For example, there is much more urban and recreational water use in Colorado 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 probabililty 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-

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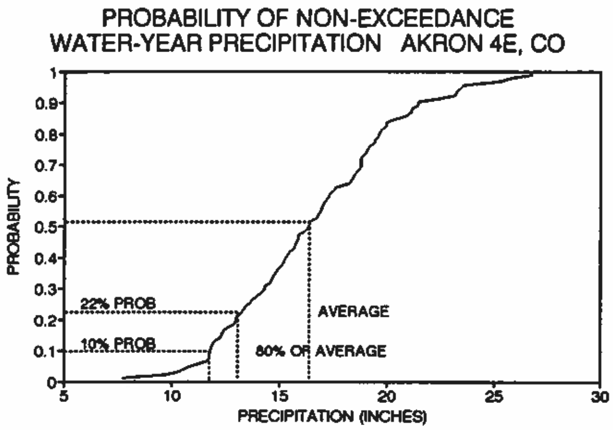
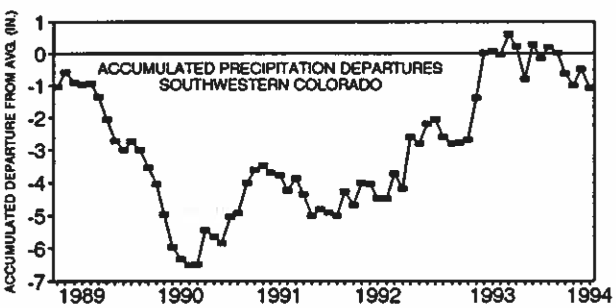
of-record average at Akron. Since the variability of precipitation is greater in some areas than others, the same percent of average does not equate directly with a precipitation probability. Durango receives less than 80% of their average water-year precipitation totals 27% of the years. Steamboat Springs,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



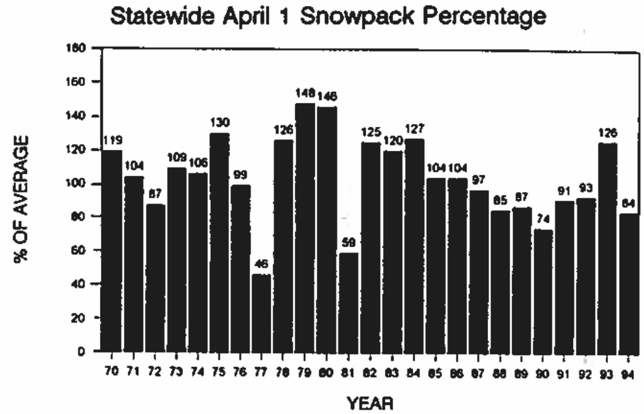
3) Accumulated precipitation departures from average

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 30-year 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 man-made 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

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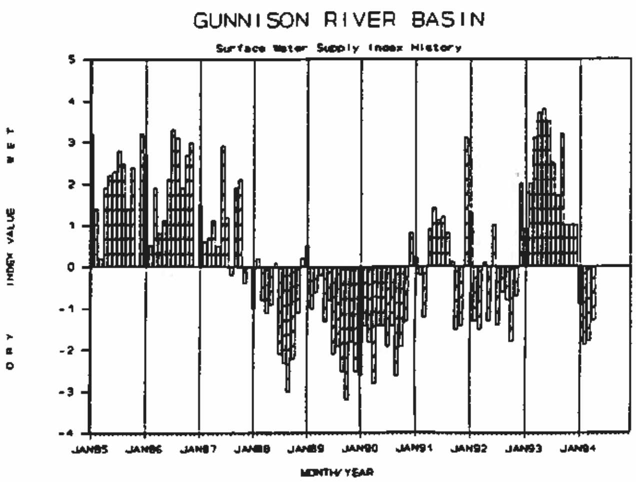
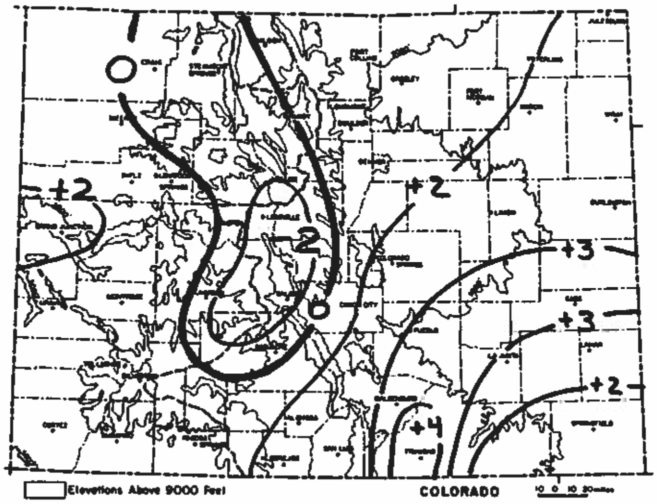
while positive numbers relate to moisture surplus. Indexes identify extremely wet and dry periods and are well suited for graphical display. However, they sometimes are not consistent with other water supply information, especially during those all-important periods when drought is emerging or retreating.

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:

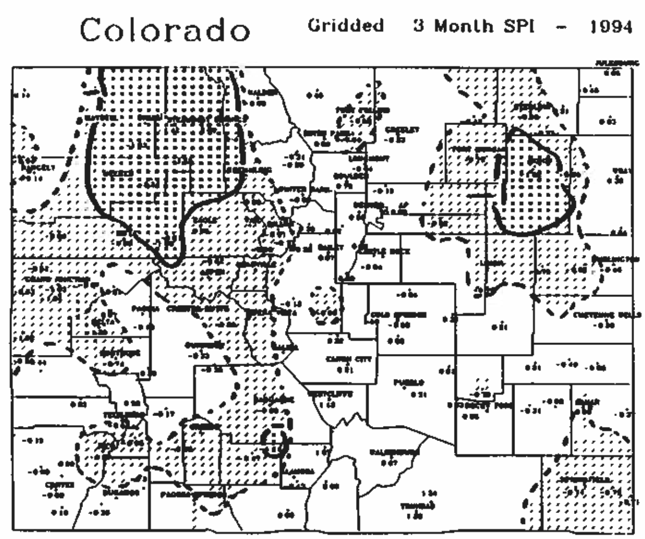
1) Surface Water Supply Index (SWSI). This index was developed jointly by the USDA Soil Conservation Service and the Colorado Division of Water Resources in 1981 to help monitor water supplies in areas where mountain snowpack contributes the majority of surface water. This index combined precipitation, 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.

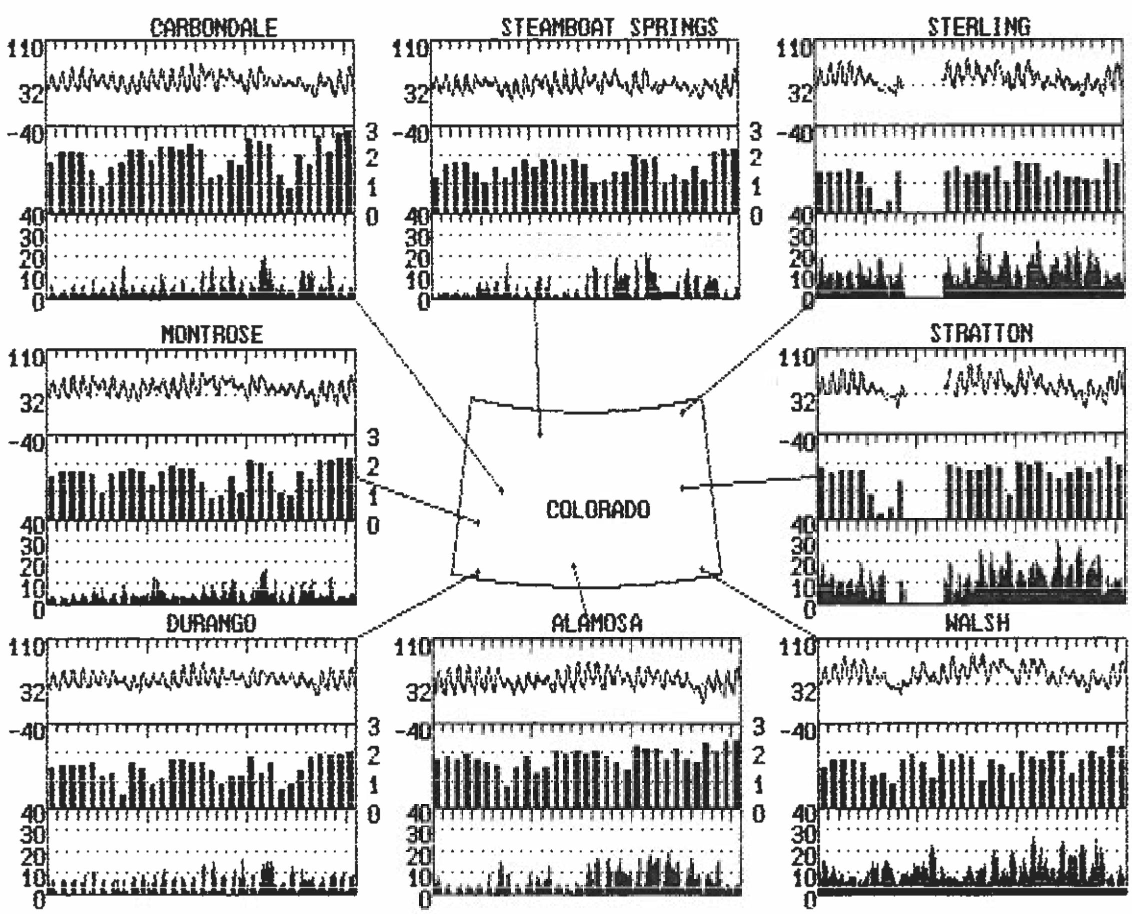


Next month, we will describe Colorado's drought history since the late 1800s using several of these drought monitoring tools.

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	36.0	38.0	38.4	41.6	31.7	41.8	42.8	46.0
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	68.0 16/15	65.3 15/15	69.3 16/14	67.8 16/15	63.1 16/14	75.9 16/14	80.1 16/14	80.6 16/16
minimum:	-1.1 28/ 6	10.6 28/ 6	11.7 28/ 4	10.4 28/ 4	5.4 9/ 6	11.1 27/ 0	6.8 9/ 3	13.3 9/ 8
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	86 / 19	76 / 22	82 / 22	72 / 23	91 / 19	67 / 22	28 / 9	67 / 26
11 AM	45 / 30	49 / 32	38 / 26	43 / 32	58 / 28	32 / 27	19 / 22	39 / 33
2 PM	33 / 29	39 / 32	27 / 26	32 / 32	44 / 29	25 / 27	18 / 24	29 / 32
5 PM	34 / 28	38 / 31	25 / 25	29 / 30	45 / 28	26 / 26	18 / 23	28 / 30
11 PM	65 / 23	68 / 26	53 / 22	56 / 26	79 / 24	49 / 21	25 / 11	48 / 26
monthly average wind direction (degrees clockwise from north)								
day	184	193	233	250	189	236	116	188
day	150	79	170	151	118	239	225	235
monthly average wind speed (miles per hour)								
	4.77	3.41	3.29	3.58	2.84	9.58	9.98	9.37
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	306	423	459	335	454	43	77	14
3 to 12	338	290	239	370	166	419	358	553
12 to 24	76	19	22	15	24	169	184	170
> 24	0	0	0	0	0	10	11	7
monthly average daily total insolation (Btu/ft²•day)								
	1783	1400	1951	1575	1550	1279	1586	1641
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	140	170	48	161	120	125	170	191
40-60%	55	72	47	52	72	89	50	76
20-40%	26	72	34	57	53	51	32	50
0-20%	18	42	19	18	20	43	27	15

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.



COLORADO CLIMATE

April 1994
Volume 17 Number 7

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

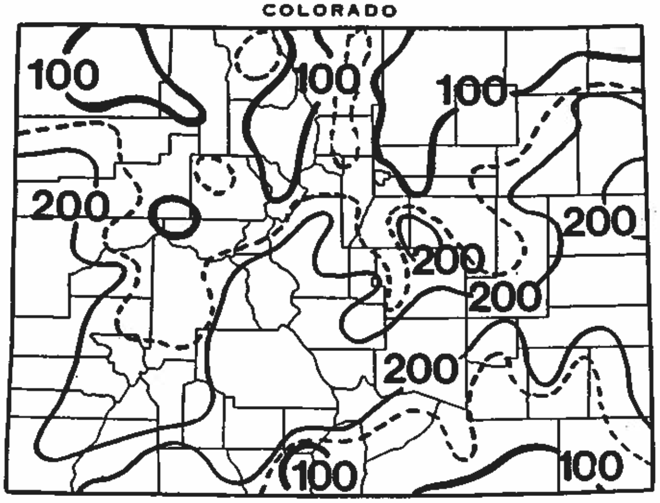
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

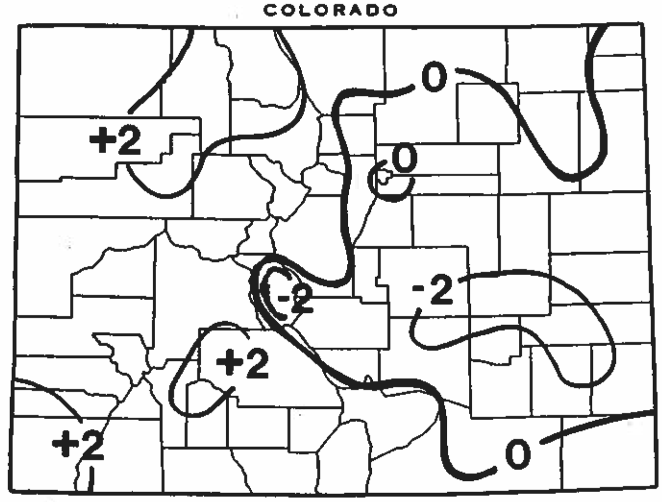


April 1994 precipitation as a percent of the 1961-1990 average.

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.

Inside This Issue

APRIL 1994 DAILY WEATHER

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 east-central 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 low-elevation 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.

24-30 Clouds and winds increased on the 24th as a large 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.

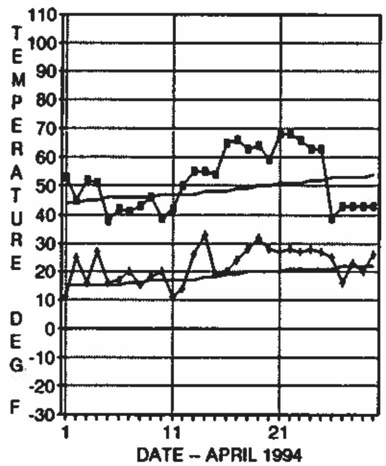
Weather Extremes

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

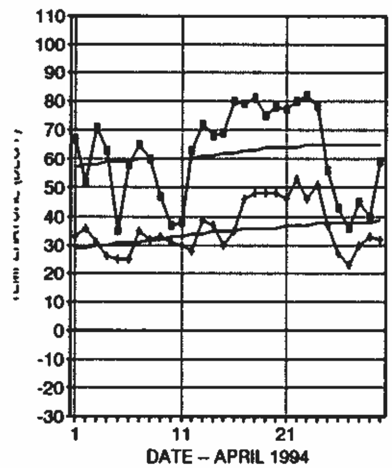
APRIL 1994 TEMPERATURE COMPARISON

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.)

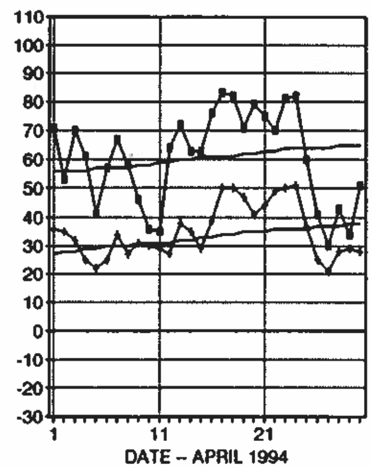
GRAND LAKE 1NW



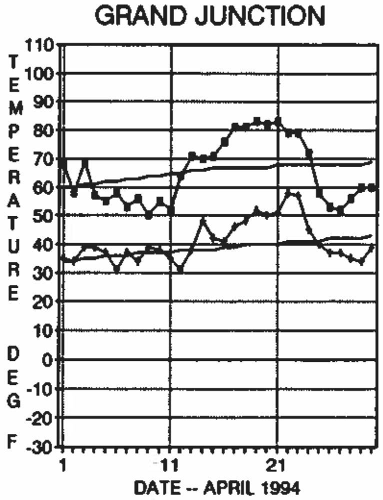
DENVER



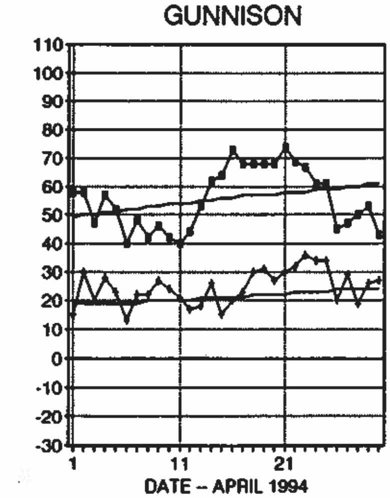
AKRON 1N



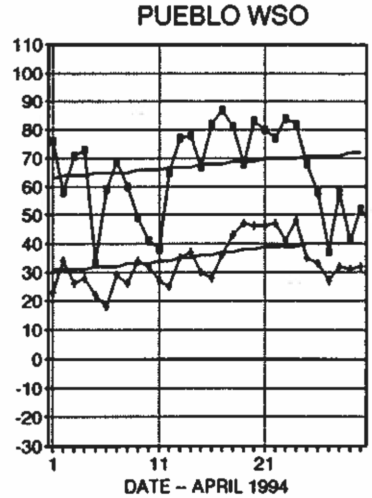
GRAND JUNCTION



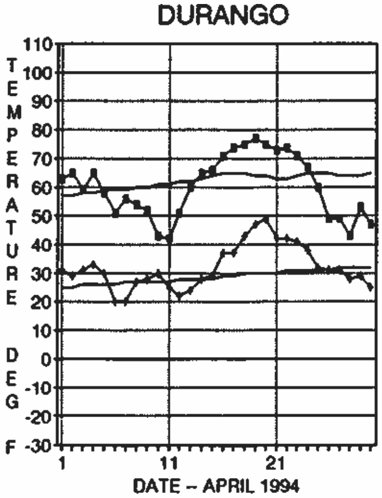
GUNNISON



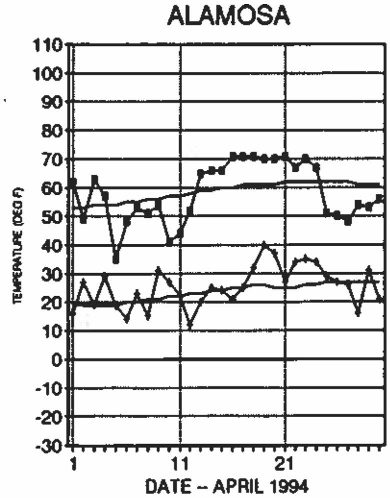
PUEBLO WSO



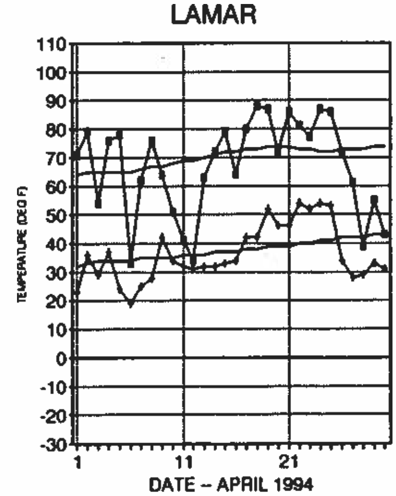
DURANGO



ALAMOSA



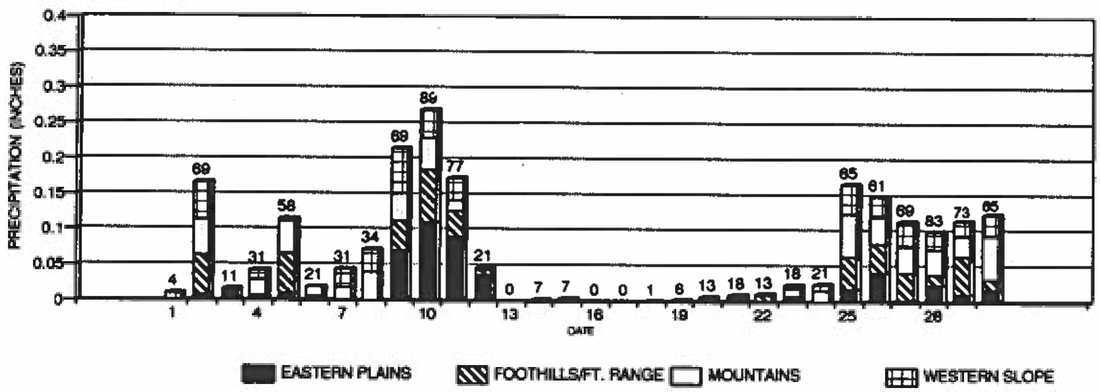
LAMAR



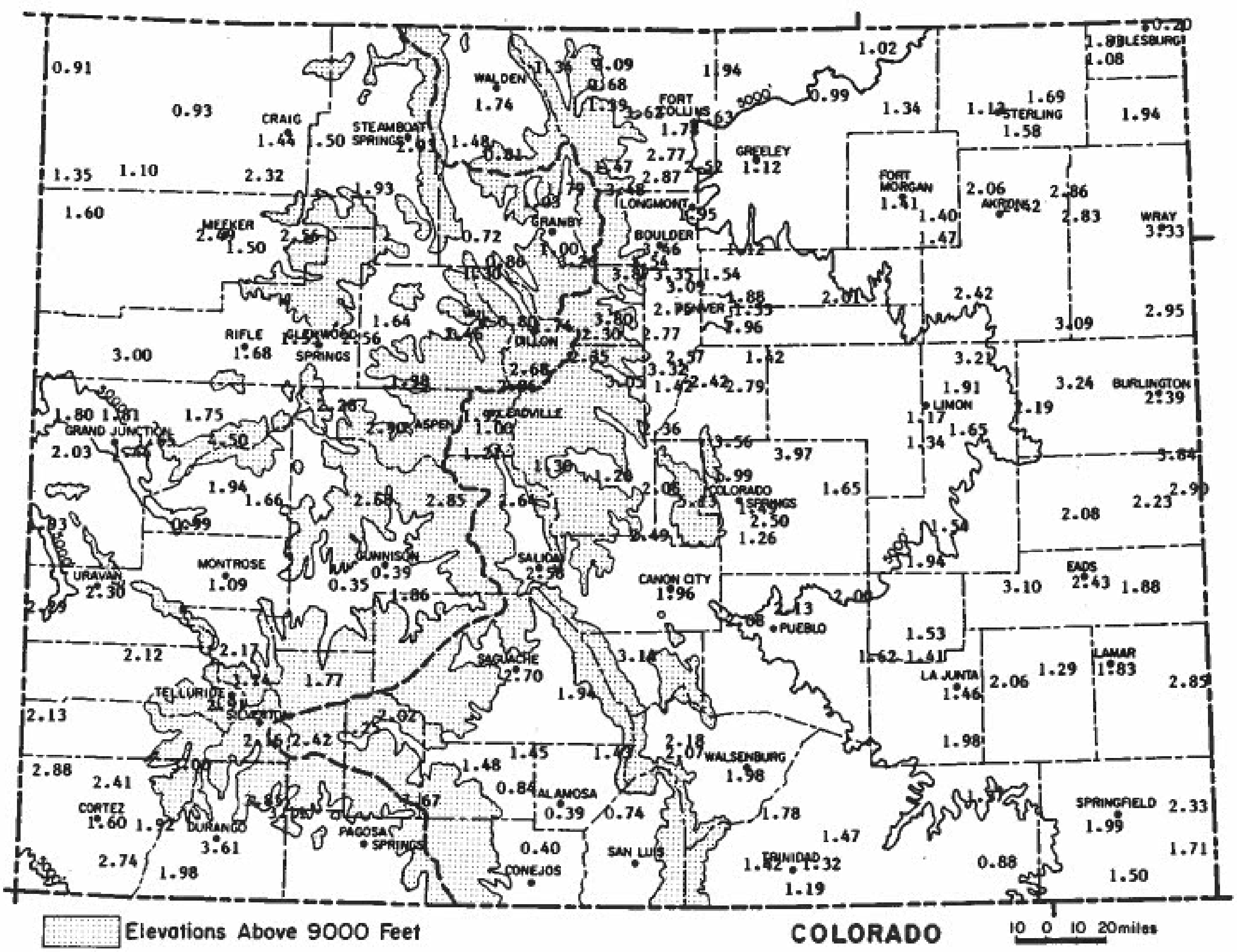
APRIL 1994 PRECIPITATION

Several April storms contributed significant precipitation. The heaviest precipitation statewide and especially on the Eastern Plains fell April 9-11. State-averaged 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

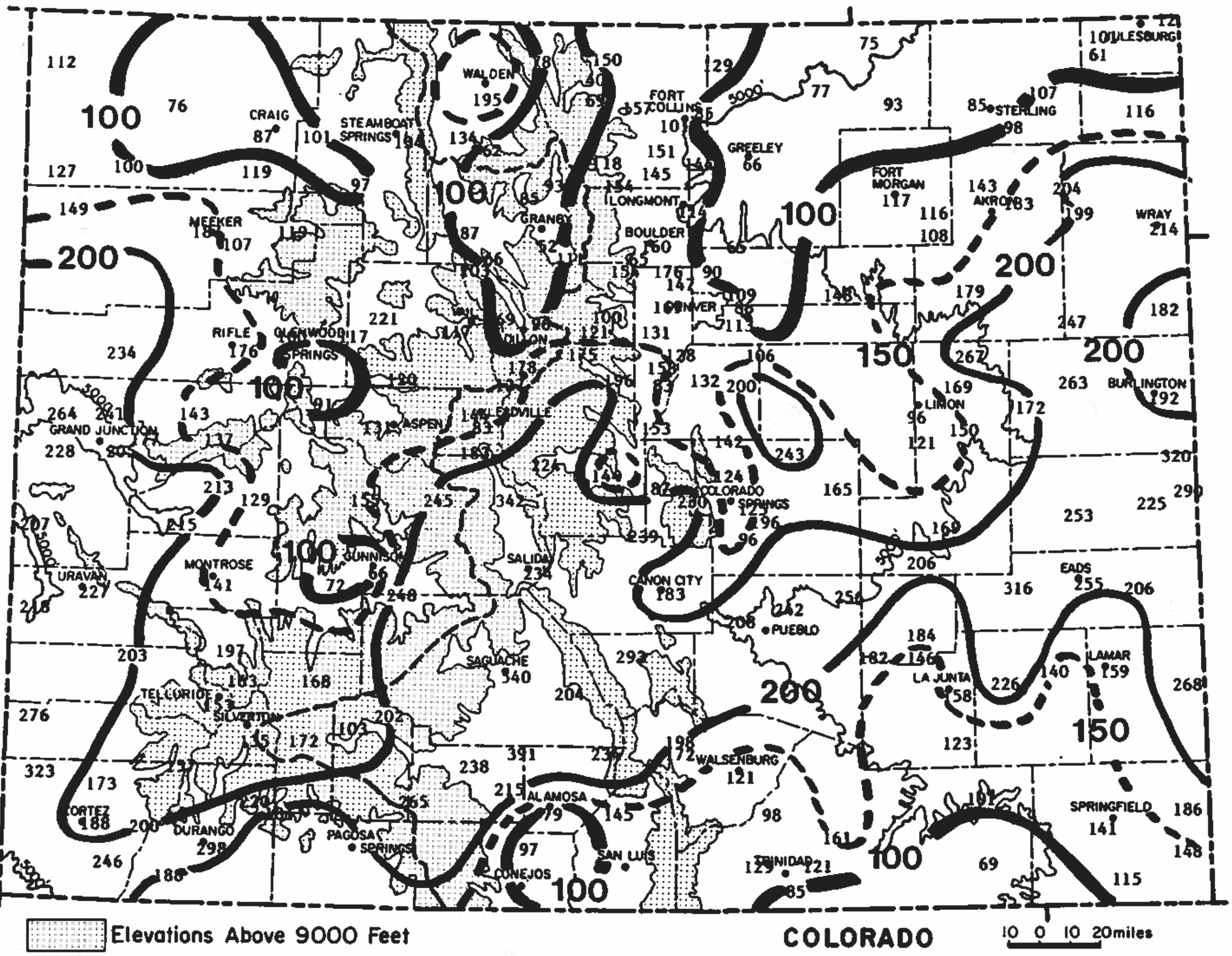


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

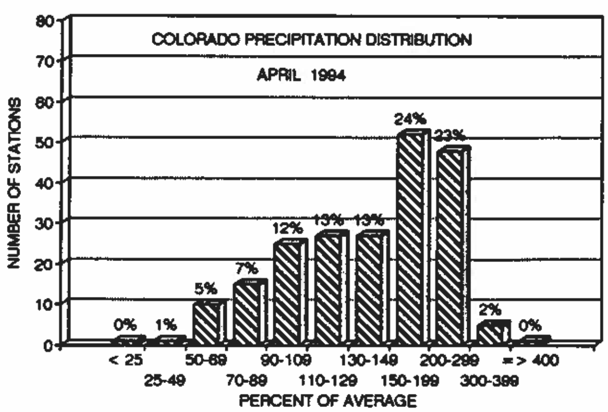


Precipitation Amounts (in inches) for April 1994.

APRIL 1994 PRECIPITATION COMPARISON



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



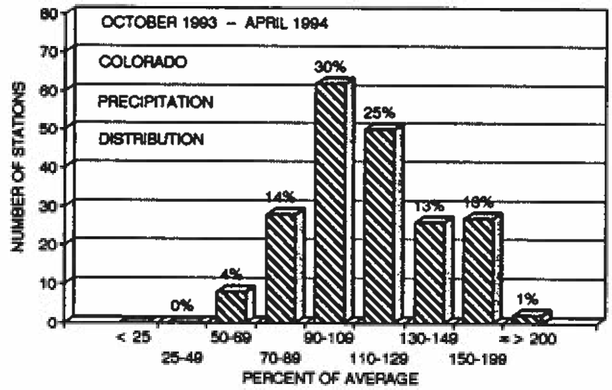
April precipitation ranged from less than 70% of average over portions of northeastern Colorado to more than 300% at Buena Vista, Center, Haswell, and Yellow Jacket. Wet areas greatly outnumbered the drier regions. Nearly half of Colorado's official reporting stations reported more than 150% of the average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

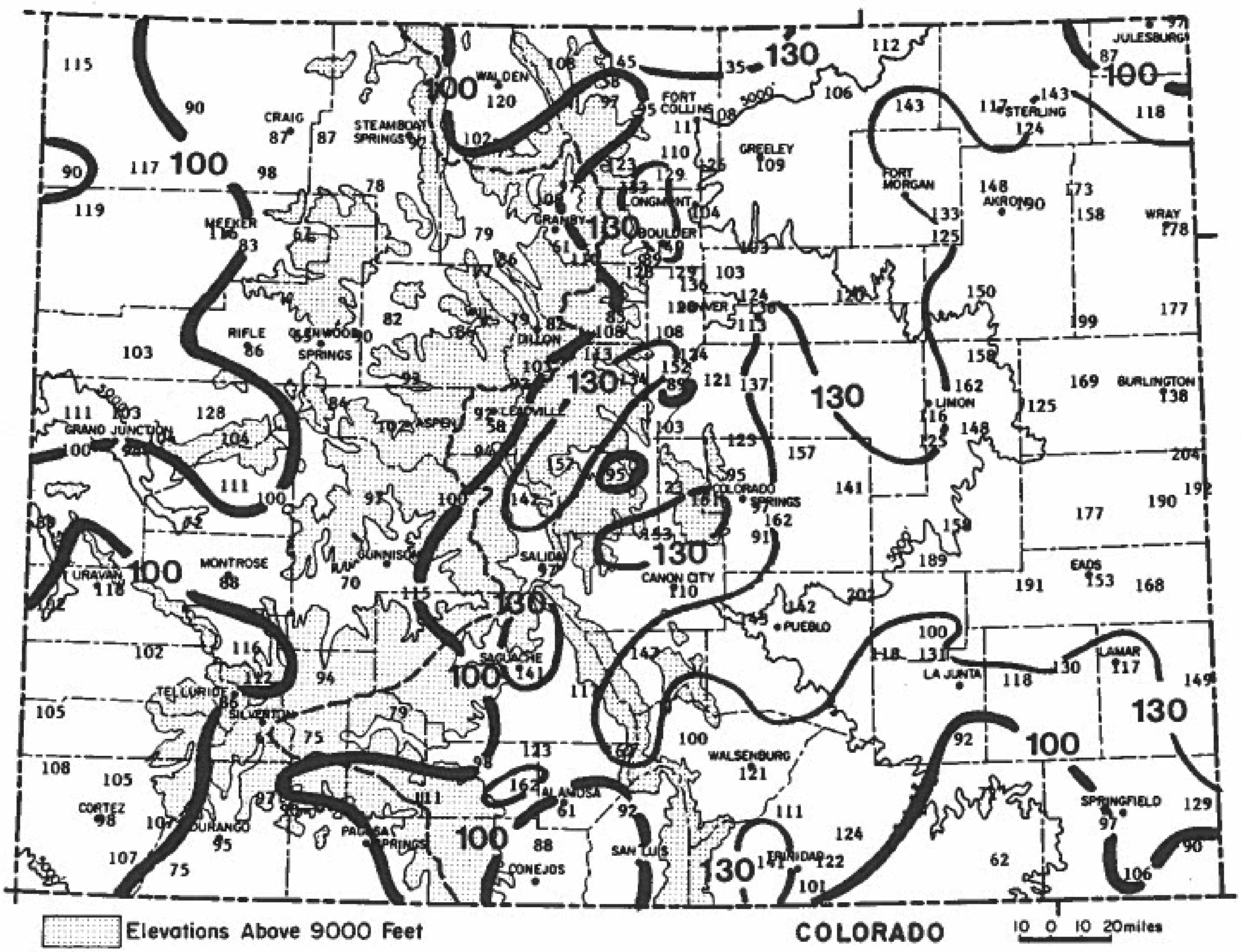
APRIL 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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)

1994 WATER YEAR PRECIPITATION

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1280	958	692	435	185	9394
	93-94	51	118	342	735	1187	1435	1412	1179	930	699			7369
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	563	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351	1290	1172	979	771			7576
BOULDER	AVE	0	7	136	367	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	506	875	905	905	899	651	514			4976
BUENA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
VISTA	92-93	107	146	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1206	1172	1124	882	762			6727
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953	978	1060	1068	654	499			5377
CANON	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
CITY	92-93	2	29	73	305	882	976	1064	885	688	482	199	55	5620
	93-94	0	22	153	435	816	864	886	828	609	468			4613
COLORADO	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
SPRINGS	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972	1008	1032	926	749	578			5458
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	985	1276	1051	880	760	578	282	106	6453
	93-94	10	14	165	508	928	1148	1086	1038	695	528			5590
CRAIG	AVE	32	58	275	608	998	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	384	203	8441
	93-94	87	80	286	619	1168	1369	1317	1237	837	621			6980
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	783	649	469	161	52	5600
	93-94	13	33	232	598	1052	1245	1231	1010	758	533			6172
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	469	195	71	6189
	93-94	1	20	152	488	900	948	946	879	618	465			4952
DILLON	AVE	282	341	555	856	1203	1504	1567	1356	1321	1008	747	459	11216
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10962
	93-94	327	350	579	889	1291	1464	1488	1307	1152	925			8865
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968	1169	1094	1057	695	561			5755
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	184	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M	1258	1080	779	639			M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1096	1079	1029	859	710			6341
FORT	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
COLLINS	92-93	22	55	87	377	940	1222	1239	1031	708	519	209	83	6490
	93-94	5	22	207	533	944	1003	965	994	689	493			5362
FORT	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
MORGAN	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1006	M	M	1166	704	550			M
GRAND	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
JUNCTION	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102	1025	853	540	360			4868

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND	AVE	214	260	468	761	1113	1476	1600	1361	1283	945	660	381	10542
LAKE	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	613	1250	1543	1577	1404	1200	828			8854
GREELEY	AVE	0	7	158	446	831	1153	1208	924	806	492	231	52	6308
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492	955	1021	1005	1059	643	473			5372
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	206	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734	1527	1044	736			M
LAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
ANIMAS	92-93	0	11	33	304	937	1267	1242	958	648	360	128	9	5895
	93-94	0	12	90	369	935	925	994	882	555	400			4762
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	728	439	10870
	92-93	383	435	536	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478	1499	1321	1196	994			9112
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	98	6981
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117	1058	766	626			5915
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	226	105	6825
	93-94	12	30	246	557	1005	1064	1022	1053	718	533			5707
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317	1258	1098	785	594			6447
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	246	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	956	1155	1120	992	664	487			5597
PAGOSA	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
SPRINGS	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M	M	M	M			M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	426	195	30	6105
	93-94	0	18	155	491	973	1020	1081	915	687	467			5340
RIFLE	AVE	0	23	184	502	856	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	634.?
	93-94	E 13	7	199	464	975	1171	1132	921	662	486			5564
STEAMBOAT	AVE *	113	166	396	725	1122	1525	1606	1318	1169	801	543	297	9779
SPRINGS	92-93	160	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260	1486	1427	1294	965	678			7847
STERLING	AVE	0	9	149	462	852	1200	1265	983	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	966	1088	1072	1056	653	464			5479
TELLURIDE	AVE	152	204	390	679	1005	1290	1338	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8568
	93-94	228	249	455	768	1210	1443	1476	1276	1049	860			8154
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5638
	93-94	0	27	123	472	857	968	1000	826	668	481			4941
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	262	510	848	1316	1469	1416	1238	1068	814			8433
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	5423
	93-94	0	17	110	408	791	865	877	780	623	433			4449

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

APRIL 1994 CLIMATE DATA

EASTERN PLAINS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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	0	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 1E	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	0	45	2.16	0.56	135	12
WOLF CREEK PASS 1E	38.4	18.4	28.4	-1.0	55	3	1091	0	12	7.67	4.78	265	18

WESTERN VALLEYS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation Tot	Dep	%Norm	#days
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	14
MEEKER 3W	59.2	30.8	45.0	2.1	77	22	594	0	165	2.49	1.16	187	15
RANGELY	63.1	34.4	48.8	1.1	80	25	480	0	206	1.60	0.53	150	10
EAGLE FAA	58.4	28.5	43.4	1.1	73	13	639	0	146	1.64	0.90	222	10
GLENWOOD SPRINGS	62.5	33.5	48.0	2.1	82	23	500	0	197	1.55	0.00	100	15
RIFLE	64.0	32.9	48.5	1.5	83	3	488	0	219	1.68	0.73	177	11
GRAND JUNCTION WS	65.4	40.9	53.1	1.1	83	31	360	13	246	1.81	1.06	241	12
CEDAREDGE	64.8	31.7	48.3	0.8	81	21	495	0	229	1.94	1.03	213	11
PAONIA 1SW	64.2	37.2	50.7	2.6	85	26	423	0	226	1.66	0.38	130	13
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	12
COCHETOPA CREEK	55.6	23.9	39.8	2.8	74	13	752	0	118	1.86	1.11	248	11
MONTROSE NO 2	62.0	35.0	48.5	0.5	79	25	487	0	191	1.09	0.32	142	9
URAVAN	67.9	37.8	52.9	1.2	85	29	359	2	276	2.30	1.29	228	11
NORWOOD	57.2	30.9	44.0	1.5	74	16	621	0	138	2.12	1.08	204	10
YELLOW JACKET 2W	59.9	33.6	46.8	2.4	75	22	540	0	163	2.88	1.99	324	7
CORTEZ	61.6	32.6	47.1	2.7	79	22	528	0	195	1.60	0.75	188	8
DURANGO	60.3	32.0	46.1	0.6	77	20	561	0	175	3.61	2.40	298	14

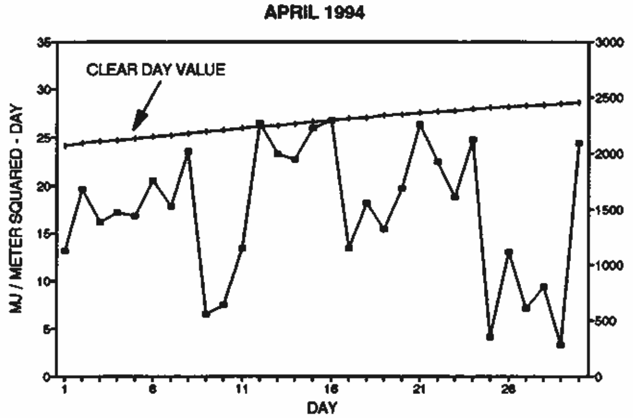
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

APRIL 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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 = Partly Cloudy   CLDY= Cloudy

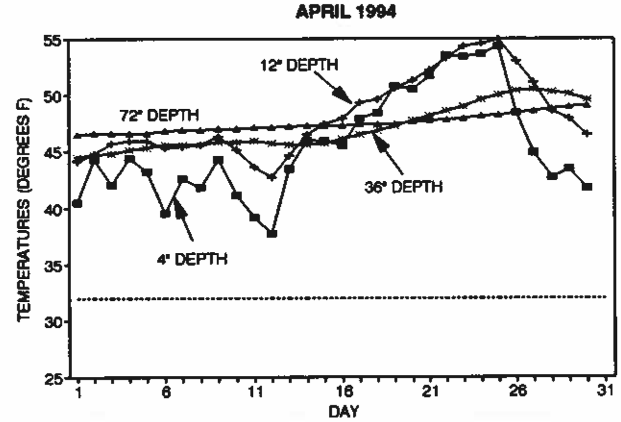
April is a relatively cloudy month for Colorado most years, but 1994 was even cloudier than normal. More than half the days in April were cloudy across much of Colorado, and all areas ended up with less sunshine and solar energy than usual.



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.



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.

** * * We temporarily interrupt our story on Colorado Drought to bring you this special news report on hail. * * **

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.

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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.

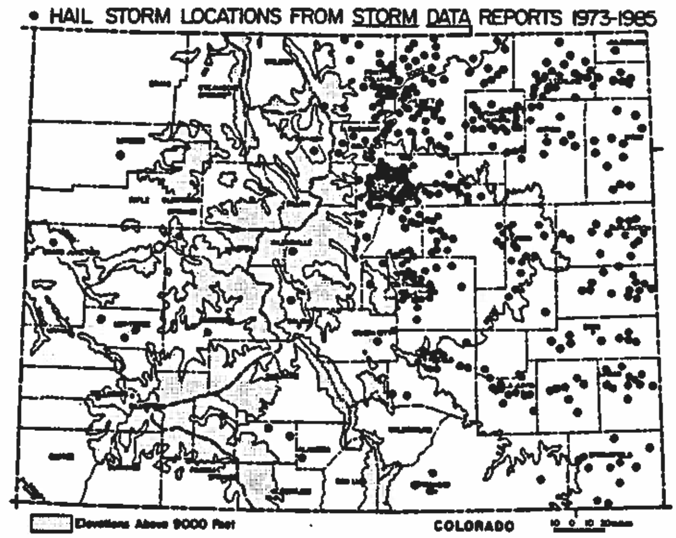
Since the 1970s, most research has turned toward modelling and predicting severe storms. Studies of Colorado severe weather and tornadoes have brought noticeable improvements in forecasting severe storms, but little information to better define the risks of hail has been assembled. In the past few years,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

CCC HAIL PROJECT

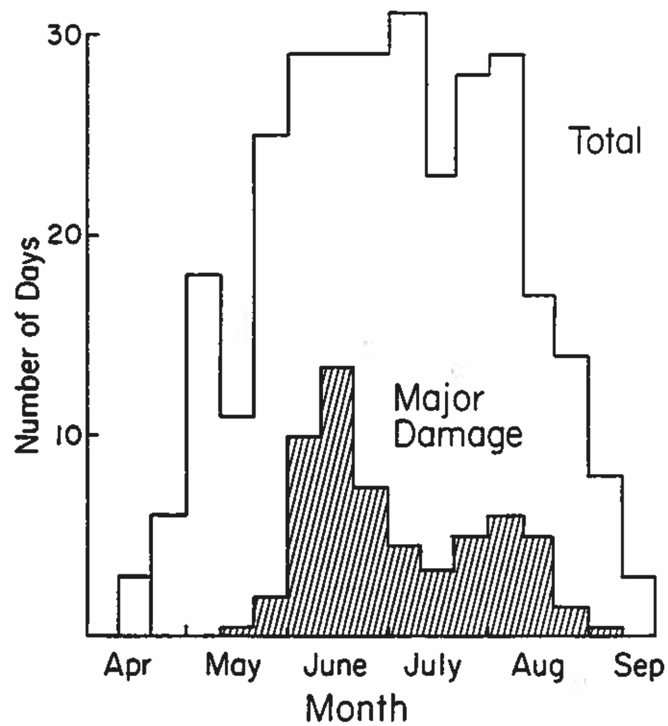
The Colorado Climate Center has been working to improve climatological information about hail for Colorado decision makers. Back in the March 1988 issue of Colorado Climate we compiled some information about hail in Colorado. All significant hail reports for Colorado for a 13 year period, 1973-1985 were 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 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.



Number of "Significant" Hail Days in Colorado for Each 10-day Period, 1973-1985 (from Storm Data Reports)

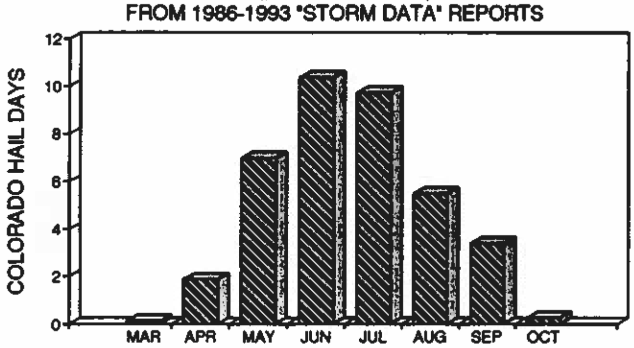


MONTHLY HAIL FREQUENCIES

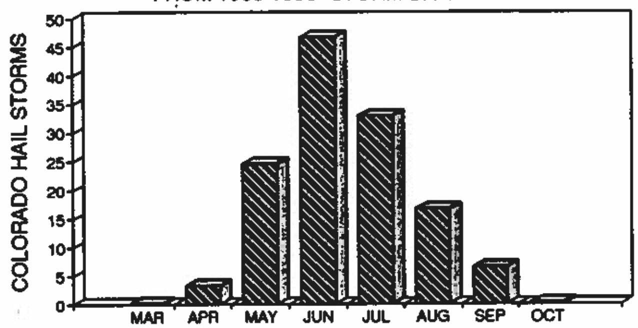
The hail season in Colorado begins in March and ends in October. Average monthly distributions of hail (all sizes included) for selected locations show that overall, June has the highest frequency of days with hail. However, some individual sites, such as Fort Collins and Grand Junction, have more frequent 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 reported severe hailstorms each year since 1986.

AVERAGE # OF HAIL DAYS / MONTH
FROM 1986-1993 'STORM DATA' REPORTS



AVERAGE # OF HAILSTORM REPORTS / MONTH
FROM 1986-1993 'STORM DATA' REPORTS



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.

Average Number of Days with Hail

	Month													
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)

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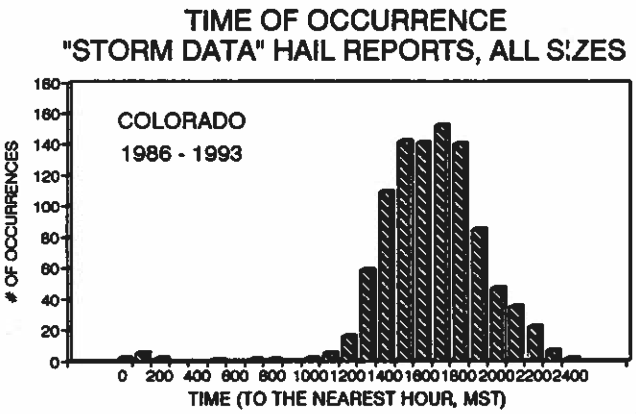

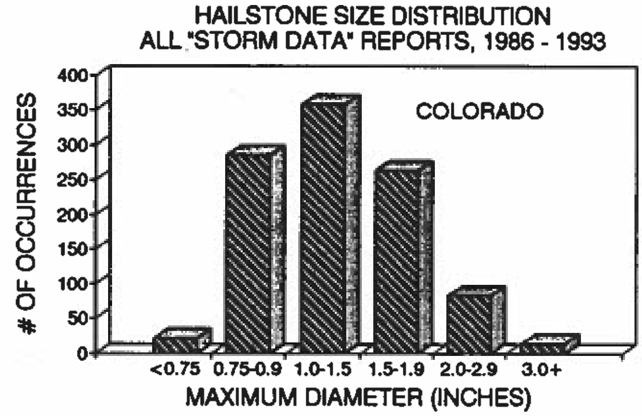

HAILSTORM DURATIONS

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" diameter or smaller. Local studies elsewhere in North America have suggested that at least 95% of all hailstones are less than 1/2" 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.

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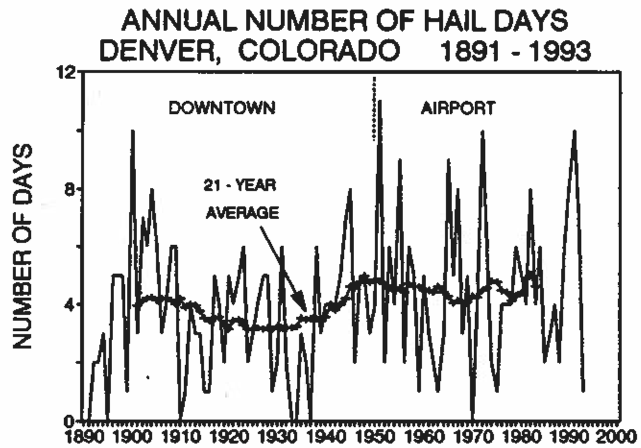
MONTHLY AND INTERANNUAL VARIABILITY

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.



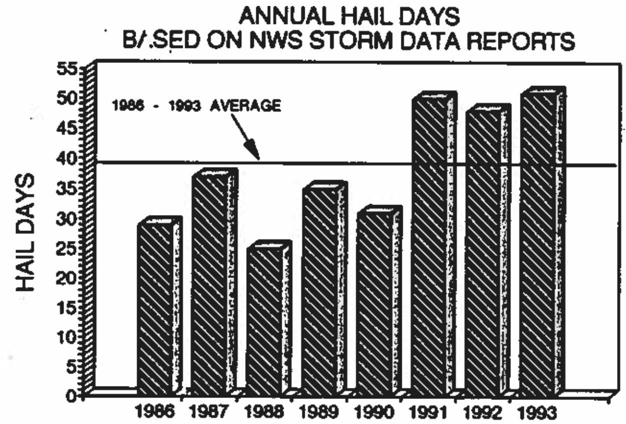
Even over the entire area of Colorado, the number of hailstorms and hail days varies considerably. For example, there were only 25 severe hail days in 1988 compared to 51 in 1993. The number of storms varies even more. There were 55 reported severe hailstorms in 1988 compared to 222 in 1993. Within a 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.

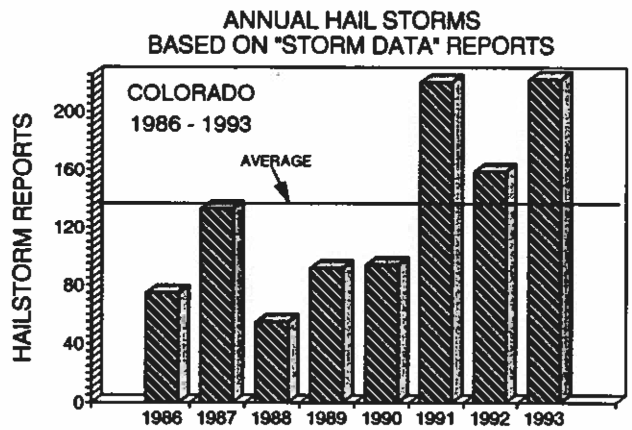
The numbers seem to suggest an upward trend in Colorado hailstorms. We predict this trend will continue, but not because hail is actually increasing. Rather, we believe that growing population, more cellular phones and greater awareness will mean that more storms will be reported in the years ahead.

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

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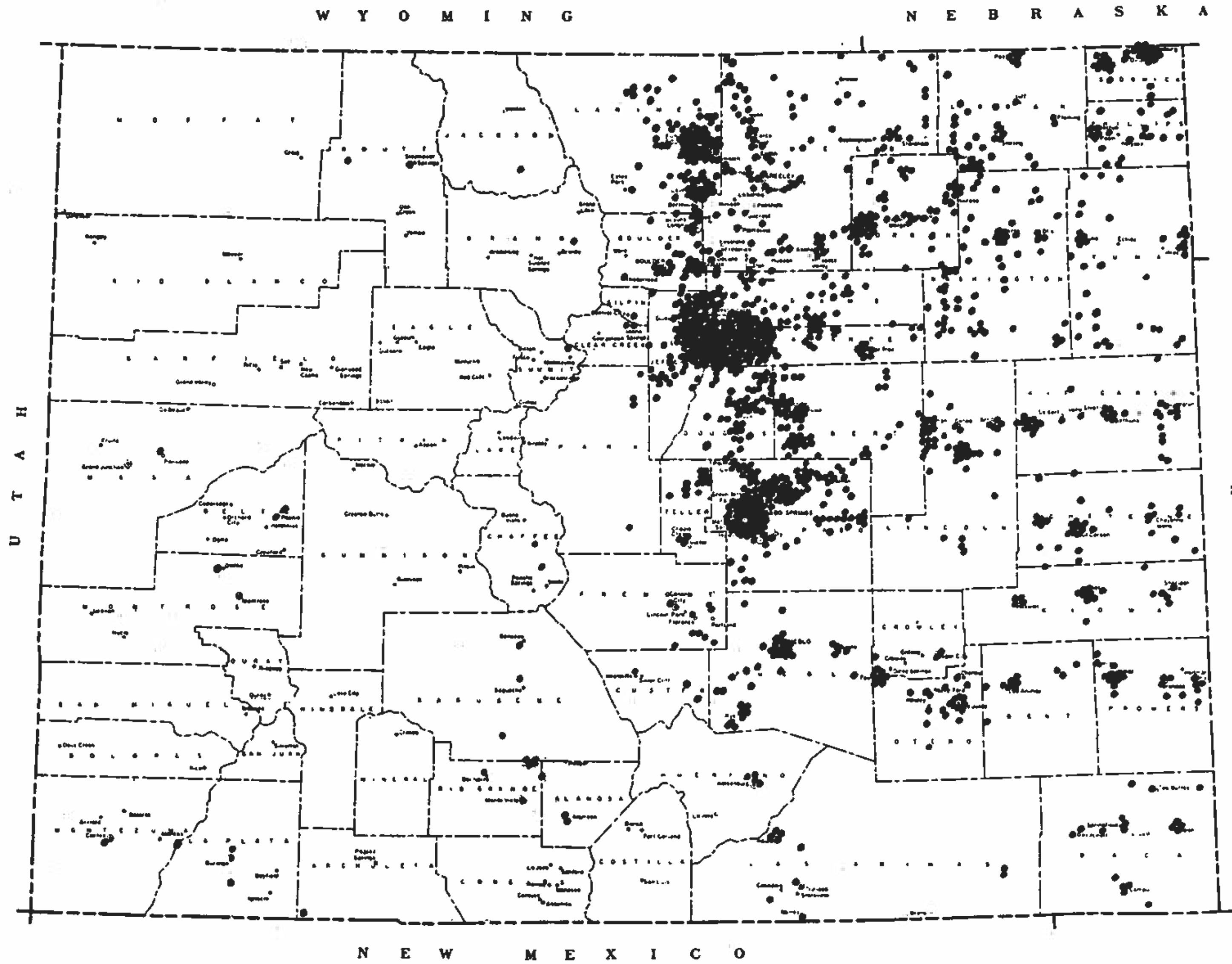

eastward beyond Limon) and the Cheyenne Ridge (high ground that extends eastward along the Colorado-Wyoming-Nebraska borders) as the most hail-prone regions of Colorado. Our study does not show these areas to be unusually stormy with respect to adjacent areas. However, except for U.S. Highway 24, these 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.

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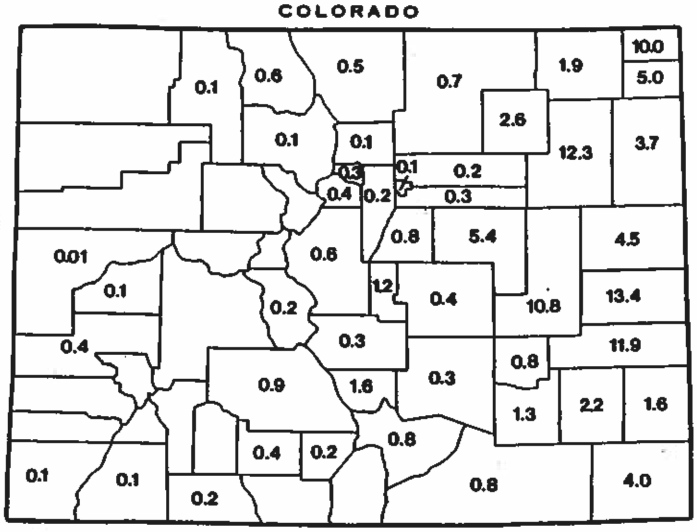
Memorable Colorado Hailstorms		
Date	Location	Remarks
7/30/1979	Fort Collins	3-4" diameter stones, baby killed.
6/4/1983	Greeley	Millions in damage.
6/13/1984	NW-W Denver	1-3" inch stones, long duration, $200 M damage.
8/2/1986	Front Range	Widespread damage, Fort Collins to Denver.
6/23/1987	Pueblo/La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

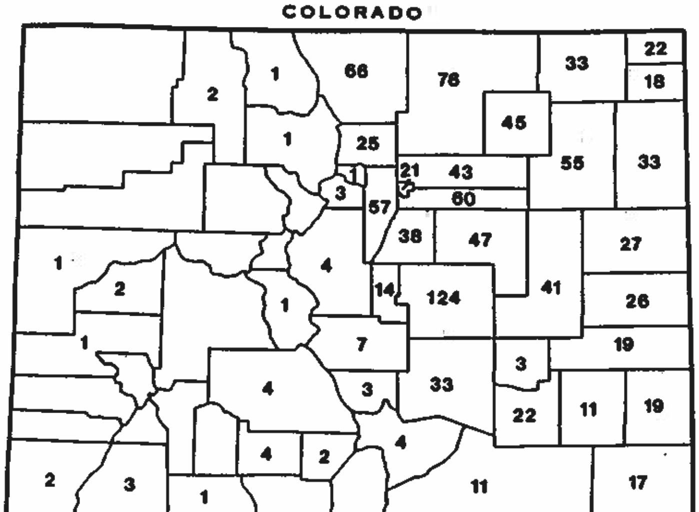
1986-93 County Hail Reports per 1,000 People

COLORADO



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

COLORADO



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.

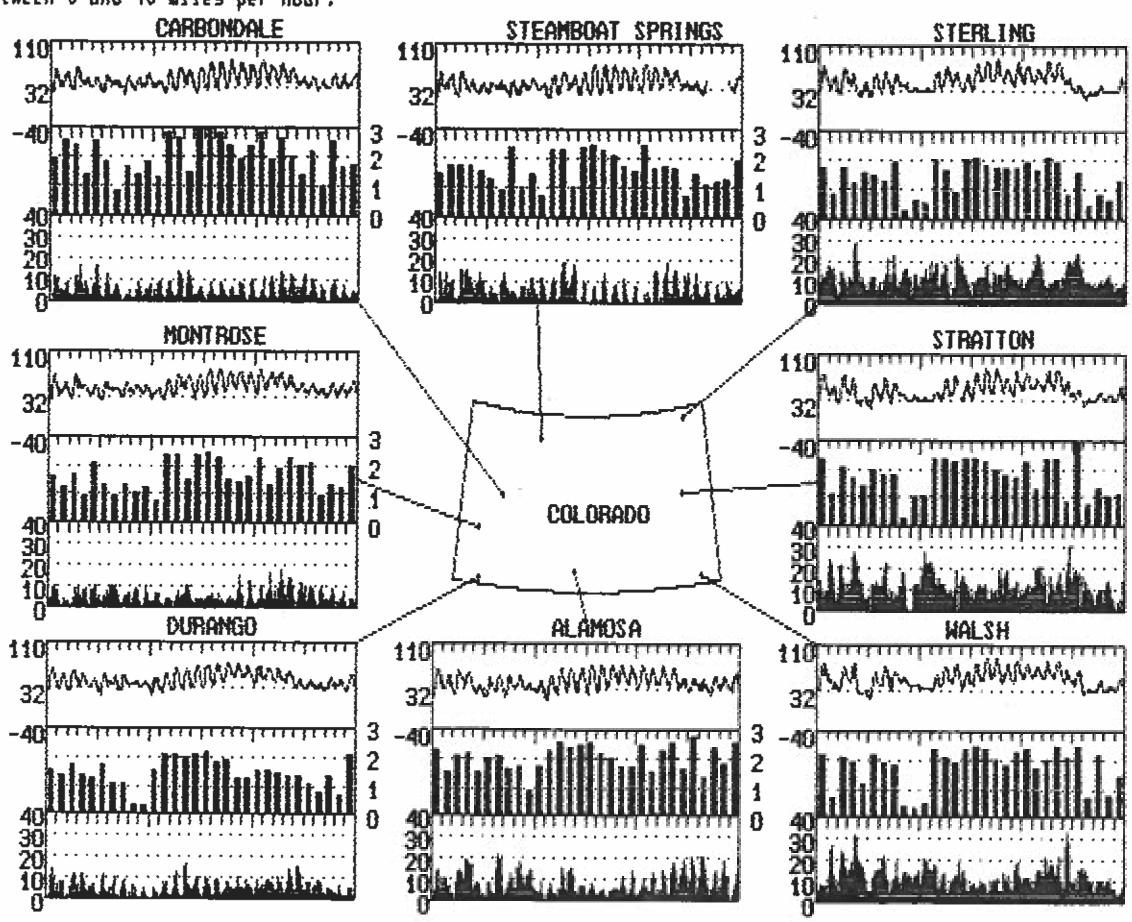
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA APRIL 1994

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	42.8	42.5	44.1	47.4	40.7	46.9	46.8	50.7
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	73.9 17/15	71.6 18/15	78.4 21/15	77.5 21/15	74.8 21/16	86.5 18/13	85.3 18/14	86.2 17/15
minimum:	12.6 12/ 5	18.0 6/ 6	18.9 8/ 6	22.8 12/ 6	15.6 1/ 5	19.0 27/ 4	14.5 6/ 6	17.8 6/ 3
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	82 / 26	80 / 28	85 / 28	69 / 29	94 / 27	69 / 29	37 / 17	73 / 33
11 AM	43 / 33	53 / 35	43 / 32	44 / 36	51 / 34	42 / 33	24 / 25	47 / 38
2 PM	31 / 31	45 / 35	31 / 31	35 / 35	45 / 34	36 / 33	20 / 25	40 / 38
5 PM	33 / 30	40 / 33	35 / 30	34 / 34	42 / 33	36 / 31	20 / 24	40 / 38
11 PM	62 / 29	70 / 31	62 / 30	57 / 31	76 / 31	54 / 29	32 / 20	66 / 36
monthly average wind direction (degrees clockwise from north)								
day	201	185	236	224	215	179	157	183
day	164	91	183	147	138	185	173	202
monthly average wind speed (miles per hour)								
	6.19	4.04	3.39	4.09	3.89	10.20	10.21	10.33
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	203	319	414	308	371	24	62	20
3 to 12	412	385	282	381	261	469	421	463
12 to 24	105	12	8	19	44	220	213	223
> 24	0	0	0	0	0	3	12	14
monthly average daily total insolation (Btu/ft²·day)								
	2009	1423	2068	1639	1640	1385	1732	1749
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	136	117	69	106	121	122	154	165
40-60%	56	86	76	101	77	82	78	63
20-40%	61	110	64	102	79	71	73	49
0-20%	26	75	33	44	49	95	42	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.



COLORADO CLIMATE

May 1994

Volume 17 Number 8

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

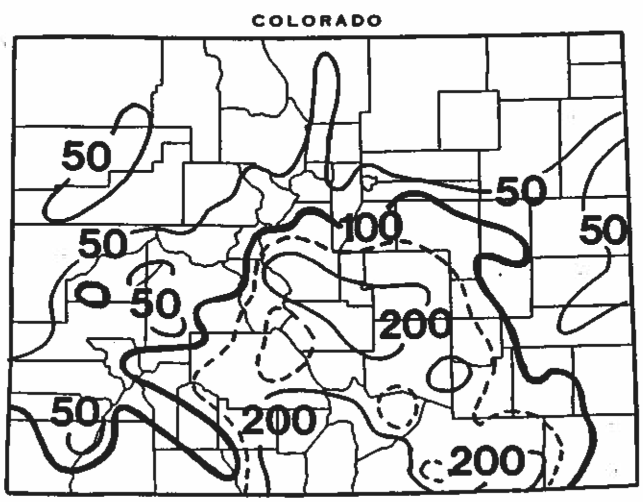
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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



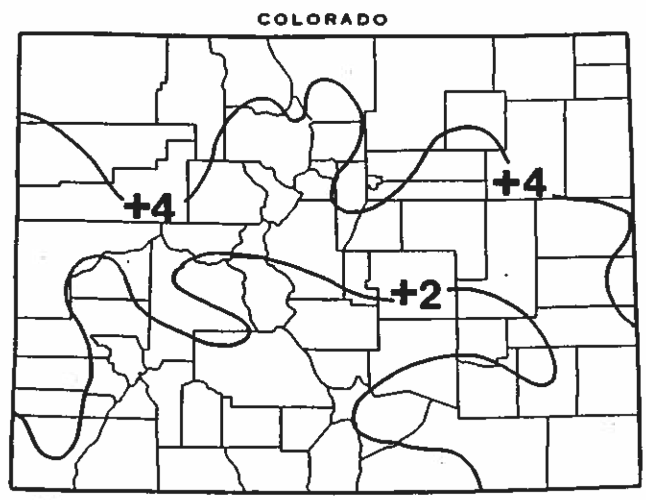
May 1994 precipitation as a percent of the 1961-1990 average.

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

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.

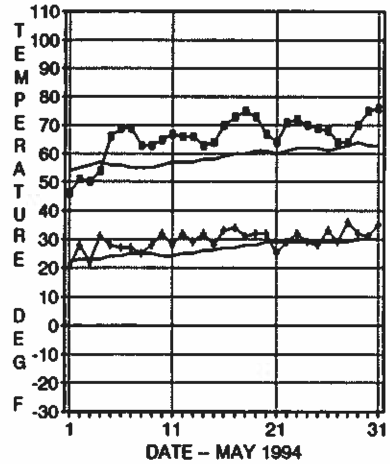
Weather Extremes

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

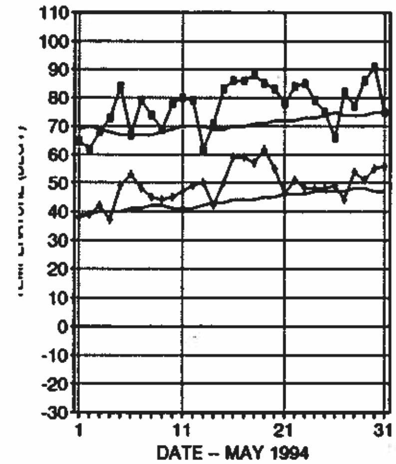
MAY 1994 TEMPERATURE COMPARISON

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.)

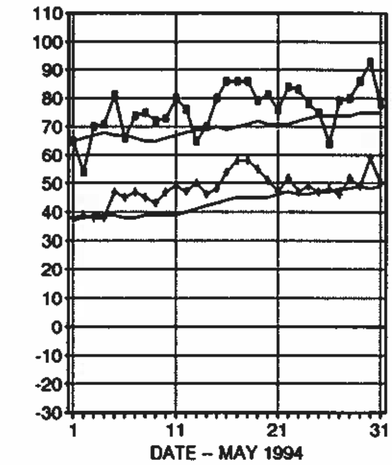
GRAND LAKE 1NW



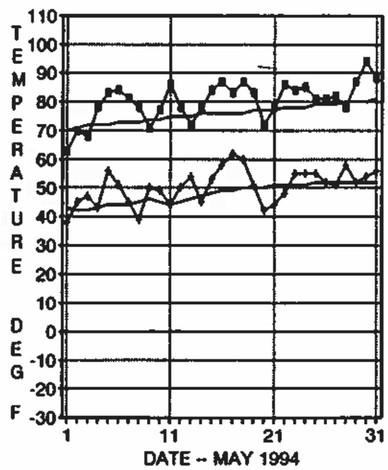
DENVER



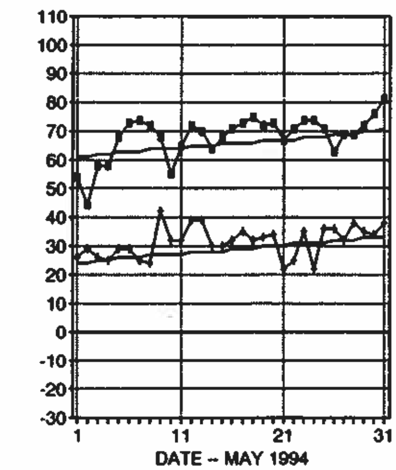
AKRON 1N



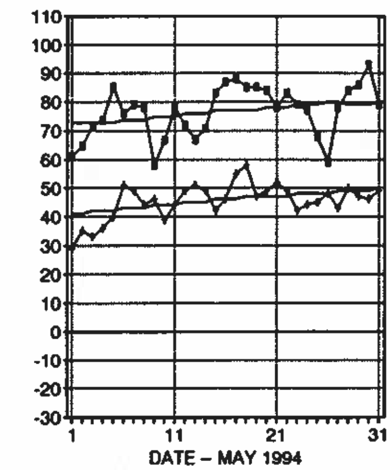
GRAND JUNCTION



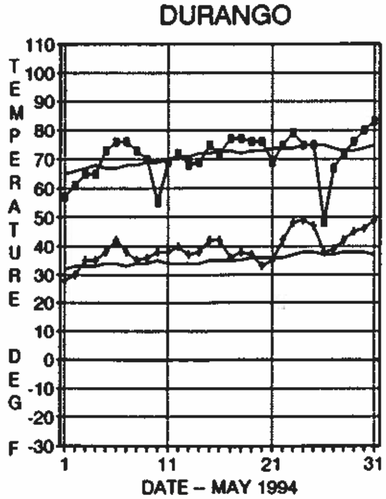
GUNNISON



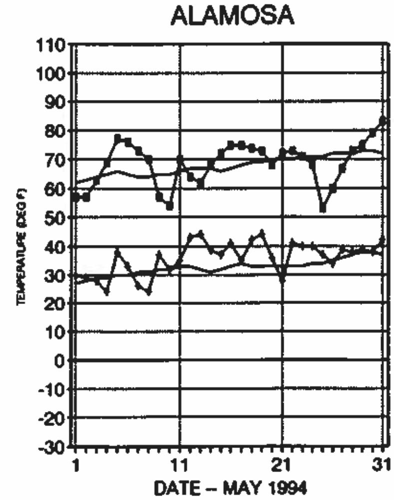
PUEBLO WSO



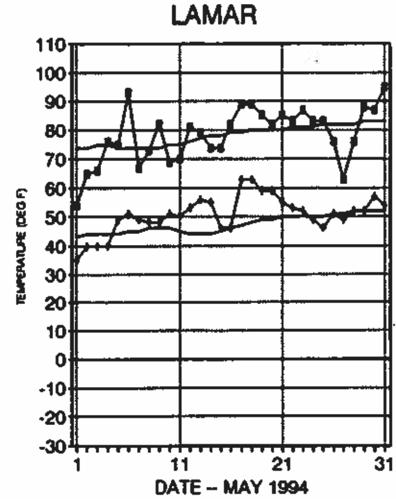
DURANGO



ALAMOSA



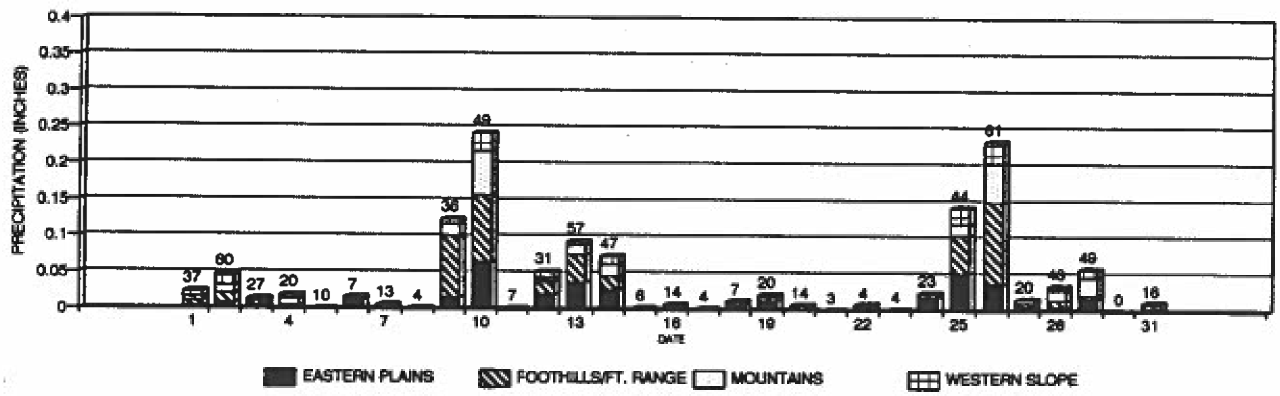
LAMAR



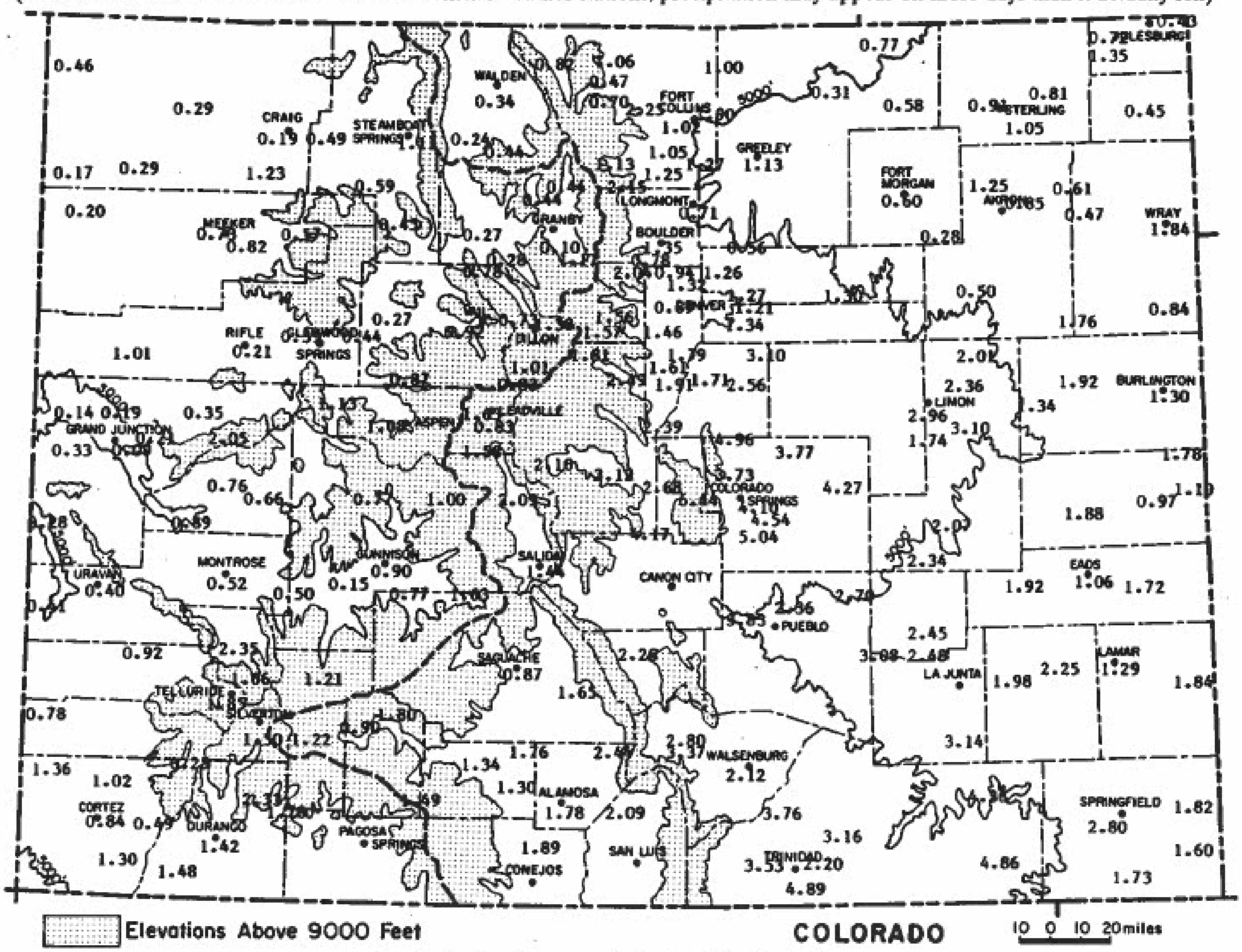
MAY 1994 PRECIPITATION

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". 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", which was somewhat less than average.

COLORADO DAILY PRECIPITATION - MAY 1994

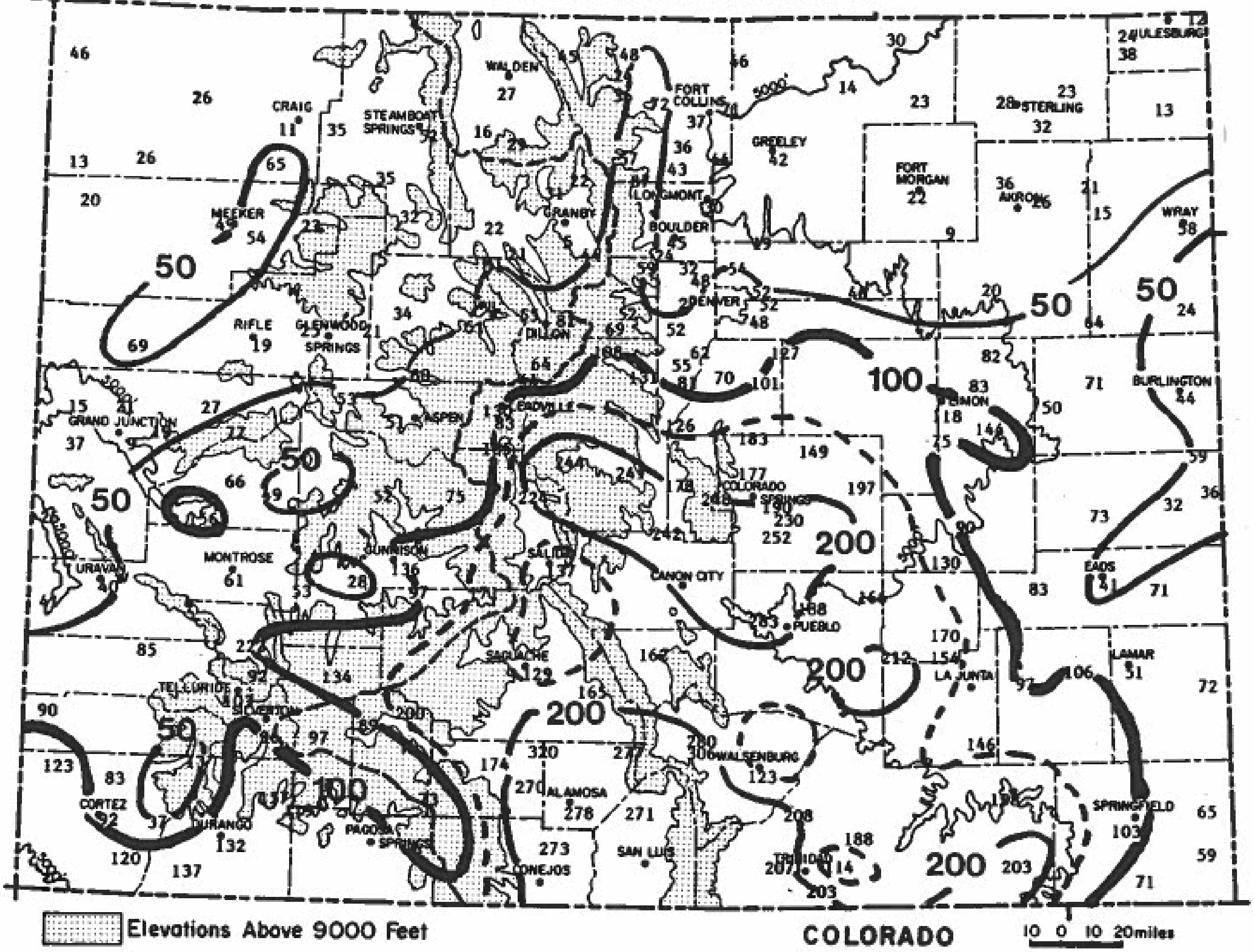


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

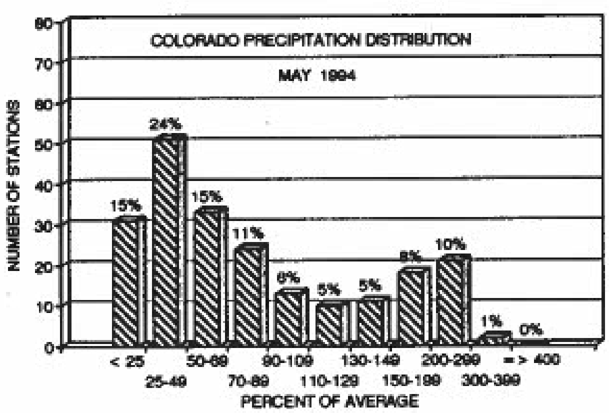


Precipitation Amounts (in inches) for May 1994.

MAY 1994 PRECIPITATION COMPARISON



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



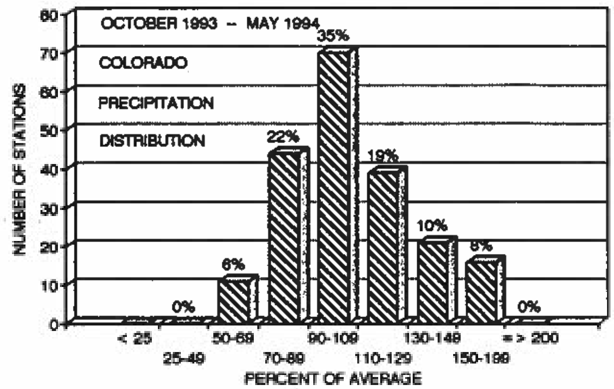
May precipitation ranged from less than 25% of average over portions of northern Colorado to more than 200% of average across south-central Colorado. Most locations were either very wet or very dry. 39% of Colorado's weather stations reported less than half of average while 19% of the stations received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

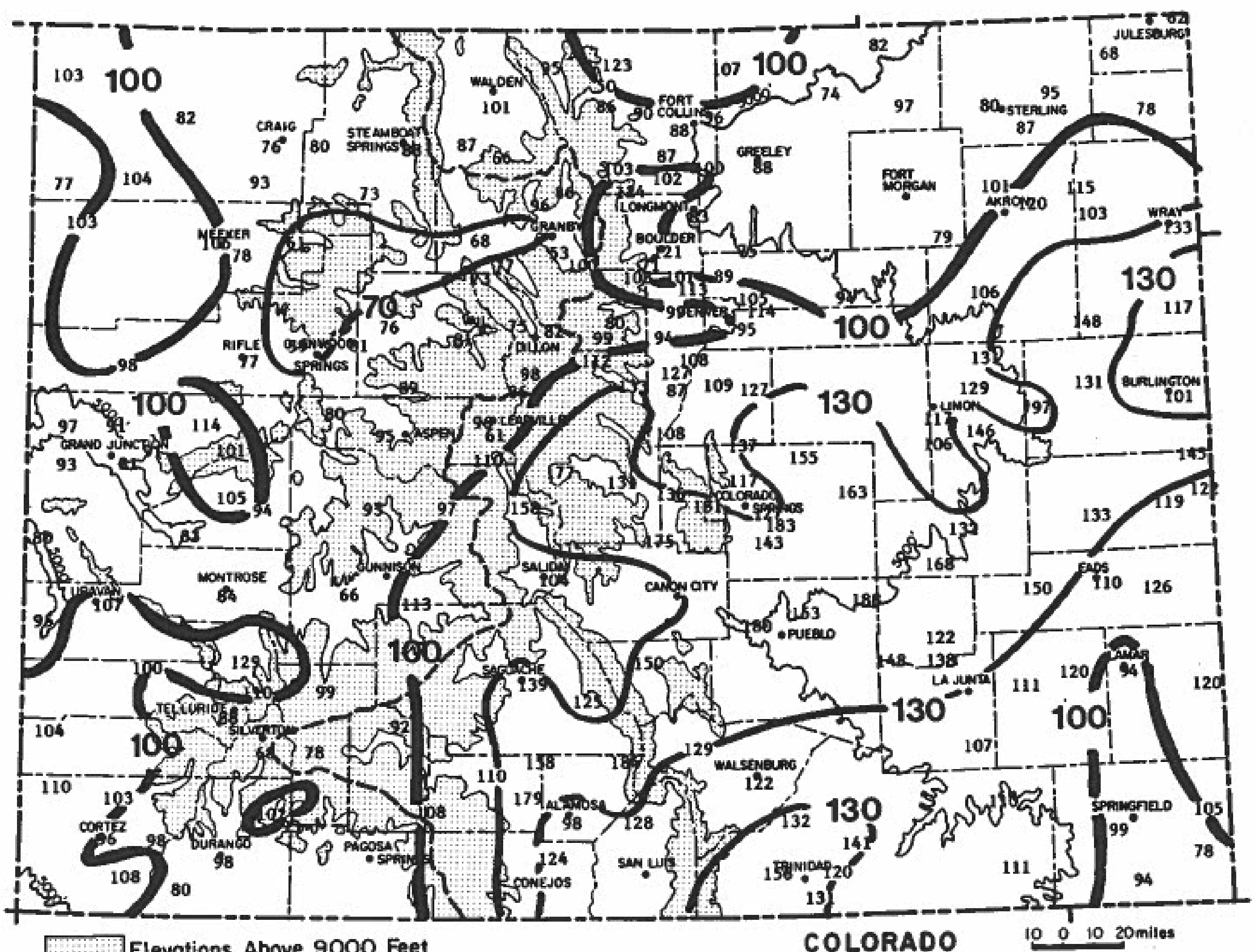
MAY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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" 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 south-central 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.





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

COMPARATIVE HEATING DEGREE DAY DATA FOR MAY 1994

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	308	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	807	1281	1798	1637	1260	958	692	435	185	9394
	93-94	51	118	342	735	1167	1435	1412	1179	930	899	387		7369
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1168	1351	1290	1172	979	771	443		7576
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	508	875	905	905	899	651	514	148		4976
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1208	1172	1124	882	762	415		6727
BURLINGTON	AVE	0	9	138	432	822	1132	1175	948	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	189	450	953	978	1060	1068	654	499	144		5377
CANON CITY	AVE *	0	11	91	325	645	896	933	758	688	406	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	482	199	55	5620
	93-94	0	22	153	435	816	864	886	828	609	468	M		4613
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1161	1179	991	776	558	286	64	6513
	93-94	0	40	212	519	972	1008	1032	920	749	576	223		5458
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	860	760	578	282	106	6453
	93-94	10	14	165	506	926	1148	1066	1038	895	528	272		5590
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	84	234	496	1139	1453	1408	1270	976	765	364	203	8441
	93-94	67	60	266	619	1168	1369	1317	1237	837	621	295		6960
DELTA	AVE	0	10	125	403	774	1126	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	763	649	469	161	52	5600
	93-94	13	33	232	596	1052	1245	1231	1010	758	533	238		6172
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948	948	879	616	485	104		4952
DILLON	AVE	282	341	555	858	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1484	1486	1307	1152	925	630		8865
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	136	6793
	93-94	6	43	201	522	968	1169	1094	1057	695	561	300		5755
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M	1258	1080	779	639	330		M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1098	1079	1029	859	710	343		8341
FORT COLLINS	AVE	0	12	176	471	825	1113	1158	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003	985	994	669	493	141		5362
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1008	M	M	1168	704	550	126		M
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102	1025	853	540	360	69		4868

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1263	945	660	381	10542
	92-93	277	311	442	665	1301	1563	1583	1340	1197	949	646	380	10676
	93-94	297	274	496	813	1250	1543	1577	1404	1200	828	526		8854
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492	955	1021	1005	1059	643	473	109		5372
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734	1527	1044	736	460		M
LAS ANIMAS	AVE	0	0	69	338	750	1068	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	360	128	9	5895
	93-94	0	12	90	389	935	925	994	882	555	400	78		4782
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	538	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478	1499	1321	1196	994	662		9112
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117	1058	766	628	238		5915
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	368	982	1299	1347	1063	721	534	226	105	6825
	93-94	12	30	246	557	1005	1064	1022	1053	718	533	182		5707
MEEKER	AVE	26	56	261	564	927	1240	1345	1066	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	565	1077	1317	1258	1096	785	594	280		6447
MONTROSE	AVE	0	11	143	453	819	1159	1248	935	791	510	248	68	6383
	92-93	15	43	87	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	956	1155	1120	992	684	487	203		5597
PAGOSA SPRINGS	AVE	64	115	324	630	984	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M	M	M	M	M		M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	398	152	10	5413
	92-93	0	15	58	390	1009	1132	1188	959	703	428	195	30	6105
	93-94	0	18	155	491	973	1020	1081	915	687	467	143		5340
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6861
	92-93	12	31	113	375	978	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464	975	1171	1132	921	682	488	194		5564
STEAMBOAT SPRINGS	AVE *	113	168	398	725	1122	1525	1608	1316	1169	801	543	297	9779
	92-93	160	119	318	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	168	144	395	710	1260	1486	1427	1294	965	678	392		7847
STERLING	AVE	0	9	149	482	852	1200	1265	963	843	504	238	58	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	968	1066	1072	1056	653	464	112		5479
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8966
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210	1443	1478	1276	1049	880	627		8154
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5838
	93-94	0	27	123	472	657	968	1000	826	668	481	161		4941
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	263	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1469	1416	1238	1088	814	514		8433
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	851	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865	877	760	623	433	170		4449

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

MAY 1994 CLIMATE DATA

EASTERN PLAINS

Name	Temperature						Degree Days			Precipitation			
	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	73.4	42.2	57.8	4.3	90	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
LIMON 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

Name	Temperature						Degree Days			Precipitation			
	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	#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

Name	Temperature						Degree Days			Precipitation			
	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 7ESE	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

	Temperature						Degree Days			Precipitation			
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.

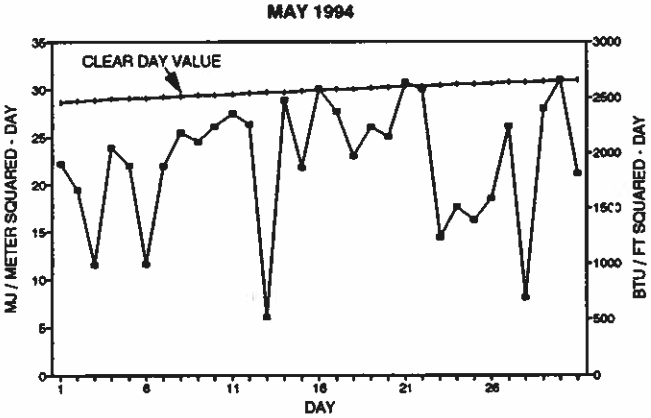
MAY 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
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

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

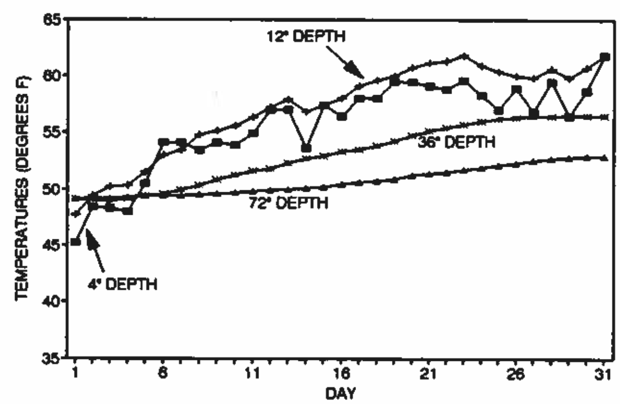


MAY 1994 SOIL TEMPERATURES

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.

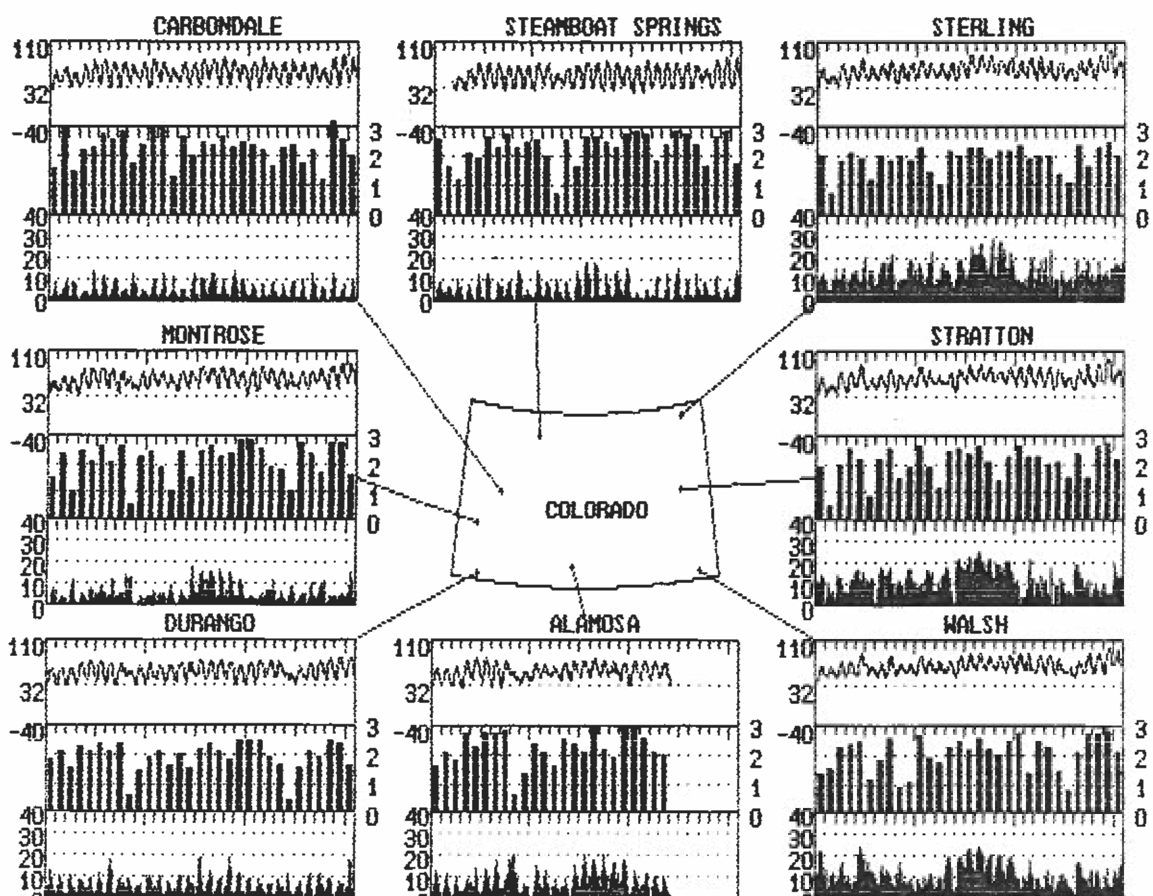
NO SPECIAL FEATURE THIS MONTH.

WTHRNET WEATHER DATA MAY 1994

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)	48.6	52.5	55.3	59.1	51.1	61.9	60.9	63.7
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	75.4 5/13	78.3 31/15	85.5 30/16	86.7 30/15	83.5 31/13	95.0 30/15	94.5 30/14	94.1 30/16
minimum:	24.4 8/ 5	28.4 2/ 5	27.9 1/ 5	32.5 4/ 5	23.7 21/ 5	32.0 30/ 0	32.0 30/ 0	34.3 1/ 1
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	81 / 34	74 / 31	80 / 32	61 / 33	96 / 30	74 / 42	42 / 31	90 / 50
11 AM	35 / 40	40 / 41	25 / 36	31 / 41	34 / 41	31 / 43	17 / 32	52 / 54
2 PM	29 / 37	33 / 40	21 / 34	29 / 40	27 / 39	23 / 41	14 / 33	42 / 53
5 PM	34 / 38	31 / 38	22 / 34	29 / 39	29 / 39	24 / 40	15 / 32	44 / 51
11 PM	55 / 36	59 / 35	47 / 33	44 / 35	75 / 37	57 / 43	27 / 29	73 / 51
monthly average wind direction (degrees clockwise from north)								
day	192	186	194	219	206	171	151	167
day	82	78	157	144	116	174	181	196
monthly average wind speed (miles per hour)	4.85	4.46	2.96	4.25	3.23	10.62	9.44	9.33
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	318	332	466	290	443	11	102	54
3 to 12	346	386	262	398	249	474	383	484
12 to 24	80	26	8	32	28	239	237	206
> 24	0	0	0	0	0	14	3	0
monthly average daily total insolation (Btu/ft²·day)	1717	1896	2265	2096	2281	1901	2060	2022
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	101	183	67	158	160	182	219	177
40-60%	75	117	61	101	81	115	86	104
20-40%	47	81	62	80	42	67	49	72
0-20%	26	51	23	31	24	60	50	53

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.



COLORADO CLIMATE

June 1994

Volume 17 Number 9

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

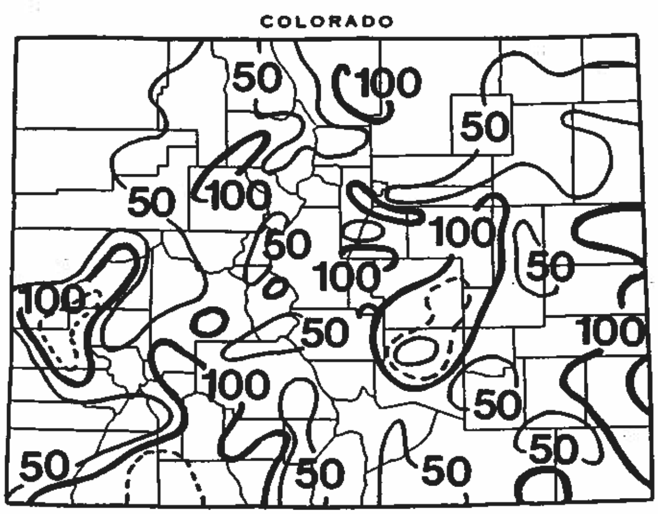
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

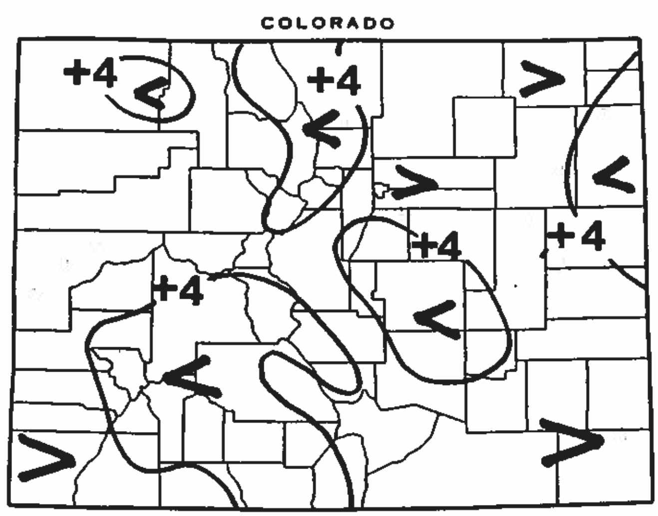
The number of days with precipitation in June was less than average over most of Colorado ranging from only 2 days with measurable precipitation over much of the Western Slope to as many as 8 days along parts of the Front Range. Some locally heavy storms 1-3rd along the Front Range, 8-9th on the Eastern 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.



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

Temperatures

The trend toward warmer than average temperatures that has been present in recent months continued into June. Daily temperatures were above the 30-year 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.

Inside This Issue

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.

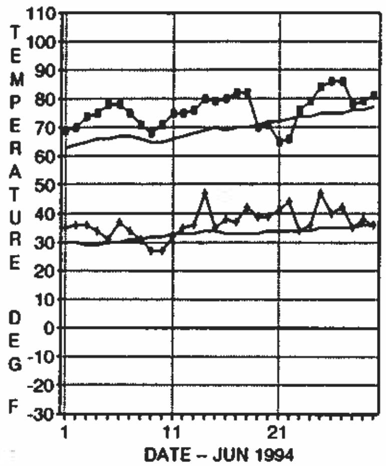
Weather Extremes

Highest Temperature	109°F	June 14	LaJunta 20S
Lowest Temperature	22°F	June 9	Spicer
Greatest Total Precipitation	4.32"		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

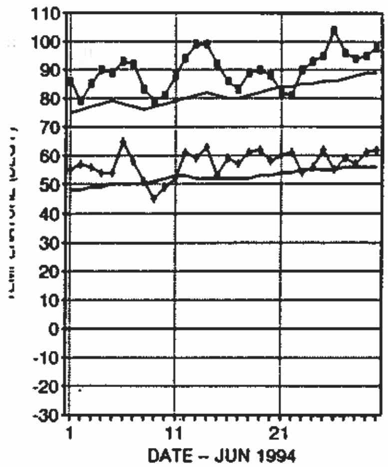
JUNE 1994 TEMPERATURE COMPARISON

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.)

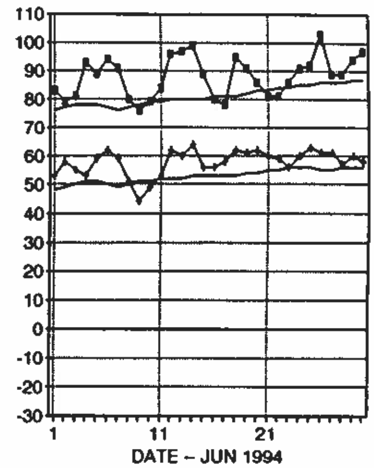
GRAND LAKE 1NW



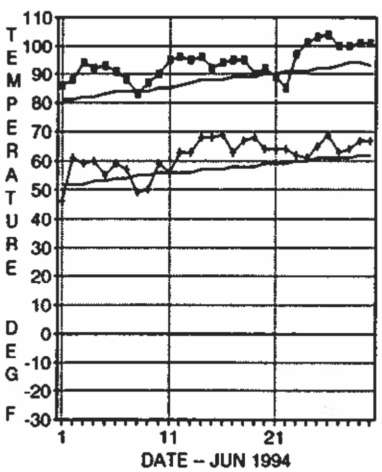
DENVER



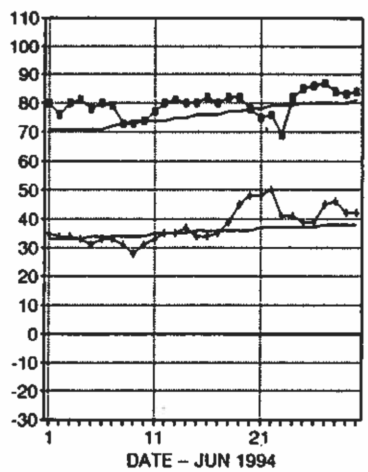
AKRON 1N



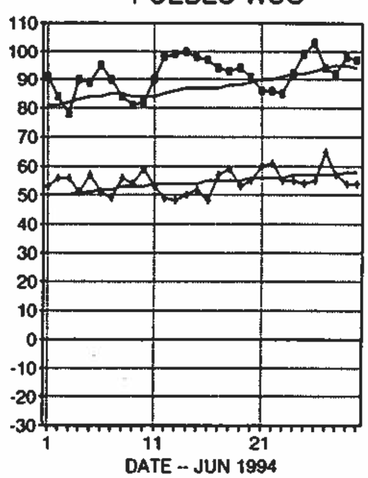
GRAND JUNCTION



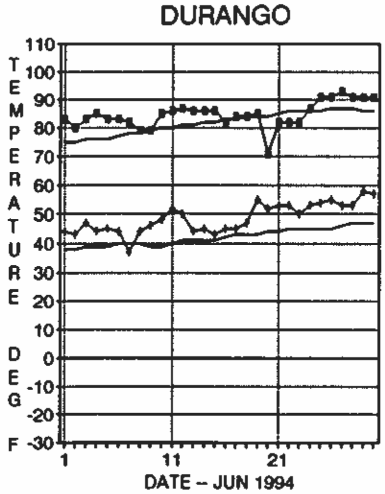
GUNNISON



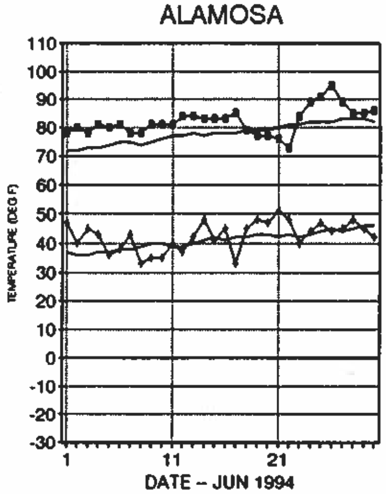
PUEBLO WSO



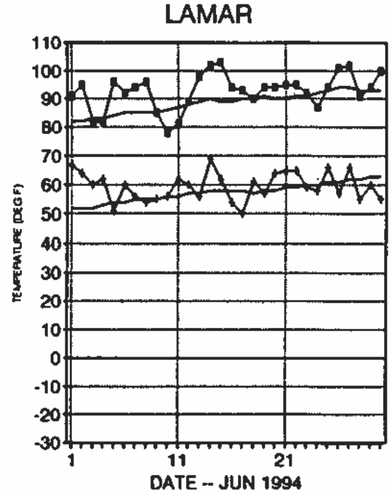
DURANGO



ALAMOSA



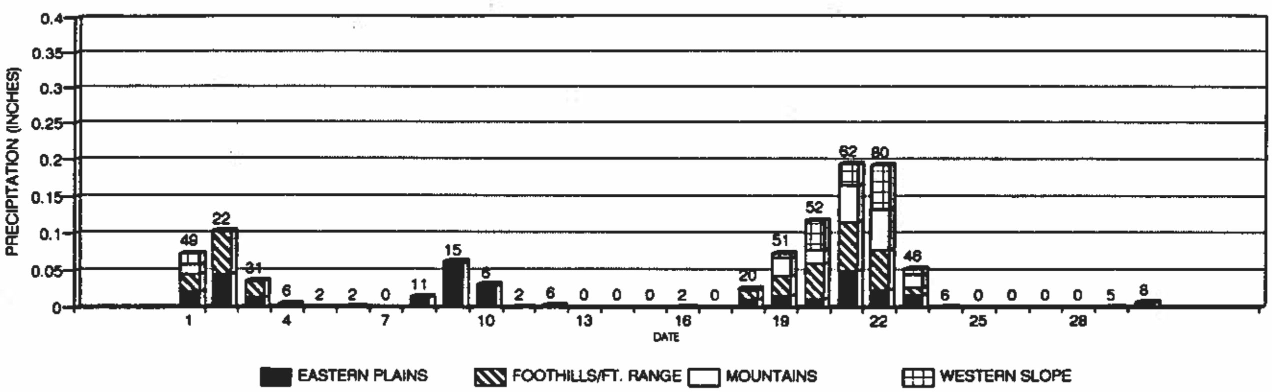
LAMAR



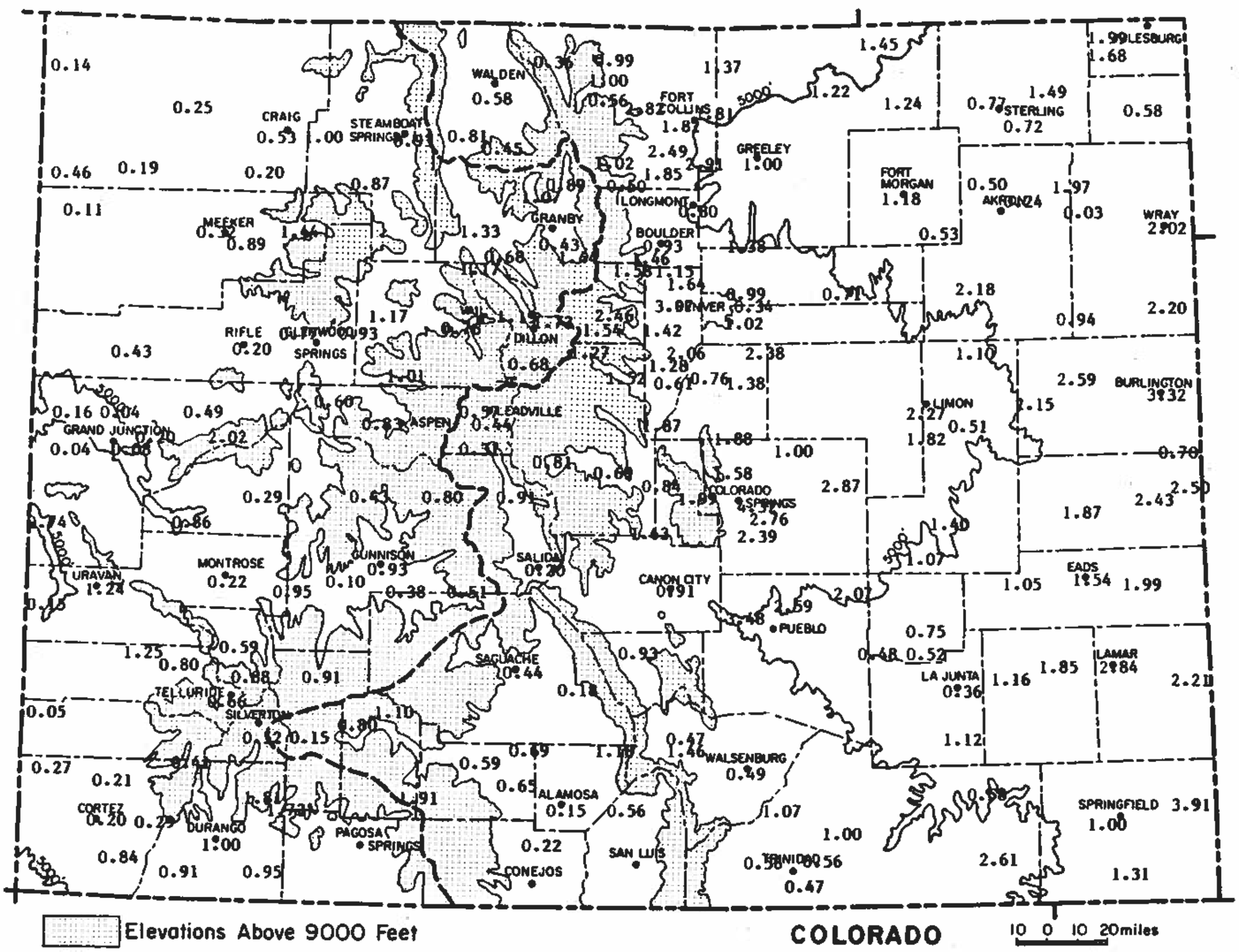
JUNE 1994 PRECIPITATION

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

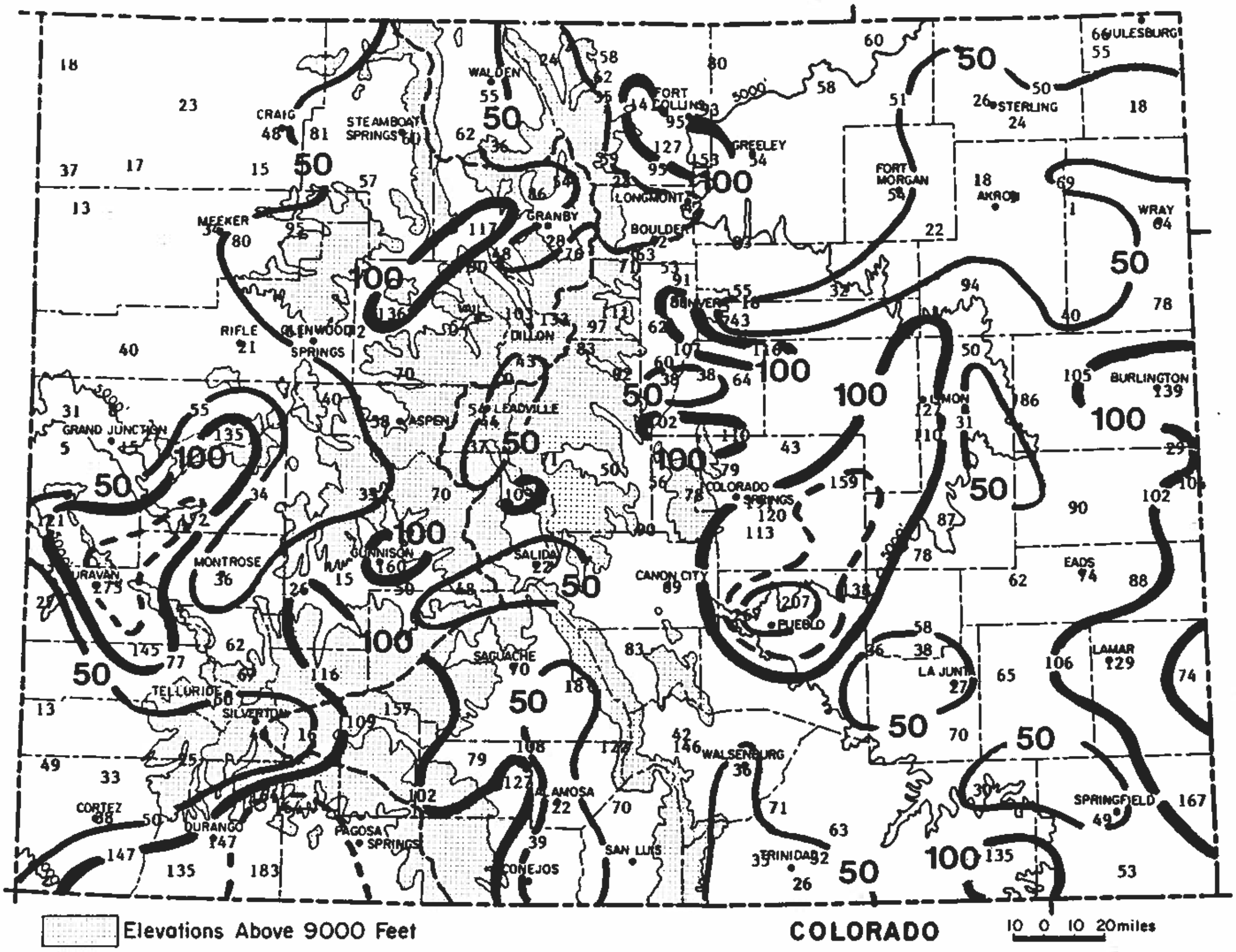


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

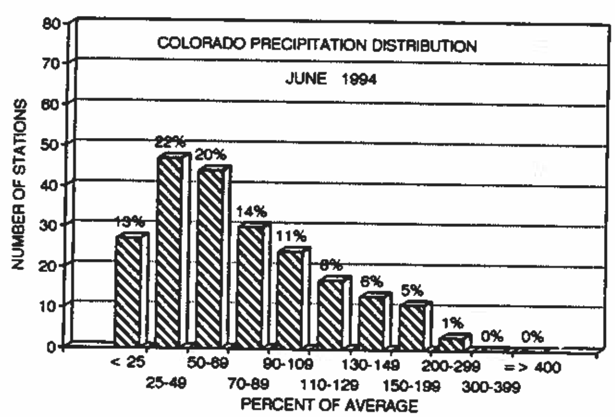


Precipitation Amounts (in inches) for June 1994.

JUNE 1994 PRECIPITATION COMPARISON



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



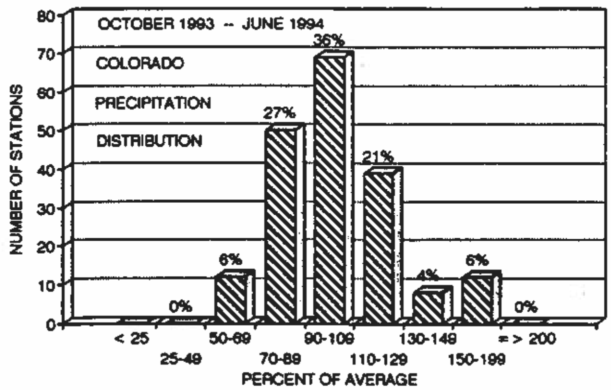
June precipitation ranged from less than 25% of average over portions of western and northeastern Colorado to more than 200% of average around Pueblo and Uravan. Despite some good rains in a few locations, the majority of Colorado was much drier than average. 13% of the official weather stations received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

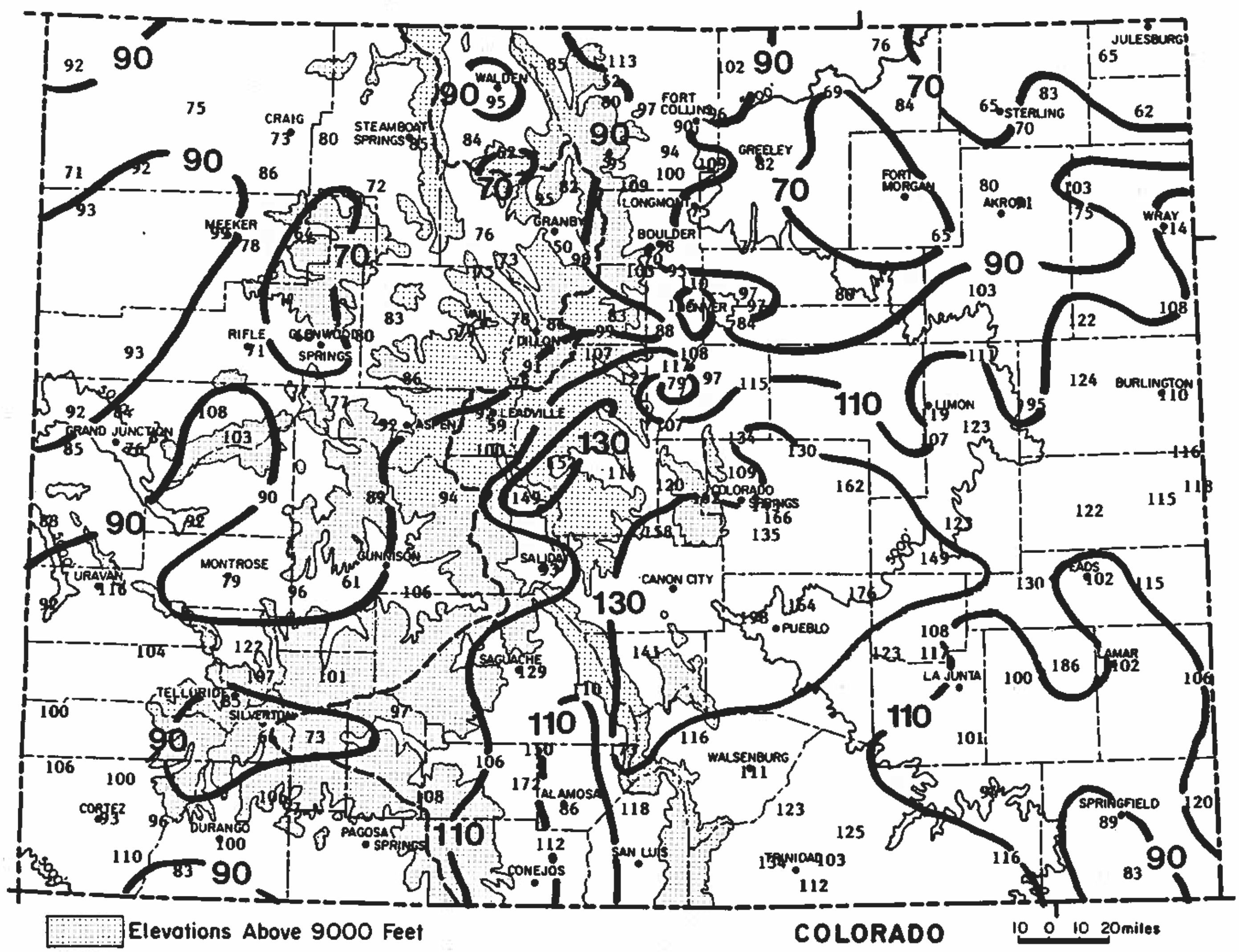
JUNE 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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.





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

COMPARATIVE HEATING DEGREE DAY DATA FOR JUNE 1994

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491 8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	92-93	97	131	295	607	1281	1796	1637	1280	958	692	435	185	9394
	93-94	51	118	342	735	1167	1435	1412	1179	930	699	387	89	8544
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	92-93	249	228	361	583	1272	1458	1325	1197	1039	901	557	363	9533
	93-94	232	221	425	718	1188	1351	1290	1172	979	771	443	149	8939
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	92-93	20	55	71	337	921	1093	1130	958	697	514	233	91	6120
	93-94	5	26	202	508	875	905	905	899	651	514	146	10	5646
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	92-93	107	148	305	536	1119	1302	1211	1093	907	735	446	232	8141
	93-94	83	144	357	687	1070	1208	1172	1124	882	762	415	77	7981
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	92-93	5	39	74	372	928	1301	1331	1103	773	531	219	68	6744
	93-94	0	25	188	450	953	978	1060	1068	854	499	144	1	6021
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	92-93	2	29	73	305	882	976	1064	885	668	482	199	55	5620
	93-94	0	22	153	435	816	864	886	828	609	468	M	0	M
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	92-93	21	53	91	383	990	1101	1179	991	776	558	286	84	6513
	93-94	0	40	212	519	972	1008	1032	926	749	576	223	14	6271
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	92-93	18	42	122	373	965	1276	1051	880	760	578	282	106	6453
	93-94	10	14	165	508	926	1148	1086	1038	695	528	272	14	6404
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	92-93	67	64	234	498	1139	1453	1408	1270	976	765	364	203	8441
	93-94	87	60	266	619	1168	1369	1317	1237	837	621	295	63	7959
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	92-93	6	10	71	301	919	1192	967	783	649	469	181	52	5600
	93-94	13	33	232	598	1052	1245	1231	1010	758	533	238	0	6943
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	92-93	10	35	58	346	926	1219	1162	992	686	489	195	71	6189
	93-94	1	20	152	488	900	948	946	879	618	485	104	3	5544
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	92-93	364	381	525	744	1346	1480	1435	1273	1220	1011	693	480	10952
	93-94	327	350	579	889	1291	1484	1486	1307	1152	925	630	312	10732
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	92-93	34	49	139	371	988	1319	1152	966	768	569	302	138	6793
	93-94	6	43	201	522	968	1169	1094	1057	695	561	300	20	6636
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	92-93	47	73	209	503	1140	1389	1387	1118	894	641	352	169	7922
	93-94	53	52	277	603	1116	M	1258	1080	779	639	330	64	M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	92-93	103	167	238	540	1074	1200	1177	1083	879	722	479	226	7888
	93-94	85	140	347	695	1011	1098	1079	1029	859	710	343	89	7483
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	92-93	22	55	87	377	940	1222	1239	1031	706	519	209	83	6490
	93-94	5	22	207	533	944	1003	985	994	669	493	141	6	6002
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	92-93	12	40	38	352	937	1472	1494	1202	789	509	156	64	7065
	93-94	0	19	168	495	1006	M	M	1166	704	550	126	6	M
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	92-93	0	6	25	222	868	1245	1018	799	597	446	144	33	5403
	93-94	4	0	59	410	875	1102	1025	853	540	360	69	0	5297

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	660	381	10542
	92-93	277	311	442	685	1301	1563	1583	1340	1197	949	648	380	10676
	93-94	297	274	496	813	1250	1543	1577	1404	1200	828	526	254	10462
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	92-93	14	43	59	374	948	1334	1348	1073	705	502	182	82	6664
	93-94	4	15	178	492	955	1021	1005	1059	643	473	109	3	5957
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	92-93	208	M	M	617	1278	M	M	M	M	M	M	M	M
	93-94	M	M	M	M	1323	1693	1734	1527	1044	736	460	185	M
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	92-93	0	11	33	304	937	1267	1242	956	648	360	128	9	5895
	93-94	0	12	90	389	935	925	994	882	555	400	78	0	5260
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	92-93	383	435	536	785	1401	1502	1462	1305	1209	1033	736	489	11276
	93-94	354	390	591	915	1368	1478	1499	1321	1196	994	662	338	11106
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	92-93	16	54	133	442	1018	1278	1339	1118	850	615	335	113	7311
	93-94	7	48	237	564	1064	1054	1117	1058	766	628	238	16	6797
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	92-93	20	61	77	388	982	1299	1347	1063	721	534	228	105	6825
	93-94	12	30	246	557	1005	1064	1022	1053	718	533	182	8	6430
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	92-93	23	44	152	426	1123	1306	1253	1117	859	644	335	183	7465
	93-94	54	42	253	585	1077	1317	1258	1098	785	594	280	52	7373
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	88	6383
	92-93	15	43	67	332	1000	1247	1023	873	687	571	241	104	6223
	93-94	14	15	161	520	958	1155	1120	992	664	487	203	9	6296
PAGOSA SPRINGS	AVE	64	115	324	636	964	1330	1423	1131	1029	756	512	244	8548
	92-93	120	126	317	538	1123	1442	1291	1096	915	714	422	261	8365
	93-94	94	143	357	M	M	M	M	M	M	M	M	M	M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	92-93	0	15	58	390	1009	1132	1186	959	703	428	195	30	6105
	93-94	0	16	155	491	973	1020	1081	915	687	467	143	0	5950
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	92-93	12	31	113	375	976	1241	1114	900	711	536	244	94	6347
	93-94 E	13	7	199	464	975	1171	1132	921	682	488	194	M	M
STEAMBOAT SPRINGS	AVE *	113	166	396	725	1122	1525	1606	1316	1169	801	543	297	9779
	92-93	160	119	316	570	1247	1583	1452	1240	1063	812	458	275	9295
	93-94	166	144	395	710	1260	1486	1427	1294	965	678	392	133	9050
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	92-93	14	36	70	400	949	1473	1401	1188	739	501	162	66	6999
	93-94	0	14	193	459	966	1066	1072	1056	653	464	112	3	6058
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	92-93	180	189	313	529	1194	1268	1193	1046	981	743	550	380	8566
	93-94	228	249	455	768	1210	1443	1476	1276	1049	860	627	234	9875
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	92-93	0	18	61	321	991	1137	1013	904	699	450	205	39	5838
	93-94	0	27	123	472	857	968	1000	826	668	481	161	0	5583
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	92-93	270	283	433	709	1310	1471	1428	1313	1153	899	592	384	10245
	93-94	286	282	510	848	1316	1469	1416	1238	1068	814	514	239	10000
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	92-93	5	29	54	271	894	951	947	875	684	461	210	42	5423
	93-94	0	17	110	406	791	865	877	760	623	433	170	0	5052

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

JUNE 1994 CLIMATE DATA

EASTERN PLAINS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation Tot	Dep	%Norm	#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	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

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation Tot	Dep	%Norm	#days
WALDEN	76.5	37.1	56.8	3.2	85	25	239	0	405	0.58	-0.46	56	4
LEADVILLE 2SW	71.8	35.2	53.5	4.7	81	26	338	0	336	0.44	-0.56	44	5
SALIDA	84.5	43.8	64.1	3.3	94	34	55	36	506	0.20	-0.70	22	2
BUENA VISTA	80.5	45.0	62.7	3.5	90	38	77	17	468	0.91	0.03	103	6
SAGUACHE	82.1	43.8	62.9	4.4	93	36	87	31	476	0.44	-0.18	71	4
HERMIT 7ESE	76.2	32.2	54.2	4.2	85	26	316	0	401	0.80	0.07	110	2
ALAMOSA WSO AP	82.2	42.5	62.3	2.9	95	33	89	16	481	0.15	-0.52	22	3
STEAMBOAT SPRINGS	82.0	39.2	60.6	5.2	91	29	133	10	481	0.93	-0.62	60	4
GRAND LAKE 1NW	76.0	36.7	56.3	5.0	86	27	254	1	396	0.89	-0.74	55	7
GRAND LAKE 6SSW	74.0	37.6	55.8	3.5	82	28	269	0	367	1.07	-0.16	87	8
DILLON 1E	72.7	36.1	54.4	3.7	82	26	312	0	348	1.19	0.04	103	8
CLIMAX	63.7	33.9	48.8	3.3	72	26	477	0	211	0.00	-1.46	0	0
ASPEN 1SW	76.8	43.0	59.9	4.4	85	33	149	3	409	0.83	-0.58	59	5
CRESTED BUTTE	74.1	33.8	53.9	2.4	84	26	324	0	368	0.43	-0.77	36	4
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	0	392	0.66	-0.64	51	5
SILVERTON	72.8	35.2	54.0	3.8	82	29	324	0	351	0.52	-0.77	40	4
WOLF CREEK PASS 1E	64.4	39.0	51.7	3.9	75	33	391	0	222	1.91	0.04	102	5

WESTERN VALLEYS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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	0	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	0	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

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.

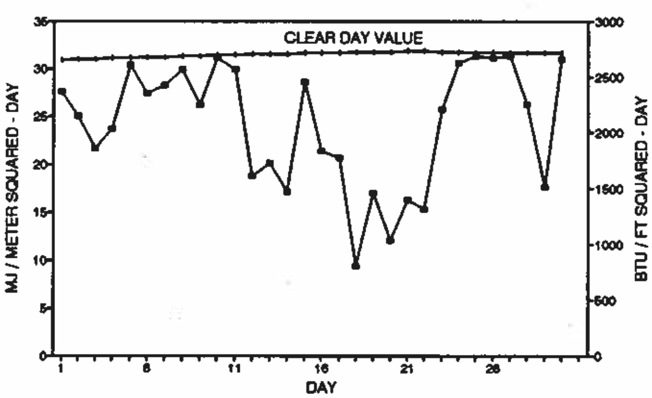
JUNE 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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 = Partly Cloudy CLDY= Cloudy

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.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
JUNE 1994

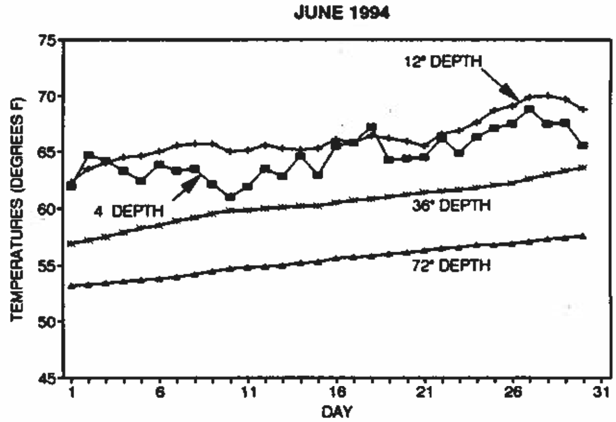


JUNE 1994 SOIL TEMPERATURES

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.

FORT COLLINS 7 AM SOIL TEMPERATURES
JUNE 1994



HATS OFF TO: *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 AND COUNTING – WHO WOULD HAVE BELIEVED IT

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.

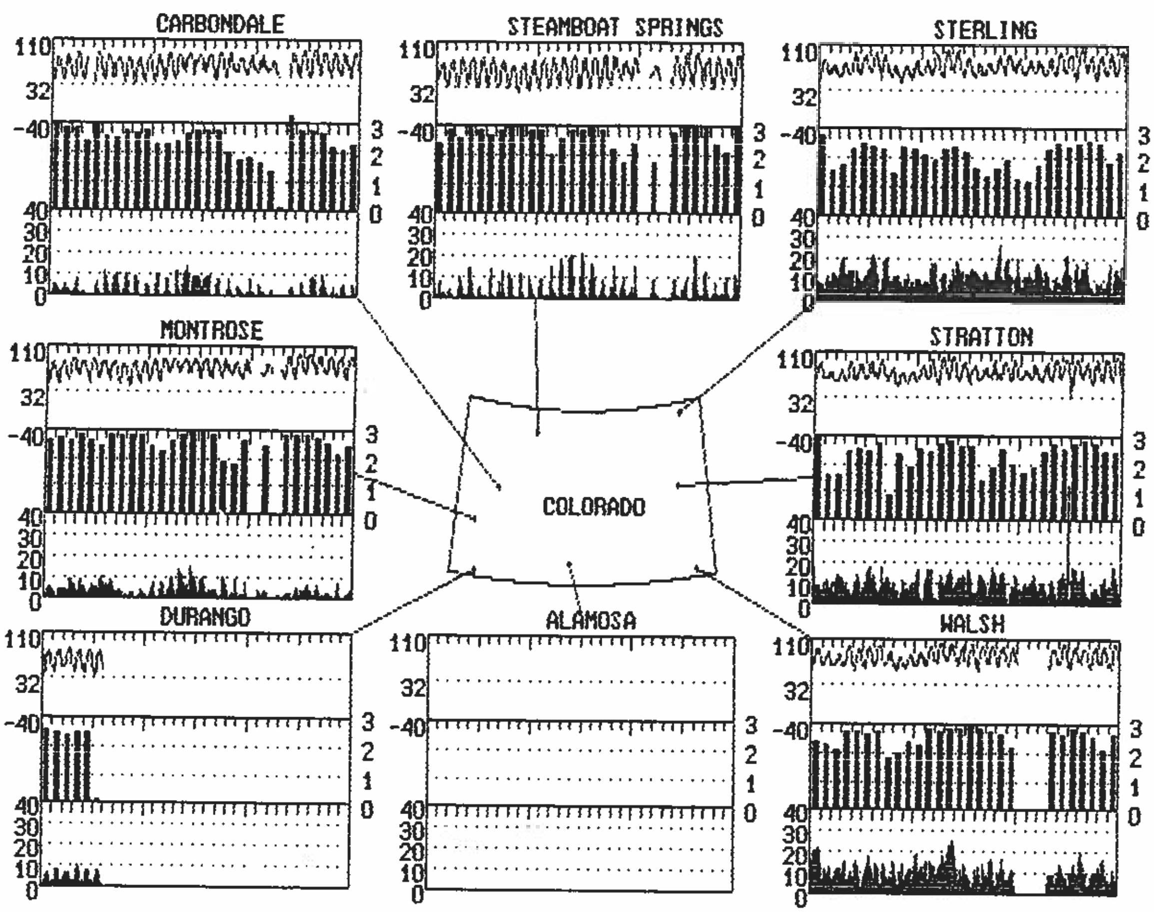
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA JUNE 1994

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)			65.7	70.8	59.5	72.5	72.7	77.5
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:			92.7 26/16	95.5 26/15	92.7 25/16	103.6 26/16	100.4 30/15	101.7 25/16
minimum:			33.1 9/ 5	39.6 9/ 5	23.4 9/ 5	32.0 29/ 0	32.0 25/ 0	53.6 5/ 5
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	n/a /n/a	n/a /n/a	68 / 36	44 / 35	96 / 34	64 / 47	51 / 43	70 / 54
11 AM	n/a /n/a	n/a /n/a	18 / 38	20 / 43	23 / 41	29 / 47	14 / 37	28 / 53
2 PM	n/a /n/a	n/a /n/a	15 / 38	17 / 41	17 / 39	21 / 46	12 / 38	20 / 50
5 PM	n/a /n/a	n/a /n/a	14 / 38	16 / 40	16 / 38	21 / 45	13 / 38	20 / 48
11 PM	n/a /n/a	n/a /n/a	32 / 34	24 / 35	65 / 41	44 / 45	25 / 35	49 / 53
monthly average wind direction (degrees clockwise from north)								
day	n/a	n/a	228	242	240	155	130	150
day			134	138	111	161	172	198
monthly average wind speed (miles per hour)			2.35	2.95	3.29	9.28	8.19	9.25
wind speed distribution (hours per month for hourly average mph range)								
0 to 3			395	407	406	26	88	33
3 to 12			182	259	157	522	502	456
12 to 24	0	0	2	5	45	171	129	156
> 24	0	0	0	0	0	1	1	3
monthly average daily total insolation (Btu/ft²·day)			2448	2582	2607	2052	2321	2527
"clearness" distribution (hours per month in specified clearness index range)								
60-80%			238	222	175	200	254	231
40-60%			84	65	50	95	69	63
20-40%			33	22	33	78	52	29
0-20%			20	11	7	60	32	16

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.



COLORADO CLIMATE

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

July 1994
Volume 17 Number 10

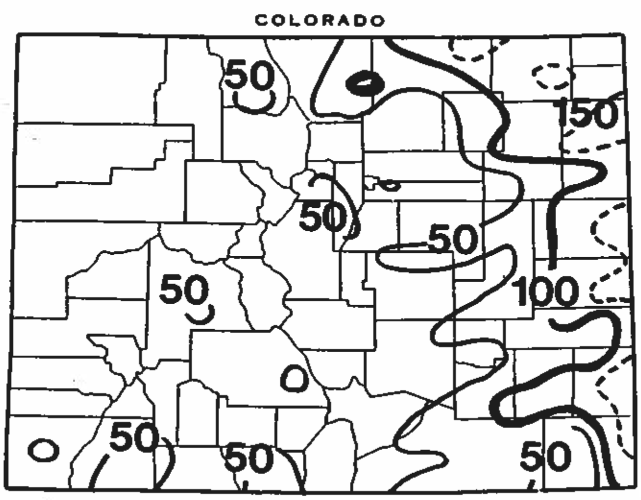
This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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

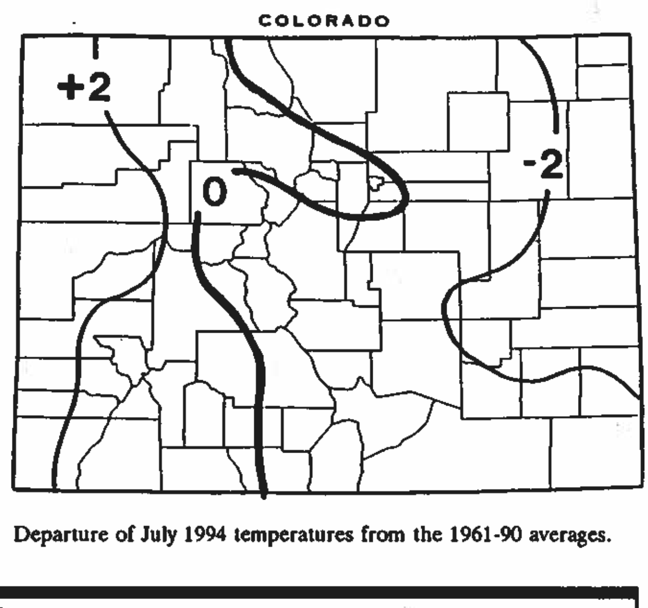
July is traditionally remembered, by the many campers and vacationers who visit Colorado, as the month when thunderstorms appear nearly every afternoon over the High Country. For the second straight year, however, most of July's storms developed over eastern Colorado. There were only one to seven days 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.



July 1994 precipitation as a percent of the 1961-1990 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 This Issue

JULY 1994 DAILY WEATHER

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.

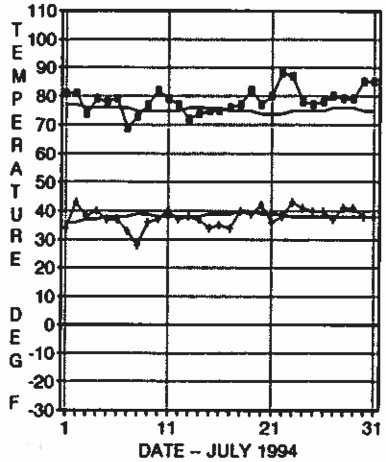
Weather Extremes

Highest Temperature	109°F	July 1	Las Animas and Springfield 7WSW
Lowest Temperature	24°F	July 7 and July 8	Climax and 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"		None reported

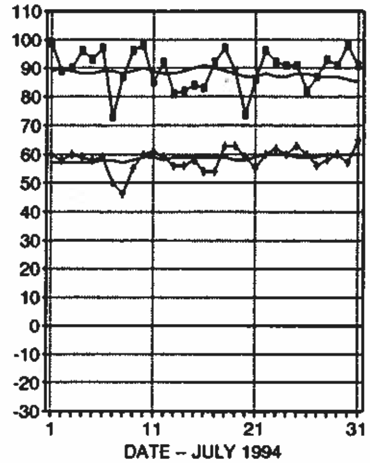
JULY 1994 TEMPERATURE COMPARISON

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.)

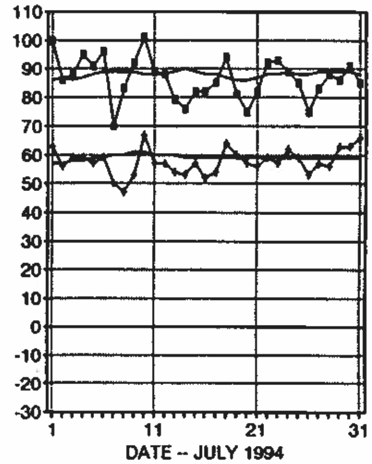
GRAND LAKE 1NW



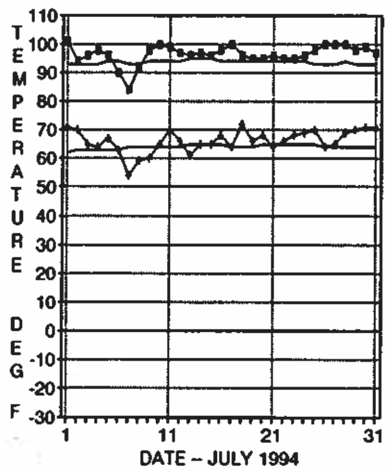
DENVER



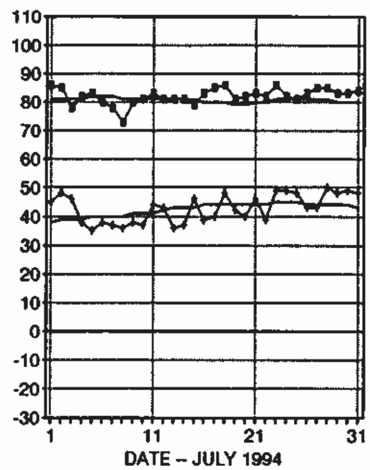
AKRON 1N



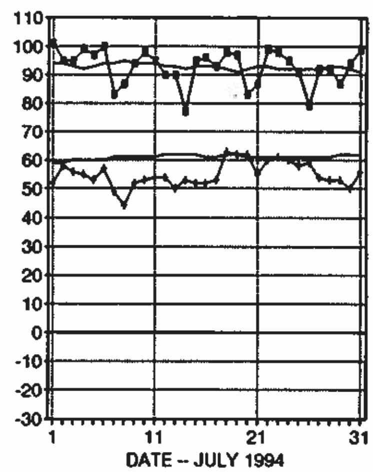
GRAND JUNCTION



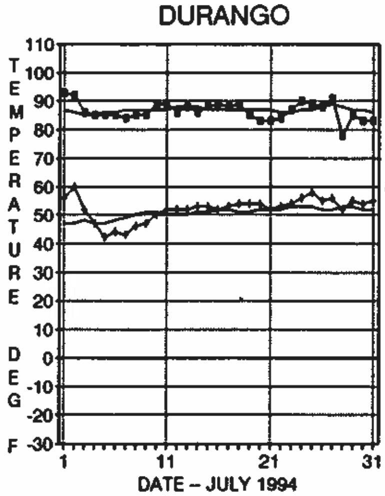
GUNNISON



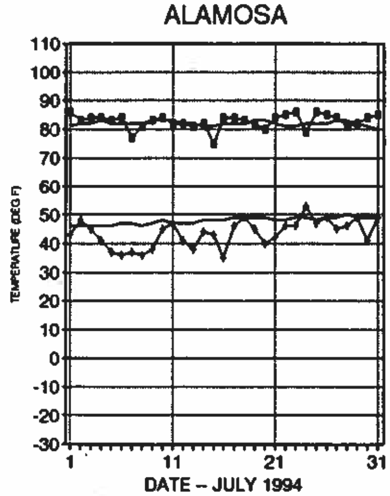
PUEBLO WSO



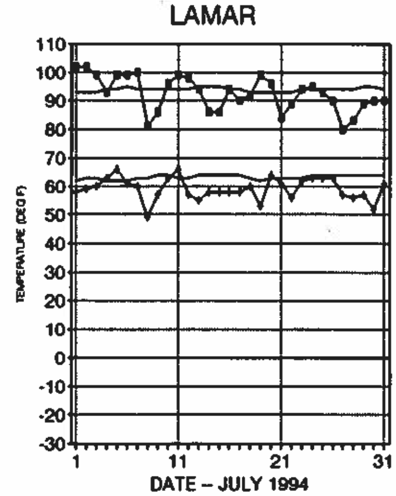
DURANGO



ALAMOSA



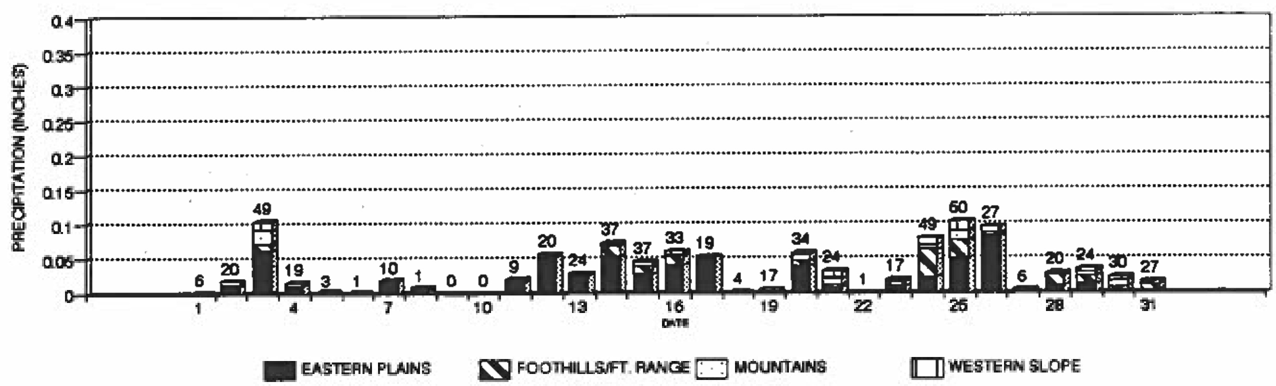
LAMAR



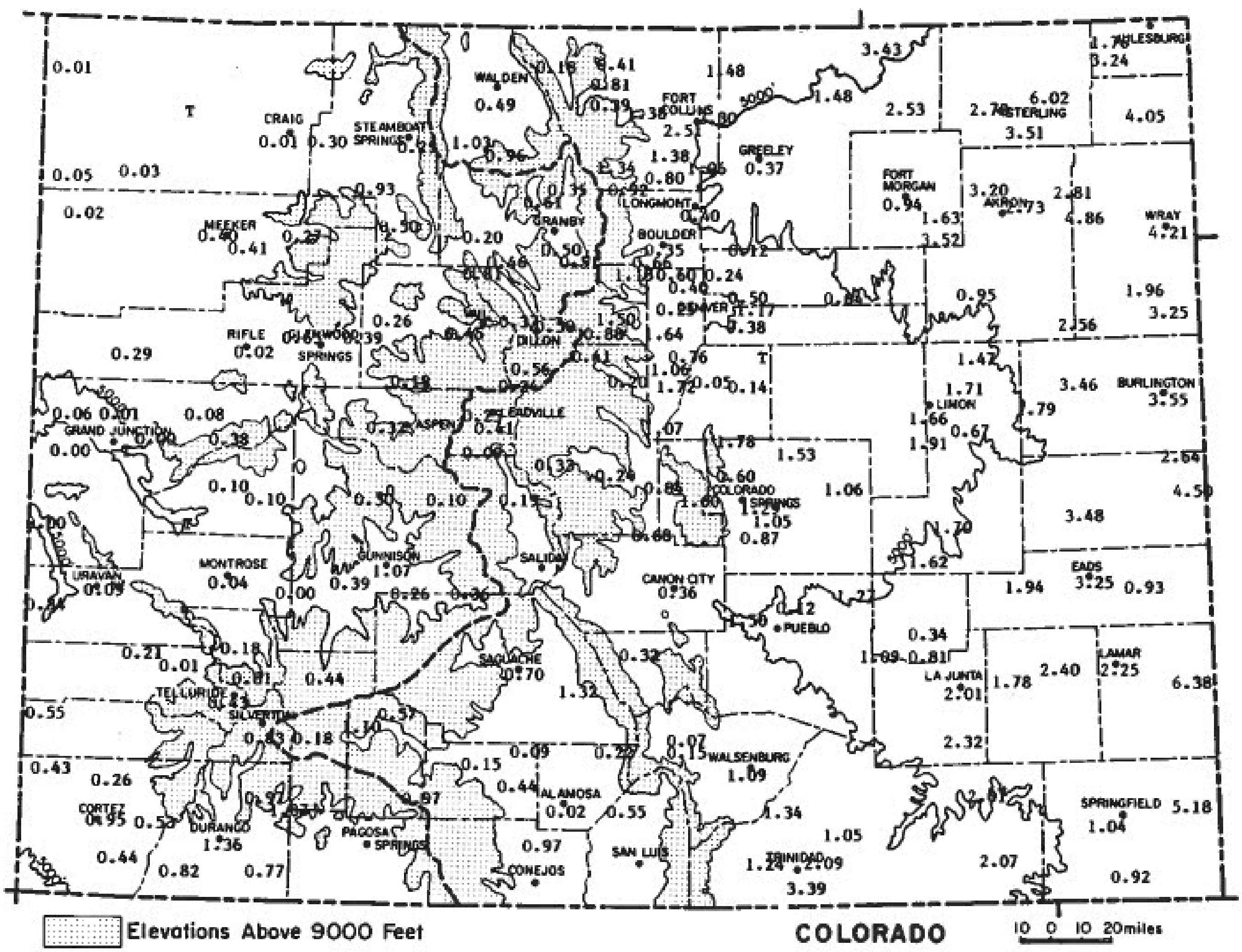
JULY 1994 PRECIPITATION

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

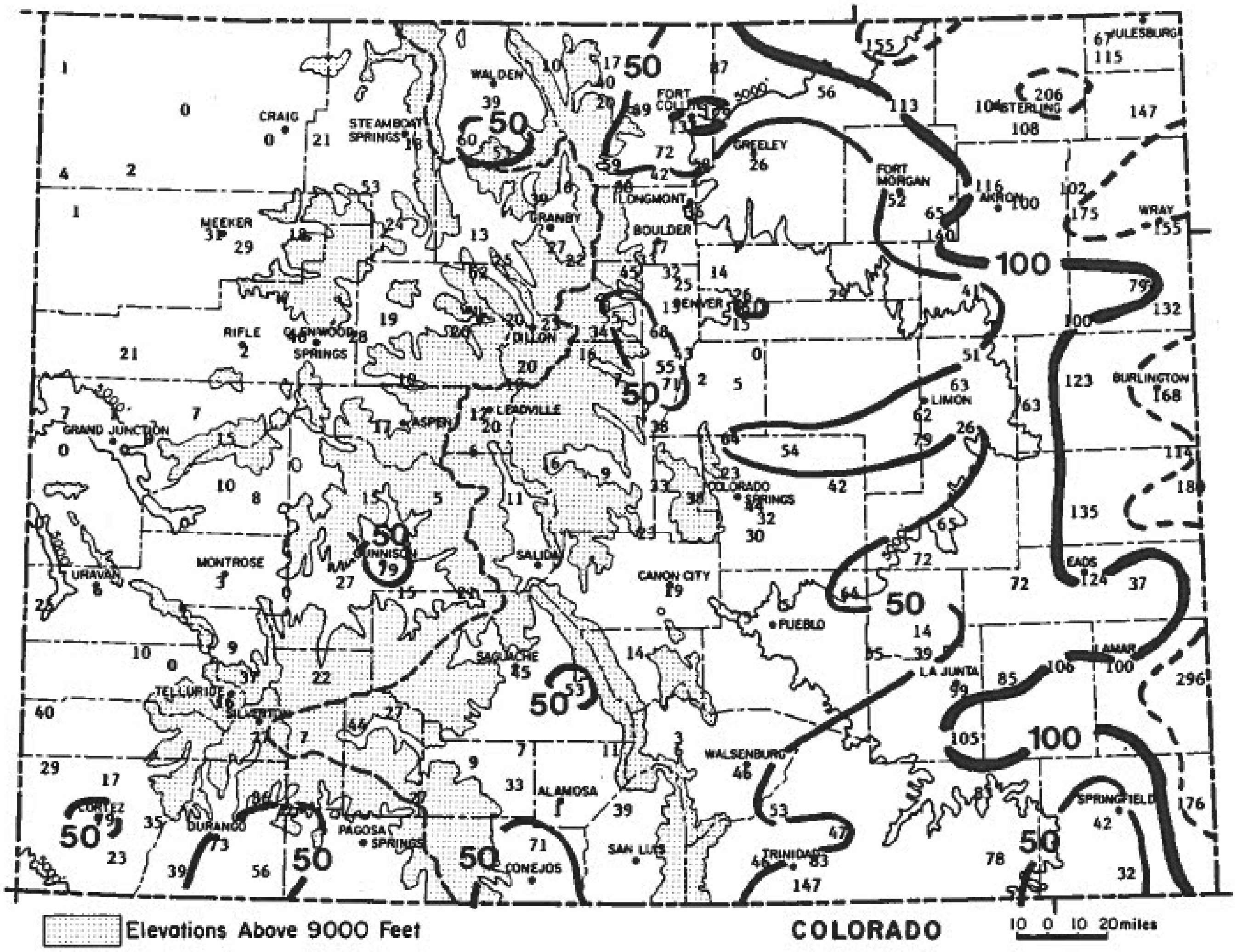


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

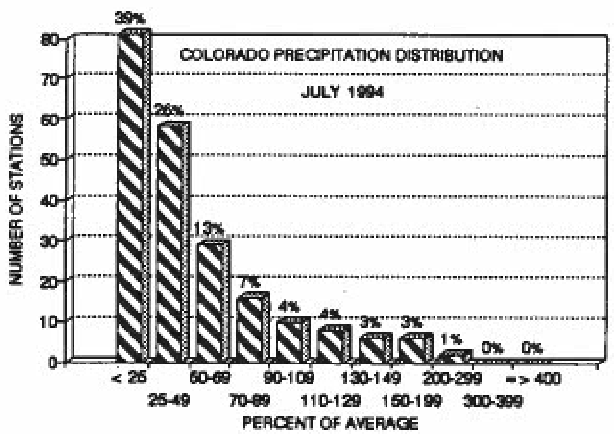


Precipitation Amounts (in inches) for July 1994.

JULY 1994 PRECIPITATION COMPARISON



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



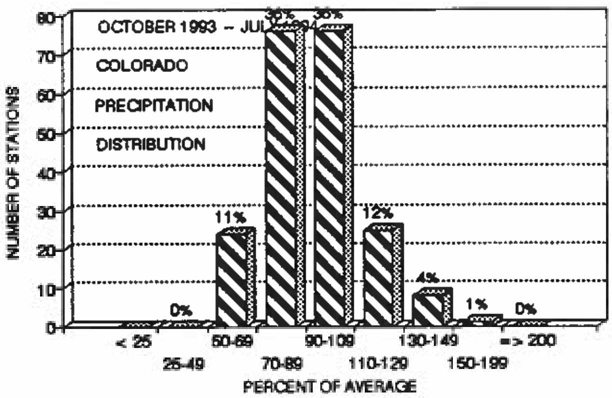
July precipitation was below average at 88% of the official reporting stations in Colorado. 65% of the stations received less than 50% of the average July rainfall and 39% of the stations got less than 25% of average. The eight stations that reported more than 150% of average were all located in extreme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

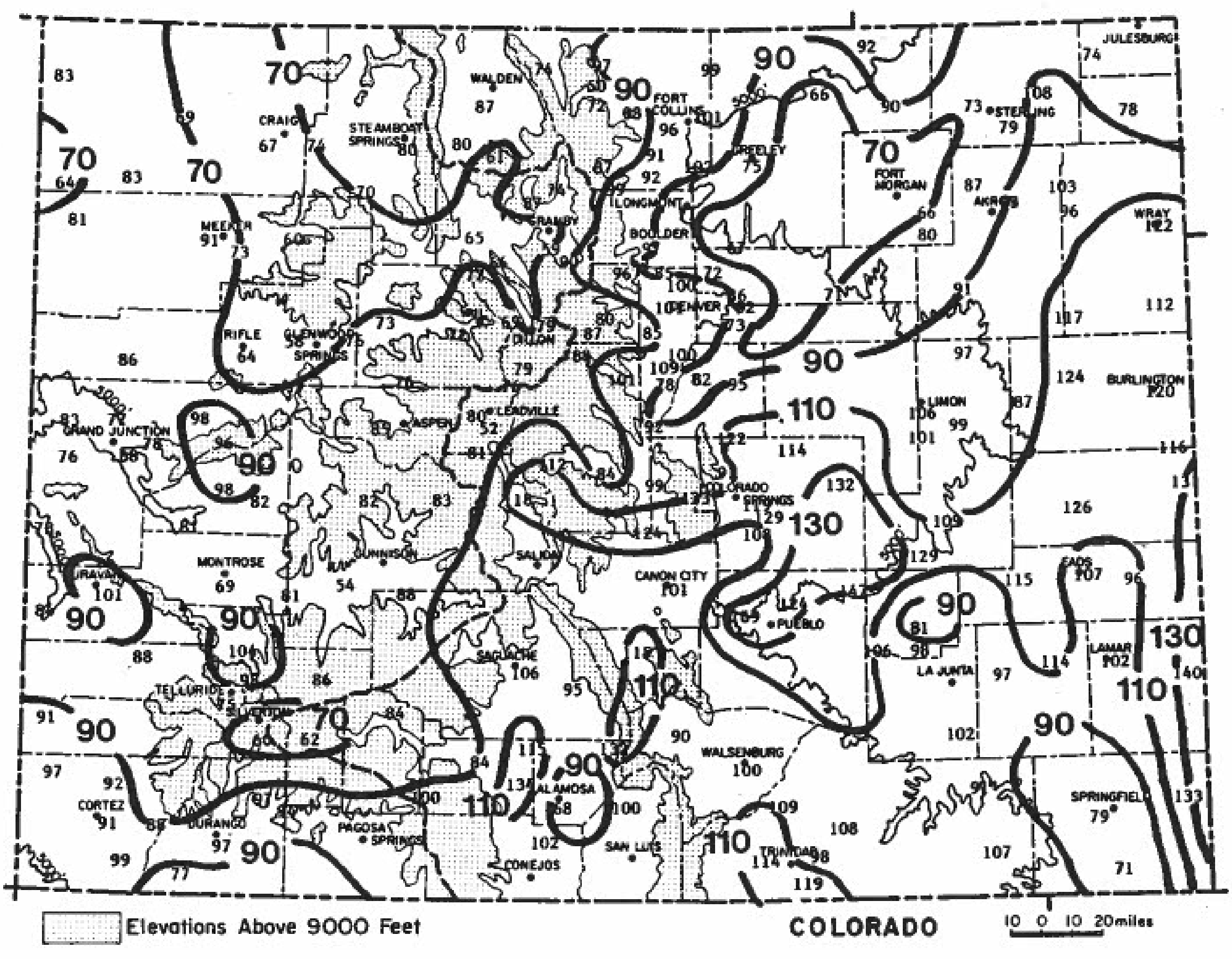
JULY 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8646

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	93-94	51	118	342	735	1167	1435	1412	1179	930	699	387	89	8544
	94-95	62												62
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	93-94	232	221	425	718	1188	1351	1290	1172	979	771	443	149	8939
	94-95	106												106
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	93-94	5	26	202	508	875	905	905	899	651	514	146	10	5646
	94-95	4												4
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	93-94	83	144	357	687	1070	1208	1172	1124	882	762	415	77	7981
	94-95	50												50
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	93-94	0	25	189	450	953	978	1060	1068	654	499	144	1	6021
	94-95	4												4
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	93-94	0	22	153	435	816	864	886	828	609	468	M	0	M
	94-95	0												0
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	67	6415
	93-94	0	40	212	519	972	1008	1032	926	749	576	223	14	6271
	94-95	10												10
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	93-94	10	14	165	508	926	1148	1086	1038	695	528	272	14	6404
	94-95	4												4
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	93-94	87	60	286	619	1168	1369	1317	1237	837	621	295	63	7959
	94-95	13												13
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	93-94	13	33	232	598	1052	1245	1231	1010	758	533	238	0	6943
	94-95	0												0
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	93-94	1	20	152	488	900	948	946	879	618	485	104	3	5544
	94-95	3												3
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	93-94	327	350	579	889	1291	1484	1486	1307	1152	925	630	312	10732
	94-95	265												265
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	93-94	6	43	201	522	968	1169	1094	1057	695	561	300	20	6638
	94-95	2												2
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	93-94	53	52	277	603	1116	M	1258	1080	779	639	330	64	M
	94-95	M												M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	93-94	85	140	347	695	1011	1096	1079	1029	858	710	343	89	7483
	94-95	59												59
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	93-94	5	22	207	533	944	1003	985	994	669	493	141	6	6002
	94-95	3												3
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	93-94	0	19	168	495	1006	M	M	1166	704	550	126	6	M
	94-95	9												9
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5546
	93-94	4	0	59	410	875	1102	1025	853	540	360	69	0	5297
	94-95	0												0

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8646

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	660	381	10542
	93-94	297	274	496	813	1250	1543	1577	1404	1200	828	526	254	10462
	94-95	205												205
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	93-94	4	15	178	492	955	1021	1005	1059	643	473	109	3	5957
	94-95	1												1
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	93-94	M	M	M	M	1323	1693	1734	1527	1044	738	460	185	M
	94-95	87												87
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	93-94	0	12	90	389	935	925	994	882	555	400	78	0	5260
	94-95	0												0
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	93-94	354	390	591	915	1368	1478	1499	1321	1196	994	662	338	11106
	94-95	310												310
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	93-94	7	48	237	564	1064	1054	1117	1058	766	628	238	18	6797
	94-95	12												12
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	93-94	12	30	248	557	1005	1064	1022	1053	718	533	182	8	6430
	94-95	13												13
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	93-94	54	42	253	565	1077	1317	1258	1096	785	594	280	52	7373
	94-95	13												13
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	93-94	14	15	161	520	956	1155	1120	992	664	487	203	9	6296
	94-95	4												4
PAGOSA SPRINGS	AVE	64	115	324	638	984	1330	1423	1131	1029	756	512	244	8548
	93-94	94	143	357	M	M	M	M	M	M	M	M	M	M
	94-95	M												M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	93-94	0	18	155	491	973	1020	1081	915	687	467	143	0	5950
	94-95	0												0
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	93-94 E	13	7	199	464	975	1171	1132	921	682	488	194	M	M
	94-95	3												3
STEAMBOAT SPRINGS	AVE *	113	166	396	725	1122	1525	1606	1316	1169	801	543	297	9779
	93-94	166	144	395	710	1260	1486	1427	1294	965	678	392	133	9050
	94-95	67												67
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	93-94	0	14	193	459	966	1066	1072	1056	653	464	112	3	6058
	94-95	6												6
TELLURIDE	AVE	152	204	390	679	1005	1290	1338	1126	1101	819	574	310	8986
	93-94	228	249	455	768	1210	1443	1476	1276	1049	860	627	234	9875
	94-95	175												175
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	93-94	0	27	123	472	857	968	1000	826	668	481	161	0	5583
	94-95	2												2
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	93-94	286	282	510	848	1316	1469	1418	1238	1068	814	514	239	10000
	94-95	193												193
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	93-94	0	17	110	406	791	865	877	760	623	433	170	0	5052
	94-95	1												1

* = AVES ADJUSTED 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

	Temperature						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	0.68	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

	Temperature						Degree Days			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 7ESE	78.5	35.4	57.0	1.0	85	29	241	0	451	1.10	-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	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	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	0.97	-2.57	27	10

WESTERN VALLEYS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation Tot	Dep	%Norm	#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
GUNNISON	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

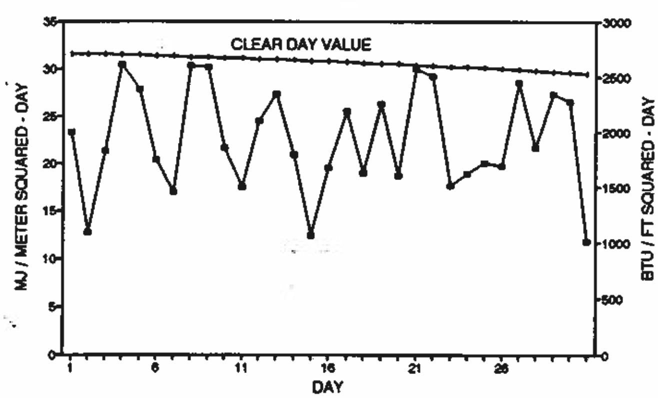
Data are received by the Colorado Climate Center for more locations than appear in these tables. Please contact the Colorado Climate Center if additional information is needed.

JULY 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	6	17	8	--	--
Denver	9	18	4	64%	71%
Fort Collins	9	13	9	--	--
Grand Junction	14	11	6	86%	78%
Limon	11	13	7	--	--
Pueblo	NA	NA	NA	90%	78%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

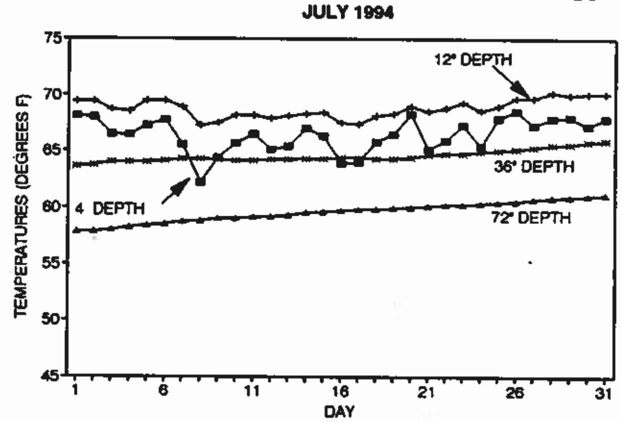
Convective clouds developed most days, as is typical for July weather. However, the clouds were not as numerous or as thick as usual, especially over western and southern Colorado. As a result, more solar radiation than usual reached much of Colorado.



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.



HATS OFF TO: *Carl Lovell of Cheyenne Wells*

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 cloud-to-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 over-grazed 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 western 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.

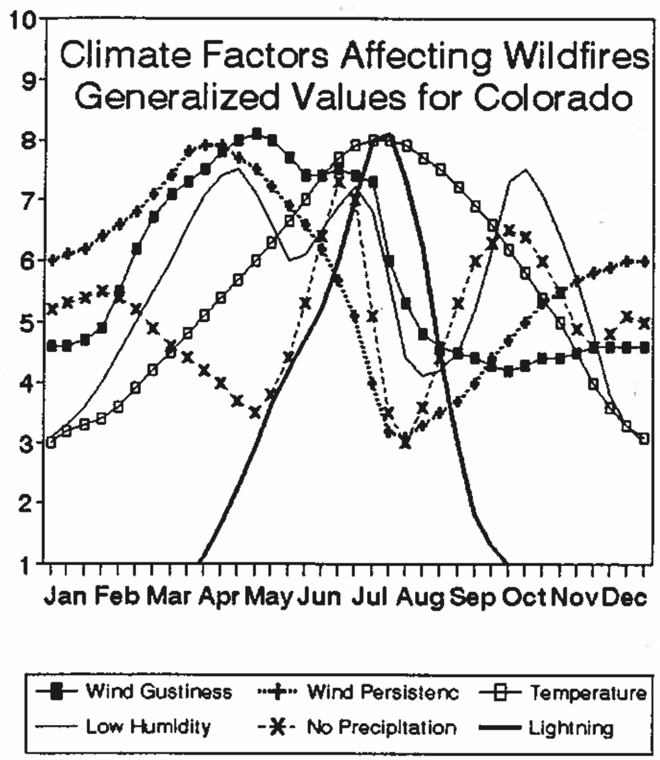
4) Whipped by the wind

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.



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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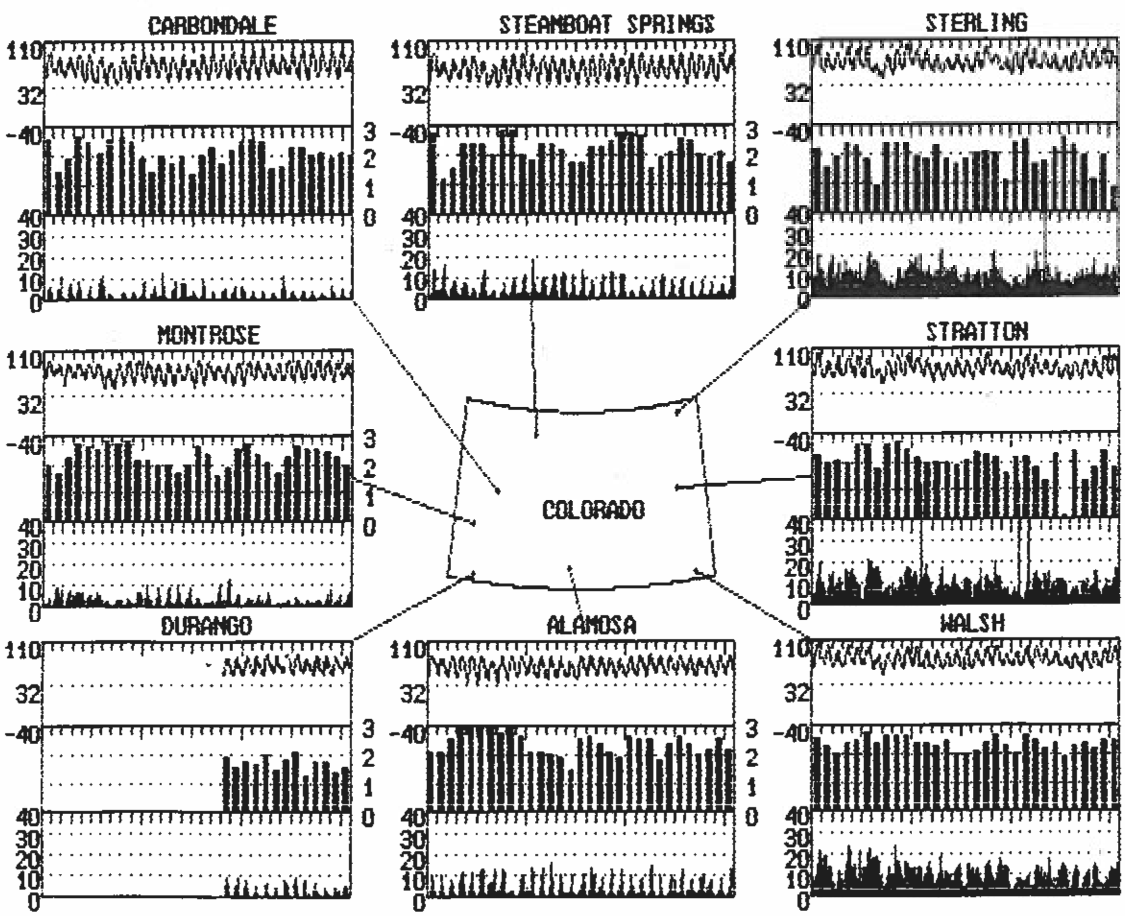
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	63.0		67.1	70.9	61.7	71.8	72.8	75.1
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	85.1 23/15	26/17	95.5 22/16	92.1 28/16	89.4 22/16	103.1 10/15	99.1 18/14	104.5 1/14
minimum:	32.0 30/ 0	30/ 0	37.8 7/ 5	41.4 7/ 5	30.7 8/ 5	46.0 8/ 5	47.8 8/ 5	46.8 8/ 5
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	86 / 42		67 / 39	57 / 41	93 / 39	64 / 48	70 / 50	83 / 56
11 AM	37 / 51		15 / 38	25 / 48	24 / 44	29 / 50	13 / 37	37 / 58
2 PM	23 / 45		14 / 39	16 / 44	18 / 40	20 / 46	13 / 40	23 / 53
5 PM	26 / 43		12 / 38	17 / 43	19 / 40	24 / 46	17 / 42	24 / 51
11 PM	51 / 43		27 / 34	37 / 43	58 / 42	47 / 48	42 / 43	61 / 56
monthly average wind direction (degrees clockwise from north)								
day	198		191	245	212	150	141	134
day	132		n/a	140	106	181	181	194
monthly average wind speed (miles per hour)								
	2.76		1.26	1.92	2.58	8.49	8.47	9.04
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	508		530	583	464	32	76	40
3 to 12	215		101	160	201	595	528	508
12 to 24	21		0	1	11	116	137	194
> 24	0		0	0	0	1	3	2
monthly average daily total insolation (Btu/ft²·day)								
	2370		2090	2275	2201	1924	2061	2333
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	146		220	211	185	177	231	253
40-60%	81		96	102	100	104	78	83
20-40%	54		93	66	57	77	44	50
0-20%	26		20	18	30	60	29	35

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.



COLORADO CLIMATE

August 1994

Volume 17 Number 11

This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

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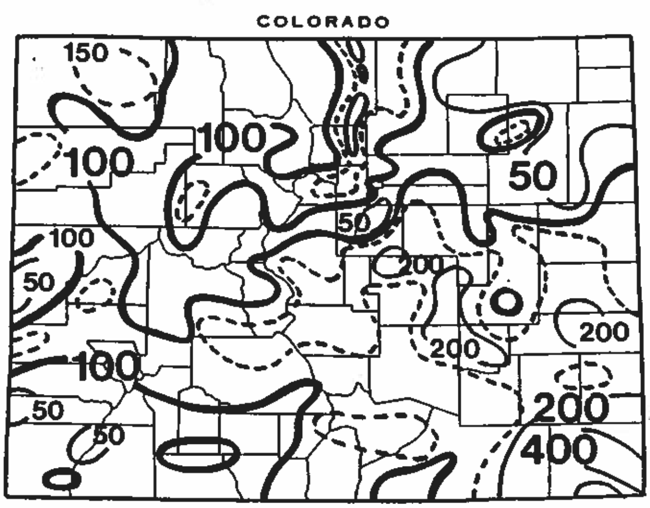
August Climate in Perspective – Wetter but Still Hot

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.

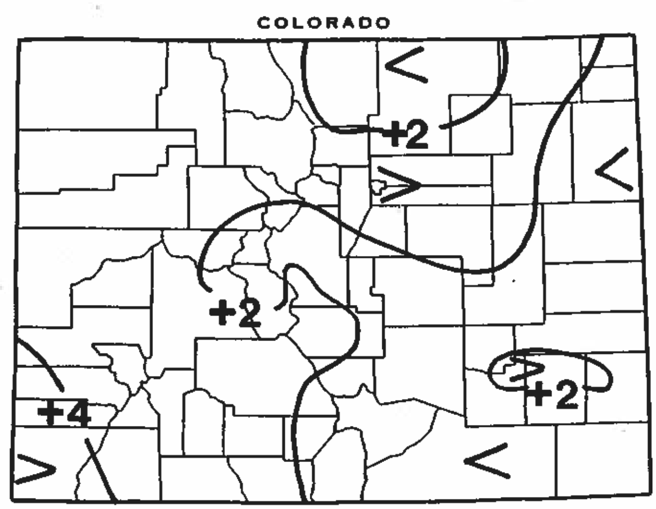


August 1994 precipitation as a percent of the 1961-1990 average.

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.

Inside This Issue

AUGUST 1994 DAILY WEATHER

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 western 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.

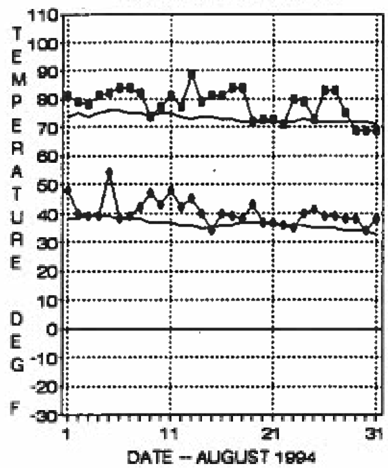
Weather Extremes

Highest Temperature	107°F	August 7	LaJunta 20S
		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	0"		No snow – A few hail accumulations
Greatest Snow Depth	0"		None reported

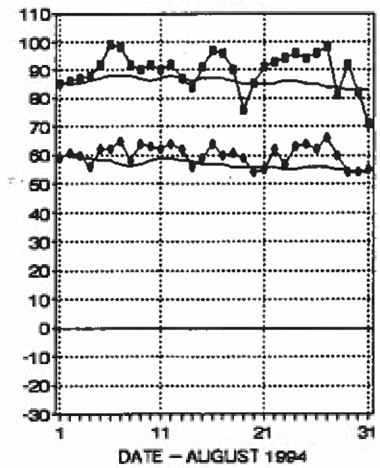
AUSGUST 1994 TEMPERATURE COMPARISON

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.)

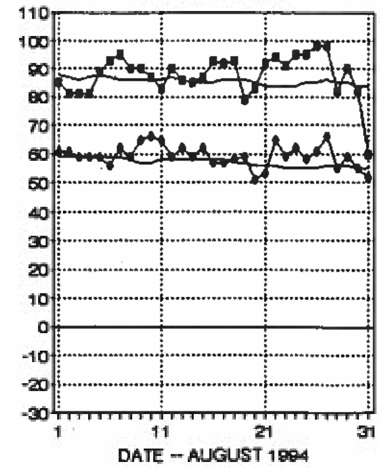
GRAND LAKE 1NW



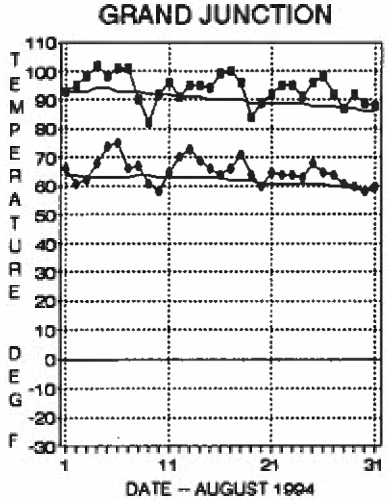
DENVER



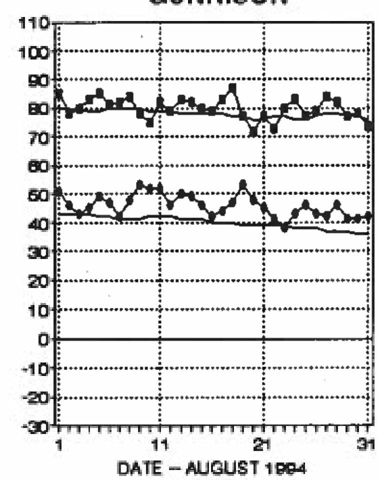
AKRON 1N



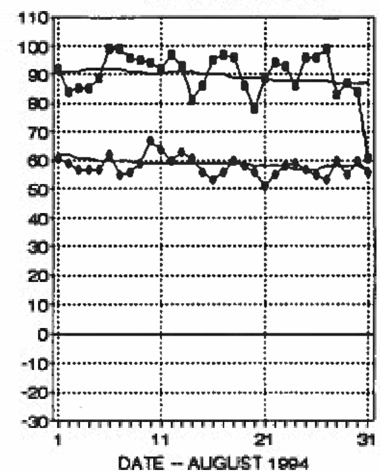
GRAND JUNCTION



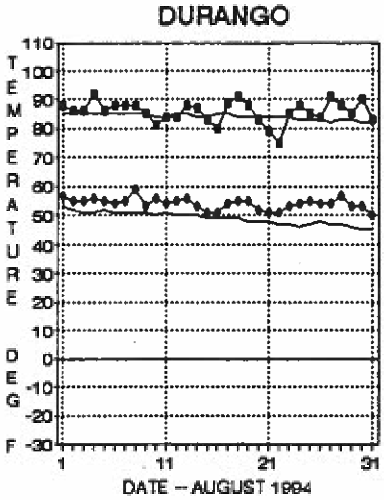
GUNNISON



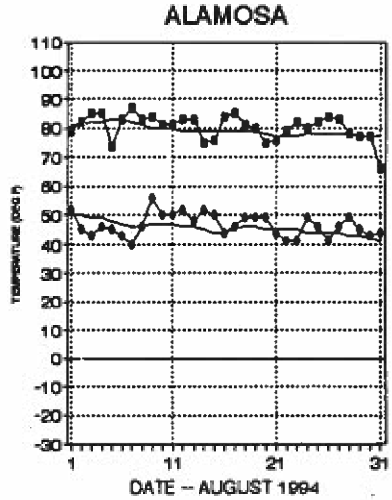
PUEBLO WSO



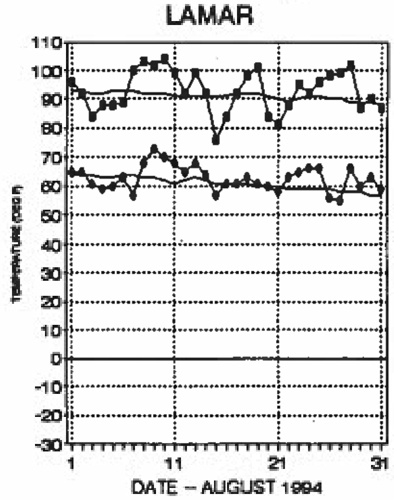
DURANGO



ALAMOSA



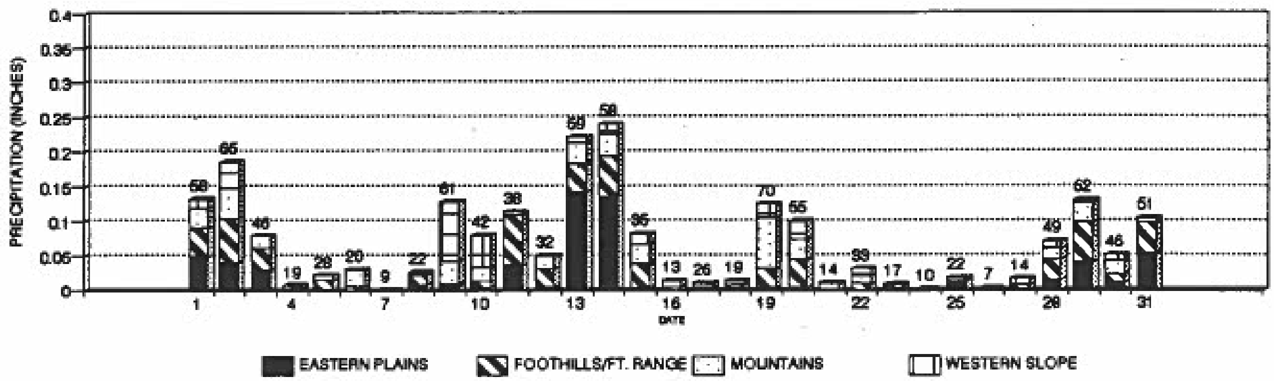
LAMAR



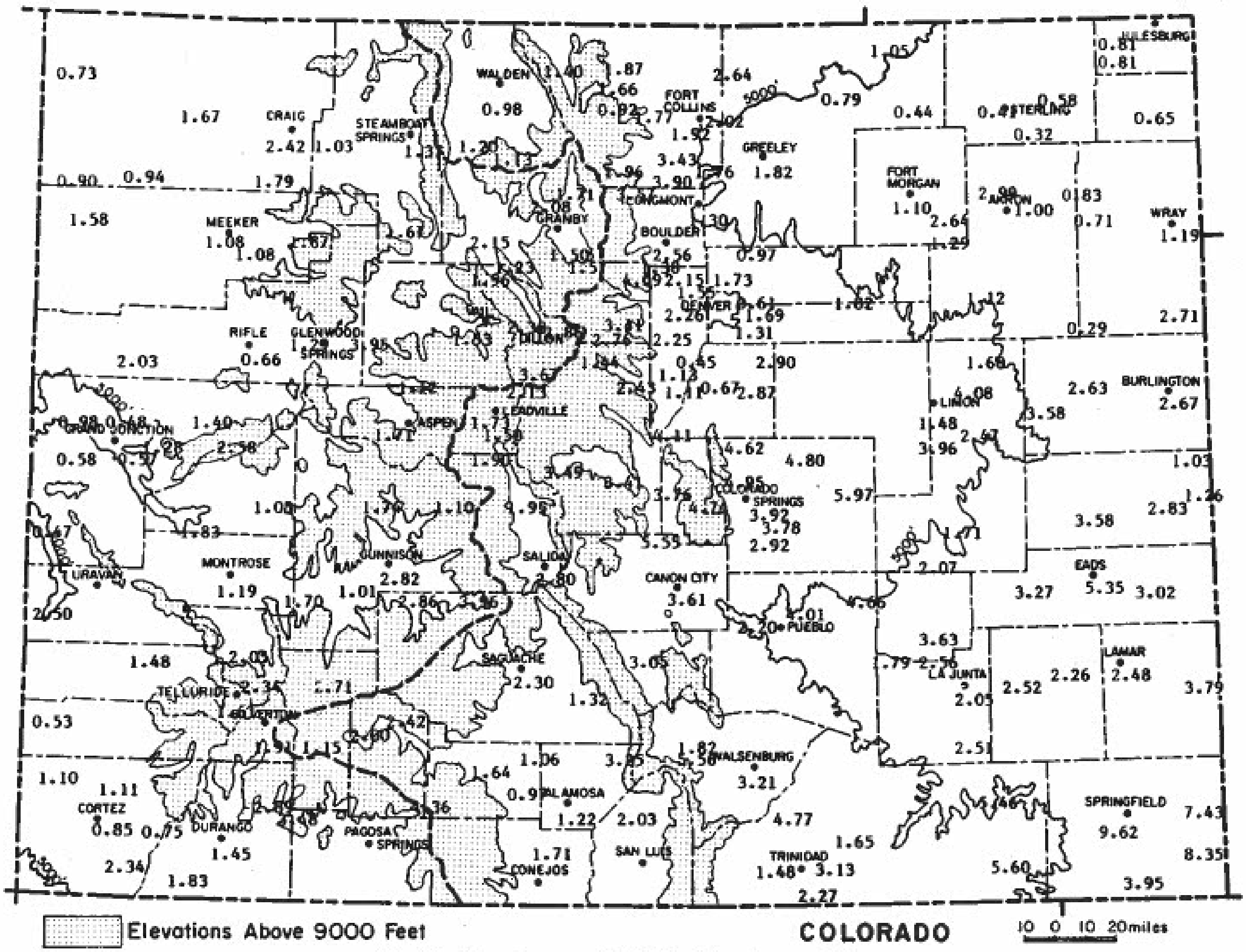
AUGUST 1994 PRECIPITATION

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

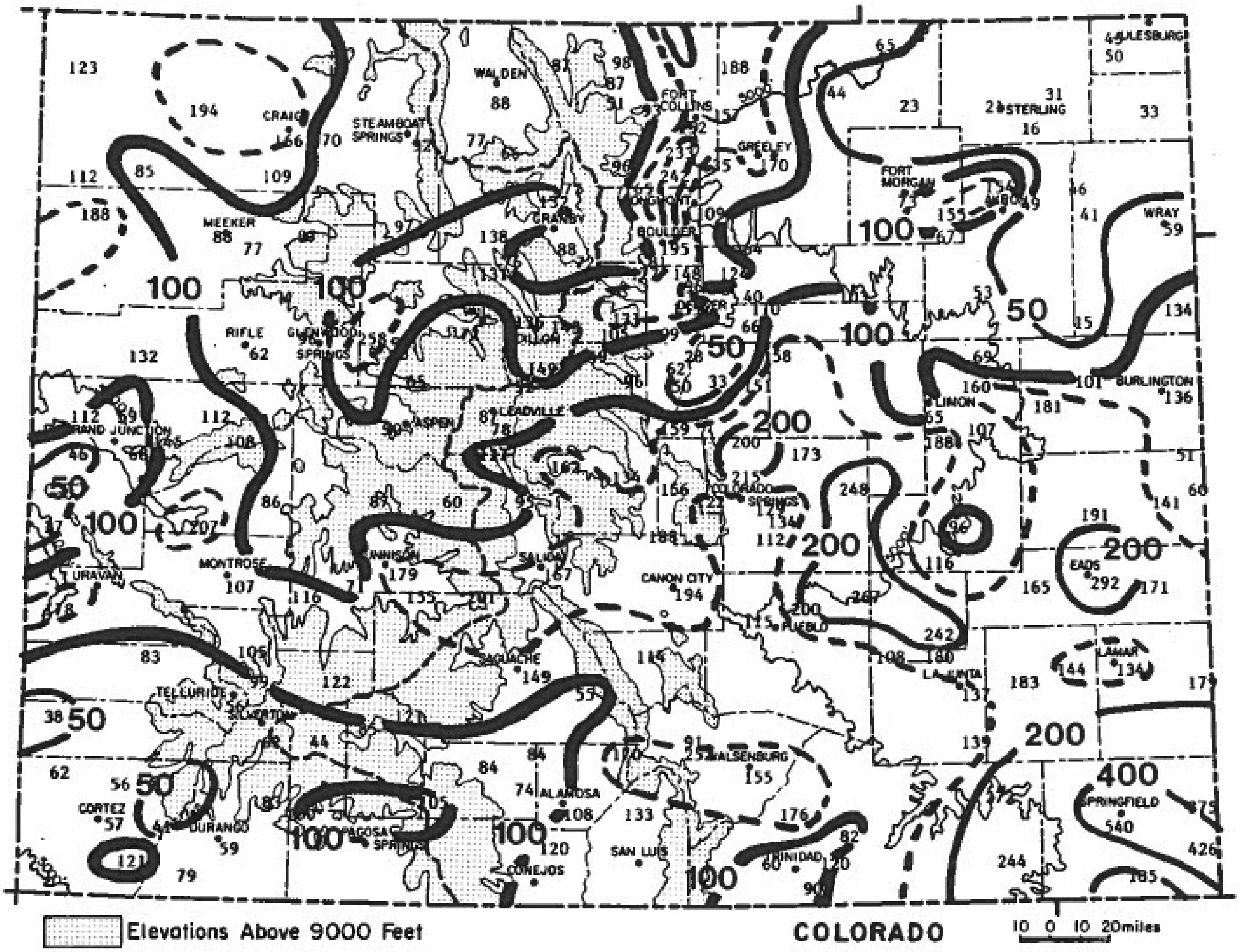


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

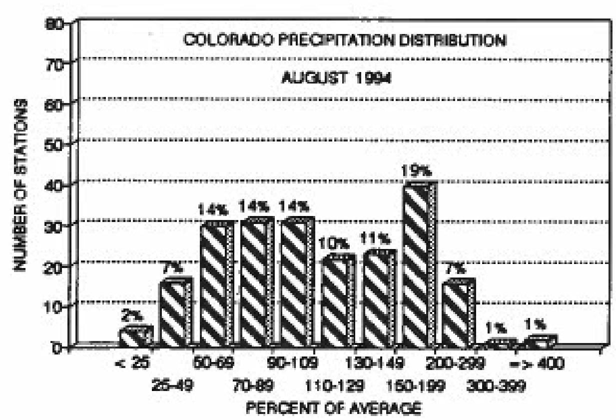


Precipitation Amounts (in inches) for August 1994.

AUGUST 1994 PRECIPITATION COMPARISON



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

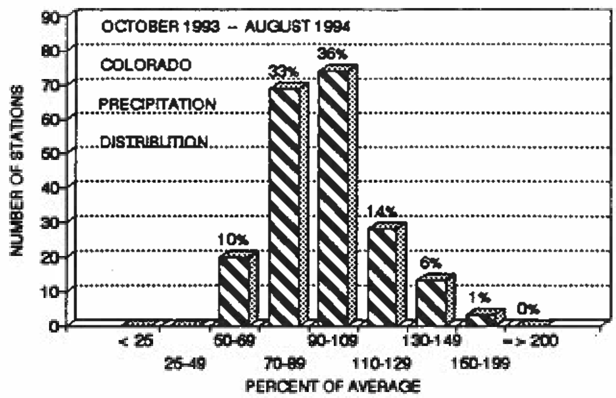


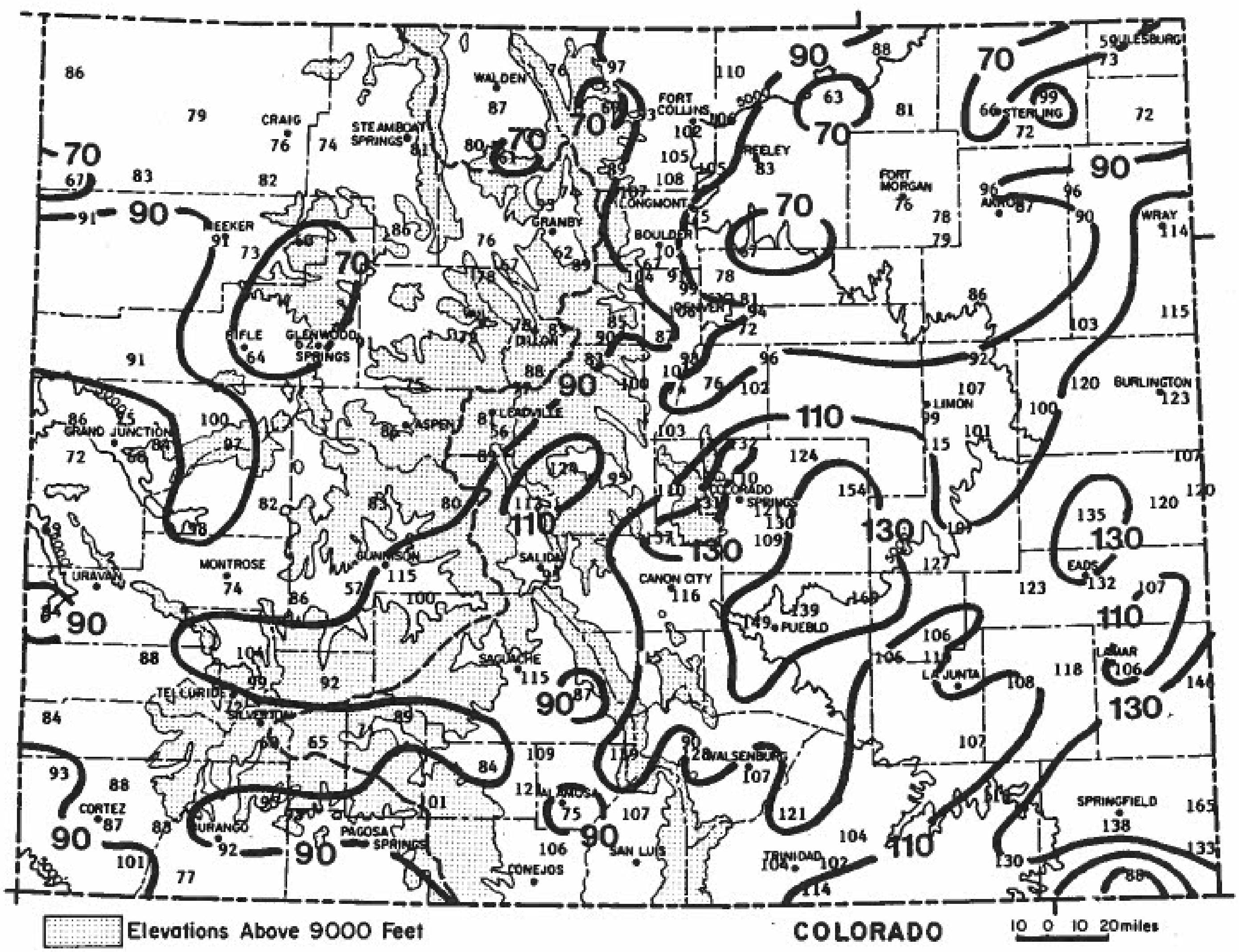
There was a broad distribution of precipitation in August with totals ranging from less than 25% of average in parts of northeastern Colorado to more than 400% of average in Baca County. Overall, the number of wetter than average stations outnumbered drier than average locations modestly.

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 Springs	1.37"	39th driest in 88 years of record (driest = 0.17" in 1944)

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

HEATING DEGREE DATA

COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	93-94	51	118	342	735	1167	1435	1412	1179	930	699	387	89	8544
	94-95	62	53											115
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	93-94	232	221	425	718	1188	1351	1290	1172	979	771	443	149	8939
	94-95	106	65											191
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	93-94	5	26	202	508	875	905	905	899	651	514	146	10	5646
	94-95	4	0											4
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	93-94	83	144	357	687	1070	1208	1172	1124	882	762	415	77	7981
	94-95	50	65											115
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	93-94	0	25	189	450	953	978	1060	1068	854	499	144	1	6021
	94-95	4	0											4
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	93-94	0	22	153	435	816	864	886	828	609	468	M	0	M
	94-95	0	0											0
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	93-94	0	40	212	519	972	1008	1032	926	749	576	223	14	6271
	94-95	10	14											24
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	93-94	10	14	165	508	926	1148	1086	1038	695	528	272	14	6404
	94-95	4	0											4
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	93-94	87	60	286	619	1168	1369	1317	1237	837	621	295	63	7959
	94-95	13	14											27
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	93-94	13	33	232	598	1052	1245	1231	1010	758	533	238	0	6943
	94-95	0	0											0
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	93-94	1	20	152	488	900	948	946	879	618	485	104	3	5544
	94-95	3	2											5
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	93-94	327	350	579	889	1291	1484	1486	1307	1152	925	630	312	10732
	94-95	265	247											512
DURANGO	AVE	6	37	203	512	846	1172	1246	952	853	594	363	127	6911
	93-94	6	43	201	522	968	1169	1094	1057	695	561	300	20	6636
	94-95	2	2											4
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	93-94	53	52	277	603	1116	M	1258	1080	779	639	330	64	M
	94-95	M	M											M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	93-94	85	140	347	695	1011	1096	1079	1029	859	710	343	89	7483
	94-95	59	48											107
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	93-94	5	22	207	533	944	1003	985	994	669	493	141	6	6002
	94-95	3	3											6
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	93-94	0	19	168	495	1006	M	M	1166	704	550	126	6	M
	94-95	9	8											17
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	93-94	4	0	59	410	875	1102	1025	853	540	360	69	0	5297
	94-95	0	0											0

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

HEATING DEGREE DATA

COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	660	381	10542
	93-94	297	274	496	813	1250	1543	1577	1404	1200	828	526	254	10462
	94-95	205	188											393
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	93-94	4	15	178	492	955	1021	1005	1059	643	473	109	3	5957
	94-95	1	3											4
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	93-94	M	M	M	M	1323	1693	1734	1527	1044	736	460	185	M
	94-95	87	74											161
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	93-94	0	12	90	389	935	925	994	882	555	400	78	0	5260
	94-95	0	3											3
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	93-94	354	390	591	915	1368	1478	1499	1321	1196	994	662	338	11106
	94-95	310	314											624
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	93-94	7	48	237	564	1064	1054	1117	1058	766	628	238	16	6797
	94-95	12	13											25
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	93-94	12	30	246	557	1005	1064	1022	1053	718	533	182	8	6430
	94-95	13	0											13
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	93-94	54	42	253	565	1077	1317	1258	1096	785	594	280	52	7373
	94-95	13	5											18
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	93-94	14	15	161	520	956	1155	1120	992	664	487	203	9	6296
	94-95	4	2											6
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
	93-94	94	143	357	M	M	M	M	M	M	M	M	M	M
	94-95	M	M											M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	93-94	0	18	155	491	973	1020	1081	915	687	467	143	0	5950
	94-95	0	6											6
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	93-94 E	13	7	199	464	975	1171	1132	921	682	488	194	M	M
	94-95	3	0											3
STEAMBOAT SPRINGS	AVE *	113	166	398	725	1122	1525	1606	1316	1169	801	543	297	9779
	93-94	166	144	395	710	1260	1486	1427	1294	965	678	392	133	9050
	94-95	67	49											116
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	93-94	0	14	193	459	966	1068	1072	1056	653	464	112	3	6058
	94-95	6	0											6
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	93-94	228	249	455	768	1210	1443	1476	1276	1049	860	627	234	9875
	94-95	175	161											336
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	93-94	0	27	123	472	857	968	1000	826	668	481	161	0	5583
	94-95	2	4											6
WALDEN	AVE	189	273	498	825	1161	1457	1528	1296	1237	909	657	348	10378
	93-94	266	282	510	848	1316	1469	1416	1238	1068	814	514	239	10000
	94-95	193	160											353
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	93-94	0	17	110	406	791	865	877	760	623	433	170	0	5052
	94-95	1	1											2

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

AUGUST 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	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

	Temperature						Degree Days			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	2.13	-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	1.91	-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

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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	1.10	-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.

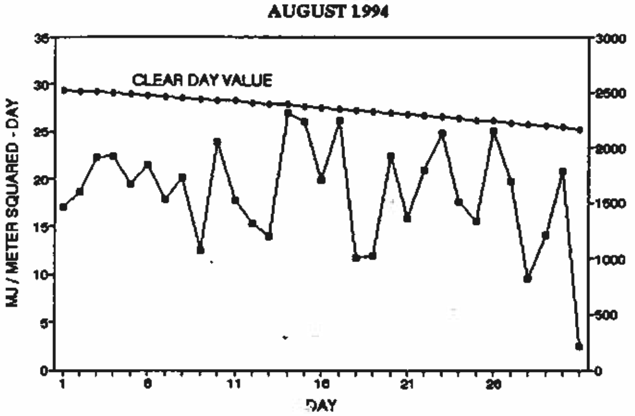
AUGUST 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of 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

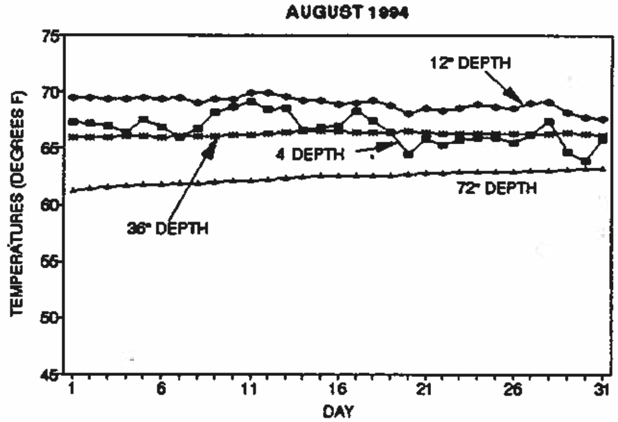


AUGUST 1994 SOIL TEMPERATURES

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.

FORT COLLINS 7 AM SOIL TEMPERATURES
AUGUST 1994



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.

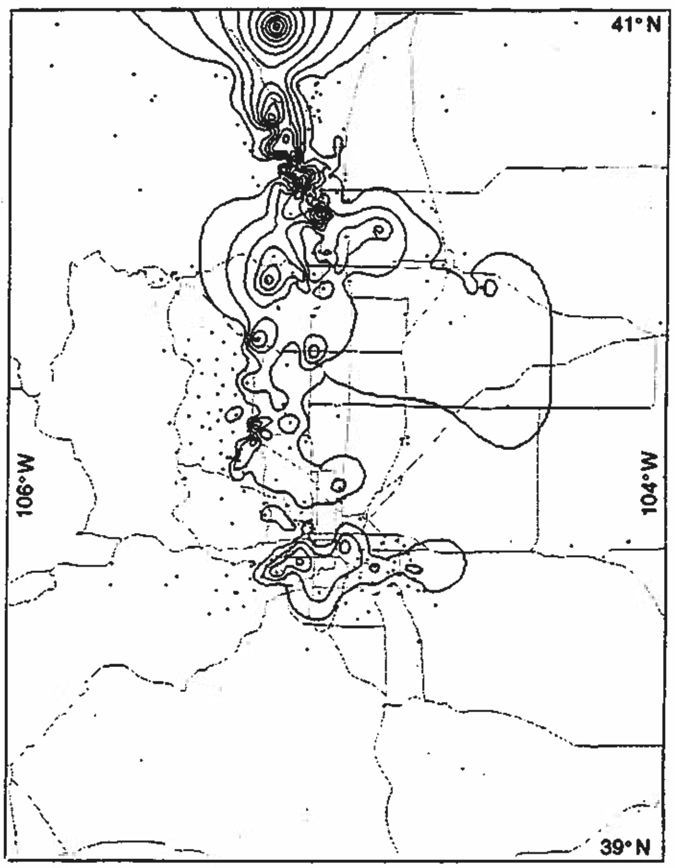
Our little data search turned up some amazing results. What amazed me the most is how much information we could obtain without ever leaving our office. Pete used **Internet** to let our students and faculty know about our data search. I called Jim Wirshborn of Mountain States Weather Services to get 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.

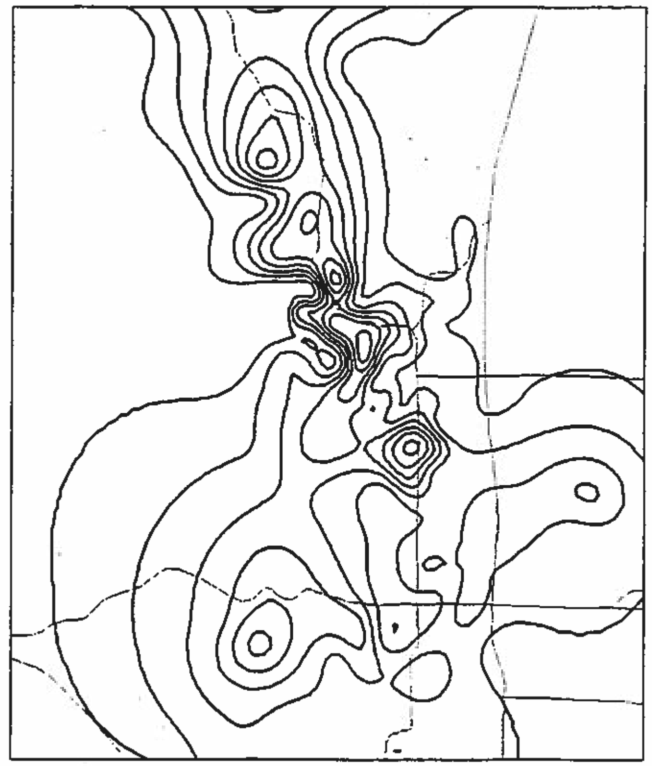
than 5" of rain was reported. As this storm intensified, very moist easterly winds with dewpoints rising into the low 60s created "upslope" conditions along much of the Front Range. Outflow from the Virginia Dale storm enhanced the vertical motions, and storms erupted almost spontaneously throughout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

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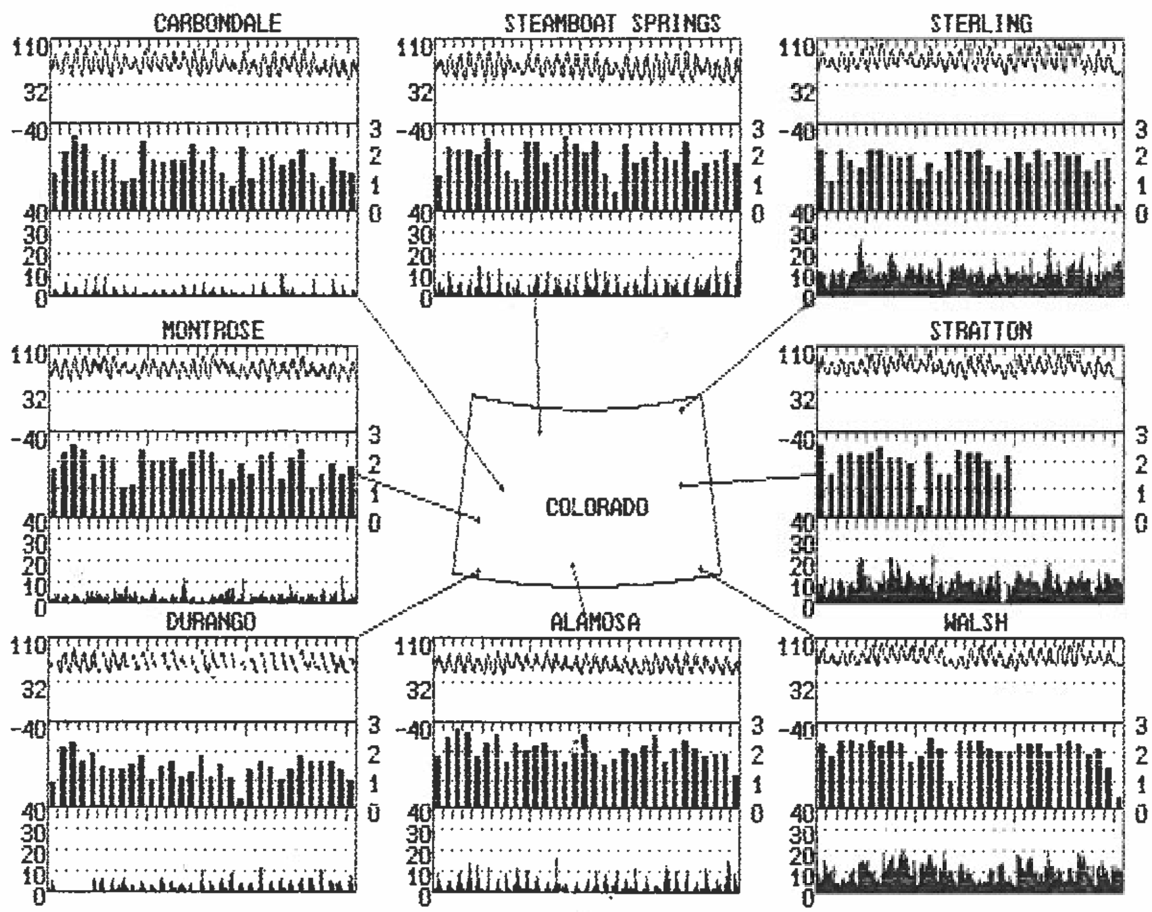
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	62.7	64.9	65.7	68.8	61.4	73.5	73.5	75.0
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	86.5 7/15	88.7 3/16	96.1 4/15	92.7 17/17	89.2 7/14	100.4 25/14	100.0 27/14	99.9 7/14
minimum:	42.4 7/ 4	47.1 29/ 6	41.2 31/ 5	48.0 30/ 6	34.7 23/ 6	32.0 30/ 0	32.0 30/ 0	55.4 21/ 3
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	92 / 47	80 / 47	88 / 47	80 / 50	94 / 43	59 / 47	64 / 50	82 / 59
11 AM	47 / 55	n/a /n/a	46 / 58	44 / 57	34 / 48	21 / 44	24 / 45	45 / 61
2 PM	31 / 50	33 / 52	39 / 57	31 / 52	26 / 45	15 / 42	19 / 45	34 / 58
5 PM	37 / 48	38 / 51	41 / 56	34 / 52	26 / 44	16 / 41	18 / 43	34 / 57
11 PM	71 / 50	71 / 50	68 / 51	58 / 51	71 / 46	36 / 43	46 / 47	67 / 59
monthly average wind direction (degrees clockwise from north)								
day	166	167	190	212	150	165	135	137
day	148	85	n/a	144	86	184	183	206
monthly average wind speed (miles per hour)								
	2.16	1.59	0.78	1.68	2.44	8.82	8.55	8.52
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	562	504	547	619	453	56	75	68
3 to 12	168	141	47	122	193	549	541	513
12 to 24	6	0	0	3	10	138	128	163
> 24	0	0	0	0	0	1	0	0
monthly average daily total insolation (Btu/ft²·day)								
	2048	1414	1646	1865	1891	1710	1470	2057
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	135	106	157	177	189	180	152	247
40-60%	74	98	100	89	79	102	59	85
20-40%	72	81	95	84	65	54	30	45
0-20%	37	96	57	39	41	69	17	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/ft²/day, and the bottom graph illustrates the hourly average wind speed between 0 and 40 miles per hour.



COLORADO CLIMATE

SEPTEMBER 1994

Volume 17 Number 12

Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

This report has been prepared each month since February 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

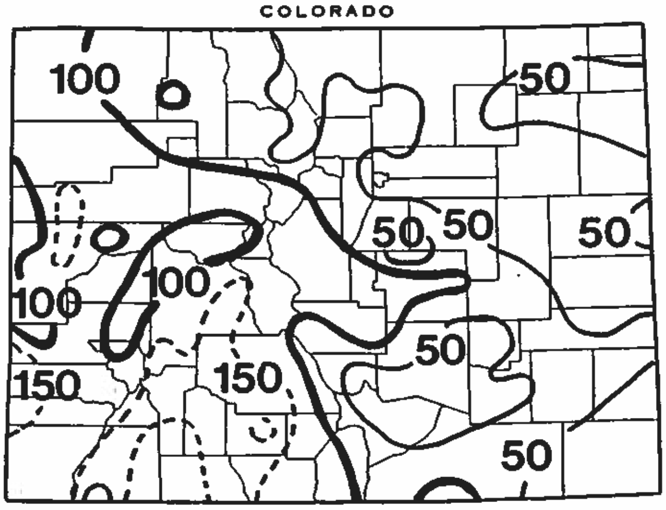
September Climate in Perspective – Varied Moisture But Still Warm

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

COLORADO



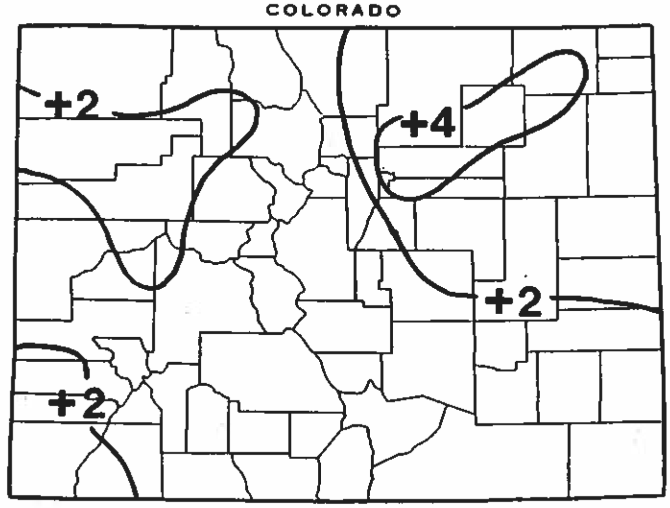
September 1994 precipitation as a percent of the 1961-1990 ave.

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.

COLORADO



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

Inside This Issue

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.

6-10 Summerlike temperatures continued with partly cloudy 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.

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.

18-20 Clouds and humidity increased on the 18th from the 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.

21-22 An early blast of winter plummeted southward from 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 day-night 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.

29-30 Clouds increased on the 29th and temperatures cooled 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.

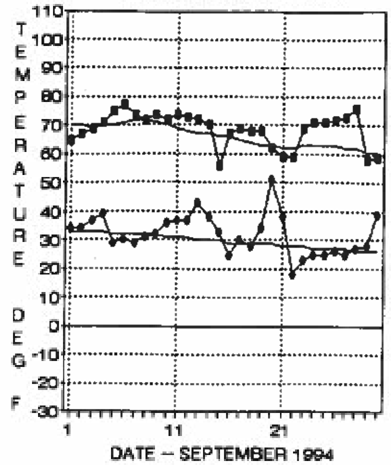
Weather Extremes

Highest Temperature	98°F	September 10	Sterling, Leroy 5WSW
		September 29	Holly, Campo 7S
Lowest Temperature	6°F	September 22	Spicer
Greatest Total Precipitation	8.00"		Wolf Creek Pass 1E
Least Total Precipitation	Trace		Kit Carson 6S, Shaw
Greatest Total Snowfall	5"		Rocky Flats
Greatest Snow Depth	2"		Cherry Creek Reservoir, Coal Creek Canyon, Gross Reservoir, Inter Canyon, Ralston Reservoir

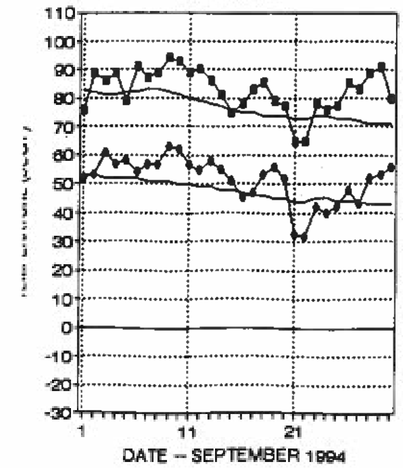
SEPTEMBER 1994 TEMPERATURE COMPARISON

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.)

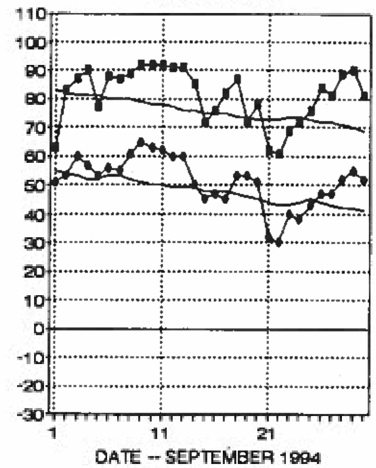
GRAND LAKE 1NW



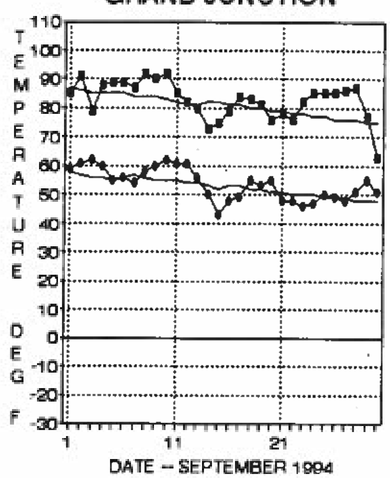
DENVER



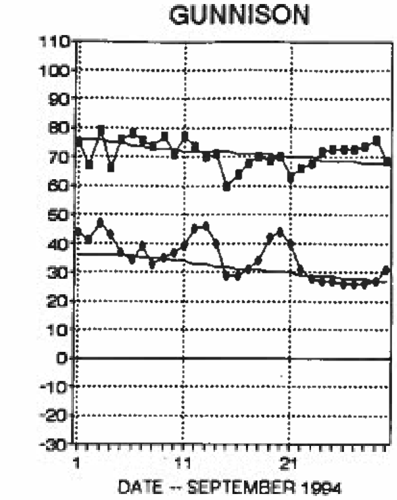
AKRON 1N



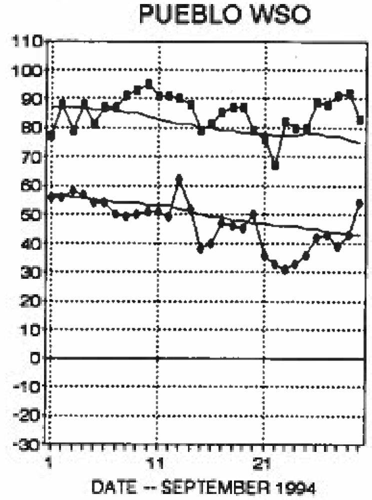
GRAND JUNCTION



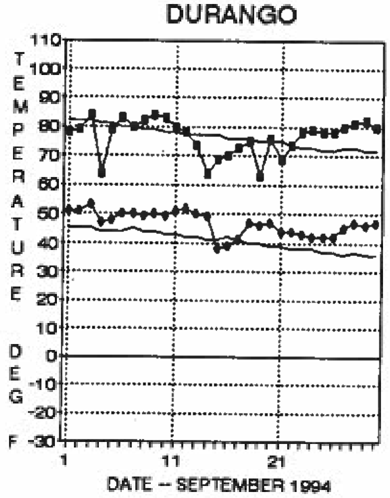
GUNNISON



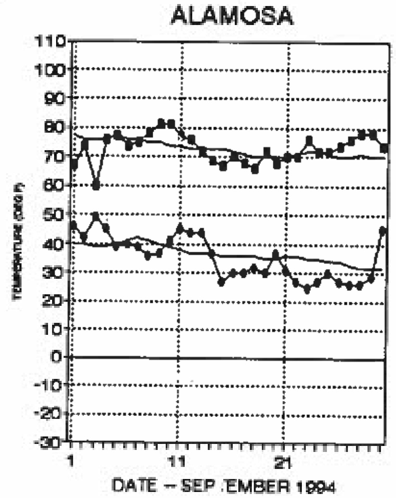
PUEBLO WSO



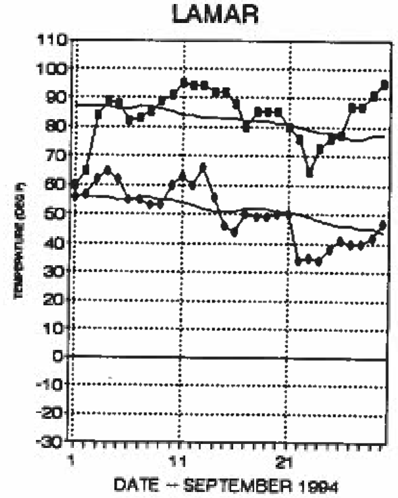
DURANGO



ALAMOSA



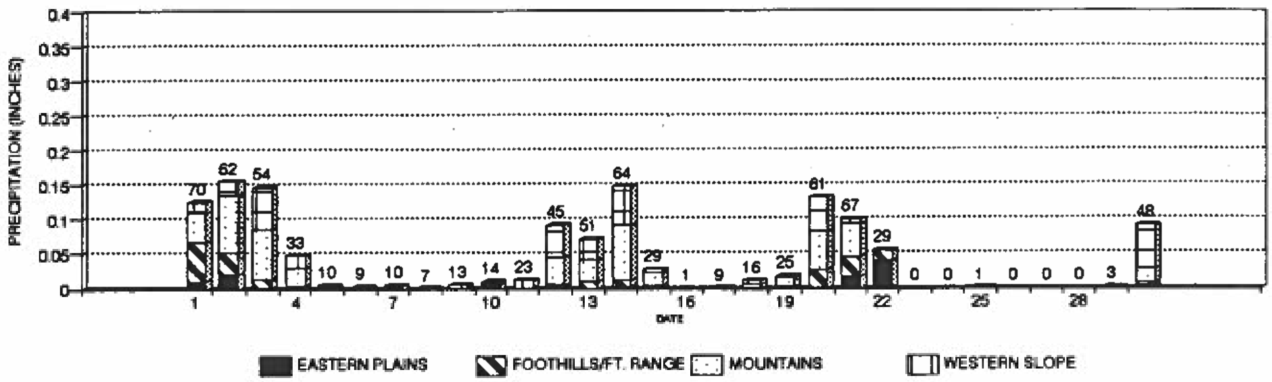
LAMAR



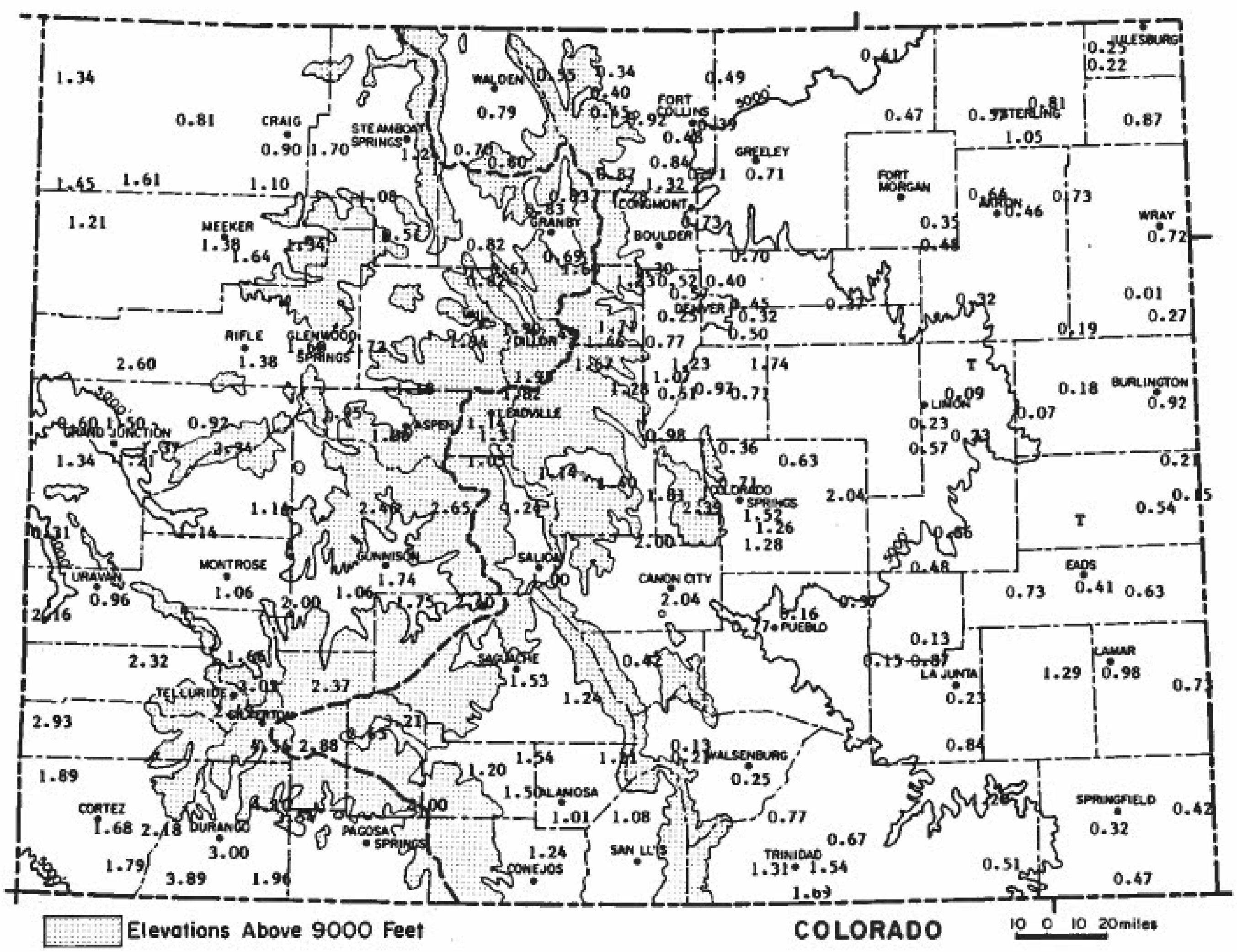
SEPTEMBER 1994 PRECIPITATION

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

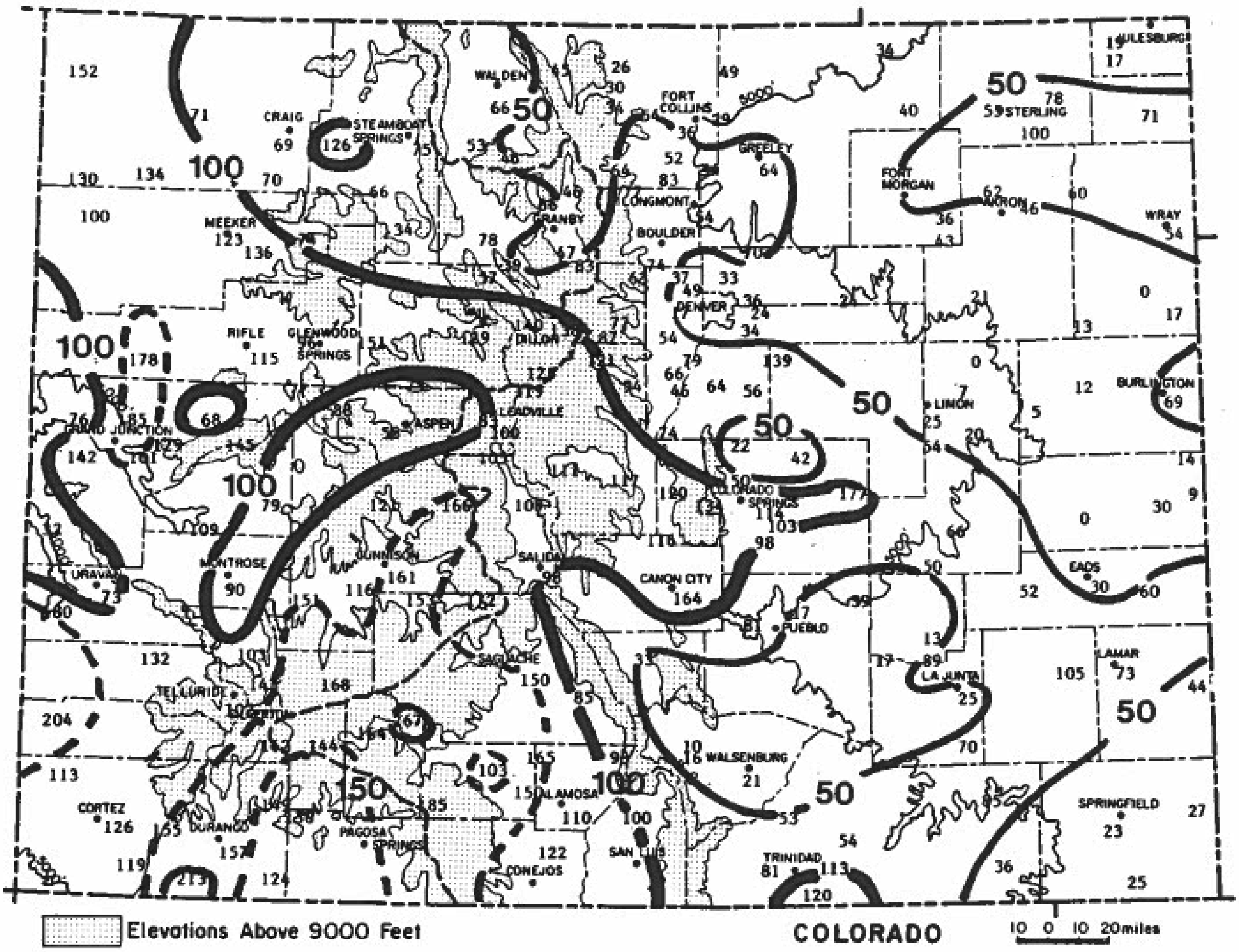


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

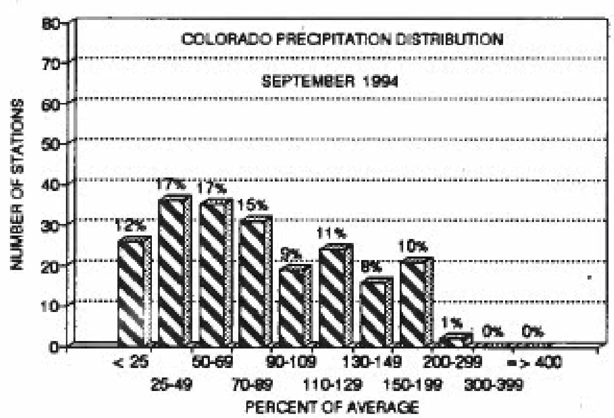


Precipitation Amounts (in inches) for September 1994.

SEPTEMBER 1994 PRECIPITATION COMPARISON



September 1994 Precipitation as a Percent of the 1961–90 average.



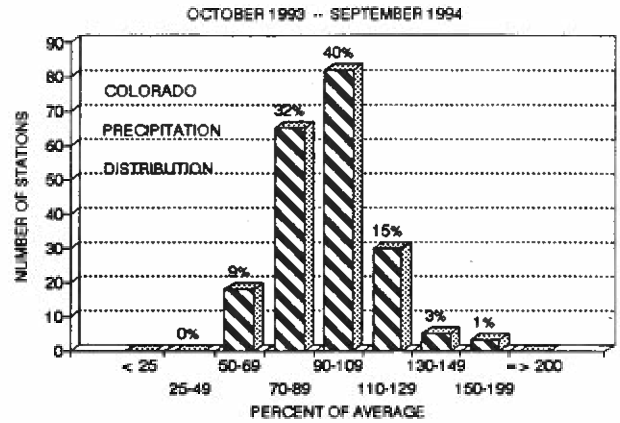
September precipitation totals ranged from less than 25% of average at many weather stations in eastern Colorado to more than 150% of average over portions of southwestern Colorado. Overall, drier than average locations outnumbered wetter than average areas.

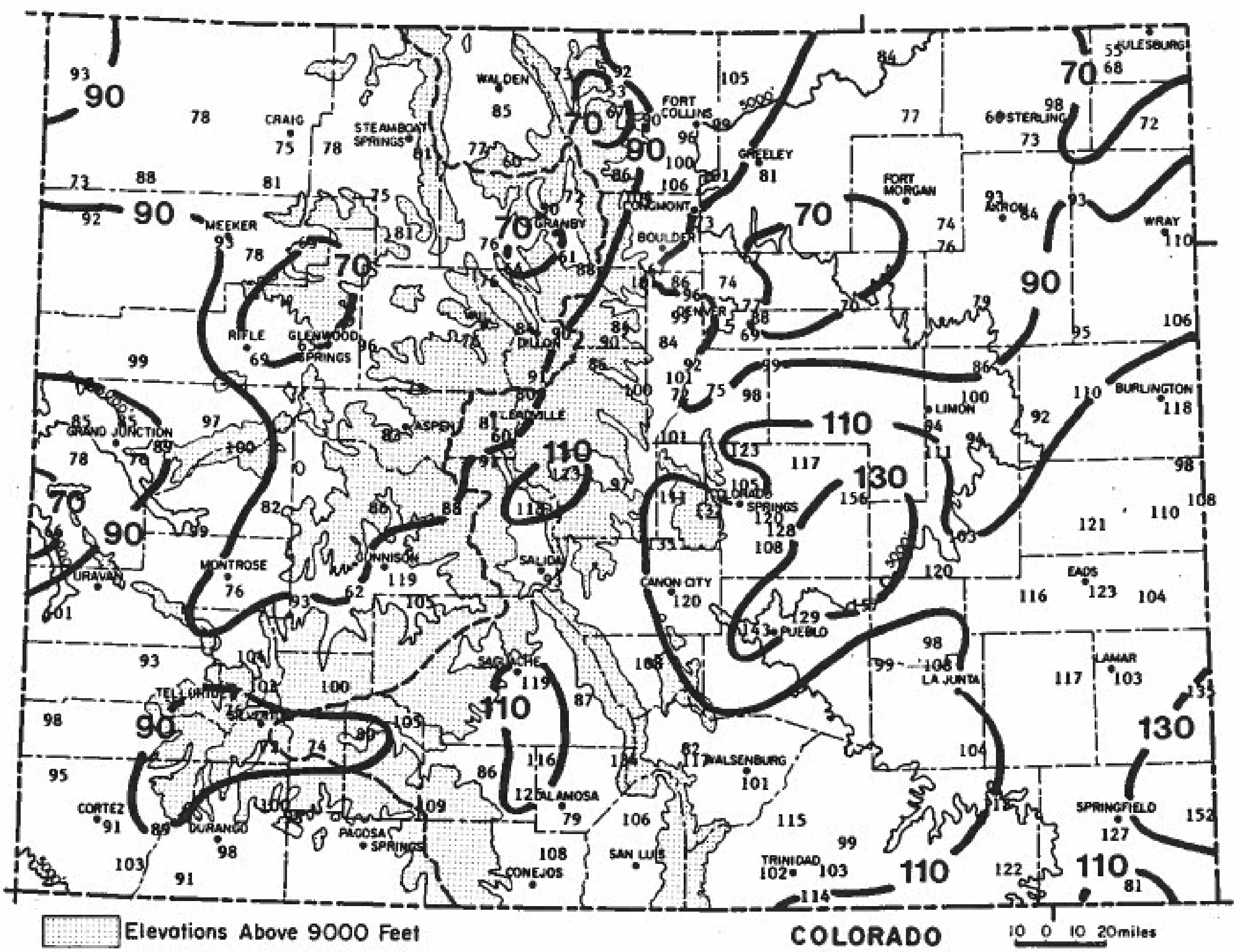
SEPTEMBER 1994 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

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 Year in Colorado. September brought continued 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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	42	98	306	667	1053	1473	1559	1193	1014	717	453	174	8749
	93-94	51	118	342	735	1167	1435	1412	1179	930	699	387	89	8544
	94-95	62	53	319										434
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	93-94	232	221	425	718	1188	1351	1290	1172	979	771	443	149	8939
	94-95	106	85	335										526
BOULDER	AVE	0	7	136	387	726	973	1004	815	744	474	235	53	5554
	93-94	5	26	202	508	875	905	905	899	651	514	146	10	5646
	94-95	4	0	77										81
BUENA VISTA	AVE	50	111	318	620	960	1243	1259	1047	992	729	477	197	8003
	93-94	83	144	357	687	1070	1208	1172	1124	882	762	415	77	7981
	94-95	50	65	286										401
BURLINGTON	AVE	0	9	138	432	822	1132	1175	946	859	519	254	34	6320
	93-94	0	25	189	450	953	978	1060	1068	654	499	144	1	6021
	94-95	4	0	80										84
CANON CITY	AVE *	0	11	91	325	645	896	933	756	688	408	193	41	4987
	93-94	0	22	153	435	816	864	886	828	609	468	M	0	M
	94-95	0	0	42										42
COLORADO SPRINGS	AVE	6	18	164	468	816	1091	1122	924	859	558	302	87	6415
	93-94	0	40	212	519	972	1008	1032	926	749	576	223	14	6271
	94-95	10	14	98										122
CORTEZ	AVE *	0	11	146	474	828	1163	1237	958	853	594	322	81	6667
	93-94	10	14	165	508	926	1148	1086	1038	695	528	272	14	6404
	94-95	4	0	111										115
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	93-94	87	60	286	619	1168	1369	1317	1237	837	621	295	63	7959
	94-95	13	14	196										223
DELTA	AVE	0	10	125	403	774	1128	1221	888	719	435	186	38	5927
	93-94	13	33	232	598	1052	1245	1231	1010	758	533	238	0	6943
	94-95	0	0	67										67
DENVER	AVE	0	0	144	429	780	1054	1094	885	806	504	253	71	6020
	93-94	1	20	152	488	900	948	946	879	618	485	104	3	5544
	94-95	3	2	57										62
DILLON	AVE	282	341	555	856	1203	1504	1587	1355	1321	1008	747	459	11218
	93-94	327	350	579	889	1291	1484	1466	1307	1152	925	630	312	10732
	94-95	265	247	505										1017
DURANGO	AVE	6	37	203	512	848	1172	1246	952	853	594	363	127	6911
	93-94	6	43	201	522	968	1169	1094	1057	695	561	300	20	6636
	94-95	2	2	104										108
EAGLE	AVE	25	72	275	617	981	1376	1435	1106	958	675	422	164	8106
	93-94	53	52	277	603	1116	M	1258	1080	779	639	330	64	M
	94-95	M	M	M										M
EVERGREEN	AVE	78	122	349	651	945	1194	1218	1039	1011	741	512	234	8094
	93-94	85	140	347	695	1011	1096	1079	1029	859	710	343	89	7483
	94-95	59	48	286										393
FORT COLLINS	AVE	0	12	176	471	825	1113	1156	913	828	525	272	77	6368
	93-94	5	22	207	533	944	1003	985	994	669	493	141	6	6002
	94-95	3	3	89										95
FORT MORGAN	AVE	0	8	144	445	840	1197	1277	963	831	492	222	41	6460
	93-94	0	19	168	495	1006	M	M	1166	704	550	126	6	M
	94-95	9	8	M										17
GRAND JUNCTION	AVE	0	0	55	332	738	1125	1240	854	670	389	132	13	5548
	93-94	4	0	59	410	875	1102	1025	853	540	360	69	0	5297
	94-95	0	0	24										24

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

HEATING DEGREE DATA — COLORADO CLIMATE CENTER (303) 491-8545

STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
GRAND LAKE	AVE	214	260	468	781	1113	1476	1600	1361	1283	945	660	381	10542
	93-94	297	274	496	813	1250	1543	1577	1404	1200	828	526	254	10462
	94-95	205	188	423										816
GREELEY	AVE	0	7	158	446	831	1153	1206	924	806	492	231	52	6306
	93-94	4	15	178	492	955	1021	1005	1059	643	473	109	3	5957
	94-95	1	3	68										72
GUNNISON	AVE	130	204	435	763	1143	1609	1786	1456	1237	867	580	306	10516
	93-94	M	M	M	M	1323	1693	1734	1527	1044	736	460	185	M
	94-95	87	74	343										504
LAS ANIMAS	AVE	0	0	69	338	750	1088	1141	862	707	370	121	9	5455
	93-94	0	12	90	389	935	925	994	882	555	400	78	0	5260
	94-95	0	3	M										M
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	93-94	354	390	591	915	1368	1478	1499	1321	1198	994	662	338	11106
	94-95	310	314	539										1163
LIMON	AVE	6	21	189	521	879	1169	1218	991	924	603	344	96	6961
	93-94	7	48	237	564	1064	1054	1117	1058	766	628	238	16	6797
	94-95	12	13	124										149
LONGMONT	AVE	0	10	171	468	834	1141	1190	941	840	525	253	70	6443
	93-94	12	30	246	557	1005	1064	1022	1053	718	533	182	8	6430
	94-95	13	0	62										75
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	93-94	54	42	253	565	1077	1317	1258	1096	785	[illegible]	280	52	[illegible]
	94-95	13	5	170										[illegible]
MONTROSE	AVE	0	11	143	453	819	1159	1246	935	791	510	248	68	6383
	93-94	14	15	161	520	956	1155	1120	992	664	487	203	9	6296
	94-95	4	2	113										119
PAGOSA SPRINGS	AVE	64	115	324	636	984	1330	1423	1131	1029	756	512	244	8548
	93-94	94	143	357	M	M	M	M	M	M	M	M	M	M
	94-95	M	M	M										M
PUEBLO	AVE	0	0	62	357	735	1051	1091	837	722	396	152	10	5413
	93-94	0	18	155	491	973	1020	1081	915	687	467	143	0	5950
	94-95	0	6	57										63
RIFLE	AVE	0	23	184	502	858	1237	1330	980	825	549	298	95	6881
	93-94 E	13	7	199	464	975	1171	1132	921	682	488	194	M	M
	94-95	3	0	105										108
STEAMBOAT SPRINGS	AVE *	113	166	396	725	1122	1525	1606	1316	1169	801	543	297	9779
	93-94	166	144	395	710	1260	1486	1427	1294	965	678	392	133	9050
	94-95	67	49	289										405
STERLING	AVE	0	9	149	462	852	1200	1265	963	843	504	238	56	6541
	93-94	0	14	193	459	966	1066	1072	1056	653	464	112	3	6058
	94-95	6	0	78										84
TELLURIDE	AVE	152	204	390	679	1005	1290	1336	1126	1101	819	574	310	8986
	93-94	228	249	455	768	1210	1443	1476	1276	1049	860	627	234	9875
	94-95	175	161	395										731
TRINIDAD	AVE	0	7	87	364	690	955	995	815	722	444	218	42	5339
	93-94	0	27	123	472	857	968	1000	826	668	481	161	0	5583
	94-95	2	4	66										72
WALDEN	AVE	189	273	498	825	1161	1457	1528	1298	1237	909	657	348	10378
	93-94	286	282	510	848	1316	1469	1416	1238	1068	814	514	239	10000
	94-95	193	160	442										795
WALSENBURG	AVE	0	8	105	371	693	955	992	820	744	477	229	44	5438
	93-94	0	17	110	406	791	865	877	760	623	433	170	0	5052
	94-95	1	1	62										64

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

SEPTEMBER 1994 CLIMATE DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Station	Max	Min	Ave	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

	Temperature						Degree Days			Precipitation			
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	0	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

	Temperature						Degree Days			Precipitation			
Station	Max	Min	Ave	Dep	Highest	Lowest	Heat	Cool	Grow	Tot	Dep	%Norm	#days
WALDEN	69.7	30.3	50.0	1.4	79	11	442	0	306	0.79	-0.40	66	7
LEADVILLE 2SW	62.9	30.8	46.9	0.5	71	24	539	0	202	1.31	0.01	101	10
SALIDA	76.0	38.5	57.2	0.6	83	28	227	2	400	1.00	-0.02	98	8
BUENA VISTA	72.5	38.0	55.2	0.1	80	27	286	0	347	1.24	0.11	110	9
SAGUACHE	71.1	39.4	55.2	1.0	79	31	286	0	323	1.53	0.51	150	10
HERMIT 7ESE	67.4	32.1	49.8	2.1	77	22	449	0	270	2.65	1.04	165	4
ALAMOSA WSO AP	72.9	35.4	54.2	-0.5	81	25	319	0	348	1.01	0.10	111	6
STEAMBOAT SPRINGS	75.8	34.5	55.1	2.9	86	20	289	0	393	1.24	-0.41	75	8
YAMPA	69.5	38.5	54.0	2.2	78	20	324	0	300	0.51	-0.95	35	6
GRAND LAKE 1NW	69.3	32.0	50.7	2.6	77	18	423	0	299	0.83	-0.95	47	12
GRAND LAKE 6SSW	68.1	33.1	50.6	1.2	74	20	423	0	281	0.83	-0.41	67	12
DILLON 1E	64.7	31.3	48.0	0.2	72	21	505	0	227	1.90	0.55	141	12
CLIMAX	55.3	26.9	41.1	-2.2	63	10	710	0	91	1.82	0.30	120	10
ASPEN 1SW	69.4	37.8	53.6	0.6	77	29	335	0	300	1.01	-0.79	56	9
CRESTED BUTTE	66.3	31.7	49.0	0.7	74	22	470	0	253	2.46	0.43	121	11
TAYLOR PARK	61.6	32.0	46.8	-0.2	70	23	537	0	182	2.65	1.06	167	10
TELLURIDE	67.9	35.3	51.6	-0.4	77	26	395	0	277	2.49	0.07	103	11
SILVERTON	64.0	32.6	48.3	1.1	74	25	491	0	219	4.54	1.75	163	12
WOLF CREEK PASS 1E	56.5	33.9	45.2	0.1	63	25	587	0	113	8.00	3.68	185	14

WESTERN VALLEYS

Station	Temperature Max	Min	Ave	Dep	Highest	Lowest	Degree Days Heat	Cool	Grow	Precipitation 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.

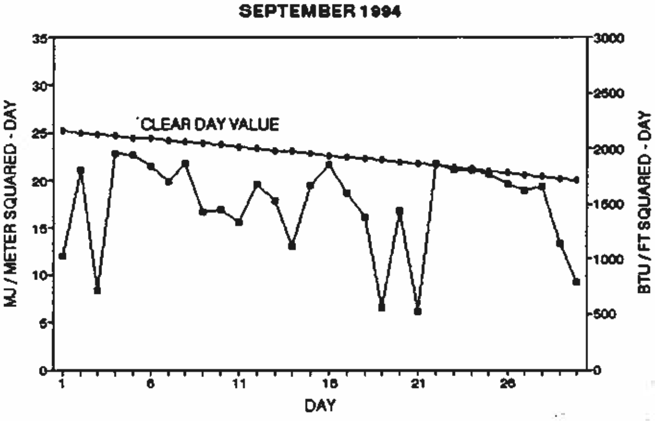
SEPTEMBER 1994 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	8	13	9	--	--
Denver	12	13	5	72%	74%
Fort Collins	12	8	10	--	--
Grand Junction	13	11	6	77%	79%
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

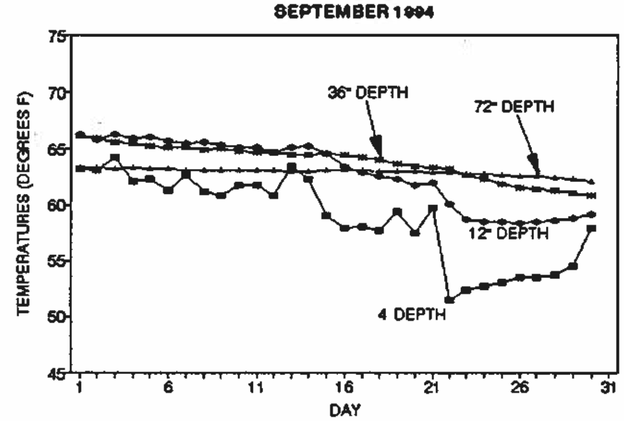


SEPTEMBER 1994 SOIL TEMPERATURES

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.

A REVIEW OF THE 1994 WATER YEAR

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
OCT	Statewide Storm	Cold and Snowy
NOV	Record Cold Thanksgiving	
DEC	Mild and Sunny Christmas	Windy -- Little Snow
JAN	Beneficial Snow at Last	Mild for Midwinter
FEB	Brief Coldwave East	Good Mountain Snow
MAR	Big Snowstorm Southeast	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

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.

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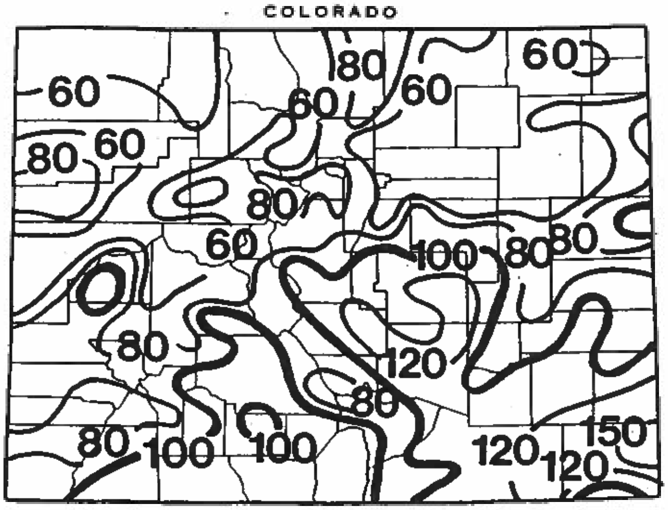
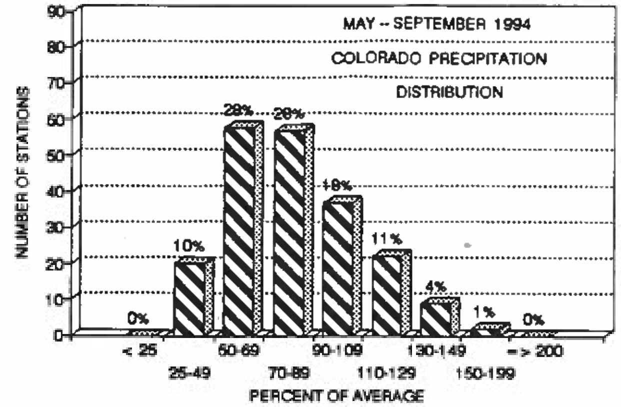
On the bright side, there were not as many hailstorms or tornadoes as in some recent summers. Still there were combined losses totalling millions of dollars to crops and property from several of the hailstorms. Also, Colorado's water supplies stored in reservoirs were above average before this summer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



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

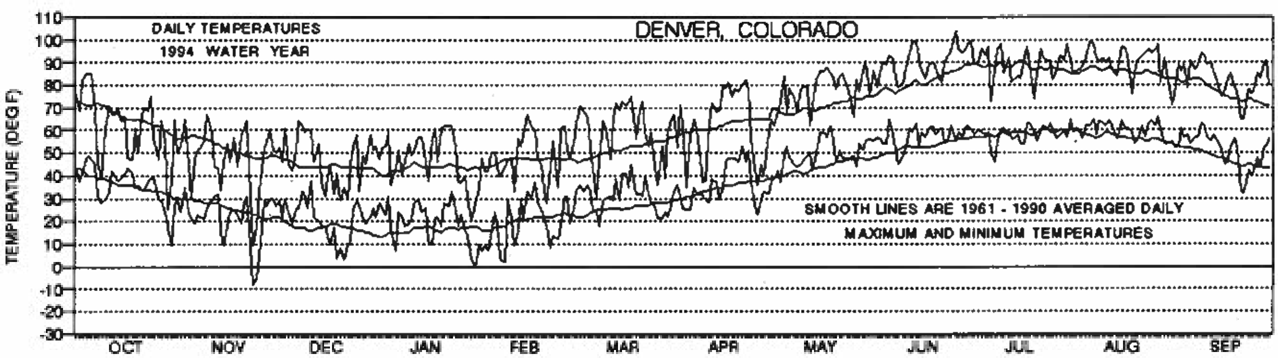
Overall, the 1994 growing season was one of the driest in recent memory for portions of northeastern and western Colorado. Approximately 2/3 of Colorado received less than 90% of the growing season average precipitation. Denver, Byers, Brighton, Sedalia, Sedgwick and other locations in northeastern Colorado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

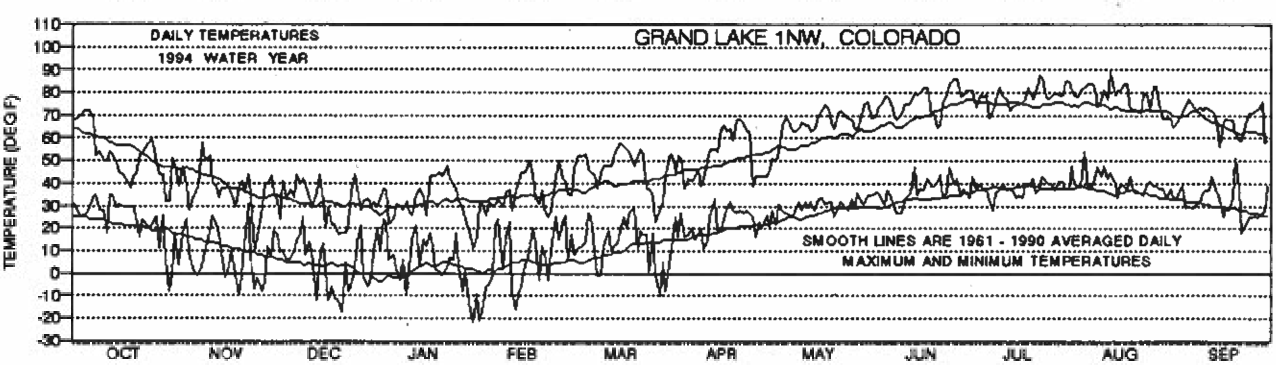


season now ranks as one of the 5 driest growing season this century. Areas of northwestern Colorado were comparably dry. Grand Lake 1N received only 4.22" (43% of average) and Rifle just 2.47" (46%) during the growing season. At the same time, southeastern Colorado enjoyed average to above average rainfall 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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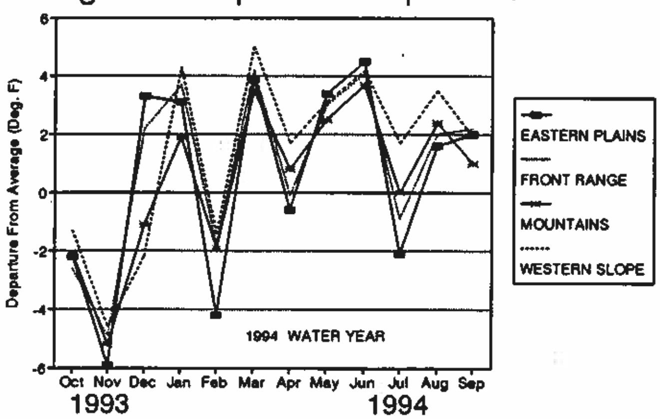
levels, while several days during the growing season approached new record highs.

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).

Regional Temperature Departures

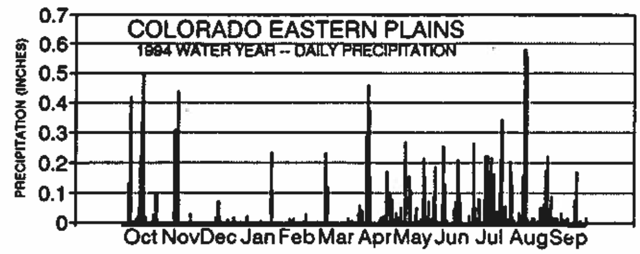


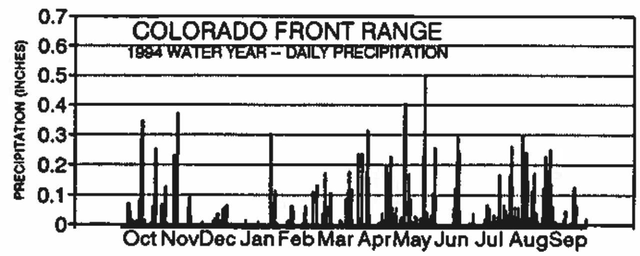
Precipitation Summary

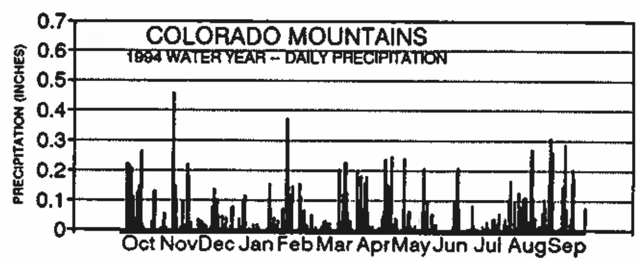
The 1994 Water Year brought less precipitation than normal to the majority of Colorado. Over the entire area of the State, precipitation for the year ended up 95% of the longterm average and 11% less than last year. Portions of northern Colorado were especially dry with several areas totalling less than 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".

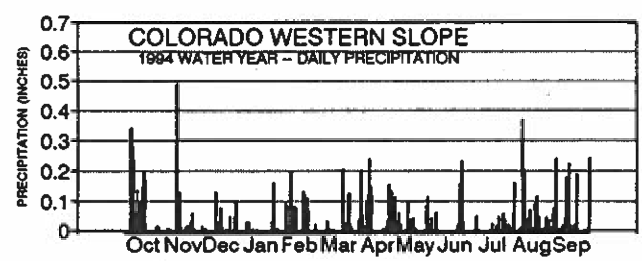
Daily precipitation events through the year are shown in the graphs that follow. In general, there were fewer precipitation days than usual across Colorado during the past year. A few large storms accounted for a large percentage of the year's precipitation. This is a normal part of climate in semiarid 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.









THANKS

Our sincere thanks to those of you who made contributions to the Colorado Climate Center in 1994. Your gifts will be put to good use. Refer to the special feature story in the June 1994 issue for details on how (and why) to make tax deductible donations.

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	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	54.4	56.4	55.9	59.3	51.7	65.0	65.3	67.1
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	79.9 10/15	79.2 2/15	86.0 8/15	84.6 9/15	83.5 8/15	97.5 10/15	93.9 12/15	95.0 29/14
minimum:	25.3 23/ 6	32.9 15/ 7	28.4 23/ 6	34.0 23/ 6	17.1 22/ 6	31.8 22/ 6	32.0 29/ 0	34.7 22/ 6
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	88 / 36	n/a /n/a	92 / 39	77 / 40	93 / 32	47 / 36	74 / 46	74 / 47
11 AM	38 / 43	n/a /n/a	47 / 48	40 / 46	33 / 39	19 / 37	36 / 51	38 / 52
2 PM	27 / 41	30 / 44	35 / 48	29 / 43	22 / 38	16 / 37	27 / 49	28 / 50
5 PM	31 / 40	28 / 41	38 / 47	27 / 41	25 / 36	16 / 36	28 / 48	27 / 47
11 PM	63 / 38	64 / 40	65 / 42	55 / 41	67 / 36	32 / 32	56 / 46	55 / 47
monthly average wind direction (degrees clockwise from north)								
day	202	194	206	234	218	187	189	176
day	147	82	n/a	145	106	220	216	227
monthly average wind speed (miles per hour)								
	2.26	1.72	0.79	1.82	3.13	8.62	8.82	9.17
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	519	513	489	575	389	57	24	55
3 to 12	186	167	45	144	221	530	546	455
12 to 24	7	0	0	1	10	131	150	207
> 24	0	0	0	0	0	2	0	3
monthly average daily total insolation (Btu/ft²•day)								
	1835	1344	1501	1685	1663	656	n/a	1825
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	130	143	181	177	151	69	n/a	238
40-60%	42	67	86	70	48	25	n/a	57
20-40%	47	48	59	48	45	13	n/a	31
0-20%	20	71	32	19	32	23	n/a	15

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.