Colorado Climate Summary
Water-Year Series

(October 1991-September 1992)

Nolan J. Doesken
Thomas B. McKee

Climatology Report No. 93-1

DEPARTMENT OF ATMOSPHERIC SCIENCE
COLORADO STATE UNIVERSITY
FORT COLLINS, COLORADO

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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 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 automating much of the data analysis has been very helpful.

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I. INTRODUCTION

The 1992 Water Year marked the 18th year of existence of the Colorado Climate Center (CCC) and the 15th 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, brief dry periods, some of the snowiest years in the past 60 years and one of the wettest consecutive periods in the state as a whole. 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 can hopefully always be used 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. Irrigated agriculture still accounts for the majority of water used in Colorado. 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.

The format for the monthly report changed during the 1992 Water Year. The original format, described in previous issues of this report was continued through October 1991. In November 1991, a new two-column layout was initiated and continued for the remainder of the year. The first page of this new format 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.

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 influences 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 varying 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.

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.

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 page 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, the extreme highest (High) and lowest (Low) temperature recorded during the month, the monthly total of heating (Heat), cooling

(Cool) and growing (Grow) degree days (see Section II for definitions), the monthly total precipitation (Total), the departure from the 1961-1980 average (Dep), the percent of the 1961-1990 average (% Norm) and the total number of days with measurable 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 three 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 1992 Water Year.

3) Trends in Cloudiness Over Colorado – A Fresh Look, December 1991, Page 44.

4) What Happened to Alamosa? – The 1992 Island of Ice, January 1992, Page 57.

5) Solar Energy and Climate: An Inseparable Duo, February 1992, Page 70.

6) Solar Energy in Colorado – A Climatic Perspective, March 1992, Page 83.

7) A Storm to Remember (March 8-9, 1992), March 1992, Page 84.

8) Solar Energy in Colorado – How much do we get?, April 1992, Page 86.

9) Heavy Rains in a Dry State – The Colorado Story, May 1992, Page 107.

10) Heavy Rains in a Dry State – The Rest of the Story, June 1992, Page 120.

11) A Classic Severe Thunderstorm – June 24, 1992, Fort Collins, CO, June 1992, Page 121.

12) Weather Enthusiasts Come to Colorado, July 1992, Page 133.

13) The ASOS Era Begins, July 1992, Page 134.

14) Coolest Early Summer Graph, July 1992, Page 134.

15) After a Cold Summer, What Lies Ahead?, August 1992, Page 144.

16) Reader Survey Summary, August 1992, Page 146.

17) A Review of the 1992 Water Year, September 1992, Page 157.

The final components of each monthly report is a feature on climate and energy which is 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 (303) 449-4547. Occasionally a one-page narrative on an important climate-energy issue is also included authored by University of Colorado JCEM graduate students. Here is the index of special energy features during the 1992 Water Year.

1. One Beam at a Time, October 1991, page 22.
2. Keep the Home Fires Burning, December 1991, page 47.
3. Typical Meteorological Year, January 1992, page 60.
4. Thermal Storage in Buildings, February 1992, page 72.
5. The Importance of Kite Flying, March 1992, page 85.

No more special JCEM summaries were published in the Colorado Climate past March 1992.

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.

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 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 and precipitation were calculated using 1961-1990 data. Heating degree day normals were based on 1951-1990 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.

II. 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. 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, especially 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 counted at 50° and any maximum above 86° is counted as 86°F. Growing degree day totals are this adjusted mean temperature (°F) minus 50°F summed for each day.

III. 1992 WATER-YEAR IN REVIEW

In previous years up through the 1984 water year summary, several pages were written recapping the highlights of the year's climate and the impact it had on Colorado. This section now appears as the special feature story that accompanies the September 1992 summary found on pages 157-159.

COLORADO CLIMATE

OCTOBER 1991

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

Volume 15 Number 1

October in Review:

Mother nature dished out her absolute best and her absolute worst to Colorado during October. Warm, calm, and dry weather prevailed for most of the first three weeks of the month. Many new record high temperatures were set. The gorgeous weather all came to a screeching halt in the final week of October with one of the most severe cold blasts ever to hit Colorado so early in the season. For the month as a whole, temperatures ended up near or a bit below average east of the mountains and warmer than average in the west. Precipitation was below average except over areas hit hard by the late October winter fury.

Colorado's December Climate:

It is with some trepidation that I attempt to describe our December climate. This fall has already been exciting, with record heat, record cold, and record snow in some areas. We also still have strong memories of recent December weather. Starting with the Christmas Eve blizzard of 1982, several recent Decembers have brought spirited weather to Colorado. Past records don't guarantee future performance, but it does make me a bit nervous.

There are a few things we can count on in December, but there are many uncertainties. Daylength is shorter than in any other month. That means that colder weather is unavoidable. December almost always ranks as one of the three coldest months of the year and has been the coldest month east of the mountains in half of the winters during the past decade. Short days also mean that mid-latitude westerly winds aloft will be strong. This has several immediate implications. Storms will approach regularly and pass quickly. Sunny periods will develop, but they won't last long. Most of our moisture will come from the west. If the jet stream stays south over the U.S., as it often does in December, this means frequent and sometimes heavy mountains snows and quite a few cloudy days on the West Slope. It also means the Front Range cities and adjacent lower foothills will likely be the warmest part of the State. Westerly winds descending east of the Continental Divide warm by compression and often lift temperatures into the 50s and sometimes the 60s. The air also dries, so get out your hand lotion. The only problem with downslope winds is that sometimes they are very strong, gusting to 80 mph or greater near the eastern base of the foothills.

It is unlikely that we will see temperatures as cold as they were last December. Daytime highs usually climb into the 20s in the mountains with 30s in the valleys. East of the mountains highs often reach the 40s and 50s. Nighttime lows average in the teens over eastern Colorado while lows near or below zero become the norm on clear nights in the mountains. December temperatures are changeable, however, especially east of the mountains. Often in December we have an outbreak of arctic air that will likely keep temperatures well below freezing for a few days and bring subzero readings at night. Precipitation can be expected on 3-6 days during the month east of the mountains increasing to 10-15 days in the northern and central mountains. Precipitation totals average less than 0.50" east of the mountains (5-10" snow). December snows east of the Front Range tend to fall in small amounts, but strong winds can still cause transportation and human safety problems. Closer to the mountains, precipitation increases sharply to as much as 5" of moisture (about 80" snow) in some highcountry locations. Fortunately, except near passes and mountains peaks, December snows in and west of the mountains usually fall with light winds.

New Precipitation Averages for Colorado -- How Much Have They Changed?

Climatologists participate in an interesting ritual not unlike the taking of our national census. Every ten years, we scurry about compiling, checking and verifying all available long-term climatic data that we can get our hands on, hoping and praying that as many weather stations as possible have maintained complete and consistent records for at least the past 30 years. Then we assemble all the data for a uniform time period and compute new averages or "normals." For the next ten years these averages will be used in all our reports and climate summaries for describing and comparing climatic conditions. (Note: We have been using 1961-80 averages in our report, COLORADO CLIMATE. Beginning with this issue, we will now employ 1961-90 averages. See explanations and analyses presented in the August 1991 issue (Vol. 14, No. 11) of COLORADO CLIMATE.)

OCTOBER 1991 DAILY WEATHER

Date	Event
1-2	Sunny and warm weather marked the beginning of October. Highs climbed into the 70s and 80s at elevations below 7500 feet. There was a little fog in parts of eastern Colorado early on the 1st, and some downslope breezes along the Front Range on the 2nd.
3-5	Warm temperatures continued on the 3rd over much of Colorado, but a strong cold front moved southward out of Wyoming late in the day bringing strong winds and sharply colder temperatures. High temperatures on the 4th were 30 to 45 degrees colder than the 3rd from the foothills eastward, while temperatures in southwestern Colorado remained unseasonably mild. Durango's high temperatures on the 4th was 77° compared to 45° at Denver. Rains developed early on the 4th along the northern Front Range and across the Northeastern Plains changing to wet snow at elevations above 5,000 feet--the first snow of the year for places like Denver and Boulder. Precipitation ended by noon on the 4th and was generally light, but Boulder did report 0.31" and Holyoke got 0.58" of rain. Southern and western Colorado remained dry. Skies cleared late on the 4th and temperatures dropped to their chilliest readings so far this autumn early on the 5th. Walden dipped to 9°F.
6-21	A prolonged period of dry weather in Colorado with predominantly above average temperatures and many sunny days. Temperatures began warming on the 6th and reached into the 80s 7th-8th at many low-elevation locations. A weak cool front crossed the area late on the 8th bringing some clouds and slightly cooler temperatures but no rain or snow. Very warm and nearly cloudless weather occurred 10-12th with temperatures near 70° well up into the mountains. It was a bit cooler 13-14th over northern and eastern Colorado as a storm passed well north of the State. Then temperatures rebounded again 15-17th as a large high pressure ridge dominated the West. Record high temperatures were widespread on the 16th matching or exceeding the highest temperatures ever observed in Colorado this late in the season. Craig hit 81°, dillon reached 70°, fort collins was 88° and Pueblo had an all-time October record of 94°F. More records were set in eastern Colorado on the 17th while western Colorado cooled a bit. Las Animas hit 97° just three degrees short of Colorado's all-time October high. Much cooler air pushed into eastern Colorado on the 18th but with no moisture. Western Colorado stayed mild. Some clouds approached Colorado 19-21, but conditions remained mild and dry.
22-25	Colorado enjoyed one more very warm day on the 22nd but clouds increased as a strong storm system took shape over the Northwest. Valley rains and mountain snows began in western Colorado on the 23rd and temperatures began to drop. Precipitation became heavy over central Colorado early on the 24th and a little rain also developed along the Front Range. Fruita received 1.02" of rain from the storm, and Rifle reported 1.35". Another surge of rain and snow moved across the State late on the 24th. Aspen reported 17" of new snow and 1.64" of moisture. The Grand Mesa received more than 2" of water equivalent. Snow ended on the 25th, but conditions remained cool and unsettled.
26-31	It was cool but pleasant on the 26th with wave clouds over the mountains. Meanwhile, a new surge of cold and snow began to push down from western Colorado and roared into Colorado late on the 27th. As the cold arrived, snow developed in the northern mountains spreading south with rain and freezing rain over northeastern Colorado changing to light snow. Temperatures dropped nearly 50 degrees out on the plains and stayed below freezing for the rest of the month. By the afternoon of the 28th, temperatures in northeast Colorado were down in the teens. The mountains received 4-14" of snow for this initial surge. Record low temperatures were set in some areas on the 29th. Then temperatures dropped even more and snow intensified late on the 29th as a 2nd disturbance pushed south. Deep snow piled up, especially over southern Colorado on the 30th. Many location east of the mountains experienced their coldest October day on record. Greeley only reached a high of 18°F. Snow ended on the 31st. Alamosa ended up with 15° of new snow and a record low of -9°F. Westcliffe reported 30" of new snow, Pueblo came in with 16" and Burlington got 12". The skies cleared on Halloween but it seemed more like Christmas with fresh snow and icy temperatures.

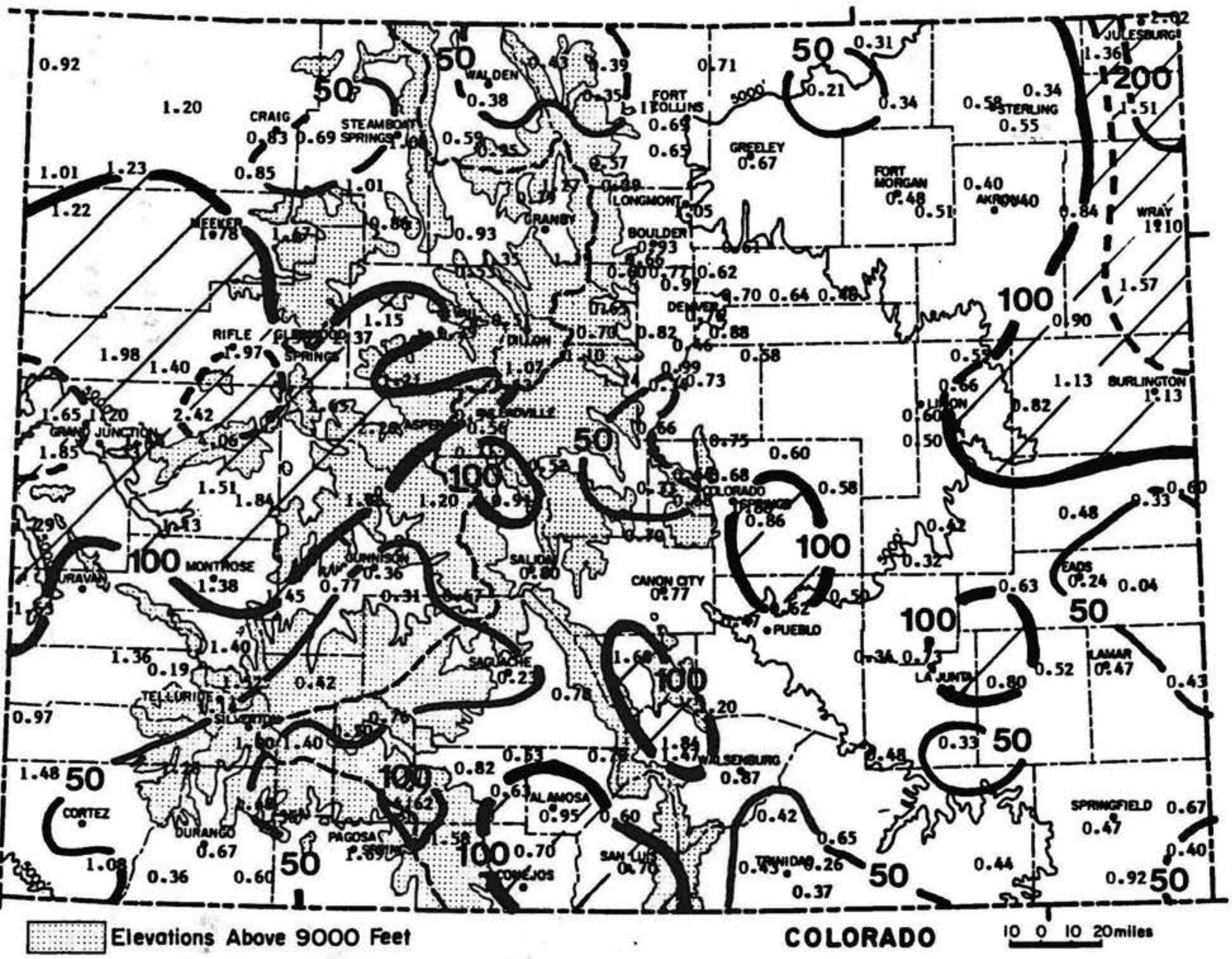
October 1991 Extremes

Highest Temperature	97°F	October 17	Las Animas
Lowest Temperature	-12°F	October 29 October 31	Antero Reservoir Rand
Greatest Total Precipitation	4.62"		Wolf Creek Pass 1E
Least Total Precipitation	0.21"		Briggsdale
Greatest Total Snowfall	59.0"		Wolf Creek Pass 1E
Greatest Depth of Snow on Ground	47"	October 31	Wolf Creek Pass 1E

OCTOBER 1991 PRECIPITATION

During the first 22 days of October, precipitation only fell on one day (Oct. 4) and that was limited to portions of northeast Colorado. Precipitation was widespread in late October, and unusually large amounts of snowfall was reported in many areas. However, the snow was fluffy with low water equivalent for so early in the season. As a result, monthly precipitation remained below average over much of the State. For the month as a whole, above average precipitation was observed over west central Colorado from the Utah border to Aspen. Other wet areas included the south half of the San Luis Valley, Wolf Creek Pass, a band just east of the Sangre de Cristo Mountains, and an area of eastern Colorado from La Junta northeastward to Julesburg. Holyoke and Julesburg each reported more than double the October average. The driest areas compared to average were found over southwestern Colorado from Durango to Gunnison, in Routt and eastern Moffat counties and in the eastern foothills of the Front Range from Pikes Peak north to Wyoming.

Greatest		Least	
Wolf Creek Pass 1E	4.62"	Briggsdale	0.21"
Bonham Reservoir	4.06"	Saguache	0.23"
Redstone 4W	2.65"	Eads	0.24"
Collbran	2.42"	Trinidad	0.26"
Shoshone	2.37"	Cochetopa Creek	0.31"
Aspen 1SW	2.26	New Raymer 21N	0.31"



Precipitation amounts (inches) for October 1991 and contours of precipitation as a percent of the 1961-1990 average.

After about five months of data processing here at the Climate Center, we have completed our preliminary data analysis. Some adjustments may be made in 1992 when the National Climatic Data Center computes their new "normals" for the entire country, but I anticipate the differences will be minor. Here are our findings.

GENERAL COMPARISON BETWEEN 1961-80 AVERAGES AND 1961-90 AVERAGES

The 1980s were generally a decade of abundant precipitation for Colorado. The extremely wet years of 1982-86 more than compensated for dry years early and late in the decade in many parts of Colorado. For most areas of Colorado the new annual precipitation averages are somewhat greater than the 1961-80 averages. The greatest increase is in west central Colorado. Grand Junction, for example, now has an average of 8.64", an increase of 7%. Rifle has increased 1.33" to 12.28" per year. Most areas east of the mountains have also gotten wetter. The Akron area has increased by about 1". The Arkansas Valley has seen a welcome increase as well. Pueblo's annual average has increased from 10.58" to 11.21". Denver, despite many memorable storms in the 1980s, has increased only 0.26" to 15.43". Meanwhile, some of the higher mountain stations have experienced a slight decrease. Breckenridge, for example, has dropped from 19.86" to 19.50".

Averages for individual months have shown much greater changes in comparison to the 1961-80 period:

January: Drier along and west of Continental Divide (10-20% drier in some areas). Slightly drier along the Front Range. Wetter (about 10%) across the Eastern Plains.

February: Little consistent change over western half of Colorado. Generally wetter east of mountains. More than 20% wetter over most of the Eastern Plains.

March: Wetter statewide. Ten to 20% wetter along the Front Range.

April: Varied. A little wetter over parts of western Colorado and Northeast Plains. Drier along the Front Range.

May: The majority of the State is wetter especially over the Northern and Central Mountains and on the Northeast Plains. A little drier in extreme southwest Colorado.

June: The majority of Colorado is now a little wetter.

July: Considerably and consistently wetter west of Continental Divide (5-20%). Drier in the San Luis Valley. Considerable local variations but no systematic change east of the mountains.

August: Drier Northern Mountains. Wetter southwest. Considerably wetter southern Front Range, Trinidad to Castle Rock.

September: Wetter Western Slope, southwest and extreme southeastern counties. A little drier northeast quarter of Colorado.

October: Much wetter (10-20%) northwestern Colorado. Varied, but generally a little wetter over the Eastern Plains. A little drier in extreme southwest Colorado.

November: Systematically wetter western half of Colorado. Ten to 20% wetter south-western Colorado. Slightly wetter Front Range and Northeast Plains. Slightly drier Southeast Plains.

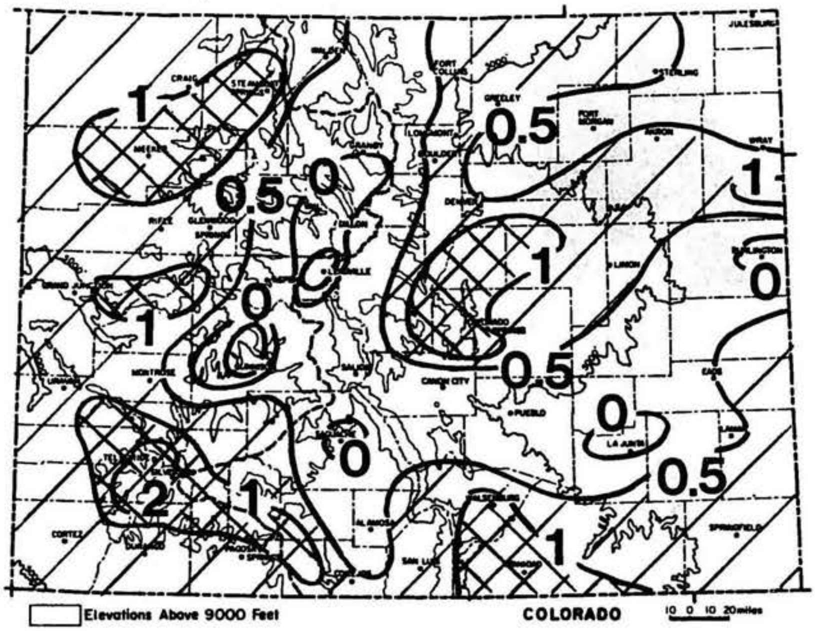
December: Wetter Front Range and Eastern Plains. Drier southwest. Little change elsewhere.

There may or may not be much significance to these changes. Precipitation is such a highly variable climate element that some of these changes, while large, may simply indicate some of typical natural variations in our climate. The large increase in March precipitation along the northern Front Range, for example, was due almost entirely to one remarkably wet month -- March 1990. But some features deserve a closer watch. The tendencies for wetter summers, wetter autumns and drier midwinters in the mountains and western valleys along with wetter winters on the plains have been quite consistent for much of the past decade. These could be the result of some systematic variations in the general circulation of the atmosphere. We'll keep you posted on how this progresses in the 1990s.

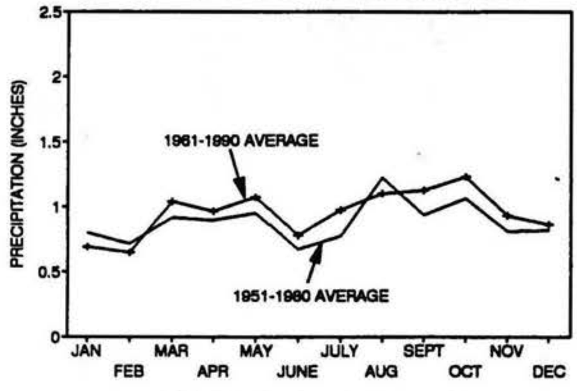
HOW DO THE 1961-90 AVERAGES COMPARE TO THE 1951-80 COLORADO PRECIPITATION MAP?

In the early 1980s, precipitation data for the 1951-80 period were analyzed to produce a very detailed color map of average annual precipitation for Colorado. This map has become a standard reference for educators, resource managers, engineers and consultants in Colorado. (Note: copies of this map are still available at the Colorado Climate Center.) The question that users of that map are beginning to ask is "Is the map still accurate?" My reply is, "Yes, it is still accurate, but the past 10 years have deviated somewhat from those values." With the help of Kim Zikmund, an enthusiastic student intern from the University of Denver who worked with the Climate Center during this past summer, we were able to quantify some of the changes. The following map and graphs attempt to demonstrate the magnitudes and seasonal distributions of precipitation changes from the 1951-80 period to 1961-90. In general, the seasonal changes are similar to those outlined above. We plan to include a more complete analysis of this information in a publication on Colorado precipitation characteristics planned for publication in 1992.

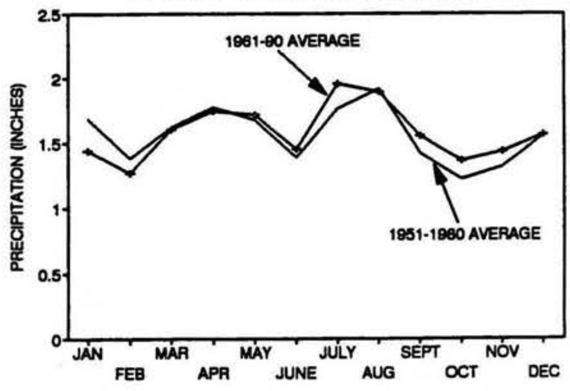
Change in precipitation (in inches) from 1951-80 annual average to the 1961-90 average.



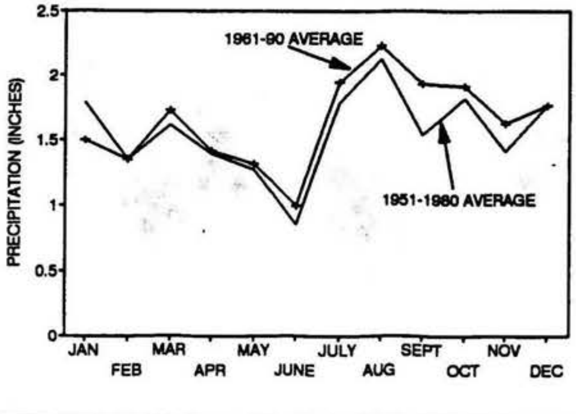
COLORADO -- WESTERN SLOPE
AVERAGE MONTHLY PRECIPITATION



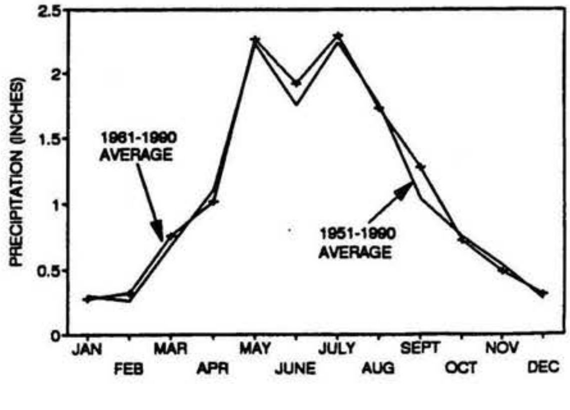
NORTHERN AND CENTRAL MOUNTAINS
AVERAGE MONTHLY PRECIPITATION



SOUTHWEST MOUNTAINS
AVERAGE MONTHLY PRECIPITATION



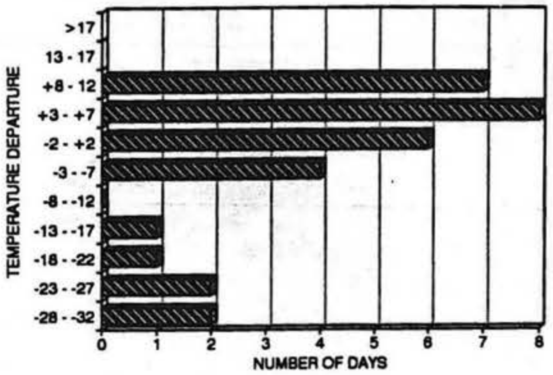
SOUTHEAST PLAINS
AVERAGE MONTHLY PRECIPITATION



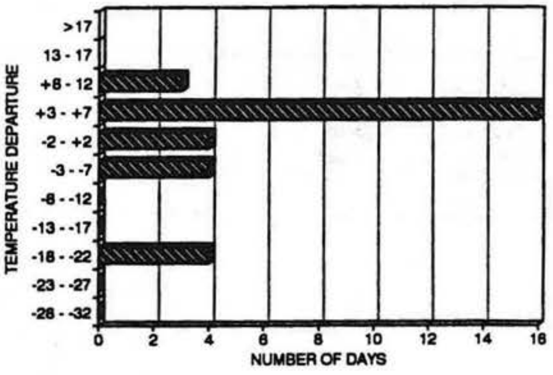
OCTOBER 1991 TEMPERATURES AND DEGREE DAYS

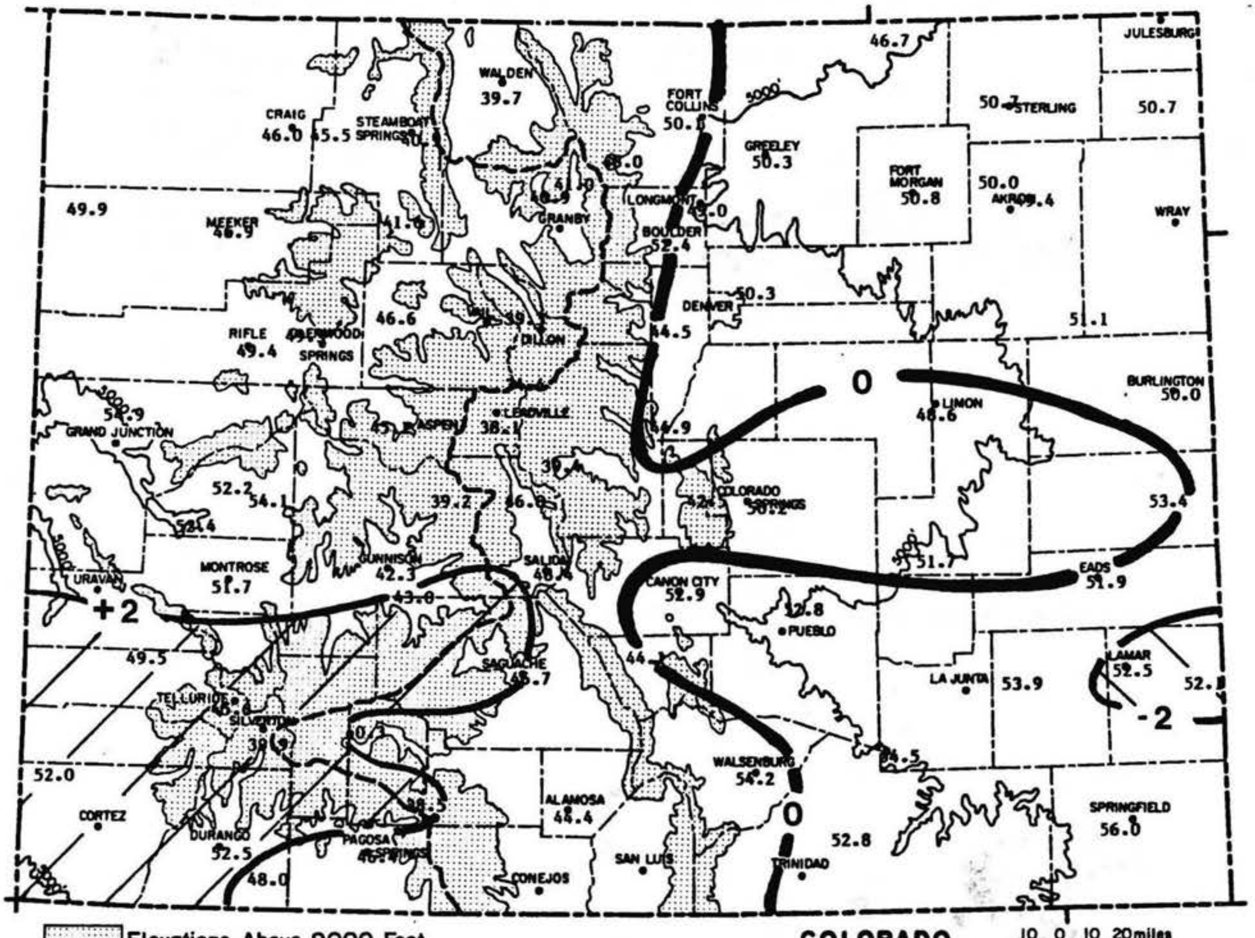
This month was a good example of how misleading average data can sometimes be. Temperatures for October as a whole ended up just slightly below average over eastern Colorado and a little warmer than average in the mountains and on the Western Slope. The warmest part of the State was the southwestern counties where temperatures were 2-3°F warmer than average. But the real story of the month can be found in the frequency distributions. Many days ended up above average with several days much below average. There weren't many days in the middle.

DENVER, COLORADO OCTOBER 1991



GRAND JUNCTION, CO OCTOBER 1991





October 1991 temperatures (degrees Fahrenheit) and contours of departures from 1961-1990 averages.

Table 1. Heating Degree Day Data through October 1991 (base temperature, 65°F).

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630									994
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610									1161
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403									548
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580									M
BURLING-	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
TON	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462									595
CANON	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379									492
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453									630
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423									605
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582									852
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383									473
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449									577
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788									1946
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379									539
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563									803
EVER-	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
GREEN	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627									1113
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457									614
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437									535
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304									343

* = 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	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
6SSW	91-92	220	255	427	739									1641
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450									582
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698									1351
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350									413
LEAD-	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
VILLE	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826									2071
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503									707
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489									640
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553									805
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404									539
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568									938
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380									457
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475									620
STEAMBOAT	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742									1404
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437									535
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	89-90	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595									1272
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377									489
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776									1630
WALSEN-	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
BURG	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337									438

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

OCTOBER 1991 CLIMATIC DATA

Eastern Plains

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	63.4	30.0	46.7	-1.3	85	3	562	3	270	0.31	-0.29	51.7	6
STERLING	68.7	32.8	50.7	0.7	91	6	437	4	333	0.58	-0.22	72.5	4
FORT MORGAN	67.7	33.8	50.8	-0.0	91	6	437	5	320	0.48	-0.18	72.7	6
AKRON FAA AP	64.9	35.2	50.0	-0.7	88	4	466	11	288	0.40	-0.32	55.6	4
AKRON 4E	66.2	32.6	49.4	-0.8	90	1	485	12	306	0.40	-0.20	66.7	6
HOLYOKE	65.8	35.6	50.7	-0.8	90	6	446	12	298	1.51	0.80	212.7	5
JOES	67.5	34.7	51.1	-0.9	91	6	434	13	316	0.90	0.10	112.5	2
BURLINGTON	65.2	34.9	50.0	-3.5	89	10	462	7	296	1.13	0.36	146.8	5
LIMON WSMO	65.1	32.2	48.6	0.3	85	2	503	3	284	0.60	-0.04	93.7	3
CHEYENNE WELLS	70.9	35.9	53.4	0.2	93	10	381	30	363	0.33	-0.48	40.7	2
EADS	68.8	34.9	51.9	-1.9	92	10	413	12	326	0.24	-0.57	29.6	1
ORDWAY 21N	71.7	31.7	51.7	0.2	93	6	410	6	367	0.32	-0.16	66.7	3
LAMAR	75.0	30.0	52.5	-2.2	95	8	392	11	394	0.47	-0.24	66.2	3
LAS ANIMAS	73.4	34.4	53.9	-1.6	97	12	350	14	379	0.80	0.10	114.3	3
HOLLY	68.7	35.6	52.1	-2.0	93	14	397	5	334	0.43	-0.45	48.9	2
SPRINGFIELD 7WSW	73.8	38.3	56.0	0.9	92	10	303	31	411	0.47	-0.32	59.5	2
TIMPAS 13SW	71.5	37.5	54.5	1.1	89	10	331	11	362	0.48	-0.22	68.6	3

Foothills/Adjacent Plains

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	66.0	34.2	50.1	0.3	88	4	457	3	286	0.69	-0.29	70.4	5
GREELEY UNC	66.7	33.8	50.3	-0.2	91	8	450	3	309	0.67	-0.28	70.5	5
ESTES PARK	64.3	31.7	48.0	3.1	76	-2	521	2	247	0.57	-0.29	66.3	5
LONGMONT 2ESE	66.4	31.5	49.0	-0.9	90	3	489	0	302	1.05	0.20	123.5	7
BOULDER	66.9	37.9	52.4	-1.1	87	5	403	20	319	0.93	-0.36	72.1	7
DENVER WSFO AP	66.3	34.3	50.3	-1.1	89	7	449	1	304	0.70	-0.28	71.4	5
EVERGREEN	63.1	25.9	44.5	-0.1	84	-3	627	0	251	0.82	-0.49	62.6	6
CHEESMAN	65.9	23.8	44.9	-1.8	83	-1	615	0	294	0.66	-0.54	55.0	5
LAKE GEORGE 8SW	59.3	25.3	42.3	-0.0	73	4	697	0	196	0.17	-0.56	23.3	5
ANTERO RESERVOIR	58.8	19.9	39.4	1.5	73	-12	787	0	183	0.52	-0.17	75.4	6
RUXTON PARK	58.7	26.3	42.5	4.1	76	-3	692	0	188	0.68	-0.75	47.6	6
COLORADO SPRINGS	65.1	35.4	50.2	0.1	85	7	453	4	287	0.88	0.04	104.8	5
CANON CITY 2SE	68.5	37.4	52.9	-1.3	88	12	379	12	328	0.77	-0.18	81.1	4
PUEBLO WSO AP	71.6	33.9	52.8	-0.8	94	13	380	9	359	0.62	0.05	108.8	3
WESTCLIFFE	63.7	24.5	44.1	0.1	77	4	641	0	252	1.60	0.47	141.6	4
WALSENBURG	71.0	37.5	54.2	1.1	87	11	337	12	378	0.87	-0.16	84.5	3
TRINIDAD FAA AP	70.5	35.1	52.8	-0.7	89	10	377	2	354	0.65	-0.15	81.2	3

Mountains/Interior Valleys

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	58.1	21.3	39.7	1.0	76	-5	776	0	171	0.38	-0.54	41.3	4
LEADVILLE 2SW	53.8	22.3	38.1	1.3	69	-1	826	0	122	0.56	-0.44	56.0	4
SALIDA	67.6	29.2	48.4	1.9	80	11	507	0	302	0.80	-0.30	72.7	3
BUENA VISTA	64.6	27.5	46.0	0.6	78	6	580	0	266	0.91	0.10	112.3	6
SAGUACHE	65.0	28.5	46.7	2.1	75	11	559	0	261	0.23	-0.47	32.9	2
HERMIT 7ESE	61.5	19.1	40.3	1.8	76	5	760	0	209	0.50	-1.09	31.4	3
ALAMOSA WSO AP	65.9	23.0	44.4	0.9	77	-9	630	0	287	0.95	0.25	135.7	2
STEAMBOAT SPRINGS	61.5	20.3	40.9	-1.3	78	0	742	0	226	1.00	-0.87	53.5	5
YAMPA	57.5	25.7	41.6	-0.2	73	-5	718	0	177	0.86	-0.44	66.2	2
GRAND LAKE 1NW	60.3	21.6	41.0	2.1	73	3	736	0	195	1.27	-0.15	89.4	4
GRAND LAKE 6SSW	58.9	22.9	40.9	1.0	71	5	739	0	184	0.79	-0.20	79.8	4
DILLON 1E	56.5	22.1	39.3	0.8	70	4	788	0	146	0.51	-0.29	63.7	5
CLIMAX	47.6	21.1	34.4	1.0	63	-5	940	0	38	1.63	0.27	119.9	7
ASPEN 1SW	60.6	29.6	45.1	1.6	76	7	610	0	215	2.20	0.49	128.7	5
TAYLOR PARK	55.7	22.7	39.2	1.4	69	7	792	0	147	1.20	-0.10	92.3	5
TELLURIDE	64.9	26.4	45.6	2.5	82	6	595	0	273	1.14	-1.08	51.4	8
PAGOSA SPRINGS	67.5	25.4	46.4	1.2	80	19	568	0	304	1.69	-0.42	80.1	6
SILVERTON	57.1	22.7	39.9	2.9	72	4	769	0	169	1.00	-1.27	44.1	7
WOLF CREEK PASS 1	51.2	25.9	38.5	2.3	65	5	809	0	106	4.62	0.27	106.2	8

Western Valleys

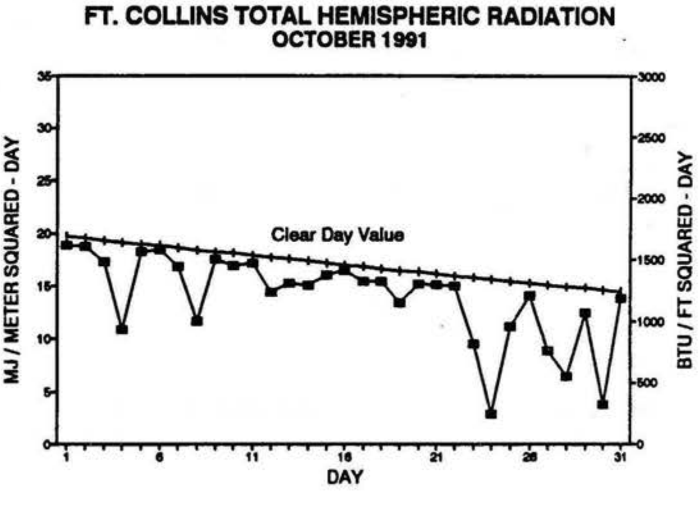
Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	63.2	28.7	46.0	0.9	81	1	582	0	258	0.83	-0.47	63.8	5
HAYDEN	63.9	27.2	45.5	0.3	81	2	596	0	261	0.69	-0.91	43.1	6
MEEKER NO. 2	64.8	29.0	46.9	0.8	80	-4	553	0	274	1.78	0.01	100.6	5
RANGELY 1E	66.8	33.0	49.9	1.0	83	0	461	0	308	1.22	0.04	103.4	4
EAGLE FAA AP	65.9	27.3	46.6	1.7	81	10	563	0	288	1.15	0.11	110.6	6
GLENWOOD SPRINGS	68.1	30.6	49.3	0.9	84	13	460	0	309	1.50	-0.25	85.7	5
RIFLE	69.1	29.8	49.4	0.4	84	7	475	0	335	1.97	0.66	150.4	7
GRAND JUNCTION WS	68.8	41.1	54.9	0.3	81	19	304	0	327	1.20	0.22	122.4	6
CEDAREDGE	69.9	34.4	52.2	1.5	84	12	393	0	331	1.51	0.05	103.4	4
PAONIA 1SW	70.0	38.2	54.1	2.6	83	19	330	0	342	1.84	0.20	112.2	7
DELTA	71.5	33.3	52.4	0.5	84	20	383	0	359	1.13	0.08	107.6	4
GUNNISON	65.4	19.1	42.3	1.1	77	10	698	0	268	0.36	-0.48	42.9	5
COCHETOPA CREEK	64.7	21.3	43.0	2.2	77	10	674	0	255	0.31	-0.58	34.8	3
MONTROSE NO. 2	67.5	35.9	51.7	1.3	80	17	404	0	295	1.38	0.24	121.1	6
URAVAN	74.3	36.9	55.6	1.0	88	16	287	0	401	1.39	-0.01	99.3	6
NORWOOD	64.5	34.5	49.5	3.3	79	2	473	0	264	1.36	-0.23	85.5	3
YELLOW JACKET 2W	66.7	37.3	52.0	2.3	81	9	392	0	297	1.48	-0.33	81.8	3
CORTEZ	68.4	34.0	51.2	1.2	81	14	421	0	319	0.18	-1.42	11.2	1
DURANGO	69.6	35.4	52.5	3.7	80	15	379	0	334	0.67	-1.35	33.2	6
IGNACIO 1N	65.6	30.4	48.0	0.2	77	16	518	0	288	0.60	-0.86	41.1	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.

OCTOBER 1991 SUNSHINE AND SOLAR RADIATION

Station	Number of Days CLR	PTLY CLDY	CLDY	% of possible sunshine	ave % of possible
Colorado Springs	13	10	8	--	--
Denver	12	12	7	78%	73%
Fort Collins	13	11	7	--	--
Grand Junction	19	4	8	78%	74%
Limon	12	13	6	--	--
Pueblo	17	8	6	79%	79%

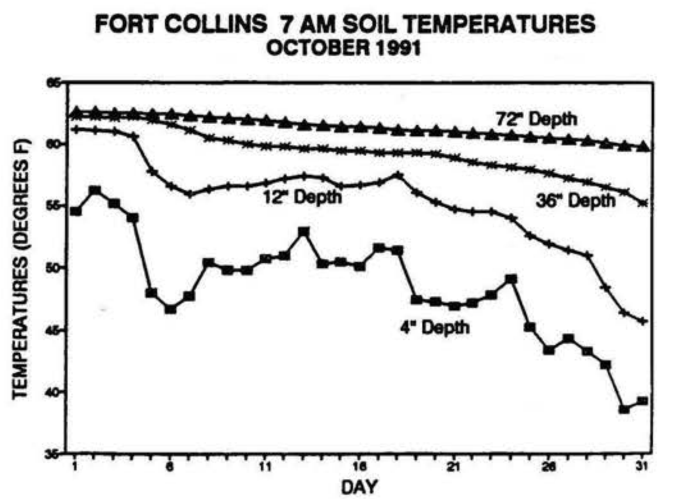
CLR = Clear
PTLY CLDY = Partly Cloudy
CLDY = Cloudy



OCTOBER 1991 SOIL TEMPERATURES

Soil temperatures remained warmer than normal for October until late in the month. The snowcover that accompanied the late-month arctic blast helped keep soil temperatures from freezing.

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.



ONE BEAM AT A TIME

This column often emphasizes the use of solar and other alternative energy resources. Here at the Joint Center for Energy Management we study the feasibility of these renewable resources and recommend ways in which to use them. Often, however, the data we require for our methods of analysis differ from the standard format with which weather information is traditionally measured.

For example, the usual measurement of solar radiation is one taken on a horizontal plane that views the total irradiance of the sky. The sensor used to take these kinds of measurements is known as a pyranometer. By using yearly solar intensity measurements we can model the performance of various types of solar systems. But rarely will one find a solar collector oriented facing straight up. In order to use this 'horizontal' radiation to model many different types of systems we must first decide what the sky conditions are, such as the percentage and type of cloud cover and the angular distribution of the available solar energy.

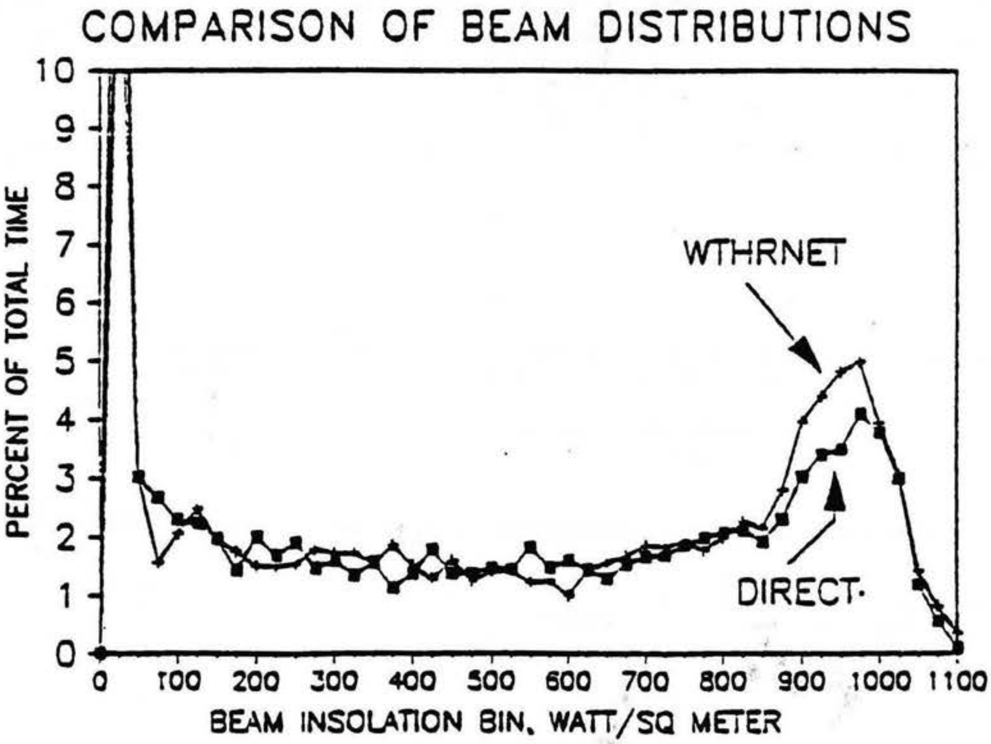
For a collector that is tilted up from the horizontal (as are most of the solar hot water systems you see in Colorado), there are three different parts of the total solar irradiance that should be accounted for: the beam, diffuse and reflected components. The beam radiation is that which comes directly from the solar disk itself. Collectors which 'track' the sun across the sky see mostly the beam radiation, and on clear days this will be the largest component. Diffuse radiation is the sky radiation without the beam part. When the sky is cloudy the diffuse component is often greater than the beam. The reflected component is the the solar energy intercepted a tilted surface which is first reflected off the foreground. Under normal condition the reflected component is small, but when there's snow or water on the ground it can become quite significant.

It is difficult to measure these various components due to the constantly changing seasonal and daily position of the sun. Beam radiation is typically measured using a tracking sensor with a narrow field of view, called a pyrheliometer. Diffuse radiation is usually measured using a horizontally oriented pyranometer which has a thin strip of metal (a shadow band) blocking out the direct beam radiation. These devices must constantly be adjusted, however, to account for the daily and seasonal motions of the sun and are not recommended for use at remote sites.

The WTHRNET stations use stationary pyranometers to measure the solar radiation on four fixed planes, each at a different tilt and azimuth. Using the hourly average from each pyranometer and the solar geometry for that hour, it is possible to get a good idea of what the sky conditions are and the relative magnitudes of the three solar components. This method is prefered to having tracking sensors or devices, since the stations are visited just a few times a year and cannot be susceptible to the whims of the extreme Colorado climate.

This "multi-pyranometer array" technique is a relatively new and untested method for finding the various components; much work has been done recently on figuring out just how well this system performs. Here in Boulder we have been comparing the data from one of our arrays to the beam radiation measured with a pyrheliometer located nearby. With several years of data to work with, we have shown that this is a valid method for use on remote weather stations and can give accurate estimates of the radiation components.

The graph to the right shows the distribution of beam insolation over the a period of more than 3000 hours of daylight (about eight months). The X-axis shows the intensity of the beam radiation in increments of 25 watts per square meter. The Y-axis shows the percent of total time that the beam magnitude fell within a specific range. The two distributions compare fairly well; the error in the measurements is rather small for beam values in the middle ranges, and averages out to about eight percent in the higher ranges.

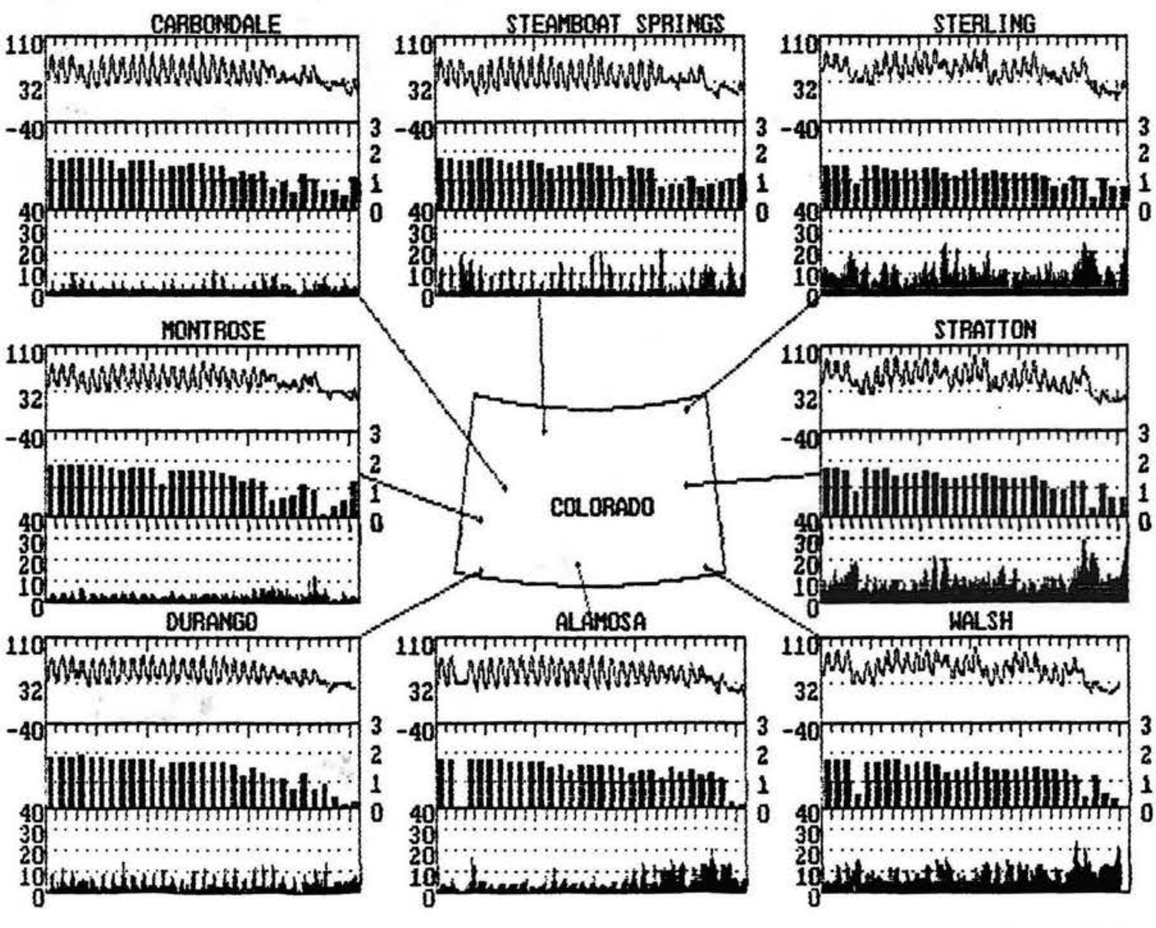


This report was prepared by Peter Curtiss of the Joint Center for Energy Management, University of Colorado, Campus Box 428, Boulder 80309-0428

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	44.2	46.9	45.1	48.4	38.6	48.8	49.6	52.0
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	77.4 16/16	77.7 17/15	84.6 11/16	80.8 16/15	79.0 11/15	88.0 16/16	90.9 16/14	92.1 16/15
minimum:	-4.4 31/23	15.3 29/ 1	9.5 31/ 6	16.7 31/22	1.6 29/ 6	0.1 30/23	8.6 29/ 6	12.2 31/ 4
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	67 / 17	59 / 20	79 / 23	57 / 20	83 / 17	27 / 5	65 / 25	63 / 26
11 AM	31 / 24	33 / 22	33 / 22	31 / 22	31 / 17	17 / 11	39 / 30	38 / 31
2 PM	23 / 21	24 / 21	25 / 22	26 / 21	23 / 16	16 / 14	31 / 28	33 / 31
5 PM	24 / 19	25 / 19	26 / 20	27 / 20	27 / 16	17 / 12	33 / 26	34 / 29
11 PM	43 / 17	43 / 17	53 / 21	43 / 18	56 / 15	21 / 3	54 / 24	54 / 28
monthly average wind direction (degrees clockwise from north)								
day	165	222	237	106	234	198	127	149
night	168	88	170	100	113	222	221	211
monthly average wind speed (miles per hour)								
	4.32	3.62	2.43	2.48	3.93	8.14	9.15	7.29
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	329	400	563	492	475	82	14	87
3 to 12	358	334	181	242	213	542	581	537
12 to 24	41	10	0	2	52	120	141	116
> 24	0	0	0	0	0	0	8	0
monthly average daily total insolation ($Btu/ft^2 \cdot day$)								
	1326	1355	1286	1335	1325	1138	1315	1291
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	234	96	190	135	189	170	235	217
40-60%	45	57	52	51	48	79	58	58
20-40%	15	48	49	29	35	53	31	36
0-20%	21	36	16	28	11	27	12	14

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. One day of data is missing for both Alamosa and Walsh stations due to station changes.



COLORADO CLIMATE

November 1991

Volume 15 Number 2

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

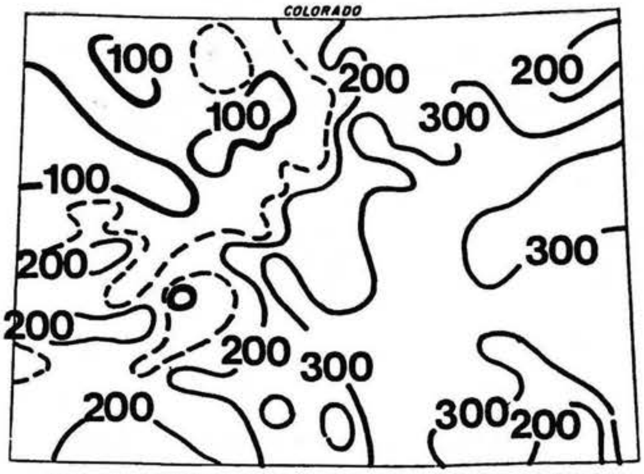
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

November Climate in Perspective – Cold and Wet

November 1991 started cold, ended cold, and was stormy and wet in between. Mountain snow accumulation got off to an excellent start, and Eastern Plains soil moisture also benefitted greatly. Snowfall was excessive over portions of eastern Colorado. This year challenged but fell far short of the remarkable snowfall record of November 1946 when 3-5 feet of wet snow blanketted much of eastern Colorado.

Precipitation

November was wetter than average over more than 90% of Colorado. Eastern and southern Colorado was especially wet. A handful of locations including Holly,

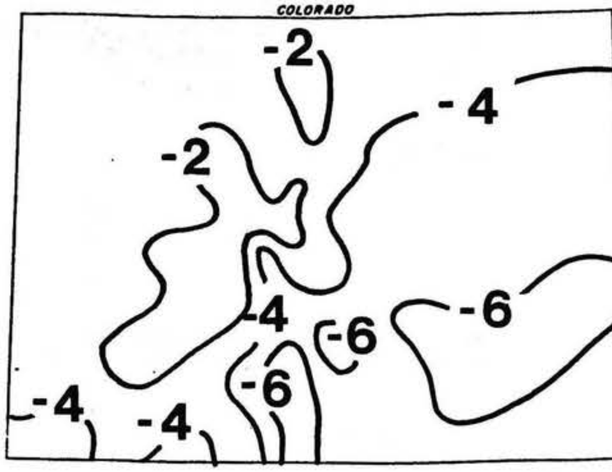


November 1991 precipitation as a percent of the 1961-1990 average.

Ordway, Genoa, Kit Carson, Monte Vista, Pueblo and Colorado Springs received more than 4 times their November average. Mountain precipitation was generally 120-200% of average. The only areas that remained below average were in the northwest quarter of Colorado. Eagle totalled just 0.45" (61% of average) even though a trace or more of precipitation fell on 18 days during the month.

Temperatures

There were a few brief episodes of warmth early in November. Highs east of the mountains were in the 60s and 70s on the 8-9th and again 12-13th. However, the month as a whole was considerably colder than average ranging from 1-3 degrees below average in western Colorado to 4-8 degrees below average over southeast counties. The most unusual feature of the month was the Halloween cold snap that continued into early November. Many records were set during the first 3 days of the month. Pueblo's -17°F reading on November 3 tied their all-time coldest temperature for any day in November. Fraser and Crested Butte each dropped to -30° that morning – the coldest temperature ever officially observed in Colorado so early in the winter.



Departure of November 1991 temperatures from the 1961-90 averages.

Inside This Issue

NOVEMBER 1991 DAILY WEATHER

1-4 Colorado's Halloween snowstorm headed northeast on the 1st burying Minnesota. Behind the storm, a powerful new surge of Arctic air moved into Colorado engulfing the whole state by the 2nd. Incredibly cold daytime temperatures for so early in the season were observed on the 2nd, especially east of the mountains. Colorado Springs' high of 10° broke the previous record by 19 degrees. Light snow accompanied the polar push. Skies cleared and much of Colorado awoke to record cold temperature on the 3rd. Examples included -17° at Pueblo, -18° at Lamar and -26° at Alamosa. Fraser and Crested Butte shared honors for the coldest in the State with -30°F. That appears to be the earliest -30° ever officially recorded here in Colorado. A much-welcomed warming trend then began on the 4th.

5-7 Snow in the Northern Mountains and strong northwesterly downslope winds along the Front Range developed on the 5th. Strong winds along with colder temperatures and rain and snowshowers spread across the Eastern Plains on the 6th. Snow and fog continued over southeast Colorado early on the 7th. Much of the Colorado plains picked up a trace to as much as 3" of snow before skies cleared during the day on the 7th.

8-13 The only real warm spell of November tried to develop over the State 8-9th. Cheraw (near LaJunta) reached a high of 78° on the 9th, the warmest in the State for the month. A disturbance SW of Colorado then spread clouds and moisture into westen Colorado at the same time that a cool upslope flow developed east of the mountains. Precipitation was light but widespread over much of the State falling mostly as rain. Pagosa Springs picked up 0.45" of rain which fell all day on the 10th. Skies cleared from west to east on the 11th. Dry, warm and beautiful weather then returned 12-13th with low elevation temperatures climbing into the 60s and 70s.

14-19 A large low pressure area formed over the Southwest U. S. on the 14-15th and tracked northeastward across Southern Colorado 16-17th. Then a second storm took a similar track but moved more quickly across the southern Rockies 18-19th. Both storms were moisture laden, and except in the high mountains, temperatures didn't drop much below the freezing point. Plentiful wet snow fell in many areas and helped mountain snowpack get off to an excellent start. Durango totalled 3.83" of water equivalent from the storm. Wolf Creek Pass reported 51" of snow with more than 4" water content. The Front Range and Eastern Plains were also hit hard, but warm temperatures helped melt most of the snow from highways. The two storms in quick succession dropped at least 20" of snow on the Denver area. Some lower areas received mostly rain. In these few days, some areas on the plains received more precipitation than they normally receive in the entire November-January period.

20-26 Northwest winds aloft dominated this period, and temperatures remained near or below average. Snow fell daily in the northern and central mountains but in small quantities. The heaviest precipitation fell 21-22nd as a strong, cold, upper-level disturbance crossed the State. Lower elevation precipitation was sparse, but Walsenburg did report 10" of snow from the storm on the 22nd. The high temperatures in Vail and Dillon on the 22nd only reached 18°F.

27-30 Colorado enjoyed above average temperatures on the 27th, but a new, vigorous storm was rapidly developing west of Colorado. Thanksgiving (28th) remained dry and mild over much of the State, but much colder air with fog, freezing drizzle and light snow began spreading southward along the Front Range. Snow expanded over much of southern and eastern Colorado on the 29th and continued intermittently on the 30th. Most areas received 1-5" of snow from the storm, but Rye reported well over a foot and Wolf Creek Pass got more than 20 inches. Temperatures were cold with highs on the 30th mostly in the teens and 20s across the State.

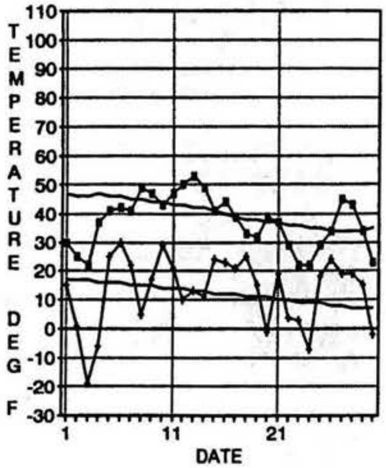
Weather Extremes

Highest Temperature	78°	November 9	Cheraw 1N
Lowest Temeprature	-30°	November 3	Crested Butte, Fraser
Greatest Total Precipitation	5.66"		Wolf Creek Pass 1E
Least Total Precipitation	0.38"		Green Mountain Dam
Greatest Total Snowfall	83.5"		Wolf Creek Pass 1E
Greatest Depth of Snow on Ground	48"		Wolf Creek Pass 1E

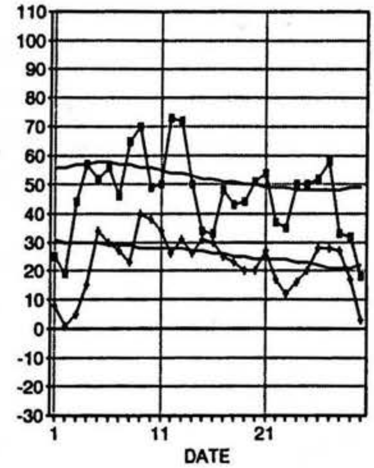
NOVEMBER 1991 TEMPERATURE COMPARISON

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.)

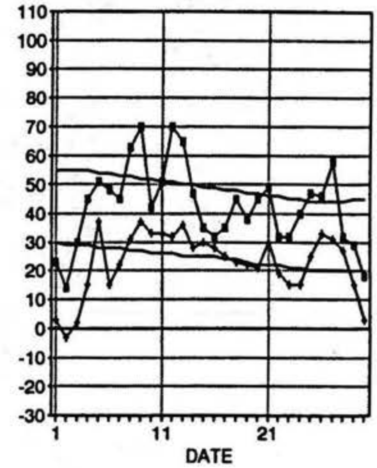
GRAND LAKE 1NW



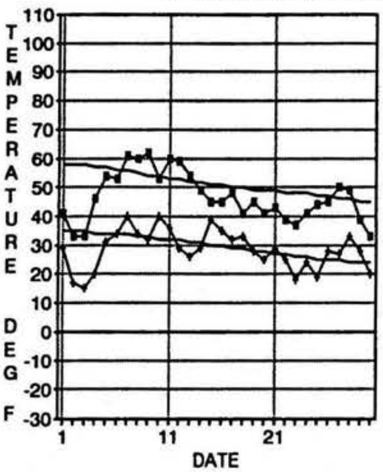
DENVER



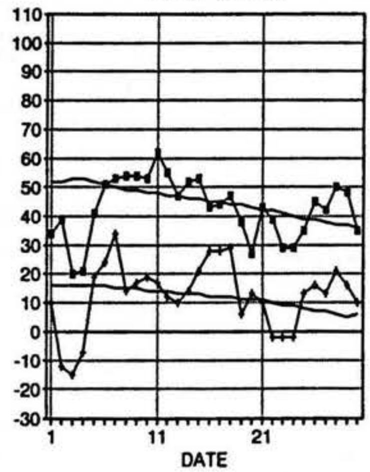
AKRON 1N



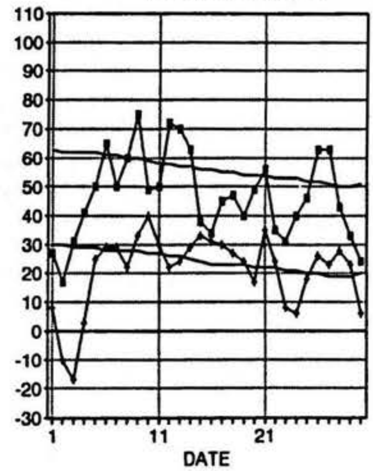
GRAND JUNCTION



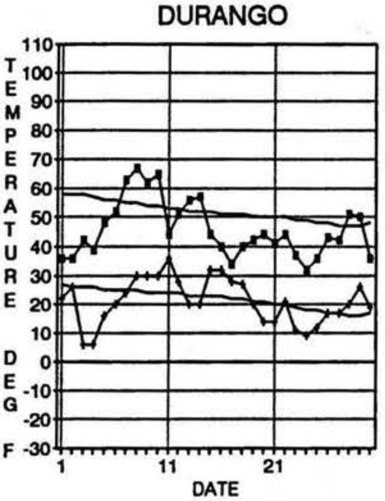
GUNNISON



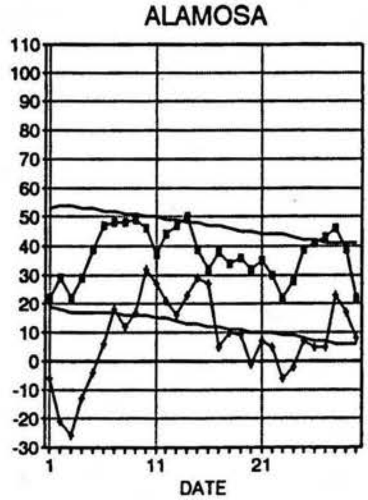
PUEBLO WSO



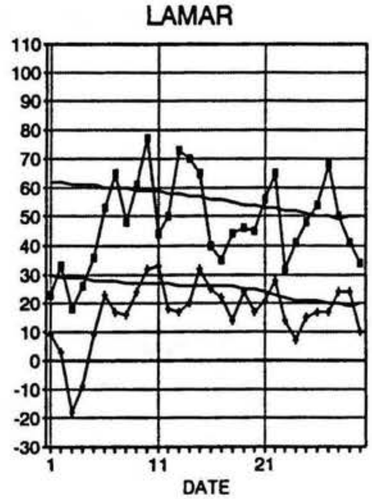
DURANGO



ALAMOSA



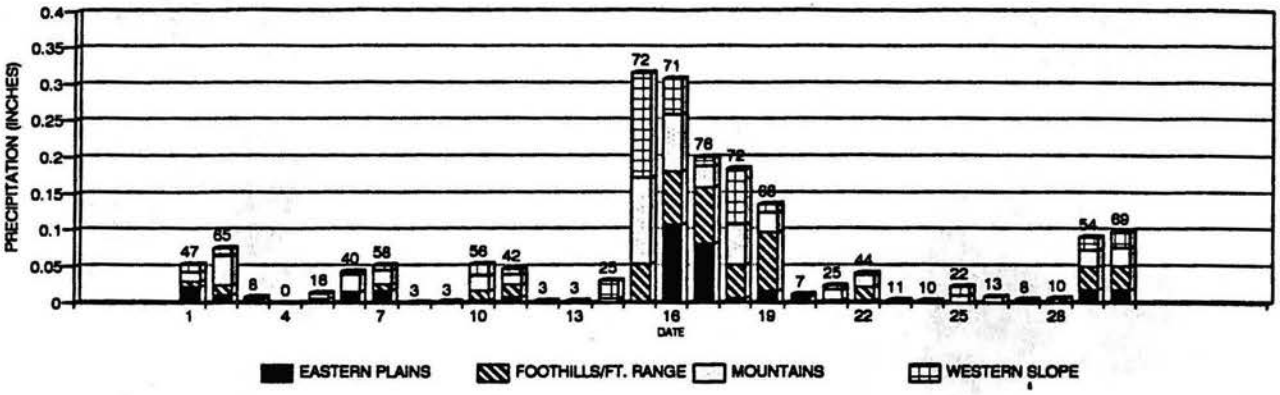
LAMAR



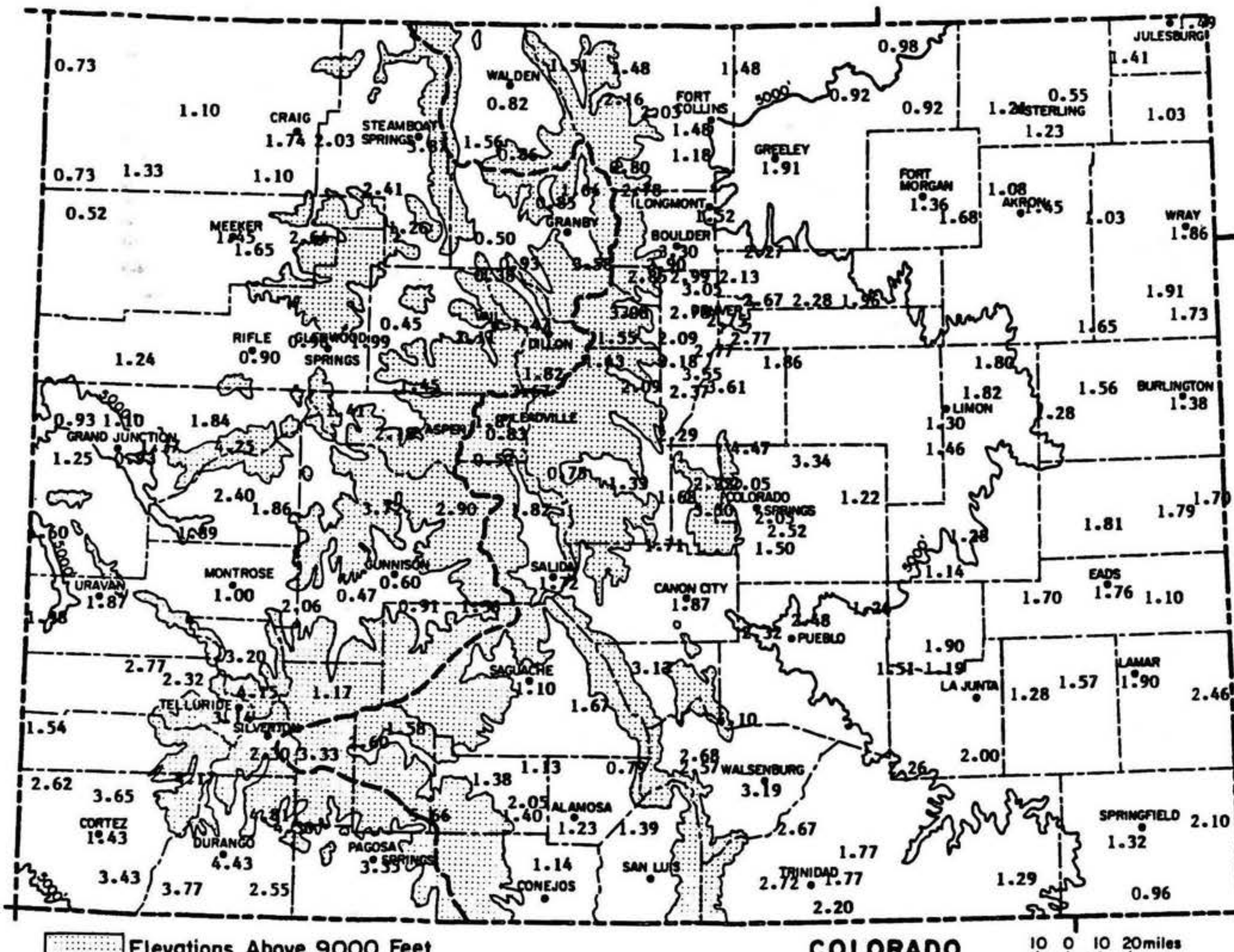
NOVEMBER 1991 PRECIPITATION

November was characterized by a progression of storms, one every 3 to 5 days, for the entire month. However, it was the sequence of mid-month storms that made this one of the 10 wettest Novembers on record. This new graphic shows statewide daily precipitation based on an average of about 80 representative stations. The number indicates what percent of those stations received precipitation on each day.

COLORADO DAILY PRECIPITATION - NOV 1991

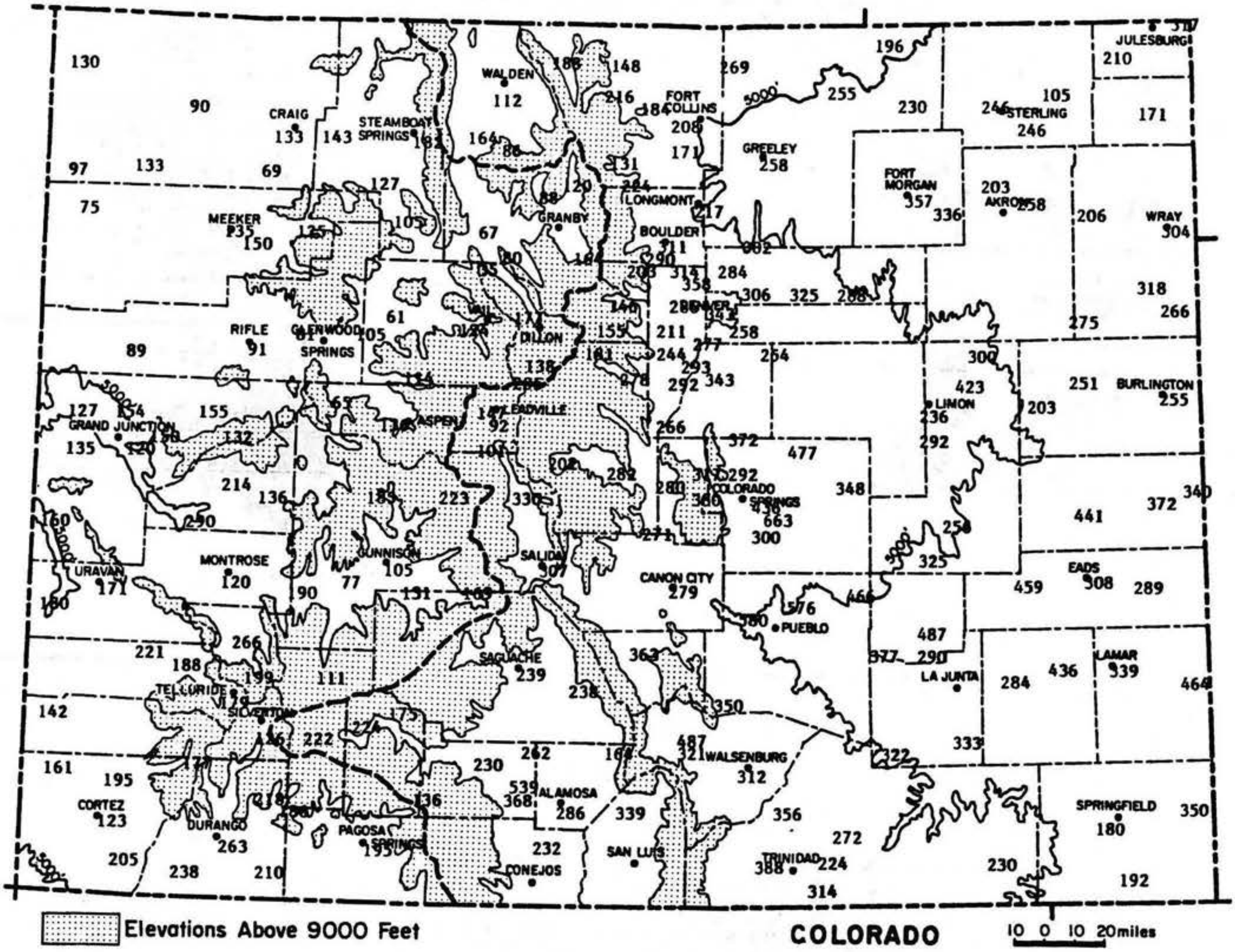


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

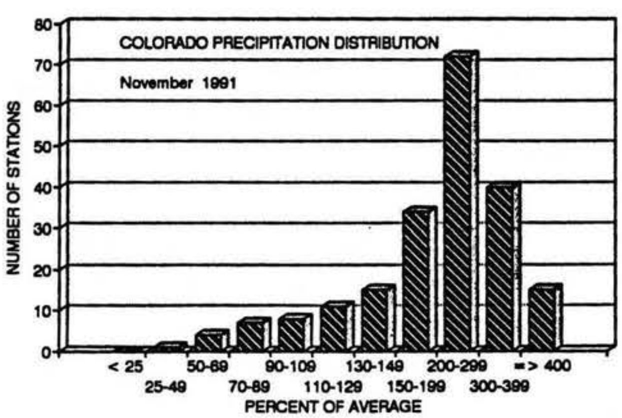


Precipitation Amounts (in inches) for November 1991.

NOVEMBER 1991 PRECIPITATION COMPARISON



November 1991 Precipitation as a Percent of the 1961–90 average.

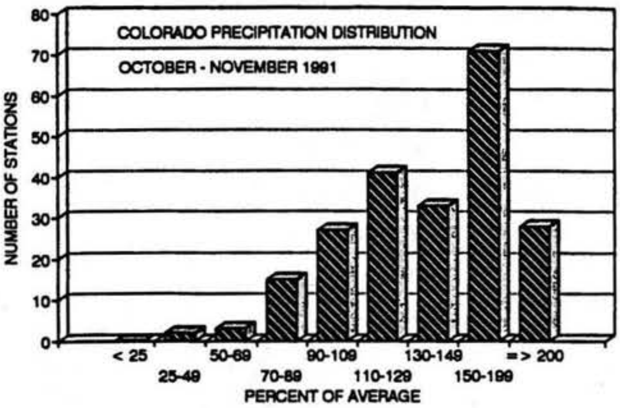


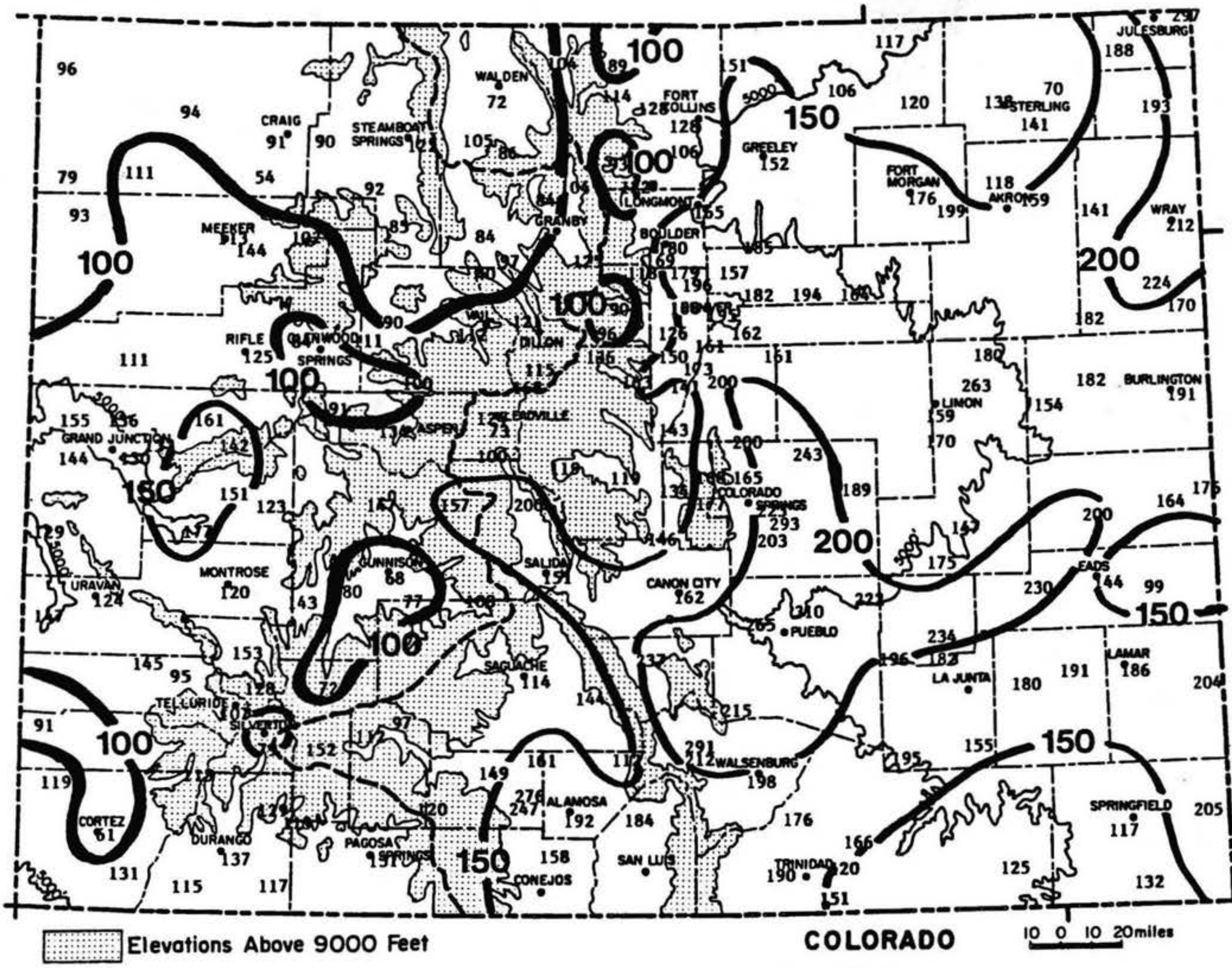
NOVEMBER 1991 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	2.67"	2nd wettest in 120 years of record (wettest = 3.21" in 1946)
Durango	4.43"	2nd wettest in 98 years of record (wettest = 4.55" in 1982)
Grand Junction	1.10"	14th wettest in 100 years of record (wettest = 2.39" in 1895)
Las Animas	1.28"	11th wettest in 125 years of record (wettest = 3.06" in 1946)
Pueblo	2.48"	Wettest ever in 123 years of record
Steamboat Springs	3.97"	4th wettest in 87 years of record (wettest = 5.59" in 1985)

1992 WATER YEAR PRECIPITATION

Heavy November precipitation helped the 1992 water year get off to an excellent start. More than 85% of the State is currently wetter than average. Eastern and southern parts of Colorado are doing particularly well. Drier than average conditions are limited to portions of Routt and Moffat counties and to relatively small portions of the Upper Colorado Valley and the Upper Gunnison.





October–November 1991 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR NOVEMBER 1991

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263								2257
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106								2267
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831								1379
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056								M
BURLING-TON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903								1498
CANON CITY	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800								1292
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954								1584
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947								1552
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080								1932
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832								1305
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902								1479
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210								3156
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940								1479
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972								1775
EVER-GREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988								2101
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891								1505
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947								1482
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815								1158

* = 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 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
	91-92	220	255	427	739	1169								2810
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925								1507
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120								2471
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896								1309
LEAD-VILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245								3316
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000								1707
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936								1576
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003								1808
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901								1440
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116								2054
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927								1384
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906								1526
STEAMBOAT SPRINGS	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140								2544
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930								1465
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	89-90	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013								2285
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876								1365
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217								2847
WALSEN-BURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818								1256

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

NOVEMBER 1991 CLIMATE DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	40.9	20.6	30.8	-4.0	66	-8	1020	0	34	0.98	0.48	196.0	13
STERLING	45.5	21.9	33.7	-2.9	73	-2	930	0	53	1.21	0.72	246.9	8
FORT MORGAN	44.5	21.8	33.2	-3.8	71	-2	947	0	48	1.36	0.98	357.9	8
AKRON FAA AP	42.6	22.8	32.7	-4.4	70	-3	962	0	41	1.08	0.55	203.8	7
AKRON 4E	42.8	21.5	32.2	-4.4	71	-6	979	0	45	1.45	0.89	258.9	10
HOLYOKE	45.2	23.2	34.2	-3.8	73	2	913	0	61	1.03	0.43	171.7	6
JOES	44.6	22.3	33.4	-5.6	74	-7	938	0	56	1.65	1.05	275.0	4
BURLINGTON	43.9	25.3	34.6	-3.4	71	3	903	0	39	1.38	0.84	255.6	5
LIMON WSMO	41.4	21.3	31.4	-3.8	70	-3	1000	0	34	1.30	0.75	236.4	12
CHEYENNE WELLS	46.7	20.5	33.6	-6.0	74	-4	932	0	60	1.79	1.31	372.9	9
EADS	45.2	21.4	33.3	-6.5	73	-12	944	0	60	1.76	1.19	308.8	8
ORDWAY 21N	46.7	19.1	32.9	-4.6	76	-12	956	0	75	1.14	0.79	325.7	7
ROCKY FORD 2SE	49.8	21.7	35.7	-4.7	76	-16	870	0	79	1.19	0.78	290.2	10
LAMAR	48.2	16.8	32.5	-8.2	77	-18	968	0	82	1.90	1.34	339.3	9
LAS ANIMAS	48.4	21.4	34.9	-6.5	77	-10	896	0	78	1.28	0.83	284.4	9
HOLLY	48.9	21.0	34.9	-4.9	73	-9	893	0	78	2.46	1.93	464.2	9
SPRINGFIELD 7WSW	49.8	24.4	37.1	-5.2	72	-9	830	0	87	1.32	0.59	180.8	6
TIMPAS 13SW	46.7	23.6	35.1	-5.7	72	-10	889	0	67	2.26	1.56	322.9	12

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	45.9	24.2	35.1	-2.4	69	-1	891	0	47	1.48	0.77	208.5	11
GREELEY UNC	43.9	24.0	33.9	-3.5	69	1	925	0	44	1.91	1.17	258.1	12
ESTES PARK	45.2	24.7	34.9	0.3	59	-8	893	0	25	0.80	0.19	131.1	9
LONGMONT 2ESE	46.6	20.4	33.5	-3.7	74	-8	936	0	55	1.52	0.82	217.1	10
BOULDER	47.8	26.3	37.0	-3.7	69	-1	831	0	67	3.30	2.24	311.3	14
DENVER WSFO AP	46.7	22.7	34.7	-4.3	73	1	902	0	57	2.67	1.80	306.9	17
EVERGREEN	45.8	17.9	31.9	-2.5	68	-6	988	0	53	2.09	1.10	211.1	11
CHEESMAN	46.4	15.1	30.8	-5.3	66	-8	1017	0	49	2.29	1.43	266.3	12
LAKE GEORGE 8SW	39.3	13.9	26.6	-2.1	57	-4	1145	0	12	1.33	0.86	283.0	8
ANTERO RESERVOIR	38.6	9.2	23.9	-0.8	56	-18	1226	0	8	0.75	0.38	202.7	9
RUXTON PARK	36.7	10.2	23.4	-4.3	56	-16	1239	0	9	3.50	2.58	380.4	12
COLORADO SPRINGS	43.4	22.5	32.9	-5.0	70	-5	954	0	46	2.05	1.58	436.2	12
CANON CITY 2SE	50.5	25.7	38.1	-4.2	73	-7	800	0	96	1.87	1.20	279.1	10
PUEBLO WSO AP	46.9	20.9	33.9	-6.6	75	-17	927	0	71	2.48	2.05	576.7	11
WESTCLIFFE	37.1	9.9	23.5	-9.2	54	-24	1234	0	4	3.13	2.27	364.0	11
WALSENBURG	49.1	25.8	37.5	-4.3	69	-7	818	0	77	3.19	2.17	312.7	11
TRINIDAD FAA AP	48.9	22.1	35.5	-5.8	71	-15	876	0	77	1.77	1.12	272.3	11

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	35.4	12.8	24.1	-2.4	53	-22	1217	0	3	0.82	0.09	112.3	11
LEADVILLE 2SW	35.0	11.5	23.2	-1.7	55	-17	1245	0	3	0.83	-0.07	92.2	13
SALIDA	44.6	17.2	30.9	-5.1	64	-17	1016	0	33	1.62	1.06	289.3	8
BUENA VISTA	42.3	16.8	29.6	-4.3	59	-14	1056	0	18	1.82	1.27	330.9	9
SAGUACHE	38.2	13.3	25.7	-5.7	55	-2	1171	0	9	1.10	0.64	239.1	8
HERMIT 7ESE	37.3	5.5	21.4	-3.6	49	-20	1302	0	0	2.60	1.44	224.1	3
ALAMOSA WSO AP	37.1	8.3	22.7	-7.2	50	-26	1263	0	0	1.23	0.80	286.0	10
STEAMBOAT SPRINGS	38.0	15.4	26.7	-2.4	61	-18	1140	0	13	3.55	1.43	167.5	18
YAMPA	37.2	16.8	27.0	-2.2	53	-17	1132	0	5	1.26	0.07	105.9	9
GRAND LAKE 1NW	37.5	13.1	25.3	-0.9	53	-19	1185	0	2	1.64	0.28	120.6	18
GRAND LAKE 6SSW	35.9	15.7	25.8	-2.1	51	-10	1169	0	1	0.85	-0.11	88.5	15
DILLON 1E	36.4	12.4	24.4	-2.4	56	-15	1210	0	5	1.47	0.64	177.1	14
CLIMAX	27.2	0.9	14.0	-7.6	49	-14	1524	0	0	3.67	1.88	205.0	19
ASPEN 1SW	39.7	16.0	27.9	-2.6	55	-5	1106	0	9	2.18	0.58	136.2	13
CRESTED BUTTE	34.2	7.6	20.9	-4.5	50	-30	1314	0	0	3.72	1.71	185.1	14
TAYLOR PARK	34.6	10.8	22.7	-1.6	47	-11	1262	0	0	2.90	1.60	223.1	13
TELLURIDE	44.2	17.7	31.0	-0.5	63	-5	1013	0	36	3.14	1.39	179.4	14
PAGOSA SPRINGS	43.1	11.9	27.5	-5.7	63	-6	1116	0	31	3.35	1.64	195.9	10
SILVERTON	40.6	9.9	25.3	-1.6	56	-20	1187	0	12	2.30	0.48	126.4	15
WOLF CREEK PASS 1	35.0	11.5	23.3	-2.4	51	-10	1243	0	1	5.66	1.50	136.1	16

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	39.0	18.4	28.7	-2.9	62	-10	1080	0	22	1.74	0.44	133.8	16
HAYDEN	39.6	19.4	29.5	-2.7	61	-14	1057	0	19	2.03	0.62	144.0	10
MEEKER NO. 2	41.6	20.9	31.3	-2.4	62	-16	1003	0	24	1.45	0.38	135.5	9
RANGELY 1E	42.4	20.6	31.5	-2.8	59	-5	998	0	24	0.52	-0.17	75.4	3
EAGLE FAA AP	44.2	20.7	32.4	0.5	63	-1	972	0	28	0.45	-0.28	61.6	8
GLENWOOD SPRINGS	44.8	22.0	33.4	-2.5	63	0	939	0	36	0.98	-0.22	81.7	11
RIFLE	45.5	23.6	34.6	-2.1	63	5	906	0	38	0.90	-0.08	91.8	7
GRAND JUNCTION WS	46.8	28.5	37.6	-2.7	62	15	815	0	35	1.10	0.39	154.9	12
CEDAREDGE	47.4	23.2	35.3	-2.7	65	3	884	0	46	2.40	1.28	214.3	9
PAONIA 1SW	48.1	26.2	37.2	-1.9	67	8	828	0	57	1.86	0.50	136.8	10
DELTA	48.2	25.9	37.0	-2.1	63	10	832	0	47	1.87	1.22	287.7	6
GUNNISON	42.8	11.9	27.4	-1.0	62	-15	1120	0	21	0.60	0.03	105.3	5
COCHETOPA CREEK	42.3	14.9	28.6	0.6	58	-16	1088	0	15	0.91	0.22	131.9	9
MONTROSE NO. 2	45.5	23.9	34.7	-3.0	62	5	901	0	42	1.00	0.17	120.5	9
URAVAN	51.6	27.3	39.5	-1.4	67	13	761	0	72	1.87	0.78	171.6	10
NORWOOD	44.1	19.5	31.8	-2.4	62	-2	990	0	30	2.77	1.52	221.6	6
YELLOW JACKET 2W	45.8	22.9	34.3	-2.8	64	4	913	0	36	2.62	1.00	161.7	7
CORTEZ	47.2	19.3	33.2	-5.0	66	7	947	0	51	1.43	0.27	123.3	9
DURANGO	45.8	21.1	33.4	-3.7	67	6	940	0	40	4.43	2.75	263.7	8
IGNACIO 1N	43.8	21.1	32.4	-3.6	64	5	969	0	28	2.55	1.34	210.7	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.

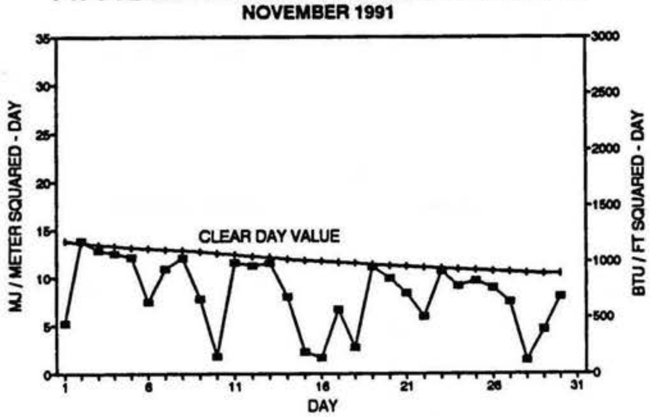
NOVEMBER 1991 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	8	10	12	--	--
Denver	5	12	13	50%	65%
Fort Collins	4	14	12	--	--
Grand Junction	6	9	15	53%	63%
Limon	7	10	13	--	--
Pueblo	6	12	12	70%	73%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

The cold, wet weather of November was accompanied by more and denser cloudiness and less solar radiation than average.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
NOVEMBER 1991

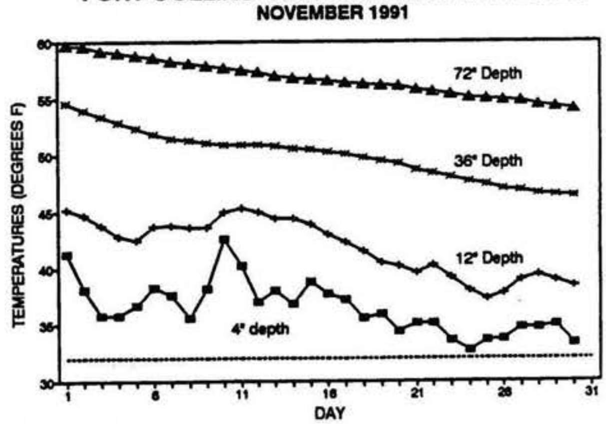


NOVEMBER 1991 SOIL TEMPERATURES

A brief warmup followed the dramatic early coldwave in Colorado. Near-surface soil temperatures were a little cooler than average for this time of year but remained above freezing throughout November.

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 1991



COLORADO TEMPERATURES – HAVE THE AVERAGES CHANGED?

As I told you in the October 1991 issue of Colorado Climate, we have recently completed the arduous task of updating the climatic averages for Colorado weather stations based on data for the 1961-1990 period. Last time, we described some of the changes that have occurred in precipitation. In general, the 1980s were a wet decade and caused an increase in long-term averages over most of Colorado. There was no strong indication, however, that any of these changes were out of the ordinary. Precipitation fluctuates greatly from month to month, year to year, and even decade to decade. More than likely, these observed increases were simply a result of natural variations in our climate. In another 10 years when we again update the averages, values will probably decrease again.

Now lets talk about temperature. With all the hubbub over global warming that has bombarded us during the past few years, we were extremely interested to see the new temperature averages. Has Colorado continued to get warmer?

Before I begin to answer, first let me remind you that temperatures are much more consistent from year to year than precipitation. Certainly there are variations, but the progression of seasons with the accompanying changes in solar energy dominate temperature characteristics throughout the year. It is quite unusual for temperatures to deviate from average by more than about 8 degrees Fahrenheit when averaged over an entire month. In the summer, a 4-degree departure is extreme. When all 12 months are combined, a difference in annual temperature of 2 degrees is considered large. My point is, when you see the new averages and how they compare with the past, don't expect any dramatic changes.

It is also important to remember that temperatures are extremely sensitive to any changes in how data are collected. Changes in thermometers, time of observation, location of instrument, or surrounding structures and vegetation can easily have as much effect on temperature averages as variations in the climate itself. Any individual or organization collecting weather data must keep this in mind. Regrettably, many of Colorado's weather stations have experienced one or more of the above changes during the past 30 years. Therefore, results must always be carefully interpretted.

1961-1990 AVERAGES COMPARED TO 1961-1980

No systematic changes in temperature averages have been noted that are consistent throughout entire seasons and across the entire area of Colorado. The following generalizations appear to be valid, based on comparative data from 100 weather stations scattered across the State.

January: New averages are a little warmer than before (+0.46–+1.2°F).
February: New averages are cooler east of the mountains but unchanged or a bit warmer west of the Continental Divide.
March: Warmer statewide (+0.3–+1.5°F).
April: Unchanged to a little warmer east of the mountains, warmer (+0.3–+0.9°F) over western Colorado.
May: Generally unchanged statewide.
June: Unchanged eastern Colorado, somewhat warmer across western Colorado.
July: Mostly unchanged.
August: A little warmer than in the past (+0.2–+0.6°F) most areas.
September: A little warmer than in the past (+0.2–+0.6°F) most areas.
October: Slightly cooler (-0.1– -0.5°F) across most of Colorado.
November: Mostly unchanged southwest Colorado but a little warmer elsewhere (+0.2–+0.6°F).
December: Unchanged or slightly warmer west of the Continental Divide. Cooler (-0.1– -1.1°F) east of the Divide.

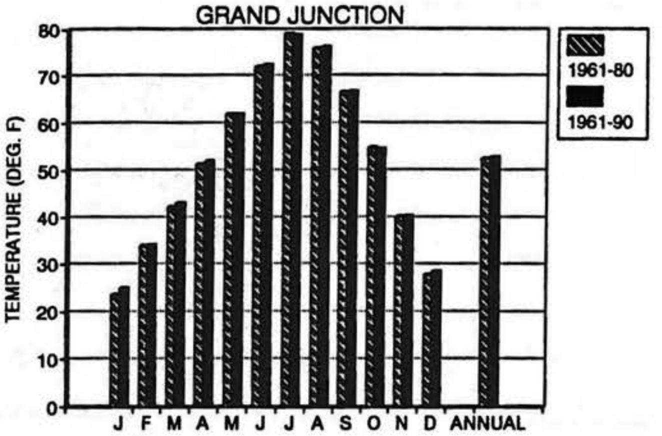
Overall, no dramatic changes were observed anywhere in the State. A number of larger monthly differences (> 1.5°F) were observed, but almost all of the larger changes were attributable to station changes. It is worth noting, though, that in the list above the word "cooler" appears just three times, "unchanged" is mentioned seven times, and "warmer" is stated 10 times.The new averages are warmer than before in four months (January, March, August and September) statewide and unchanged in two months (May and July). Only one month (October) was cooler statewide. The remaining months showed mixed signals although December was distinctly cooler east of the mountains.

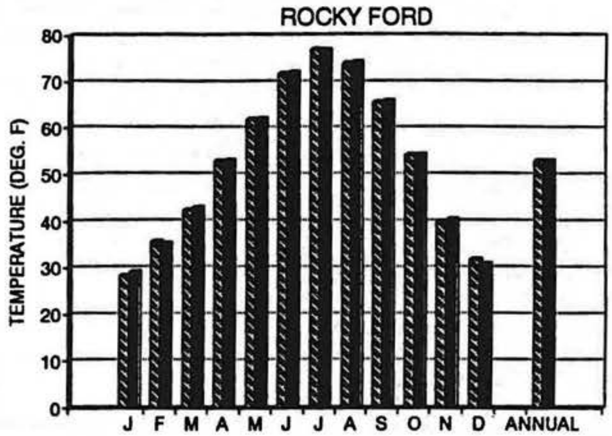
Graphs are shown below comparing the averages we have been using during the past decade (1961-1980) with the averages we will be using for the next ten years (1961-1990) for two example locations, Grand Junction and Rocky Ford. As you can see, when compared to the annual cycle of temperatures, the changes in averages are indeed very small.

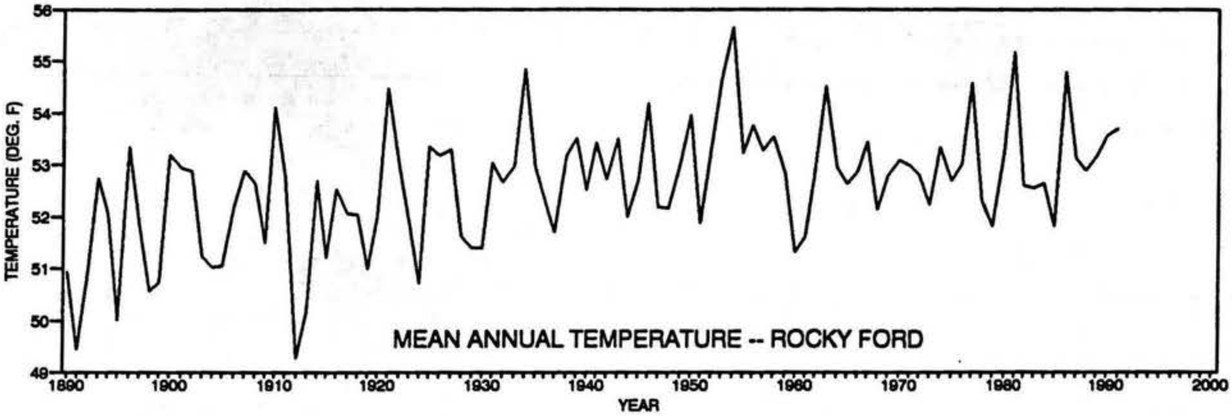
LONG-TERM TEMPERATURE COMPARISONS

It is important to put these recent climatic statistics into a better long-term perspective by including data from before 1961 in this comparison. For most purposes, the average annual temperature does not communicate much about the climate of a location and I rarely suggest using it. Seasonal patterns and daily variations are much more significant. But for the benefit of this comparison, I would like to show you how the new 1961-90 averages that we will be using throughout the 1990s compare to data collected throughout the past century.

A time series of more than 100 years of mean annual temperatures for Rocky Ford (one of Colorado's most consistent long-term stations) suggests that we are indeed warmer now than during the early part of this century. Most long-term stations in Colorado show somewhat similar results. The following table compares mean annual temperatures at selected Colorado locations for 30-year periods beginning each new decade.







Once again, don't expect to see any huge changes here. Thirty-year averages do change, but not by much. Of the six stations shown, two (Durango and Fort Collins) have now reached their warmest average temperature of record. The mean annual temperature at Fort Collins has risen by nearly 2.5 degrees F from the 1891-1920 period to the 1961-1990 period. This is the largest change noted in Colorado but appears to be caused by urbanization in the vicinity of the weather station instead of any widespread regional warming. In Durango, the area surrounding their weather station has also experienced urban growth. At each of the other four locations listed here, the weather stations are outside the main city limits. They each reached their warmest 30-year averages during the middle of the 1900s. The 1961-1990 average for Grand Junction and Rocky Ford are only slightly cooler than their peak values which occurred 1931-1960.

The Center station shows something quite different. The data show that it is now at its coolest level on record. This winter's extreme cold conditions in the San Luis Valley, while other parts of the State are having mild conditions, suggests that it could be true. However, it could easily be attributed to relocation of that station 22 years ago to a more open exposure outside of Center.

What is our conclusion? Without a doubt, the majority of Colorado weather stations have consistently reported warmer temperatures in the past few decades than they did prior to 1930. There is little indication from these data, however, that a dramatic warm-up is underway in our State. In fact, some local areas now appear to be cooler than in the past. It is truly possible in a topographically complex state like Colorado, for warming and cooling to occur simultaneously in areas that are not far apart.

As we continue to gather and analyze statewide data in the years ahead, you can be sure we will revisit this topic on a regular basis.

Mean Annual Temperature (° F) for the indicated time period. * = incomplete 30-year period.

Location	1891-1920	1901-30	1911-40	1921-50	1931-60	1941-70	1951-80	1961-90
Center	40.8*	41.0	41.1	41.1	41.7	41.9	41.1	40.6
Cheyenne Wells	50.4*	50.7	51.5	51.7	52.0	51.3	51.5	51.4
Durango	46.5*	45.9	45.6	45.6	46.2	46.4	46.7	46.8
Fort Collins	46.3	46.4	47.0	47.5	48.1	48.0	48.4	48.8
Grand Junction	52.0*	52.1	52.5	53.0	53.1	52.7	52.6	52.8
Rocky Ford	51.8	52.1	52.3	52.8	53.1	53.1	53.0	53.0

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.

COLORADO CLIMATE

December 1991

Volume 15 Number 3

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

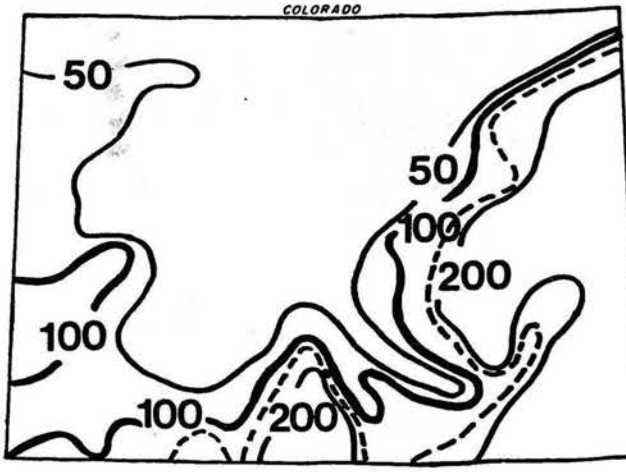
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

December Climate in Perspective – Cold in the Valleys

Fewer storms than normal moved across Colorado during December 1991. The persisting storm track was very far south with storms grazing southern and eastern parts of Colorado while missing northern areas. Temperatures were quite mild with only minor intrusions of arctic air into the State, but some high-elevation valleys generated their own frigid air. Snowcover, frequent clear skies and light winds allowed very cold air to become trapped in several valleys for most of December.

Precipitation

For the second consecutive month, parts of the eastern plains were much wetter than average. Some of the winter precipitation on the plains even fell as rain.

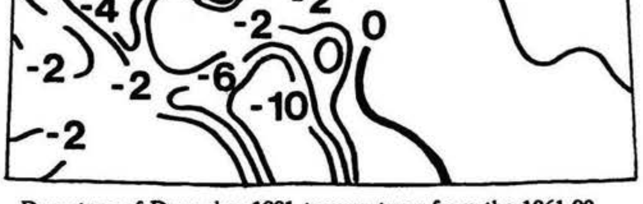


December 1991 precipitation as a percent of the 1961-1990 average.

Monthly precipitation totals exceeded 1.00" at several plains stations – three to four times their paltry December averages. The situation was much different elsewhere in the state. The southernmost mountains of Colorado received average precipitation, but the remainder of the state was much drier than average. Little or no precipitation fell along the Front Range corridor and only 20-50% of the average December precipitation was reported in the northern and central mountains.

Temperatures

An episode of arctic air early in December was the only near-zero weather that most parts of Colorado had to endure. There were also only a few days of abnormally warm weather. But the main story in December was the frigid temperatures that developed in some of Colorado's high, broad valleys. While the Eastern Plains enjoyed temperatures one to five degrees above average for December, and the high mountains were slightly warmer than average, several valley communities on the Western Slope were 2 to 6 degrees F colder than average. The San Luis Valley had a remarkable month ending up 10-12 degrees below average, the coldest December on record at Alamosa.



Departure of December 1991 temperatures from the 1961-90 averages.

Inside This Issue

DECEMBER 1991 DAILY WEATHER

1-3 Icy cold air gripped Colorado. Numerous subzero temperatures were reported in the mountains, especially 1-2nd, and single digit lows were widespread across the plains. Spicer (southwest of Walden) recorded -28° early on the 1st. Light snow ended over southeast Colorado on the 1st. Then snow showers began in the mountains on the 2nd as winds aloft shifted to the northwest and became strong. Wind gusts topped 50 mph in some eastern foothills and high mountain locations 2-3rd. Skies cleared on the 3rd, and temperatures began to moderate slightly.

4-9 The entire state was dry and sunny 4-7th with pleasantly mild temperatures. Eastern Colorado enjoyed daytime temperatures in the 50s and 60s while the mountains and western valleys were generally in the 30s and 40s. Very mild nighttime temperatures were also noted in the eastern foothills. However, pockets of colder air formed in some mountain valleys, particularly the snow-covered San Luis Valley. Wheat Ridge soared to 72° on the 7th, the warmest in Colorado for December. That same day, Alamosa only reached 26°. A Pacific cold front then zipped across the State on the 8th bringing cooler temperatures and dropping a few inches of snow across northwest Colorado. Sunshine returned on the 9th along with seasonal temperatures.

10-12 A low pressure area aloft which had been spinning harmlessly off the California coast began drifting eastward on the 10th. Clouds increased, and temperatures remained very mild that night. Precipitation began early on the 11th and became quite heavy over parts of extreme southern Colorado. Pagosa Springs picked up 1.04" of moisture in the form of wet, sloppy snow. Manassa, southwest of Alamosa, got 12" of new snow. Later on the 11th, rain, freezing rain and wet snow spread out onto the eastern plains, but totally missed most Front Range locations. Burlington picked up 0.65" of moisture, mostly rain, and Bonny Lake reported 0.88" (their greatest 1-day precipitation total ever recorded in December). Skies cleared on the 12th over most of Colorado, but fog remained in some valley locations.

13-17 Strong northwesterly winds developed on the 13th driving very cold air into Colorado. Temperatures only rose into the teens in the northern and central mountains on the 13th with periods of light snow. The rest of the State remained dry, and areas east of the mountains were much warmer as a result of downslope winds. Alamosa dipped to -28° early on the 14th which tied for the coldest temperature in Colorado this December. Winds and temperatures then moderated over most areas, but frigid stable air remained trapped in many mountain valleys which set up some amazing local contrasts. On the 16th, Pueblo basked in sunshine and 64° warmth while Alamosa only reached a high of 11° with dense fog.

18-22 Unsettled weather marked this period as a strong storm approached from the west on the 18th, stalled and sank southward into Mexico (bringing good rains to the Arizona deserts), and then nipped Colorado again on the 22nd as it suddenly moved northeastward. Moderate to heavy snow began late on the 18th and ended on the 19th across parts of southwest Colorado with lighter amounts in the northern and central mountains. Cedaredge measured 5" of new snow. Durango got 10" of snow with 1.21" water content. Wolf Creek Pass totalled 17". A scant dusting of snow fell along the Front Range on the 20th. Then snows developed again on the 22nd mostly in a band from Alamosa and Walsenburg northeast to Akron and Holyoke. As much as 6" of snow fell in some areas.

23-28 A large ridge of high pressure over the Rockies brought calm and sunny weather, mild days and cold nights to most of Colorado for the Christmas holiday. Fog and cold temperatures remained trapped in some western valleys (Delta and Grand Junction, for example) and some cloudiness slipped into extreme southern Colorado 25-28th. But most of the state enjoyed cloudless skies and dry roads for holiday travel.

29-31 December ended with a weak storm system passing across southern Colorado. Very light snows began on the 29th in western Colorado and continued sporadically on the 30th. The storm became better organized on the 31st and spread snow out across most of eastern Colorado. Limon received 5" and Akron 6". For a few hours on New Year's Eve, snow also fell along the Front Range corrider producing hazardous driving conditions just in time for holiday festivities.

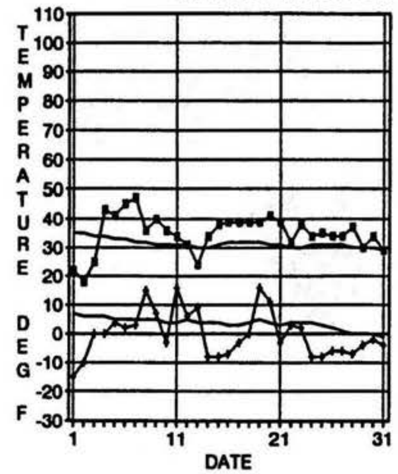
Weather Extremes

Highest Temperature	72°	December 7	Wheat Ridge
Lowest Temeprature	-28°	December 1	Spicer
		December 14, 15	Alamosa WSO
Greatest Total Precipitation	3.80"		Wolf Creek Pass 1E
Least Total Precipitation	0.00"		Briggsdale, Nunn, Littleton, Waterdale, Estes Park, and others
Greatest Total Snowfall	46"		Wolf Creek Pass 1E
Greatest Depth of Snow on Ground	52"	December 1, 19	Wolf Creek Pass 1E

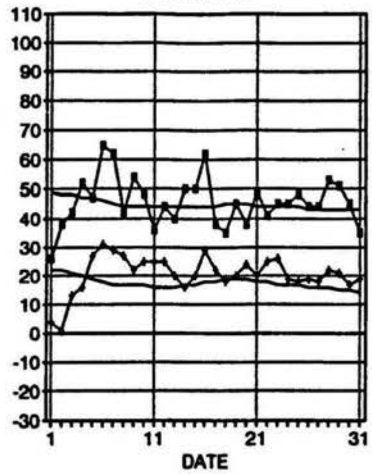
DECEMBER 1991 TEMPERATURE COMPARISON

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.)

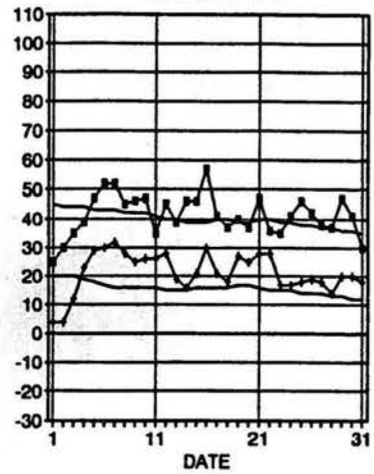
GRAND LAKE 1NW



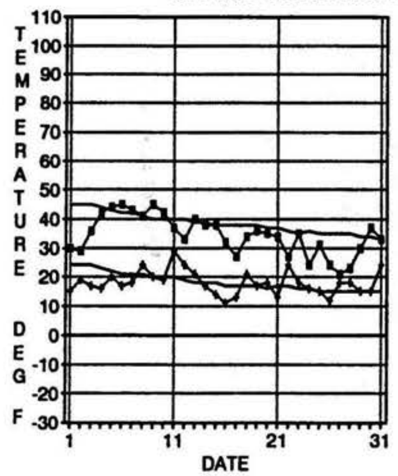
DENVER



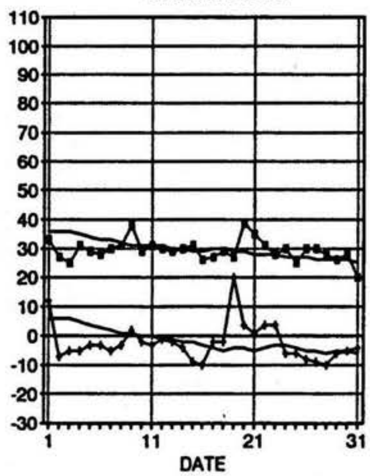
AKRON 1N



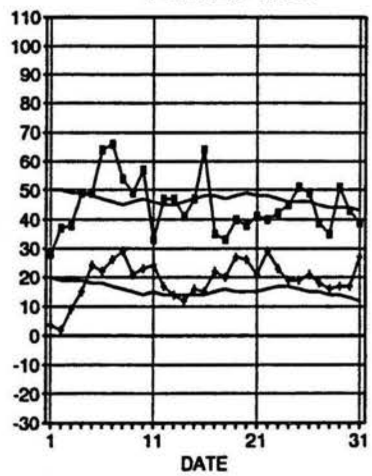
GRAND JUNCTION



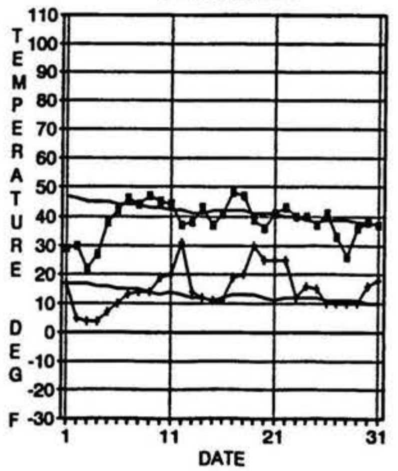
GUNNISON



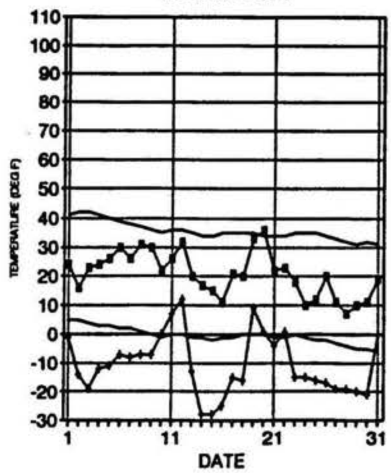
PUEBLO WSO



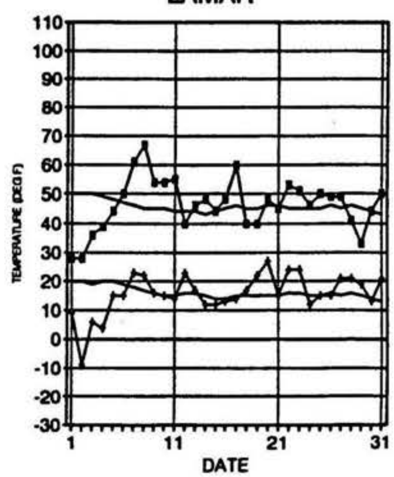
DURANGO



ALAMOSA

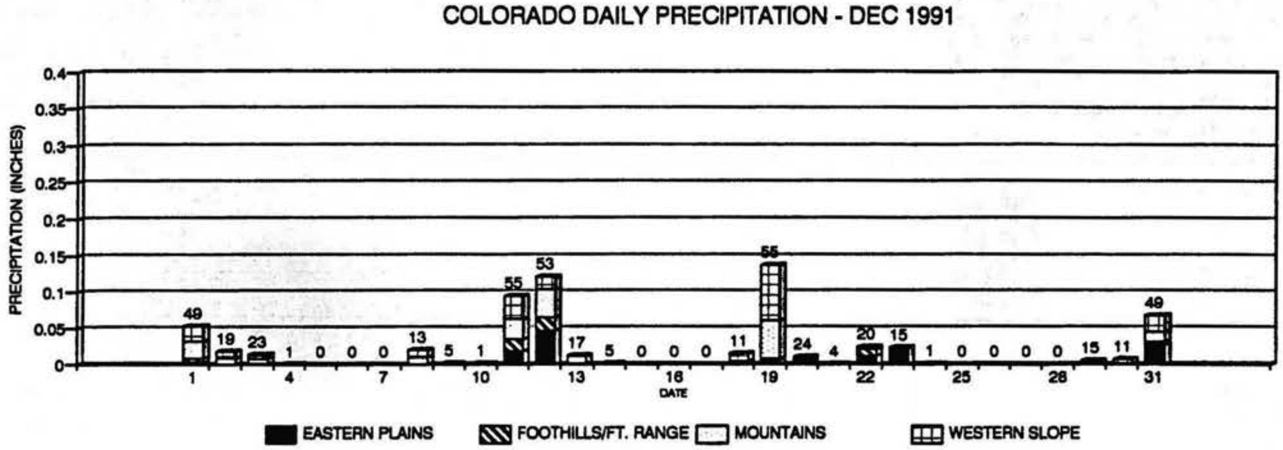


LAMAR

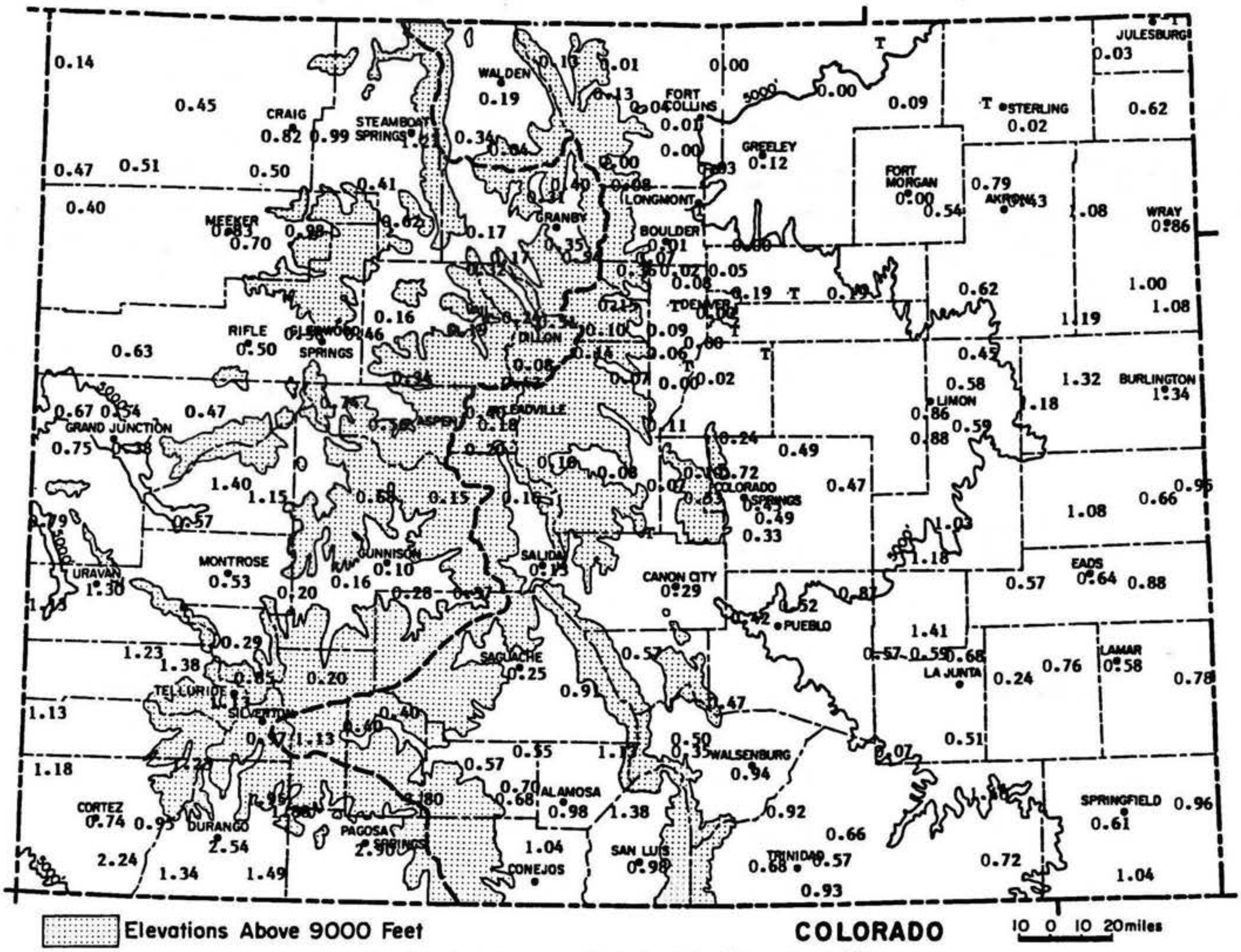


DECEMBER 1991 PRECIPITATION

On five days in December close to half of the State received precipitation. The heaviest precipitation fell on the 19th, primarily over the mountains and Western Slope. This graphic provides a quick analysis of when and where precipitation fell based on data from 80 representative stations. Each bar represents an estimate of total daily precipitation averaged over the entire area of Colorado. The small number above the bar indicates what percent of the weather stations received precipitation on that day.

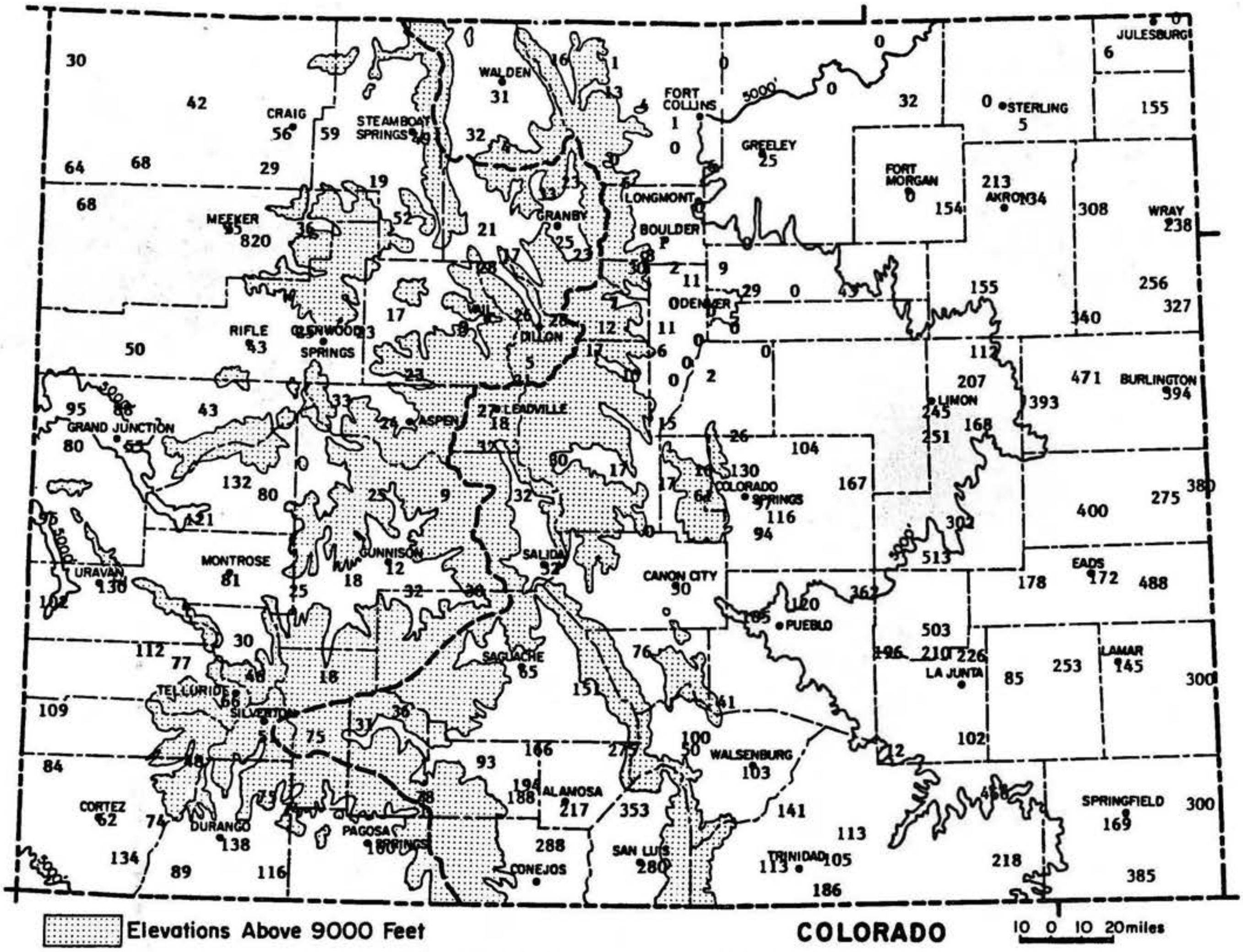


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

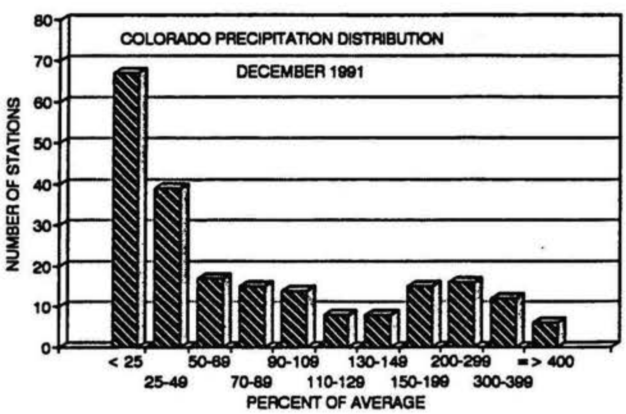


Precipitation Amounts (in inches) for December 1991.

DECEMBER 1991 PRECIPITATION COMPARISON



December 1991 Precipitation as a Percent of the 1961–90 average.

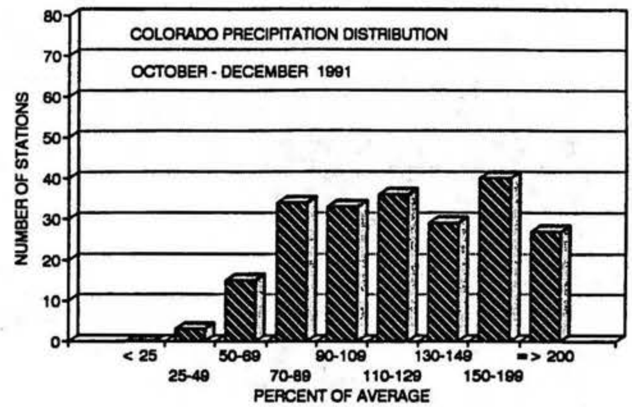


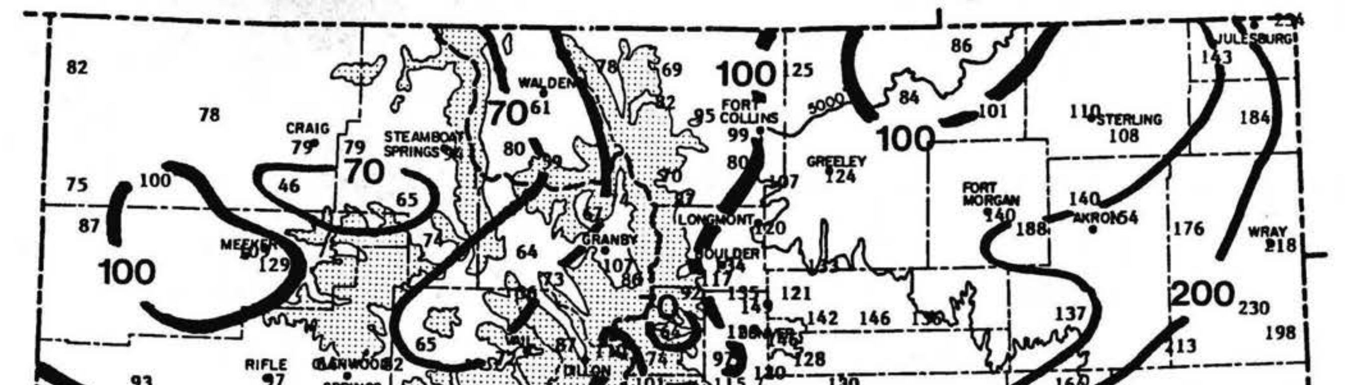
DECEMBER 1991 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.19"	24th driest in 120 years of record (driest < 0.01" in 1881 and 1905)
Durango	2.54"	22nd wettest in 98 years of record (wettest = 7.37" in 1921)
Grand Junction	0.54"	45th wettest in 100 years of record (wettest = 1.89" in 1951)
Las Animas	0.24"	61st wettest in 125 years of record (wettest = 3.69" in 1913)
Pueblo	0.52"	40th wettest in 123 years of record (wettest = 1.35" in 1913)

1992 WATER YEAR PRECIPITATION

After the first three months of the 1992 water year, accumulated precipitation is much above average across the San Luis Valley and most of eastern Colorado. The situation has deteriorated quickly in the northern and central mountains, however, as a result of a very dry December at a time when precipitation is normally heavy. A sizeable portion of the snow accumulation season still lies ahead, so there will still be many opportunities for this situation to change between now and the summer.





October–December 1991 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR DECEMBER 1991

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849							4106
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369							3636
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911							2290
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265							M
BURLING-	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
TON	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004							2502
CANON	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945							2237
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048							2632
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227							2779
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517							3449
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302							2607
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982							2461
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447							4603
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179							2658
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358							3133
EVER-	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
GREEN	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078							3179
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002							2507
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025							2507
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193							2351

* = 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	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
6SSW	91-92	220	255	427	739	1169	1468							4278
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011							2518
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597							4068
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966							2275
LEAD-	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
VILLE	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461							4777
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095							2802
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047							2623
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367							3175
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312							2752
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362							3416
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014							2398
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185							2711
STEAMBOAT	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626							4170
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028							2493
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	89-90	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264							3549
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004							2369
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422							4269
WALSEN-	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
BURG	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915							2171

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

DECEMBER 1991 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	43.8	15.7	29.7	3.2	67	5	1088	0	25	0.00	-0.40	0.0	0
STERLING	45.2	18.0	31.6	5.3	64	0	1028	0	16	0.00	-0.33	0.0	0
FORT MORGAN	44.8	18.6	31.7	5.3	60	5	1025	0	16	0.00	-0.27	0.0	0
AKRON FAA AP	41.1	21.3	31.2	3.4	57	4	1040	0	5	0.79	0.42	213.5	3
AKRON 4E	40.5	17.4	28.9	2.2	58	0	1111	0	8	0.43	0.11	134.4	2
HOLYOKE	45.7	19.1	32.4	3.7	69	5	1002	0	34	0.62	0.22	155.0	3
JOES	42.2	19.4	30.8	1.2	61	4	1054	0	15	1.19	0.84	340.0	3
BURLINGTON	41.5	23.3	32.4	3.2	62	6	1004	0	16	1.34	1.00	394.1	4
LIMON WSMO	38.8	20.0	29.4	2.2	59	4	1095	0	8	0.86	0.51	245.7	6
CHEYENNE WELLS	43.7	21.7	32.7	2.5	63	0	990	0	19	0.66	0.42	275.0	5
EADS	43.7	20.6	32.2	1.9	64	3	1011	0	22	0.64	0.27	173.0	3
ORDWAY 21N	43.3	16.8	30.1	1.6	66	2	1075	0	27	1.18	0.95	513.0	4
ROCKY FORD 2SE	45.5	18.7	32.1	1.2	68	4	1014	0	28	0.59	0.31	210.7	6
LAMAR	46.5	15.7	31.1	0.3	67	-9	1042	0	30	0.58	0.18	145.0	5
LAS ANIMAS	47.7	19.5	33.6	2.2	69	5	966	0	37	0.24	-0.04	85.7	4
HOLLY	46.1	21.3	33.7	3.5	59	2	963	0	22	0.78	0.52	300.0	6
SPRINGFIELD 7WSW	46.6	23.9	35.3	1.7	71	8	916	0	43	0.61	0.25	169.4	5
TIMPAS 13SW	43.6	21.0	32.3	1.3	65	9	1005	0	27	0.07	-0.48	12.7	2

FOOTHILLS/ADJACENT PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
FORT COLLINS	46.2	18.4	32.3	3.2	67	7	1002	0	25	0.01	-0.50	2.0	1
GREELEY UNC	44.6	19.5	32.1	3.8	62	11	1011	0	19	0.12	-0.36	25.0	1
ESTES PARK	42.0	18.3	30.1	2.2	52	-6	1072	0	2	0.00	-0.47	0.0	0
LONGMONT 2ESE	45.3	16.5	30.9	2.7	65	2	1047	0	24	0.00	-0.58	0.0	0
BOULDER	46.9	23.7	35.3	1.8	63	8	911	0	29	0.01	-0.79	1.2	1
DENVER WSFO AP	45.6	20.6	33.1	2.1	65	1	982	0	26	0.19	-0.45	29.7	2
EVERGREEN	46.7	13.2	29.9	2.2	64	-1	1078	0	35	0.09	-0.70	11.4	3
CHEESMAN	45.9	9.5	27.7	-0.8	63	-3	1149	0	30	0.11	-0.60	15.5	2
LAKE GEORGE 8SW	27.9	-0.2	13.9	-3.4	42	-11	1578	0	0	0.08	-0.38	17.4	2
ANTERO RESERVOIR	27.2	-10.7	8.2	-7.0	42	-27	1750	0	0	0.10	-0.23	30.3	2
RUXTON PARK	34.5	6.1	20.3	-1.0	51	-8	1380	0	1	0.53	-0.33	61.6	7
COLORADO SPRINGS	41.3	20.7	31.0	1.2	61	4	1048	0	16	0.45	-0.01	97.8	5
CANON CITY 2SE	46.6	21.7	34.2	-1.8	66	0	945	0	38	0.29	-0.29	50.0	2
PUEBLO WSO AP	44.9	19.2	32.0	1.0	66	2	1014	0	30	0.52	0.09	120.9	4
WESTCLIFFE	32.5	1.7	17.1	-7.1	48	-14	1475	0	0	0.57	-0.18	76.0	6
WALSENBURG	47.1	23.4	35.2	1.2	60	1	915	0	32	0.94	0.03	103.3	5
TRINIDAD FAA AP	45.7	19.1	32.4	-0.1	64	-1	1004	0	26	0.66	0.08	113.8	5

MOUNTAINS/INTERIOR VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
WALDEN	33.4	4.5	18.9	0.8	46	-22	1422	0	0	0.19	-0.42	31.1	4
LEADVILLE 2SW	34.2	0.9	17.6	0.1	50	-9	1461	0	0	0.18	-0.82	18.0	5
SALIDA	39.6	11.9	25.8	-1.3	54	-2	1208	0	2	0.13	-0.27	32.5	3
BUENA VISTA	37.8	8.5	23.2	-2.4	49	-5	1285	0	0	0.16	-0.33	32.7	2
SAGUACHE	24.6	-5.4	9.6	-11.1	35	-16	1709	0	0	0.25	-0.13	65.8	4
HERMIT 7ESE	22.6	-14.2	4.2	-8.4	30	-23	1877	0	0	0.40	-0.88	31.2	3
ALAMOSA WSO AP	20.8	-10.5	5.1	-12.3	36	-28	1849	0	0	0.98	0.53	217.8	7
STEAMBOAT SPRINGS	27.9	-3.3	12.3	-4.9	38	-22	1626	0	0	1.27	-1.31	49.2	9
YAMPA	32.0	8.6	20.3	0.1	45	-9	1378	0	0	0.62	-0.57	52.1	5
GRAND LAKE 1NW	35.1	-0.3	17.4	-0.2	47	-15	1468	0	0	0.40	-1.29	23.7	7
GRAND LAKE 6SSW	27.8	-1.6	13.1	-4.3	40	-13	1603	0	0	0.31	-0.62	33.3	9
DILLON 1E	34.6	1.5	18.1	-0.1	48	-7	1447	0	0	0.24	-0.68	26.1	6
CLIMAX	30.3	5.1	17.7	3.1	44	-9	1459	0	0	0.43	-1.59	21.3	6
ASPEN 1SW	35.1	6.0	20.6	-1.9	46	-3	1369	0	0	0.56	-1.69	24.9	7
CRESTED BUTTE	26.9	-11.0	7.9	-6.1	42	-23	1763	0	0	0.68	-1.95	25.9	7
TAYLOR PARK	22.2	-10.0	6.1	-4.2	37	-24	1822	0	0	0.15	-1.43	9.5	2
TELLURIDE	39.3	8.6	23.9	0.5	50	-2	1264	0	0	1.13	-0.57	66.5	7
PAGOSA SPRINGS	38.2	3.3	20.8	-2.3	46	-6	1362	0	0	2.90	1.09	160.2	8
SILVERTON	33.9	-5.7	14.1	-3.1	42	-15	1570	0	0	0.97	-0.93	51.1	7
WOLF CREEK PASS 1	33.9	8.1	21.0	0.3	46	-6	1357	0	0	3.80	-1.05	78.4	10

WESTERN VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
CRAIG 4SW	26.3	5.4	15.8	-5.0	45	-6	1517	0	0	0.82	-0.63	56.6	9
HAYDEN	25.6	2.3	14.0	-6.1	36	-15	1576	0	0	0.99	-0.67	59.6	7
MEEKER NO. 2	32.7	8.6	20.7	-4.1	50	-7	1367	0	0	0.83	-0.04	95.4	5
RANGELY 1E	29.8	12.1	20.9	0.7	45	3	1358	0	0	0.40	-0.18	69.0	2
EAGLE FAA AP	36.5	5.3	20.9	0.6	46	-4	1358	0	0	0.16	-0.75	17.6	4
GLENWOOD SPRINGS	37.2	12.3	24.7	-0.6	46	5	1243	0	0	0.38	-1.09	25.9	6
RIFLE	39.3	13.7	26.5	1.3	48	5	1185	0	0	0.50	-0.65	43.5	7
GRAND JUNCTION WS	34.4	18.0	26.2	-2.3	45	11	1193	0	0	0.54	-0.07	88.5	4
CEDAREDGE	39.1	11.5	25.3	-3.2	57	0	1223	0	5	1.40	0.34	132.1	6
PAONIA 1SW	34.5	10.3	22.4	-6.1	50	0	1310	0	0	1.15	-0.28	80.4	6
DELTA	32.1	13.3	22.7	-6.2	48	1	1302	0	0	0.57	0.10	121.3	5
GUNNISON	29.4	-2.9	13.3	-1.2	39	-10	1597	0	0	0.10	-0.68	12.8	1
COCHETOPA CREEK	33.4	-0.9	16.3	1.3	42	-10	1502	0	0	0.28	-0.58	32.6	4
MONTROSE NO. 2	32.7	12.2	22.5	-5.1	59	5	1312	0	5	0.53	-0.12	81.5	4
URAVAN	38.1	18.7	28.4	-2.0	54	11	1129	0	2	1.30	0.30	130.0	5
NORWOOD	35.7	8.4	22.0	-2.9	46	-3	1323	0	0	1.23	0.14	112.8	7
YELLOW JACKET 2W	39.2	15.5	27.3	-0.5	50	1	1162	0	0	1.18	-0.21	84.9	7
CORTEZ	37.3	13.2	25.2	-2.8	48	2	1227	0	0	0.74	-0.44	62.7	7
DURANGO	38.5	15.1	26.8	-0.6	48	4	1179	0	0	2.54	0.71	138.8	8
IGNACIO 1N	36.8	15.8	26.3	0.4	46	3	1190	0	0	1.49	0.21	116.4	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.

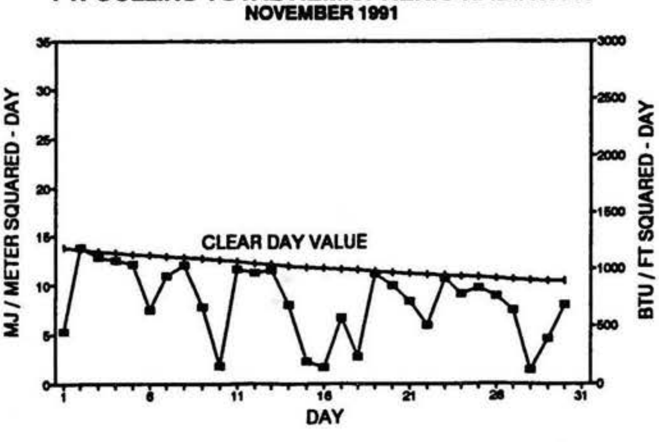
DECEMBER 1991 SUNSHINE AND SOLAR RADIATION

	Number of Days			Percent Possible	Average % of
	CLR	PC	CLDY	Sunshine	Possible
Colorado Springs	16	5	10	--	--
Denver	14	7	10	70%	67%
Fort Collins	16	9	6	--	--
Grand Junction	13	4	14	57%	61%
Limon	11	9	11	--	--
Pueblo	14	7	10	68%	72%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Fog and low clouds were a problem in December in some of Colorado's western valleys. Still, there were an unusually large number of clear days statewide for this time of year.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
NOVEMBER 1991

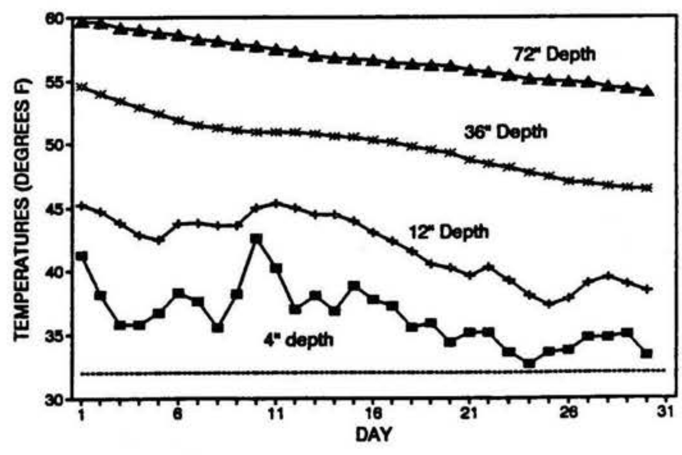


DECEMBER 1991 SOIL TEMPERATURES

Soil temperatures continued to decrease during December, as expected. Although air temperatures were above average in Fort Collins, a total lack of snowcover throughout the month allowed heat to escape steadily. The frost penetration was not deep, though. Episodes of prolonged or extreme cold accompanied by minimal snowcover are required for deep frost penetration east of the mountains.

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 1991



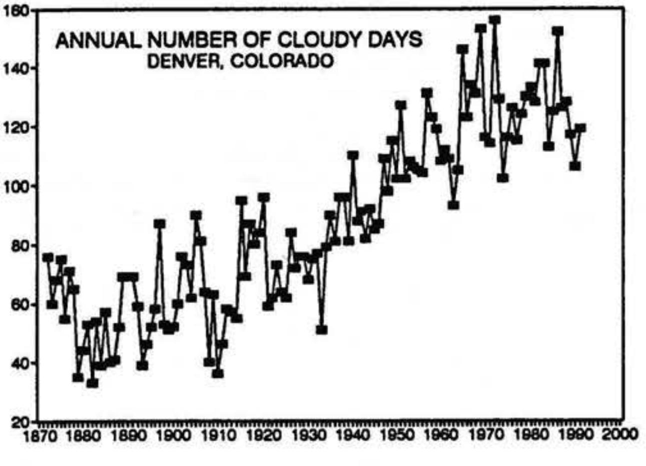
Surprise – Here is a little empty space. Each month, beginning in January we will use this space to acknowledge one of Colorado's cooperative weather observers. Watch for it!

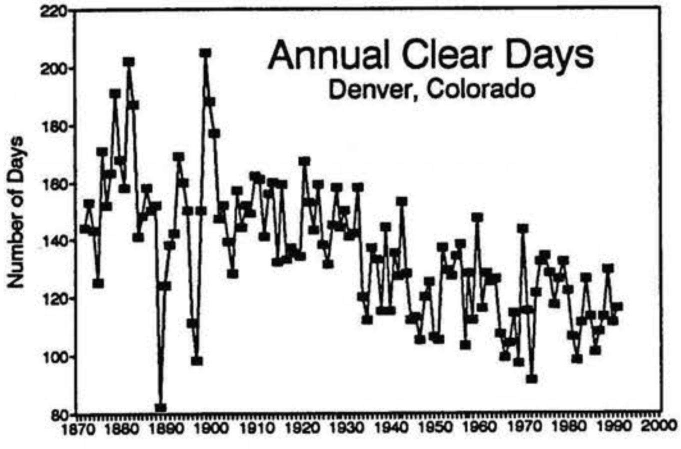
TRENDS IN CLOUDINESS OVER COLORADO – A FRESH LOOK

In earlier editions of "**Colorado Climate**" (October 1986 and February 1987) we looked into the number of clear and cloudy days in Colorado. At that time we took issue with the popular chamber of commerce statement "Colorado enjoys at least 300 days of sunshine each year." We also noted what appeared to be a very significant increase in the number of cloudy days compared to previous decades.

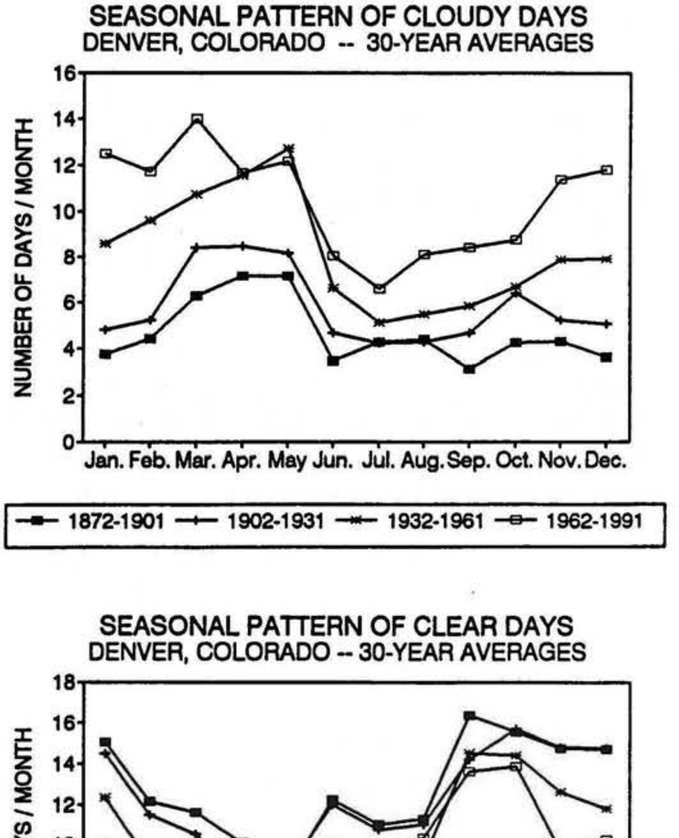
Five years have passed, and I don't know about you, but it sure has seemed to me that sunshine is alive and well again right here in Colorado. So what's the deal? Has the climate changed its mind again? Rather than speculating – which is always easy (and dangerous) to do – let's look at some data.

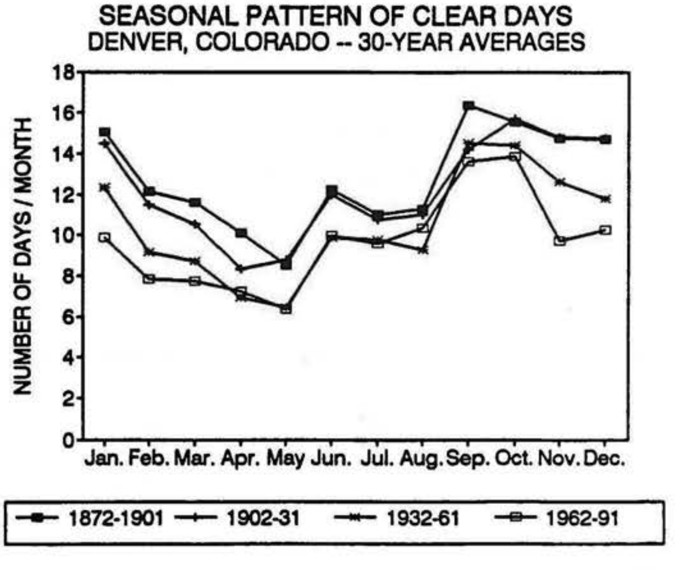
The longest available record on cloudiness in Colorado comes from the official National Weather Service office in Denver. Observations of cloudiness have now been taken at Denver every day for 120 consecutive years. The following two graphs show quite a remarkable "apparent" change in cloudiness with almost twice as many cloudy days now compared with pre-1910 conditions. Any scientist in his right mind would get very excited looking at such a dramatic trend. At the same time, the number of clear days has decreased, although not as dramatically. The remainder of days are classified as partly cloudy. No graph is shown here, but a decrease in partly cloudy days has been observed.





The number of clear and cloudy days appear to have changed, but the seasonal aspects of cloudiness have not. The following graphs show monthly averages of clear and cloudy days for Denver for each of four non-overlapping 30-year periods. Spring has always been the cloudiest time of year, and that fact remains. The number of cloudy days have increased during all months of the year with each successive 30-year period. The most dramatic changes appear during the winter months. For example, Denver averaged just 4 cloudy days in January for the 1872-1901 period. The average for 1962-1991 is more than 12. Clear days have decreased but wuth almost no change in seasonality. In an average year in Denver, clear days decline throughout the spring, reach a low point in May, shoot up in June and then decline slightly in July and August. September and October continue, as always, to be the time of year with the most clear days.





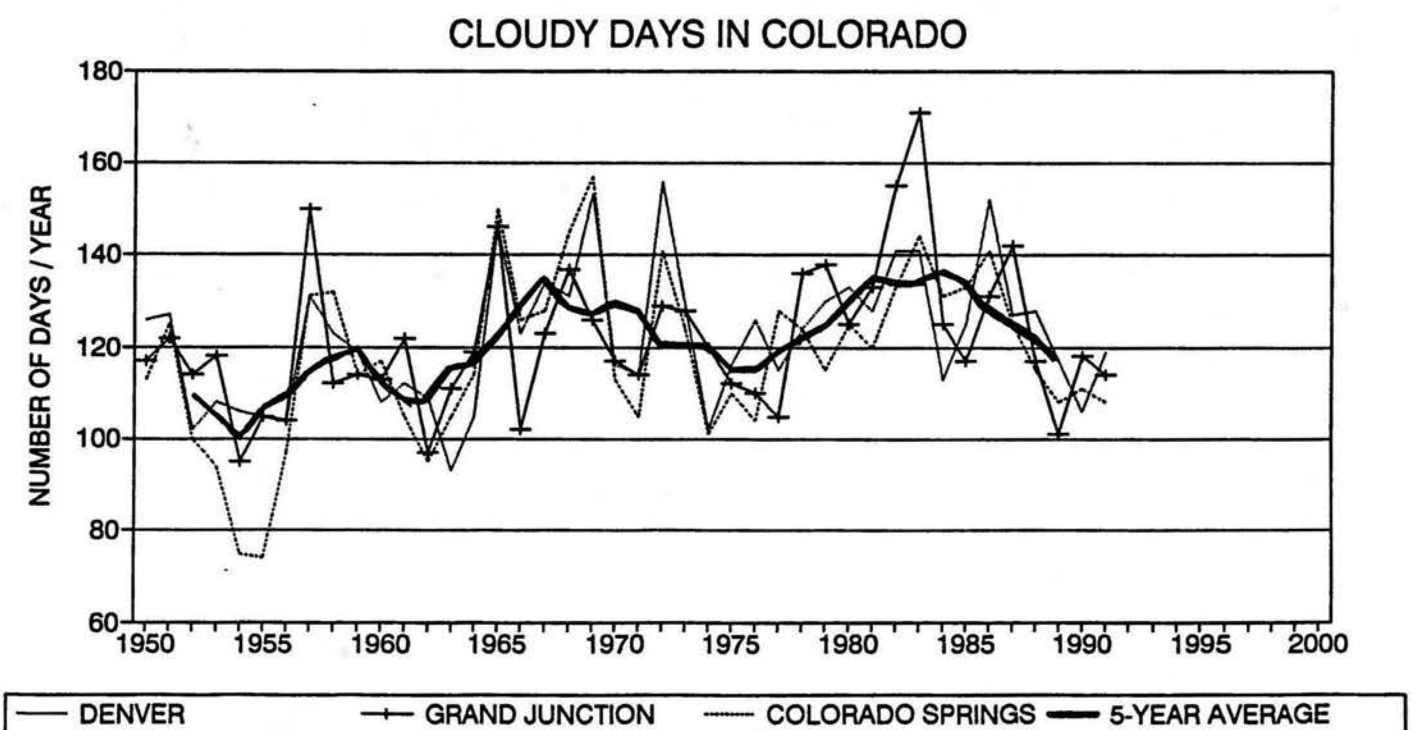
Are these statistics believable? The seasonal patterns are certainly true. As for the upward trend in cloudiness – that may also be true, but the rate of change is hard for me to swallow. Doubling in the number of cloudy days in less than a century seems impossible or at least very unlikely. There has been no systematic trend in precipitation over that period, and temperatures have changed only a little. On the other hand, the definition of clear, partly cloudy and cloudy is the same now as it was 120 years ago. The evaluation of cloudiness then and now was done visually by a human at specific times of day. Eachday's observations were combined to determine daily average skycover. 0-30% sky cover constitutes a clear day. 80-100% sky cover is classified as a cloudy day.

The definition has not changed, but procedures for sky cover evaluation may not have been specific early in weather observing history. For example, we are uncertain if early observers reported thin clouds through which sunlight easily penetrated. However, starting in the 1930s with the rapid growth of civil aviation, specific rules for evaluating sky condition were adopted and federal certification became a requirement for all aviation weather observers. Based on current weather observing regulations, clouds which are fairly transparent to sunlight do contribute to total sky cover. This might explain some of the observed increases.

When we only look at the past 40-years, the period when we are confident that the cloud observations are consistent, the increase in cloudy days is still noticeable. For three Colorado cities; Denver, Colorado Springs and Grand Junction; cloudy days increased by about 15% from the 1950s to the 1980s. When we first looked at this graph in early 1987 we had just experienced some of the cloudiest years in Colorado history. Since then, several well-known climatologists have published papers documenting significant increases in cloudiness over various regions of the Northern Hemisphere including most of the United States.

But lets get back to our original question. Has sunshine returned to Colorado? Indeed, the last four years have brought a marked decline in the number of cloudy days. Based on these three stations, the annual average number of cloudy days 1988-1991 has been 114. By comparison, the average for the previous decade had been 133. Solar energy enthusiasts can take heart – at least for now, the trend has reversed. The sun is back!

By the way, while we disagree with the idea that we have 300 or more sunny days everywhere in Colorado, we certainly know that sunshine is a very important and enjoyable part of our climate. Las Vegas and El Paso have us beat by a mile, if the number of sunny days is the only thing you're concerned about. But it takes a balance of sunshine and clouds to produce the things that we have come to take for granted – our four-season climate, rushing rivers, a very productive statewide agricultural industry, snow and tree-covered mountains, and entertaining summer thunderstorms. We can argue about increasing clouds if we wish, but any newcomer from Michigan, Ohio, Washington or many other places would probably just laugh.



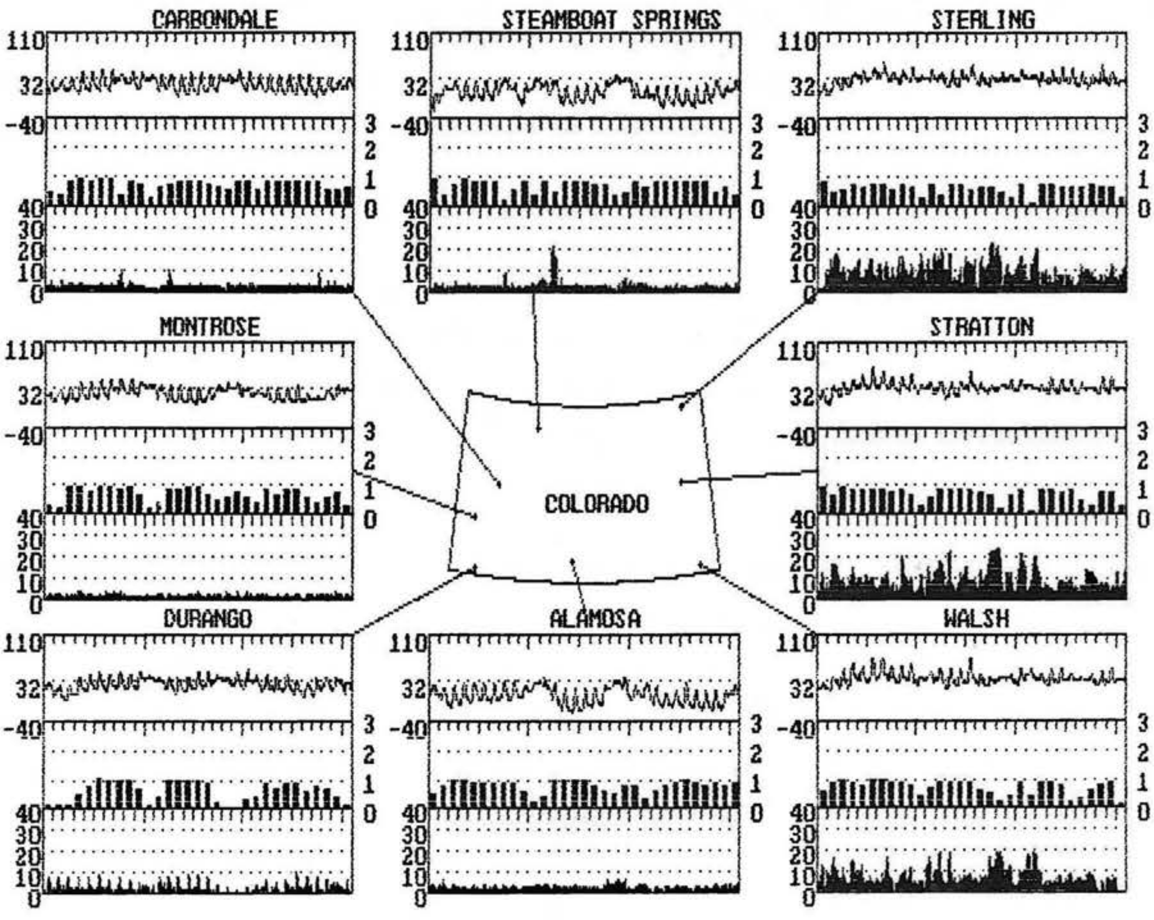
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA DECEMBER 1991

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)	4.2	23.3	20.1	20.7	7.6	30.5	30.6	33.1
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	34.5 12/14	46.6 21/15	45.9 6/15	45.7 7/15	36.1 19/14	638.6 3/ 4	65.3 6/14	69.3 6/15
minimum:	-25.1 15/ 7	-4.0 3/ 7	1.0 14/ 7	2.7 3/ 1	-22.7 1/ 8	1.6 1/23	3.9 2/ 3	10.6 2/ 6
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	86 / -8	87 / 13	92 / 10	86 / 10	88 / -2	34 / -2	90 / 22	83 / 21
11 AM	86 / 7	63 / 19	64 / 15	69 / 16	81 / 8	25 / 1	72 / 29	58 / 25
2 PM	72 / 12	59 / 20	47 / 16	60 / 17	60 / 9	22 / 4	63 / 29	49 / 25
5 PM	77 / 8	70 / 20	54 / 14	68 / 15	68 / 5	26 / 0	78 / 27	60 / 23
11 PM	88 / -3	89 / 17	87 / 12	85 / 12	89 / 2	31 / -0	87 / 23	79 / 23
monthly average wind direction (degrees clockwise from north)								
day	191	200	169	122	144	219	185	193
night	175	85	155	205	116	241	234	255
monthly average wind speed (miles per hour)	2.26	2.17	1.91	1.58	1.67	8.90	8.76	6.84
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	580	567	688	694	684	114	32	91
3 to 12	164	157	52	50	50	491	561	542
12 to 24	0	0	0	0	10	138	148	91
> 24	0	0	0	0	0	1	3	0
monthly average daily total insolation (Btu/ft²·day)	751	581	664	670	660	565	694	690
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	140	100	115	113	135	88	132	129
40-60%	92	47	68	60	68	89	76	69
20-40%	56	53	83	74	57	42	40	47
0-20%	18	96	21	38	19	47	29	40

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.



KEEP THE HOME FIRES BURNING

Fire was most likely one of the main reasons that the species *homo sapiens* flourished. It certainly allowed man to spread to climates that otherwise were hostile. Jumping forward a bit, western European men had their fires outside during the summer for cooking and brought them inside to hearths that were nothing more than a stone slab in the middle of the floor. Smoke escaped through a hole in the roof or through crannies within the walls. It wasn't until the late thirteenth century that a crude chimney was built. Hearths were moved to the walls in the Norman castles because the second floors were made of wood which made the central hearth impractical. And by the late fourteenth century, there were wall fireplaces with chimneys in many room within a castle. But the common man made do with a hole in the roof of his cottage until the late 1500's. The closed stove began to appear in the 1700's. It provided prodigious amounts of heat to a room with just a small amount of wood as long as minimal fresh air was allowed into the room. Thermostatic controls for these stoves were invented in 1849 by the American Elisha Foote. We Americans produced more iron stoves than other countries during the 1800's. Now, with the advent of central heating, wood stoves are a rarity, not the common sight they once were.

Among the problems facing us today is the fact that the fossil fuel used to heat our homes is a dwindling fuel source. Some people are choosing to revert back to the days when the fuel was burned in the home to provide the heat directly. However, wood stoves have changed since the days of Ben Franklin. Technology has built stoves that burn wood pellets made of sawdust and agricultural residue. Not only is the fuel source different, these pellets can be added to the fire as needed by automatic controls. Definitely not the 'tending of the home fires' one may think of when referring to a wood stove. Even stoves using wood as fuel can provide heat for up to 8 hours without refueling. Today's wood stoves may have small electric blowers which circulate the warmed air. This allows for convective heat transfer as well as radiative heat transfer. Homes with a ceiling fan can create their own convection to work in tandem with a stove whose main form of heat transfer is radiation.

In the early days when the hearth was the only form of heating and cooking, wood preparation was an art. Wood was well seasoned and usually 'toasted' into a semi-charcoal state before being brought into the home. In parts of the Mediterranean, the wood was soaked in oils and aromatics. The laying of the fire had a precise method with its own vocabulary. Generations passed down how to choose the best woods for particular uses. Today, the U.S. Department of Energy can tell us approximate heating values on varying woods. Their values are for a cord of wood. A standard cord of wood is 128 cubic feet, an 8 foot by 4 foot stack which has a depth of 4 feet. Table 1 shows some of these values in millions of BTU's per cord. The cost of the heat in the wood is (2 x cost per cord/MMBTU per cord) assuming a 50% efficient stove. The actual wood heating cost includes the cost of the stove and chimney.

TABLE 1

Approximate Heating Values per Cord of Wood

High (24-31 MMBtu)	Medium (20-24 MMBtu)	Low (16-20 MMBtu)
Oak	Western larch	Black Spruce
Dogwood	Pond pine	Red fir
Slash pine	Juniper	Black willow
Apple	Red maple	Ponderosa pine
Sugar maple	American elm	Quaking aspen
Longleaf pine	Douglas fir	Sugar pine
White ash	Norway pine	White pine
Black walnut	Chestnut	Western red cedar

When deciding what size stove is best, the saying "bigger is better" does not apply. If the stove is too large for the home, the heat it puts out will overwhelm the residents and it will be damped way down. This causes the fire to be oxygen starved and created excess creosote which can build up and be a potential chimney fire. Most dealers of stoves give an approximate floor size for which their stove will comfortably provide heat. This is fine for the typical home, however, it your home has more than average insulation, or has more than average infiltration of air, this approximation may not hold.

Environmentally, wood heating is not a 'clean' burning form of energy. It releases carbon dioxide into the air which may or may not influence the greenhouse effect so prevalent in today's news. The metro area of Denver and Boulder regulate this by codes requiring specific equipment which helps to reduce this wood air pollution. This air pollution is a problem that man has been dealing with since he started using stoves for heating. There were formal complaints from France during Tudor times that the vines were being ruined by London smoke. And an anti-smog leaflet tried to influence the burning of coal in London in 1661. Wood, as a fuel source, needs to be tended by man to assure its continued existence. This is especially true in developing countries where 80% of the people use wood as a principle fuel source. It is expected that wood, as a form of solar energy, will be used for many years to come if the resource it treated properly and not overused.

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COLORADO CLIMATE

JANUARY 1992

Volume 15 Number 4

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

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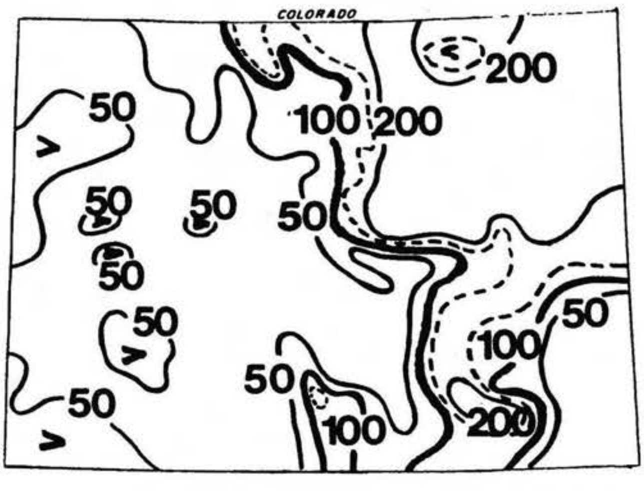
January Climate in Perspective – Dry in the Mountains

A pair of respectable winter storms struck Colorado during the first half of January. These were followed by a brief shot of arctic air that hit late on the 14th. The rest of the month was remarkably dull for this time of year with many days of sunshine and light winds. This allowed cold, stagnant air to linger in several of Colorado's high valleys, especially near Alamosa and Delta.

Precipitation

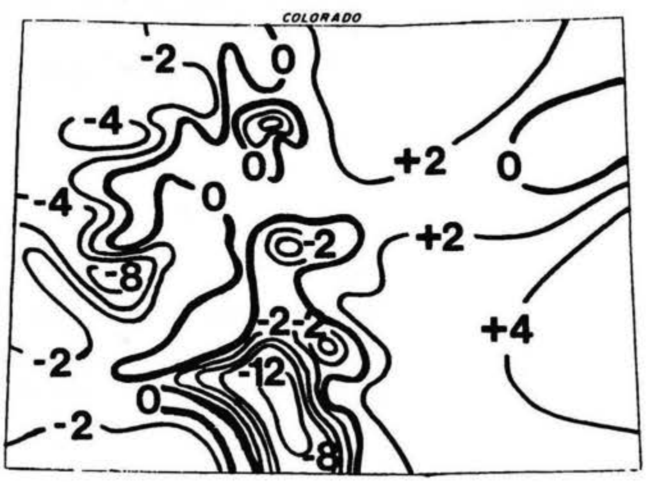
January was the third consecutive month with above average precipitation over the normally dry Eastern Plains. But for the mountains and Western Slope, where mid-winter precipitation normally falls frequently and abundantly, this was the second month in a row with few storms and much drier than average conditions. For much of the mountains, the storm of Jan. 7 was the only significant snow event. For the month as a whole, the northeast quarter of Colorado ended up with more than double their meager average for January, while most of the remainder of Colorado recorded less than 50% of average. Monte Vista reported no precipitation all month.



January 1992 precipitation as a percent of the 1961-1990 average.

Temperatures

One brief surge of arctic air whipped down across eastern Colorado late on the 14th dropping temperatures below zero for a few hours. Otherwise, January was characterized by fairly pleasant midwinter temperatures for most mountains and plains locations. There were several dramatic local exceptions, however, as frigid air collected and remained in the San Luis Valley, the valleys from Paonia and Montrose downstream to Grand Junction and a few other locations. For the month as a whole, temperatures ranged from more than 13 degrees below average at Alamosa to several degrees above average along the Front Range and the southeastern plains.



Departure of January 1992 temperatures from the 1961-90 averages.

Inside This Issue

JANUARY 1992 DAILY WEATHER

1-3 Snow ended during the morning of the 1st over northeastern Colorado leaving cold temperatures and a 3-8" blanket of brilliant white snow. Meanwhile, fog and low clouds filled some western valleys, and all of the Western Slope remained cold. With plenty of sunshine, temperatures moderated quickly 2-3rd east of the mountains, but cold air remained entrenched in the western valleys. Alamosa only reached a high of +2°F on the 3rd. Taylor Park Dam reported a low of -32° on the 3rd – the coldest in Colorado for the month.

4 A California storm system raced eastward across the Rockies. The mountains and Western Slope picked up a few inches of snow, but the storm moved too quickly to drop heavy amounts. Only a few flakes spilled across into the eastern foothills, and the plains remained dry.

5-8 The 5th was a pleasant midwinter day over much of the State and pleasant weather continued on the 6th over eastern portions of Colorado. Clouds and wind increased on the Western Slope and pressure dropped sharply statewide on the 6th. Snow began in southwest Colorado and spread northeastward. Then, early on the 7th, the deep low pressure area emerged from the mountains over southeast Colorado. Heavy snow developed quickly across northeast Colorado including Denver, and strong winds lashed all of the Eastern Plains. The storm behaved like a typical spring storm with snowfall rates in excess of 1" per hour, considerable water content, and strong winds. Blizzard conditions closed many highways, and the Denver airport suspended operations for several hours The heaviest snow fell in a band from Monument northward along and east of I-25. Greeley and Parker each reported 9". Denver's Stapleton Airport totalled 14.8". The eastern foothills missed the brunt of the storm, but an area in the northern mountains was hit surprizingly hard. 18" fell at the Hohnholz Ranch on the Laramie River. Rand got 14". Walden reported 0.96" of water equivalent on the 7th (12" snow), setting a new 1-day precipitation record for January. Snow ended and skies cleared on the 8th but temperatures were quite cold.

9-13 Sunny but cold on the 9th. Continued very cold in the mountain valleys on the 10th with local dense fog, but from the mountains eastward, temperatures warmed nicely. Clouds increased on the 11th as a disturbance approached Colorado from the northwest and another system south of Arizona began moving northward. Snow fell over much of the Front Range and Eastern Plains on the 12th as the two systems combined. Most locations received 1-5" of snow but local areas including Monument and the foothills west of Boulder got more than a foot of fluffy snow. The 13th was sunny but cold.

14-15 Arctic air plummetted southward from Canada on the 14th. The cold wave hit the Eastern Plains late that evening accompanied by blowing snow and white-out conditions. Temperatures dropped below zero over much of the State by the 15th, the only subzero reading of the month for eastern Colorado. Akron dipped to -10° and Denver hit -5°. The coldwave was brief, however, and by late on the 15th a warming trend had already begun.

16-20 A dry and sunny period for most of Colorado. A few light snow showers fell on the 17th, mostly in the northern mountains, associated with an upper level disturbance. A very strong ridge of high pressure then developed over the western U.S. keeping frigid, stable air trapped in all the high valleys. From Craig to Alamosa, subzero nighttime temperatures in the valleys were widespread.

21-24 An upper-level low pressure center passed south of Colorado on the 21st. Downslope winds developed east of the Front Range on the 22nd as the storm moved toward the Midwest. Very strong winds continued at mountain-top level on the 23rd with a few mountain snowshowers. A warm chinook wind developed early on the 24th, raising temperatures into the 50s and 60s east of the Front Range. Winds were locally very severe, however, with localized damaging wind gusts over 75 mph from Fort Collins south to Golden.

25-31 Dry, sunny and warm for the mountains and eastern plains. Even the mountain valleys began to moderate as high pressure persisted. The month ended with the mildest temperatures of the month – highs in the 30s and 40s in the mountains with 50s and 60s out on the plains. Pueblo hit 72° on the 31st, the warmest in Colorado for the month.

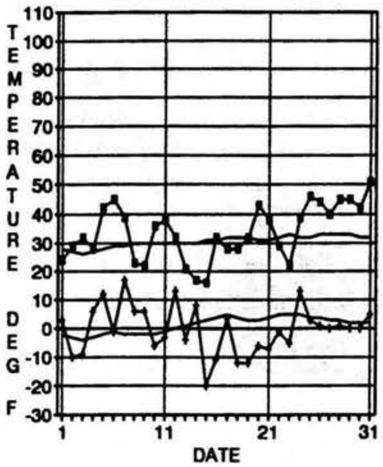
Weather Extremes

Highest Temperature	72°	January 31	Pueblo WSO AP
Lowest Temperature	-32°	January 3	Taylor Park Dam
Greatest Total Precipitation	2.23"		Monument
Least Total Precipitation	0.00"		Monte Vista
Greatest Total Snowfall	37.0"		Monument
Greatest Depth of Snow on Ground	56"	January 8	Wolf Creek Pass 1E

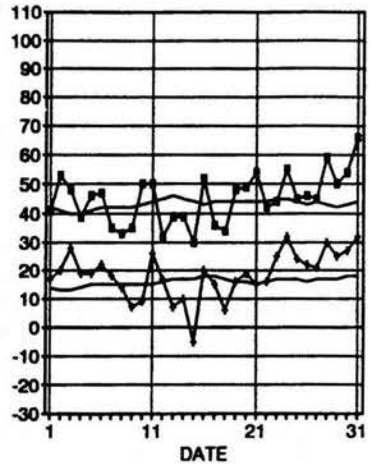
JANUARY 1992 TEMPERATURE COMPARISON

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.)

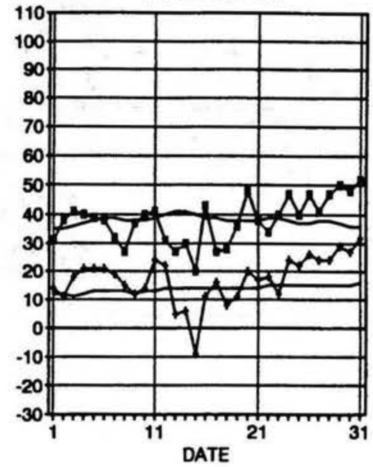
GRAND LAKE 1NW



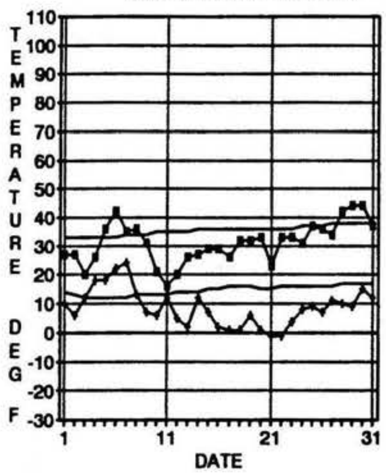
DENVER



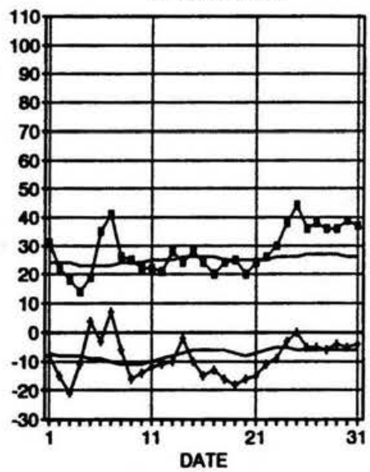
AKRON 1N



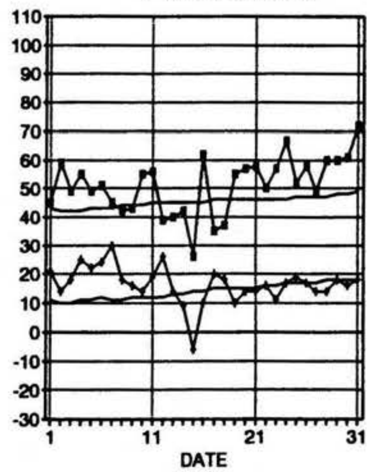
GRAND JUNCTION



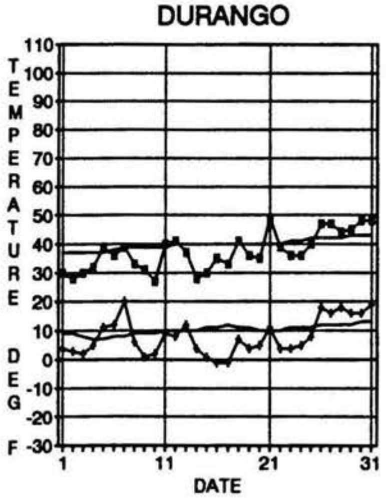
GUNNISON



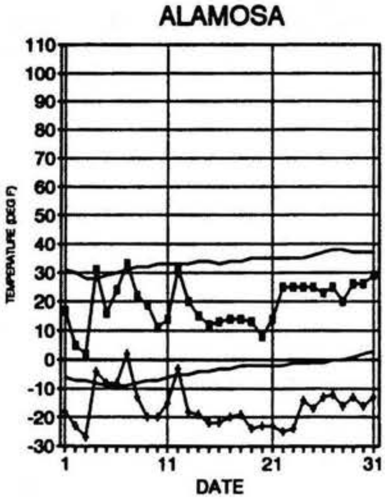
PUEBLO WSO



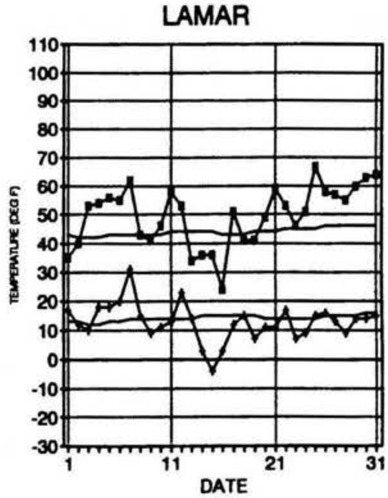
DURANGO



ALAMOSA



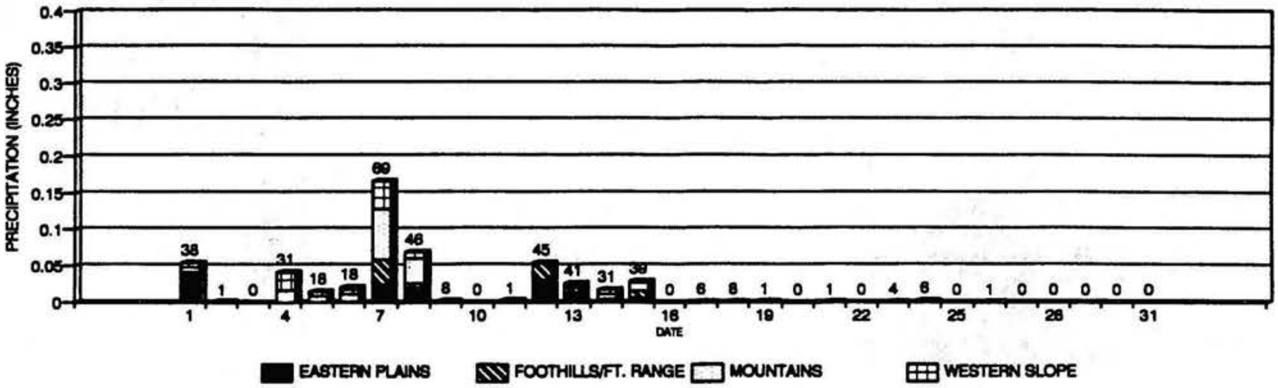
LAMAR



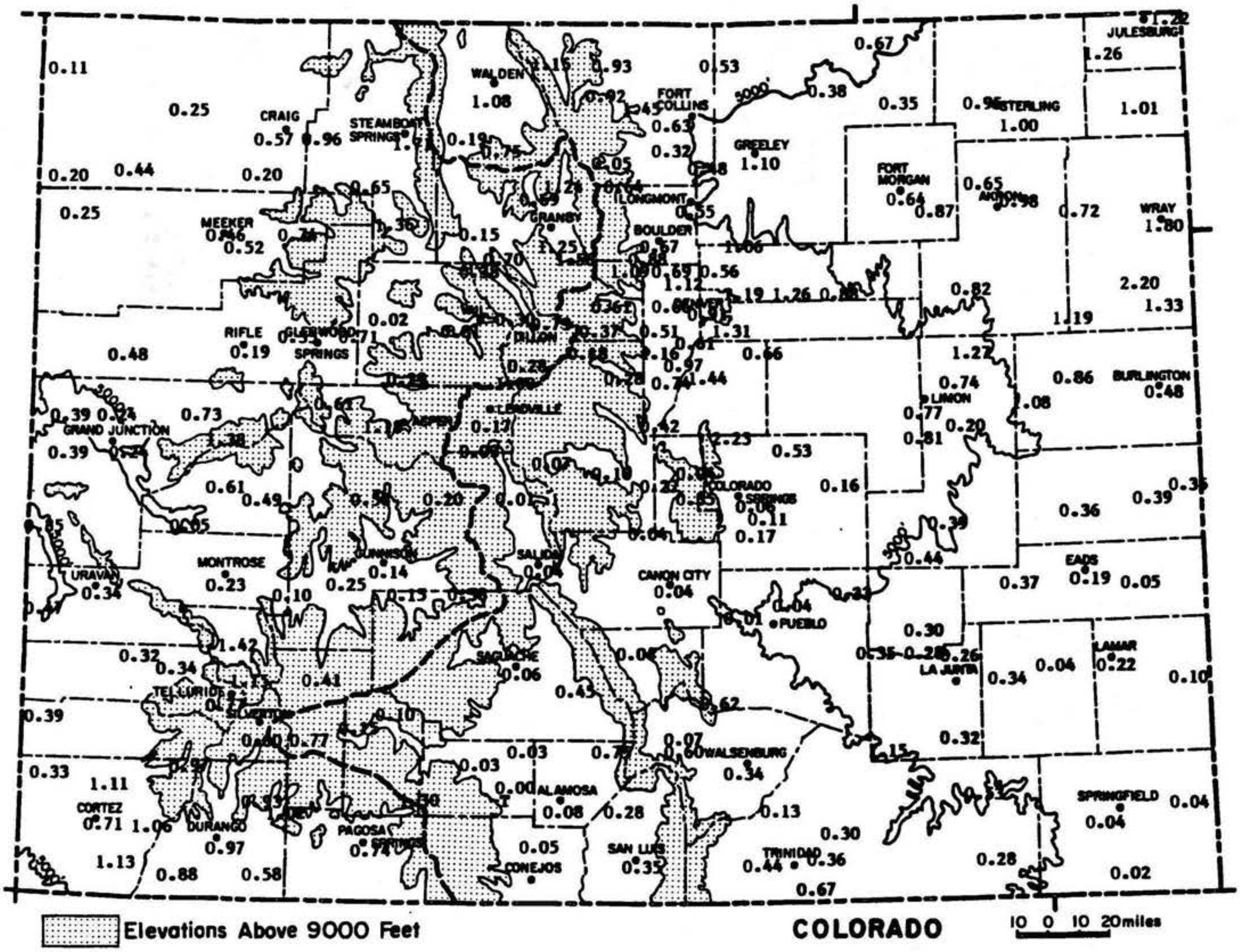
JANUARY 1992 PRECIPITATION

Practically all of January's precipitation fell during the first half of the month. Precipitation on January 1, 12 and 13 was limited to eastern Colorado. Moisture which fell on January 4-6 was concentrated over the mountains and Western Slope. The only large storm that encompassed the majority of Colorado occurred on the 7th. This storm (including moisture recorded on the 6th and 8th) produced a statewide average of over 0.25" of precipitation -- a large amount for midwinter.

COLORADO DAILY PRECIPITATION - JAN 1992

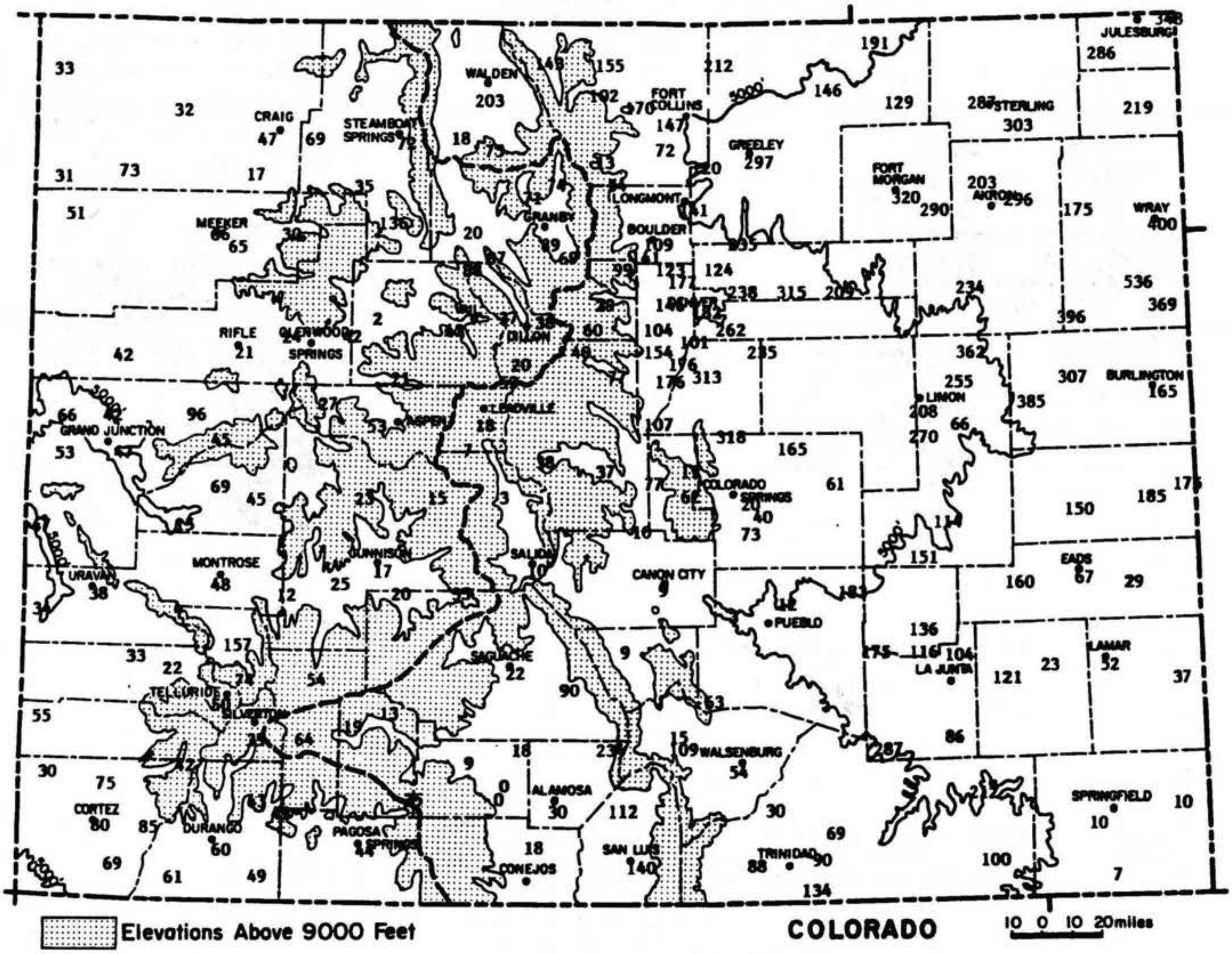


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

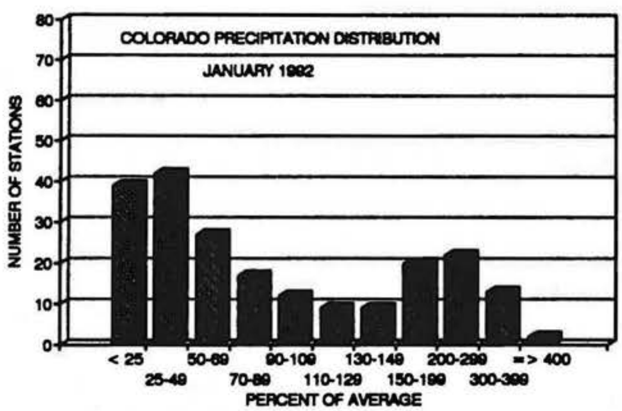


Precipitation Amounts (in inches) for January 1992.

JANUARY 1992 PRECIPITATION COMPARISON



January 1992 Precipitation as a Percent of the 1961–90 average.



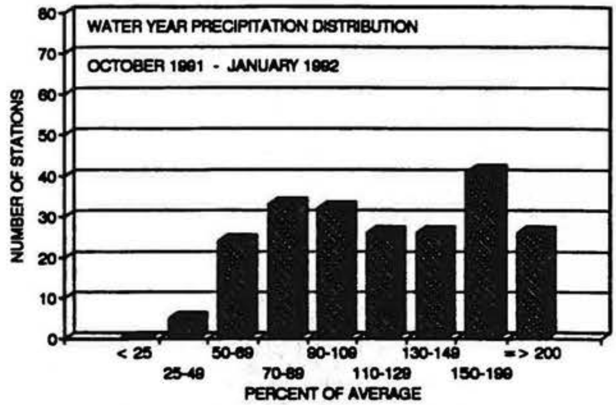
For the second month in a row, parts of eastern Colorado were much wetter than average while the majority of Colorado was very dry. Denver reported a record January snowfall total of 24.3", which exceeded the January snow totals at most mountain locations including Wolf Creek Pass.

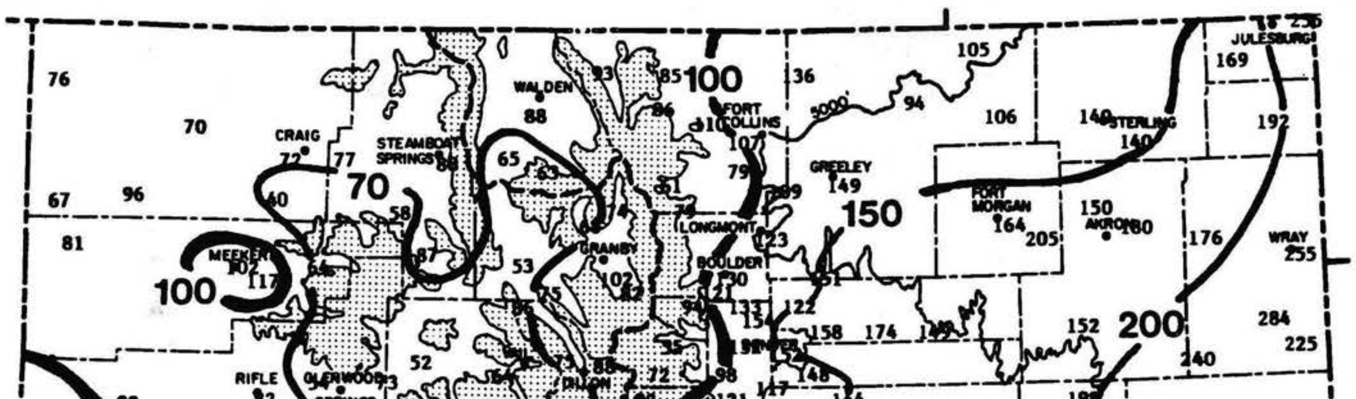
JANUARY 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	1.19"	8th wettest in 121 years of record (wettest = 2.35" in 1883)
Durango	0.97"	37th driest in 99 years of record (driest = 0.08" in 1934 amd 1936)
Grand Junction	0.24"	17th driest in 101 years of record (driest = Trace in 1961)
Las Animas	0.34"	39th wettest in 126 years of record (wettest = 1.60" in 1944)
Pueblo	0.04"	9th driest in 124 years of record (driest = 0 or T in 1880, 1923, '33, '34)
Steamboat Springs	1.33"	19th driest in 86 years of record (driest = 0.23" in 1919)

1992 WATER YEAR PRECIPITATION

The Eastern Plains continue to enjoy a moist start to the 1992 water year with most areas reporting at least 150% of the average precipitation for October–January. Yuma and Kit Carson counties have had well over 200% of average. It is a different story up in the mountains, however. Were it not for the heavy storms of November, there would now be a serious shortage of snow. Precipitation totals in Western Colorado currently range from a little above average in extreme southern areas to less than 50% of average over portions of the Gunnison and Colorado watersheds.





October 1991–January 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR JANUARY 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963						6069
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410						5046
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901						3191
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246						M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021						3523
CANON CITY	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870						3107
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998						3630
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310						4089
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556						5005
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486						4093
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022						3483
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517						6120
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305						3963
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387						4520
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123						4302
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029						3536
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193						3700
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390						3741

* = 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 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
	91-92	220	255	427	739	1169	1468	1735						6013
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088						3606
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707						5775
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943						3218
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471						6248
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161						3963
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124						3747
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490						4665
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385						4137
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477						4893
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958						3356
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283						3994
STEAMBOAT SPRINGS	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680						5850
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191						3684
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	89-90	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291						4840
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946						3315
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547						5816
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870						3041

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

JANUARY 1992 CLIMATIC DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	39.4	15.6	27.5	4.3	57	-8	1156	0	10	0.67	0.32	191.4	6
STERLING	38.8	13.7	26.3	2.2	59	-9	1191	0	14	0.95	0.62	287.9	5
FORT MORGAN	39.8	12.8	26.3	2.5	57	-6	1193	0	12	0.64	0.44	320.0	5
AKRON FAA AP	38.4	17.3	27.8	1.8	52	-9	1144	0	1	0.65	0.33	203.1	4
AKRON 4E	35.9	13.7	24.8	-0.6	46	-10	1238	0	0	0.98	0.65	297.0	3
HOLYOKE	40.1	16.0	28.0	0.8	59	-9	1139	0	10	1.01	0.55	219.6	4
JOES	39.1	15.5	27.3	-1.3	51	-5	1160	0	1	1.19	0.89	396.7	4
BURLINGTON	41.6	22.1	31.9	3.9	64	-1	1021	0	15	0.48	0.19	165.5	3
LIMON WSMO	38.4	16.3	27.3	1.8	58	-8	1161	0	4	0.77	0.40	208.1	6
CHEYENNE WELLS	47.3	20.5	33.9	5.1	69	-5	959	0	42	0.39	0.18	185.7	3
EADS	45.1	19.7	32.4	4.6	62	-1	1003	0	34	0.19	-0.09	67.9	3
ORDWAY 21N	42.1	15.1	28.6	2.6	60	2	1120	0	11	0.44	0.15	151.7	5
ROCKY FORD 2SE	47.1	17.0	32.1	3.0	66	-3	1014	0	40	0.28	0.04	116.7	3
LAMAR	49.7	12.8	31.3	2.3	67	-4	1040	0	70	0.22	-0.20	52.4	3
LAS ANIMAS	51.1	17.7	34.4	4.9	71	2	943	0	76	0.34	0.06	121.4	2
HOLLY	50.5	18.3	34.4	6.6	70	6	944	0	72	0.10	-0.17	37.0	2
SPRINGFIELD 7WSW	49.5	21.7	35.6	3.8	68	1	902	0	60	0.04	-0.34	10.5	3
TIMPAS 13SW	44.0	19.6	31.8	2.6	57	-6	1023	0	25	1.15	0.75	287.5	3

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	44.9	18.2	31.5	3.8	59	-2	1029	0	21	0.63	0.20	146.5	2
GREELEY UNC	41.9	17.3	29.6	2.4	54	-2	1088	0	10	1.10	0.73	297.3	3
ESTES PARK	44.2	18.2	31.2	3.8	54	-13	1041	0	7	0.05	-0.31	13.9	2
LONGMONT 2ESE	43.8	13.3	28.6	2.0	56	-9	1124	0	17	0.55	0.16	141.0	5
BOULDER	48.3	23.1	35.7	5.2	63	-5	901	0	39	0.67	0.06	109.8	6
DENVER WSFO AP	45.0	18.5	31.8	2.1	66	-5	1022	0	23	1.19	0.69	238.0	7
EVERGREEN	46.1	10.8	28.5	1.8	60	-14	1123	0	33	0.51	0.02	104.1	6
CHEESMAN	45.1	5.7	25.4	-1.2	60	-15	1219	0	21	0.42	0.03	107.7	6
LAKE GEORGE 8SW	30.4	-3.3	13.5	-1.0	43	-17	1588	0	0	0.10	-0.17	37.0	2
ANTERO RESERVOIR	26.5	-14.1	6.2	-7.5	41	-27	1816	0	0	0.07	-0.11	38.9	3
RUXTON PARK	35.2	5.5	20.3	0.2	51	-14	1378	0	1	0.35	-0.21	62.5	5
COLORADO SPRINGS	44.6	20.5	32.6	3.8	62	1	998	0	27	0.06	-0.23	20.7	3
CANON CITY 2SE	51.2	22.3	36.7	3.2	64	-4	870	0	76	0.04	-0.37	9.8	2
PUEBLO WSO AP	51.2	16.5	33.8	4.2	72	-6	958	0	77	0.04	-0.28	12.5	2
WESTCLIFFE	33.4	0.5	16.9	-5.3	48	-13	1483	0	0	0.04	-0.40	9.1	1
WALSENBURG	50.4	22.9	36.6	3.7	69	-3	870	0	68	0.34	-0.28	54.8	3
TRINIDAD FAA AP	48.9	19.5	34.2	3.0	67	1	946	0	58	0.30	-0.13	69.8	4

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	30.9	-1.2	14.8	-1.1	44	-27	1547	0	0	1.08	0.55	203.8	4
LEADVILLE 2SW	34.3	0.2	17.2	2.3	54	-15	1471	0	2	0.17	-0.73	18.9	8
SALIDA	42.0	9.4	25.7	-1.2	55	-2	1209	0	9	0.04	-0.34	10.5	3
BUENA VISTA	39.2	9.8	24.5	-1.1	54	-2	1246	0	3	0.01	-0.27	3.6	1
SAGUACHE	22.9	-7.2	7.9	-10.2	32	-22	1763	0	0	0.06	-0.21	22.2	2
HERMIT 7ESE	25.4	-12.0	6.7	-3.1	40	-24	1801	0	0	0.15	-0.63	19.2	2
ALAMOSA WSO AP	19.3	-16.5	1.4	-13.3	33	-27	1963	0	0	0.08	-0.18	30.8	1
STEAMBOAT SPRINGS	26.5	-5.2	10.7	-4.2	38	-18	1680	0	0	1.71	-0.66	72.2	9
YAMPA	29.7	5.2	17.5	-1.4	41	-13	1464	0	0	1.36	0.36	136.0	8
GRAND LAKE 1NW	33.8	-1.0	16.4	0.5	51	-20	1498	0	1	1.24	-0.42	74.7	11
GRAND LAKE 6SSW	23.9	-6.5	8.7	-4.7	35	-20	1735	0	0	0.69	-0.27	71.9	10
DILLON 1E	32.5	-0.8	15.8	0.1	47	-10	1517	0	0	0.30	-0.49	38.0	8
CLIMAX	28.1	-0.2	14.0	1.1	42	-27	1575	0	0	1.00	-0.87	53.5	8
ASPEN 1SW	35.8	2.5	19.2	-1.0	49	-5	1410	0	0	1.18	-1.02	53.6	9
CRESTED BUTTE	26.4	-11.4	7.5	-3.4	38	-26	1775	0	0	0.58	-1.92	23.2	4
TAYLOR PARK	25.0	-13.9	5.6	-1.1	38	-32	1833	0	0	0.20	-1.08	15.6	2
TELLURIDE	41.2	5.0	23.1	1.2	52	-5	1291	0	3	0.77	-0.76	50.3	7
PAGOSA SPRINGS	38.2	-3.9	17.1	-3.0	50	-13	1477	0	0	0.74	-0.94	44.0	5
SILVERTON	36.2	-7.8	14.2	-0.9	49	-16	1568	0	0	0.60	-0.91	39.7	5
WOLF CREEK PASS 1	35.4	4.5	20.0	2.7	48	-7	1387	0	0	1.30	-2.39	35.2	5

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	26.3	2.8	14.5	-3.0	40	-9	1556	0	0	0.57	-0.63	47.5	8
HAYDEN	26.1	2.7	14.4	-2.6	38	-13	1562	0	0	0.96	-0.43	69.1	9
MEEKER NO. 2	31.4	2.1	16.8	-6.4	46	-11	1490	0	0	0.46	-0.23	66.7	2
RANGELY 1E	25.6	0.2	12.9	-3.5	35	-15	1605	0	0	0.25	-0.24	51.0	2
EAGLE FAA AP	36.5	3.5	20.0	1.5	50	-9	1387	0	0	0.02	-0.72	2.7	1
GLENWOOD SPRINGS	36.4	8.7	22.5	-1.0	49	2	1307	0	0	0.35	-1.09	24.3	6
RIFLE	38.5	8.2	23.4	1.0	54	0	1283	0	6	0.19	-0.71	21.1	2
GRAND JUNCTION WS	31.1	8.6	19.9	-5.1	44	-1	1390	0	0	0.24	-0.32	42.9	3
CEDAREDGE	38.7	6.9	22.8	-3.6	54	-6	1298	0	3	0.61	-0.27	69.3	5
PAONIA 1SW	33.5	3.8	18.6	-6.8	45	-9	1427	0	0	0.49	-0.59	45.4	5
DELTA	30.5	3.1	16.8	-9.3	40	-5	1486	0	0	0.05	-0.28	15.2	1
GUNNISON	28.2	-8.8	9.7	0.6	44	-21	1707	0	0	0.14	-0.64	17.9	1
COCHETOPA CREEK	33.1	-5.5	13.8	4.1	45	-20	1583	0	0	0.15	-0.58	20.5	3
MONTROSE NO. 2	32.0	8.2	20.1	-4.7	45	-2	1385	0	0	0.23	-0.24	48.9	4
URAVAN	38.7	10.0	24.4	-3.2	47	2	1252	0	0	0.34	-0.54	38.6	3
NORWOOD	34.8	4.8	19.8	-2.8	48	-10	1394	0	0	0.32	-0.64	33.3	3
YELLOW JACKET 2W	37.7	10.9	24.3	-0.9	55	1	1255	0	5	0.33	-0.75	30.6	3
CORTEZ	37.1	8.0	22.5	-2.0	48	0	1310	0	0	0.71	-0.17	80.7	3
DURANGO	37.4	7.9	22.7	-2.3	49	-1	1305	0	0	0.97	-0.63	60.6	4
IGNACIO 1N	33.8	6.8	20.3	-2.1	48	-7	1380	0	0	0.58	-0.59	49.6	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.

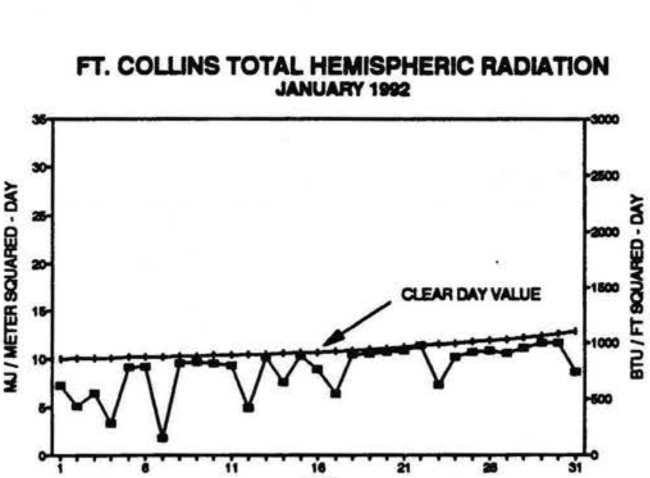
JANUARY 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	17	4	10	--	--
Denver	15	9	7	79%	71%
Fort Collins	17	7	7	--	--
Grand Junction	18	4	9	81%	61%
Limon	12	12	7	--	--
Pueblo	18	7	6	95%	75%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Sunshine and solar radiation exceeded the average for January as high pressure dominated the Rocky Mountain region.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
JANUARY 1992

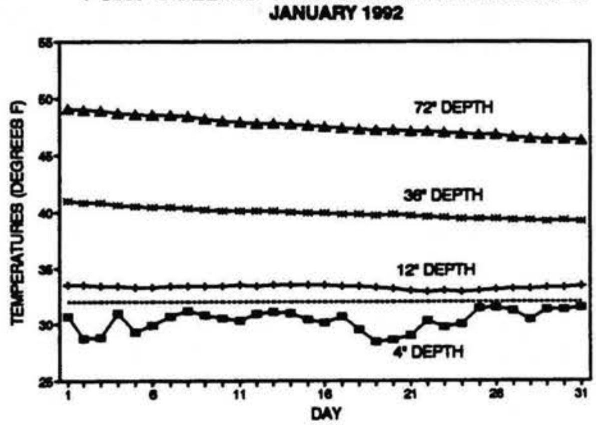


JANUARY 1992 SOIL TEMPERATURES

Snowcover during mid-January stabilized soil temperatures. The top soil remained frozen all month, but no deep frost penetration occured.

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 1992



HATS OFF TO: *Ethal Jordan of Hamilton, Colorado*

Hamilton is a tiny village in a steep, narrow valley southwest of Craig. Mrs. Jordan has been reporting daily precipitation there without interruption since April 1957. Thanks so much, and keep up the great work!

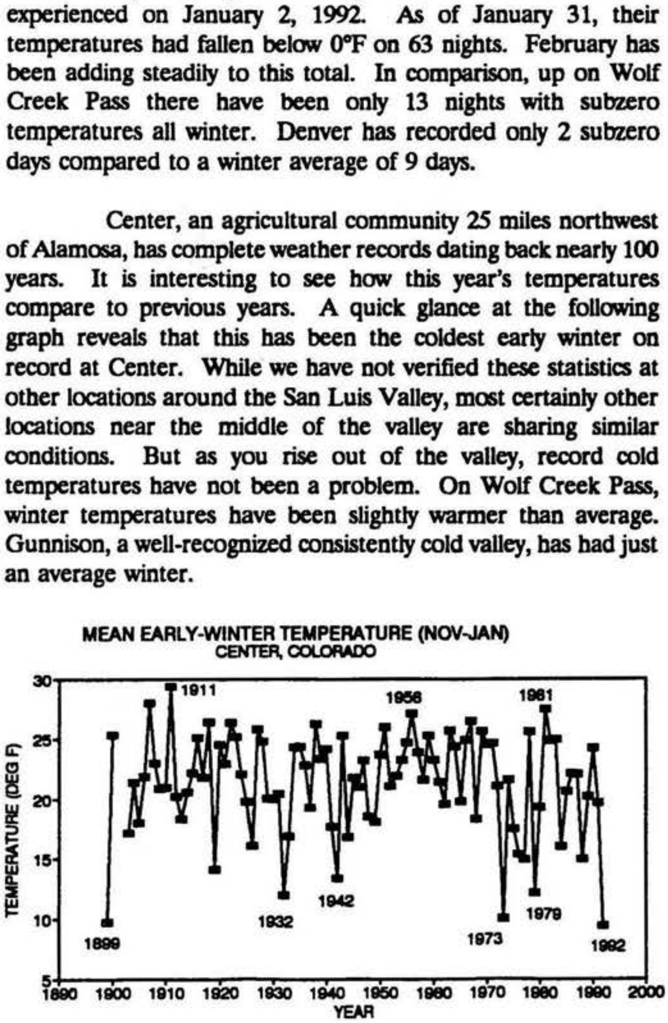
What Happened to Alamosa – The 1992 Island of Ice.

Most of the nation has been enjoying a very mild winter. Were it not for some frigid airmasses and major snowstorms back in late October and November, many areas of the U.S. may have thought they missed out on winter completely. Colorado has shared in this mild weather. For the Front Range and Eastern Plains, there has only been a handful of days all winter with temperatures below freezing during the day and below ten at night. But have you talked to anyone from Alamosa and the San Luis Valley recently? They have quite a different story to tell.

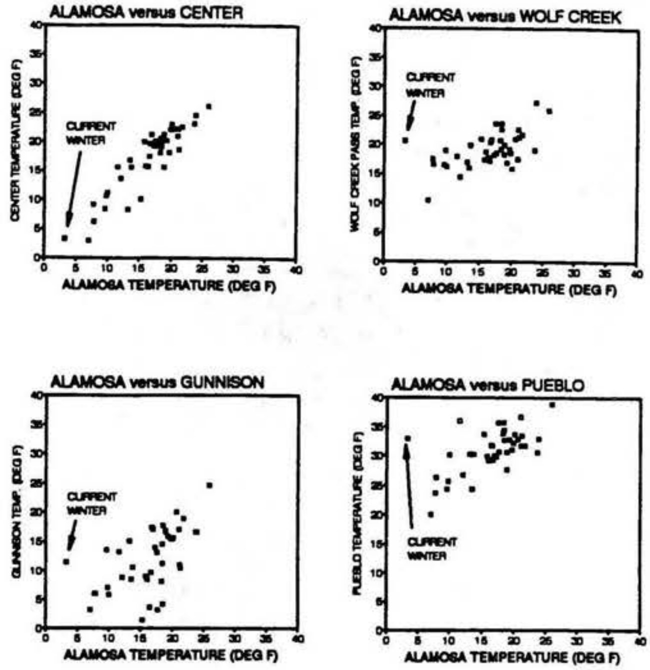
Looking at the statistics from the Alamosa National Weather Service office at the Alamosa airport, since October 28th through the end of January, there have been only 14 days when the temperature climbed above the daily average. During the same period there have been 58 days when the mean daily temperature was at least 10 degrees F colder than average. On 22 days, the temperatures have been at least 20 degrees colder than average. When you stop for just a minute and think what average midwinter temperatures are like in Alamosa – with daytime temperatures typically climbing from below zero readings at sunrise to highs in the 20s and 30s – that's when the significance of this winter begins to sink in. Just for an example, imagine a high temperature of 2 degrees after a morning low of -27° accompanied by dense fog. That is what Alamosa experienced on January 2, 1992. As of January 31, their temperatures had fallen below 0°F on 63 nights. February has been adding steadily to this total. In comparison, up on Wolf Creek Pass there have been only 13 nights with subzero temperatures all winter. Denver has recorded only 2 subzero days compared to a winter average of 9 days.

Center, an agricultural community 25 miles northwest of Alamosa, has complete weather records dating back nearly 100 years. It is interesting to see how this year's temperatures compare to previous years. A quick glance at the following graph reveals that this has been the coldest early winter on record at Center. While we have not verified these statistics at other locations around the San Luis Valley, most certainly other locations near the middle of the valley are sharing similar conditions. But as you rise out of the valley, record cold temperatures have not been a problem. On Wolf Creek Pass, winter temperatures have been slightly warmer than average. Gunnison, a well-recognized consistently cold valley, has had just an average winter.

MEAN EARLY-WINTER TEMPERATURE (NOV-JAN)
CENTER, COLORADO



Now I would like you to look at a set of scatter diagrams comparing Alamosa winter temperatures to 4 surrounding locations all within a distance of less than 100 miles: Center, Wolf Creek Pass, Gunnison, and Pueblo.



Scatter graphs are a great way to quickly see if two variables are related to each other. Don't worry about the minute size of these graphs. It is not essential that you see every point. In analyzing these graphs, you can see that winter temperatures at Alamosa and Center are closely related. When Alamosa is warm, so is Center. When Center is cold, so is Alamosa. From the linear relationship that exists between these two sites, you can estimate quite accurately the mean winter temperature at one town if you know the temperature at the other town. This winter's temperature fits neatly on the cold end of the graph, right in line with the expected relationship between the two sites.

The comparisons between Alamosa and the other three locations are not quite so tidy. There is a general tendency for Gunnison, Pueblo, and Wolf Creek Pass to be colder than average when Alamosa is cold, and warmer than average when Alamosa is warm, but there is plenty of variability. One point sticks out as a particular exception – and it happens to be this winter. While Alamosa has been extremely cold, the other locations have been average or above.

How can this be? How can Alamosa and the middle of the San Luis Valley be so cold, while the rest of the region has been having a mild winter? It turns out that there is one simple factor that affects temperatures greatly everywhere, but especially in the San Luis Valley. It is a four letter word – SNOW. When the Valley is covered with snow, the entire climate of the valley changes. The plentiful sunshine that usually warms this broad, high-elevation valley is reflected back into the atmosphere once the snow is deep enough to cover the sparse vegetation. On a clear night radiational heat loss continues even more dramatically. The air direclty above the snow cools steadily. Eventually, the whole valley fills with cold air. This air, being denser and heavier than surrounding air, becomes very difficult to displace. Only storm systems with strong winds, dense clouds, and vertical updrafts can displace the air. After storms pass, however, the lake of frigid air can quickly redevelop.

The cold air trapping phenomenon is tied closely to the elevation angle of the sun. Once the ground is covered by snow in early and mid winter, it is practically impossible to get enough energy to melt the snow. As long as the snow remains, the valley continues to trap cold air. Once it snows, it gets cold. When it gets cold, the snow doesn't melt. If the snow doesn't melt, it stays cold. The whole process is self reinforcing. The only salvation is the fact that by the end of February the sun climbs high enough that solar energy begins to win the battle with the snow, and by March even a heavy snowfall is soon attacked and melted by the sun.

So why isn't Alamosa always as cold as this winter? As it turns out, the San Luis Valley is the driest part of Colorado. Even though it is plenty cold to snow throughout the fall, winter and spring, snow in excess of a few inches rarely accumulates over the dry central portion of the valley (where the coldest air can collect). In an average winter, there are only about a dozen days with at least four inches of snow on the ground. In roughly 25% of all winters, snow never accumulates to a depth of 4" during the November-February period. Without snow, temperatures never stay cold. But in those occasional wet years when snow does acccumulate – look out! Looking back to the time series of Center winter temperatures, sure enough all the cold years were years with persisting snowcover and all the warmest years had little or no lasting snow. In 1981, for example, there was only one day from December through February in Alamosa when the ground was covered by an inch of snow. For the San Luis Valley, snowcover explains more than half of the year to year variance in winter temperatures. Snowcover is also important in other western valleys, but other valleys – Gunnison, for example – tend to have much more consistent and reliable snowcover from winter to winter.

This year was Alamosa's year for snow. 15" fell at the end of October. 10" more fell in November and 9" in December. Storms were separated by periods of clear, dry weather allowing energy to reflect and radiate out of the Valley. Furthermore, the entire San Luis Valley was snowcovered, not just parts of it. Since October 30, the Alamosa NWS office has reported only 5 days with bare ground – all back in November. Only 1" of new snow fell in January, but more than 8" remained on the ground all month from previous storms. As of January 31, 8" or more of snow had been on the ground for 52 days – the longest on record at the Alamosa weather office. It didn't take a PhD for local residents to know they were in for a long, hard winter. When there is a foot of settled snow on the ground on the winter solstice it is almost a sure bet that temperatures will be brutal at least until late February. Sure enough, that's what's happening.

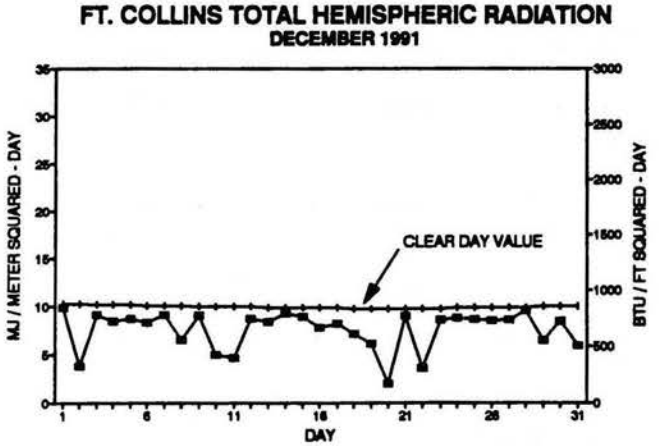
There is some consolation for those who have spent the winter in the San Luis Valley. When it is cold, the wind doesn't blow. Alamosa's average wind speed in January was 3.7 mph. Wind chill wasn't a factor!

OUR APOLOGIES!!

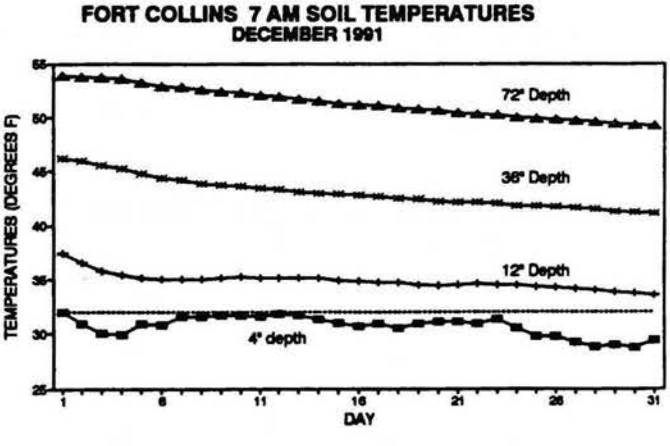
As you can tell, our monthly climate description, **Colorado Climate**, has been undergoing some changes. As a result of attempting these changes, we fell behind our normal publication schedule. We even made a few outright mistakes (did you notice??)

At last it looks like we're back on the right track. Reports should again be mailed out 4 to 6 weeks after the end of each month. We hope you like our new format, and we'll try not to make any more mistakes. To set the record straight here are the solar and soil temperature graphs that should have appeared in the December 1991 issue.

DECEMBER 1991 SOLAR RADIATION



DECEMBER 1991 SOIL TEMPERATURES

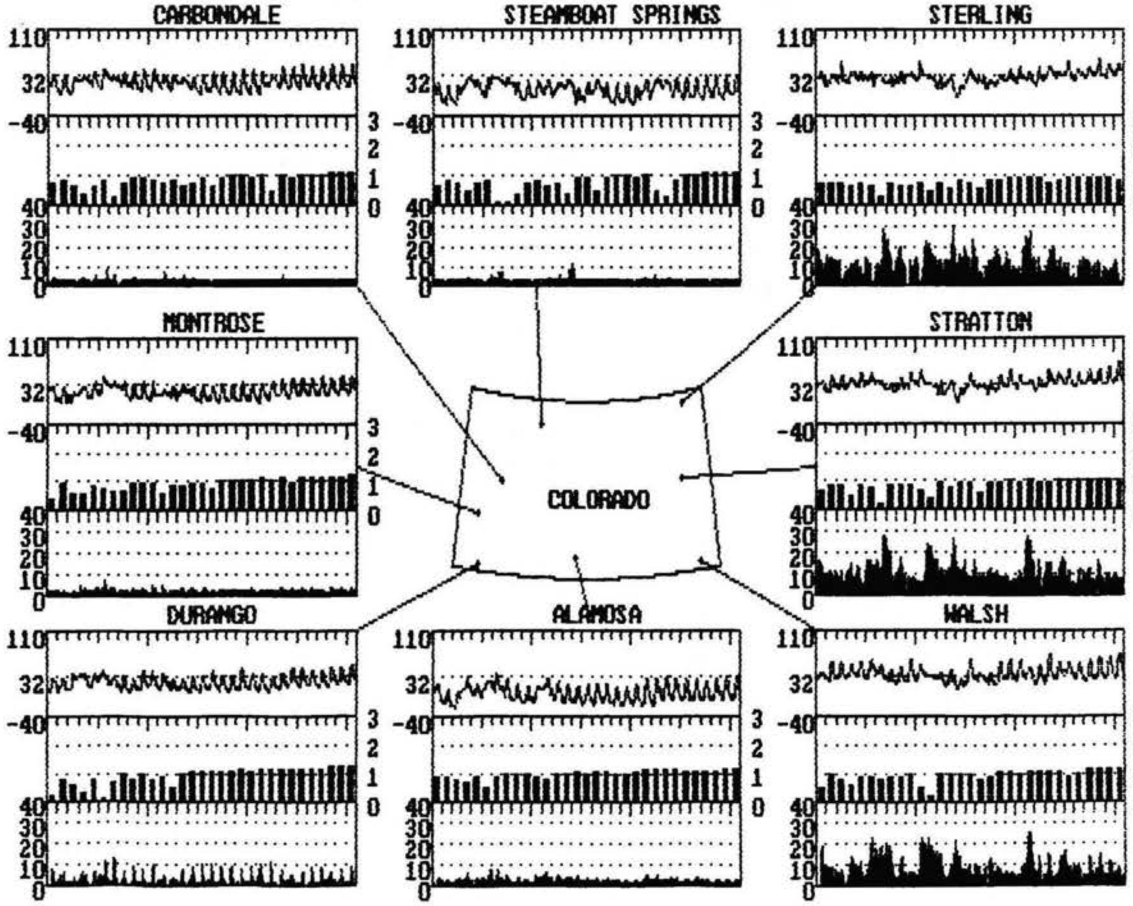


Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	0.4	19.6	19.6	17.4	6.6	27.2	30.7	33.7
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	33.4 7/13	48.0 31/14	50.7 31/15	43.9 31/13	32.5 31/15	60.1 29/15	64.8 31/14	69.1 31/15
minimum:	-26.0 3/ 7	0.9 19/ 8	-2.7 3/ 7	-5.1 3/ 8	-20.9 15/ 8	-7.6 15/ 8	-1.8 15/ 7	6.1 15/ 8
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	82 /-14	84 / 7	90 / 7	85 / 6	86 / -4	31 / -5	79 / 18	78 / 18
11 AM	81 / 1	50 / 11	59 / 11	59 / 13	79 / 6	26 / -2	64 / 26	47 / 22
2 PM	68 / 8	46 / 13	39 / 11	51 / 14	59 / 8	24 / 2	58 / 27	37 / 20
5 PM	70 / 6	50 / 12	42 / 10	57 / 12	65 / 5	26 / -1	70 / 26	43 / 18
11 PM	84 / -9	82 / 10	77 / 10	85 / 8	87 / -1	30 / -3	82 / 22	69 / 18
monthly average wind direction (degrees clockwise from north)								
day	167	210	187	115	147	247	196	234
night	178	73	164	222	118	254	217	253
monthly average wind speed (miles per hour)								
	2.35	2.40	1.99	2.00	1.74	9.63	10.20	8.40
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	573	547	675	640	665	109	13	48
3 to 12	171	196	69	104	79	404	546	528
12 to 24	0	1	0	0	0	217	164	158
> 24	0	0	0	0	0	14	21	6
monthly average daily total insolation (Btu/ft²·day)								
	953	916	800	920	720	721	867	895
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	172	149	144	166	126	117	177	175
40-60%	92	55	57	61	60	98	83	62
20-40%	37	33	57	41	58	36	32	58
0-20%	1	29	21	6	33	40	12	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.



TYPICAL METEOROLOGICAL YEAR

One purpose of collecting weather data is to have representative and typical conditions of the climate that can be used as reference. This art has been passed throughout generations in many cultures. The Egyptians could approximately predict the flood season of the Nile. American farmers used their almanac to seed and harvest at the correct time.

CHARACTER POSITION	DESCRIPTION
001-005	WBAN STATION NUMBER
006-015	SOLAR TIME(YR,MO,DY,HR,MN)
016-019	LOCAL STANDARD TIME (HR,MN)
	SOLAR DATA
020-023	EXTRATERRESTRIAL RADIATION
024-028	DIRECT RADIATION
029-033	DIFFUSE RADIATION
034-038	NET RADIATION
	GLOBAL RADIATION
039-043	TILTED SURFACE
044-048	HORIZONTAL SURFACE DATA
049-053	HRZ.SFCE. ENGINEERING DATA
054-058	HRZ.SFCE. STANDARD YEAR
059-068	ADDITIONAL RADIATION MEASM.
069-070	MINUTES OF SUNSHINE.
	SURFACE DATA
071-072	TIME OF OBSUN.
073-076	CEILING HEIGHT (DEKAMETERS)
077-081	SKY CONDITIONS
082-085	VISIBILITY
086-093	WEATHER
094-103	PRESSURE (KILOPASCALS)
104-111	TEMPERATURE (DEGREES CELSIUS)
112-118	WIND (SPEED IN METERS/SEC)
119-122	CLOUDS
123	SNOW COVER INDICATOR

Today in the information era, weather information is used for more purposes than in the past. Architects need weather data to design energy efficient homes. Engineers need wind speed and direction to calculate structural strength and loads. Weather patterns are used to study climate effects in the environment such as the green house effect and the after effects of natural events such as the ash released by volcanos in the Philippines.

Now that we fallen in love with information access, mass storage of data challenges climatologists all over the world. Usually a simple set of weather data consists of: Dry Bulb Temperature, Humidity Ratio, Barometric Pressure, Horizontal Solar Radiation, Wind Speed and Direction, and Precipitation. These data for every hour of the day for a whole year, storing some 50,000 numbers. Since this is only data for one site for one year, data management can become a nightmare for a network or a state.

To deal with this problem a group of American climatologists came up with an standard format called TMY. The Typical Meteorological Year weather information was created by a project that involved 40 years worth of data in each chosen city. TMY data are for a statistically typical year constructed from this 40-year period. The TMY format base became a standard for US weather data. The weather data values are stored in a continuous line of 132 characters (usually numbers), twenty four lines form a block for one day; 365 blocks make up a year. For the example below for Pueblo, CO the first 5 characters correspond to the station number, the next two are the year, then the month number, etc. The lines are divided into three main sections: Site Information, Solar Data, Surface Data. The data are stored in ASCII format readable by any computer system.

TMY Pueblo, CO

```
9305859010101000999999999999999999999999999999999999999998000999999999999
99090188888880240002410000000000010920 8477 -8 -522293 20007069
```

In the United States there are 248 cities that have TMY information. In the state of Colorado the following cities have TMY records; Denver, Colorado Springs, Pueblo, Grand Junction, Eagle. These data can be obtained thorough a bulletin board system that will download the specific information to a user's computer using a modem. The National Climatic Center in Asheville, North Carolina 28801, will do this using the following phone number (704)258-2850.

This report was prepared by Carlos Lopez-Alonso at the Joint Center for Energy Management (303) 492-3915 University of Colorado at Boulder 80309-0428.

COLORADO CLIMATE

FEBRUARY 1992

Volume 15 Number 5

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

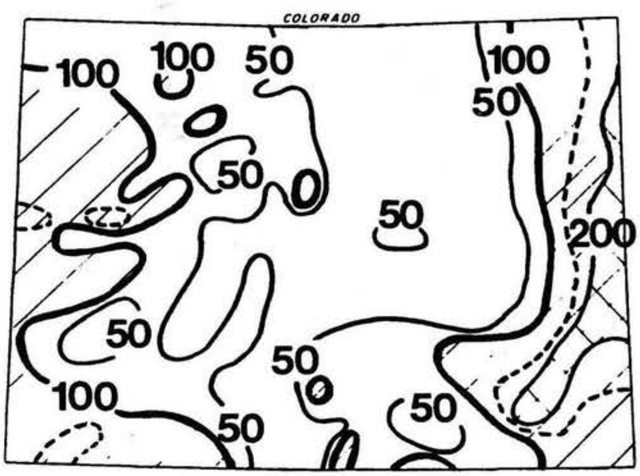
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

February Climate in Perspective – A Warm Month

Colorado escaped another winter month with no strong arctic airmasses. Temperatures ended up well above average except in the San Luis Valley. Several major storm systems moved inland across California during February. Most of these storms weakened drastically before bumping up against the Rockies. As a result, although precipitation fell on many days during the month, total moisture remained well below average in the mountains. Just east of the Front Range was extremely dry.

Precipitation

Pacific storms systems took aim on Colorado during February. Frequent mountain snows brought happy reports from many Colorado skiers, but there were very few

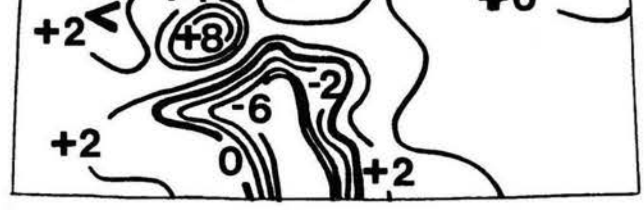


February 1992 precipitation as a percent of the 1961-1990 average.

widespread snowfall episodes. When the totals were tallied, most of the mountains ended up with considerably less February moisture than usual – the third dry month in a row for the high country. Almost no precipitation at all fell just east of the mountains along the Front Range urban corrider. Fort Collins experienced their driest February in 104 years of record. But there were some wet areas. Above average precipitation was observed over much of the Western Slope and across extreme eastern Colorado.

Temperatures

No intrusions of arctic air made it to Colorado in February, and a late-month heatwave raised temperatures above 70° east of the mountains. The most unusual aspect of the months temperatures, however, where the persistently mild nighttime temperatures. The coldest temperature all month at Denver and Akron was only 20°F. Temperatures for the month as a whole ended up 1°-9° above average over most of the State. Gunnison was nearly 10 degrees warmer than average – their 8th warmest February on record. But again the San Luis Valley was the exception. Temperatures there remained cold ending up more than 7° below average.



Departure of February 1992 temperatures from the 1961-90 averages.

Inside This Issue

FEBRUARY 1992 DAILY WEATHER

Storms knocked on the door frequently in February, but despite many favorable opportunities, no heavy widespread precipitation events occurred over Colorado.

1-4 February began sunny and quite mild with temperatures climbing into the 50s and 60s east of the mountains. Clouds increased over southern Colorado on the 2nd as a storm took an unusual track moving nearly straight northward out of Mexico toward southeast Colorado. Precipitation began as rain late on the 2nd over southeastern counties. Winds increased over the plains and rain turned to snow in some areas on the 3rd and spread northward. Lamar, Holly and John Martin Dam all reported more than 0.50" of moisture with several inches of snow on higher ridges. Precipitation stayed east of Limon leaving the rest of the state dry but unsettled. The main storm weakened on the 4th, but an upper level disturbance lingered over Colorado and triggered a few convective snow showers east of the mountains.

5-7 Weak high pressure returned to the Rockies giving Colorado dry, sunny weather. Temperatures were mostly near average statewide, but the cold pool of air remained entrenched in the San Luis Valley. Alamosa only reached a high of 16° on the 7th after a morning low of -16°F. Wolf Creek Pass was nearly 20 degrees warmer than the Valley.

8-19 A series of storms crashed into California bringing that state many inches of much-needed moisture. Each storm weakened drastically before reaching Colorado. At the same time, pulses of Arctic air tried unsuccessfully to slip down out of Canada into eastern Colorado. Cooler temperatures were observed east of the mountains on the 8th and 11th with some local fog and low upslope clouds 8-12th. Moisture from the California storms reached western Colorado on the 8th with periods of light wet snow near the mountains ending on the 9th. Clouds increased again from the west on the 10th. Up to 0.33" of moisture was measured over southwest Colorado on the 11th. The strongest storm system moved toward Colorado on the 13th and moved rapidly eastward. Nearly all of western Colorado received some moisture. Hardest hit was Wolf Creek Pass where 1.55" of water was measured in more than a foot of snow. The storm dissipated quickly as it pushed east on the 14th. Breckenridge only reported 3" of new snow and only a few flakes spilled over east of the mountains. One more strong-looking storm targetted Colorado 16-17th. The San Juan Mountains and the Vail area received several inches of snow, but elsewhere snowfall was much less than expected. Strong winds buffetted the Eastern Plains as the storm headed east, but the only precipitation on the plains fell out near the Kansas border. The storm did manage to pull in some chilly air behind it. The Mount Evans Research Center had a high of only 18° on the 18th. Taylor Park Dam had Colorado's coldest temperature in February with -27° on the morning of the 19th.

20-25 After a lovely mild day on the 20th, weak cold fronts associated with upper air disturbances crossed Colorado in rapid succession on the 21st, 23rd and 25th. Each storm brought small amounts of precipitation (mostly to the northern sections of Colorado), periods of strong winds, and minor episodes of colder weather. Even so, temperatures over most of the State were still warmer than average. Akron picked up 2" of snow and Burlington received 0.26" of moisture on the 23rd. Moisture on the 25th was very limited, but up to 4" fell near Georgetown contributing to a nasty traffic accident on I-70.

26-29 February ended with dry weather statewide and an episode of near-record warmth. Temperatures in the 60s and 70s were widespread 28-29th. Even Alamosa managed to hit the 40° mark on the 27th for the first time since late November. Holly took honors for the Colorado hot spot with 81° on the 29th.

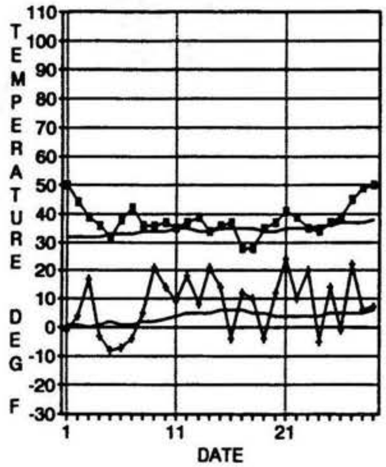
Weather Extremes

Highest Temperature	81°	February 29	Holly
Lowest Temperature	-27°	February 19	Taylor Park Dam
Greatest Total Precipitation	3.34"		Wolf Creek Pass 1E
Least Total Precipitation	0.00"		Briggsdale, Estes Park, Littleton, Waterdale (numerous sites with Trace)
Greatest Total Snowfall	45.0"		Wolf Creek Pass 1E
Greatest Depth of Snow on Ground	67"	February 16	Wolf Creek Pass 1E

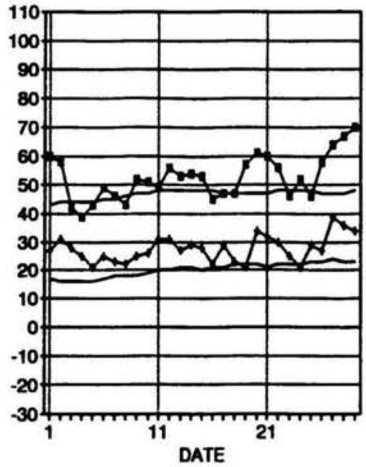
FEBRUARY 1992 TEMPERATURE COMPARISON

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.)

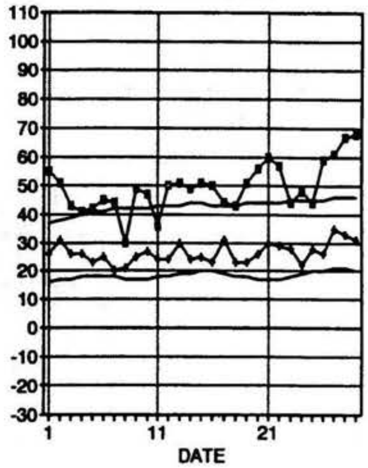
GRAND LAKE 1NW



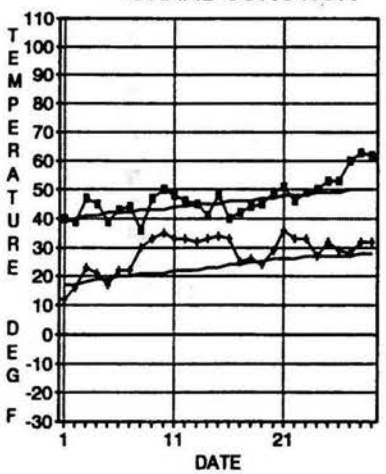
DENVER



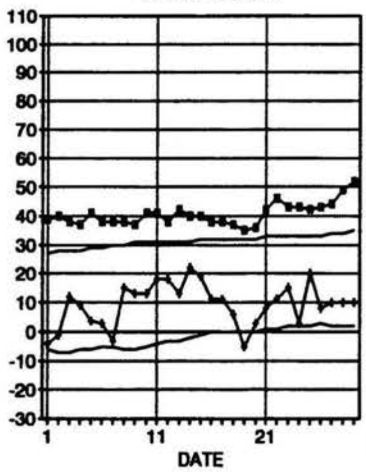
AKRON 1N



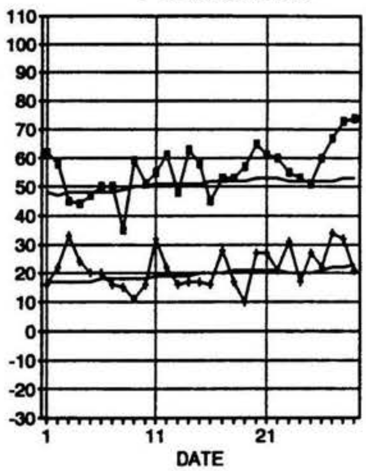
GRAND JUNCTION



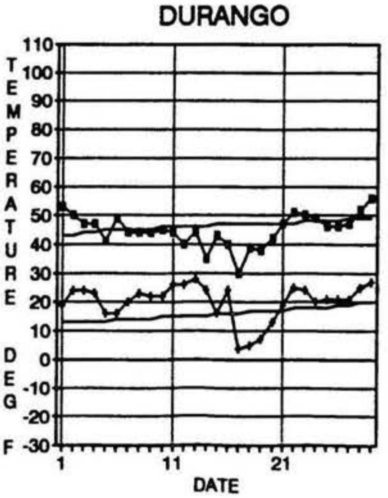
GUNNISON



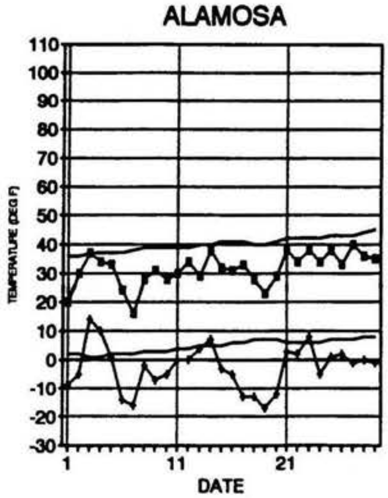
PUEBLO WSO



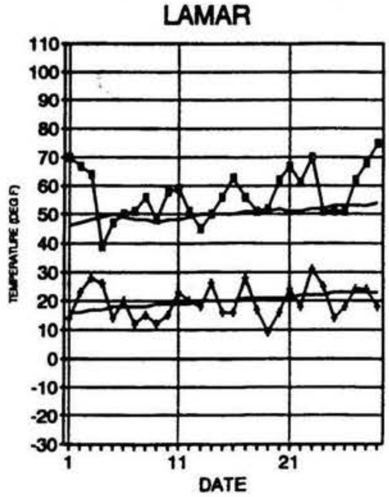
DURANGO



ALAMOSA



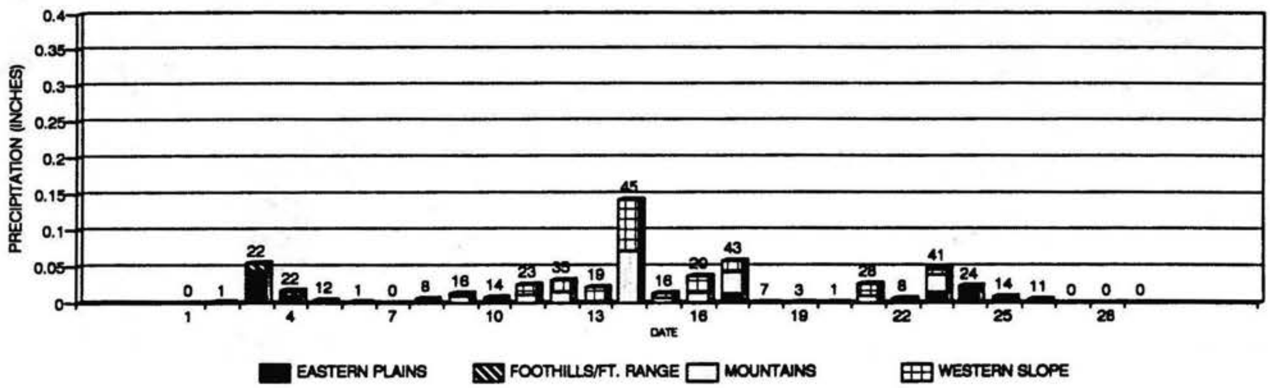
LAMAR



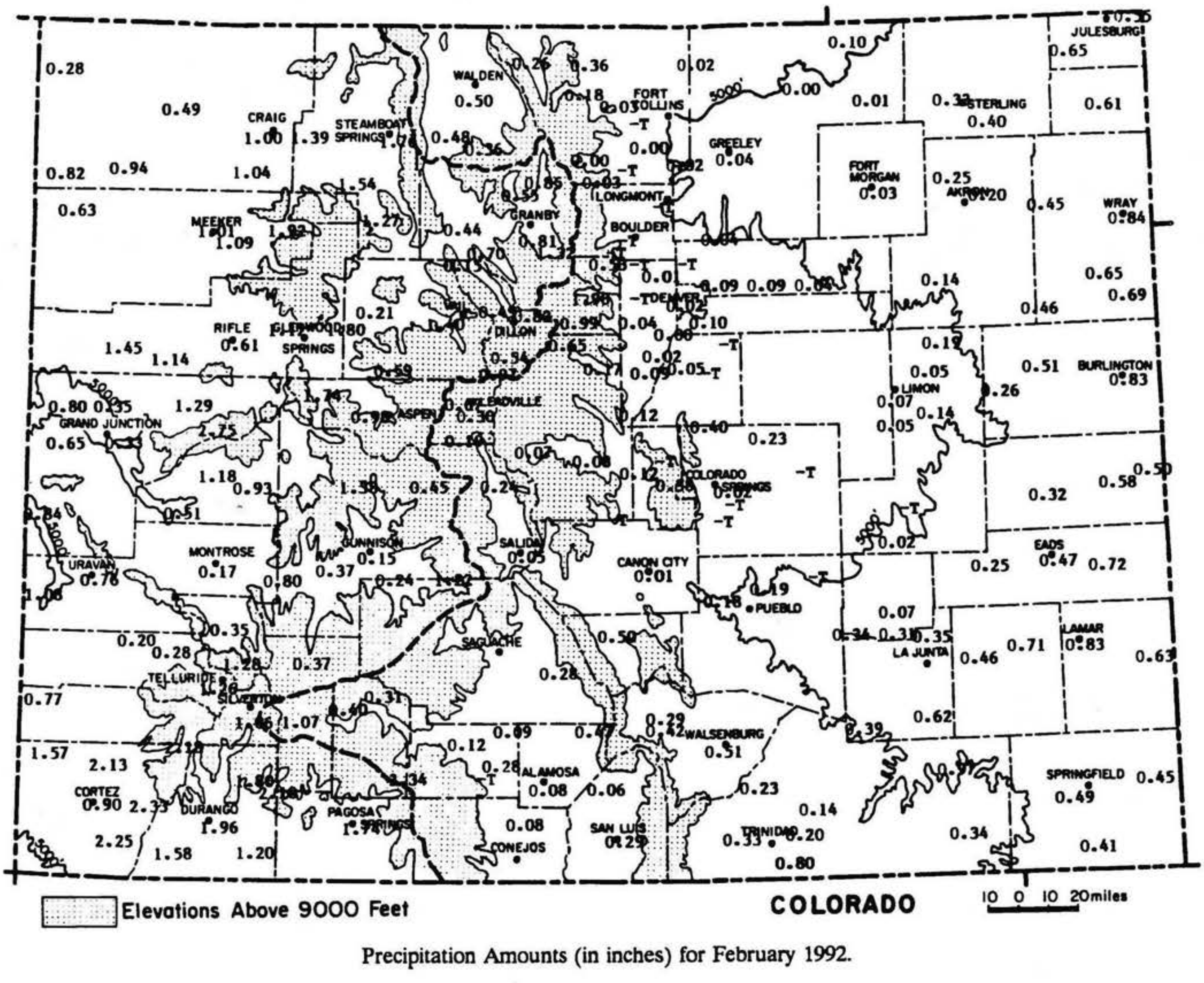
FEBRUARY 1992 PRECIPITATION

Precipitation fell somewhere in Colorado on over half of the days in February, but storms were typically small in quantity and in coverage. Significant moisture fell on the 3rd but only affected southeast Colorado. Nearly all of the moisture from storms 8-17th fell in the mountains and western valleys. The storm 13-14th was the only storm of the month that dropped significant moisture over nearly half of Colorado. Precipitation 21-25th was scattered across the State but was again quite light.

COLORADO DAILY PRECIPITATION - FEB 1992

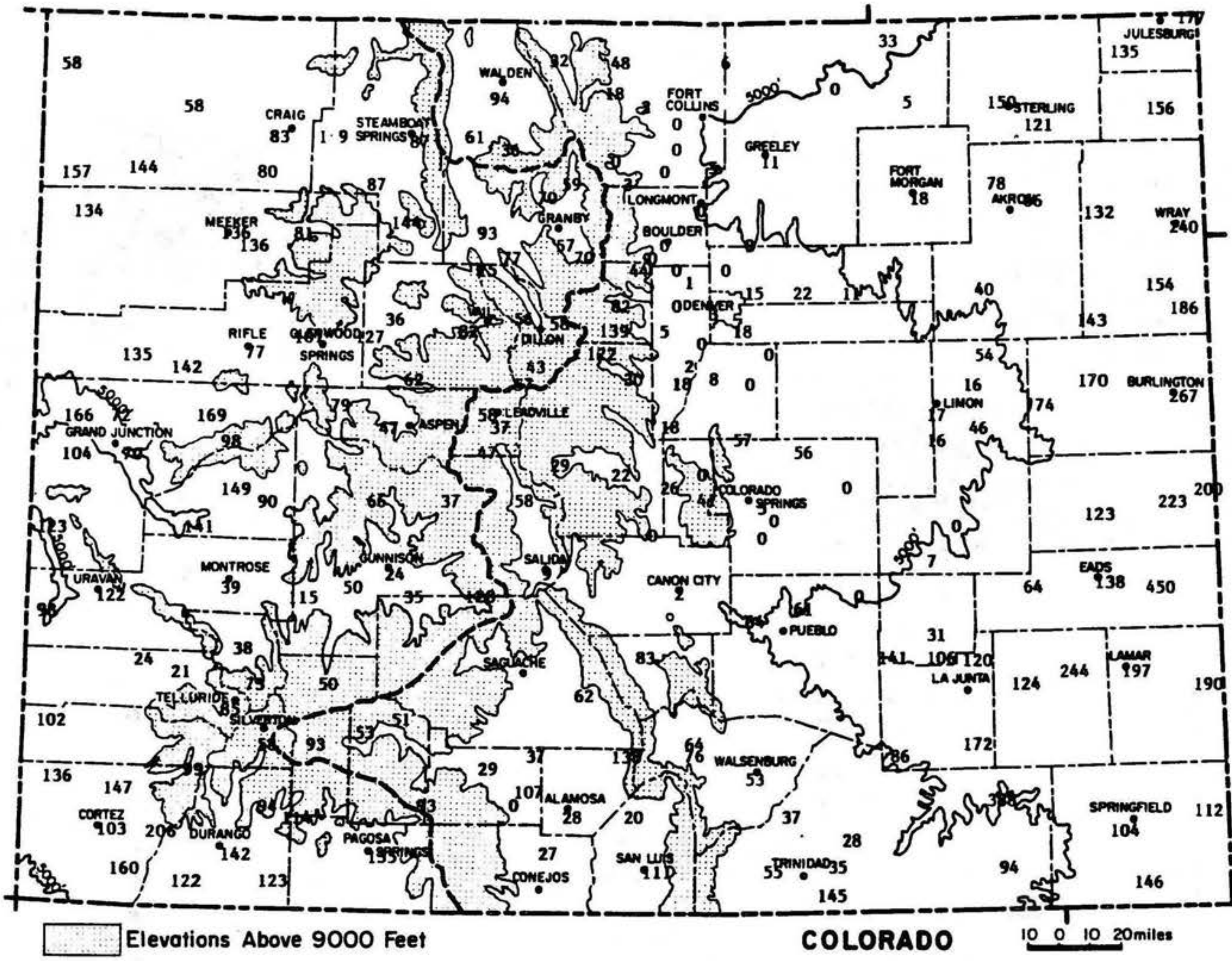


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

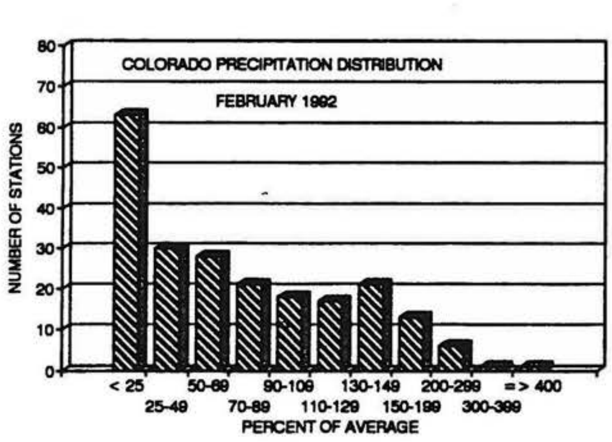


Precipitation Amounts (in inches) for February 1992.

FEBRUARY 1992 PRECIPITATION COMPARISON



February 1992 Precipitation as a Percent of the 1961–90 average.



Fort Collins had its driest February in 104 years of recorded data. But it is always rare for the whole State to be dry (or wet) at the same time. Out at Wray, during the past year, 11 months have been wetter than the long-term average. During that same period, Leadville has been drier than average 11 out of 12 months.

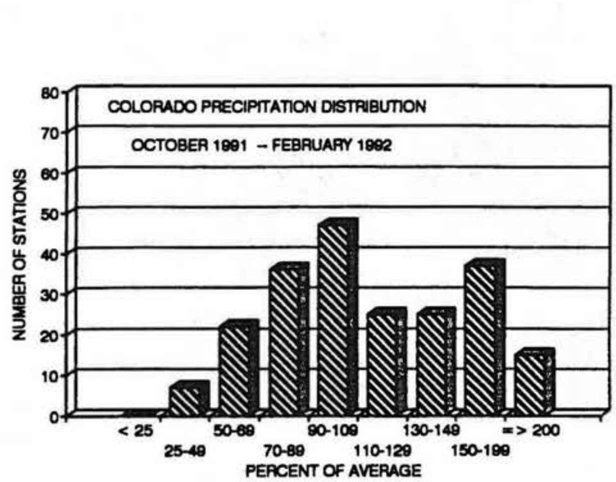
FEBRUARY 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

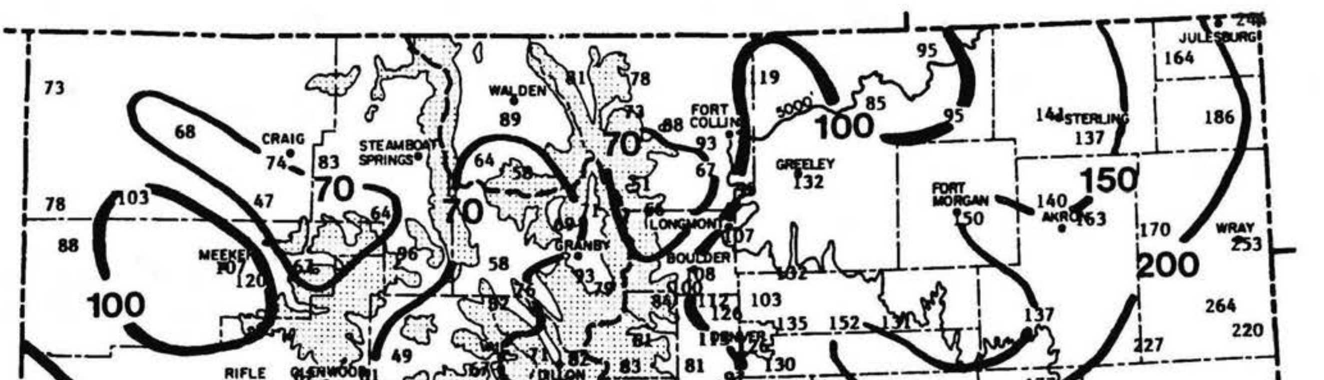
Station	Precip.	Rank
Denver	0.09"	11th driest in 121 years of record (driest = 0.01" in 1970)
Durango	1.96"	24th wettest in 98 years of record (wettest = 7.02" in 1911)
Grand Junction	0.35"	34th driest in 101 years of record (driest = Trace in 1898 and 1972)
Las Animas	0.46"	39th wettest in 126 years of record (wettest = 2.13" in 1903)
Pueblo	0.19"	41st driest in 124 years of record (driest = 0 or T in 1880, 1916, '52, '70)
Steamboat Springs	1.76"	29th driest in 87 years of record (driest = 0.30" in 1935)

1992 WATER YEAR PRECIPITATION

Drier than average conditions have continued to spread and now encompass most of the mountains. Only the Sangre de Cristo Mountains and southern portions of the San Juans remain wetter than average. The driest areas compared to average are some of the high valleys – less than 50% of average moisture has fallen at Eagle, Leadville and Gunnison. Areas with less than 75% of average are now widespread across the northern and central mountains.

Much of the Western Slope remains a bit wetter than average, and the San Luis Valley is still much above average. Elsewhere, conditions vary from dry in the northern foothills, near average over the Front Range cities with precipitation then increasing to the east and south. More than double the average October-February precipitation has fallen in a band from just east of Pueblo northeast to Burlington and Wray.





October 1991–February 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR FEBRUARY 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963	1459					7528
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410	1124					6170
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901	700					3891
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246	1048					M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021	751					4274
CANON	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870	688					3795
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998	788					4418
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310	892					4981
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556	1078					6083
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486	874					4967
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022	714					4197
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517	1306					7426
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305	935					4898
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387	970					5490
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123	939					5241
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029	736					4272
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193	756					4456
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390	788					4529

* = 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	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
6SSW	91-92	220	255	427	739	1169	1468	1735	1354					7367
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088	724					4330
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707	1167					6942
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943	712					3930
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471	1296					7544
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161	827					4790
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124	786					4533
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490	1025					5690
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385	911					5048
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477	1087					5980
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958	759					4115
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283	804					4798
STEAMBOAT	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680	1126					6976
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191	731					4415
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	90-91	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291	1057					5897
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946	774					4089
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547	1234					7050
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870	717					3758

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

FEBRUARY 1992 CLIMATIC DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	49.5	21.7	35.6	6.1	66	14	847	0	49	0.10	-0.20	33.3	3
STERLING	52.9	26.1	39.5	9.0	71	19	731	0	75	0.33	0.11	150.0	1
FORT MORGAN	53.0	24.5	38.8	8.2	69	19	756	0	66	0.03	-0.13	18.7	1
AKRON FAA AP	49.5	26.4	37.9	7.3	68	20	779	0	48	0.25	-0.07	78.1	1
AKRON 4E	49.1	26.7	37.9	7.8	68	20	779	0	42	0.20	-0.10	66.7	2
HOLYOKE	51.4	27.0	39.2	7.2	69	19	743	0	72	0.61	0.22	156.4	4
JOES	49.8	27.1	38.5	4.9	69	20	762	0	60	0.46	0.14	143.7	3
BURLINGTON	49.7	28.1	38.9	5.9	73	19	751	0	58	0.83	0.52	267.7	3
LIMON WSMO	46.3	26.2	36.3	6.5	67	18	827	0	31	0.07	-0.34	17.1	2
CHEYENNE WELLS	54.1	25.5	39.8	6.5	75	17	725	0	88	0.58	0.32	223.1	3
EADS	52.6	26.1	39.4	5.2	69	18	735	0	77	0.47	0.13	138.2	2
ORDWAY 21N	52.4	21.9	37.2	5.2	69	13	799	0	74	0.02	-0.25	7.4	1
ROCKY FORD 2SE	55.9	24.1	40.0	4.9	77	11	717	0	104	0.31	0.02	106.9	2
LAMAR	56.9	19.4	38.2	3.2	75	9	770	0	117	0.83	0.41	197.6	4
LAS ANIMAS	56.3	24.0	40.2	4.7	79	11	712	0	112	0.46	0.09	124.3	2
HOLLY	57.3	24.4	40.9	7.5	81	13	693	0	123	0.63	0.30	190.9	3
SPRINGFIELD 7WSW	55.6	26.8	41.2	5.5	75	16	682	0	102	0.49	0.02	104.3	4
TIMPAS 13SW	51.7	25.4	38.6	5.1	68	15	760	0	62	0.39	-0.06	86.7	3

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	52.7	26.0	39.4	7.0	70	15	736	0	63	0.00	-0.39	0.0	0
GREELEY UNC	52.5	27.1	39.8	6.9	71	19	724	0	67	0.04	-0.31	11.4	2
ESTES PARK	45.1	21.3	33.2	4.2	57	2	913	0	13	0.00	-0.46	0.0	0
LONGMONT 2ESE	53.3	22.0	37.7	6.3	71	13	786	0	71	0.00	-0.39	0.0	0
BOULDER	52.2	29.0	40.6	5.1	69	19	700	0	60	0.00	-0.75	0.0	0
DENVER WSFO AP	52.6	27.6	40.1	6.7	70	21	714	0	69	0.09	-0.48	15.8	2
EVERGREEN	47.9	16.9	32.4	3.7	64	7	939	0	32	0.04	-0.74	5.1	1
CHEESMAN	48.3	11.6	29.9	1.0	62	2	1012	0	31	0.12	-0.52	18.7	1
LAKE GEORGE 8SW	37.0	3.7	20.3	1.4	51	-6	1287	0	1	0.08	-0.27	22.9	3
ANTERO RESERVOIR	34.8	-1.4	16.7	-0.4	48	-17	1395	0	0	0.06	-0.18	25.0	3
RUXTON PARK	37.7	7.7	22.7	1.4	52	-9	1217	0	2	0.38	-0.54	41.3	4
COLORADO SPRINGS	50.0	25.1	37.5	5.5	68	17	788	0	47	0.02	-0.38	5.0	1
CANON CITY 2SE	54.4	27.5	41.0	3.8	69	17	688	0	92	0.01	-0.44	2.2	1
PUEBLO WSO AP	55.6	21.6	38.6	3.6	74	10	759	0	107	0.19	-0.12	61.3	1
WESTCLIFFE	37.6	6.2	21.9	-3.7	52	-8	1243	0	1	0.50	-0.10	83.3	6
WALSENBURG	52.1	28.0	40.1	4.5	68	17	717	0	64	0.51	-0.45	53.1	4
TRINIDAD FAA AP	53.8	22.4	38.1	3.2	71	11	774	0	83	0.14	-0.35	28.6	1

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	36.2	8.1	22.2	3.3	49	-11	1234	0	0	0.50	-0.03	94.3	6
LEADVILLE 2SW	34.9	5.4	20.1	3.1	48	-6	1296	0	0	0.30	-0.50	37.5	10
SALIDA	46.4	17.2	31.8	2.1	61	3	953	0	22	0.05	-0.49	9.3	2
BUENA VISTA	43.1	14.0	28.6	0.1	57	5	1048	0	7	0.24	-0.17	58.5	4
SAGUACHE	31.4	2.7	17.0	-7.5	43	-10	1385	0	0	0.08	-0.15	34.8	2
HERMIT 7ESE	30.3	-9.3	10.5	-3.7	39	-18	1574	0	0	0.40	-0.35	53.3	4
ALAMOSA WSO AP	31.5	-2.6	14.4	-7.6	40	-17	1459	0	0	0.08	-0.20	28.6	3
STEAMBOAT SPRINGS	40.3	11.6	25.9	6.4	49	-4	1126	0	0	1.76	-0.26	87.1	9
YAMPA	35.6	12.2	23.9	2.7	48	-2	1184	0	0	1.27	0.39	144.3	5
GRAND LAKE 1NW	38.1	8.0	23.0	3.9	50	-8	1207	0	0	0.85	-0.58	59.4	12
GRAND LAKE 6SSW	33.3	2.8	18.1	1.7	44	-16	1354	0	0	0.55	-0.23	70.5	13
DILLON 1E	34.8	4.7	19.7	1.2	45	-8	1306	0	0	0.49	-0.37	57.0	9
CLIMAX	29.3	2.3	15.8	0.9	47	-9	1421	0	0	0.97	-0.72	57.4	9
ASPEN 1SW	40.9	11.3	26.1	3.1	53	2	1124	0	2	0.98	-1.07	47.8	11
CRESTED BUTTE	34.0	-0.1	16.9	2.0	44	-25	1386	0	0	0.00	-2.06	0.0	0
TAYLOR PARK	33.4	-5.6	13.9	3.3	44	-27	1473	0	0	0.45	-0.74	37.8	5
TELLURIDE	43.8	12.7	28.3	3.5	56	-2	1057	0	7	1.26	-0.22	85.1	10
PAGOSA SPRINGS	44.1	10.4	27.2	1.4	56	-10	1087	0	7	1.74	0.46	135.9	7
SILVERTON	38.7	0.8	19.7	1.3	51	-15	1305	0	1	1.06	-0.74	58.9	6
WOLF CREEK PASS 1	33.5	8.9	21.2	2.8	49	-6	1262	0	0	3.34	-0.25	93.0	11

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	40.2	15.0	27.6	6.1	54	-8	1078	0	3	1.00	-0.20	83.3	8
HAYDEN	37.0	14.7	25.9	4.2	46	-3	1131	0	0	1.39	0.23	119.8	10
MEEKER NO. 2	41.4	17.4	29.4	1.9	56	2	1025	0	5	1.01	0.27	136.5	5
RANGELY 1E	41.9	16.0	28.9	4.6	58	-1	1039	0	6	0.63	0.16	134.0	4
EAGLE FAA AP	45.2	17.3	31.3	6.0	60	4	970	0	12	0.21	-0.36	36.8	3
GLENWOOD SPRINGS	46.6	21.4	34.0	3.9	60	12	891	0	11	1.12	0.02	101.8	7
RIFLE	51.0	23.0	37.0	6.9	65	13	804	0	42	0.61	-0.18	77.2	8
GRAND JUNCTION WS	47.1	28.1	37.6	3.4	63	12	788	0	23	0.35	-0.13	72.9	5
CEDAREDGE	46.7	21.3	34.0	1.6	65	12	894	0	17	1.18	0.39	149.4	8
PAONIA 1SW	46.8	23.4	35.1	3.0	61	12	859	0	18	0.93	-0.10	90.3	7
DELTA	47.0	22.1	34.6	0.7	62	1	874	0	18	0.51	0.15	141.7	2
GUNNISON	40.6	8.4	24.5	9.8	52	-5	1167	0	1	0.15	-0.47	24.2	1
COCHETOPA CREEK	41.8	8.7	25.2	9.7	53	-7	1146	0	2	0.24	-0.43	35.8	5
MONTROSE NO. 2	44.2	22.4	33.3	1.7	57	10	911	0	8	0.17	-0.26	39.5	2
URAVAN	50.2	25.2	37.7	2.1	67	12	784	0	35	0.76	0.14	122.6	9
NORWOOD	42.5	20.0	31.2	3.3	56	6	972	0	7	0.20	-0.62	24.4	2
YELLOW JACKET 2W	45.1	21.4	33.3	3.5	60	8	912	0	17	1.57	0.42	136.5	5
CORTEZ	45.7	22.2	33.9	3.9	59	5	892	0	15	0.90	0.03	103.4	5
DURANGO	44.9	20.1	32.5	1.3	56	4	935	0	7	1.96	0.58	142.0	7
IGNACIO 1N	43.9	19.7	31.8	3.0	57	-5	956	0	8	1.20	0.23	123.7	6

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.

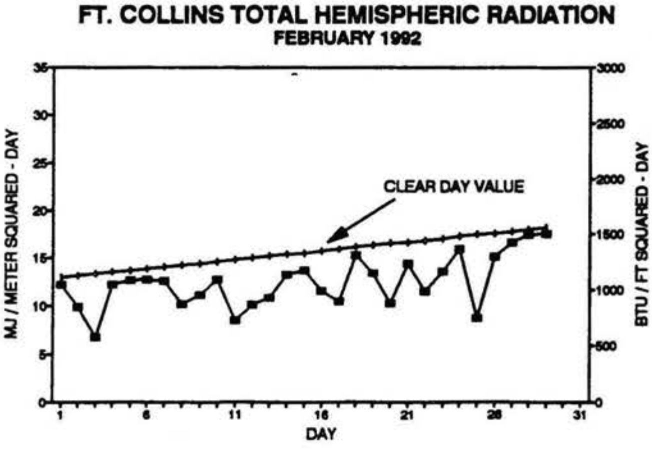
FEBRUARY 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	8	13	8	--	--
Denver	8	10	11	70%	70%
Fort Collins	12	8	9	--	--
Grand Junction	9	7	13	77%	65%
Limon	7	11	12	--	--
Pueblo	8	12	9	85%	73%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Lots of high clouds streamed into Colorado as storm systems moved in from California. But there were few days of dense overcast. The result was plenty of solar energy.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
FEBRUARY 1992

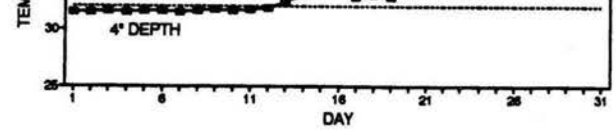


FEBRUARY 1992 SOIL TEMPERATURES

Frost came out of the soil earlier than usual with the help of air temperatures that were persistently well above average throughout February.

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 1992



HATS OFF TO: *Edward Thompson* of Ouray, Colorado

Mr. Thompson is just starting his 16th year as the official weather observer for Ouray. His records are always complete and precise. Since he took over the station, the wettest year in Ouray was 1984 when 33.66" of precipitation was measured in Mr. Thompson's rain gage, 10" more than average.

SOLAR ENERGY AND CLIMATE – AN INSEPARABLE DUO

We've talked a lot about sunshine and clouds in our special climate articles, and for good reason. Sunshine, and the energy it transmits into the earth's atmosphere, is the true lifeblood of our climate. The sun's energy, which climatologists call solar radiation, is the energy source that heats the air and evaporates water. Differences in heating from the tropics to polar areas and between land and sea establish wind patterns which redistribute enery throughout the atmosphere. Ocean currents also circulate energy from the tropics to the colder polar regions. The energy used to evaporate water is later released in the atmosphere as condensation occurs and clouds form. All of these processes are the essential ingredients that make up our observed climate – temperature, pressure, wind, humidity, clouds and precipitation, and their seasonal changes.

I find it somewhat ironic, considering the vast importance of solar energy in our climate system, how little effort has been made to measure and record it. Nationally we have thousands of weather stations recording temperatures and precipitation. There are hundreds of stations where detailed observations of cloud heights, visibility, wind, humidity and weather conditions are taken each hour. National networks have been in place for many decades to make sure these data are collected and available. But when it comes to monitoring solar radiation – the very heart of our climate – data are surprisingly hard to come by. For example, here in Colorado, some of our weather stations date back more than 100 years. At least one or two stations measuring temperature and precipitation can be found in every county in our state. But if you ask for 20 years of solar radiation measurements, you are pretty much out of luck.

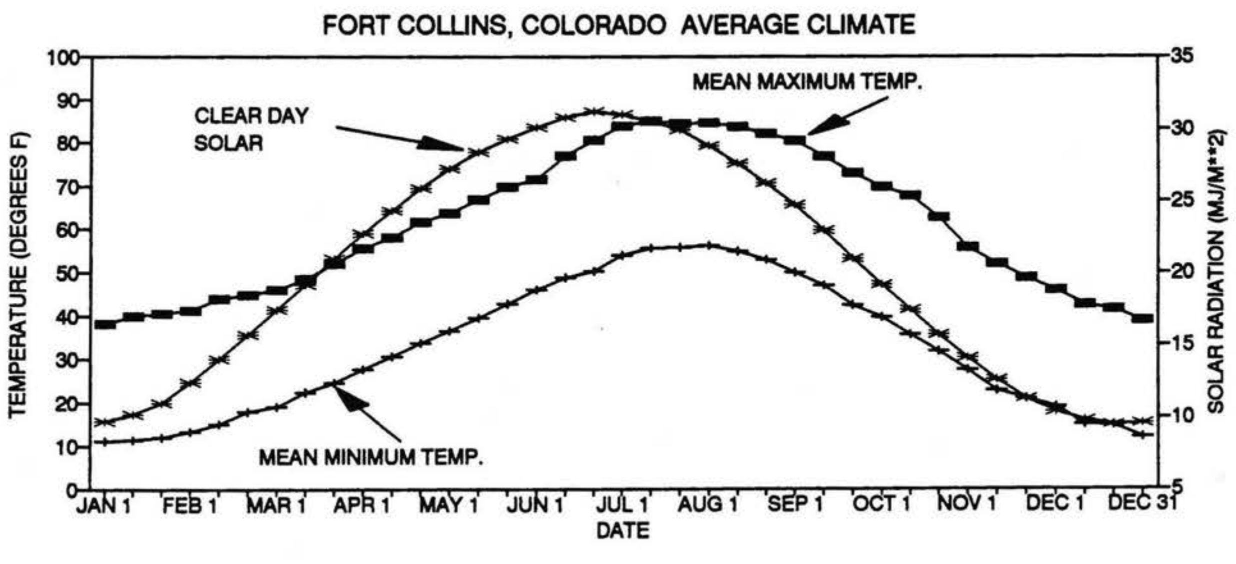
There has been a national solar network operating about 30 stations nationwide since the late 1970s. Colorado was lucky and had two locations included in this network, Boulder and Grand Junction. Unfortunately, this small network has constantly struggled and has come close to termination on several occasions.

There are three main reasons why solar radiation measurements have received such low priority. 1) A meteorologist can make a weather forecast without knowing how much solar energy is reaching the ground. 2) A pilot can land a plane without knowing the amount of incoming solar radiation. 3) Accurate measurements of solar energy are more difficult and require more expensive equipment than thermometers and raingages. These three factors have had the greatest impact during recent history on determining how our resources are spent for data collection. Monitoring solar radiation takes a back seat to most other meteorological measurements.

While weather forecasters, pilots, and taxpayers may get along fine without solar energy measurements, there are a number of others who have a different attitude. Here in Colorado, the management of our water resources is very sensitive to solar energy. Evaporation rates from reservoirs and irrigation ditches and evapotranspiration from plants are directly related to solar radiation. Solar radiation also affects snowmelt rates and runoff efficiencies. As a result, several organizations have begun their own solar radiation monitoring activities including golf courses, cities, and water companies.

Plant growth and crop yield is also related to solar energy, so several agricultural groups have initiated solar monitoring. Solar energy during the summer months helps dry out vegetation and increases wild fire potential. Organizations responsible for fire control have begun closer monitoring of solar radiation as it relates to fire potential. Air pollution potential is related to solar radiation and the development of temperature inversions. Air quality monitoring stations sometimes include solar radiation sensors.

Another obvious application of solar radiation is in providing energy for heating our homes, businesses, and public buildings. Back in the 1970s when energy shortages were



anticipated, Public Service Company of Colorado began collecting solar data at a number of locations in Colorado. Since energy shortages and rapid cost escalations failed to materialize, their monitoring program faded away. In 1985, the City of Fort Collins Light and Power Utility provided funds to the Colorado Climate Center to begin ongoing measurements of solar energy in Fort Collins. We have published a graph of Fort Collins daily solar energy in **Colorado Climate** continuously since that time. More recently the Joint Center for Energy Management, with support from the Colorado Office of Energy Conservation, set up a weather network in Colorado specifically designed to provide data pertinent for evaluating potential use of renewable energy resources (specifically wind and solar energy) here in Colorado. We have been publishing data from their small network now since January of 1988.

It is good to see this growing interest in monitoring solar energy. Sources of data are expanding every year. Unfortunately, there are severe disadvantages to having disjointed data collection systems as have emerged here in the Rocky Mountain region. It is difficult to know what data are available and how good those data are. It is difficult for potential users to obtain data. At the present time only a small portion of the solar data currently being collected in Colorado is sent to the Climate Center for archiving and public access. It is difficult to maintain consistent data collection standards and quality control when data collection is in the hands of many different groups. Some organizations have the resources to calibrate and maintain their equipment. Others simply purchase an instrument, install it, hope it works right and never give it another thought.

While it is easy and inexpensive to measure temperature to an accuracy of a degree or two, solar measurements accurate to within 3-5% require considerable care and expense. Measurements that are accurate to within 0-2% require special equipment and frequent calibration. At this time, most of the measurements in Colorado fall into the ± 3-5% accuracy range, and some are probably not even that good. For most applications we suggest discarding any data that is outside of those limits.

The day will come, and probably quite soon, when satellite data and networked surface stations will be used for real-time high resolution monitoring and display of Colorado solar radiation. I can imagine computer maps with contour lines or color shading identifying regions of greater and lesser solar energy. Computations of evapotranspiration, plant growth, and even insect pest development could then be made for the entire State using available computer simulations. This technology already exists and is being used in some parts of our country. Over time, that data could be assembled into detailed climatic descriptions of solar energy and water usage.

We have a long way to go before we are solar experts. But even now, with only a few years of data from a few selected locations in Colorado, we can already piece together a lot of useful information about our solar climate. Next month, we will describe some of the characteristics of solar energy in Colorado.

CENTENNIAL BOOKLET AVAILABLE

Last year we celebrated the Centennial of the Cooperative Weather Observation Program in Colorado. Eleven Colorado communities were recognized for maintaining cooperative weather stations for the entire past century. The highlight of the whole event was the first-ever meeting of the two most experienced weather observers in Colorado. Marvin Rankin (52 years as Westcliffe weather observer – longest individual official weather observer in Colorado history) and Lynn Woods (50 years of volunteer service as Del Norte weather observer) met and exchanged stories while more than 200 joyous onlookers, some teary-eyed, applauded. Who ever said weather observing and climatology aren't exciting. What a blast we had!

Reprints of the Centennial Booklet that were distributed at the celebration are now available to the public. This booklet contains a history of weather observations in Colorado, a brief description of our climate, highlights of the top climatic events in Colorado during the past 100 years, and a write-up on each centennial weather station and each of the special long-time individual weather observers.

This neat little 40-page booklet will stand as a lasting reminder of the importance of human weather observers in Colorado history.

To get your own Centennial booklet please send a check for **$2.50** payable to <u>Colorado State University</u> and send it to our regular mailing address. Please allow 3 weeks for delivery. Make sure your return address is clearly indicated.

Official Weather Observers – Send <u>no</u> payment. Free copies have been reserved for every official weather observer in Colorado as a small expression of our thanks for your service to the State and Nation.

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.

Thermal Energy Storage in Buildings

Have you ever walked in bare feet on an asphault roadway on a warm, sunny afternoon? If the sun has been shining on the road long enough, you probably regretted not wearing your shoes that day. The dark pavement absorbs the incident solar radiation and stores it in the form of heat. Even after sunset the roadway remains warm for a few hours.

Buildings also exhibit this effect. It is more noticable in "light" houses (wood frame construction), where there is less mass to temper the effects of the added energy, than in "heavy" (masonry) houses. That is, a heavy building will store more energy than a similarly sized light structure, and will tend to show less radical temperature changes within the occupied zones. This thermal storage is a benefit in the spring and fall when it gets chilly after sunset, but can be undesirable during a hot summer night when you are trying to sleep.

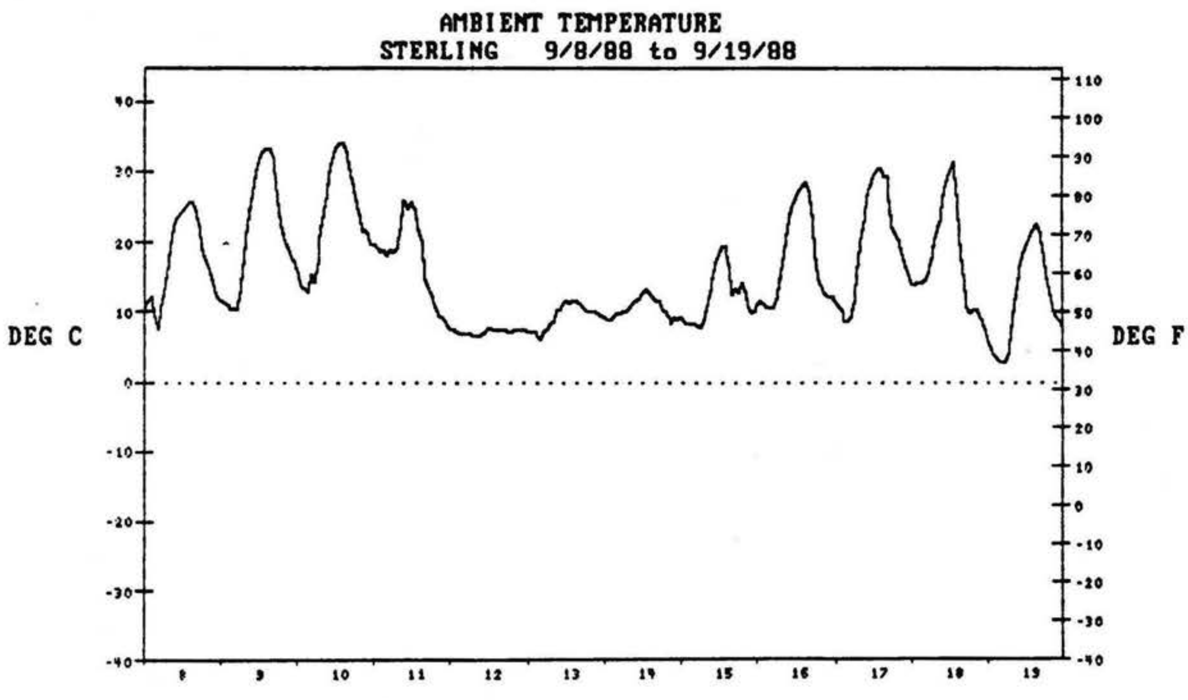
The mass of a building also plays a role during the heating season. A heavy building which cools off (for example, over a weekend) is more difficult to bring up to normal habitable temperatures. A light building, like most residences, does not store much heat within the structure itself, and therefore relies on insulation to prevent heat loss through the walls and roof.

Of course, any deviation from normal operating conditions translates into energy use: heaters or air-conditioners must be used to bring the internal climate back into the "comfort zone." When designing low energy-use homes, therefore, it is important to correctly size the thermal mass of the building for optimal heating and cooling applications.

In passive solar-heated homes, sizing the thermal mass is an integral part of the design process. Since the main energy source is not available for half of the day, solar houses are designed to take advantage of the heat capacity of the construction materials through correct orientation and thicknesses of heat storage walls.

An Example

In September most of the state experienced a cold spell from the 11th to the 15th. This little preview of winter clearly illustrates the benefit of thermal storage, since most of us had probably not done our yearly furnace maintenance by then. The graphic below shows the temperature in Sterling over a twelve day period starting on the 8th. Just before the cold snap the daytime temperatures reached 94°F, then plummeted to around 45° for the next four and a half days. Whereas the interior of a thick-walled stone house might not "see" this temperature drop for a few days, a stud and sheetrock framed home would most likely be uncomfortably cool by the end of the first day.

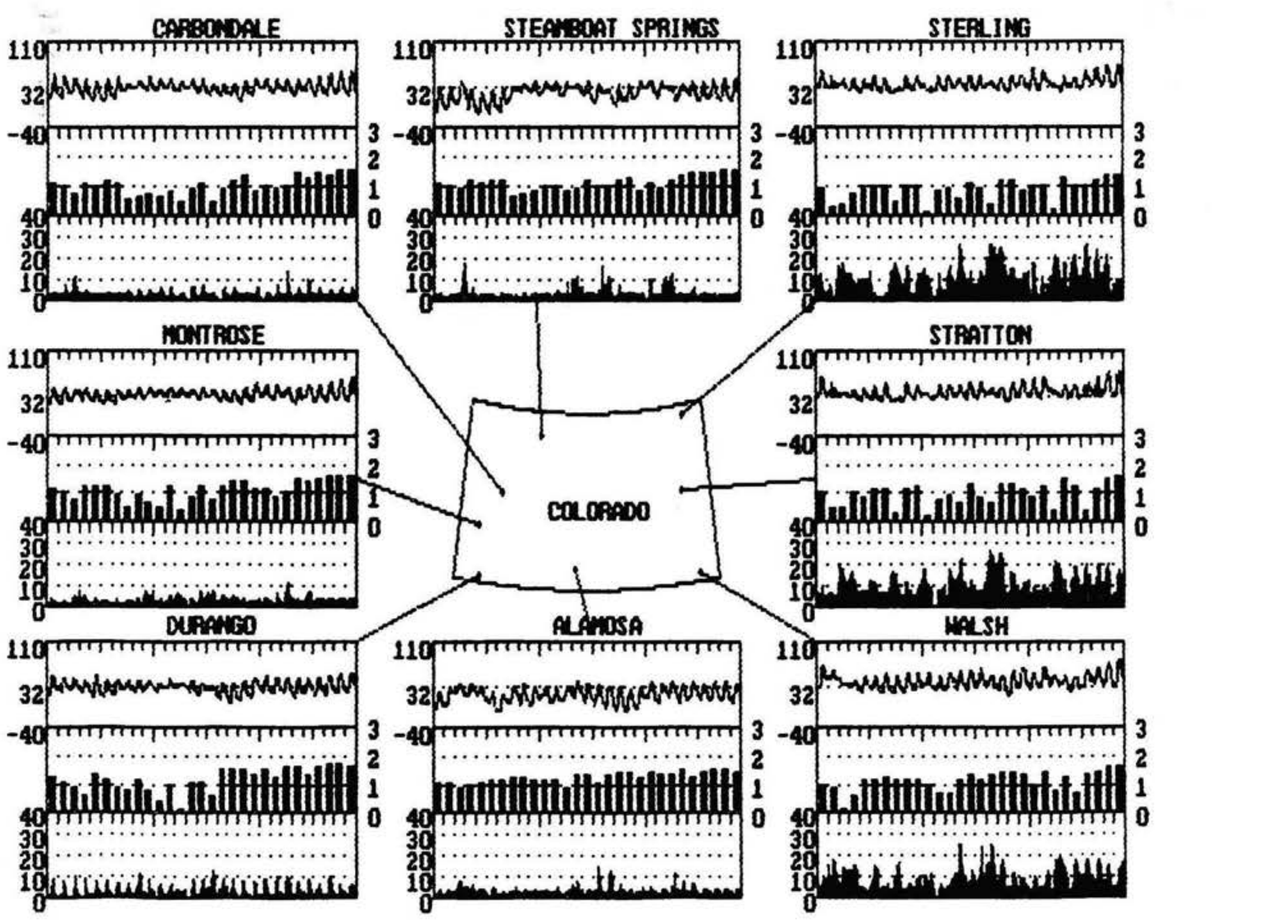


This report prepared by Peter Curtiss of the Joint Center for Energy Management, a collaboration between Colorado State University and the University of Colorado at Boulder.

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	16.0	29.2	30.5	32.4	20.8	36.9	36.8	39.6
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	40.1 23/14	54.7 28/16	60.6 29/15	60.8 29/15	44.6 27/14	69.4 28/14	72.9 29/15	74.7 29/14
minimum:	-12.6 19/ 7	2.7 18/ 4	6.4 19/ 7	13.6 6/ 7	-14.8 5/ 7	21.6 7/ 5	19.9 8/ 8	15.4 19/ 6
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	91 7 3	77 / 14	90 / 19	80 / 19	88 / 9	37 / 5	88 / 26	78 / 23
11 AM	77 / 16	47 / 17	54 / 20	52 / 22	65 / 15	26 / 8	60 / 27	50 / 28
2 PM	65 / 20	43 / 17	37 / 17	41 / 20	47 / 16	22 / 8	48 / 24	40 / 26
5 PM	68 / 18	44 / 17	40 / 16	43 / 19	55 / 16	21 / 5	51 / 23	43 / 25
11 PM	91 / 11	74 / 19	74 / 20	74 / 22	85 / 14	30 / 4	80 / 25	69 / 23
monthly average wind direction (degrees clockwise from north)								
day	175	214	216	88	166	229	114	216
night	179	96	165	217	126	241	214	262
monthly average wind speed (miles per hour)								
	2.85	2.71	2.14	2.64	2.28	8.77	9.19	8.36
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	451	464	549	460	561	158	55	49
3 to 12	241	223	142	236	116	356	468	491
12 to 24	4	1	1	0	7	174	164	141
> 24	0	0	0	0	0	8	9	7
monthly average daily total insolation (Btu/ft²·day)								
	1227	1159	988	1110	1093	854	973	1103
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	175	89	117	139	127	98	127	150
40-60%	86	72	68	65	83	72	66	65
20-40%	44	66	88	73	48	58	45	50
0-20%	1	37	33	17	19	51	39	30

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 1992

Volume 15 Number 6

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

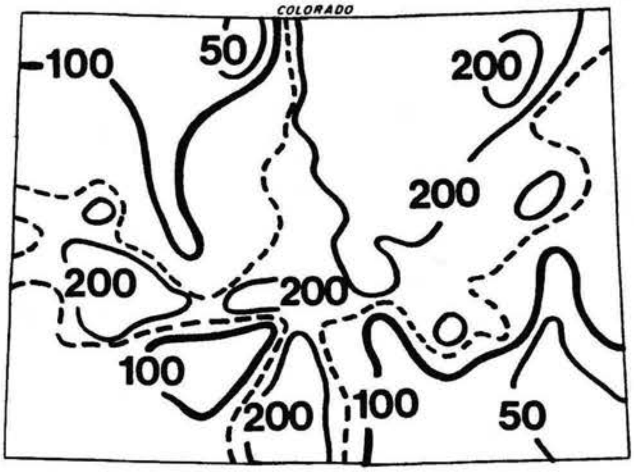
Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

March Climate in Perspective – Wet and Mild

While much of the Western United States experienced a dry March, a series of moisture-laden storms snuck into Colorado from the southwest. As a result, much of the State ended up considerably wetter than average. Again there were only a few brief intrusions of cold air into the State, continuing the pattern of mild weather that has characterized much of the winter.

Precipitation

Three major storms in March followed similar tracks and delivered heavy precipitation from southwestern Colorado northeastward into the South Platte Basin. The entire last half

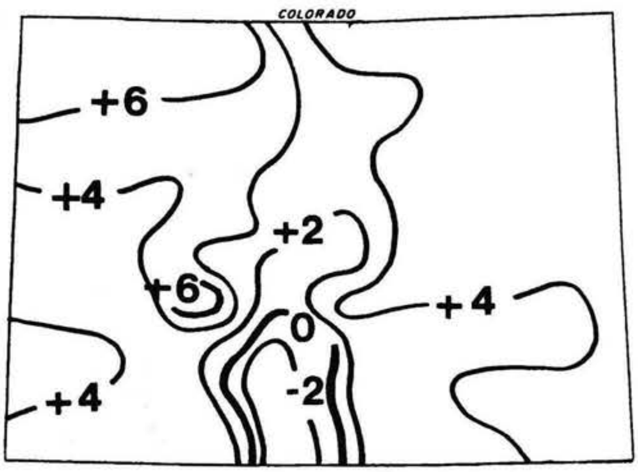


March 1992 precipitation as a percent of the 1961-1990 average.

of the month was unsettled with frequent but mostly light and scattered rain and snow showers, particularly from the Front Range west across the mountains. March precipitation greatly improved mountain snowpack and summer water supply projections. However, the storms managed to miss portions of northwest and southeast Colorado. Totals ranged from less than 50% of average over portions of extreme southeast Colorado and the Walden-Steamboat Springs area to near record levels (close to 400% of average) in the San Luis Valley and along the Front Range urban corrider.

Temperatures

With persisting snowcover, the San Luis Valley remained colder than average in March, continuing the winter-long pattern. Elsewhere, the entire State was warmer than average with most areas ending up 3-5 degrees F above their 1961-1990 averages. The warmest parts of Colorado, compared to average, were the upper Gunnison Valley and northwestern counties where temperatures were 6-8 degrees above average, one of the 3 warmest Marches on record this century. It was the warmest March on record at Steamboat Springs. Continuing the trend of the past months, there were very few intrusions of polar air into the State. The few cold episodes we did have, such as March 9, were very brief.



Departure of March 1992 temperatures from the 1961-90 averages.

Inside This Issue

MARCH 1992 DAILY WEATHER

1-2 Temperatures were much warmer than average. Even some summer-like convective clouds developed near the foothills on the 2nd. Daytime temperatures climbed into the 60s and 70s at lower elevations with 40s and 50s in the mountains. Holly's 81°F on the 1st was the warmest in the State. The San Luis Valley remained cold.

3-5 A major upper-level storm system moved across the southern Rockies. Temperatures cooled, but not dramatically, and rain and wet snow began over southwest Colorado on the 3rd spreading northeastward. Steady moderate rain greeted residents along the Front Range on the morning of the 4th. Heavy snow fell in the foothills. Parts of the San Luis Valley were clobbered by snow on the 4th. Precipitation tapered off late in the day, but low clouds, local fog and a few rain and snow showers lingered on the 5th. Precipitation totals from the storm were impressive in some areas and triggered a number of major mountain avalanches. From Paonia to Ouray well over one inch of precipitation fell. More than 2 feet of new snow accumulated on the Grand Mesa. More than a foot of wet snow fell on parts of the San Luis Valley. Manassa reported 1.31" of precipitation (15" of snow) in 24-hours on the 4th, their heaviest March storm on record. One to two inch rains fell along the Front Range from Denver northward with 1-2 foot snows in the foothills. Fort Collins totalled 2.16" – all rain – the heaviest March rainfall ever recorded there.

6-7 Partly cloudy and fairly humid with statewide temperatures remaining at or above average.

8-10 A powerful storm erupted over Colorado on the 8th as a moisture-laden system moved northeastward from southern California at the same time that one of the few surges of Arctic air of the entire winter pushed down from Canada. Sunday, the 8th, began mild and springlike east of the mountains while mountain snows began from the southwest. Thunderstorms developed during the afternoon, especially over northeast Colorado as the air masses collided. Local hail and even a small tornado were reported. Then suddenly the rain changed to a ferocious and dangerous blizzard across northeastern Colorado east of the Continental Divide (see feature story). By the morning of the 9th the storm was over, but it left widespread power outages, broken trees and stranded vehicles from Monument to Cheyenne and east to Julesburg. Boulder, Fort Collins and Wheat Ridge reported 16.3", 16.7" and 17.8" of snowfall, respectively, skies cleared and winds diminished, temperatures plummeted to their lowest points of the month. Highs only reached the 20s and 30s on the 9th. Denver hit +8° early on the 10th, and many mountain areas fell far below zero.

11-16 Warmer temperatures returned statewide. Low elevation temperatures were back in the 60s and 70s each day 12-16th quickly melting the remaining snow.

17-19 Much cooler weather for Colorado as Canadian air slipped down across the Eastern Plains and a cold low pressure trough crossed the mountains. No major storms developed, but several inches of new snow fell in many parts of the mountains. Some light rain, snow and fog dampened the Front Range.

20-25 Unsettled changeable spring weather. Warmer on the 20th. Colder again on the 21st with developing snow in the mountains and along the Front Range. Precipitation was generally light, but Bailey recorded 6" of new snow. Cool and breezy on the 22nd. A new disturbance crossed the mountains 23-24th delivering several inches of snow. Skies cleared on the 25th but northwesterly winds were brisk in some areas.

26-28 A storm off the southern California coast lifted northeastward and brought a new surge of moisture to parts of Colorado. Dry and mild on the 26th, but clouds and moisture reached southwestern Colorado on the 27th. Significant rain and snow developed quickly overnight. By noon on the 28th Denver had recorded 1.11" of rain. Cedaredge and Paonia also received an inch or more of moisture from a rain/snow mixture. Mountain snows were substantial with 6-15" totals in many areas from Wolf Creek Pass to Winter Park. The Mount Evans Research Station totalled 19 inches.

29-31 Clearing 29th but still unsettled. Some moisture snuck into extreme southern Colorado 30-31st from a storm over southern California. A strong Canadian cold front then pushed rapidly southward across much of the State on the 31st and triggered some light upslope precipitation along the Front Range – generally less than 0.10".

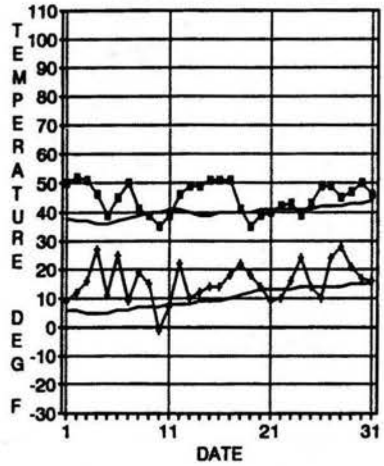
Weather Extremes

Highest Temperature	81°	March 2	Holly
Lowest Temperature	-19°	March 10	Taylor Park Dam
Greatest Total Precipitation	7.00"		Coal Creek
Least Total Precipitation	0.18"		Campo 7S
Greatest Total Snowfall	73.0"		Bonham Reservoir
Greatest Depth of Snow on Ground	76"	March 24	Bonham Reservoir
Greatest Depth SCS Snowcourse	91"	March 30	Upper San Juan

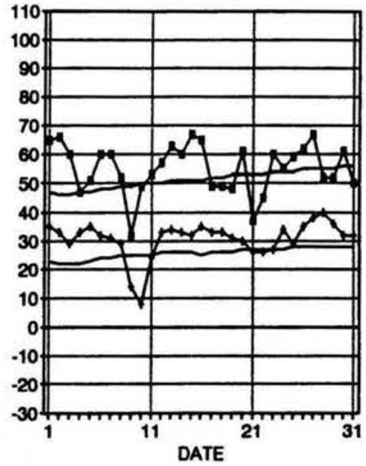
MARCH 1992 TEMPERATURE COMPARISON

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.)

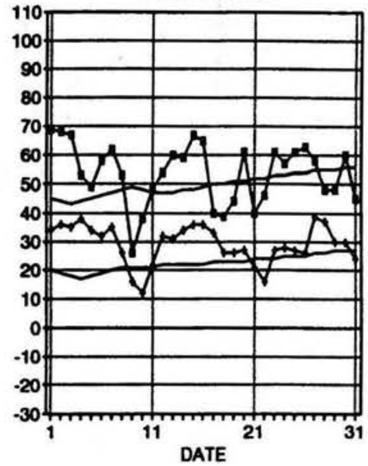
GRAND LAKE 1NW



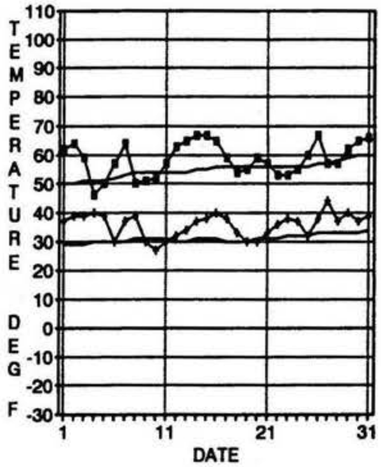
DENVER



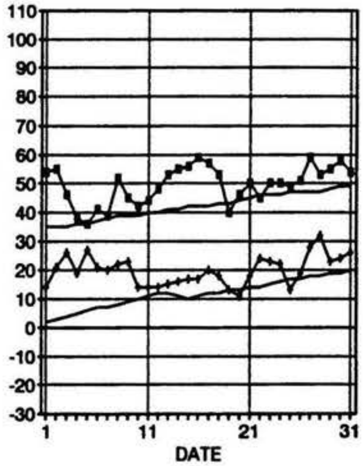
AKRON 1N



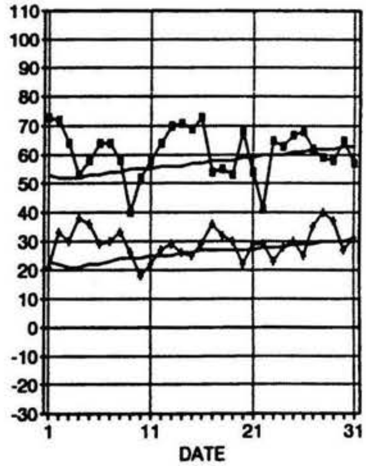
GRAND JUNCTION



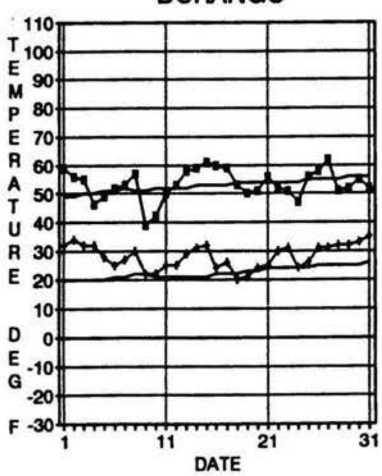
GUNNISON



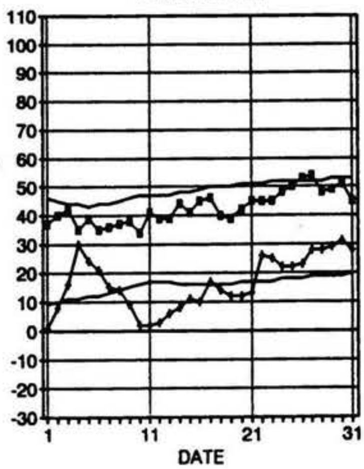
PUEBLO WSO



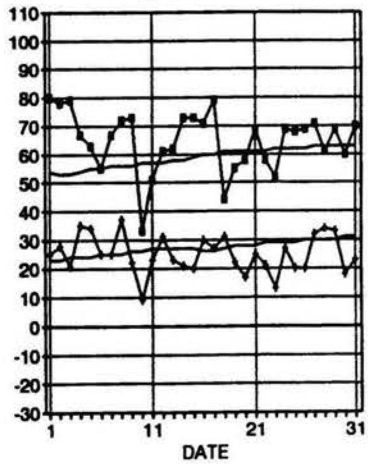
DURANGO



ALAMOSA



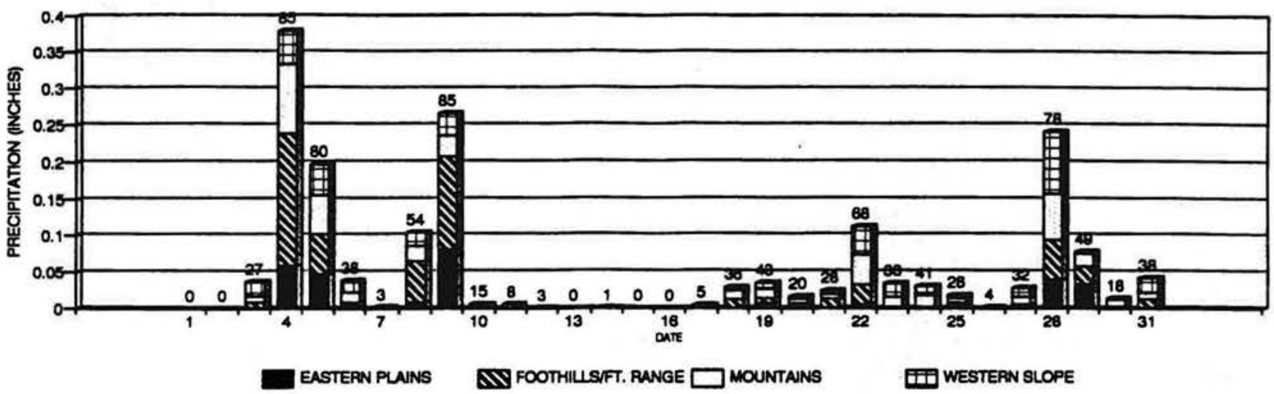
LAMAR



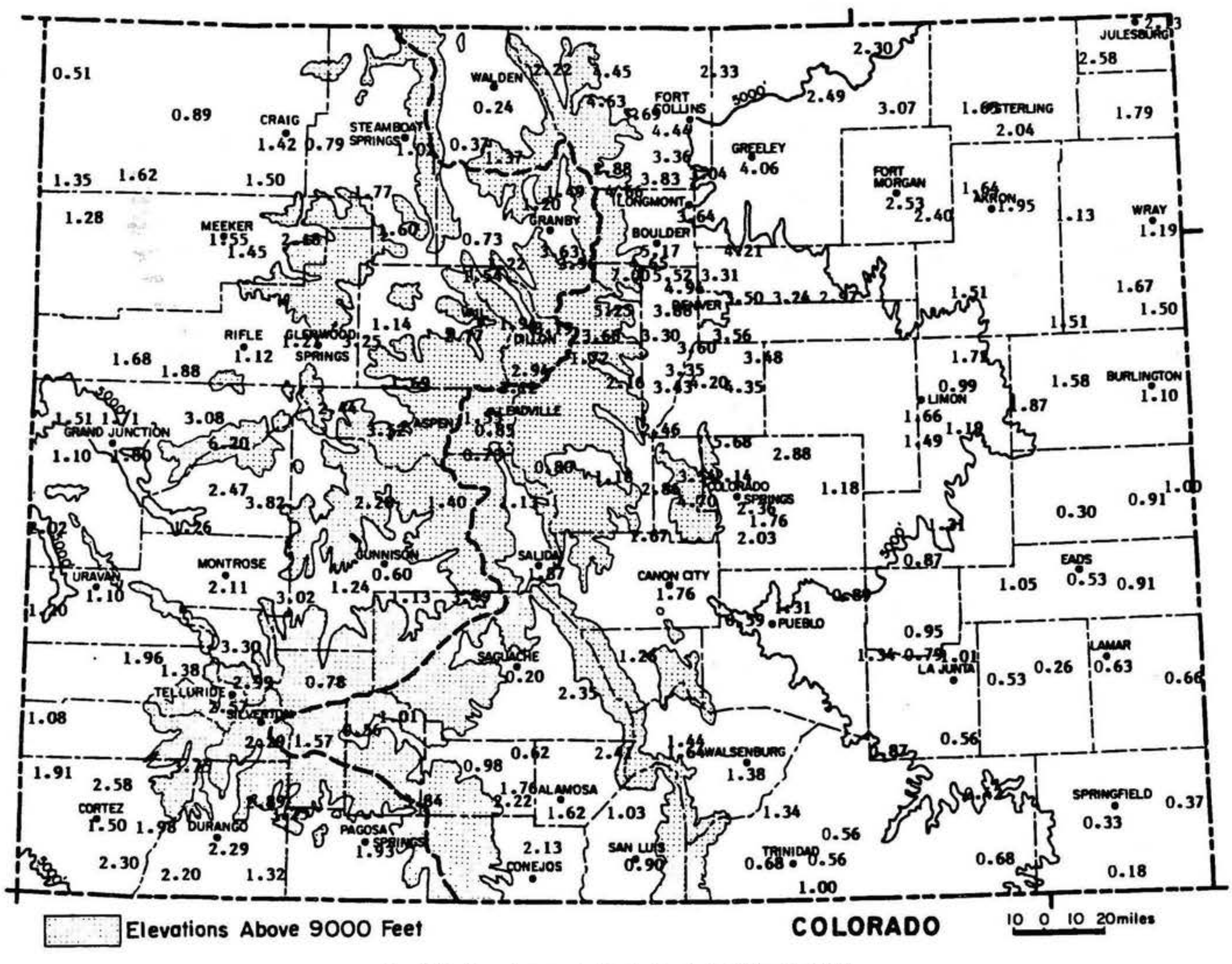
MARCH 1992 PRECIPITATION

Three major storms, March 3-5th, 8-9th and 28th all followed similar paths across Colorado and accounted for the majority of March precipitation statewide. Scattered, lighter precipitation fell daily throughout the last two weeks of March. Precipitation March 4-5 averaged 0.57" statewide. This single storm dropped more than 3 million acre-feet of water on Colorado, enough to totally fill Blue Mesa Reservoir more than three times.

COLORADO DAILY PRECIPITATION - MAR 1992

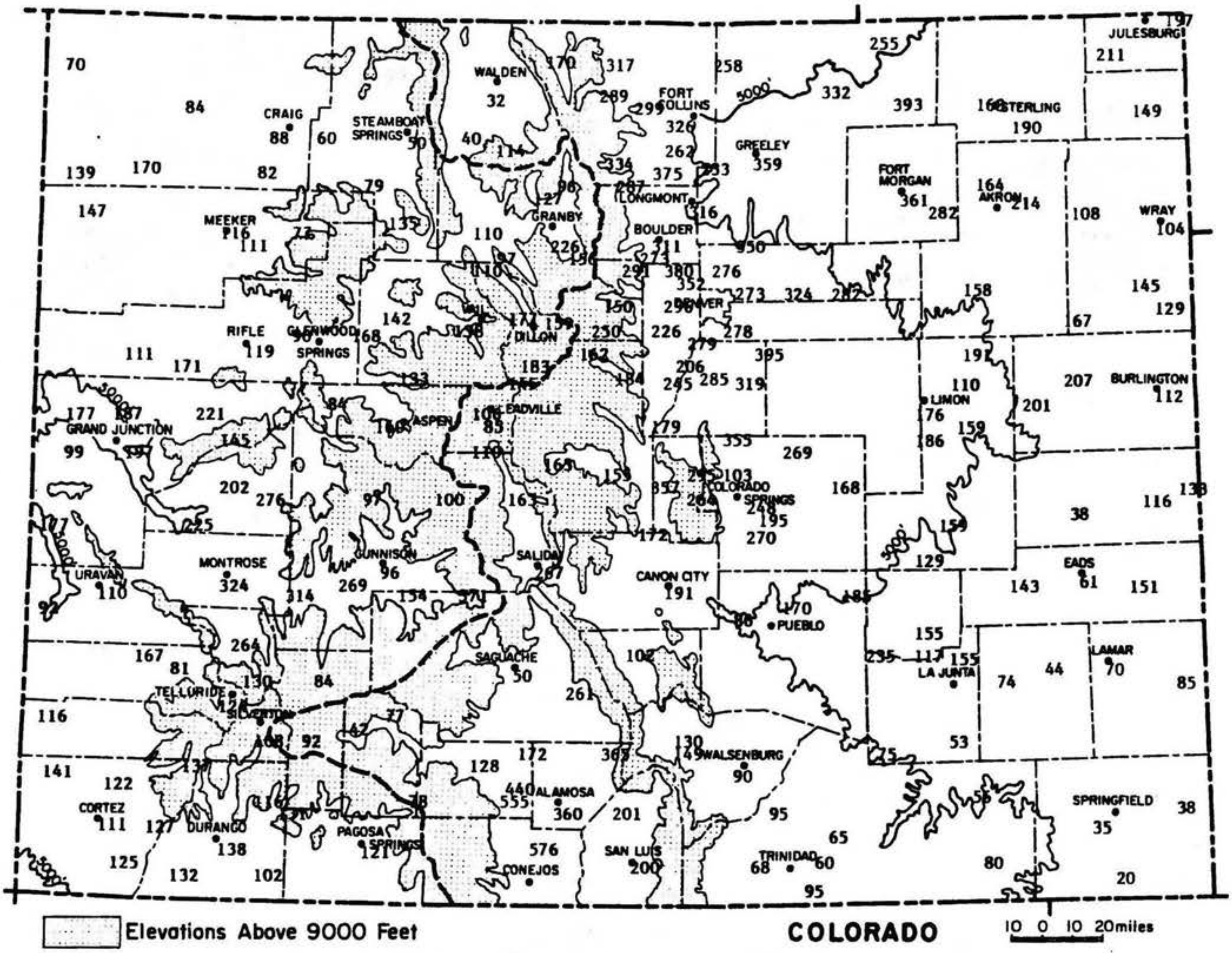


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

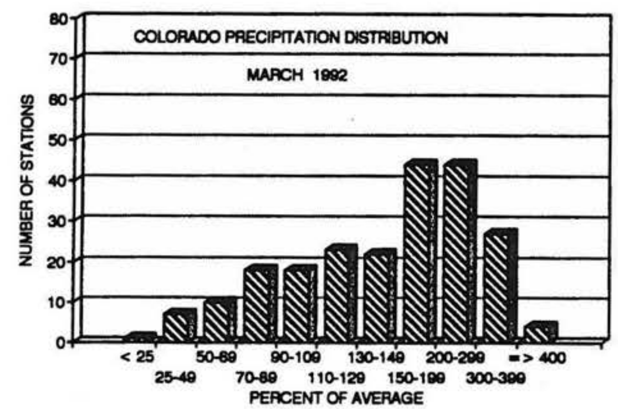


Precipitation Amounts (in inches) for March 1992.

MARCH 1992 PRECIPITATION COMPARISON



March 1992 Precipitation as a Percent of the 1961–90 average.



Roughly 75% of Colorado received more March precipitation than average. About 1/3 of the State reported more than 200% of average. Boulder's 5.17" monthly total established a new record for March. Fort Collins and Greeley each had their second wettest March on record, second only to March 1990.

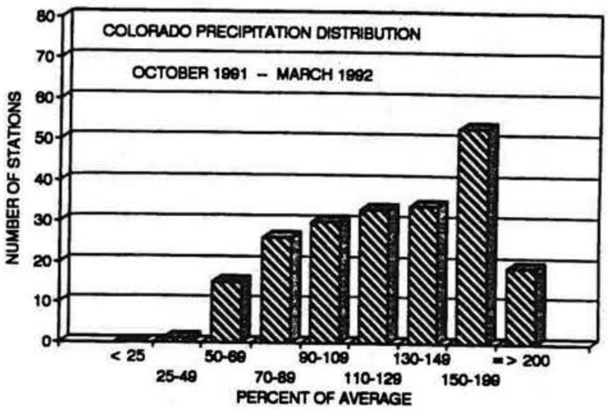
MARCH 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

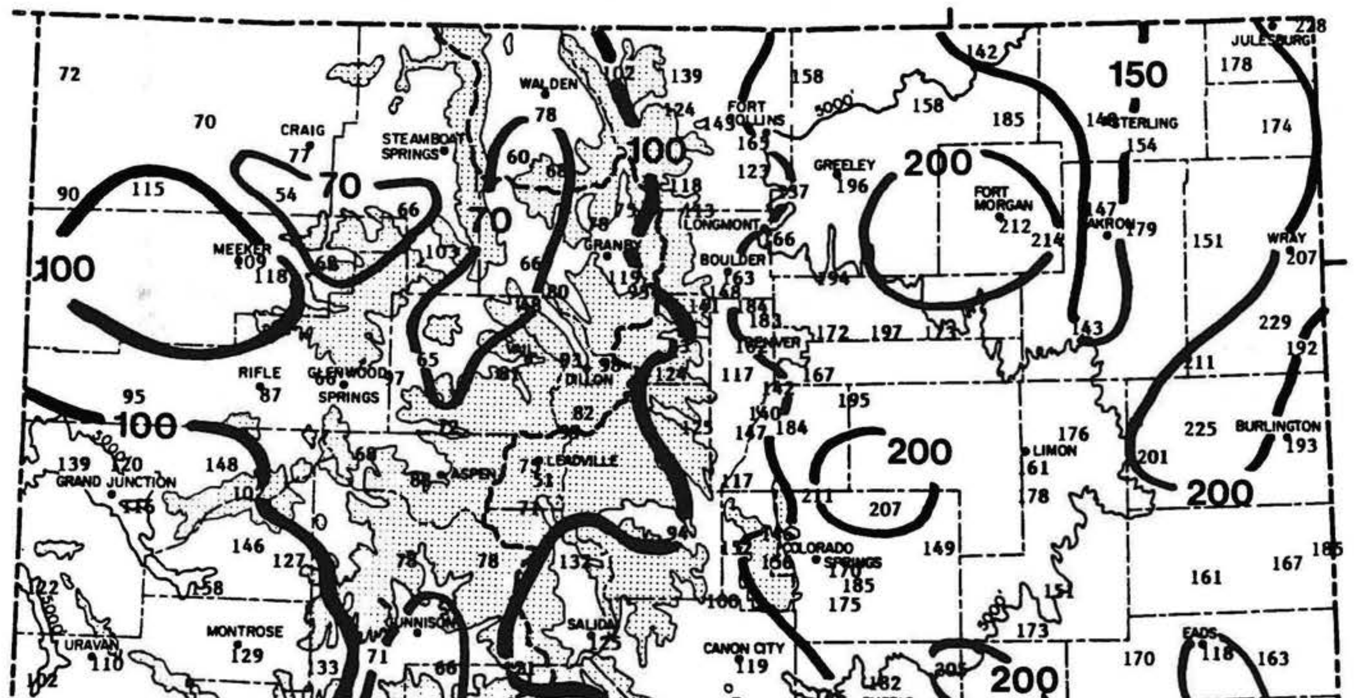
Station	Precip.	Rank
Denver	3.50"	2nd wettest in 121 years of record (wettest = 4.56" in 1983)
Durango	2.29"	30th wettest in 98 years of record (wettest = 4.87" in 1938)
Grand Junction	1.71"	9th wettest in 101 years of record (wettest = 2.36 in 1912)
Las Animas	0.53"	53rd wettest in 126 years of record (wettest = 3.06" in 1973)
Pueblo	1.31"	15th wettest in 124 years of record (wettest = 3.06" in 1905)
Steamboat Springs	1.02"	10th driest in 87 years of record (driest = 0.49" in 1910)

1992 WATER YEAR PRECIPITATION

The abundant March precipitation improved the 1992 water supply outlook for much of Colorado. Dry areas persist in some of the mountains and over limited areas of northwest Colorado, but these areas retreated in March. March precipitation especially helped the South Platte River Basin.

Most of the Eastern Plains continue to enjoy very good early moisture. For the first 6-months of the 1992 water year, all of the Plains are wetter than usual except the immediate Springfield area which is just slighltly below average. The majority of the Eastern Plains now stand between 160% and 225% of average. This is excellent for most agricultural activities. The San Luis Valley has also been much wetter than normal. However, these conditions can change rapidly during the next few months as we move into what is normally the wet season for areas east of the Continental Divide.





October 1991–March 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR MARCH 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963	1459	1093				8621
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410	1124	980				7150
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901	700	664				4555
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246	1048	901				M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021	751	639				4913
CANON CITY	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870	688	604				4399
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998	788	717				5135
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310	892	744				5725
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556	1078	809				6892
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486	874	625				5592
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022	714	673				4870
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517	1306	1144				8570
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305	935	745				5643
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387	970	809				6299
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123	939	887				6128
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029	736	681				4953
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193	756	652				5108
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390	788	608				5137

* = 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 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
	91-92	220	255	427	739	1169	1468	1735	1354	1118				8485
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088	724	665				4995
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707	1167	940				7882
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943	712	539				4469
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471	1296	1186				8730
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161	827	734				5524
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124	786	730				5263
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490	1025	758				6448
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385	911	683				5731
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477	1087	899				6879
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958	759	608				4723
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283	804	660				5458
STEAMBOAT SPRINGS	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680	1126	863				7839
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191	731	645				5060
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	90-91	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291	1057	946				6843
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946	774	642				4731
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547	1234	1025				8075
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870	717	634				4392

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

MARCH 1992 CLIMATIC DATA

EASTERN PLAINS

			Temperature				Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	50.9	26.2	38.5	4.9	69	10	811	0	81	2.30	1.40	255.6	8
STERLING	58.7	29.2	44.0	6.4	75	13	645	0	171	1.65	0.64	163.4	6
FORT MORGAN	57.3	30.3	43.8	5.6	73	8	652	0	143	2.53	1.83	361.4	6
AKRON FAA AP	53.9	29.2	41.6	4.7	69	12	718	0	109	1.64	0.64	164.0	3
AKRON 4E	54.7	29.0	41.9	5.5	69	12	710	0	123	1.95	1.04	214.3	8
HOLYOKE	56.3	29.3	42.8	3.7	74	12	681	0	140	1.79	0.59	149.2	8
JOES	57.5	29.9	43.7	5.2	74	9	654	0	151	1.51	0.61	167.8	5
BURLINGTON	57.5	30.7	44.1	4.6	72	12	639	0	143	1.10	0.12	112.2	4
LIMON WSMO	53.5	28.6	41.1	4.6	66	13	734	0	93	1.66	0.72	176.6	8
CHEYENNE WELLS	60.5	29.0	44.7	4.5	75	13	623	0	175	0.91	0.13	116.7	7
EADS	59.9	30.7	45.3	3.6	75	16	604	0	179	0.53	-0.33	61.6	3
ORDWAY 21N	60.4	27.6	44.0	5.5	75	15	645	0	182	0.87	0.20	129.9	8
ROCKY FORD 2SE	63.8	29.1	46.5	3.6	74	17	566	0	221	0.79	0.12	117.9	8
LAMAR	64.8	24.9	44.9	1.8	80	9	616	0	251	0.63	-0.27	70.0	5
LAS ANIMAS	64.1	30.7	47.4	3.7	80	16	539	0	234	0.53	-0.18	74.6	7
HOLLY	65.2	29.5	47.4	5.9	81	15	541	0	244	0.66	-0.11	85.7	7
SPRINGFIELD 7WSW	63.4	31.0	47.2	4.8	76	13	543	0	217	0.33	-0.61	35.1	9
TIMPAS 13SW	60.4	30.7	45.5	4.3	73	18	595	0	181	0.87	-0.28	75.7	5

FOOTHILLS/ADJACENT PLAINS

			Temperature				Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	55.3	30.4	42.8	4.5	67	10	681	0	104	4.44	3.08	326.5	10
GREELEY UNC	55.6	30.9	43.2	2.9	70	5	665	0	119	4.06	2.93	359.3	7
ESTES PARK	47.5	23.7	35.6	2.6	57	8	905	0	22	2.88	2.02	334.9	6
LONGMONT 2ESE	55.4	27.0	41.2	3.3	73	-1	730	0	122	3.64	2.49	316.5	6
BOULDER	54.8	31.8	43.3	3.8	65	13	664	0	104	5.17	3.51	311.4	14
DENVER WSFO AP	55.3	30.7	43.0	4.0	67	8	673	0	110	3.50	2.22	273.4	10
EVERGREEN	50.7	21.7	36.2	3.2	60	4	887	0	58	3.30	1.84	226.0	8
CHEESMAN	51.9	19.5	35.7	1.6	62	0	899	0	68	2.46	1.09	179.6	8
LAKE GEORGE 8SW	43.4	12.5	28.0	1.3	59	-13	1139	0	6	1.18	0.42	155.3	9
ANTERO RESERVOIR	42.1	11.5	26.8	2.9	51	-3	1177	0	1	0.80	0.31	163.3	7
RUXTON PARK	41.6	11.5	26.6	1.1	54	-1	1185	0	7	4.70	2.92	264.0	11
COLORADO SPRINGS	53.5	29.7	41.6	4.4	64	16	717	0	91	2.36	1.41	248.4	10
CANON CITY 2SE	59.0	31.6	45.3	4.6	70	17	604	0	153	1.76	0.84	191.3	5
PUEBLO WSO AP	61.0	29.2	45.1	3.4	73	18	608	0	187	1.31	0.54	170.1	10
WESTCLIFFE	46.0	17.9	32.0	-0.1	56	2	1015	0	9	1.26	0.03	102.4	7
WALSENBURG	58.2	30.4	44.3	3.5	67	13	634	0	140	1.38	-0.15	90.2	11
TRINIDAD FAA AP	60.4	27.6	44.0	3.0	73	14	642	0	179	0.56	-0.29	65.9	7

MOUNTAINS/INTERIOR VALLEYS

			Temperature				Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	45.4	17.9	31.7	6.3	54	3	1025	0	10	0.24	-0.51	32.0	7
LEADVILLE 2SW	40.7	12.3	26.5	4.5	48	0	1186	0	0	0.85	-0.15	85.0	15
SALIDA	52.0	22.5	37.3	0.8	60	14	854	0	57	1.87	1.17	267.1	5
BUENA VISTA	49.5	21.9	35.7	1.7	57	14	901	0	32	1.13	0.44	163.8	6
SAGUACHE	43.0	18.5	30.7	-2.5	55	5	1054	0	4	0.20	-0.20	50.0	7
HERMIT 7ESE	37.9	6.7	22.3	2.6	45	-5	1319	0	0	0.56	-0.75	42.7	1
ALAMOSA WSO AP	42.6	16.5	29.5	-2.8	54	1	1093	0	5	1.62	1.17	360.0	7
STEAMBOAT SPRINGS	50.7	23.3	37.0	8.7	62	12	863	0	54	1.02	-1.02	50.0	8
YAMPA	43.7	21.4	32.5	4.5	52	2	1001	0	3	1.60	0.42	135.6	11
GRAND LAKE 1NW	44.9	15.5	30.2	5.0	52	-1	1068	0	5	1.49	-0.05	96.8	15
GRAND LAKE 6SSW	42.4	14.7	28.6	5.0	51	-1	1118	0	1	1.20	0.26	127.7	20
DILLON 1E	41.7	14.1	27.9	3.8	50	-5	1144	0	0	1.94	0.85	178.0	16
CLIMAX	36.6	3.0	19.8	0.8	45	-18	1395	0	0	3.12	0.98	145.8	15
ASPEN 1SW	46.3	20.0	33.1	4.6	55	11	980	0	15	3.52	1.32	160.0	16
CRESTED BUTTE	42.6	10.6	26.6	3.9	51	-9	1183	0	1	2.28	-0.06	97.4	12
TAYLOR PARK	39.1	1.8	20.5	2.6	45	-19	1372	0	0	1.40	0.01	100.7	12
TELLURIDE	47.9	20.5	34.2	4.7	57	4	946	0	23	2.57	0.50	124.2	16
PAGOSA SPRINGS	50.9	20.6	35.7	2.8	59	12	899	0	53	1.93	0.34	121.4	11
SILVERTON	43.4	9.9	26.7	2.7	49	-6	1183	0	0	2.29	0.18	108.5	14
WOLF CREEK PASS 1	37.3	14.0	25.7	3.8	45	1	1211	0	0	3.84	-1.08	78.0	17

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	51.3	25.9	38.6	7.2	62	15	809	0	55	1.42	-0.18	88.7	12
HAYDEN	49.5	26.1	37.8	7.4	62	15	835	0	38	0.79	-0.52	60.3	12
MEEKER NO. 2	53.3	27.4	40.3	5.1	65	17	758	0	81	1.55	0.22	116.5	10
RANGELY 1E	55.4	29.5	42.5	6.0	64	20	690	0	107	1.28	0.41	147.1	6
EAGLE FAA AP	52.5	24.9	38.7	4.8	62	17	809	0	73	1.14	0.34	142.5	10
GLENWOOD SPRINGS	54.1	28.8	41.5	3.9	65	18	724	0	92	1.27	-0.13	90.7	11
RIFLE	58.8	28.2	43.5	4.8	70	7	660	0	152	1.12	0.18	119.1	14
GRAND JUNCTION WS	61.0	29.2	45.1	2.0	73	18	608	0	187	1.31	0.40	144.0	10
CEDAREDGE	56.5	27.3	41.9	2.3	69	19	707	0	113	2.47	1.25	202.5	11
PAONIA 1SW	56.2	32.4	44.3	4.5	66	27	637	0	121	3.82	2.44	276.8	12
DELTA	58.1	31.0	44.6	2.8	69	22	625	0	143	1.26	0.70	225.0	8
GUNNISON	49.5	19.5	34.5	7.5	59	11	940	0	42	0.06	-0.56	9.7	2
COCHETOPA CREEK	49.7	19.3	34.5	7.8	58	10	936	0	36	1.13	0.40	154.8	10
MONTROSE NO. 2	54.5	31.0	42.7	3.2	65	24	683	0	95	2.11	1.46	324.6	11
URAVAN	61.1	32.7	46.9	3.6	74	24	552	0	181	1.10	0.10	110.0	12
NORWOOD	50.4	28.0	39.2	4.4	59	17	791	0	44	1.96	0.79	167.5	6
YELLOW JACKET 2W	52.3	29.1	40.7	4.9	61	18	746	0	62	1.91	0.56	141.5	10
CORTEZ	52.9	28.7	40.8	3.5	64	21	744	0	78	0.30	-1.04	22.4	7
DURANGO	53.4	28.0	40.7	3.0	62	20	745	0	72	2.29	0.64	138.8	11
IGNACIO 1N	52.8	25.9	39.3	3.0	61	15	787	0	65	1.32	0.03	102.3	9

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.

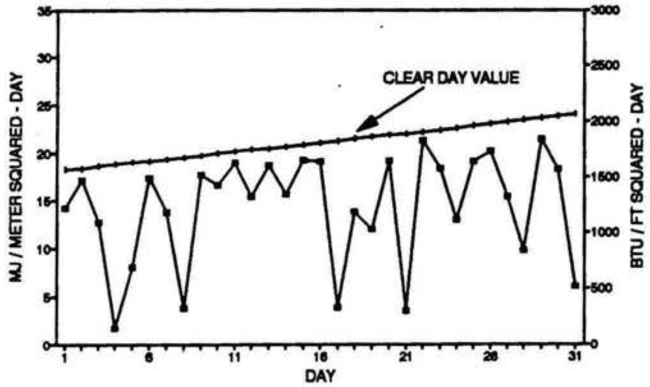
MARCH 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	6	9	16	--	--
Denver	7	8	16	60%	69%
Fort Collins	3	14	14	--	--
Grand Junction	5	8	18	65%	64%
Limon	5	8	18	--	--
Pueblo	7	9	15	76%	74%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Solar energy reaching the ground was only a little less than average in March, but clear days were a rare commodity.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
MARCH 1992

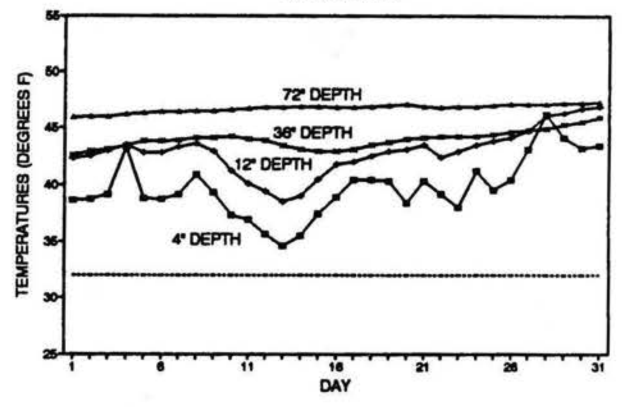


MARCH 1992 SOIL TEMPERATURES

March soil temperatures got off to a very warm start but then retreated to more normal levels following the early March blizzard. After the snow melted, the spring warmup then continued.

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 1992

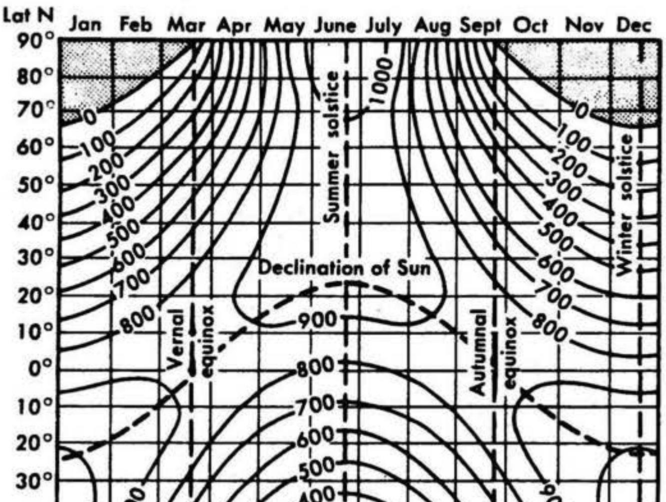


HATS OFF TO: *Bob Florian* of Akron, Colorado

There are only a handful of Colorado citizens who can come close to matching what Mr. Florian has done as a cooperative weather observer. Bob has taken most of the weather observations out at the Central Great Plains Research Center 4 miles east of Akron since 1954. Thanks alot, Bob!!

If there were no clouds and no atmosphere, it would be a very easy thing for us to figure out how much energy we were receiving from the sun here in Colorado. We wouldn't even need to measure it. By knowing the amount of energy emitted from the sun, which we do with a fairly high degree of accuracy, it is possible to compute the amount of energy that reaches the earth. As long as the sun's output is constant (in truth, it isn't, but the variations are small relative to the overall output), the energy which reaches the top of our atmosphere is simply a function of our distance from the sun and our position on the earth. Our position, in turn, is just a geometric function of the time of year and time of day. If you can deal with sines and cosines and one or two tangents and maybe a pi or two, you can calculate this energy. Scientists refer to this as extraterrestrial solar radiation – ETR for short.

Over the surface of the earth, ETR is distributed approximately as shown in the following graph. Near the equator, there is only a minor seasonal fluctuation in solar energy as the sun migrates north and again back to the south but remains mostly overhead. At the poles the changes are much more dramatic. During the month of April, the incoming solar radiation near the North Pole doubles every few days as the sun climbs steadily above the horizon.



Solar energy at the top of the atmosphere on a horizontal surface as a function of latitude and date (cal/cm^2/day).

But life is never simple. We have an atmosphere – thankfully. It scatters, reflects and absorbs a portion of the incoming solar radiation. Depending on the clearness of the air, the length of the path the sun must make through the atmosphere and factors like how much ozone and water vapor are in the air, anywhere from 60% to 85% of the extraterrestrial radiation reaches the earth's surface on clear days. The line labelled "Clear Day Value" which we show on the Fort Collins solar radiation graph each month in **Colorado Climate,** has been found by experience to be about 72% to 75% of the extraterrestrial radiation (ETR) and varies a little through the year. For example, clear days in the autumn typically receive a higher percentage of the ETR than clear summer days since the total water vapor in the atmosphere declines from summer to fall here.

Elevation is a factor in determining what percent of ETR reaches the surface. Percentages tend to be lower at low elevations and higher at higher elevations for the obvious reason that more solar energy is absorbed, scattered and reflected the deeper into the atmosphere that it penetrates. Near Alamosa, for example, the clear day solar radiation is between 74% and 78% of ETR. Above elevations of 9000 feet, clear day radiation probably exceeds 80% of ETR. We have no baseline solar measurements at high elevations above timberline here in Colorado, but at those elevations solar energy may approach 85% of ETR.

Atmospheric water vapor (water in gaseous form that is not condensed to form cloud layers) is another variable contributing to variations in solar energy reaching the earth's surface since it absorbs a small amount of the incoming radiation. Also, when more vapor is present in the air, some of the moisture collects on dry particles in the air making those particles more effective light scatterers. Therefore, clear-day solar radiation reaching the ground is slightly lower when the moisture is greater in the atmosphere. The atmosphere over Colorado is normally quite dry, but moisture patterns change through the year. In winter, atmospheric water vapor is often greatest west of the mountains. During the summer, water vapor is consistently greatest east of the mountains. As a result, on a clear day in July, more solar radiation is likely to reach the ground at Grand Junction than at Flagler. In the winter, the reverse occurs.

Having an atmosphere complicates the distribution of solar radiation that the earth receives. But if every day was a clear day, our solar radiation would still be fairly predictable. The real challenge is clouds. On most days of the year, even here in "sunny" Colorado, there are some clouds. Depending on the extent, thickness, liquid water content, height above ground, and the angle to the sun, clouds reflect and absorb varying amounts of solar radiation. On some cloudy days, as much as 80% to 90% of the clear-day radiation makes it to the ground. On those days, the cloud bases are typically quite high above the ground and the clouds themselves are thin enough that some direct sunlight penetrates through them. On such days, we can easily get sunburns. But on days when clouds are thick, contain considerable liquid water, and have solid, low bases not far above the surface, as little as 10% of the clear-day radiation reaches the ground.

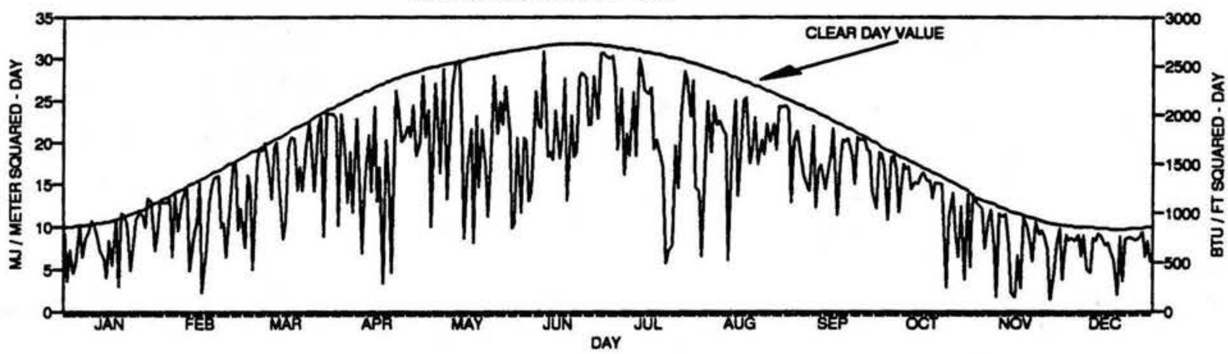
Even if we knew all the characteristics and frequencies of clouds in every region of Colorado, it would still be very difficult to estimate solar radiation. Only a handful of weather stations in Colorado evaluate cloud conditions daily (see **Colorado Climate**–October 1986). No direct measurement of cloud thickness is made, so only approximate estimates of solar radiation can be made using just cloud data.

Day to day changes in solar radiation are dramatic throughout the year as you see in the example below. But over the course of a month, solar energy tends to converge toward fairly stable and consistent averages.

Fortunately, actual measurements of daily solar energy have been made during the past two decades at a few locations in Colorado. Some of the earlier solar energy measurements from the 1970s and early 1980s were published in a 1983 Colorado Climate Center report entitled "Colorado Solar Radiation Data with Supplemental Climatic Data." Copies of this report are still available at a cost of $6.00 (which includes postage and handling). More recently, the Joint Center for Energy Management's WTHRNET system has now collected about 4 years of additional data from previously unmonitored locations primarily over western Colorado. Combining these sources, a fairly accurate picture of regional solar energy resources in Colorado can now be pieced together.

Next month we will conclude this series on Colorado solar energy by summarizing and comparing seasonal patterns of solar energy over various regions of Colorado.

TOTAL HEMISPHERIC RADIATION
FORT COLLINS, COLORADO 1991



A Storm to Remember – March 8-9, 1992

Meteorologists, watching a storm system moving slowly eastward from California while at the same time observing a sharp cold front poised north of Colorado ready to drop south at anytime, knew more than two days in advance that a dramatic change in the weather was likely to occur over parts of Colorado on March 8. But the change was even more dramatic than expected. Within the span of less than an hour, a mild, springlike day changed into a frightening blizzard from the northern and central mountains northeast to the Front Range urban corrider and northeastern plains.

The timing and location of the developing storm could not have been worse for Colorado travelers. It hit like a brick right about dinner time on Sunday evening as thousands of Coloradans were beginning their drives home after weekend outings and ski trips. In a very short time, driving conditions deteriorated from normal to nearly impossible as a combination of strong northerly winds and very intense, swirling, dense wet snow dropped visibilities to near zero, covered highways and literally broke windshield wipers that could not keep up with the accumulation. From Larimer and Weld Counties south to Monument and then west into the mountains, snow fell at rates of 2 to 4 inches per hour during the first few hours of the storms. Widespread lightning and thunder accompanied that portion of the storm and shocked residents. Trees and powerlines gave way to the strain leaving perhaps hundreds of thousands of people in the dark. At a minimum, several hundred and perhaps even a few thousand motorists were stranded overnight along I-25, I-70 and the Boulder Turnpike. Many spent the night in their cars.

By midmorning of the 9th, the storm was over, and by afternoon bright sunshine helped quickly melt the snow from most streets and highways. But for the thousands of motorists who spent as long as 24 hours trying to drive from the mountains to their Front Range homes, this storm will stick in their minds for a long, long time. My guess is that next year, a lot more people will take our Colorado spring blizzard threat a little more seriously.

March 8-9, 1992 Snowfall Totals

Akron	3.0"	Limon	3.2"
Boulder	16.3"	Longmont	15"+
Buckhorn Mountain	25.3"	Monument	21.0"
Coal Creek	25.5"	Mount Evans Research Center	25.0"
Colorado Springs	1.4"	Pueblo	0.2"
Denver Stapleton	12.4"	Ralston Reservoir	21.0"
Dillon	5.5"	Red Feather Lake	18.0"
Fort Collins	16.7"	Wheat Ridge	17.8"
Grand Junction	Trace		
Greeley	13.0"		

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.

The Importance of Flying a Kite

Science has always strived to soar higher and higher, but lately, it has been going up with a kite. Today, research is actually using kites to explore the high altitudes of the earth's atmosphere. Kites are gathering information on temperature, radiation, ozone and other important factors accurately with minimal cost. In fact, the Cooperative Institute for Research in Environmental Studies (CIRES) based at the University of Colorado Boulder is a proponent of kite based research. A recent study by B.B. Balsley et al has shown the effectiveness of kites as stable platforms for measurements and might help to remind us all to bring our kites out of closet more often.

Kite flying has been an important scientific tool for over 200 years. Everyone knows about Benjamin Franklin's famous kite flight to study electricity, but few people know that kites were used in the 1750's to fly thermostats into the atmosphere to explore the atmosphere temperatures. Around the turn of century, there were actually 17 meteorological kite stations east of the Rocky Mountains funded by the U.S. Weather Bureau. But, kites, as scientific devices, became obsolete after the First World War. The establishment of the airplane and improvements in balloons seemed to doom the kite to a mere hobby.

Today, it appears that like the kite is coming out of closet more often than on the occasional windy Sunday. Kevlar-based cords with mylar and carbon fiber support materials have made kites capable of flying higher and longer. The kite is also becoming more popular because of the ability of a kite to stay relatively stationary. Balloons are susceptible to winds and tend to float over a range of altitudes. Planes can upset the parameters to be studied, but a kite can be set to a certain altitude and a small area without seriously disturbing the surroundings.

Before you start running out to buy more kite string, there are a few restrictions to kite experimentation that you should know. First, the areas of interest are at altitudes above one and a half miles. Most kite stores do not carry that much string!. Secondly, stability of the experiment is dependent on upper-level winds. If you do not have a previous knowledge of the general upper-level wind trends, one good downburst could bring the kite and the miles of string down to earth at once. Finally and most importantly, the FAA does not allow kite flights above 300 meters in areas of air traffic without prior, difficult to get approval. The only areas that are free from these restrictions are Antarctica and the tropical Pacific Basin, but everyone already knows how important knowledge of key climate variables in these areas has become.

So, the kite might become another key player in this information age. It has become a very attractive research device because of the stability, accuracy and cost. It is also a great way to get your children excited and training for science at a young age.

This article was written by Erika Komito of the Joint Center for Energy Management. Information on acquiring our weather data can be obtained by writing Carlos Lopez-Alonso at the Joint Center for Energy Management, University of Colorado, Campus Box 428, Boulder, CO. 80309-0428 (phone: 303-492-3915).

Dear Subscriber:

For nearly 15 years the Colorado Climate Center has prepared the report, "**Colorado Climate**," and distributed it each month free of charge to hundreds of subscribers throughout Colorado. I personally have authored 165 of these reports and am amazed each and every month at the variety and complexity of our climate. I wish I could include a lot more detail, share more research results and conduct many more special studies. (My list of ideas for new research and special education feature stories is getting longer every month.) It would also be great if we could get the summary mailed out to you sooner each month. Unfortunately, we are limited in many ways, and those limits seem to be getting tighter each year.

Despite various limits, we hope to continue to produce a reliable and informative monthly report that can serve as accurate historical documentation of Colorado's unique and variable climate. We would like to continue to provide this information at no charge to educators, researchers, businesses, agencies and any other organizations and individuals who may benefit from a better knowledge of our climate.

Please take the time to fill out this response form. It is imperative that we limit our distribution of "**Colorado Climate**" to those who truly take interest in this information. We also want to do as much as we can to improve our publication to meet your needs. Please understand, however, that the historical nature of our work will always limit the potential timeliness of this report. The earliest that a complete monthly report could be written and distributed is about **four weeks** after the end of each month. Only with considerable change in data accessibility, staffing, printing and mail priority could a near real-time climate summary become possible – all of which seem very unlikely at this time.

Many thanks for your cooperation. We look forward to your reply and will do our best to respond to your comments and suggestions.

Nolan J. Doesken
Assistant State Climatologist

What change(s) would you most like to see in "**Colorado Climate**"?

____

What information currently provided could you best do without?

____

What additional climatic information would you most like to see included?

____

Suggestions for future topics in the "Special Climate Summary" section:

____

Other Comments/Suggestions:

____

____

COLORADO CLIMATE

APRIL 1992

Volume 15 Number 7

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

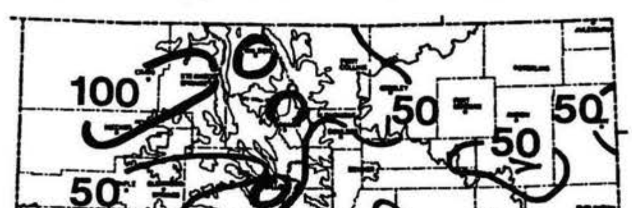
Colorado Climate Center
Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523

April Climate in Perspective – Dry and Very Warm

One mid-month storm system brought precipitation to most portions of Colorado and helped keep temperatures close to their seasonal averages for about a week. Otherwise, the month was characterized by persisting warmth and lack of moisture. In just one month, water supply projections for the coming summer declined from just a little below average (the April 1 projections) to much below average (May 1 projection) for most watersheds. The month ended with record-shattering temperatures statewide including a 100° reading at Las Animas.

Precipitation

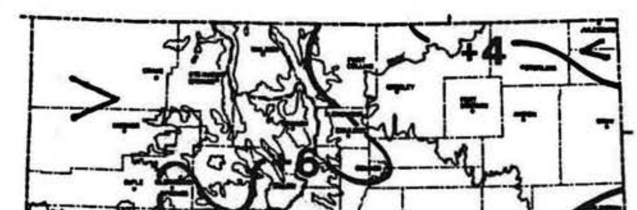
April failed to dish out its normal share of rains and wet snows. With the help of unusually warm temperatures, most of what did fall fell as rain. More than half of the State's surface area received less than 50% of the average April precipitation. A number of locations got shut out completely including portions of the Eastern Plains and the San Luis Valley. As usual, there were a few spots that fared much better. A small area from Meeker to Steamboat Springs was above average. Areas south of Colorado Springs and near Grand Lake, Breckenridge and Walden were also slightly on the wet side.



April 1992 precipitation as a percent of the 1961-1990 average.

Temperatures

Warmer than usual April weather prevailed during most of the month. The few chilly days here and there had little overall effect on monthly temperatures which ended up far above average statewide. Areas east of the mountains were generally 3 to 6 degrees warmer than average while western Colorado was mostly 5 to 7 degrees warmer. This has been one of the warmest early springs on record for portions of Colorado. For example, at Grand Junction, this is the 4th warmest March-April period this century. The result has been earlier than normal plant development along with an early decline in mountain snowpack. No freezes all month occurred over Colorado's Western Slope fruit orchard areas.



Departure of April 1992 temperatures from the 1961-90 averages.

Inside This Issue

APRIL 1992 DAILY WEATHER

1-4 Rain and snow ended early over extreme southern Colorado. Wolf Creek Pass ended up with 11" of new snow. Eastern Colorado residents awoke to the coldest morning in April with morning lows on the 1st near or below 20°F. It was still seasonally cool on the 2nd with a few trace showers early in the day. Sunshine and very warm temperatures then took over statewide for the 3rd and 4th. Low elevation temperatures climbed into the 60s and 70s (Lamar hit 85° on the 4th) while 50s were common in the mountains.

5-7 A disturbance from the west triggered some brief spring thunderstorms on the 5th. A skier was killed by lightning at Vail. Precipitation was very meager, however, and temperatures remained well above average through the period. The exception was the northeastern plains where cooler air from the north returned local temperatures to near average 5-6th.

8-12 Westerly winds aloft brought a very mild and dry period to most of Colorado. Western Slope temperatures were ten or more degrees above average each day, and low elevation temperatures statewide reached into the 70s each day. Much colder air was poised just north and east of Colorado and eventually wedged southward helping to trigger a few scattered thunderstorms on the 11th. Fog and low clouds were observed early on the 12th across northeast Colorado, and temperatures only barely reached the low 50s across the Eastern Plains that day.

13-16 Temperatures skyrocketed into the 80s across the plains on the 13th as a low pressure area developed over the State. Clouds spread into western portions of Colorado during the day with a few showers by evening. The first precipitation episode of the month then spread across the State 14-16th. No cold air accompanied the storm, so snow was limited to the highest elevations of the mountains. The storm was not well organized for this time of year so precipitation was fairly light. A few strong but localized thunderstorms developed on the 15th. The heaviest rain and high-mountain snow fell near Pikes Peak on the 15th and over a small portion of north-central Colorado early on the 16th. More than an inch of moisture fell at Fountain and Fort Carson while Fort Collins measured 0.94" and Grand Lake 0.98" on the 16th.

17-19 A strong Pacific disturbance dropped down from the northwest creating a deep low pressure area over Colorado on the 17th. Grand Junction's sea level pressure dipped to 29.20", the lowest they have seen in several years. Mountain snows developed and were accompanied by a brief return to winterlike temperatures in the high country. The heaviest snows fell late on the 17th and on the 18th and were accompanied by plenty of wind. Six or more inches of snow fell over many mountain areas. High temperatures 18-19th in the mountains only advanced into the 20s and 30s. Low elevation precipitation didn't amount to much, and strong westerly downslope winds east of the mountains helped keep temperatures from getting too cold.

20-23 The storm that crossed Colorado slowed as it moved out onto the plains and brought a surprise heavy snowstorm to eastern Nebraska 20-21st. Colorado saw a return to sunshine, but brisk winds and chilly temperatures were a reminder of the storm to our east. Then a new, fast moving storm raced across the Rockies 22-23rd. A few thunderstorms erupted on the 22nd, and a period of moderate to heavy precipitation fell over portions of the northern mountains. Steamboat Springs recorded 0.82" of moisture and 2" of wet snow.

24-30 April ended with dry weather. Temperatures were seasonal 24-25, and the morning of the 26th brought the last frost or freeze of the spring to many low-elevation areas east of the mountains. Then a major spring heatwave began that by the end of the month brought record high temperatures to many locations in the State. Grand Junction surpassed the 80-degree mark each of the last 5 days of April and hit 89° on both the 29th and 30th. Denver reached 90° for a high temperature on the 30th, the earliest 90° reading in their 121 year weather history. Even in the mountains, temperature records were shattered as the mercury soared to near 70° in the day with lows only near 32°F. This allowed a too early start to the mountain snowmelt season. Las Animas laid claim to the Colorado sizzler award with a 100° reading on the 30th. This is only the second time the 100° mark has ever been hit. The first time was April 21, 1989 – also at Las Animas.

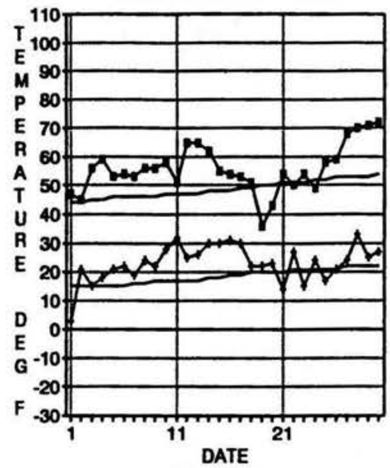
Weather Extremes

Highest Temperature	100°	April 30	Las Animas
Lowest Temperature	-4°	April 2	Climax
Greatest Total Precipitation	2.99"		Ruxton Park
Least Total Precipitation	0.00" or Trace		Creede, Brandon, New Raymer, Manassa, Monte Vista, Eads, Briggsdale, and other locations
Greatest Total Snowfall	29.0"		Climax
Greatest Depth of Snow on Ground	72"	April 1	Wolf Creek Pass 1E

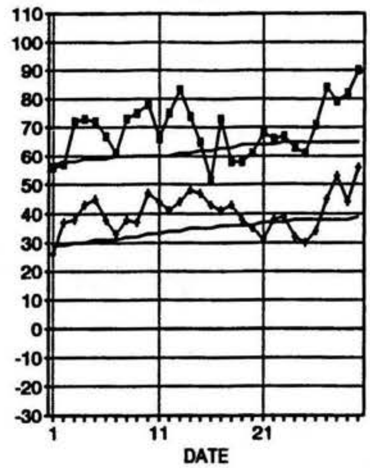
APRIL 1992 TEMPERATURE COMPARISON

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.)

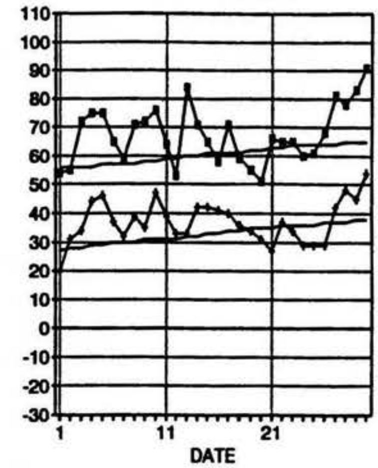
GRAND LAKE 1NW



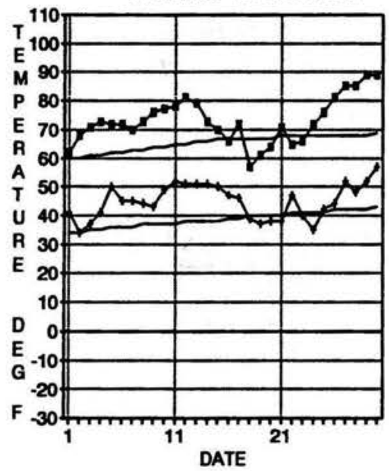
DENVER



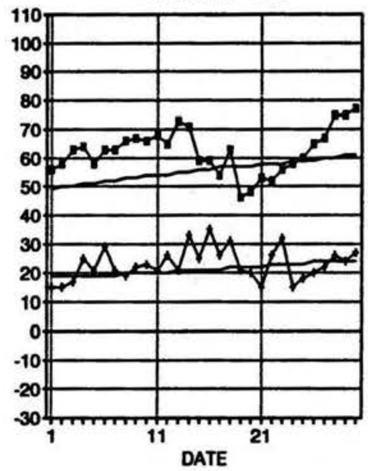
AKRON 1N



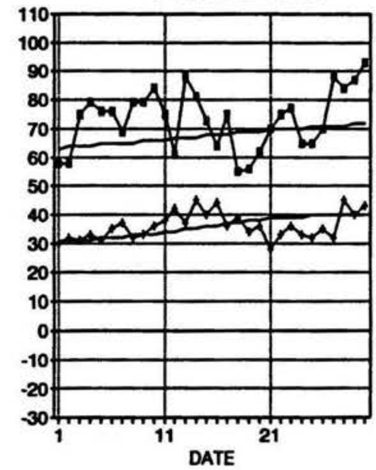
GRAND JUNCTION



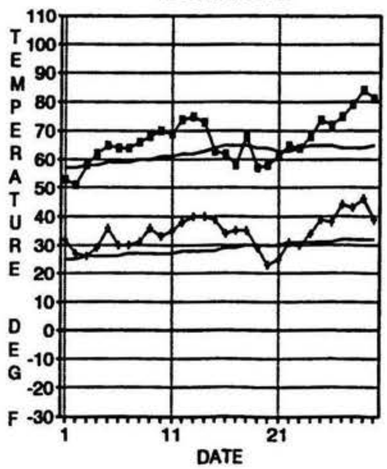
GUNNISON



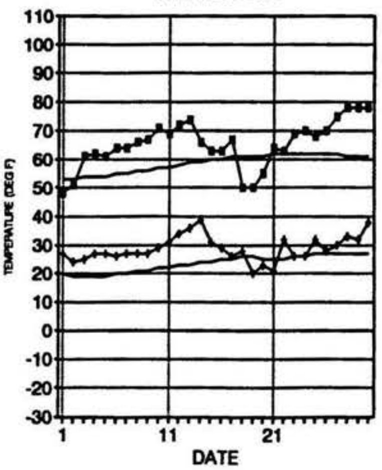
PUEBLO WSO



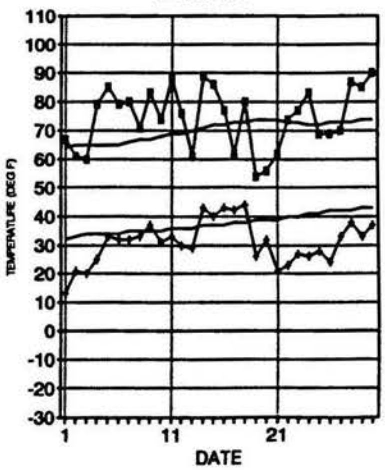
DURANGO



ALAMOSA



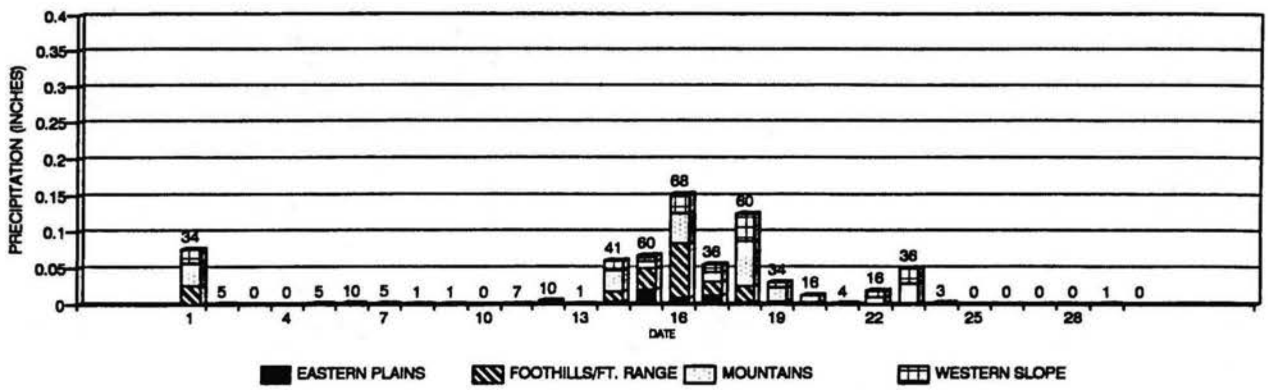
LAMAR



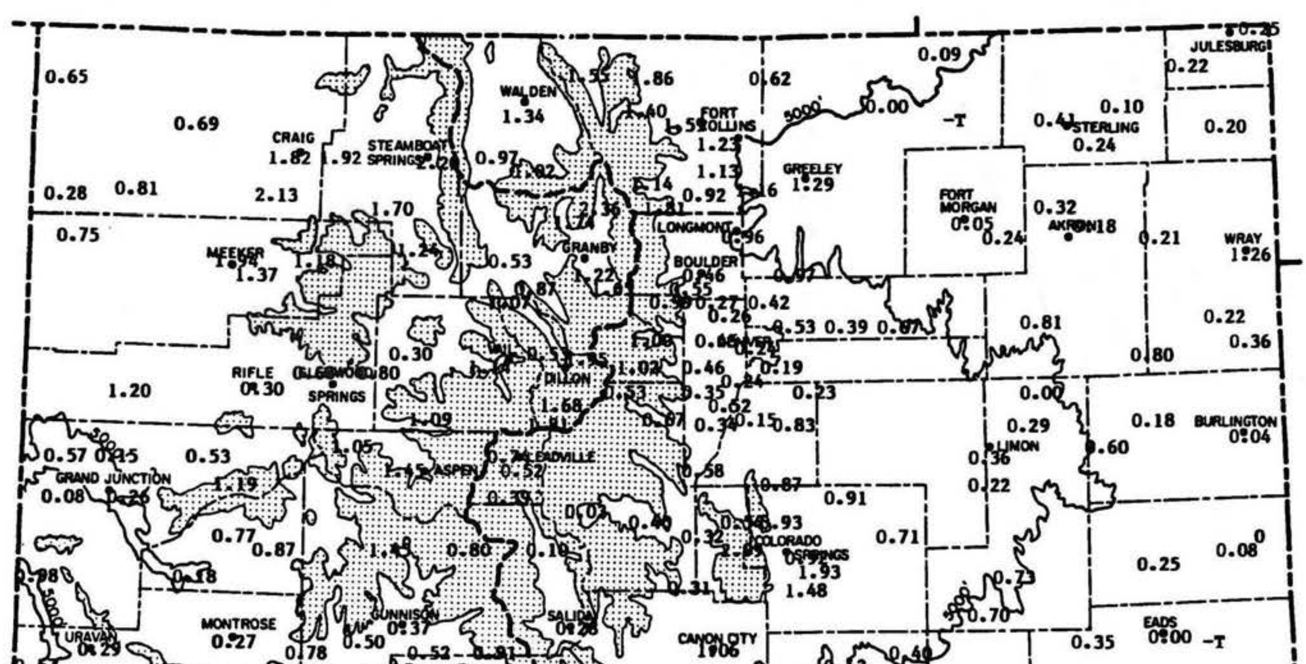
APRIL 1992 PRECIPITATION

April precipitation statewide averaged only about 0.65", less than half of what typically falls. The episode from the 14th to the 19th accounted for the vast majority of the month's total. Particularly noteworthy was the lack of significant moisture out on the Eastern Plains. This comes at a time when winter wheat begins to require water at a rapidly increasing rate.

COLORADO DAILY PRECIPITATION - APR 1992

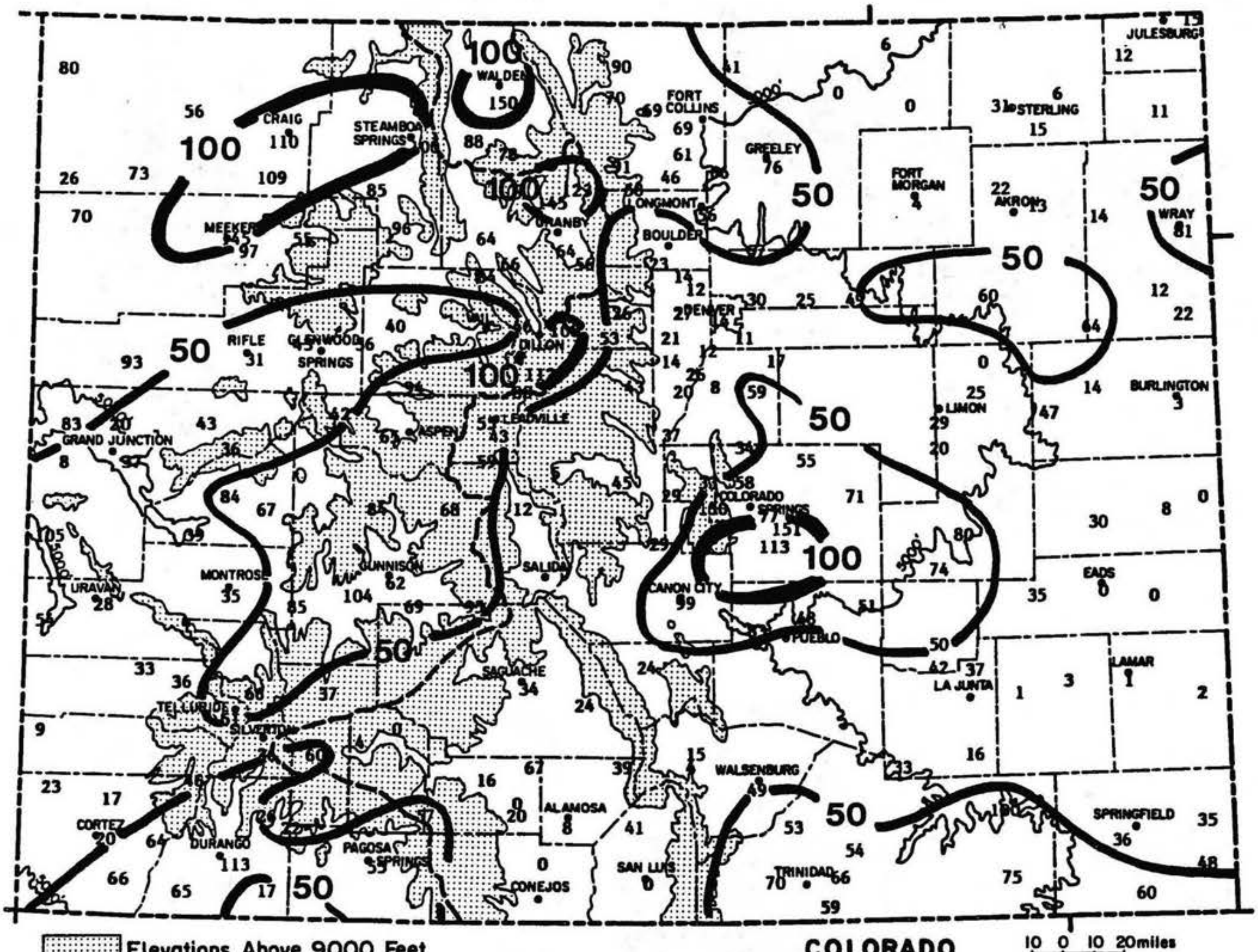


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

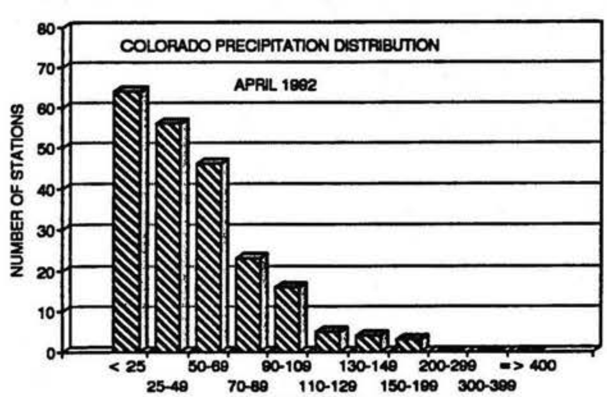


Precipitation Amounts (in inches) for April 1992.

APRIL 1992 PRECIPITATION COMPARISON



April 1992 Precipitation as a Percent of the 1961–90 average.



Approximately 90% of Colorado received below average precipitation in March with most areas receiving less than 70% of their average. This makes a dramatic contrast with March 1992 when most of the State was very wet. On the Eastern Plains, most areas experienced one of their 10 driest Aprils in the past 100 years.

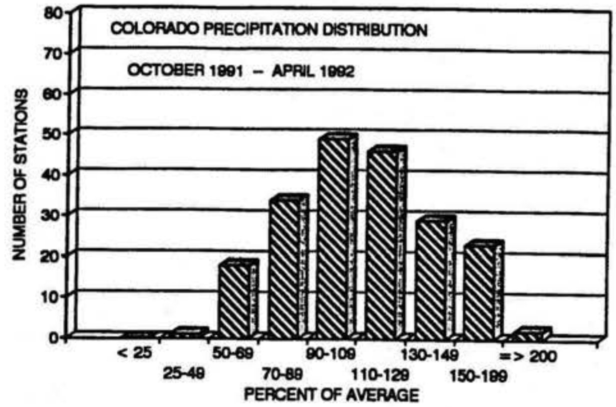
APRIL 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

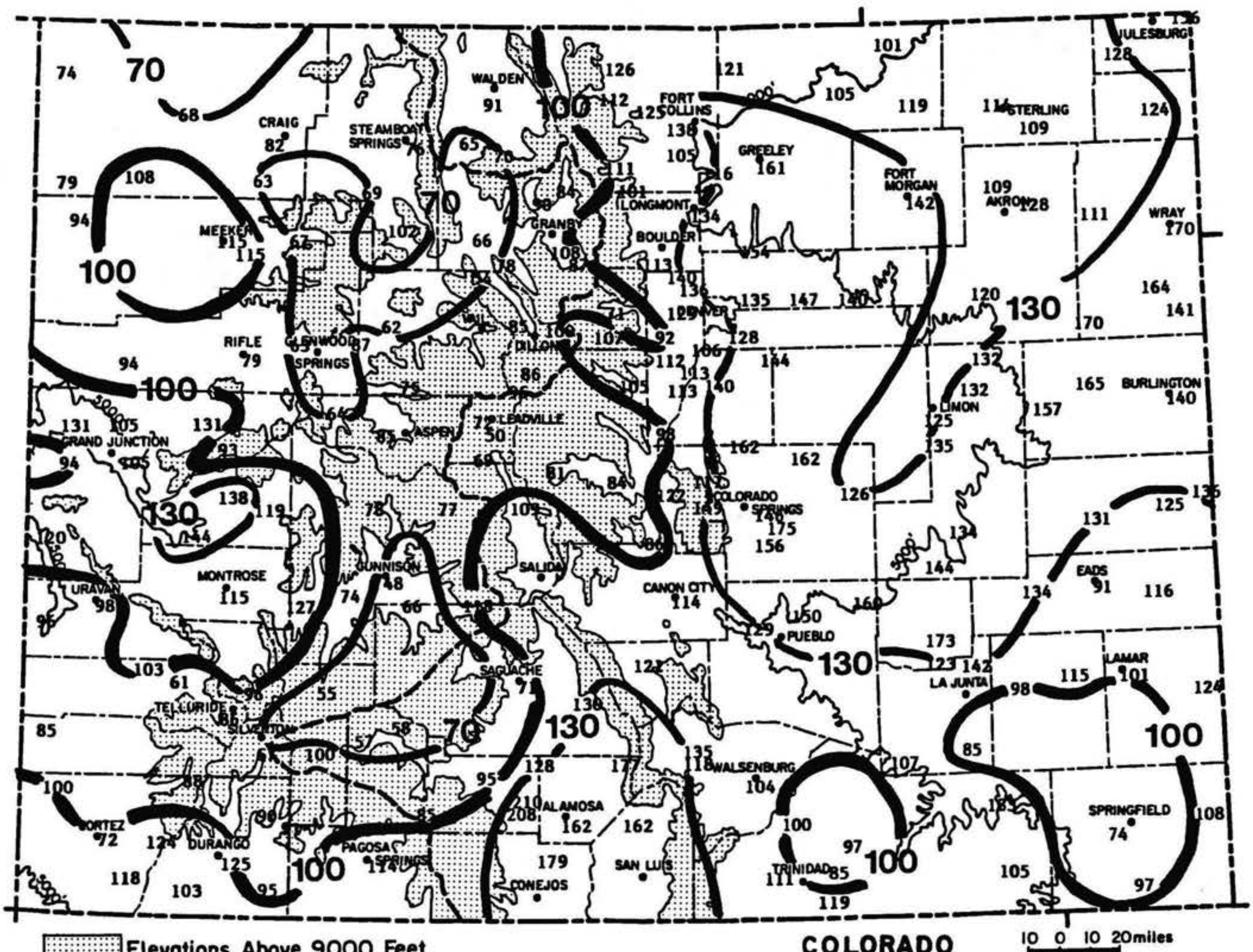
Station	Precip.	Rank
Denver	0.53"	10th driest in 121 years of record (driest = 0.03" in 1963)
Durango	1.37"	37th wettest in 98 years of record (wettest = 5.54" in 1926)
Grand Junction	0.15"	9th driest in 101 years of record (driest = 0.05" in 1939)
Las Animas	0.01"	tied for 3rd driest in 126 years (driest < 0.01" in 1899 and 1963)
Pueblo	0.43"	29th driest in 123 years of record (driest < 0.01" in 1878 and 1963)
Steamboat Springs	2.20"	40th wettest in 87 years of record (wettest = 5.13" in 1920)

1992 WATER YEAR PRECIPITATION

The driest areas of Colorado in April happened to coincide with many of the areas that had enjoyed above average moisture earlier in the 1992 water year. The result is that precipitation departures from average are decreasing and the statewide distribution of precipitation is taking on the appearance of a "normal" or bell-shaped curve. Surface soil moisture is quickly declining on the Eastern Plains, but water year precipitation totals are still above average everywhere except the extreme southeastern counties.

It is important to note that although many areas out on the Eastern Plains had been far wetter than average during the first half of the water year, this only represented 2-4" of surpluses in most areas. Dry spring and summer weather can quickly use up that surplus.





October 1991—April 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR APRIL 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535			9156
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410	1124	980	660			7810
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901	700	664	321			4876
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246	1048	901	568			M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021	751	639	360			5273
CANON CITY	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870	688	604	331			4730
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998	788	717	383			5518
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310	892	744	458			6183
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556	1078	809	497			7389
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486	874	625	273			5865
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022	714	673	309			5179
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805			9375
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305	935	745	430			6073
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387	970	809	466			6765
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123	939	887	541			6669
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029	736	681	356			5309
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193	756	652	332			5440
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390	788	608	195			5332

* = 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 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
	91-92	220	255	427	739	1169	1468	1735	1354	1118	751			9236
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088	724	665	310			5305
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707	1167	940	661			8543
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943	712	539	242			4711
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852			9582
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161	827	734	436			5960
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124	786	730	391			5654
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490	1025	758	446			6894
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385	911	683	324			6055
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477	1087	899	577			7456
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958	759	608	309			5032
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283	804	660	352			5810
STEAMBOAT SPRINGS	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680	1126	863	595			8434
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191	731	645	352			5412
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	90-91	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291	1057	946	565			7408
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946	774	642	289			5020
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700			8775
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870	717	634	309			4701

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

APRIL 1992 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	63.1	29.8	46.4	2.5	80	15	552	0	207	0.09	-1.26	6.7	4
STERLING	69.1	37.0	53.0	4.9	88	18	352	1	291	0.41	-0.91	31.1	1
FORT MORGAN	69.2	38.5	53.9	5.3	85	23	332	6	299	0.05	-1.15	4.2	1
AKRON FAA AP	67.4	37.0	52.2	5.4	91	20	382	8	270	0.32	-1.12	22.2	1
AKRON 4E	66.3	34.6	50.5	4.1	84	16	429	0	253	0.18	-1.14	13.6	1
HOLYOKE	65.3	36.3	50.8	1.4	83	18	417	0	237	0.20	-1.47	12.0	2
JOES	68.3	36.4	52.4	5.4	84	14	374	1	284	0.80	-0.45	64.0	2
BURLINGTON	68.5	37.1	52.8	3.0	84	17	360	3	286	0.04	-1.20	3.2	1
LIMON WSMO	66.0	34.5	50.3	5.3	88	22	436	2	248	0.36	-0.85	29.8	6
CHEYENNE WELLS	71.1	34.9	53.0	2.8	95	20	364	10	317	0.08	-0.91	8.1	2
EADS	70.3	37.7	54.0	2.4	85	20	325	2	313	0.00	-0.95	0.0	0
ORDWAY 21N	71.0	35.3	53.1	3.6	88	22	351	0	321	0.70	-0.24	74.5	5
ROCKY FORD 2SE	75.9	37.3	56.6	3.6	94	25	254	9	388	0.41	-0.55	42.7	5
LAMAR	74.5	31.0	52.7	-1.2	90	13	364	1	369	0.02	-1.13	1.7	1
LAS ANIMAS	76.1	38.1	57.1	2.9	100	22	242	12	387	0.01	-0.90	1.1	1
HOLLY	75.4	38.8	57.1	4.3	99	16	250	20	377	0.03	-1.03	2.8	2
SPRINGFIELD 7WSW	75.8	39.6	57.7	5.7	96	20	230	19	388	0.52	-0.89	36.9	4
TIMPAS 13SW	71.6	39.0	55.3	4.0	87	32	285	3	333	0.44	-0.86	33.8	2

FOOTHILLS/ADJACENT PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
FORT COLLINS	67.5	38.2	52.9	5.4	89	19	356	3	268	1.23	-0.53	69.9	4
GREELEY UNC	69.6	39.5	54.5	5.5	91	21	310	6	300	1.29	-0.39	76.8	5
ESTES PARK	60.1	32.5	46.3	6.1	75	7	553	0	162	1.14	-0.10	91.9	7
LONGMONT 2ESE	68.6	34.9	51.8	4.3	84	21	391	1	287	0.96	-0.74	56.5	4
BOULDER	68.1	40.3	54.2	6.4	87	21	321	6	282	0.46	-1.70	21.3	6
DENVER WSFO AP	69.3	40.3	54.8	6.6	90	26	309	9	300	0.53	-1.18	31.0	4
EVERGREEN	63.7	29.8	46.7	5.6	82	22	541	0	212	0.46	-1.64	21.9	4
CHEESMAN	65.0	26.2	45.6	3.4	82	15	577	0	235	0.58	-0.96	37.7	5
LAKE GEORGE 8SW	57.3	27.4	42.4	6.0	73	17	670	0	137	0.40	-0.47	46.0	4
ANTERO RESERVOIR	54.9	22.7	38.8	5.4	72	13	779	0	104	0.03	-0.55	5.2	1
RUXTON PARK	52.6	20.5	36.5	3.0	71	0	845	0	72	2.99	0.69	130.0	5
COLORADO SPRINGS	66.8	37.4	52.1	5.5	87	26	383	4	260	0.92	-0.27	77.3	4
CANON CITY 2SE	69.0	38.8	53.9	4.1	84	29	331	4	292	1.06	-0.01	99.1	6
PUEBLO WSO AP	73.2	35.9	54.6	2.8	93	28	309	3	350	0.43	-0.45	48.9	4
WESTCLIFFE	62.6	27.2	44.9	4.1	76	18	598	0	198	0.26	-0.81	24.3	2
WALSENBURG	70.7	38.8	54.7	5.8	85	26	309	7	324	0.80	-0.83	49.1	7
TRINIDAD FAA AP	72.5	38.4	55.5	5.4	90	28	289	10	345	0.50	-0.41	54.9	3

MOUNTAINS/INTERIOR VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
WALDEN	57.2	25.6	41.4	6.4	74	4	700	0	126	1.34	0.45	150.6	9
LEADVILLE 2SW	50.3	22.3	36.3	5.9	65	12	852	0	48	0.52	-0.68	43.3	9
BUENA VISTA	62.0	29.6	45.8	4.4	76	23	568	0	191	0.10	-0.67	13.0	2
SAGUACHE	62.2	29.3	45.7	4.4	77	21	569	0	195	0.17	-0.33	34.0	3
HERMIT 7ESE	49.4	20.1	34.8	4.6	60	10	901	0	43	0.05	-1.16	4.1	1
ALAMOSA WSO AP	65.2	28.7	47.0	5.6	78	20	535	0	236	0.04	-0.45	8.2	3
STEAMBOAT SPRINGS	61.2	28.7	44.9	6.1	78	17	595	0	182	2.20	0.02	100.9	11
YAMPA	57.7	29.3	43.5	6.5	73	17	636	0	131	1.24	-0.04	96.9	6
GRAND LAKE 1NW	56.0	23.0	39.5	5.9	72	3	758	0	110	2.36	0.45	123.6	8
GRAND LAKE 6SSW	55.8	23.7	39.7	6.2	73	4	751	0	109	1.74	0.54	145.0	12
DILLON 1E	52.4	23.4	37.9	5.1	68	11	805	0	71	0.53	-0.62	46.1	8
CLIMAX	44.4	16.9	30.6	4.6	59	-4	1024	0	19	1.81	-0.43	80.8	7
ASPEN 1SW	56.9	28.4	42.7	4.2	73	21	660	0	124	1.45	-0.75	65.9	10
CRESTED BUTTE	53.1	23.8	38.5	6.0	69	13	788	0	78	1.45	-0.27	84.3	8
TAYLOR PARK	50.6	18.6	34.6	5.8	66	4	904	0	51	0.80	-0.36	69.0	6
TELLURIDE	64.0	27.9	45.9	8.2	78	20	565	0	220	0.97	-0.92	51.3	7
PAGOSA SPRINGS	64.3	26.6	45.5	4.2	78	21	577	0	222	0.67	-0.53	55.8	4
SILVERTON	53.4	23.9	38.6	5.6	70	15	784	0	85	0.58	-1.02	36.2	6
WOLF CREEK PASS 1	49.6	23.3	36.4	7.0	69	11	851	0	48	1.65	-1.24	57.1	8

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	63.1	33.3	48.2	6.0	79	22	497	0	208	1.82	0.17	110.3	6
HAYDEN	64.2	31.5	47.8	5.6	79	20	507	0	226	1.92	0.44	129.7	6
MEEKER NO. 2	65.9	33.9	49.9	7.0	80	22	446	0	246	1.94	0.61	145.9	6
RANGELY 1E	69.3	38.0	53.6	5.9	85	28	334	0	298	0.75	-0.32	70.1	6
EAGLE FAA AP	67.2	31.2	49.2	6.9	83	23	466	0	264	0.30	-0.44	40.5	5
GLENWOOD SPRINGS	67.2	34.7	51.0	5.1	83	28	413	0	266	0.68	-0.87	43.9	3
RIFLE	71.5	34.9	53.2	6.2	90	27	352	3	326	0.30	-0.65	31.6	4
GRAND JUNCTION WS	73.1	44.9	59.0	7.0	89	34	195	21	358	0.15	-0.60	20.0	6
CEDAREDGE	70.0	36.0	53.0	5.5	85	27	353	0	305	0.77	-0.14	84.6	5
PAONIA 1SW	69.7	39.7	54.7	6.6	85	28	304	3	304	0.87	-0.41	68.0	7
DELTA	72.2	39.3	55.7	5.1	89	29	273	3	342	0.18	-0.28	39.1	3
GUNNISON	62.4	22.9	42.7	4.4	77	15	661	0	198	0.37	-0.22	62.7	1
COCHETOPA CREEK	62.6	24.6	43.6	6.6	78	15	633	0	201	0.52	-0.23	69.3	6
MONTROSE NO. 2	68.5	39.3	53.9	5.9	84	29	324	0	285	0.27	-0.50	35.1	5
URAVAN	74.7	41.4	58.0	6.5	90	33	209	7	371	0.29	-0.72	28.7	6
NORWOOD	64.7	35.0	49.8	7.3	79	22	448	0	225	0.35	-0.69	33.7	3
YELLOW JACKET 2W	67.1	37.1	52.1	7.7	78	26	381	0	263	0.21	-0.68	23.6	4
CORTEZ	66.1	32.8	49.4	5.0	82	23	458	0	249	0.17	-0.68	20.0	5
DURANGO	66.7	34.2	50.5	5.0	84	23	430	0	257	1.37	0.16	113.2	7
IGNACIO 1N	65.6	30.1	47.8	3.6	80	20	508	0	240	0.15	-0.72	17.2	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.

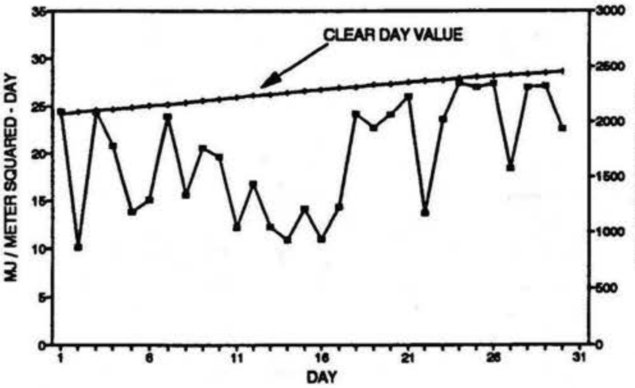
APRIL 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	8	9	13	--	--
Denver	8	9	13	67%	67%
Fort Collins	7	11	12	--	--
Grand Junction	7	14	9	77%	69%
Limon	10	6	14	--	--
Pueblo	10	7	13	74%	74%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

There were close to the average number of clear and cloudy days in April. Due to relatively thin clouds on many days, the solar energy reaching the ground was a bit more than average in many areas.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
APRIL 1992

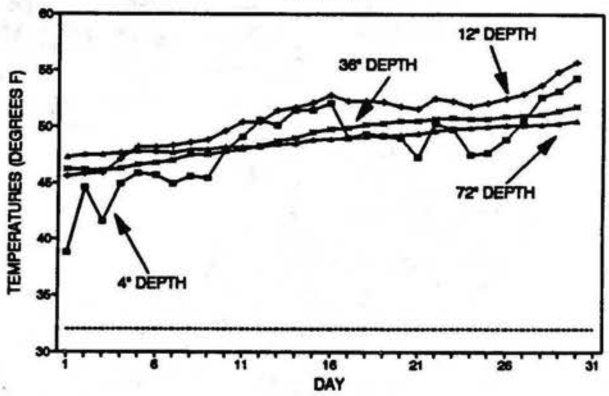


APRIL 1992 SOIL TEMPERATURES

With persisting mild and dry weather, April soil temperatures stayed warmer than average throughout most of the month. The last few days of April were especially warm.

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

FORT COLLINS 7 AM SOIL TEMPERATURES
APRIL 1992



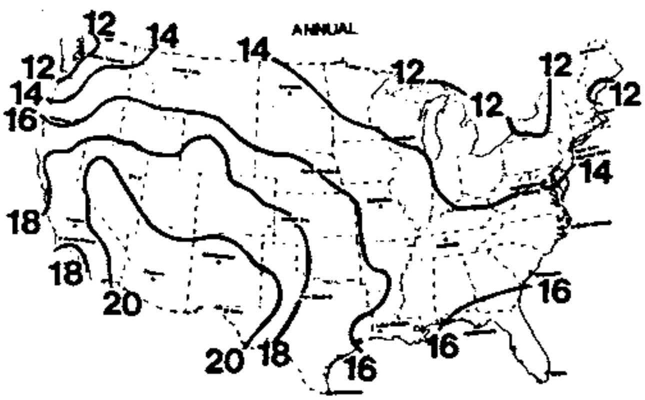
HATS OFF TO: *Carl Guy* of Eastonville (5 NW), Colorado

Mr. Guy lives in the climatically fascinating high prairie northeast of Colorado Springs (elevation above 7,000 feet). He has observed plenty of nasty blizzards and raging thunderstorms since taking over the weather station there just over 36 years ago. Carl, we thank you!

Solar Energy in Colorado -- How Much Do We Really Get?

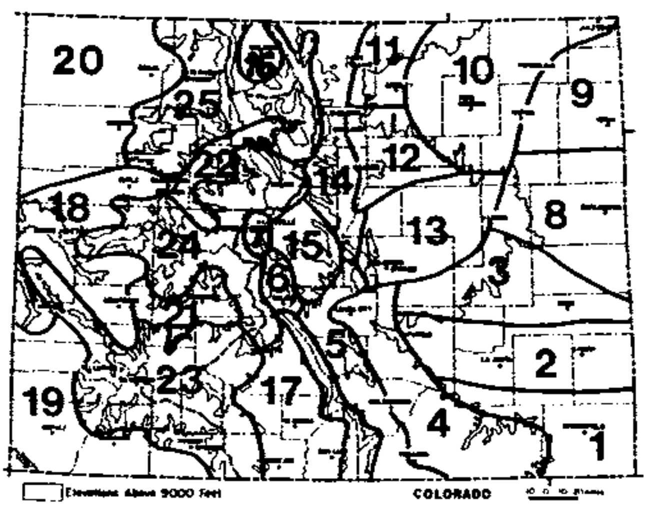
The National Renewable Energy Laboratory in Golden Colorado (formerly called the Solar Energy Research Institute) prepared a lovely atlas a few years ago containing national maps of the amount of solar energy reaching the ground. The maps are very useful and show clearly that solar energy is least over the Pacific Northwest, the Great Lakes area and New England. Solar energy resources increase steadily toward the south and west reaching a maximum over Arizona, New Mexico, Nevada, and portions of southern Utah and southwest Colorado.

The atlas gives excellent information on how much solar energy we have on a national scale. But locally, the atlas can be very misleading. A good example is right here in Colorado. If all we had was the national atlas, Colorado's solar resources would appear to increase smoothly from northeast to southwest. The data we have here in Colorado, shows the pattern to be much more complex.



Annual average daily solar radiation on a horizontal surface in megajoules per square meter.

Combining actual observations of total solar energy on a horizontal surface with general cloudiness and precipitation patterns, we have developed regional estimates of monthly average solar energy for 25 regions in Colorado.



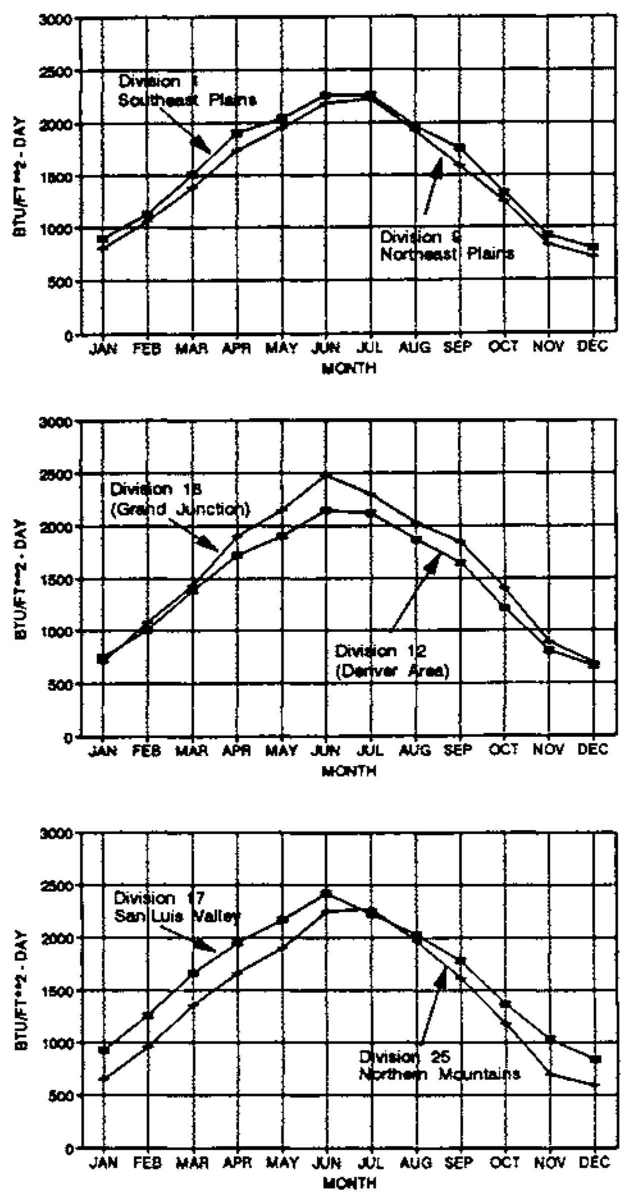
Climatic divisions used in Solar Energy Resource Evaluation.

How much variation do we see in solar radiation across Colorado? Since the primary influence is latitude, and latitudes only range from 37°N at the New Mexico border to 41°N at the Wyoming stateline, the entire State experiences a fairly smilar sinusoidal annual cycle. But regional differences are still quite significant.

The top figure compares average daily solar radiation by month for southeasternmost Colorado with that of the northeastern plains. Southeast Colorado systematically and reliably receives more solar energy than areas to the north in every season of the year. The differences are greatest during spring and fall and are least during the summer months.

An east-west comparison from the Denver area over to the lower valleys of western Colorado show that solar energy is very similar during the winter but is significantly greater on the Western Slope from April to October. The month of June stands out with at least 15% more solar radiation reaching the ground near Grand Junction than in the Denver area.

TOTAL HEMISPHERIC RADIATION
DAILY AVERAGES -- BY MONTH



Our final example compares solar energy in the San Luis Valley to that of the Colorado northern mountains. North-south differences in horizontal solar energy are most extreme. Winter is also the time when clouds frequently hang over the mountains but dissipate as air descends over the valley. Then look at the months of July and August. For a brief period there is no difference in solar resources. Monsoon moisture moving north from Mexico triggers frequent thunderstorms over the mountains that surround the San Luis Valley. These clouds then spread out over the valley diminishing solar radiation during the afternoon hours. The Northern Mountains also see cloud development but as much as southern areas.

Let us conclude by looking at contour maps of solar radiation on a horizontal surface. Remember, these analyses are based on regional estimates for 25 climatic divisions in Colorado and are smoothed in response to known terrain influences on cloudiness. If more data were available, greater local variations would be observed than these maps indicate.

Despite our complex topography, solar radiation is distributed quite uniformly in June with the lowest amounts in northeast Colorado and along the northern Front Range. Solar radiation is greatest in the southwestern valleys of the State. June in the mountains is the sunniest month of the year. As seen here, daily solar radiation averages between 25 and 26 megajoules per meter^2 over almost the entire mountain area.

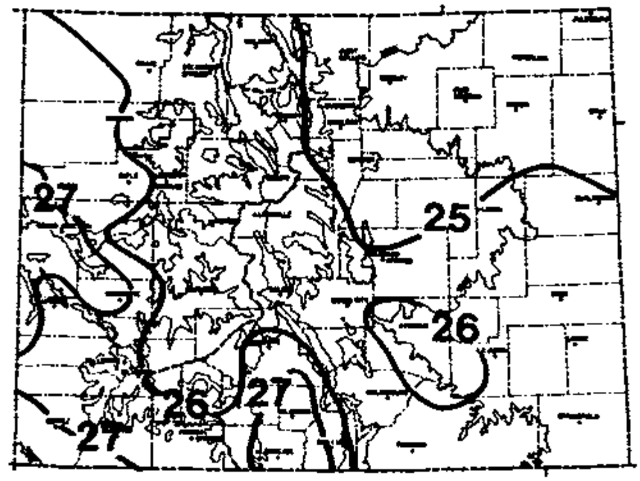
In December, the lowest solar radiation totals are expected along and just west of the State's northern and central mountain ranges. The highest totals are, of course, in the San Luis Valley, but southeast and extreme southwest parts of the State are also quite high. An interesting feature is the narrow band of higher insolation observed in the Front Range foothills west from Denver. Many who live there confirm that there are numerous days each winter when the Front Range cities are hidden by low clouds but the foothills are up in the sunshine.

Averaged over the whole year, the San Luis Valley has the greatest solar energy resources in Colorado. Because of their cold temperatures there, the Valley is well suited for utilizing the sun's energy. Large solar values are also found over southeastern counties and the western valleys.

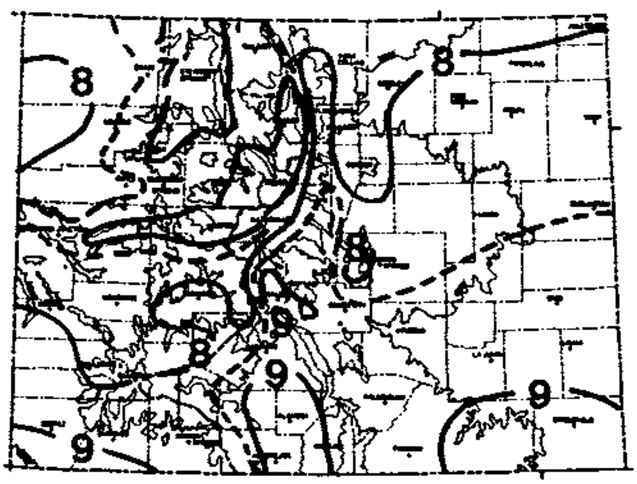
Solar radiation is lowest in a band along the Continental Divide from south of Loveland Pass up to Rocky Mountain National Park. This area is a preferred location for winter orographic cloud formation, spring "upslope" clouds and moisture from the east, and summer convective cloud development. Other portions of the State generally are preferred locations for only one or two of these cloud formation processes.

Not only do our State maps show more detail than the Solar Radiation Energy Resource Atlas of the U.S., but we also see that our values are systematically lower. Apparently, their methods provided consistent overestimates of solar energy for this region of the country.

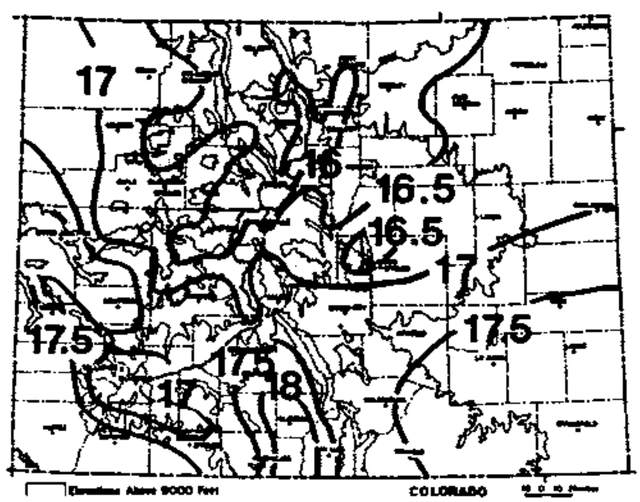
As we conclude this series on solar energy, I hope you now recognize its importance both as an energy resource and as the key ingredient for our climate. My hope is that 10 years from now I can write another report and, at last, present conclusive results instead of educated estimates. Whatever you readers can do in your respective fields to encourage the establishment of ongoing top-quality solar energy monitoring just might make a difference.



JUNE



DECEMBER



ANNUAL

Average daily solar radiation on a horizontal surface (MJ/m^2).

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.

COLORADO CLIMATE

MAY 1992
Volume 15 Number 8

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

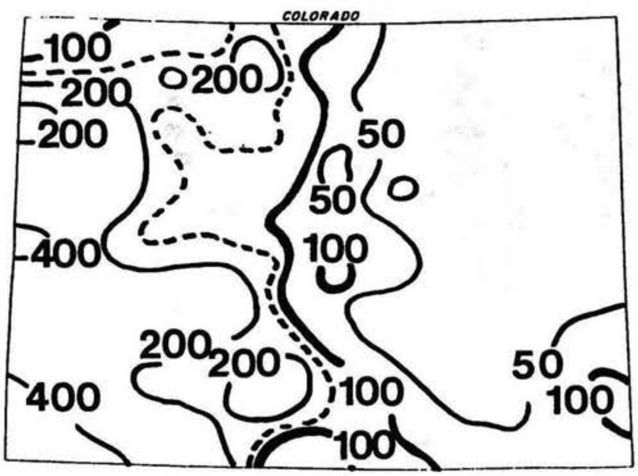
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

May Climate in Perspective – Backwards Weather ??

May weather seemed like it came in reverse order. The month began very warm and dry and ended up very cool and wet. After almost three weeks of getting used to sunshine and temperatures in the 70s and 80s, the final 12 days of the month brought chilly temperatures, dense clouds and frequent rains. There was even some snow late in the month both in the mountains and at a few points out on the plains.

Precipitation

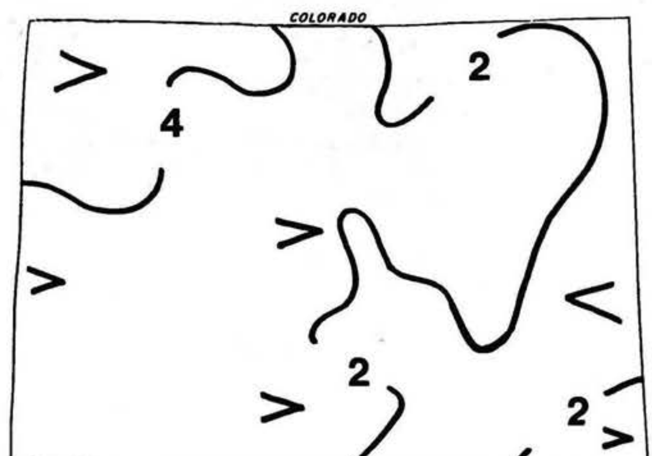
Fear of drought spread quickly in May as temperatures soared and the Eastern Plains dryland agricultural areas missed most of the storms for the second critical month in a row. At the same time, mountain snowpack melted much too quickly. Then an unusual weather pattern for this time of year brought a steady stream of moisture into western Colorado for the last two weeks of May. Parts of southwest Colorado ended up with 3 to 5 times their May average, and nearly all of western Colorado ended up well above average. Areas from the plains to the eastern foothills, which are typically wet in May, benefitted from the late-May moisture but still ended up well below average.



May 1992 precipitation as a percent of the 1961-1990 average.

Temperatures

The temperatures during the first three weeks of May pushed the month toward the record books as one of the warmest May's on record. Then one of the cold, damp episodes that so often strikes Colorado in the spring, finally arrived after we had almost given up. Unfortunately, it was accompanied by subfreezing temperatures after Memorial Day over parts of the plains. This was one of the latest freezes to strike the area in many years. Despite the late cold, monthly temperatures still ended up 1 to 4 degrees Fahrenheit above average for the month with even warmer anomalies in parts of northwest Colorado.



Departure of May 1992 temperatures from the 1961-90 averages.

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MAY 1992 DAILY WEATHER

1-7 May began with lots of sunshine, low humidity, consistently warmer than average temperatures, and melting mountain snowpack. Day-night temperature differences were often 40 degrees or more. May 1st was one of the hottest days of the month as temperatures climbed into the 80s amd 90s at lower elevations. Las Animas hit 101°F, the hottest in the State. Temperatures were a little more seasonal on the 2nd behind a Pacific cold front, and a few light showers were reported east of the mountains. Then warm and dry weather returned with highs mostly in the 50s and 60s in the mountains with 70s and 80s at lower elevations. With mostly clear skies, chilly nighttime temperatures occurred in the mountains. Hohnholz Ranch on the Laramie River had the coldest reading of the month with 17° on the morning of the 4th. Clouds increased in western Colorado on the 7th with a few showers.

8-10 A Pacific cold front combined with an upper-level low pressure area over the Southwest to bring some wet weather to much of the State. It was still warm 8-9th, especially east of the mountains, but rain and high mountain snow spread eastward. Much cooler temperatures then moved in 9-10th. Substantial rainfall was reported over southwest Colorado and over portions of northwestern counties. Meeker reported 1.06" on the 9th from all-day rains. Cortez and Mesa Verde picked up nearly an inch that day – close to their average for the entire month. A few thunderstorms, with local small hail, moved out on the plains that evening. Rain ended in western Colorado on the 10th but continued in parts of southeast Colorado. Rocky Ford picked up 0.58" on the 10th. Northeastern Colorado received very little moisture from the storm.

11-15 Temperatures rebounded sharply on the 11th. Then cooler air pushed in from the northeast on the 12th with low clouds over northeast Colorado. A few showers developed with some moderate thunderstorms in southeastern areas. Colorado Springs picked up 0.40" of rain. The cool, moist air retreated again on the 13th and was replaced with more unseasonable warmth. Low elevation temperatures again returned to near 80°, but a stationary front lingered out near the Kansas border. A few scattered showers and thunderstorms developed each day but were heaviest in southeastern Colorado on the 15th. Walsh and Stonington both received more than 1" of rain from storms late on the 15th.

16-19 Mostly dry statewide with temperatures continuing much warmer than normal. Rapid snowmelt took place as mountain temperatures pushed well up into the 50s and 60s with nighttime temperature falling only slightly below freezing. A few summerlike isolated afternoon and evening thundershowers developed. Then on the 19th, winds increased and a major surge of subtropical moisture pushed northward in advance of a large approaching storm system. A few thundershowers appeared on the Western Slope marking the beginning of a dramatic change in the spring weather pattern.

20-21 Still dry and warm on the plains, but cooler air with widespread precipitation enveloped western Colorado. Most precipitation fell as rain, except at elevations above 11,000 feet. Yellow Jacket measured 0.94" of rain on the 20th. The Climax weather station (elev. 11,300 ft.) found 1.10" of moisture with 5" of new snow at their 8 a.m. observation on the 22nd.

22-31 The month ended with a prolonged period of cool and unsettled weather. An upper-level low over Arizona and New Mexico pumped moisture into southwestern Colorado 22-27th while a large high pressure area moved down out of Canada into the Midwest pushing cool, damp air into eastern Colorado for the remainder of the month. Temperatures dropped sharply on the 22nd across eastern Colorado. Showers continued over southwestern Colorado 22-25th with some locally heavy thunderstorms. Upslope clouds gradually cleared east of the mountains, but then a line of thundershowers developed late on the 24th along the Front Range. A new surge of even cooler air pushed in early on Memorial Day (25th). With occasional drizzle and light rain, holiday temperatures east of the mountains stayed in the 50s. Skies cleared out on the plains early on the 26th and temperatures dipped unexpectedly below the freezing point. The Leroy 5WSW weather station near Sterling reported a low of 28°, the latest hard freeze in many years. Then a disturbance from the northwest helped trigger widespread precipitation. Hayden measured 1.33" of rain and small hail on the 26th. Dinosaur National Monument got more than 2" over two days. All of eastern Colorado had cold rain on the 27th, and high temperatures were only in the 40s in many areas. Snow fell in the foothills, and even some flakes were seen out on the plains. Another freeze occurred that night in some areas. As the month ended, temperatures moderated a little east of the mountains, but remained cold in the mountains. Showers diminished on the 28th but became more numerous again 30-31st. Lamar recorded 0.98" of rain on the 30th. Denver had 0.48" on the 31st.

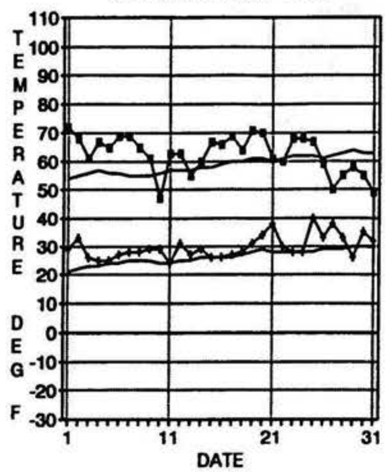
Weather Extremes

Highest Temperature	101°F	May 1	Las Animas
Lowest Temeprature	17°	May 4	Hohnholz Ranch
Greatest Total Precipitation	5.43"		Yellow Jacket
Least Total Precipitation	0.13"		Ordway 2 ENE
Greatest Total Snowfall	8.0"		Climax

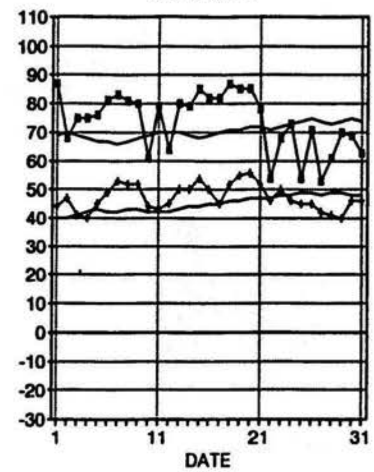
MAY 1992 TEMPERATURE COMPARISON

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.)

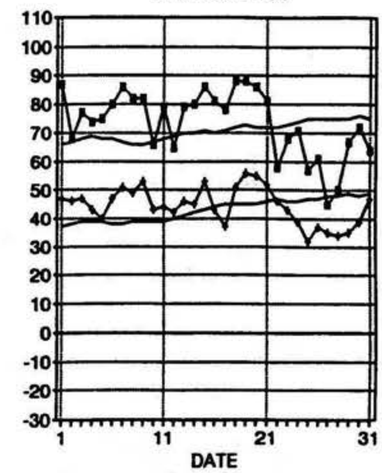
GRAND LAKE 1NW



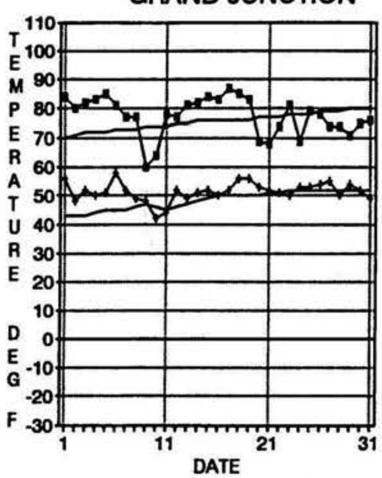
DENVER



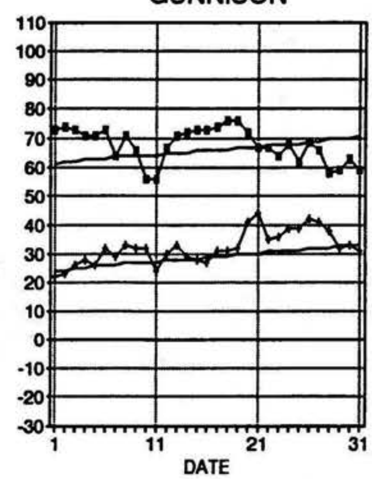
AKRON 1N



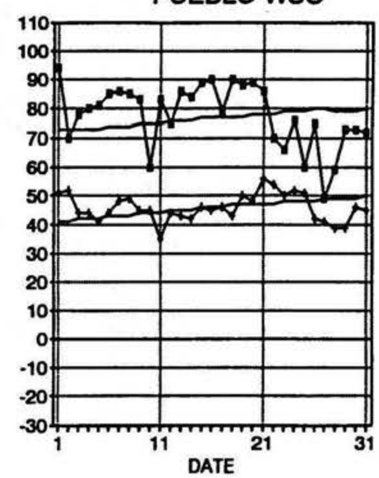
GRAND JUNCTION



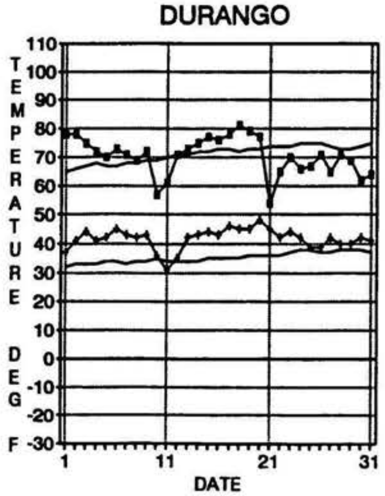
GUNNISON



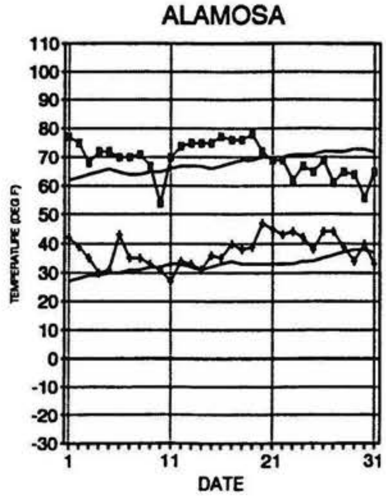
PUEBLO WSO



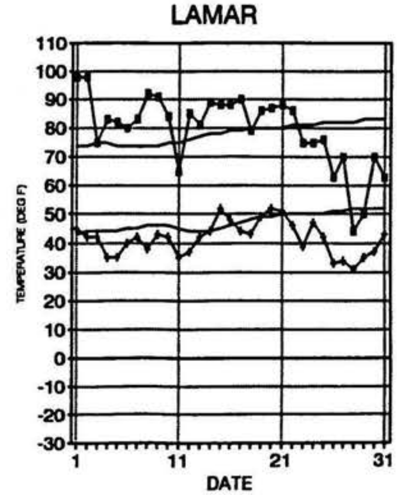
DURANGO



ALAMOSA



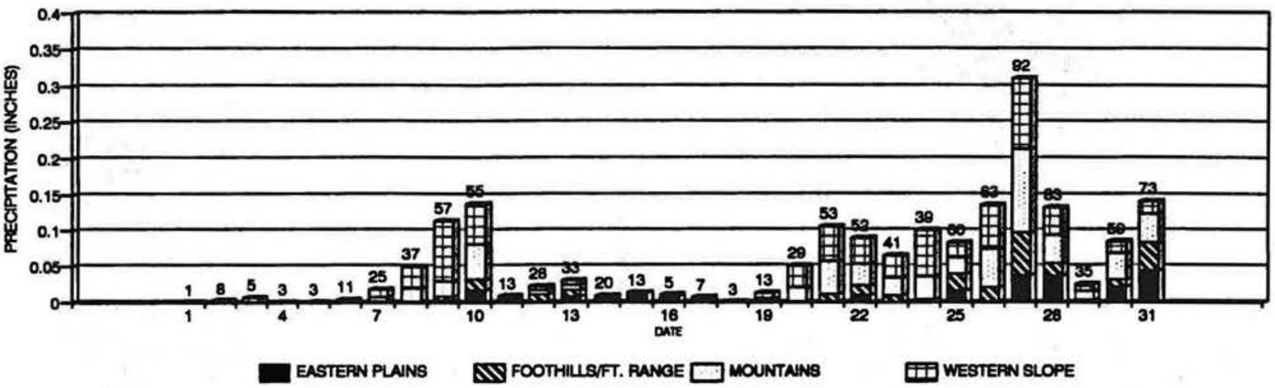
LAMAR



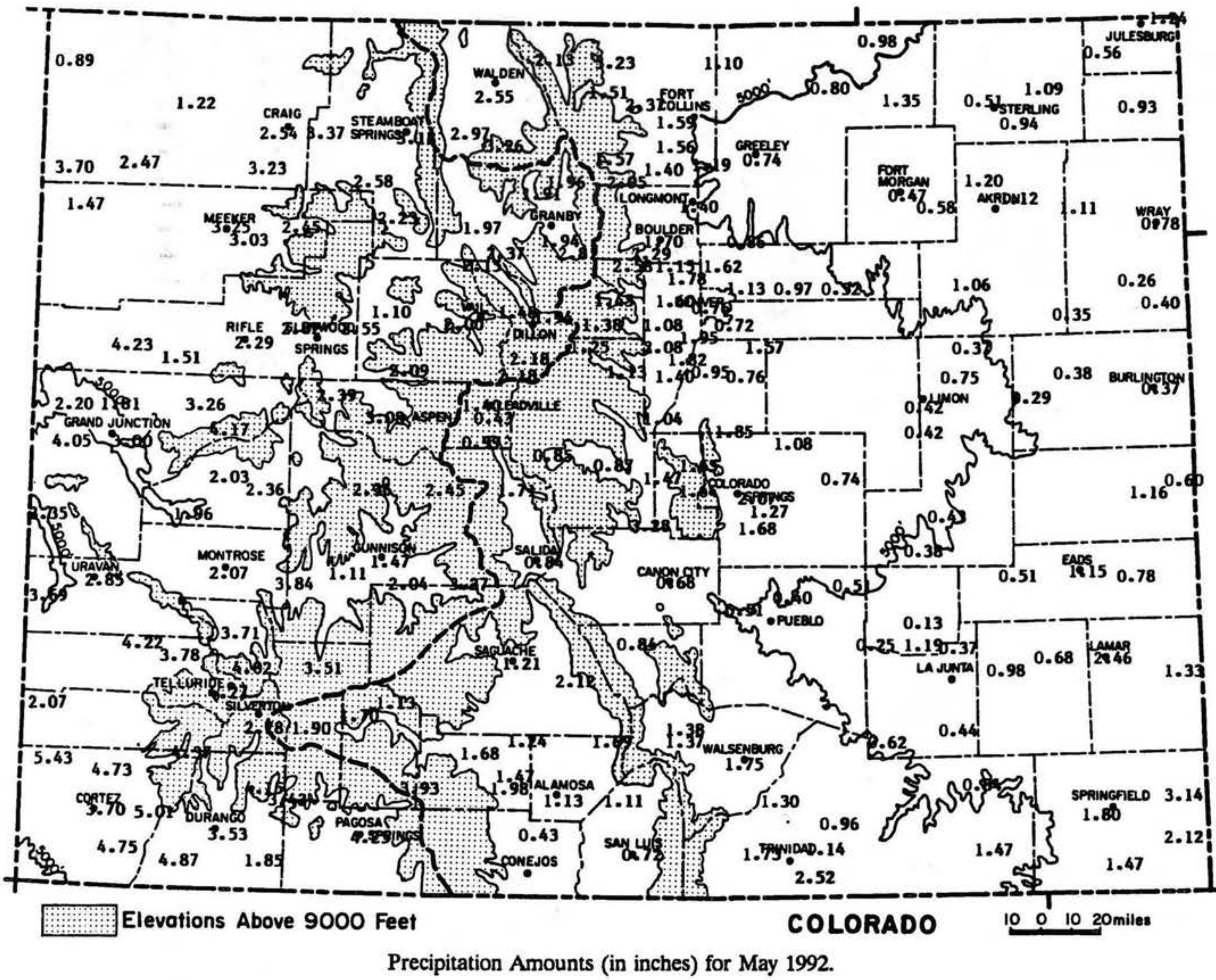
MAY 1992 PRECIPITATION

May typically boasts frequent and sometimes heavy precipitation, especially east of the mountains. This year was much differenct. Only one significant storm system was observed during the first 19 days of May and it mostly affected western Colorado. Late May is usually dry and sunny over western Colorado, but this year rain fell with nearly unprecedented proportions on the Western Slope. Pagosa Springs and Silverton each reported rainfall on all of the last 12 days of May. Precipitation totals were heaviest on the 27th, averaging over 0.30" statewide.

COLORADO DAILY PRECIPITATION - MAY 1992

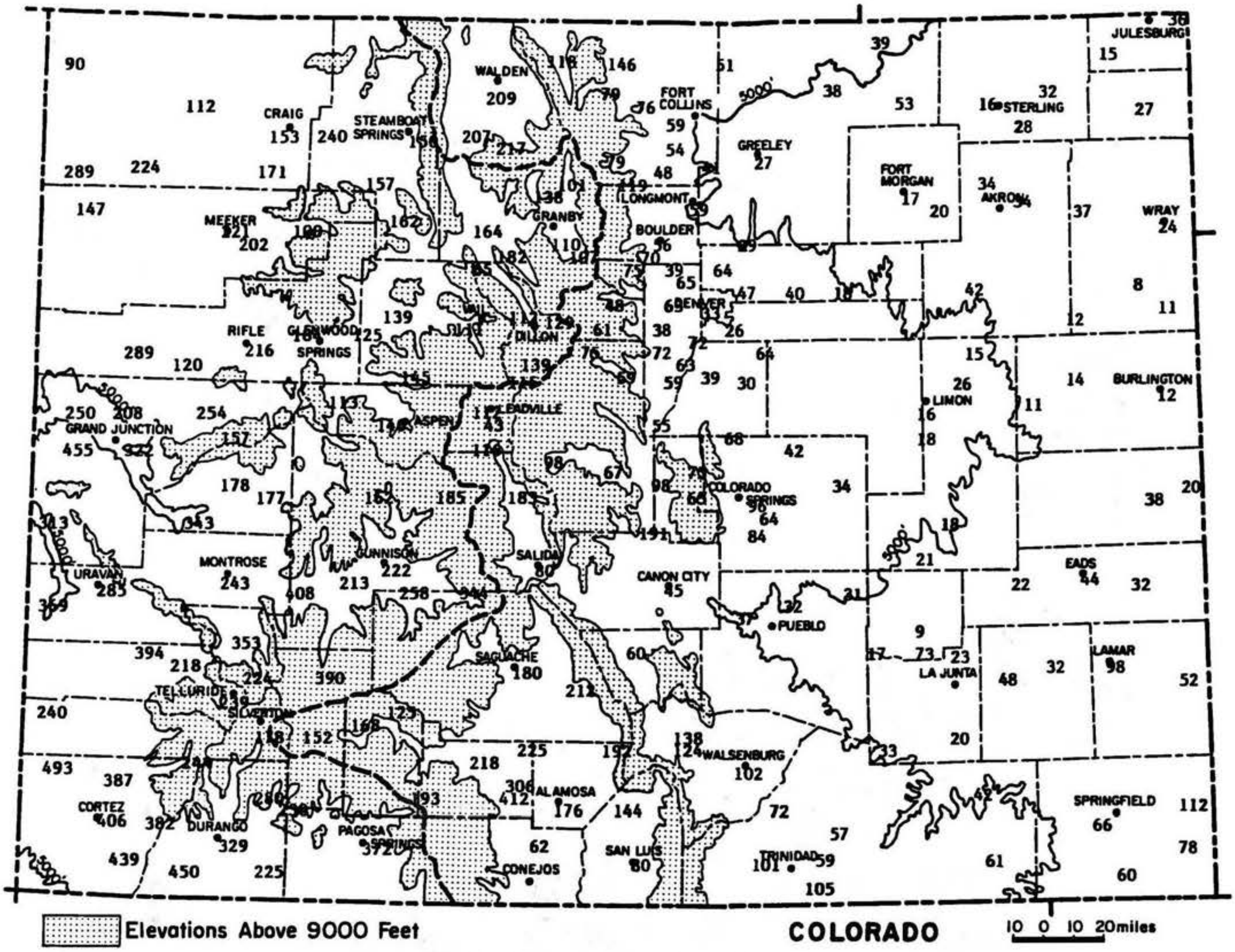


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

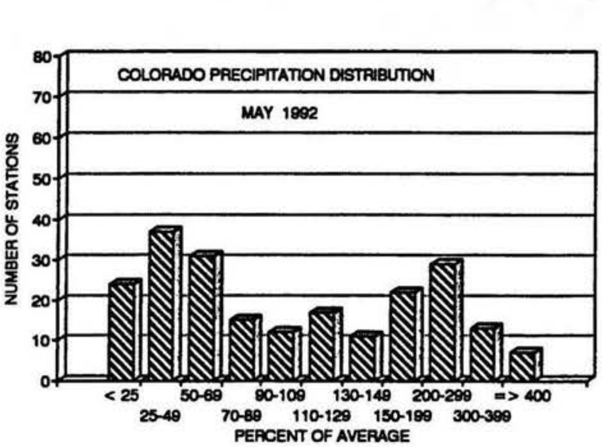


Precipitation Amounts (in inches) for May 1992.

MAY 1992 PRECIPITATION COMPARISON



May 1992 Precipitation as a Percent of the 1961–90 average.



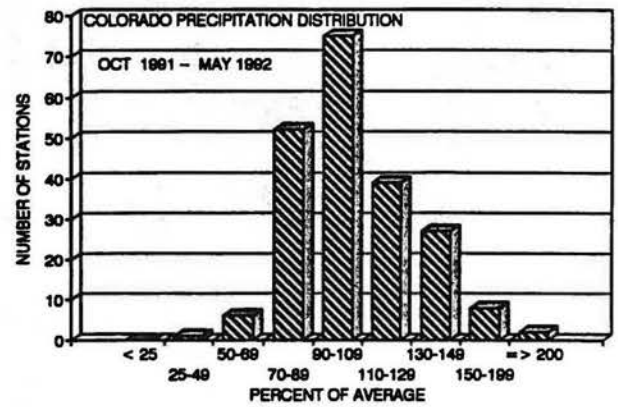
May precipitation had a bimodal distribution in Colorado. Only a small area of the State was near average while large regions were either much above or much below average. Several sites in southwest Colorado established new records for the wettest May in recorded history.

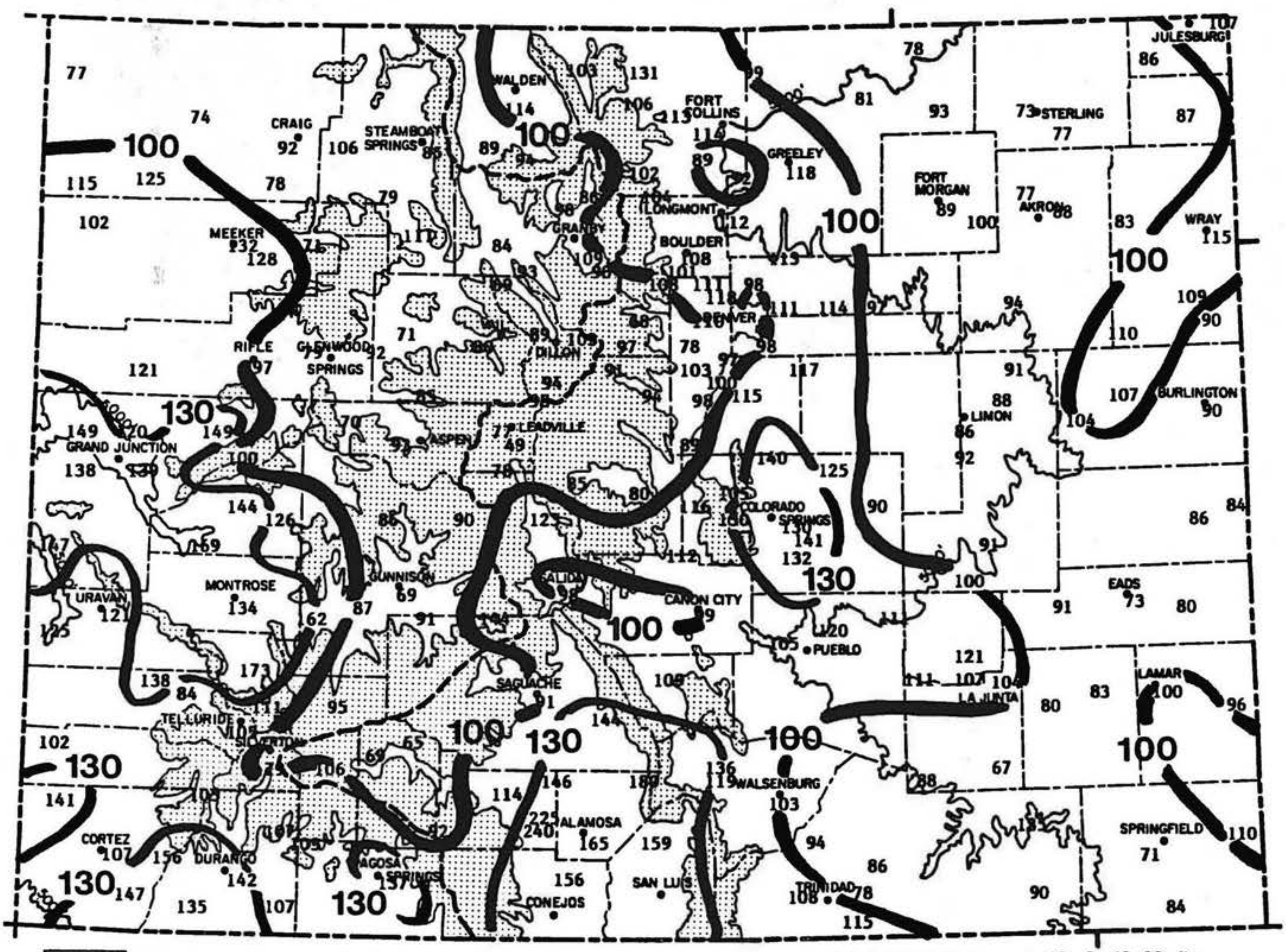
MAY 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	1.13"	23th driest in 121 years of record (driest = 0.06" in 1974)
Durango	3.53"	2nd wettest in 98 years of record (wettest = 3.72" in 1947)
Grand Junction	1.81"	3rd wettest in 101 years of record (wettest = 2.74" in 1906)
Las Animas	0.98"	31st driest in 126 years of record (driest < 0.01" in 1932)
Pueblo	0.40"	12th driest in 124 years of record (driest < 0.01" in 1868 and 1899)
Steamboat Springs	3.18"	13th wettest in 86 years of record (wettest = 5.42" in 1981)

1992 WATER YEAR PRECIPITATION

Dry May weather east of the mountains dropped water year precipitation totals below average for the first time since October over much of the Eastern Plains. At the same time, several Western Slope areas rose above 130% of average. Mountain areas also improved somewhat but generally remain below average. In combination with the warm weather of recent months, mountain snowpack has been melting quickly. May streamflow volumes have been near normal on most major rivers in Colorado, but prospects for abundant surface water supplies during the rest of the summer are not good. The distribution of water year precipitation shows that most stations are now fairly close to their long-term average. It is normal, as we move later into the water year, for this distribution to compress toward the average.





October 1991–May 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR MAY 1992

Heating Degree Data — Colorado Climate Center (303) 491-8545

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STATION		JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	ANN
ALAMOSA	AVE	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535	350		9506
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410	1124	980	660	487		8297
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901	700	664	321	192		5068
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246	1048	901	568	391		M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021	751	639	360	173		5446
CANON CITY	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870	688	604	331	167		4897
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998	788	717	383	219		5737
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310	892	744	458	266		6449
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556	1078	809	497	270		7659
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486	874	625	273	86		5951
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022	714	673	309	158		5337
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805	609		9984
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305	935	745	430	267		6340
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387	970	809	466	289		7054
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123	939	887	541	410		7079
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029	736	681	356	193		5502
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193	756	652	332	163		5603
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390	788	608	195	53		5385
GRAND LAKE 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
	91-92	220	255	427	739	1169	1468	1735	1354	1118	751	534		9770
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088	724	665	310	181		5486
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707	1167	940	661	452		8995
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943	712	539	242	107		4818
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852	656		10238
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161	827	734	436	272		6232
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124	786	730	391	201		5855
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490	1025	758	446	280		7174
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385	911	683	324	176		6231
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477	1087	899	577	392		7848
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958	759	608	309	125		5157
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283	804	660	352	142		5952
STEAMBOAT SPRINGS	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680	1126	863	595	383		8817
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191	731	645	352	142		5554
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	90-91	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291	1057	946	565	450		7858
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946	774	642	289	186		5206
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700	500		9275
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870	717	634	309	163		4864

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

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MAY 1992 CLIMATIC DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	70.7	38.5	54.6	1.1	87	29	318	6	333	0.98	-1.52	39.2	7
STERLING	77.8	45.8	61.8	3.9	95	35	142	50	433	0.51	-2.66	16.1	6
FORT MORGAN	76.2	46.0	61.1	2.7	94	33	163	48	420	0.47	-2.17	17.8	4
AKRON FAA AP	73.6	44.3	58.9	2.4	88	32	213	35	384	1.20	-2.23	35.0	9
AKRON 4E	75.0	42.5	58.8	2.4	91	29	216	32	397	1.12	-2.13	34.5	8
HOLYOKE	73.9	45.6	59.8	0.8	94	33	191	37	390	0.93	-2.43	27.7	8
JOES	74.7	45.6	60.2	2.2	93	31	183	41	397	0.35	-2.40	12.7	2
BURLINGTON	75.3	45.3	60.3	1.1	92	31	173	36	408	0.37	-2.54	12.7	4
LIMON WSMO	70.7	41.3	56.0	2.4	85	33	272	3	333	0.42	-2.08	16.8	7
CHEYENNE WELLS	76.6	42.7	59.7	0.1	95	29	181	24	412	1.16	-1.87	38.3	4
EADS	76.0	46.6	61.3	0.6	94	36	162	55	418	1.15	-1.42	44.7	4
ORDWAY 21N	77.7	44.9	61.3	2.3	92	36	145	40	435	0.38	-1.41	21.2	6
ROCKY FORD 2SE	81.5	47.6	64.6	2.5	96	36	78	72	494	1.19	-0.42	73.9	7
LAMAR	79.5	41.5	60.5	-2.0	98	31	173	40	444	2.46	-0.04	98.4	7
LAS ANIMAS	79.0	49.2	64.1	0.6	101	35	107	87	461	0.98	-1.06	48.0	10
HOLLY	79.2	47.5	63.4	1.4	99	38	116	73	459	1.33	-1.20	52.6	7
SPRINGFIELD 7WSW	80.1	47.5	63.8	3.2	96	36	97	67	478	1.80	-0.90	66.7	7
TIMPAS 13SW	76.5	48.1	62.3	1.8	91	35	137	62	432	0.62	-1.23	33.5	5

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	72.8	45.0	58.9	2.5	86	38	193	10	364	1.59	-1.10	59.1	12
GREELEY UNC	74.0	45.7	59.9	2.0	90	38	181	26	386	0.74	-1.92	27.8	9
ESTES PARK	64.5	36.8	50.7	2.5	77	29	436	0	235	1.57	-0.41	79.3	14
LONGMONT 2ESE	75.4	42.5	59.0	1.9	92	35	201	19	395	1.40	-0.94	59.8	10
BOULDER	73.0	45.1	59.1	2.1	87	37	192	15	369	1.70	-1.30	56.7	13
DENVER WSFO AP	73.8	47.3	60.6	3.4	87	40	158	29	389	1.13	-1.27	47.1	9
EVERGREEN	66.0	37.0	51.5	2.6	80	30	410	0	257	1.08	-1.70	38.8	9
CHEESMAN	71.0	33.7	52.3	1.8	83	24	388	0	335	1.04	-0.85	55.0	9
LAKE GEORGE 8SW	62.2	34.5	48.4	2.5	73	30	509	0	200	0.87	-0.42	67.4	9
ANTERO RESERVOIR	63.4	30.8	47.1	4.1	71	22	547	0	215	0.85	-0.01	98.8	12
RUXTON PARK	58.7	30.1	44.4	1.9	77	23	632	0	156	1.64	-0.95	63.3	9
COLORADO SPRINGS	70.4	45.2	57.8	2.4	85	37	219	3	329	2.07	-0.08	96.3	9
CANON CITY 2SE	73.5	47.1	60.3	2.0	90	37	167	28	384	0.68	-0.81	45.6	8
PUEBLO WSO AP	77.9	45.8	61.8	0.8	94	35	125	34	435	0.40	-0.85	32.0	7
WESTCLIFFE	65.0	34.8	49.9	0.6	75	23	433	0	228	0.84	-0.55	60.4	9
WALSENBURG	74.4	45.5	59.9	2.2	85	36	163	12	395	1.75	0.04	102.3	10
TRINIDAD FAA AP	74.1	44.6	59.4	0.5	91	37	186	19	385	0.96	-0.72	57.1	12

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	65.0	32.3	48.6	4.5	77	20	500	0	241	2.55	1.33	209.0	13
LEADVILLE 2SW	58.6	28.5	43.6	3.8	67	25	656	0	143	0.43	-0.57	43.0	9
SALIDA	70.1	37.9	54.0	2.0	81	28	330	0	320	0.84	-0.21	80.0	10
BUENA VISTA	67.8	36.4	52.1	2.1	77	32	391	0	283	1.71	0.78	183.9	8
SAGUACHE	67.4	37.5	52.5	2.5	79	31	383	0	280	1.21	0.54	180.6	7
HERMIT 7ESE	60.4	29.9	45.2	3.7	72	19	610	0	164	1.70	0.69	168.3	11
ALAMOSA WSO AP	69.5	37.4	53.5	3.1	78	27	350	0	311	1.13	0.49	176.6	11
STEAMBOAT SPRINGS	69.5	35.2	52.4	4.6	79	28	383	0	309	3.18	1.07	150.7	15
YAMPA	63.9	35.6	49.8	3.0	73	28	463	0	226	2.23	0.86	162.8	12
GRAND LAKE 1NW	62.6	29.8	46.2	3.4	72	24	577	0	207	1.96	0.03	101.6	16
GRAND LAKE 6SSW	63.2	31.9	47.5	3.8	72	24	534	0	214	1.91	0.53	138.4	18
DILLON 1E	60.2	30.1	45.2	3.1	70	25	609	0	167	1.48	0.17	113.0	13
CLIMAX	50.2	25.5	37.8	2.6	61	19	836	0	48	2.18	0.30	116.0	6
ASPEN 1SW	63.9	34.1	49.0	2.0	72	27	487	0	225	3.08	0.98	146.7	15
CRESTED BUTTE	60.9	31.4	46.2	3.0	69	25	576	0	180	2.36	0.90	161.6	16
TAYLOR PARK	56.6	30.6	43.6	3.4	64	23	656	0	112	2.45	1.13	185.6	12
TELLURIDE	67.3	33.3	50.3	3.8	75	25	450	0	275	4.27	2.49	239.9	13
PAGOSA SPRINGS	68.6	35.4	52.0	2.8	78	27	392	0	298	4.25	3.11	372.8	15
SILVERTON	59.1	31.0	45.0	2.4	67	25	610	0	157	2.78	1.22	178.2	14
WOLF CREEK PASS 1	54.0	30.8	42.4	3.2	64	21	695	0	86	3.93	1.90	193.6	16

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	70.7	41.4	56.0	5.5	78	33	270	0	328	2.54	0.89	153.9	12
HAYDEN	70.5	40.3	55.4	3.7	81	32	290	0	327	3.37	1.97	240.7	11
MEEKER NO. 2	70.8	40.6	55.7	4.2	79	33	280	0	332	3.25	1.78	221.1	11
RANGELY 1E	75.6	46.5	61.1	4.4	84	38	122	7	411	1.47	0.47	147.0	8
EAGLE FAA AP	72.5	38.3	55.4	4.2	81	30	289	0	358	1.10	0.31	139.2	14
GLENWOOD SPRINGS	74.2	42.1	58.1	3.5	83	34	205	1	383	2.82	1.29	184.3	12
RIFLE	75.3	45.2	60.3	4.7	85	34	142	2	400	2.29	1.23	216.0	11
GRAND JUNCTION WS	77.5	51.4	64.4	2.4	87	42	53	43	465	1.81	0.94	208.0	15
CEDAREDGE	75.7	40.3	58.0	1.4	85	32	208	1	408	2.03	0.89	178.1	12
PAONIA 1SW	75.6	45.8	60.7	3.6	85	39	133	6	405	2.36	1.03	177.4	12
DELTA	77.8	47.1	62.5	3.1	89	38	86	15	448	1.96	1.39	343.9	8
GUNNISON	68.0	32.2	50.1	2.7	76	22	452	0	288	1.47	0.81	222.7	3
COCHETOPA CREEK	69.2	33.8	51.5	5.1	78	23	409	0	305	2.04	1.25	258.2	14
MONTROSE NO. 2	73.0	45.1	59.1	1.9	82	37	176	0	364	2.07	1.22	243.5	12
URAVAN	80.3	48.7	64.5	3.3	89	38	53	47	482	2.85	1.85	285.0	11
NORWOOD	67.8	40.4	54.0	2.7	77	28	302	0	252	4.22	3.15	394.4	10
YELLOW JACKET 2W	69.7	42.4	56.0	1.9	79	31	270	0	313	5.43	4.33	493.6	18
CORTEZ	71.5	40.8	56.2	2.8	81	32	266	1	340	3.70	2.79	406.6	16
DURANGO	70.5	41.7	56.1	2.6	81	31	267	0	328	3.53	2.46	329.9	15
IGNACIO 1N	69.7	38.5	54.1	1.2	78	33	277	0	262	1.85	1.03	225.6	9

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.

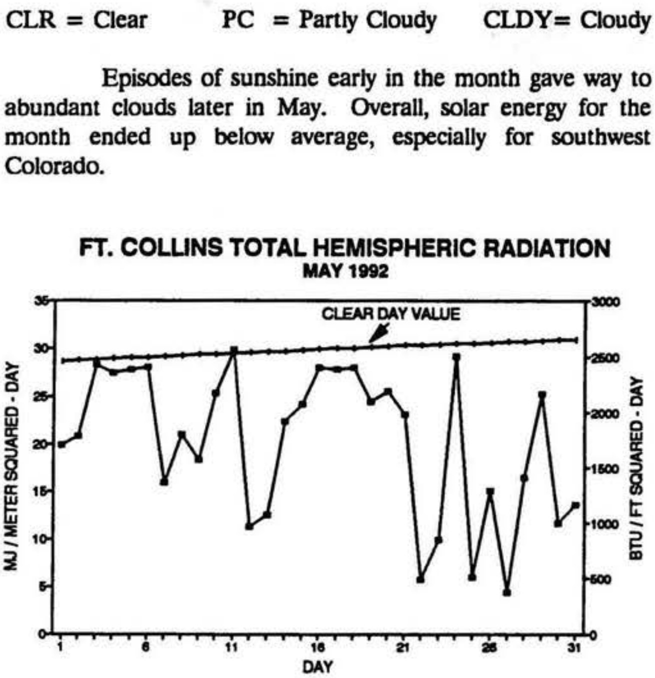
MAY 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	5	11	15	--	--
Denver	4	12	15	57%	65%
Fort Collins	5	13	13	--	--
Grand Junction	5	16	10	71%	73%
Limon	7	11	13	--	--
Pueblo	8	10	13	70%	74%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Episodes of sunshine early in the month gave way to abundant clouds later in May. Overall, solar energy for the month ended up below average, especially for southwest Colorado.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
MAY 1992

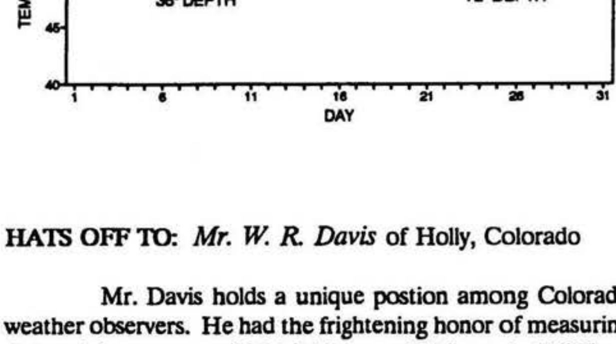


MAY 1992 SOIL TEMPERATURES

Soil temperatures were off to a very warm start throughout the first two-thirds of May. A dramatic change late in May quickly returned near-surface soil temperatures to average or below average values.

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 1992



HATS OFF TO: *Mr. W. R. Davis* of Holly, Colorado

Mr. Davis holds a unique postion among Colorado weather observers. He had the frightening honor of measuring Colorado's greatest official 24-hour rainfall total, 11.08" on June 17, 1965. Mr. Davis has faithfully reported Holly's weather since March 1958. Great job!!

Heavy Rains in a Dry State -- The Colorado Story

It's summertime in Colorado and I'm sure you know what that means. Yes, indeed, its the crash boom time of year where black-bottomed, white-topped thunderheads (meteorological name: cumulonimbus) erupt over the mountains and plains adding a fearsome beauty to our State. Meteorologists delight in the summer thunderstorms. Farmers and gardeners carry on a love-hate relationship -- loving the rain (if it falls when they need it) and hating the hail that all too often comes along for the ride. And then there are dogs. I've known dogs that would gladly hitchhike to California to miss our convective season if they could just figure out how to raise a thumb.

Lots of things amaze me about climate in general and our Colorado climate in particular. A question I often ask myself at this time of year is "how can it rain so hard and still be so dry?" That seems to be a fact of life here in the summer -- always on the verge of drought but with a flood possible at any moment.

Anyway, let's talk about heavy rain. The National Weather Service definition of heavy rain is based appropriately on the rate of fall. By their standards, more than 0.03" of rain in 6 minutes or 0.30" in an hour is heavy rain. At that rate, you can't even dash across a narrow street without getting pretty wet. A few of our big widespread spring and fall storms will produce general rains that fall at about that rate. Those storms more commonly drop moisture at a rate of 0.15" to 0.25" per hour, but since they may last for several hours, total rainfall may add up to 1 to 3 inches. By comparison, when precipitation falls as snow, rates of water accumulation are typically only 0.01" to 0.10" per hour. Only exceptionally heavy, wet snows like the one we experienced March 8, 1992 deposit precipitation at a rate close to 0.20" per hour. It is a rare and frightening snowstorm indeed that drops precipitation at a rate of more than 0.30" per hour.

The type of storm most capable of producing heavy rainfall rates is, of course, the thunderstorm. In fact, a good thunderstorm would be embarrassed among its friends if it could only muster up 0.30" per hour. Strong storms from May to September (but especially in the heat of mid summer) may drop rain at rates of 0.05" on up to as much as 0.18" per minute. These high rainfall rates are normally found only near the core of the storm and are most likely to occur out on the plains or in the lower foothills. On occasion, the higher mountains and the Western Slope see comparable downpours, but the storms there tend to be brief and localized. "Gully washers," as they have long been called, are likely to last longer and cover larger areas east of the mountains. The Palmer Ridge northeast of Colorado Springs is also a favored area.

With all the thunderstorms we get from May to September, the reason we aren't a lush, overgrown jungle is the fact that our storms are often in the form of single cells or poorly organized groups of thunderstorm cells just barely getting enough moisture from the lower atmosphere to keep them going. While capable of producing brief and localized heavy rain, Colorado storms generally are fairly short lived and cover relatively small areas -- a few square miles for a typical storm. This is in sharp contrast to the spring and summer thunderstorm systems of the Great Plains and Midwest that cover broad areas and feed on copious amounts of very humid air.

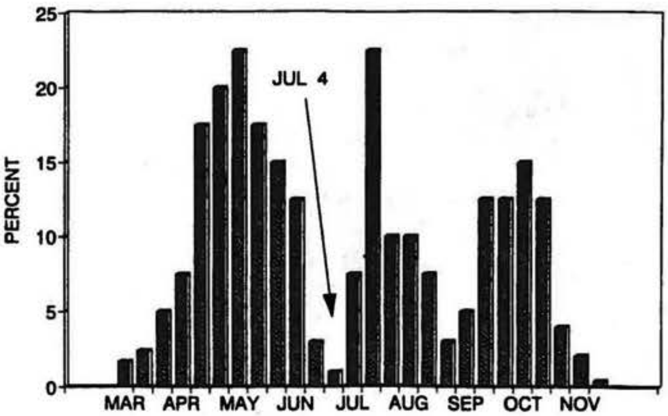
From time to time there are exceptions to these rules. These exceptions often stand out as memorable floods in our State's history. For example, the flood in the Big Thompson Canyon west of Loveland on the night of July 31, 1976 was not a typical localized thunderstorm cell. It was a part of a large storm complex that developed on a day when the atmosphere over all of Colorado was exceptionally rich with moisture. Most of Colorado received some rain that day. At the center of the storm near the town of Drake rainfall maximized at close to 12" in just a few hours of time. The devasting results are well known to most Coloradans. The ensuing flash flood claimed at least 139 lives.

Even more impressive meteorologically was the episode of storms that developed from the mountains eastward to Kansas and Nebraska June 13-18, 1965 which brought widespread flooding. Localized downpours became more widespread on the 16th and 17th over many areas east of the mountains. Unofficial reports of up to 14" of rain in a few hours on the 16th south and east of Denver were likely true. The largest official 24-hour and 48-hour rainfall measurement in Colorado's history were taken at Holly in extreme southeast Colorado. They measured 11.08" at their observation on June 17th with an additional 4.09" on the 18th. Unprecedented flooding followed.

Storms like these do not happen often, but more than likely they will occur again. The many years of climate data we have from various locations across Colorado may not allow us to anticipate the exact time and place of future heavy rains, but they can give us a useful background. First of all, experience has shown that heavy rains do have certain times of year when they are most likely. The following graph shows that heavy rains of at least 2.00" are unheard of in mid winter. (Snowstorms do produce more than 2" of moisture on occasion. Such storms may pose an avalanche hazard but are not responsible for flooding.) Chances for heavy rain begin in March and reach a peak in May. Probabilities remain high until plummetting near the end of June. Remarkably, very heavy rains are extremely unlikely around the 4th of July. Then probabilities shoot up again to another peak near the end of July. Thereafter, chances for heavy rains decrease to another minimum only to shoot up yet a third time from late September through October.

Each of these peaks in heavy rain activity represents a different mechanism in the atmosphere above Colorado. The spring peak tends to be widespread rains resulting from large, slow-moving disturbances aloft tapping moisture from the Gulf of Mexico. These are frequently all-day or multi-day rains which may snow at higher elevations. The heaviest precipitation from this type of storm is usually found in the eastern foothills of the Rockies. The summer peak is composed of more localized afternoon and evening thunderstorms of short duration that can occur almost anywhere in the State. Heaviest rainfall from these storms is often found at the lowest elevations where the most moisture

HEAVY RAIN PROBABILITIES
> 2" IN 24 HOURS SOMEWHERE IN COLORADO
DURING CONSECUTIVE 10-DAY PERIOD



is available to fuel thunderstorm activity or along geographic features where summer airmasses often converge like the Palmer Ridge between Denver and Colorado Springs. Finally, the autumn peak is characterized by more widespread, longer-lasting and less intense rainfall. Southwest Colorado is most at risk for heavy rains during that period since the moisture source is often tropical Pacific moisture swept northward by dying hurricanes.

We have examined maximum 1-day precipitation totals from hundreds of official weather stations in Colorado. The following table highlights some of the key results. These data confirm that the areas most prone to heavy precipitation are predominantly east of the mountains. In the mountains, it is the southern areas where heavy precipitation is most likely. The driest areas are the San Luis Valley and the northwestern valley areas of Moffat and Rio Blanco Counties. This should not be surprising when you stop to think where moisture comes from to feed Colorado storms.

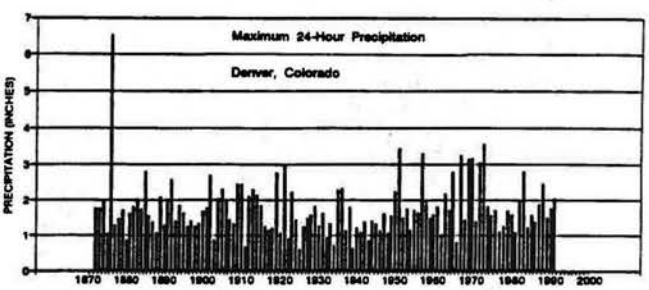
Summary of Greatest Observed* One-Day Precipitation Totals in Colorado

Region	Greatest (inches)	Regional Median (inches)	Most Likely Season
Northeast Plains	5.00	3.55	Summer
East-Central Plains	8.00	3.65	Summer
Southeast Plains	11.08	4.13	Summer
North Front Range	7.60	3.36	Spring (foothills) Summer (plains)
South Front Range	6.46	2.95	Spring (foothills) Summer (plains)
Northern Mountains	3.20	2.27	Autumn/Spring
Central Mountains	4.60	2.05	Winter/Spring/Summer
Southern Mountains	4.90	3.00	Autumn/Winter
San Luis Valley	2.55	1.77	Summer/Autumn
Northwest Valleys	2.33	1.96	Summer/Autumn
West-Central Valleys	3.20	1.87	Summer/Autumn
Southwest Valleys	3.65	2.45	Summer/Autumn

* Number of stations per region ranged from 9 in the San Luis Valley to 46 for the North Front Range. Average record length of 30 years per station. Minimum record length of 10 years.

It is critically important to know how much rain could fall in short time periods. Such information is extremely valuable for adequately designing bridges, culverts, drains, storm sewers and any structure that might be affected by heavy rains. Proper planning not only saves property, it also saves lives. But it is not as easy as you might think to anticipate how much precipitation could fall. Let me give you an example.

Careful measurements of 24-hour precipitation have been taken for more than 120 years at the official National Weather Service station in Denver. One would think that would be more than adequate to judge the magnitude of heavy rain one might expect and to accurately generate estimates of storms of various return periods (e.g. 100-year storm). As you can see from the following time series, when it comes to maximum daily precipitation, there is no such thing as enough data. Annual maximum 24-hour totals have ranged from less than 1" in 10 of the 120 years of data to more than 3" in 8 years. Interestingly, 5 of those 8 years occurred within a 7-year period around 1970. Denver has never gone more than 13 years without at least one 2-inch rain at the official gage.



If all you had was the past 115 years of data from 1877-present you would estimate with considerable confidence a 100-year 24-hour rain event of somewhere a little greater than 3.5". Throw 1876 into the sample, however, and what can you say? Was that 6.53" value a freak? – perhaps a 500-year storm? Why isn't there a single point between 3.55" (1973) and 6.53"? Well folks, that's what we're up against when we try to establish design criteria from available heavy precipitation data. Statisticians have been challenged with this extreme value problem for years, and there is no perfect solution. It is common practice to group several stations from an area believed to be climatically homogeneous and combine all their records to obtain smoother statistical results. That is probably a valid approach, but it does us very little good here in Colorado where long-term weather stations are much too few in number in and near the mountains to have a large number of "climatically similar" stations to group together.

Daily rainfall data is interesting and available for lots of locations. But the real problems from heavy rains develop amazingly quickly from short-duration intense downpours that are often extremely localized. Accurate long-term measurements of rainfall rates are taken at surprisingly few locations. Next month, I will conclude this discussion with some examples of short duration heavy rains that have been measured in Colorado. I'll also mention an opportunity for new rainfall studies that might be appearing in the next few years. Enjoy your summer.

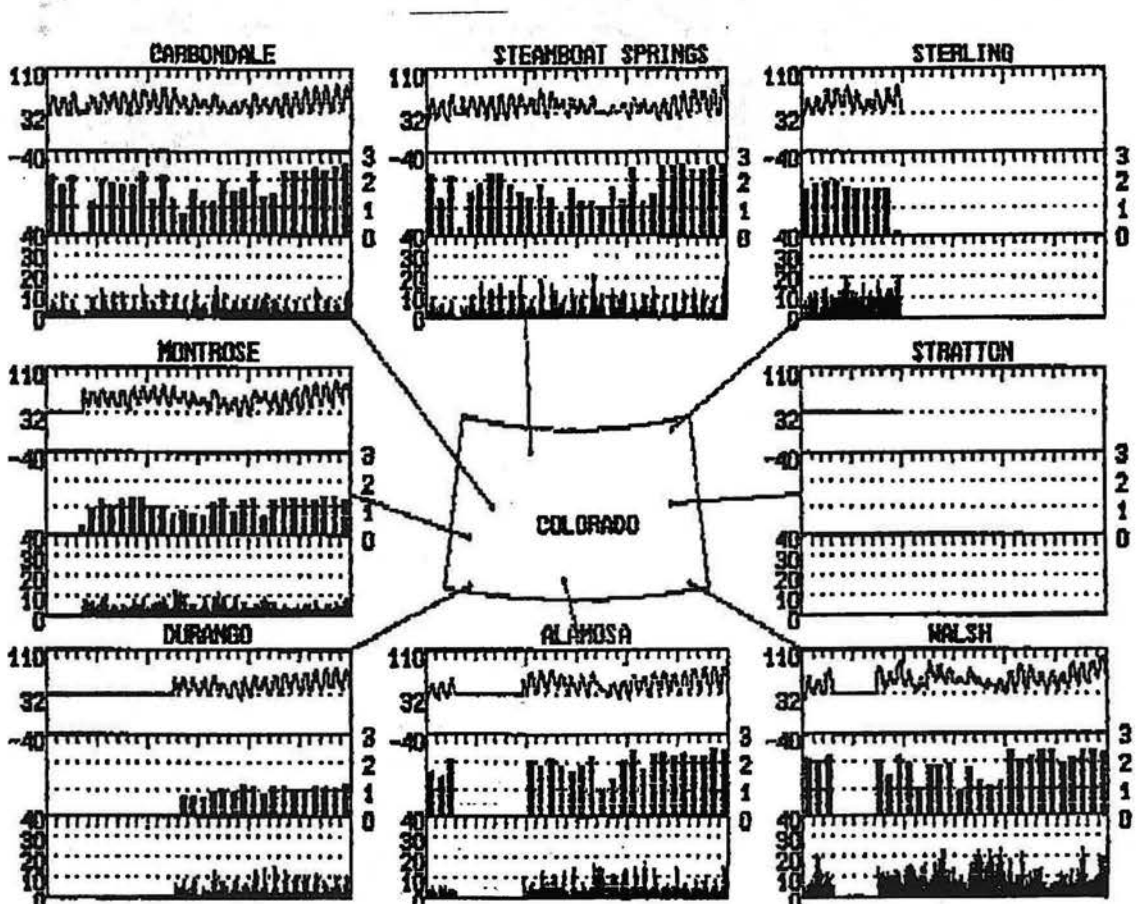
Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

WTHRNET WEATHER DATA APRIL 1992

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)	46.5	45.7	48.6	53.2	43.6	38.3	32.0	54.6
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	77.4 29/16	74.8 28/15	81.0 29/15	83.7 29/16	76.3 30/15	76.8 10/13	32.0 1/ 4	94.3 30/16
minimum:	21.0 21/ 6	22.5 20/ 6	24.3 2/ 5	23.7 20/ 6	13.5 1/ 6	14.9 1/ 4	32.0 1/ 4	19.4 1/ 5
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	65 / 19	42 / 15	81 / 27	56 / 25	82 / 23	11 / 3	0 /-13	65 / 28
11 AM	28 / 21	25 / 20	32 / 26	35 / 31	35 / 22	5 / 3	0 /-13	34 / 29
2 PM	19 / 17	21 / 17	25 / 21	28 / 29	28 / 19	5 / 5	0 /-13	26 / 27
5 PM	20 / 15	21 / 18	22 / 20	27 / 27	25 / 19	5 / 5	0 /-13	28 / 27
11 PM	40 / 20	37 / 17	46 / 23	42 / 25	59 / 23	7 / 2	0 /-13	53 / 30
monthly average wind direction (degrees clockwise from north)								
day	166	113	229	229	242	56	0	154
night	124	50	171	143	115	63	0	177
monthly average wind speed (miles per hour)	4.84	3.28	3.73	4.04	4.37	2.54	0.00	8.84
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	230	323	415	233	391	529	720	61
3 to 12	337	184	284	426	252	150	0	425
12 to 24	45	13	9	5	57	41	0	164
> 24	0	0	0	0	0	0	0	2
monthly average daily total insolation (Btu/ft²·day)	1491	530	1744	988	1747	551	0	1606
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	161	1	138	51	119	63	0	169
40-60%	83	2	100	70	90	26	0	69
20-40%	42	165	79	99	72	18	0	64
0-20%	10	64	22	117	38	11	0	29

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

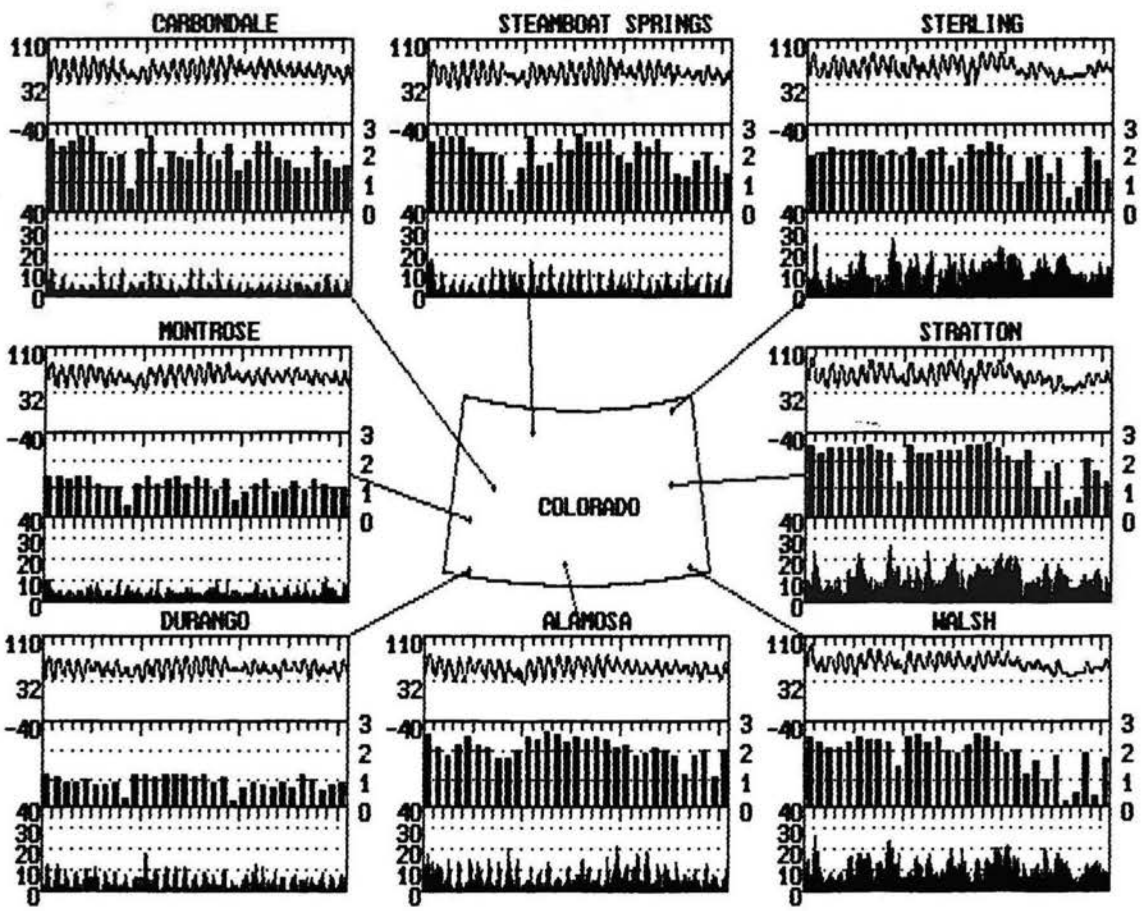


WTHRNET WEATHER DATA MAY 1992

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	52.9	52.1	54.8	58.0	50.3	60.0	59.2	61.0
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	75.7 1/14	74.1 17/16	81.0 19/14	82.2 17/16	79.0 19/15	88.7 7/15	92.1 1/16	94.3 1/15
minimum:	26.8 11/ 5	30.2 11/ 5	30.4 11/ 5	33.1 11/ 5	23.7 4/ 5	29.8 17/ 5	28.6 26/ 1	37.6 28/ 2
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	91 / 36	87 / 36	86 / 35	76 / 36	87 / 31	32 / 16	78 / 39	81 / 43
11 AM	43 / 37	54 / 43	36 / 34	49 / 44	38 / 33	19 / 19	41 / 39	49 / 43
2 PM	32 / 30	47 / 40	28 / 30	40 / 41	30 / 29	18 / 21	34 / 36	39 / 39
5 PM	35 / 30	49 / 39	33 / 31	40 / 39	35 / 29	16 / 20	32 / 34	40 / 39
11 PM	66 / 36	78 / 39	59 / 34	64 / 39	71 / 34	22 / 14	59 / 37	64 / 43
monthly average wind direction (degrees clockwise from north)								
day	182	205	228	250	216	166	137	134
night	161	99	175	162	123	183	195	177
monthly average wind speed (miles per hour)								
	5.83	3.65	2.88	3.57	3.41	9.78	10.60	10.05
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	194	407	492	334	433	93	12	20
3 to 12	479	325	248	410	286	396	479	464
12 to 24	71	12	4	0	21	251	249	258
> 24	0	0	0	0	0	4	4	2
monthly average daily total insolation (Btu/ft²·day)								
	2065	891	1932	1146	2003	1839	2074	1897
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	190	0	146	49	143	171	220	194
40-60%	125	2	113	109	84	103	98	88
20-40%	76	255	91	98	82	84	62	68
0-20%	31	175	50	177	59	68	48	80

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 1992

Volume 15 Number 9

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

June in Perspective – Stormy East, Dry West and Cool

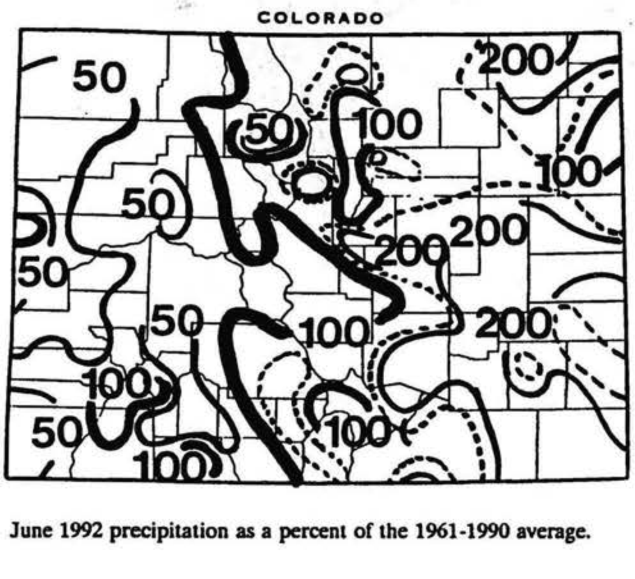
June often provides plenty of exciting weather, but this year outdid itself. Severe weather watches were issued on more than half the days in June, and thunderstorms popped like popcorn. The Coal Creek weather observer counted a total of 85 separate thunderstorms during the month at his station. A few tornadoes were spotted, but the real story was hail. Hail was reported somewhere in the State on all but four days during the month. Some locations were hit by as many as eight separate hail storms. Wind was also a problem. Many locations recorded wind gusts in excess of 40 mph on at least 5 different days. To add insult to injury, many mountain stations also reported snow.

Precipitation

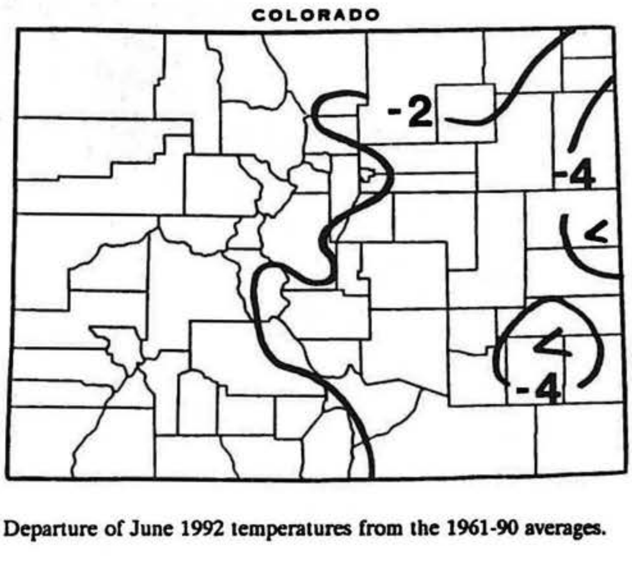
The wet weather that surprised western Colorado in late May turned its attention to eastern Colorado in June. The mountains and Western Slope had numerous opportunities for rain early in the month, but not much materialized. Along the Front Range precipitation was erratic. Some locations were inundated (5.78" in Fort Collins) while nearby areas were missed (0.77" at Boulder). Meanwhile, many areas on the Eastern Plains made up for the disappointingly dry weather of April and May. Several locations totalled more than 8" of rain for the month.

Temperatures

There was one decent heatwave across western Colorado in the second half of June. Other than that, hot summer weather just couldn't get organized. New intrusions of cool air moved in every few days. Except for a few localized areas in western Colorado, most of State ended up cooler than average for the month as a whole. Areas east of the mountains were especially chilly – generally two to four degrees cooler than expected. A few places out near the Kansas border were nearly five degrees below average. As a result, crop development slowed considerably.



June 1992 precipitation as a percent of the 1961-1990 average.



Departure of June 1992 temperatures from the 1961-90 averages.

Inside This Issue

JUNE 1992 DAILY WEATHER

1-2 Widespread steady rains fell east of the mountains on the 1st, and temperatures stayed in the 50s and 60s making it feel like April. Limon, Akron, and many other areas measured more than 1" of welcome rain. Several inches of snow fell in the mountains, and the snow line snuck as far down as Monument. Climax reported 21°F on the 1st, the coldest in Colorado for the month. Skies cleared and temperatures warmed on the 2nd, but many locations had their coolest morning of the month. Limon recorded 39°F.

3-11 Most Coloradans enjoyed a lovely early-summer day on the 3rd, but a cold front late in the day brought strong winds and set off a few evening thunderstorms. This initiated a long period of stormy weather. Cool high pressure over the Midwest and Northern Plains helped pump moist air into eastern Colorado. Meanwhile, a series of disturbances from the west and northwest acted as triggers to set off storm development. Large thunderstorms with hail struck northeast Colorado on the 4th. Storms were widespread on the 5th with the southeastern plains getting hit the hardest. The Springfield 7WSW station recorded 2.27". Storms were lighter on the 6th but got rolling late at night over southeastern counties. Springfield received an additional 1.95". Storms were active again on the 7th with several reports of hail and possible tornadoes. On the 8th, storms took aim on the Front Range, hitting north Denver and Ft. Collins with heavy downpours and directly over Colorado on the 9th, and numerous heavy storms again erupted. A dozen towns reported 1"+ rains. Temperatures warmed on the 10-11th, but there was still enough moisture to fuel numerous local storms. At least 8 cities reported hail on the 11th.

12-16 Lingering moist air allowed some thunderstorm formation again on the 12th, but drier air then swept in from the southwest in advance of an unusually intense low pressure center over the Intermountain West. Strong, dry southwest winds swept across Colorado on the 13th. Some storms erupted east of the mountains where the dry air collided with moister air out over the plains. Very severe weather exploded over northeast Colorado on the 14th with numerous funnel cloud sightings and hail reports. The storms continued overnight in extreme northeast Colorado dumping at least 2-3" of rain. The Sedgwick 5S weather observer measured 3" diameter hailstones and 2.69" of rain. Julesburg got 2.72". Winds gusting locally to 40 mph or more continued on the 15th. The storm system finally picked up speed and headed northeastward on the 16th. It kicked off a few more storms across northern Colorado as it left, dropping some rain, hail and high-mountain snow in some areas. Cool mountain temperatures accompanied the storm. Fraser reported 23° early on the 16th.

17-18 A brief period of seasonally warm, dry and tranquil weather.

19-24 Summer heat established itself over western Colorado with temperatures rising into the 90s each day. Uravan hit 100°F 22-23rd, the warmest of the year for the Western Slope. East of the mountains, a new cool front on the 19th spawned widespread hail-producing storms. More severe weather developed in eastern Colorado on the 20th. The Leroy 5 WSW station (near Sterling) reported 3.08" of rain and hail 4 inches deep on the level. Storms were less active 21-23rd, but a few still rumbled east of the mountains each day. Finally, on the 24th, temperatures on the plains began to soar into the 90s only to have a new cold front sneak in. As it did, a potent thunderstorm exploded over Fort Collins dropping nearly 3" of rain and tons of hail in a one-hour period (see Special Feature).

25-28 A stormy period statewide as weak low pressure aloft combined with cool but moist "upslope" breezes east of the mountains. Temperatures cooled statewide on the 25th, especially over northeast Colorado. Numerous storms still erupted, some containing hail and heavy rain. Sterling measured 1.77" from the storm late on the 26th. Storms were strong in the mountains as well. Yampa recorded 0.62" on the 26th. Storms diminished 27-28th, and temperatures gradually returned to normal.

29-30 A very strong spring-like storm pushed in from California. Severe storms seemed likely on the 29th as cool, moist air collided with a hot and dry airmass. A spectacular but mostly harmless tornado was sited near Palmer Lake. Most of the other developing storms were ripped apart by strong winds aloft before they could get organized. On the 30th, Wyoming was buffeted by severe weather, but Colorado only experienced the hot, windy and very dry air circulating around the south side of the large low pressure area. Las Animas finally managed to hit 101°F, the warmest in the State for the month but only their 3rd 100°+ read temperature for the year. Interestingly, their first two occurred on April 30 and May 1, respectively.

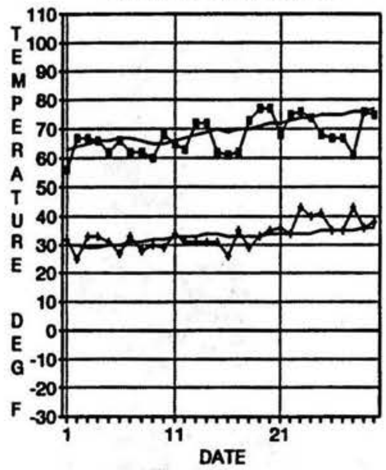
Weather Extremes

Highest Temperature	101°	June 30	Las Animas
Lowest Temperature	21°	June 1	Climax
Greatest Total Precipitation	9.21"		Sedgwick 5 S
Least Total Precipitation	0.04"		Uravan
Greatest Total Snowfall	4.0"		Coal Creek, Hohnholz Ranch, Eastonville 5 NW

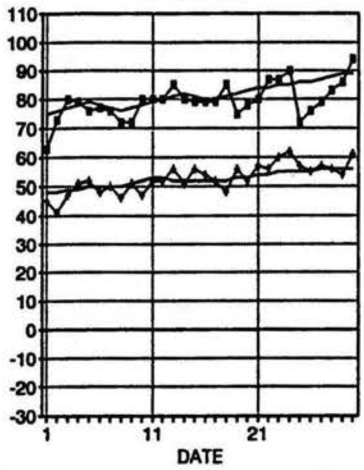
JUNE 1992 TEMPERATURE COMPARISON

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.)

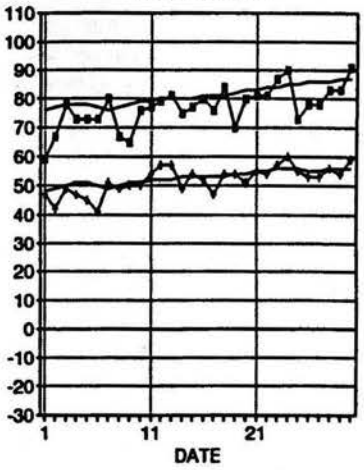
GRAND LAKE 1NW



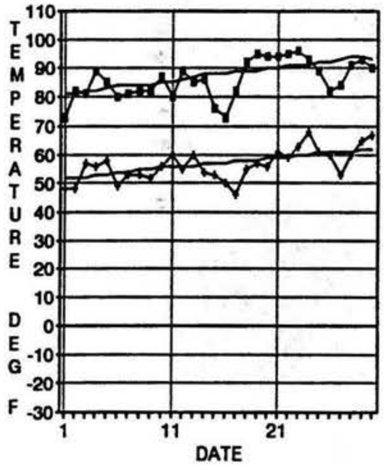
DENVER



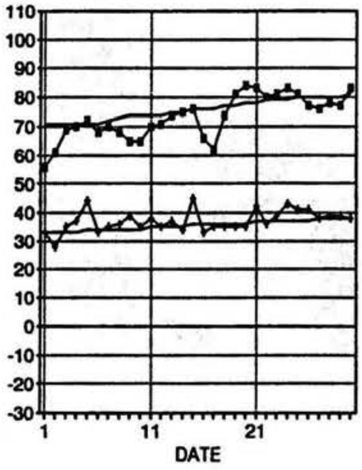
AKRON 1N



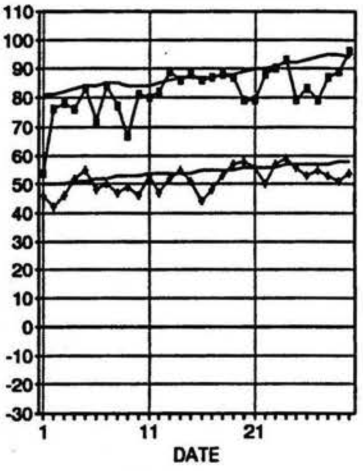
GRAND JUNCTION



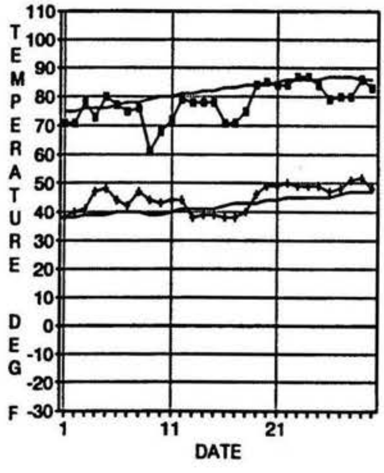
GUNNISON



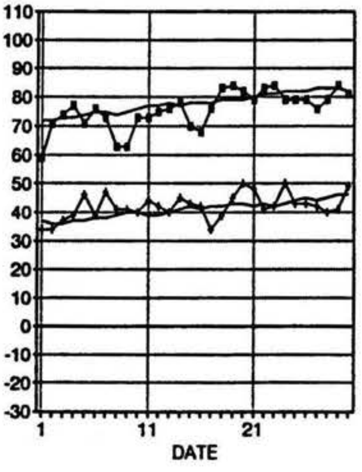
PUEBLO WSO



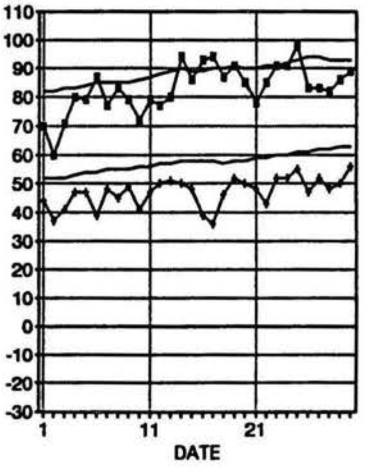
DURANGO



ALAMOSA



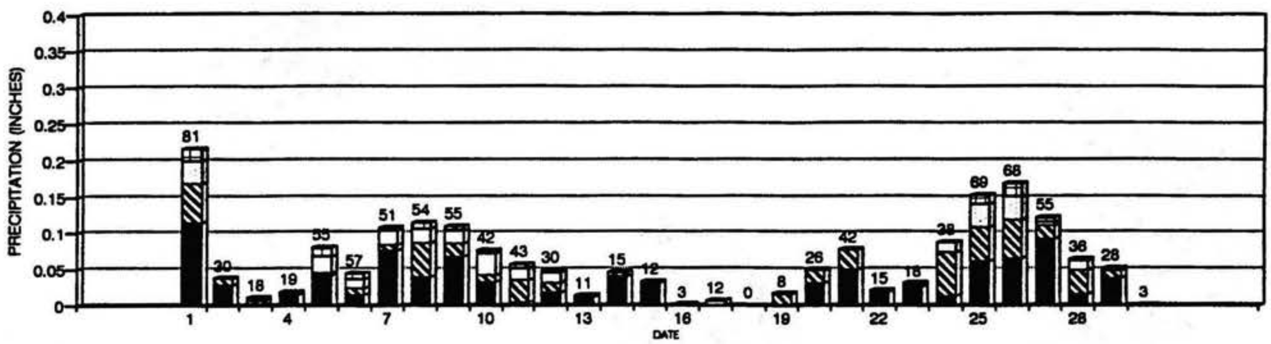
LAMAR



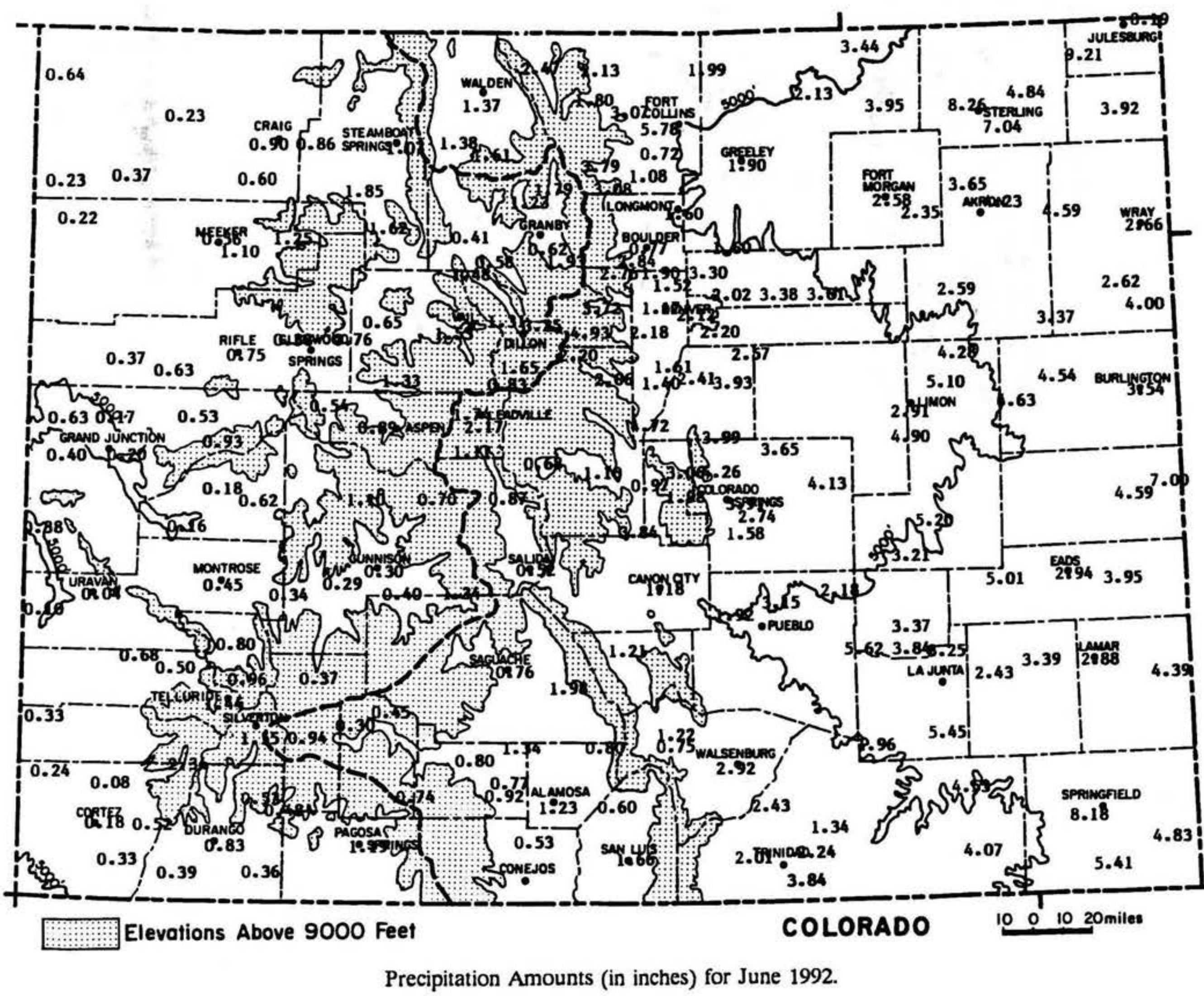
JUNE 1992 PRECIPITATION

Precipitation fell somewhere in Colorado on most days during June. Rainfall was heaviest and most widespread from the Front Range out onto the Eastern Plains. For the State as a whole, June 1 was the wettest day of the month with more than 80% of the official stations reporting moisture. While there were numerous heavy thunderstorms and dozens of local downpours of greater than 1", statewide precipitation was not excessive on any other day. That is a common feature of summer storms. Locally, rains may be very great, but rarely are large areas affected at the same time.

COLORADO DAILY PRECIPITATION - JUN 1992

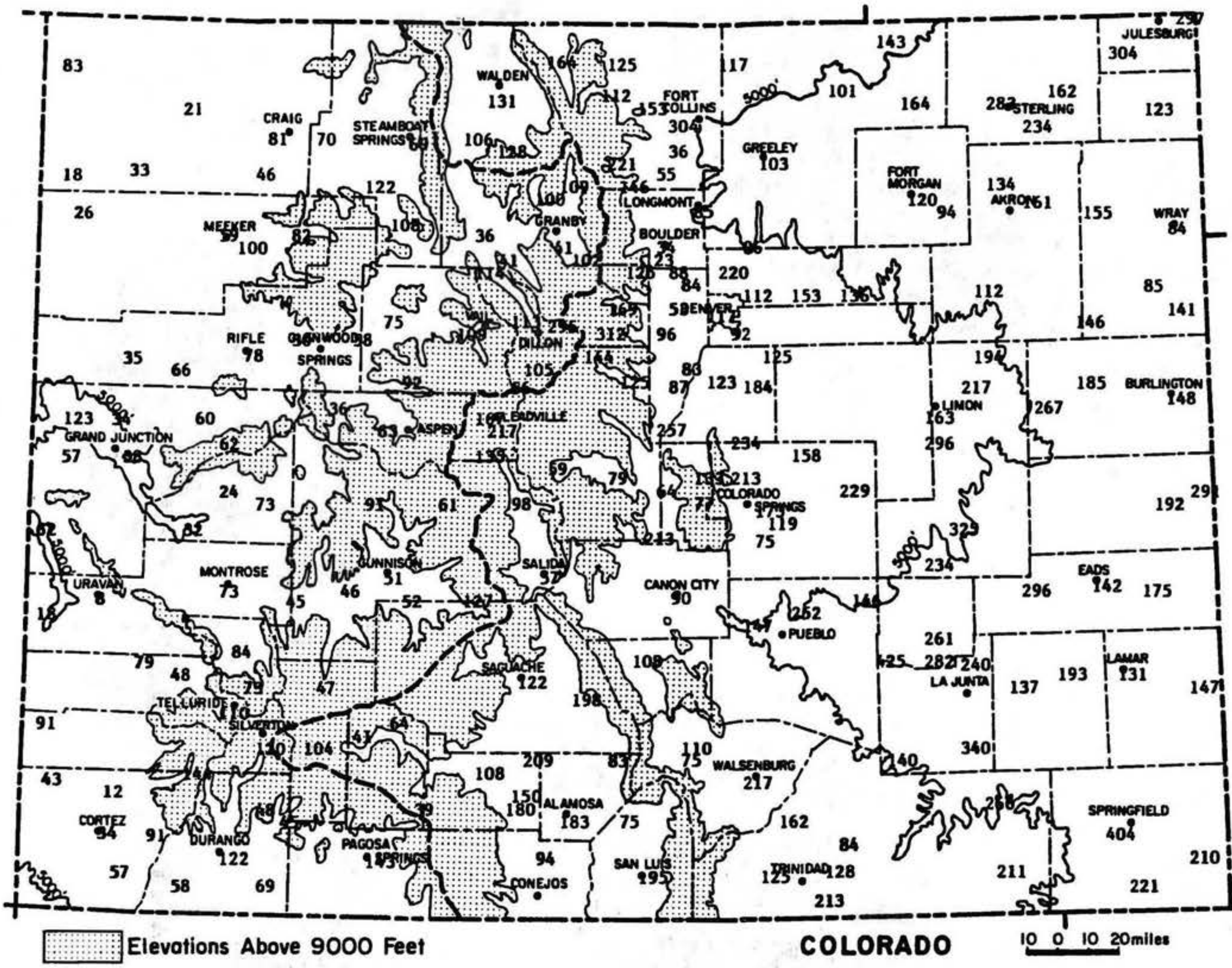


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

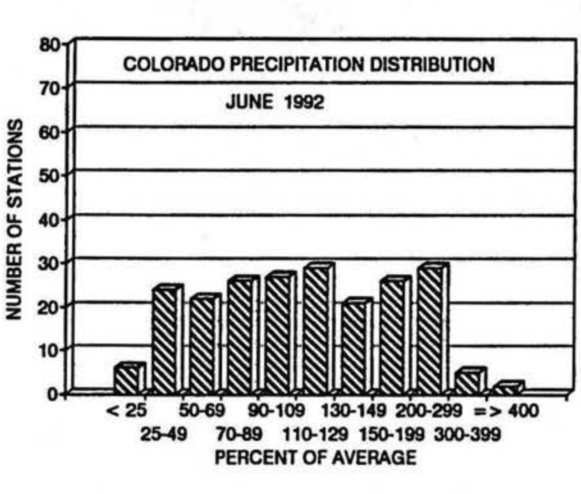


Precipitation Amounts (in inches) for June 1992.

JUNE 1992 PRECIPITATION COMPARISON



June 1992 Precipitation as a Percent of the 1961–90 average.



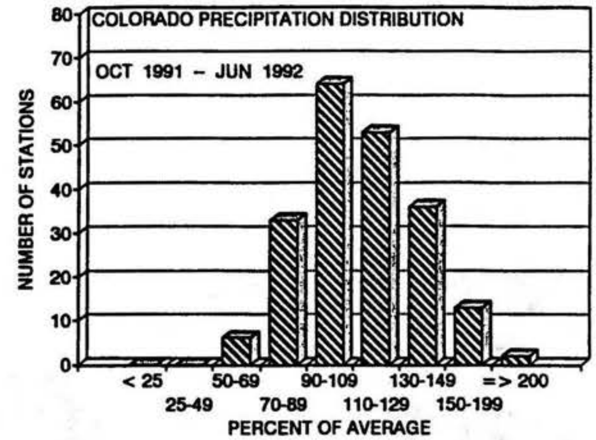
The variety that our Colorado climate dishes out is always amazing. Once again there were huge variations in precipitation in June ranging from less than 25% of average rainfall in some parts of western Colorado to more than 400% of average at a few spots out on the plains. Sterling had its wettest month since records began in 1910.

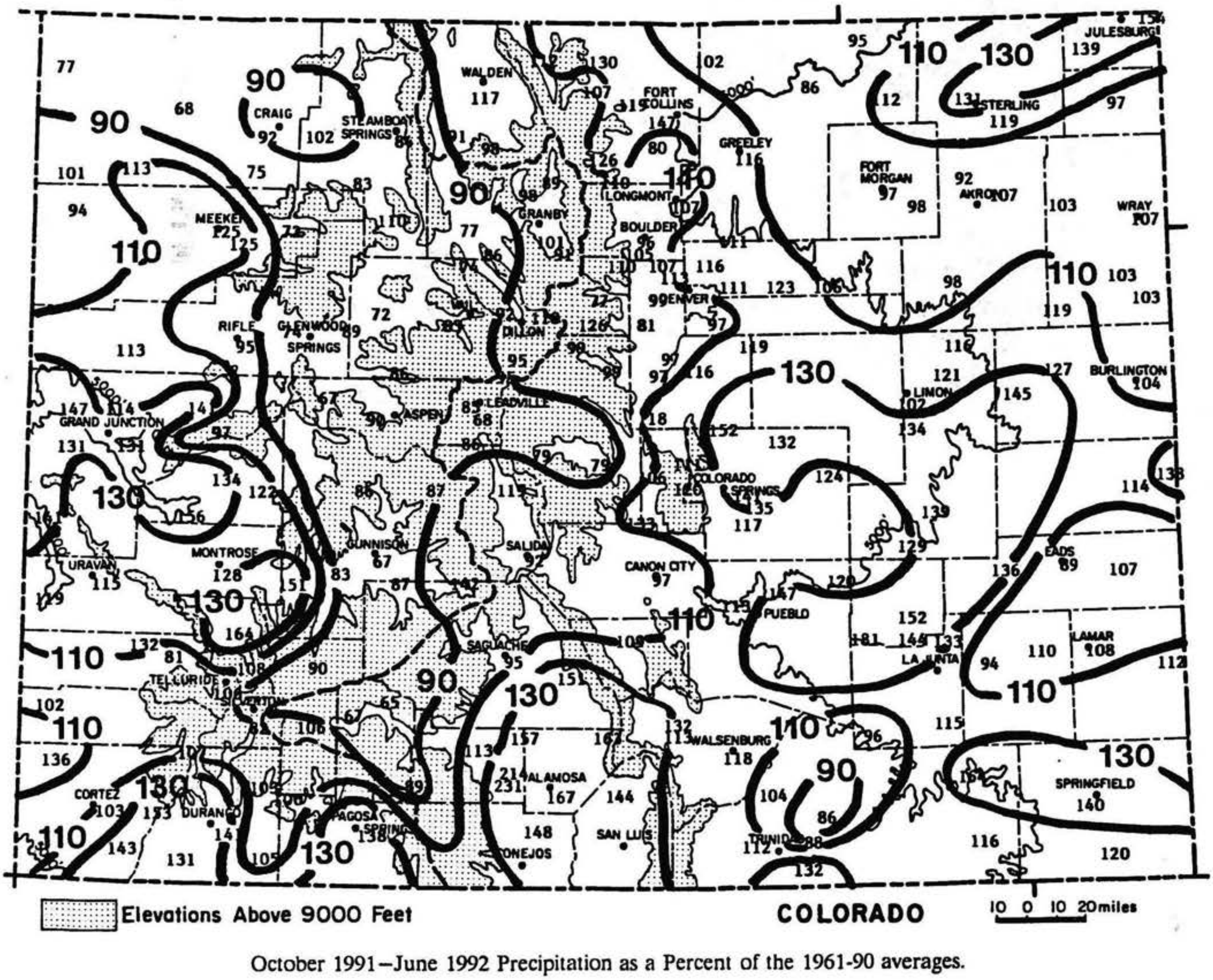
JUNE 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	2.02"	36th wettest in 121 years of record (wettest = 4.96" in 1882)
Durango	0.83"	40th wettest in 98 years of record (wettest = 5.53" in 1927)
Grand Junction	0.17"	39th driest in 101 years of record (driest < 0.01" in 1916, '61 and '80)
Las Animas	2.43"	27th wettest in 127 years of record (wettest 5.67" in 1965)
Pueblo	3.15"	7th driest in 123 years of record (wettest 7.14" in 1921)
Steamboat Springs	1.02"	36th driest in 86 years of record (driest < 0.01" in 1919)

1992 WATER YEAR PRECIPITATION

The 1992 water year roller coaster ride continues as we alternate between very wet and very dry months. Through the first nine months of the water year, the majority of Colorado's weather stations have received average or above average moisture. The wettest areas, compared to average, are found out on the Eastern Plains, down in the San Luis Valley, and in valley areas of extreme western and southwestern Colorado. A region with drier than average conditions has persisted for most of the year from northwestern Colorado down to the upper Rio Grande basin. This area includes much of the northern and central mountain ranges of Colorado. This pattern, and the timing of this year's precipitation, is resulting in less mountain runoff than average for many major watersheds. But with good low-elevation moisture, water demand has been lessened somewhat.





October 1991–June 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR JUNE 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	90-91	59	118	201	633	990	1597	1671	1081	954	742	410	172	8628
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535	350	179	9685
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	90-91	134	146	234	652	964	1462	1444	1013	1077	811	432	224	8593
	91-92	104	112	335	610	1106	1369	1410	1124	980	660	487	351	8648
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	90-91	32	13	81	338	589	1161	1081	667	685	511	211	44	5413
	91-92	17	7	121	403	831	911	901	700	664	321	192	93	5161
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	90-91	66	130	226	641	905	1326	1256	896	983	771	472	207	7879
	91-92	63	87	M	580	1056	1265	1246	1048	901	568	391	247	M
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	90-91	10	4	76	407	M	1249	1223	688	737	438	136	1	M
	91-92	13	14	106	462	903	1004	1021	751	639	360	173	61	5507
CANON	AVE*	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	90-91	14	12	58	382	548	1098	1004	626	679	459	182	26	5088
	91-92	8	0	105	379	800	945	870	688	604	331	167	63	4960
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	90-91	28	21	83	473	663	1256	1142	750	773	568	219	33	6009
	91-92	16	16	145	453	954	1048	998	788	717	383	219	96	5833
CORTEZ	AVE*	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	90-91	1	6	151	539	774	1321	1364	879	882	702	335	113	7067
	91-92	13	8	161	423	947	1227	1310	892	744	458	266	114	6563
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	90-91	14	18	116	606	876	1547	1544	1095	995	693	398	127	8029
	91-92	27	13	230	582	1080	1517	1556	1078	809	497	270	161	7820
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	90-91	0	2	58	416	751	1400	1549	998	742	512	170	26	6624
	91-92	0	2	88	383	832	1302	1486	874	625	273	86	29	5980
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	90-91	12	3	64	388	623	1209	1143	684	682	510	174	16	5508
	91-92	6	4	118	449	902	982	1022	714	673	309	158	35	5372
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	90-91	284	355	430	858	1071	1587	1569	1220	1257	1031	691	425	10778
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805	609	458	10442
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	90-91	4	28	118	481	832	1373	1274	842	919	619	364	125	6979
	91-92	6	2	152	379	940	1179	1305	935	745	430	267	123	6463
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	90-91	15	23	134	583	934	1568	1536	1052	889	693	355	99	7881
	91-92	26	6	208	563	972	1358	1387	970	809	466	289	150	7204
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	90-91	120	131	219	591	803	1330	1244	937	885	727	430	152	7569
	91-92	83	92	311	627	988	1078	1123	939	887	541	410	242	7321
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	90-91	19	6	74	460	690	1284	1212	747	703	508	203	41	5947
	91-92	11	1	145	457	891	1002	1029	736	681	356	193	56	5558
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	90-91	18	7	63	421	730	1343	1248	750	722	489	180	8	5979
	91-92	5	4	89	437	947	1025	1193	756	652	332	163	41	5644
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	90-91	0	0	28	360	759	1370	1464	919	706	478	136	18	6238
	91-92	0	2	37	304	815	1193	1390	788	608	195	53	8	5393

* = 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	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	90-91	264	268	350	774	1071	1605	1668	1148	1233	979	615	330	10305
6SSW	91-92	220	255	427	739	1169	1468	1735	1354	1118	751	534	383	10153
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	90-91	14	2	62	450	723	1309	1246	741	692	492	159	11	5901
	91-92	8	5	119	450	925	1011	1088	724	665	310	181	37	5523
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	90-91	65	179	264	771	1059	1664	1787	M	M	M	M	249	M
	91-92	131	151	371	698	1120	1597	1707	1167	940	661	452	292	9287
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	90-91	4	0	21	308	624	1220	1113	667	602	352	81	0	4992
	91-92	1	3	59	350	896	966	943	712	539	242	107	24	4842
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	90-91	331	402	464	861	1141	1556	1550	1207	1210	1068	714	449	10953
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852	656	495	10733
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	90-91	36	11	96	491	745	1280	1237	779	820	592	245	38	6370
	91-92	19	14	171	503	1000	1095	1161	827	734	436	272	104	6336
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	90-91	24	11	101	481	727	1284	1249	740	699	520	186	28	6050
	91-92	12	6	133	489	936	1047	1124	786	730	391	201	60	5915
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	90-91	9	23	121	511	885	1406	1458	1047	939	696	358	110	7563
	91-92	24	7	221	553	1003	1367	1490	1025	758	446	280	138	7312
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	90-91	0	3	81	470	804	1385	1460	974	768	571	268	49	6833
	91-92	0	0	135	404	901	1312	1385	911	683	324	176	48	6279
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	90-91	44	108	177	608	910	1538	1432	1038	1002	767	489	227	8340
	91-92	44	37	289	568	1116	1362	1477	1087	899	577	392	251	8099
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	90-91	1	0	34	360	610	1243	1116	730	667	406	103	3	5273
	91-92	1	0	76	380	927	1014	958	759	608	309	125	41	5198
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	90-91	0	4	69	474	824	1433	1462	964	814	605	265	52	6966
	91-92	1	1	143	475	906	1185	1283	804	660	352	142	57	6009
STEAMBOAT	AVE*	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	90-91	129 E	110	255	700	1013	1683	1613	1223	1120	851	518	262	9477
	91-92	127	141	394	742	1140	1626	1680	1126	863	595	383	263	9080
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	90-91	17	7	68	437	725	1359	1244	713	716	466	173	8	5933
	91-92	5	1	92	437	930	1028	1191	731	645	352	142	36	5590
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	90-91	117	179	267	635	972	1384	1351	987	1093	828	486	293	8592
	91-92	175	163	339	595	1013	1264	1291	1057	946	565	450	285	8143
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	90-91	4	6	46	334	654	1160	1048	697	709	462	156	12	5288
	91-92	3	2	107	377	876	1004	946	774	642	289	186	50	5256
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	90-91	202	258	332	794	1028	1550	1459	1105	1164	931	587	300	9710
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700	500	349	9624
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	90-91	15	8	53	311	543	1047	985	646	674	437	141	23	4883
	91-92	6	5	90	337	818	915	870	717	634	309	163	60	4924

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

JUNE 1992 CLIMATIC DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	72.5	47.4	59.9	-2.5	82	37	152	7	359	3.44	1.04	143.3	16
STERLING	80.1	54.1	67.1	-1.3	92	41	36	107	526	8.26	5.35	283.8	13
FORT MORGAN	79.6	53.6	66.6	-2.0	91	40	41	99	518	2.58	0.43	120.0	10
AKRON FAA AP	77.2	51.8	64.5	-2.4	91	41	68	59	456	3.65	0.94	134.7	14
AKRON 4E	76.5	51.1	63.8	-2.8	89	39	72	44	442	4.23	1.61	161.5	10
HOLYOKE	75.3	54.5	64.9	-3.9	87	42	57	61	461	3.92	0.74	123.3	13
JOES	77.0	52.8	64.9	-3.6	94	44	60	62	458	3.37	1.07	146.5	7
BURLINGTON	77.8	52.3	65.1	-4.7	94	41	61	70	461	3.54	1.16	148.7	13
LIMON WSMO	75.6	48.8	62.2	-2.6	89	39	104	26	409	2.91	1.13	163.5	14
CHEYENNE WELLS	80.3	52.4	66.3	-3.1	96	43	38	86	494	4.59	2.21	192.9	11
EADS	78.9	53.8	66.3	-4.5	95	45	49	96	490	2.94	0.87	142.0	10
ORDWAY 21N	80.8	51.5	66.1	-3.4	94	43	46	83	496	3.21	1.84	234.3	16
ROCKY FORD 2SE	83.3	52.8	68.1	-3.8	95	42	32	132	539	3.84	2.48	282.4	12
LAMAR	83.0	47.0	65.0	-7.0	98	36	56	63	484	2.88	0.69	131.5	12
LAS ANIMAS	83.7	54.5	69.1	-4.3	101	45	24	156	555	2.43	0.66	137.3	13
HOLLY	84.2	54.7	69.5	-3.0	99	44	20	162	562	4.39	1.41	147.3	13
SPRINGFIELD 7WSW	82.9	53.2	68.0	-2.5	96	44	36	134	534	8.18	6.16	405.0	13
TIMPAS 13SW	82.2	52.6	67.4	-3.2	91	41	46	126	522	1.96	0.56	140.0	9

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	77.0	51.3	64.1	-1.5	90	41	56	37	447	5.78	3.88	304.2	11
GREELEY UNC	80.0	52.1	66.0	-2.0	92	41	37	74	495	1.90	0.07	103.8	13
ESTES PARK	68.1	40.9	54.5	-2.4	79	30	308	0	280	3.79	2.08	221.6	18
LONGMONT 2ESE	79.2	49.2	64.2	-2.2	92	40	60	43	459	1.60	-0.27	85.6	11
BOULDER	76.4	49.2	62.8	-2.7	90	34	93	34	423	0.96	-1.27	43.0	13
DENVER WSFO AP	79.4	52.7	66.1	-0.8	94	41	35	76	497	2.02	0.22	112.2	13
EVERGREEN	72.0	41.5	56.7	-1.3	88	32	242	3	336	2.18	-0.09	96.0	14
CHEESMAN	75.0	39.2	57.1	-2.9	84	30	232	0	382	4.72	2.89	257.9	22
LAKE GEORGE 8SW	69.0	39.5	54.3	-0.8	87	31	316	0	293	1.10	-0.28	79.7	13
ANTERO RESERVOIR	67.3	34.1	50.7	-1.2	77	25	420	0	268	0.68	-0.46	59.6	10
RUXTON PARK	62.7	33.6	48.2	-3.0	75	26	498	0	204	1.98	-0.57	77.6	18
COLORADO SPRINGS	75.0	50.0	62.5	-2.7	87	43	96	28	405	3.91	1.65	173.0	16
CANON CITY 2SE	77.8	50.5	64.2	-3.5	88	41	63	45	455	1.18	-0.13	90.1	11
PUEBLO WSO AP	82.1	51.4	66.8	-4.2	96	42	41	100	511	3.15	1.90	252.0	15
WESTCLIFFE	72.0	38.0	55.0	-3.1	81	29	293	0	338	1.21	0.09	108.0	10
WALSENBURG	79.1	49.9	64.5	-2.3	87	40	60	54	468	2.92	1.58	217.9	13
TRINIDAD FAA AP	82.1	49.9	66.0	-2.6	93	39	50	88	495	1.34	-0.24	84.8	11

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	69.6	36.7	53.1	-0.5	81	27	349	0	299	1.37	0.33	131.7	12
LEADVILLE 2SW	64.8	31.6	48.2	-0.6	75	26	495	0	229	2.17	1.17	217.0	13
SALIDA	76.0	41.6	58.8	-2.0	86	31	180	2	400	0.52	-0.38	57.8	6
BUENA VISTA	73.3	39.7	56.5	-2.7	83	29	247	0	359	0.87	-0.01	98.9	10
SAGUACHE	71.9	41.0	56.4	-2.0	81	32	249	0	336	0.76	0.14	122.6	7
HERMIT 7ESE	68.0	30.7	49.3	-0.6	76	23	463	0	279	0.30	-0.43	41.1	2
ALAMOSA WSO AP	75.6	42.0	58.8	-0.6	84	34	179	1	393	1.23	0.56	183.6	8
STEAMBOAT SPRINGS	73.5	38.6	56.0	0.6	85	31	263	1	359	1.02	-0.53	65.8	10
YAMPA	69.9	41.0	55.4	0.3	80	25	282	1	307	1.62	0.13	108.7	12
GRAND LAKE 1NW	67.6	33.3	50.4	-0.9	77	25	430	0	270	1.79	0.16	109.8	15
GRAND LAKE 6SSW	68.1	35.8	51.9	-0.3	79	28	383	0	282	1.23	-0.00	100.0	13
DILLON 1E	64.9	34.0	49.5	-1.2	76	26	458	0	231	1.31	0.16	113.9	14
CLIMAX	57.7	30.9	44.3	-1.2	71	21	615	0	129	0.83	-0.63	56.8	4
ASPEN 1SW	69.2	36.8	53.0	-2.5	79	28	351	0	294	0.89	-0.52	63.1	10
CRESTED BUTTE	67.2	33.5	50.4	-1.1	78	25	430	0	267	1.10	-0.10	91.7	9
TAYLOR PARK	63.9	34.2	49.0	-0.9	73	28	468	0	216	0.70	-0.44	61.4	5
TELLURIDE	74.4	36.1	55.2	0.3	88	28	285	0	370	1.44	0.14	110.8	10
PAGOSA SPRINGS	74.8	37.9	56.4	-1.2	85	27	251	0	381	1.19	0.36	143.4	8
SILVERTON	64.8	33.2	49.0	-1.2	75	27	474	0	231	1.55	0.26	120.2	11
WOLF CREEK PASS 1	61.1	37.1	49.1	1.3	73	27	471	0	173	0.74	-1.13	39.6	5

WESTERN VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
CRAIG 4SW	75.5	44.8	60.2	-0.4	87	35	161	22	400	0.90	-0.20	81.8	13
HAYDEN	76.4	43.5	59.9	-0.5	87	31	158	15	406	0.86	-0.36	70.5	9
MEEKER NO. 2	78.7	42.8	60.7	-0.2	91	33	138	18	426	0.56	-0.38	59.6	9
RANGELY 1E	82.2	51.2	66.7	-0.1	94	42	44	103	509	0.22	-0.60	26.8	3
EAGLE FAA AP	78.8	41.3	60.0	0.0	90	32	150	7	435	0.65	-0.21	75.6	7
GLENWOOD SPRINGS	79.7	45.1	62.4	-1.2	91	36	111	42	441	0.38	-0.88	30.2	7
RIFLE	82.6	46.4	64.5	0.3	93	39	57	47	479	0.75	-0.20	78.9	6
GRAND JUNCTION WS	86.0	56.4	71.2	-1.2	96	46	8	203	608	0.17	-0.33	34.0	3
CEDAREDGE	83.1	43.2	63.1	-3.0	93	30	89	40	481	0.18	-0.57	24.0	3
PAONIA 1SW	83.1	49.9	66.5	0.1	93	40	48	98	507	0.62	-0.22	73.8	8
DELTA	85.0	50.4	67.7	-0.6	95	42	29	117	530	0.16	-0.34	32.0	2
GUNNISON	73.0	36.9	55.0	-0.8	84	28	292	0	352	0.30	-0.28	51.7	2
COCHETOPA CREEK	74.1	36.3	55.2	0.1	84	28	286	0	369	0.40	-0.36	52.6	13
MONTROSE NO. 2	80.5	50.6	65.5	-1.1	89	41	48	72	487	0.45	-0.16	73.8	5
URAVAN	88.9	54.2	71.5	0.8	100	46	6	209	596	0.04	-0.41	8.9	3
NORWOOD	76.1	44.7	60.4	-0.2	86	35	139	8	402	0.68	-0.18	79.1	3
YELLOW JACKET 2W	78.9	46.7	62.8	-1.2	88	38	89	31	442	0.24	-0.31	43.6	4
CORTEZ	80.0	42.7	61.3	-0.8	89	33	114	12	450	0.18	-0.34	34.6	2
DURANGO	77.8	44.7	61.3	-0.8	87	38	123	20	425	0.83	0.15	122.1	8
IGNACIO 1N	77.7	42.0	59.8	-2.3	86	33	150	2	422	0.36	-0.16	69.2	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.

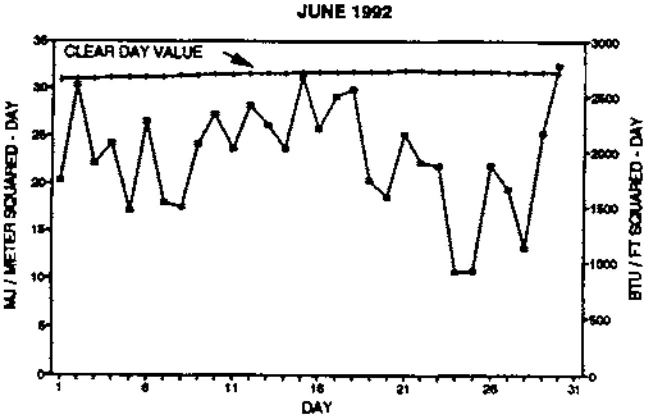
JUNE 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days			Percent Possible	Average % of
	CLR	PC	CLDY	Sunshine	Possible
Colorado Springs	7	8	14	–	–
Denver	9	11	10	62%	71%
Fort Collins	5	16	9	–	–
Grand Junction	14	11	5	86%	80%
Limon	9	11	10	–	–
Pueblo	10	5	15	73%	79%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

June was an unusually cloudy month east of the mountain with less solar energy than is normally expected. West of the mountains was a different story as blue skies and sunshine were plentiful.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
JUNE 1992

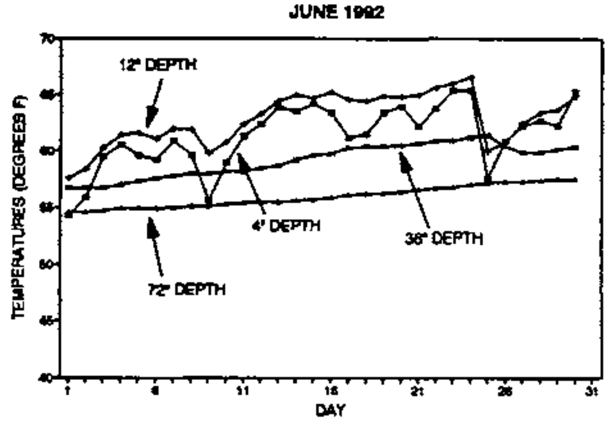


JUNE 1992 SOIL TEMPERATURES

Soil temperatures got off to a cool start in June, recovered in mid-month to more typical values, and then had another setback late in the month. The heavy rain of June 24 cooled the ground even three feet down.

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 1992



HATS OFF TO: *Mr. John W. Figal* of Walsenburg, CO

John Figal took over the Walsenburg weather station back in May 1978. Since then, he has done a superb job monitoring the local climate. Walsenburg looks like a pretty dry place, but they get their share of big storms. In his 14 years observing, he has recorded 39 snowstorms of ≥ 8".

HEAVY RAINS IN A DRY STATE – THE REST OF THE STORY

Last month we talked about some of the heaviest rains officially measured in Colorado. The majority of the long-term data that is readily available to study storm characteristics is simple once-a-day readings of total precipitation taken by cooperative observers. But as we all know, our heaviest storms are not uniformly spread out over entire 24-hour periods. Most often, especially in mid-summer, the rain falls in brief but intense bursts.

For the past few decades a network of several dozen recording raingages have been operated in Colorado by the National Weather Service. That's not a lot, if you consider the size of our State, but the data have been extremely valuable. Recording raingages register both time and amount of rain, which means it is possible to determine rainfall rates with reasonable accuracy. Data are available in digital form back to 1948 for hourly time increments. The older raingages read to the nearest 0.01". When properly cared for, these gages worked very reliably. Beginning in the 1970s, a gage requiring less human assistance began to replace the older gages. These solar-powered gages can run for long periods unattended. But unfortunately they only register to the nearest 0.10" and to the nearest 15 minutes. We operate both types of recording gages along with two standard manually-read raingages at our Fort Collins weather station.

Some examples of maximum observed 1-hour rainfall totals for a few Colorado locations are listed below. You can be sure that heavier amounts have fallen, but this at least gives an idea of what has been observed.

Location	Maximum 1-hour rainfall and date	
Denver Stapleton	2.00"	July 25, 1965
Fort Collins	2.33"	August 18, 1961
Colorado Springs	2.78"	August 4. 1976
Pueblo	3.41"	October 8, 1957
Lake George	3.45"	July 31, 1945

Data for very short time periods are even harder to come by. Many anecdotal reports can be found of extreme rainfall rates, but actual measurements are few. On July 25, 1965, Denver received 0.68" in 5 minutes. Fort Collins recorded 1.05" of rain in 9 minutes on August 3, 1988. These amounts, impressive as they seem, are totally dwarfed by a few official measurements taken east of Colorado. The national record is a remarkable 1.23" of rain in just one minute. This value was studied and confirmed. That, my friends, is truly deserving of the name "cloudburst." I would be very happy to never experience such a rain here in Colorado.

In recent years, a number of local agencies have begun installing recording raingages to help monitor and respond to storms capable of producing flash floods. The Urban Drainage and Flood Control District (Denver metropolitan area) now operates several automatic gages. There are also networks in the Colorado Springs area and in Boulder County. This trend toward increased data collection is likely to continue. It is my sincere hope that these new networks are collecting high quality data and that data are being carefully stored to aid in future studies. The fact is that even with these new data collection networks, you could still take every single raingage currently in use in Colorado (several hundred in all) and probably fit them all in your backyard. That gives you an idea of what a tiny area we are actually sampling when we use raingages for monitoring precipitation.

It is hoped that the new weather surveillance radars (NEXRAD) that the National Weather Service will begin using throughout in country in the next few years will greatly enhance our meager precipitation measuring networks. Radar has been used for decades to observe precipitation and judge intensities, but only with the help of modern electronics and computer power is it becoming possible to make good quantitative precipitation estimates over sizable areas. There are several reasons why NEXRAD precipitation estimates may not be as good here in Colorado as they will be in other parts of the country, but hopefully it will be an improvement over what we have now. In the meantime, if you know of any unofficial weather observers who are currently taking careful year-round precipitation measurements, please have them contact our office. We would love to add their information to our State database.

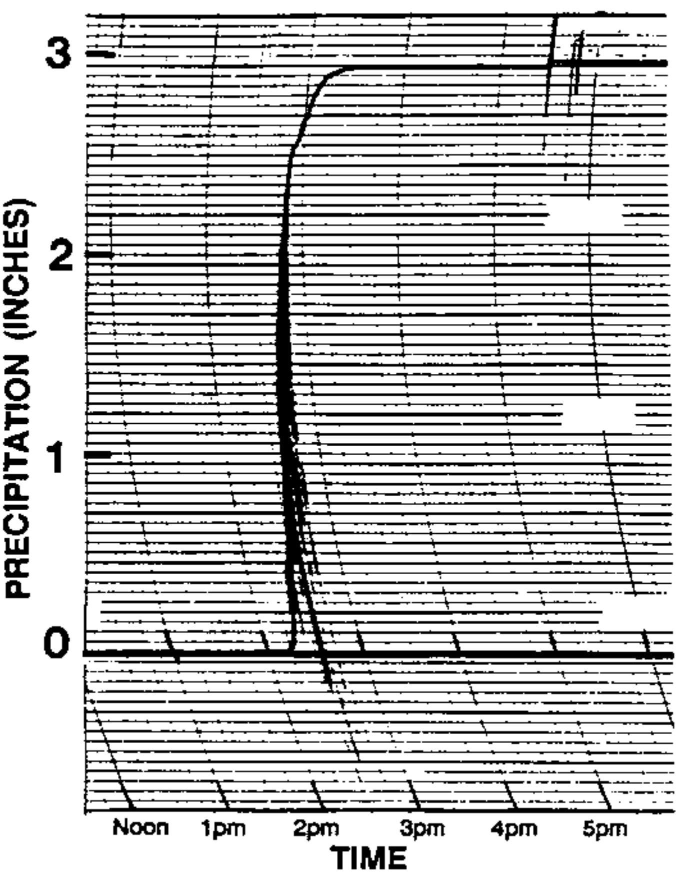
Since raingages aren't everywhere, efforts have been made to estimate, from available data, how much rain could reasonably be expected for given time periods and for various probabilities. About 20 years ago, the National Weather Service's Office of Hydrology completed a statewide analysis for Colorado with support from the U.S. Department of Agriculture Soil Conservation Service. Using available data through 1970, statewide maps were developed showing expected 6 and 24-hour rainfall totals for various return periods. It is this report, NOAA Atlas 2, Precipitation Frequency Atlas for the Western United States, Volume III – Colorado, that most engineers have used during the past two decades to evaluate 2, 5, 10, 25, 50, and 100-year storms. Accurate information is critical for the appropriate design and construction of numerous structures and developments.

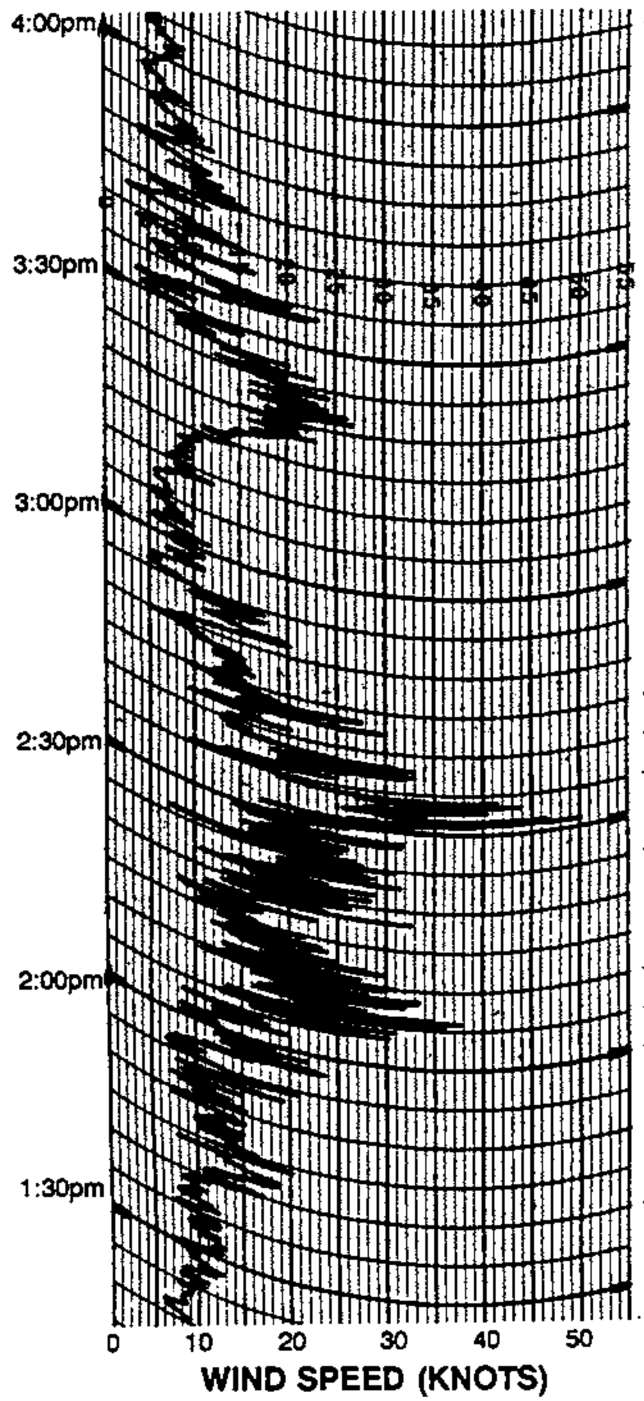
Twenty years is a fairly long time, and we now have at least 25% more daily and hourly precipitation data than was available when the NOAA Atlas was developed. As a result, the rumblings are now beginning that will hopefully lead within the next few years to a new precipitation frequency-intensity-duration analysis for Colorado. If you or your agency would like to have some involvement in this process, please let us know. For national consistency, it will probably be best to again support the National Weather Service Office of Hydrology in the completion of this project. But it is extremely important that those of us who are familiar with the unique characteristics of Colorado climate and hydrology be directly and personally involved. We don't yet know who may take the lead and provide the majority of funding for this major task. However, it is not too soon to begin to gather a group whose collective expertise can be tapped to improve the analyses of the past. Heavy rains will fall again, and we need to be prepared.

A CLASSIC SEVERE THUNDERSTORM – JUNE 24, 1992 FORT COLLINS, CO

I am not just a climatologist. I also wear the hat of an official weather observer. Shortly after I began writing this series on heavy rain, we got to experience the real thing at the Colorado State University main campus weather station. Depending on which of our four raingages you looked at, we received anywhere between 2.50" and 3.00" in one hour during the afternoon of 24 June 1992. By the end of the storm, water and floating hail were rushing past our little building and flowing through our outdoor instrument enclosure like a small river – and we thought we were on high ground. Fortunately, all of our equipment worked flawlessly throughout the storm, and I would like to show you the results.

The following five graphs capture the essence of this classic storm better than I could ever describe it in words.





As you study these graphs, try to imagine the situation. The skies grew dark. Distant thunder began to rumble northwest of town. It finally got so dark that the street lights all came on. Suddenly a stiff wind from the northwest brought a sharp drop in temperature. Then, as the winds diminished a bit, lightning began to strike nearby. Everything to the north of campus disappeared into a blur, and you could hear the roar of pounding rain and hail just a few blocks to the north. Just before 2:15pm MST the rain began. At first there were just a few big drops, but within a minute or two it was pouring. Simultaneously, the wind shifted to a northerly direction and gathered speed again. The temperature plummetted, the humidity soared and the barometric pressure surged dramatically upward. Then the hail began. (Note how the precipitation chart jumped erratically during this portion of the storm. The recording raingage is sensitive enough to respond to the impact of each hailstone.) The hail continued for more than 15 minutes. Shortly after 2:30pm MST, when the hail and rainfall were at their peak intensity, the winds attained their highest velocity – a respectable 50 kt. The hail (stone diameter was 3/4" briefly

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.

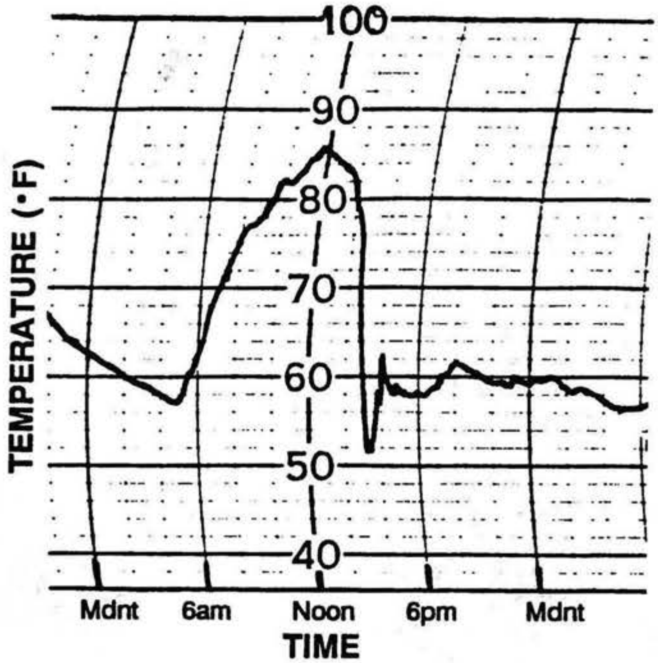
at this same time) and wind each separately were sufficient to meet the National Weather Service criteria for a severe thunderstorm. But in combination, they were incredible.

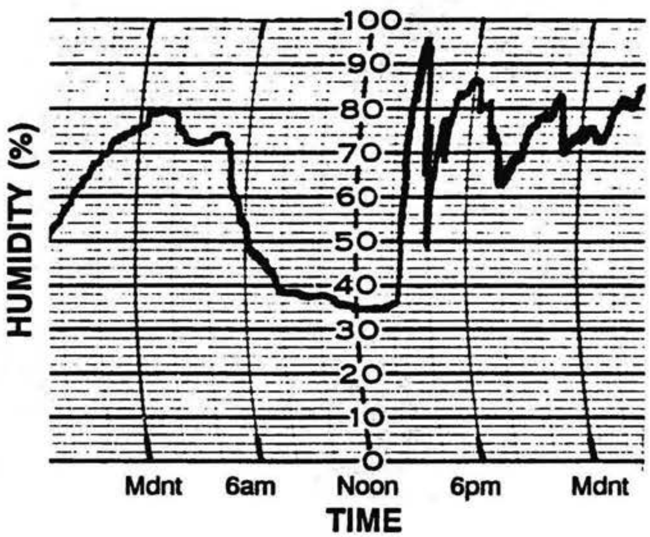
We were beginning to wonder if the end of our comfortable lives was at hand, when suddenly the winds began to let up. The rain continued to pour down, however. When it finally subsided (approximately 2:54pm MST) more than 2.5" of rain had already fallen – not bad for 40 minutes. The hail ended, and winds became quite light. The pressure peaked and the temperature reached its lowest point. On the official thermometers the temperature tumbled a total of 36 degrees F from 86° before the storm hit to a chilly 50° near the end of the storm.

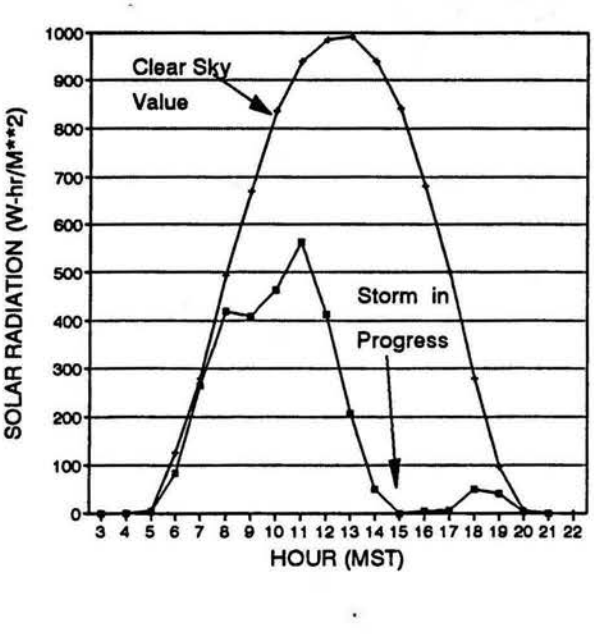
As the rain ended, winds shifted direction and became quite strong again. Now the winds were blowing out the back of the storm as it headed toward Greeley. Soon thereafter, the barometer began a sudden drop. Winds gusted erratically for a little while longer. A few sprinkles of rain continued and the temperature climbed back to something a little more comfortable. At this time, huge lakes of water were covering areas that were supposed to be roads, and people were mopping up water from places it just wasn't supposed to be. But that is what happens when one of the biggies hits. The storm was over.

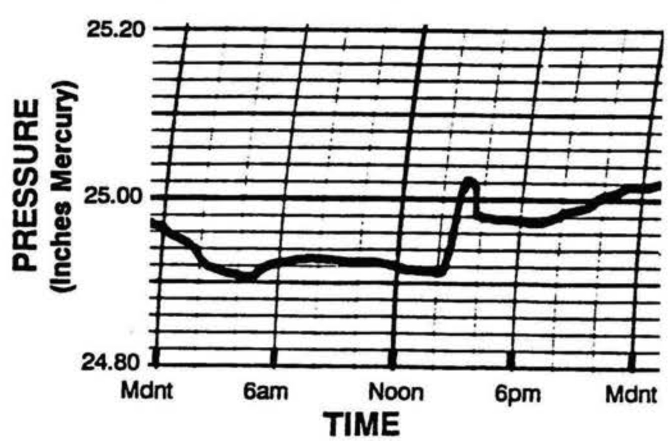
I don't mean to make it sound like this was the worst storm of all time. It wasn't. But it was such a classic in terms of how all the weather elements responded. When your house gets struck by "a biggie," you will most likely experience a lot of these same features. I just hope your neighborhood is designed to handle it.

By no means have we exhausted the topic of heavy rain. There is much more we could look into. But I think it's time to move on. I will be out of town for a few weeks, so I hope nothing floats away while I'm gone. Next month we'll delve into a new topic. We will also summarize the results of the Colorado Climate survey that many of you responded to. The results were most interesting.







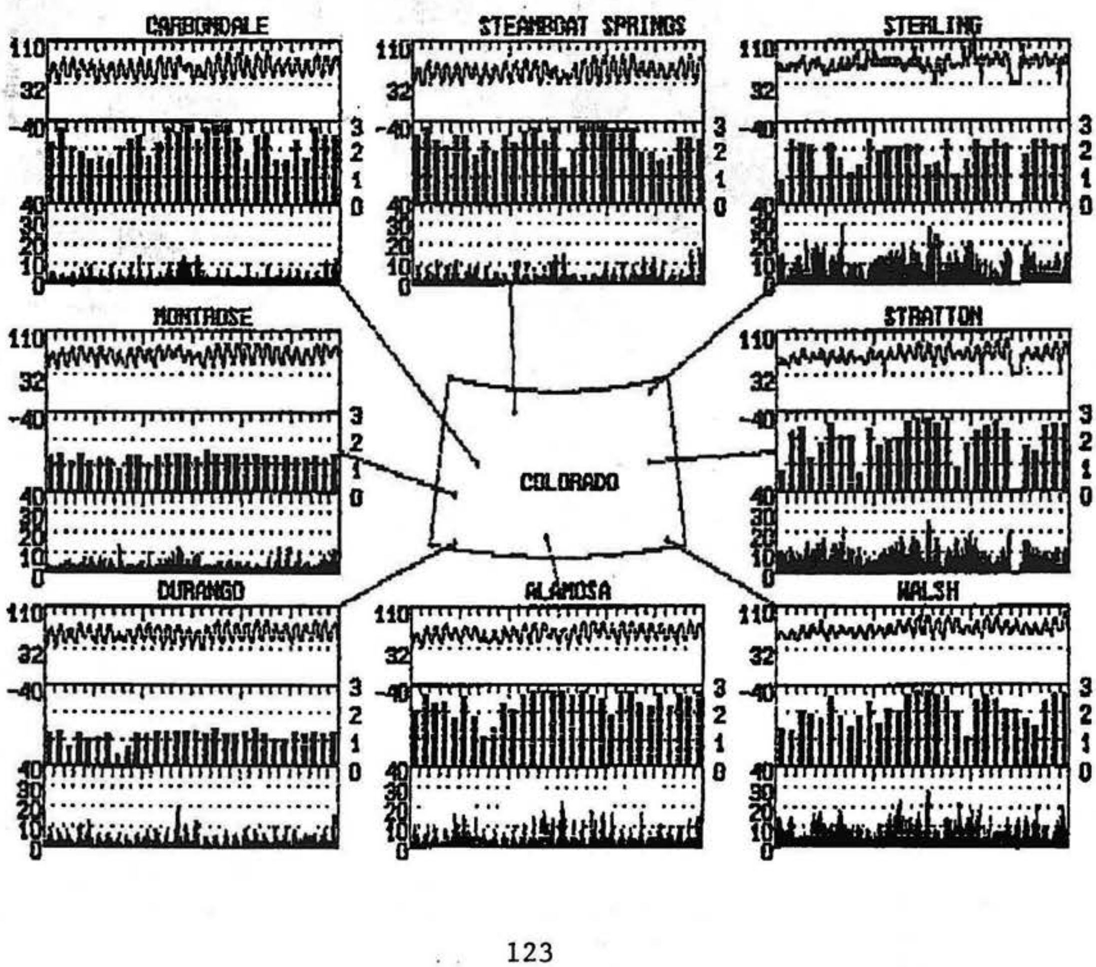


Unless noted otherwise, the special features contained in **Colorado Climate** are prepared and edited by Nolan Doesken, Assistant State Climatologist, at the Colorado Climate Center. Comments and questions are always welcome.

	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)								
	58.2	57.4	59.7	64.8	55.1	67.8	63.5	66.7
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	82.2 19/15	82.0 28/16	90.0 23/14	87.3 22/15	85.3 22/13	125.1 21/ 8	94.5 24/15	95.4 30/17
minimum:	34.0 2/ 5	30.6 17/ 5	33.4 2/ 5	37.8 2/ 5	29.7 2/ 5	32.0 17/ 6	32.0 11/ 0	45.3 3/ 3
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	84 / 38	83 / 36	82 / 36	66 / 36	81 / 32	51 / 45	87 / 48	88 / 52
11 AM	39 / 39	43 / 43	28 / 34	35 / 42	28 / 31	28 / 25	58 / 50	57 / 54
2 PM	26 / 32	34 / 39	23 / 31	26 / 37	24 / 29	21 / 23	47 / 49	45 / 51
5 PM	30 / 31	30 / 35	23 / 29	23 / 34	24 / 27	19 / 21	47 / 48	47 / 50
11 PM	56 / 36	66 / 38	32 / 34	45 / 35	70 / 37	34 / 29	80 / 51	78 / 53
monthly average wind direction (degrees clockwise from north)								
day	197	217	222	269	228	149	140	133
night	157	84	176	163	124	172	182	194
monthly average wind speed (miles per hour)								
	5.52	3.31	2.85	3.77	3.13	8.54	8.46	8.76
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	235	397	508	315	448	131	62	47
3 to 12	414	305	204	397	254	386	524	515
12 to 24	71	14	8	8	14	200	132	153
> 24	0	0	0	0	0	3	2	5
monthly average daily total insolation (Btu/ft²·day)								
	2350	1114	2224	1312	2323	1817	2029	2068
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	245	1	183	75	161	149	194	188
40-60%	91	0	98	111	98	96	79	102
20-40%	47	320	70	110	59	79	88	76
0-20%	23	99	18	138	26	77	47	51

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

JULY 1992

Volume 15 Number 10

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

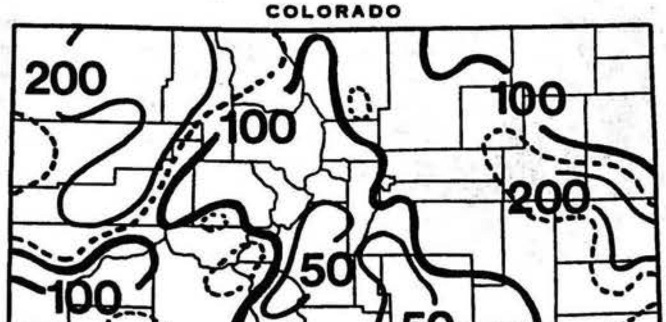
July in Perspective – Cool, Stormy and Changeable

July is supposed to be the time of year with little variation in daily weather. This year, however, numerous cold fronts swept down over Colorado, and day-to-day weather changes were quite dramatic. There were some hot days, but no persisting heatwaves, and humidity and barometric pressure stayed high much of the month. Thunderstorms were common, which is normal for July, but their behavior was a bit unusual – skipping the regular hot spots like the Pikes Peak area and pounding areas like Routt and Moffat counties that are usually quite tranquil in July.

Precipitation

July began with a week of mostly dry weather. Showers and thunderstorms then became numerous and sometimes heavy for the remainder of the month until they began to taper off again the last few days of July. Rainfall totals ended up above average for the majority of Colorado with more than 150% of average reported over much of the east central and southeastern plains and over portions of southwest Colorado. Heavy rains with up to 3 times the average were a welcome surprise in northwestern Colorado where low streamflows and dry conditions have prevailed for several years. Less rain than average fell from the Granby area southeast to Pueblo. Colorado Springs, normally wet and stormy in July, received just 26% of average.

COLORADO



July 1992 precipitation as a percent of the 1961-1990 average.

Temperatures

Much of the heartland of the nation experienced an unusually cool July. All of Colorado ended up several degrees below average. Most of western Colorado was 2 to 3 degrees F below average for the month. A few areas east of the mountains were as much as 5 degrees cooler than average. (Remember, large variations from average are typical in winter but are quite unusual for mid summer.) Especially obvious was the lack of daytime warmth. Daytime high temperatures for the month as a whole were as much as 8 degrees below average in northeast Colorado. The cool weather is gradually beginning to take a toll on Colorado agriculture as crops continue to grow and mature slower than usual.

COLORADO

Departure of July 1992 temperatures from the 1961-90 averages.

Inside This Issue

JULY 1992 DAILY WEATHER

1-3 July got off to an unusual start as a strong cold front and upper air disturbance crossed the State. Brief thundershowers developed on the 1st and continued during the night and into the morning of the 2nd, most numerous over northern Colorado. There were several reports of snow in the northern mountains above 9,000 feet. Daytime temperatures were only in the 60s over northeastern Colorado on both the 1st and 2nd. Mountain temperatures were even cooler, and Climax had a chilly high of 48° on the 2nd. Skies cleared late on the 2nd, and temperatures dipped to their lowest levels for the month on the 3rd. Many points on the plains were in the 40s, while 20s and 30s were common in the mountains. Fraser's 25° was the coldest in Colorado for July.

4-7 Perfect summer weather marked the 4th of July with just some scattered afternoon clouds. Then the mercury inched up into the 90s and 100s at lower elevations for the next 3 days – the only noteworthy heatwave of the summer. Uravan hit 101° on the 6th – the hottest temperature on the Western Slope in July. Las Animas came through with the hottest temperature in Colorado – 106° on the 7th. A few widely scattered thundershowers developed each day, helping to cool the afternoon sun, but rainfall totals were scant. Then increased humidity, clouds and more numerous storms moved into western Colorado on the 7th, bringing an end to the brief heatwave. Browns Park in extreme northwest Colorado measured 0.71" of rain on the 7th.

8-10 Much cooler on the 8th. Dense clouds with morning and midday rains held daytime temperatures on the 8th in the 60s and 70s over parts of western Colorado. Crested Butte only reached 54°F. Areas from Craig southward to near Gunnison picked up 0.20 to 0.60" of rain. Walsh reported 1.13" late on the 8th. Most of the showers ended on the 9th, and the 10th was dry over most of the State. An isolated late-day thundershower over Denver dropped a little small hail. Warmer temperatures returned, but most of Colorado continued a bit cooler than average.

11-14 An impulse of subtropical moisture nosed up across Arizona. As it collided with a slow-moving cold front dropping down from Wyoming and a disturbance aloft, widespread and locally heavy rains and thunderstorms developed. Cortez totalled 1.55" of rain in 3 days 11-13th. Marvine Ranch, east of Meeker, recorded 2.32". Rainfall was less along the eastern foothills (Colorado Springs only received 0.01"), but storms gathered strength out on the plains. Moderate to heavy rains fell in several areas, accompanied by hail at some points. Heavy one-day rainfall totals included 2.12" at Shaw, 2.38" at Holly and 2.84" near Joes. Abnormally cool temperatures again covered most of the State. Rains ended on the 13th, and warmer temperatures developed statewide on the 14th.

15-22 Two more cold fronts out of Canada pushed southward over northern and eastern Colorado on the 15th and again on the 19th. Southwestern Colorado was unaffected and enjoyed pleasant summer weather with just afternoon cloud buildups and a few showers and rumbles of thunder. As cooler air moved in on the 15th, thunderstorms, many producing hail, developed across northern and central Colorado. Rifle received 0.82" of rain and hail. Denver measured 0.97". Storms rumbled into the night on the Eastern Plains dropping more than 1" in some areas. Low clouds and fog then lingered on the 16th, and highs only reached the 60s and 70s east of the mountains. More rains fell overnight 16-17th with more than 2" reported northeast of Colorado Springs. Skies then cleared, temperatures warmed and only a few scattered showers developed on the 18th, but storms increased again on 19-20th as the next cold front moved in. Temperatures were again abnormally cool on the 20th (Sterling only hit 70°). Heavy storms late on the 20th moved across southeastern Colorado leaving close to 2" of rain at some reporting stations. Drizzle and fog were reported early on the 21st, but then temperatures warmed quickly but were cooler again on the 22nd.

23-26 A trough of low pressure over the West and plenty of subtropical moisture combined to produce a period of cool and wet weather, especially in western Colorado. Heavy storms with hail moved across northwest Colorado on the 23rd. Hayden and Craig each received close to 1" of rain. Widespread heavy rain developed over southwest Colorado on the 24th, and numerous locations reported 1.00-1.50" rains. Some heavy storms moved into eastern Colorado on the 25th and continued overnight. 1.85" of rain soaked Lamar. With cloudy skies, temperatures on the 26th only rose into the 70s over southeast Colorado.

27-31 Except for one more front that brought cooler weather again to the Eastern Plains on the 30th, July ended with fairly average temperatures and only a few scattered thundershowers each day. Storms brought little rain, but there were isolated reports of strong, damaging winds.

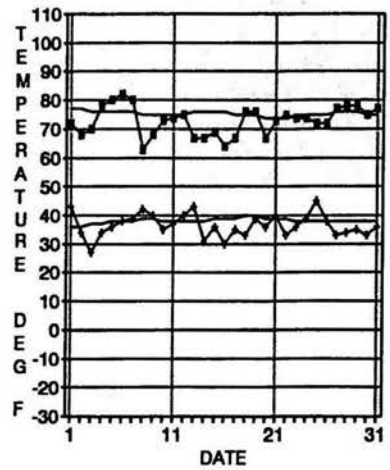
Weather Extremes

Highest Temperature	106°F	July 7	Las Animas
Lowest Temperature	25°F	July 3	Fraser
Greatest Total Precipitation	7.16"		Joes 2SE
Least Total Precipitation	0.60"		Delta
Greatest Total Snowfall	0.00"		

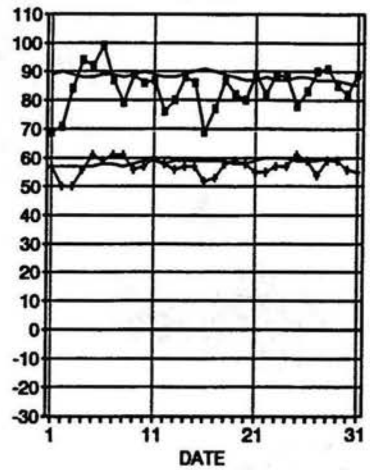
JULY 1992 TEMPERATURE COMPARISON

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.)

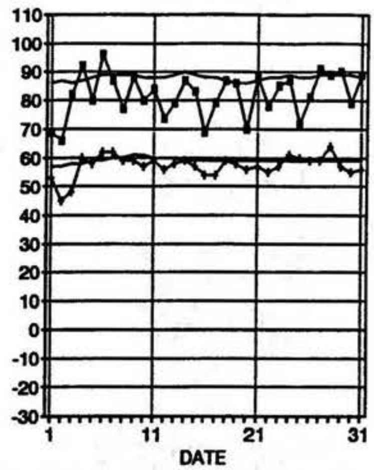
GRAND LAKE 1NW



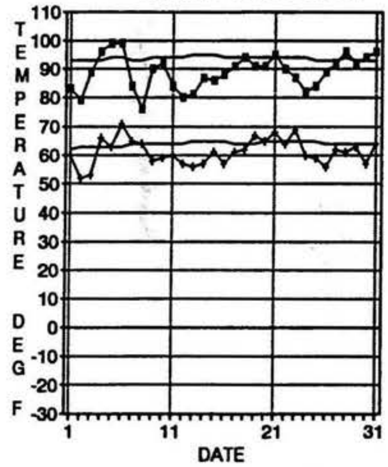
DENVER



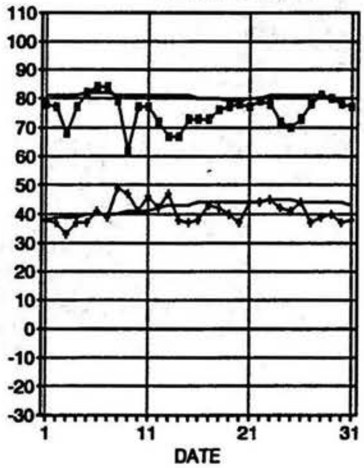
AKRON 1N



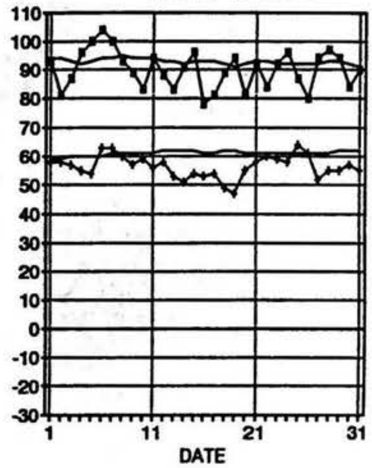
GRAND JUNCTION



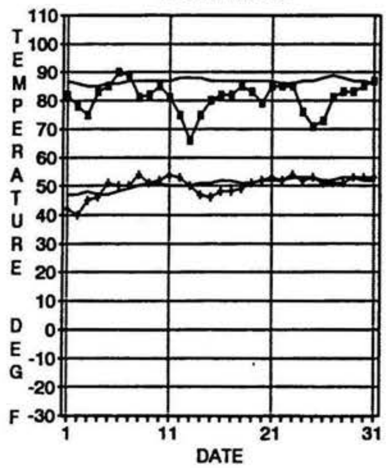
GUNNISON



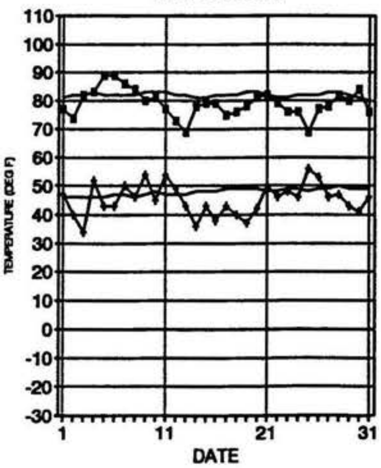
PUEBLO WSO



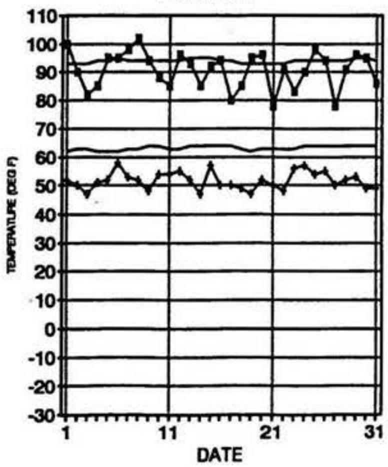
DURANGO



ALAMOSA



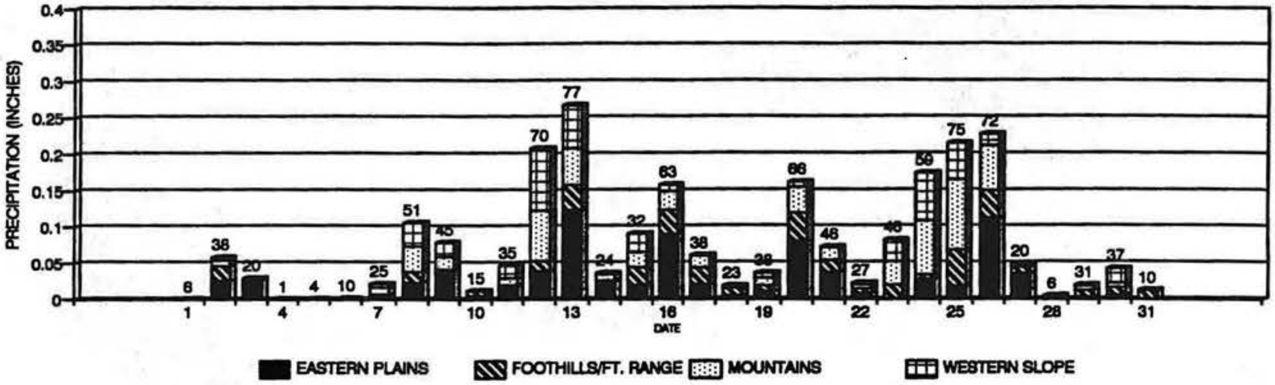
LAMAR



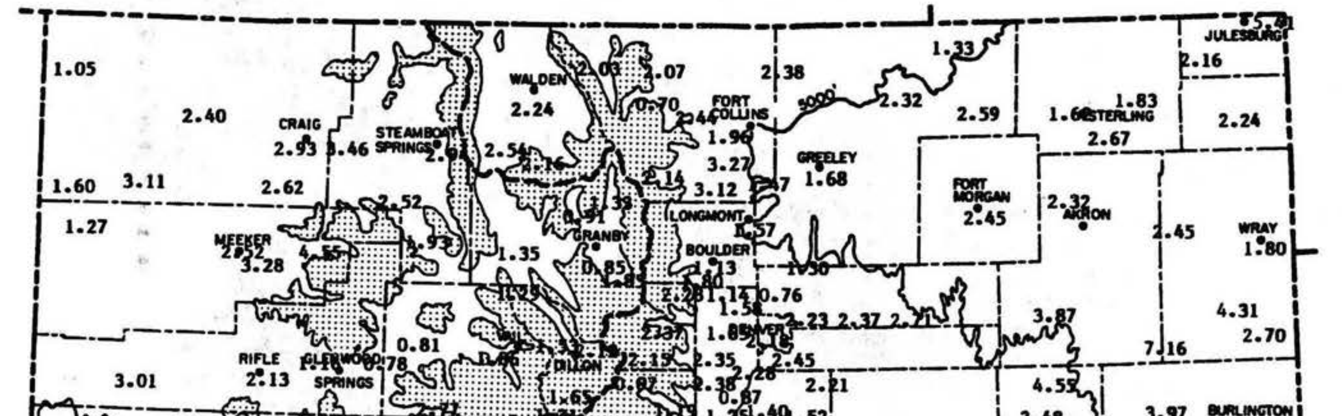
JULY 1992 PRECIPITATION

Traditionally, July is often the wettest month of the year (based on total precipitation averaged over the entire State). This year was no exception, and statewide July precipitation totalled more than 2.20". Storms on the 7-8th, 11-13th, 15-16th, 20th, and 23-26th were responsible for most of the month's rainfall in Colorado. At least 1/3 of Colorado's official weather stations reported rain on more than half of the days during July indicating that July rains were more widespread than normal.

COLORADO DAILY PRECIPITATION - JUL 1992

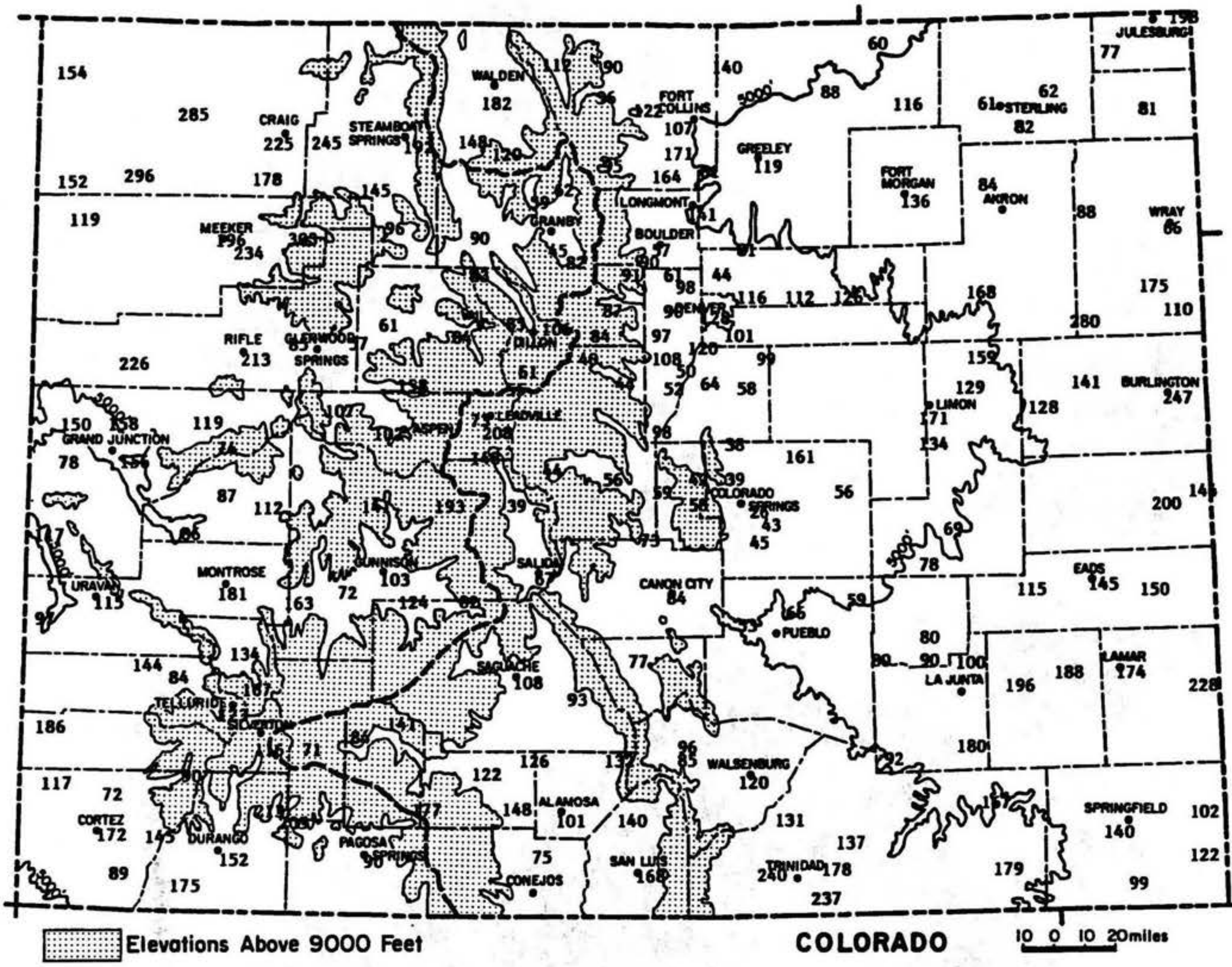


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

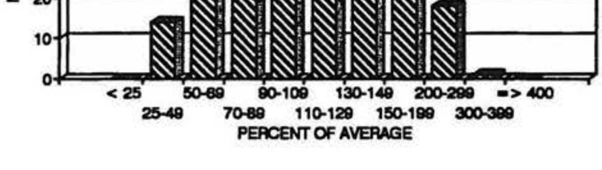


Precipitation Amounts (in inches) for July 1992.

JULY 1992 PRECIPITATION COMPARISON



July 1992 Precipitation as a Percent of the 1961–90 average.



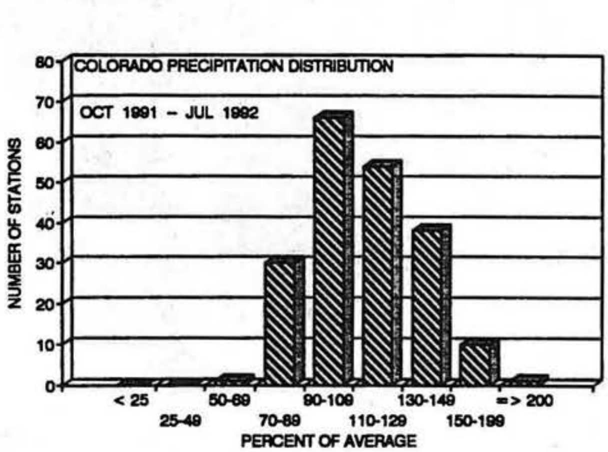
By now it should have become obvious that it is the rule, not the exception, to have great variety in monthly precipitation compared to average. Statewide, July precipitation was a little above average, but sizeable areas were both far above and far below the 1961-1990 average.

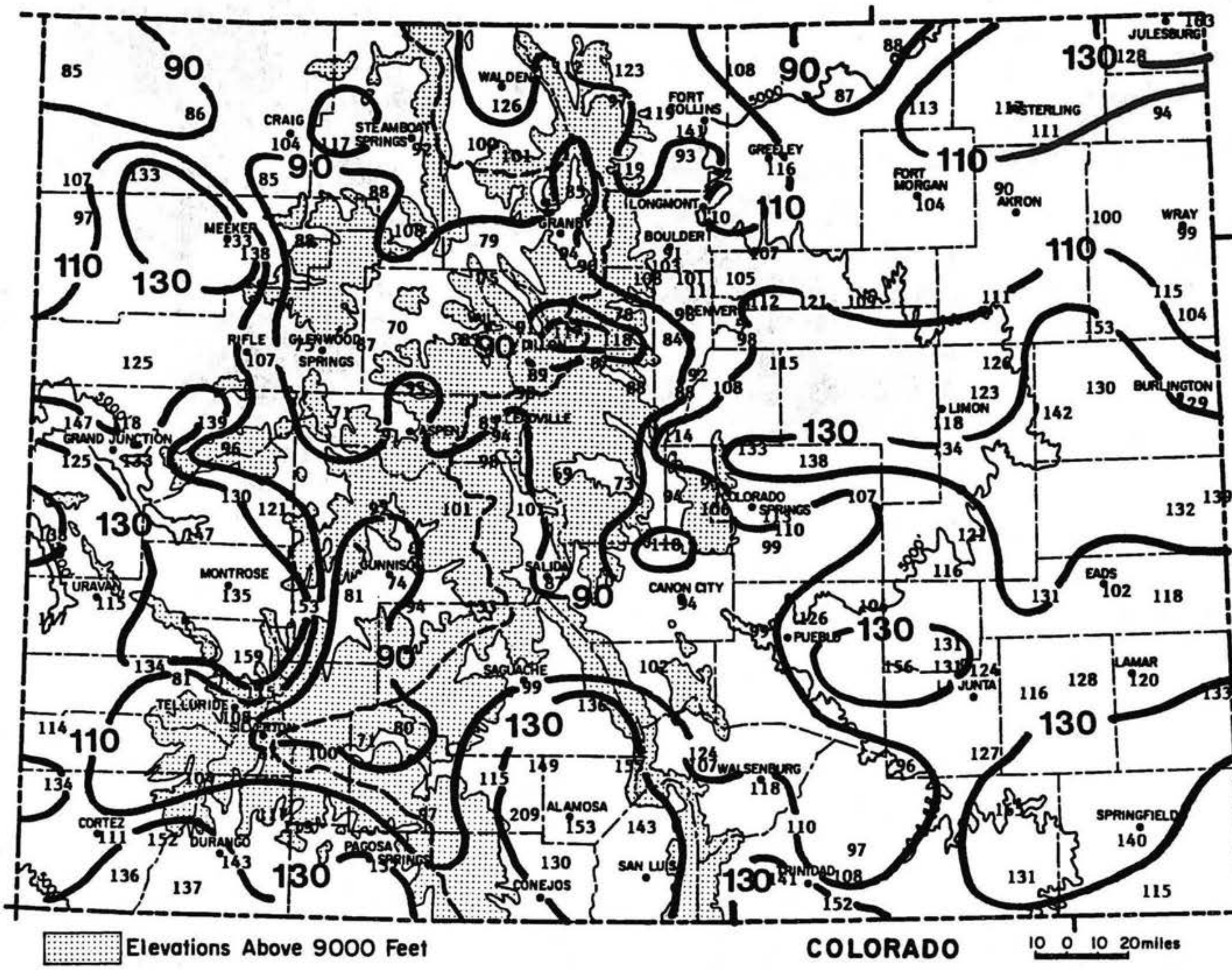
JULY 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	2.23"	32nd wettest in 121 years of record (wettest = 6.41" in 1965)
Durango	2.82"	17th wettest in 98 years of record (wettest = 5.36" in 1981)
Grand Junction	1.03"	13th wettest in 101 years of record (wettest = 2.72" in 1929)
Las Animas	4.08"	10th wettest in 126 years of record (wettest = 6.30" in 1872)
Pueblo	1.39"	52nd driest in 123 years of record (driest = 0.09" in 1987)
Steamboat Springs	2.94"	6th wettest in 86 years of record (wettest = 4.98" in 1912)

1992 WATER YEAR PRECIPITATION

Precipitation totals for the first 10 months of the 1992 water year continue their erratic improvement. Many areas in and near the mountains, from Creede and Silverton northward to Grand Lake and Steamboat Springs, continue to show less precipitation than average, but only a few locations have received less than 85% of average. The driest official stations compared to average are Antero Reservoir (4.77", 69% of average) and Eagle (5.99", 70% of average). Most of the rest of Colorado is in good shape. More than 130% of average precipitation has been reported over portions of the Western Slope, the San Luis Valley, and several areas on the Eastern Plains. Standing water and lush, green vegetation on the Plains are testimony to the moist conditions. Despite excellent low-elevation precipitation, streamflow in Colorado's major rivers continues near or below average – a reflection of the low snowpack and warm spring in the mountains earlier this year.





October 1991–July 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR JULY 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535	350	179	9685
	92-93	97												97
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	91-92	104	112	335	610	1106	1369	1410	1124	980	660	487	351	8648
	92-93	249												249
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	91-92	17	7	121	403	831	911	901	700	664	321	192	93	5161
	92-93	20												20
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	91-92	63	87	M	580	1056	1265	1246	1048	901	568	391	247	M
	92-93	107												107
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	91-92	13	14	106	462	903	1004	1021	751	639	360	173	61	5507
	92-93	5												5
CANON	AVE *	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	91-92	8	0	105	379	800	945	870	688	604	331	167	63	4960
	92-93	2												2
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	91-92	16	16	145	453	954	1048	998	788	717	383	219	96	5833
	92-93	21												21
CORTEZ	AVE *	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	91-92	13	8	161	423	947	1227	1310	892	744	458	266	114	6563
	92-93	18												18
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	91-92	27	13	230	582	1080	1517	1556	1078	809	497	270	161	7820
	92-93	67												67
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	91-92	0	2	88	383	832	1302	1486	874	625	273	86	29	5980
	92-93	6												6
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	91-92	6	4	118	449	902	982	1022	714	673	309	158	35	5372
	92-93	10												10
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805	609	458	10442
	92-93	364												364
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	91-92	6	2	152	379	940	1179	1305	935	745	430	267	123	6463
	92-93	34												34
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	91-92	26	6	208	563	972	1358	1387	970	809	466	289	150	7204
	92-93	47												47
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	91-92	83	92	311	627	988	1078	1123	939	887	541	410	242	7321
	92-93	103												103
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	91-92	11	1	145	457	891	1002	1029	736	681	356	193	56	5558
	92-93	22												22
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	91-92	5	4	89	437	947	1025	1193	756	652	332	163	41	5644
	92-93	12												12
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	91-92	0	2	37	304	815	1193	1390	788	608	195	53	8	5393
	92-93	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	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	91-92	220	255	427	739	1169	1468	1735	1354	1118	751	534	383	10153
6SSW	92-93	277												277
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	91-92	8	5	119	450	925	1011	1088	724	665	310	181	37	5523
	92-93	14												14
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	91-92	131	151	371	698	1120	1597	1707	1167	940	661	452	292	9287
	92-93	208												208
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	91-92	1	3	59	350	896	966	943	712	539	242	107	24	4842
	92-93	0												0
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852	656	495	10733
	92-93	383												383
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	91-92	19	14	171	503	1000	1095	1161	827	734	436	272	104	6336
	92-93	16												16
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	91-92	12	6	133	489	936	1047	1124	786	730	391	201	60	5915
	92-93	20												20
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	91-92	24	7	221	553	1003	1367	1490	1025	758	446	280	138	7312
	92-93	23												23
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	91-92	0	0	135	404	901	1312	1385	911	683	324	176	48	6279
	92-93	15												15
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	91-92	44	37	289	568	1116	1362	1477	1087	899	577	392	251	8099
	92-93	120												120
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	91-92	1	0	76	380	927	1014	958	759	608	309	125	41	5198
	92-93	0												0
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	91-92	1	1	143	475	906	1185	1283	804	660	352	142	57	6009
	92-93	12												12
STEAMBOAT	AVE *	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	91-92	127	141	394	742	1140	1626	1680	1126	863	595	383	263	9080
	92-93	160												160
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	91-92	5	1	92	437	930	1028	1191	731	645	352	142	36	5590
	92-93	14												14
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	91-92	175	163	339	595	1013	1264	1291	1057	946	565	450	285	8143
	92-93	180												180
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	91-92	3	2	107	377	876	1004	946	774	642	289	186	50	5256
	92-93	0												0
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700	500	349	9624
	92-93	270												270
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	91-92	6	5	90	337	818	915	870	717	634	309	163	60	4924
	92-93	5												5

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

JULY 1992 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	78.5	51.0	64.8	-4.9	95	44	60	61	480	1.33	-0.87	60.5	14
STERLING	85.2	58.0	71.6	-3.1	98	48	14	226	635	1.62	-1.00	61.8	13
FORT MORGAN	84.9	58.3	71.6	-3.6	100	49	12	225	640	2.45	0.65	136.1	8
AKRON FAA AP	82.1	57.2	69.6	-4.0	96	45	18	168	599	2.32	-0.43	84.4	13
HOLYOKE	80.3	58.2	69.2	-5.5	92	48	18	159	599	2.24	-0.51	81.5	12
JOES	82.5	56.6	69.6	-5.4	95	46	15	165	597	7.16	4.61	280.8	10
BURLINGTON	85.4	56.7	71.0	-4.6	98	49	5	199	625	5.22	3.11	247.4	10
LIMON WSMO	80.7	54.4	67.6	-2.9	95	49	16	103	544	4.57	1.91	171.8	13
CHEYENNE WELLS	88.6	54.8	71.7	-3.6	103	43	0	214	625	5.07	2.54	200.4	8
EADS	88.1	59.1	73.6	-3.1	103	51	0	274	671	3.82	1.20	145.8	7
ORDWAY 21N	89.1	56.5	72.8	-3.1	102	49	4	253	643	1.74	-0.48	78.4	8
ROCKY FORD 2SE	90.0	57.9	74.0	-2.8	102	52	0	286	672	1.84	-0.20	90.2	9
LAMAR	90.6	51.7	71.2	-6.4	102	47	2	201	581	3.90	1.67	174.9	9
LAS ANIMAS	90.4	60.4	75.4	-3.7	106	53	0	328	703	4.08	2.00	196.2	9
HOLLY	90.6	59.9	75.3	-3.1	103	54	0	324	700	4.91	2.76	228.4	10
SPRINGFIELD 7WSW	90.1	58.9	74.5	-1.2	102	49	0	300	692	3.43	0.98	140.0	10
TIMPAS 13SW	90.1	58.6	74.4	-2.2	104	54	0	296	679	1.62	-0.13	92.6	7

FOOTHILLS/ADJACENT PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
FORT COLLINS	80.8	54.9	67.8	-3.7	93	44	22	115	556	1.96	0.13	107.1	13
GREELEY UNC	83.2	55.7	69.4	-4.0	97	47	14	160	591	1.68	0.27	119.1	10
ESTES PARK	75.5	47.2	61.3	-1.3	86	37	111	6	420	2.14	-0.10	95.5	14
LONGMONT 2ESE	84.5	53.0	68.7	-3.7	102	44	20	146	564	1.57	0.46	141.4	8
BOULDER	83.0	53.6	68.3	-2.7	98	44	20	129	568	1.13	-0.84	57.4	16
DENVER WSFO AP	84.1	56.9	70.5	-3.0	99	50	10	187	616	2.23	0.32	116.8	16
EVERGREEN	77.3	45.9	61.6	-2.2	92	40	103	7	433	2.35	-0.06	97.5	13
CHEESMAN	80.8	42.1	61.5	-4.0	94	29	112	11	475	2.75	-0.03	98.9	17
LAKE GEORGE 8SW	72.6	43.5	58.0	-3.0	83	32	208	0	358	1.45	-1.13	56.2	8
ANTERO RESERVOIR	72.9	38.4	55.6	-2.3	81	32	283	0	361	0.90	-1.13	44.3	8
RUXTON PARK	68.7	36.8	52.8	-3.3	82	30	372	0	298	2.43	-1.72	58.6	18
COLORADO SPRINGS	81.6	55.1	68.3	-2.7	96	49	21	131	560	0.76	-2.14	26.2	11
CANON CITY 2SE	84.7	55.7	70.2	-3.4	97	50	2	170	605	1.58	-0.30	84.0	9
PUEBLO WSO AP	90.0	56.4	73.2	-3.8	104	47	0	262	647	1.39	-0.71	66.2	12
WESTCLIFFE	76.5	41.4	58.9	-4.3	87	34	180	0	418	1.74	-0.51	77.3	11
WALSENBURG	84.1	55.2	69.6	-2.7	97	45	5	158	599	2.79	0.47	120.3	14
TRINIDAD FAA AP	86.7	55.6	71.1	-2.9	102	51	0	199	622	3.01	0.82	137.4	17

MOUNTAINS/INTERIOR VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
WALDEN	73.8	38.4	56.1	-2.9	82	29	270	0	375	2.24	1.01	182.1	15
LEADVILLE 2SW	68.7	36.2	52.4	-1.9	77	28	383	0	299	4.17	2.17	208.5	11
SALIDA	80.9	46.5	63.7	-1.9	91	40	64	32	492	1.12	-0.53	67.9	9
BUENA VISTA	78.2	45.0	61.6	-3.1	88	38	107	10	450	0.66	-1.03	39.1	11
SAGUACHE	75.5	45.6	60.5	-3.2	87	39	134	2	401	1.68	0.13	108.4	10
HERMIT 7ESE	71.7	35.6	53.7	-2.3	81	27	344	0	346	2.10	-0.38	84.7	9
ALAMOSA WSO AP	79.0	45.2	62.1	-2.8	89	34	97	12	462	1.21	0.02	101.7	10
STEAMBOAT SPRINGS	77.4	42.0	59.7	-2.2	88	33	160	4	432	2.94	1.41	192.2	14
YAMPA	74.3	46.5	60.4	-0.6	84	38	140	7	394	1.93	-0.08	96.0	13
GRAND LAKE 1NW	72.9	36.4	54.6	-2.2	82	27	314	0	362	1.33	-0.80	62.4	18
GRAND LAKE 6SSW	72.5	39.1	55.8	-2.3	80	30	277	0	355	0.91	-0.62	59.5	12
DILLON 1E	68.7	37.4	53.1	-3.5	78	28	364	0	298	1.53	-0.26	85.5	15
CLIMAX	62.3	36.2	49.3	-2.4	76	28	482	0	198	1.31	-1.05	55.5	4
ASPEN 1SW	72.3	41.3	56.8	-5.2	82	33	249	1	352	1.89	0.04	102.2	12
CRESTED BUTTE	70.2	37.4	53.8	-3.3	79	27	340	0	319	2.77	0.81	141.3	14
TAYLOR PARK	66.7	38.1	52.4	-3.6	75	30	379	0	267	3.40	1.64	193.2	11
TELLURIDE	76.7	41.0	58.9	-1.3	86	30	180	0	420	3.22	0.62	123.8	14
PAGOSA SPRINGS	79.4	42.4	60.9	-3.4	87	32	120	1	464	1.71	-0.17	91.0	13
SILVERTON	69.4	38.3	53.8	-1.7	79	30	339	0	311	3.46	0.48	116.1	15
WOLF CREEK PASS 1	64.2	39.7	52.0	-1.2	75	31	396	0	229	6.28	2.74	177.4	15

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	78.8	48.5	63.6	-3.6	90	39	67	31	463	2.93	1.63	225.4	11
HAYDEN	80.2	46.9	63.5	-3.4	88	40	58	20	479	3.46	2.05	245.4	13
MEEKER NO. 2	84.0	46.8	65.4	-1.8	92	38	23	43	524	2.52	1.24	196.9	11
RANGELY 1E	85.5	55.3	70.4	-3.0	95	48	12	184	608	1.27	0.21	119.8	9
EAGLE FAA AP	82.3	46.2	64.2	-2.2	92	38	47	30	497	0.81	-0.50	61.8	13
GLENWOOD SPRINGS	84.1	50.0	67.0	-3.0	95	41	22	92	529	1.16	-0.19	85.9	8
RIFLE	85.7	49.2	67.5	-3.1	95	40	12	94	536	2.13	1.13	213.0	8
GRAND JUNCTION WS	88.9	61.2	75.1	-3.7	99	52	0	319	721	1.03	0.38	158.5	4
CEDAREDGE	86.1	49.4	67.8	-4.3	96	35	29	123	550	0.81	-0.12	87.1	6
PAONIA 1SW	86.0	54.6	70.3	-2.5	95	47	9	180	603	1.29	0.14	112.2	10
DELTA	87.1	54.5	70.8	-2.9	98	47	6	193	609	0.60	-0.09	87.0	5
GUNNISON	75.4	40.6	58.0	-3.6	84	33	208	0	401	1.40	0.05	103.7	7
COCHETOPA CREEK	77.2	40.8	59.0	-2.3	86	30	182	2	428	2.12	0.42	124.7	11
MONTROSE NO. 2	82.2	54.3	68.2	-4.3	91	46	15	122	569	1.83	0.82	181.2	9
URAVAN	90.2	57.7	74.0	-3.0	101	50	0	285	665	1.51	0.20	115.3	10
NORWOOD	78.9	49.6	64.3	-2.1	87	37	58	42	483	2.84	0.87	144.2	10
YELLOW JACKET 2W	82.9	51.7	67.3	-3.1	89	41	17	97	545	1.71	0.26	117.9	8
CORTEZ	84.6	50.6	67.6	-0.4	93	41	18	104	555	2.07	0.87	172.5	8
DURANGO	81.1	50.2	65.6	-3.1	90	40	34	59	507	2.82	0.97	152.4	13
IGNACIO 1N	81.9	49.3	65.6	-3.0	90	38	26	52	523	0.00	-1.36	0.0	0

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.

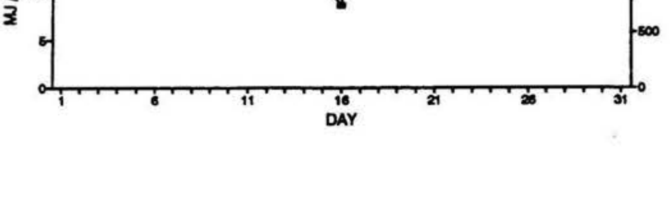
JULY 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Denver	8	12	11	58%	71%
Fort Collins	7	10	14	--	--
Grand Junction	15	8	8	78%	78%
Limon	7	15	9	--	--
Pueblo	8	13	10	72%	78%
Colorado Springs	7	8	14	--	--

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Sunshine and solar radiation were less than average over much of Colorado in July. The greatest differences from average were over northern and eastern parts of the State.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
JULY 1992

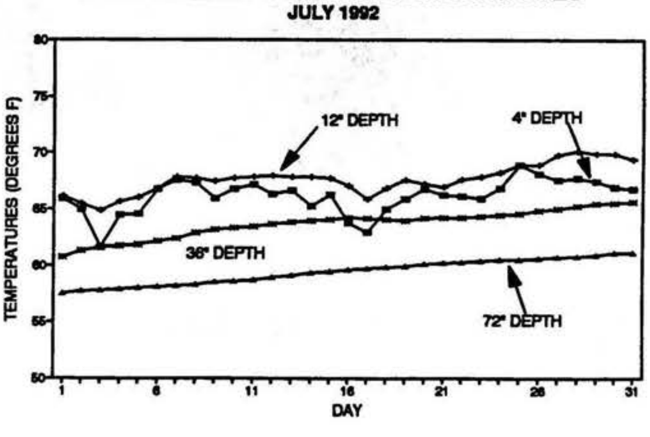


JULY 1992 SOIL TEMPERATURES

Near-surface soil temperatures were cooler than average throughout the month of July as a result of above average precipitation, below average temperature and frequent clouds. Deeper soil temperatures are close to average.

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

FORT COLLINS 7 AM SOIL TEMPERATURES
JULY 1992



HATS OFF TO: *Daniel and Linda Goldsberry,* of Wolf Creek Pass 1E, Colorado

The Goldsberrys report the dramatic and challenging weather conditions for which Wolf Creek Pass is known. They have only been taking the official observations since 1990, but the Colorado Department of Transportation highway maintenance facility where Dan works has cooperated with the National Weather Service since 1936 to report year-round weather conditions near the Pass. Thanks for your hard work.

WEATHER ENTHUSIASTS COME TO COLORADO

Considering our State's modest population, Colorado has more than its fair share of professional meteorologists and climatologists. With the help of the National Center for Atmospheric Research in Boulder, a large NOAA (National Oceanic and Atmospheric Administration) facility also in Boulder, NOAA cooperative research institutes in both Boulder and Fort Collins, U.S. Air Force facilities near Colorado Springs, the Denver Federal Center, several local offices of the National Weather Service, the Air Pollution Control Division of the Colorado Department of Health, TV weather offices, numerous private businesses, and university programs in meteorology and climatology at Colorado State University, the University of Colorado, the University of Northern Colorado, Metropolitan State College and Denver University, Colorado ends up having hundreds of professionals in meteorology and climatology employed here.

But I want to tell you something -- and it shouldn't be much of a surprise. We professionals are seriously outnumbered by a large corps of volunteer weather observers, storm chasers, cloud watchers, and overall weather lovers who don't earn a penny as meteorologists but who have chosen meteorology as a hobby. There are thousands who fall into this category right here in Colorado. If you think you're one of them, then I have some good news for you.

The Association of American Weather Observers (AAWO) is holding its Ninth Annual Meeting right here in Colorado. This is an organization composed primarily of weather-loving hobbyists who like nothing better than to swap weather stories and compare notes on new and old weather stations. As far as I can recall, this is the first meeting of this organization west of the Mississippi River. On October 2-3, 1992 some of the most enthusiastic weather hobbyists from all across the nation will be gathering in Boulder. There will be a few formal presentations given at the meeting, and I am pleased to announce that I will have the opportunity to give a talk to the group on my favorite subject -- the amazing climate of Colorado. One of our own Colorado volunteer weather observers and well-known author of readable books on weather and climate, Richard Keen from the Coal Creek weather station southwest of Boulder, is the featured banquet speaker on Friday evening (October 2).

If there is any way you can find a spare day or two, I would highly recommend that you try to attend all or part of this meeting. You will be amazed by the people -- their love for watching the weather is unsurpassed. This will be my first chance to attend one of their meetings, and I am really looking forward to it.

By the way, an interesting part of the meeting will be a discussion of the possible expanded role of volunteer weather observers in the modernized National Weather Service. High technology is a good thing and is critical to weather forecasting. But unfortunately (and this may surprise you), no one has yet been able to develop an electronic device that can measure precipitation and snow better than an enthusiastic human with a decent ruler. As the National Weather Service moves toward greater automation in the coming months, their ability to detect and predict rain and snow may improve, but their ability to measure it precisely at traditional weather station locations may, in fact, deteriorate (see ASOS story later in this issue). Take heart, all you volunteer weather observers. You are needed more than ever.

Come to the Meeting

To reserve a place for yourself at the AAWO Annual Meeting, you must act promptly. Your registration must be received at AAWO headquarters by September 21 to guarantee your spot at the meeting.

Ninth Annual Meeting
of the
Association of American Weather Observers

October 2-3, 1992

The Broker Inn
Boulder, Colorado

The meeting begins at 8:30 AM on Friday. There will be a Friday afternoon (October 2) tour of the National Center for Atmospheric Research. The registration fee for the entire program including the Friday evening banquet is $65. If you can only attend a portion of the program, fees will be lower. To register, send your name, address, daytime telephone number and a check payable to **AAWO** for your registration fee to:

AAWO
P.O. Box 455
Belvidere, IL 61008-0455

Registrations and questions may also be accepted by phone: (815) 544-5665

I hope to see you in Boulder!!

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.

THE ASOS ERA BEGINS

Since the first networks of weather stations were established in our country back in the 1800s, there have been occasional modifications made to standard weather instruments and some revisions to standard observational procedures. But considering how much the world has changed over the past century, surface weather observations and basic climate monitoring have remained remarkably unchanged. The greatest previous changes occurred beginning in the 1930s when data requirements for civil aviation forced the establishment of new procedures for observing weather conditions for the benefit of aviation. Efforts have been made to automate these observations and automated weather stations of various levels of complexity have been around now for more than two decades. Unfortunately, it had been too difficult to fully automate these intricate observations so operational surface observations at most airports and National Weather Service offices have continued to be primarily a manual operation.

Well, that is about to change. Starting this fall, the National Weather Service will begin to replace conventional human-based surface weather observations with a new generation of automated weather stations known as ASOS. This transition will be the greatest change in weather data collection in the history of our nation.

A few of you are familiar with the ASOS acronym, but most of you are not. ASOS stands for Automated Surface Observing System. This new and expensive system of instruments is designed to measure most of the basic weather elements needed for aircraft operations and weather forecasting – temperature, dew point, wind speed and direction, pressure, precipitation amounts and intensities, cloud heights, and visibility. In addition it is intended to detect precipitation, fog and certain other weather conditions and automatically distinguish between rain, snow and freezing rain.

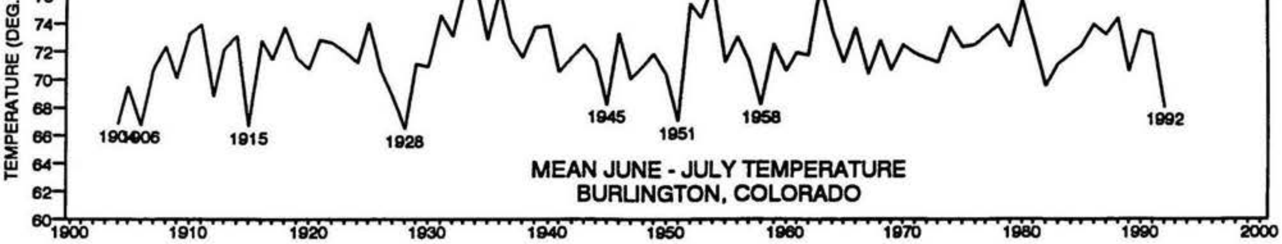
The system has many obvious advantages. It is intended to replace weather observers that need to be trained, managed and paid. It can operate around the clock, update observations at one-minute intervals (compared to the current schedule of hourly observations with occasional special updates) and transmit information quickly and automatically. Climatically there are other advantages. All ASOS weather stations across the country should be nearly identical and have more uniform instrument exposure than at present. Procedures and observing schedules should be consistent, and station upkeep and documentation should be superior.

All of this sounds great, as well it should. There is nothing worse than a bored weather observer on a clear night (note: this is an exaggeration). But it is important to realize that ASOS can't do everything and most certainly it won't do most measurements consistently with how humans have done them in the past. Some things it will do better, other things worse. Some things it can't do at all or wasn't designed to – measuring snowfall and accumulation, for example. And after all I have written about the importance of solar energy, ASOS does not have the capability to measure solar radiation. We hope this will be added later. And finally, it has not been totally proven that ASOS can function under all the conditions that nature can dish out, but then neither can humans.

We have known about ASOS for a long time. It has been in development for at least 15 years. But until now, it always seemed like a dream – sweet or nightmarish depending on ones point of view. But now it is here. There are already several units installed and in operational test mode in Colorado. Beginning this fall the first ASOS units are scheduled for commissioning. Alamosa is first on the list and will be followed quickly by Colorado Springs, Pueblo and Denver. Upon commissioning, ASOS takes over and the conventional observations cease.

This has immediate and far-reaching implications for everyone who uses aviation weather observations and anyone involved in climatology. History has shown repeatedly that whenever you change how you measure something, you usually get a different answer. ASOS will provide much more data than we have ever had before. As a result, we will learn many new things. But the records will not be consistent with the records of the past, and that presents some problems. As a climatologist I am trying to prepare myself for this transition. We are the ones who care and fuss the most over little trivial things like a one-degree change in temperature.

Fortunately, the National Weather Service, with the help of a few pushes from the climate research community, is funding some studies of climate data continuity. Hopefully, enough overlap data from both ASOS and conventional observations will be collected so that we can be fairly confident how much impact the ASOS measurements will actually have on our historic records of temperature, precipitation, wind, etc. The Colorado Climate Center is involved in some of these studies, and I intend to report our results to you in a year or so. If you don't hear from me by Christmas 1993, please bother me.



COLORADO CLIMATE

AUGUST 1992

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

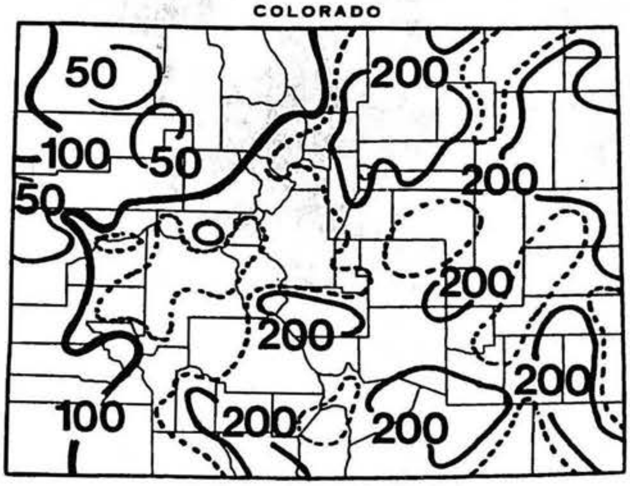
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

August in Perspective – Cool and Damp

The cool and damp weather pattern that characterized the summer of 1992 continued throughout August, especially east of the mountains. From the Front Range eastward to the borders of Kansas and Nebraska, this has been one of the 5-6 coolest summers this century. Afternoon and evening thunderstorms were numerous throughout the month, but a major autumn-like storm August 23-25th soaked much of Colorado and accounted for a large portion of the month's precipitation total.

Precipitation

There were brief interludes of dry weather during August, but afternoon and evening thunderstorms managed to develop somewhere in the State on most days. The storm of

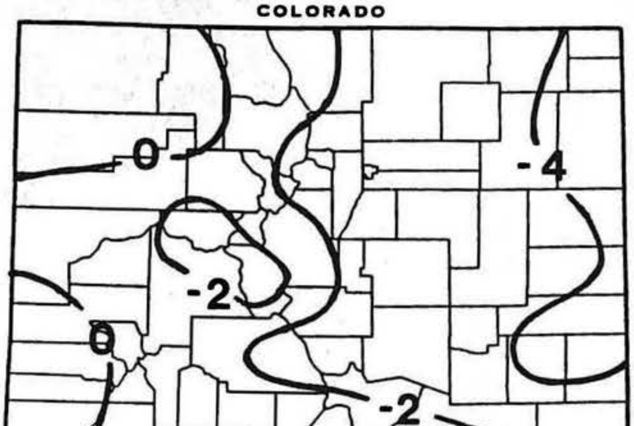


August 1992 precipitation as a percent of the 1961-1990 average.

August 23-25th was one of the heaviest statewide precipitation events to hit Colorado in a long time. The result was wetter than average conditions over most of Colorado with more than 200% of average over much of the South Platte Basin and other scattered areas in eastern and southern Colorado. Western Colorado missed out on much of the action, and some locations, including Craig and Fruita, received less than 50% of average August rainfall. The 0.22" total at Colorado National Monument was just 17% of average.

Temperatures

A series of unusually strong cold fronts plowed across the Front Range and Eastern Plains during August, but western Colorado was shielded and experienced seasonally hot weather. Then the entire state was chilled by near-record cold late in August. For the month as a whole, temperatures ended up slightly warmer than average over extreme southwest and northwest Colorado while the remainder of the State was cooler than normal. The most unusual weather occurred near the Nebraska and Kansas borders where some areas were more than five degrees F below average. At Burlington this was the 2nd coolest August this century second only to 1915. (See Special Feature story on the cool summer, pages 10-12.)



Departure of August 1992 temperatures from the 1961-90 averages.

Inside This Issue

AUGUST 1992 DAILY WEATHER

1-3 August began with hot, dry days and cool nights over western Colorado. Silverton reported a low of 35°F on the 1st. Temperatures were warm from the mountains eastward until high pressure over Canada pushed cooler, humid air into eastern Colorado 2-3rd producing morning low clouds and fog followed by late-day storms out on the plains.

4-7 Cooler, moister air slipped into western Colorado late on the 4th, while high humidity continued east of the mountains. John Martin Dam reported 1.61" of rain from storms late on the 4th. Widespread cloudcover shaded much of the State 5-6th. Scattered heavier thunderstorm activity shifted to western Colorado 5-6th as it became warmer and drier to the east. Low clouds lifted over some of Colorado's western alleys on the 7th, but some afternoon thundershowers redeveloped.

8-9 Quite hot over Colorado with only widely scattered thundershowers. The temperature reached 101° on the 9th at Cheyenne Wells and 103° at Pueblo Reservoir, their hottest day of the month.

10-17 A large ridge of high pressure prevailed west of Colorado bringing persistent heat to the Western Slope, but the resulting northwesterly winds aloft brought unsettled weather east of the mountains. Much cooler air accompanied by low clouds moved into eastern Colorado on the 10th dropping temperatures by 20 degrees in some areas. Large thunderstorms erupted along the cold front in southeast Colorado. Lamar was soaked with 2.72" of rain, much of it falling in 45 minutes. Fog developed overnight over portions of the Eastern Plains. The 11th was cool east of the mountains with scattered thundershowers. A localized evening storm dropped 1.02" on Longmont. An even stronger push of abnormally cool air dropped across eastern and northern Colorado on the 12th causing dense upslope clouds to develop along the Front Range and holding daytime temperatures in the 60s. Some large thunderstorms developed in southern Colorado. Temperatures moderated but remained below average 13-14th with numerous but fairly light thunderstorms near the mountains. Summer heat appeared briefly on the 15th, but cooler, showery weather returned again the next day. Storms were numerous near the mountains on the 16th, and then big storms rumbled across the plains late at night continuing into the 17th. Heavy rainfall reports included 1.06" at Canon City, 1.70" near Walsh and 2.47" near Idalia.

18-20 A relatively dry period statewide with just widely scattered convective showers. Cool temperatures continued east of the mountains on the 18th, but warmed statewide 19-20th. Grand Junction hit 99° on the 20th and Uravan reached 101°F, their hottest of the summer.

21-25 Winds aloft backed to the southwest on the 21st causing clouds and showers to increase over the mountains but producing hot, dry weather along the Front Range. Yampa received 0.63" of rain and hail. Hot weather continued east of the mountains on the 22nd. But in western Colorado, strong southwest winds, developing rain and colder temperatures announced the approach of an unusually deep low pressure area for this time of year. On the 23rd, cold high pressure pushed south out of Canada at the same time that the substantial remains of Pacific hurricane Lester combined with the autumn-like storm system over the Great Basin. The result was heavy rains spreading from the Southern Mountains into eastern Colorado on the 24th. The hardest hit areas were west and south of Denver where more than 3 inches of rain accumulated and in the vicinity of Wolf Creek Pass which totalled more than 5 inches of rain from the storm. Rains even changed to snow in the mountains down as low as 9,000 feet in some areas. Two inches of snow were measured near Georgetown, with more on mountain peaks and passes. Many locations set new records for the coldest daytime temperatures for this time of year. Denver and Alamosa only reached highs of 58° and 51°F, respectively, on the 24th. Climax was a chilly 43°F. The chill continued across eastern Colorado on the 25th with scattered showers and drizzle. Later, thunderstorms developed as the upper level low pressure trough passed directly over Colorado. Grand Junction, which missed the moisture from the hurricane, received 0.51" from a storm on the 25th.

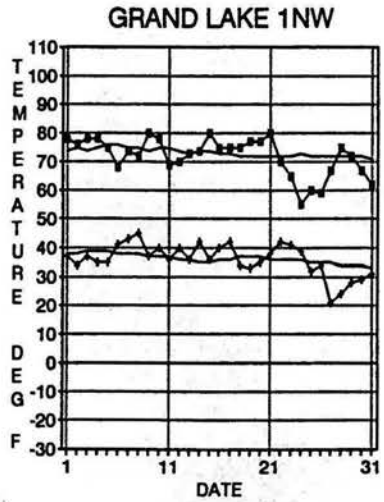
26-31 Skies cleared and daytime temperatures slowly returned to normal by the 28th. Nights, however, were quite chilly. The 27th was the coldest morning of the month in many locations. Fort Collins tied a record with 39°F. Lows were in the 20s in the mountains, and Fraser hit 18°, the coldest in Colorado in August. A new front moved down from Canada on the 29th keeping eastern Colorado cool for the remainder of August. Temperatures were more seasonal from the mountains westward, and numerous but mostly light afternoon showers and thunderstorms were the rule from the Front Range to Utah 30-31st.

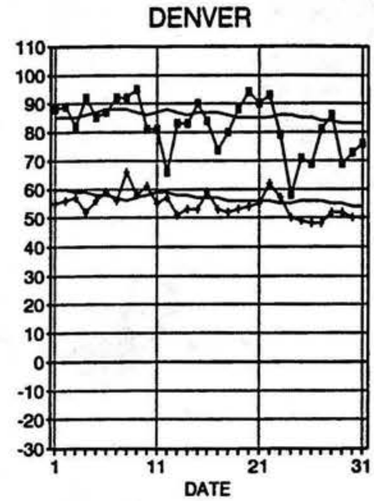
Weather Extremes

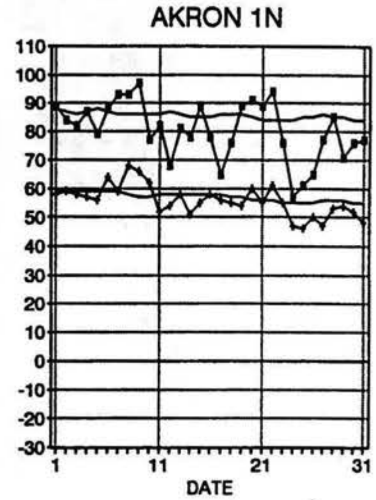
Highest Temperature	103°F	August 9	Pueblo Reservoir
Lowest Temperature	18°F	August 27	Fraser
Greatest Total Precipitation	8.97"		Wolf Creek Pass 1E
Least Total Precipitation	0.22"		Colorado National Monument
Greatest Total Snowfall	2.0"		Cabin Creek, Climax

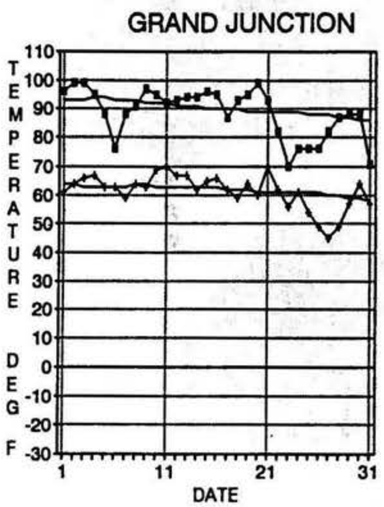
AUGUST 1992 TEMPERATURE COMPARISON

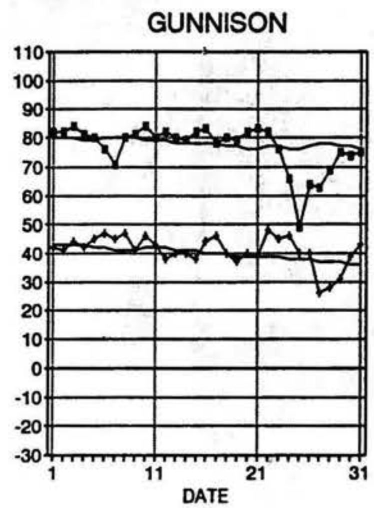
Observed daily high and low temperatures are shown below along with smoothed daily average highs and lows for the 1961-1990 period for nine selected locations. (Note: The time of observation effects the recorded high and low temperatures. Durango, Gunnison and Lamar each take their observations at 8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

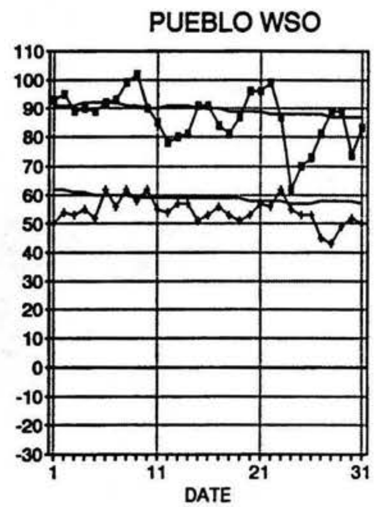


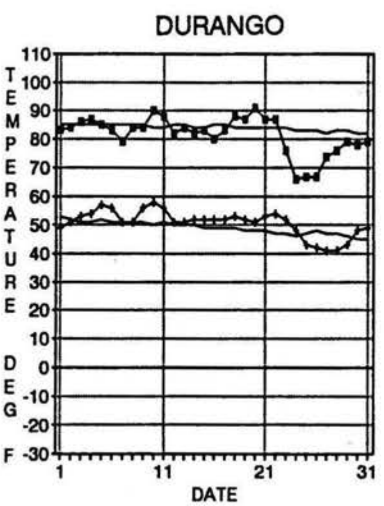


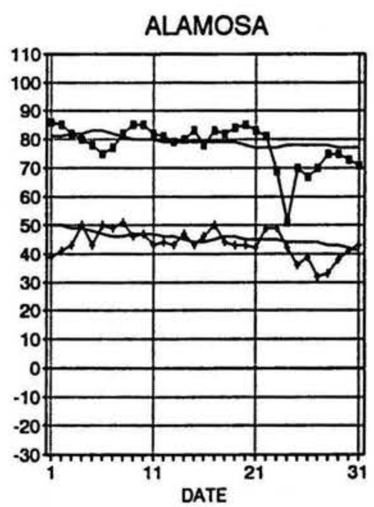


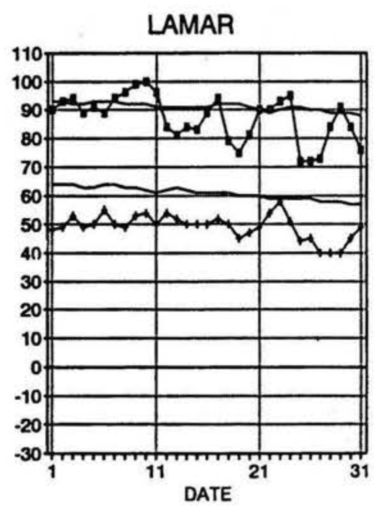








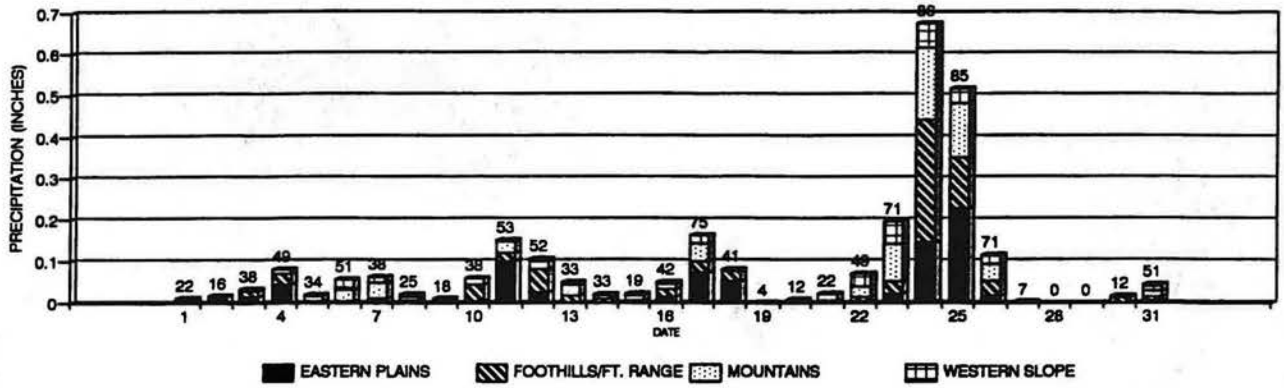




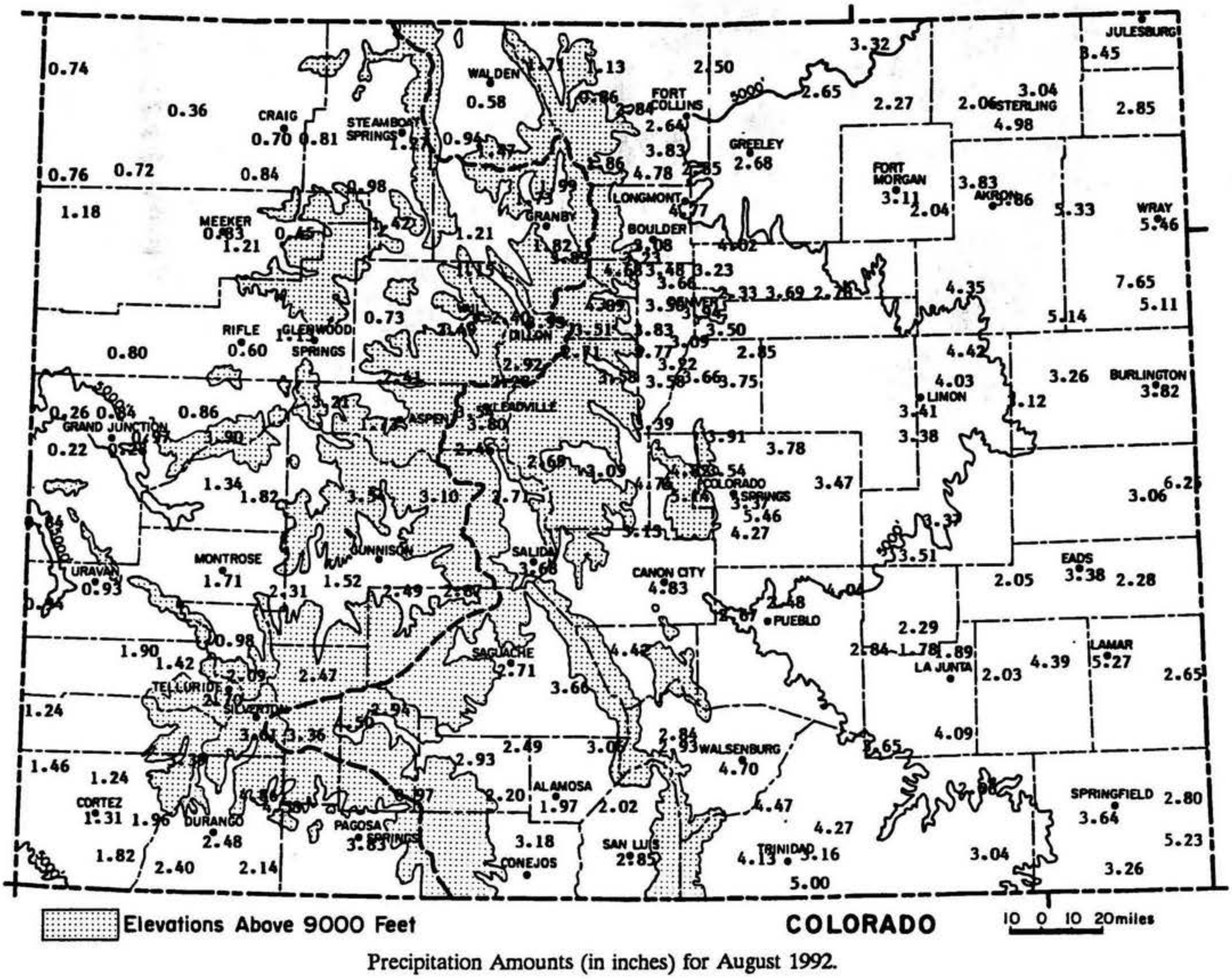
AUGUST 1992 PRECIPITATION

Scattered and generally light showers and thunderstorms characterized the first half of August with heavier precipitation events 10-12th, and 16-18th. Then along came the "storm of the year" 23-25th as moisture from Pacific Hurricane Lester combined with a strong autumn-like storm to drop heavy, steady rains (and a little mountain snow) over much of Colorado. Statewide, August precipitation averaged over 2.50", well above normal. August 23-25th contributed nearly 1.40" to that total, a very heavy widespread event for this part of the country.

COLORADO DAILY PRECIPITATION - AUG 1992

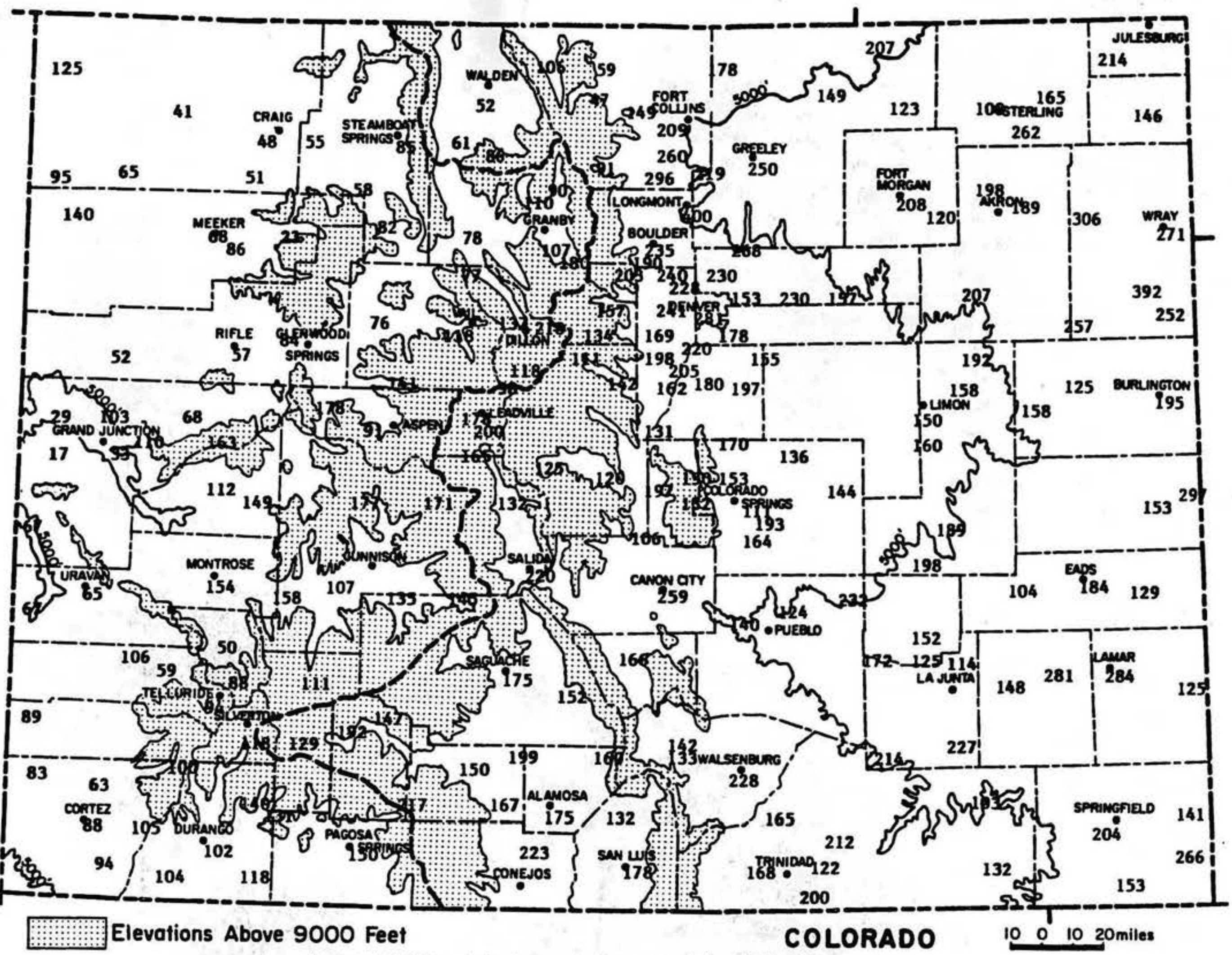


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

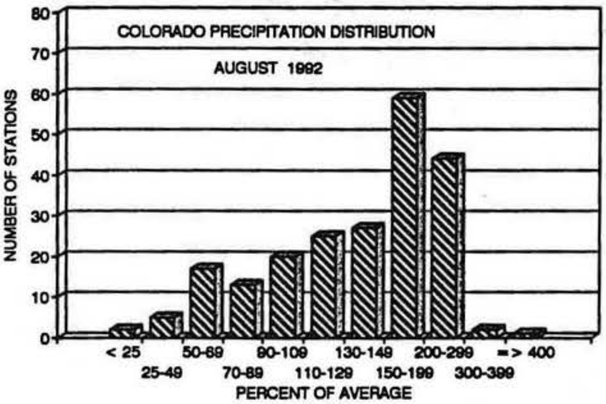


Precipitation Amounts (in inches) for August 1992.

AUGUST 1992 PRECIPITATION COMPARISON



August 1992 Precipitation as a Percent of the 1961–90 average.



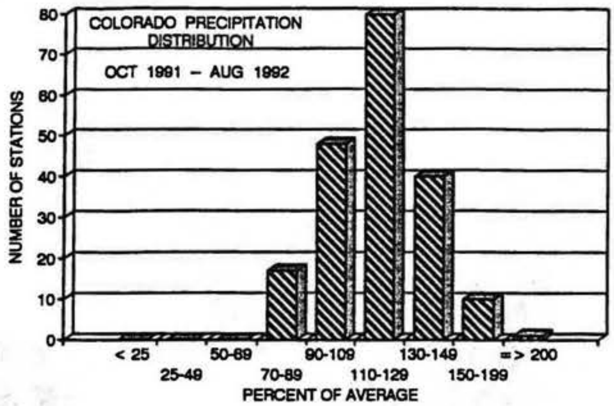
Wet areas greatly outnumbered dry areas in Colorado in August, and several locations set new records for the wettest August including 8.97" at Wolf Creek Pass 1E, 7.65" at Idalia 4NNE and 4.77" at Longmont. But, as usual, local dry spots were also evident. A handful of stations reported less than 50% of average August moisture.

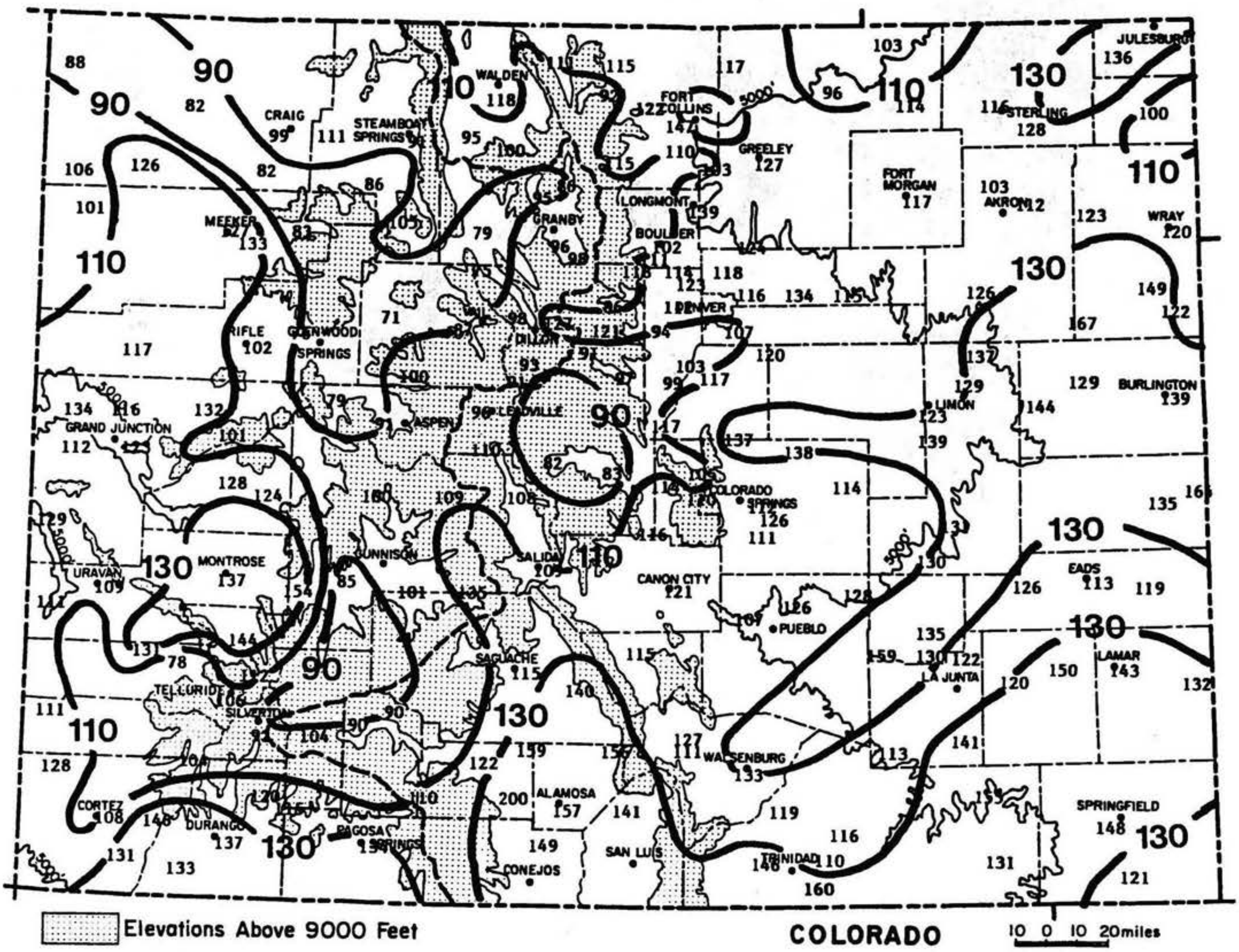
AUGUST 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	2.33"	20th wettest in 121 years of record (wettest = 5.85" in 1979)
Durango	2.48"	40th wettest in 98 years of record (wettest = 5.97" in 1947)
Grand Junction	0.84"	47th driest in 101 years of record (driest = 0.02" in 1903)
Las Animas	2.03"	43rd wettest in 127 years of record (wettest = 5.98" in 1916)
Pueblo	2.48"	33rd wettest in 123 years of record (wettest = 5.85" in 1955)
Steamboat Springs	1.27"	35th driest in 86 years of record (driest = 0.17" in 1944)

1992 WATER YEAR PRECIPITATION

A so-so winter snowpack and a dry, warm spring resulted in gloomy projections for summer water supplies. In fact, streamflows have been less than average this year. Most major rivers in Colorado have been low since 1988. But plentiful rains and cool temperatures since late May have been very beneficial. As of August 31, 1992, 80% of Colorado's official reporting stations have received average or above precipitation for the 1992 water year. 26% of the weather stations have received at least 130% of average. For much of eastern and southern Colorado this has been a year of plentiful moisture. The only remaining drier than average areas are found in parts of the Northern and Central Mountains and extreme northwest parts of the State. For the most part, rain has been sufficient to substantially offset surface water demands. As a result, reservoir storage is in remarkably good shape statewide considering that this was the 5-6th consecutive year with below average streamflow. Colorado has avoided a dry growing season over the majority of the State for more than a decade.





October 1991—August 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR AUGUST 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535	350	179	9685
	92-93	97	131											228
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	91-92	104	112	335	610	1106	1369	1410	1124	980	660	487	351	8648
	92-93	249	228											477
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	91-92	17	7	121	403	831	911	901	700	664	321	192	93	5161
	92-93	20	55											75
BUENA VISTA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
	91-92	63	87	M	580	1056	1265	1246	1048	901	568	391	247	M
	92-93	107	148											255
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	91-92	13	14	106	462	903	1004	1021	751	639	360	173	61	5507
	92-93	5	39											44
CANON CITY	AVE *	0	10	100	330	670	870	950	770	740	430	190	40	5100
	91-92	8	0	105	379	800	945	870	688	604	331	167	63	4960
	92-93	2	29											31
COLORADO SPRINGS	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
	91-92	16	16	145	453	954	1048	998	788	717	383	219	96	5833
	92-93	21	53											74
CORTEZ	AVE *	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	91-92	13	8	161	423	947	1227	1310	892	744	458	266	114	6563
	92-93	18	42											60
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	91-92	27	13	230	582	1080	1517	1556	1078	809	497	270	161	7820
	92-93	67	64											131
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	91-92	0	2	88	383	832	1302	1486	874	625	273	86	29	5980
	92-93	6	M											M
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	91-92	6	4	118	449	902	982	1022	714	673	309	158	35	5372
	92-93	10	35											45
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805	609	458	10442
	92-93	364	381											745
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	91-92	6	2	152	379	940	1179	1305	935	745	430	267	123	6463
	92-93	34	49											83
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	91-92	26	6	208	563	972	1358	1387	970	809	466	289	150	7204
	92-93	47	73											120
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	91-92	83	92	311	627	988	1078	1123	939	887	541	410	242	7321
	92-93	103	167											270
FORT COLLINS	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
	91-92	11	1	145	457	891	1002	1029	736	681	356	193	56	5558
	92-93	22	55											77
FORT MORGAN	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
	91-92	5	4	89	437	947	1025	1193	756	652	332	163	41	5644
	92-93	12	40											52
GRAND JUNCTION	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
	91-92	0	2	37	304	815	1193	1390	788	608	195	53	8	5393
	92-93	0	6											6

* = 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 6SSW	AVE	214	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
	91-92	220	255	427	739	1169	1468	1735	1354	1118	751	534	383	10153
	92-93	277	311											588
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	91-92	8	5	119	450	925	1011	1088	724	665	310	181	37	5523
	92-93	14	43											57
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	91-92	131	151	371	698	1120	1597	1707	1167	940	661	452	292	9287
	92-93	208	M											M
LAS ANIMAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
	91-92	1	3	59	350	896	966	943	712	539	242	107	24	4842
	92-93	0	11											11
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852	656	495	10733
	92-93	383	435											818
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	91-92	19	14	171	503	1000	1095	1161	827	734	436	272	104	6336
	92-93	16	54											70
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	91-92	12	6	133	489	936	1047	1124	786	730	391	201	60	5915
	92-93	20	61											81
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	91-92	24	7	221	553	1003	1367	1490	1025	758	446	280	138	7312
	92-93	23	44											67
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	91-92	0	0	135	404	901	1312	1385	911	683	324	176	48	6279
	92-93	15	43											58
PAGOSA SPRINGS	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
	91-92	44	37	289	568	1116	1362	1477	1087	899	577	392	251	8099
	92-93	120	126											246
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	91-92	1	0	76	380	927	1014	958	759	608	309	125	41	5198
	92-93	0	15											15
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	91-92	1	1	143	475	906	1185	1283	804	660	352	142	57	6009
	92-93	12	31											43
STEAMBOAT SPRINGS	AVE *	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
	91-92	127	141	394	742	1140	1626	1680	1126	863	595	383	263	9080
	92-93	160	119											279
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	91-92	5	1	92	437	930	1028	1191	731	645	352	142	36	5590
	92-93	14	36											50
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	91-92	175	163	339	595	1013	1264	1291	1057	946	565	450	285	8143
	92-93	180	189											369
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	91-92	3	2	107	377	876	1004	946	774	642	289	186	50	5256
	92-93	0	18											18
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700	500	349	9624
	92-93	270	283											553
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	91-92	6	5	90	337	818	915	870	717	634	309	163	60	4924
	92-93	5	29											34

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

AUGUST 1992 CLIMATIC DATA

EASTERN PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
NEW RAYMER 21N	77.8	49.4	63.6	-3.6	94	41	106	72	456	3.32	1.72	207.5	10
STERLING	84.5	54.8	69.7	-2.4	100	42	36	188	579	2.06	0.18	109.6	8
FORT MORGAN	82.7	55.2	69.0	-3.5	98	44	40	169	565	3.11	1.62	208.7	8
AKRON FAA AP	80.5	55.7	68.1	-3.3	97	46	47	152	550	3.83	1.90	198.4	9
AKRON 4E	81.2	53.4	67.3	-4.2	98	43	60	138	524	3.86	1.82	189.2	7
HOLYOKE	78.4	55.8	67.1	-5.4	94	44	54	128	533	2.85	0.90	146.2	8
JOES	78.9	54.9	66.9	-6.0	96	45	48	117	526	5.14	3.14	257.0	8
BURLINGTON	80.9	55.5	68.2	-4.9	98	48	39	147	554	3.82	1.87	195.9	8
LIMON WSMO	79.2	52.7	66.0	-2.5	91	45	54	91	502	3.41	1.14	150.2	9
CHEYENNE WELLS	84.1	55.6	69.9	-3.2	101	47	20	179	588	3.06	1.06	153.0	12
EADS	83.8	56.7	70.2	-3.7	97	47	16	189	604	3.38	1.55	184.7	6
ORDWAY 21N	86.4	54.3	70.3	-2.8	100	43	24	199	583	3.51	1.74	198.3	8
ROCKY FORD 2SE	87.5	54.8	71.1	-3.0	99	45	11	208	609	1.78	0.36	125.4	12
LAMAR	87.1	49.2	68.2	-6.9	100	40	32	137	536	5.27	3.42	284.9	8
LAS ANIMAS	87.2	57.0	72.1	-4.2	101	49	11	237	629	2.03	0.66	148.2	12
HOLLY	86.6	57.0	71.8	-3.7	100	44	2	223	636	2.65	0.54	125.6	8
SPRINGFIELD 7WSW	86.6	56.7	71.6	-1.9	96	47	3	215	634	3.64	1.86	204.5	11
TIMPAS 13SW	87.6	57.1	72.4	-1.7	98	49	15	249	633	3.65	1.95	214.7	8

FOOTHILLS/ADJACENT PLAINS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
FORT COLLINS	78.8	52.8	65.8	-3.4	94	39	55	88	501	2.64	1.38	209.5	15
GREELEY UNC	81.6	53.3	67.4	-3.8	97	41	43	128	535	2.68	1.61	250.5	10
ESTES PARK	74.2	44.2	59.2	-1.3	81	34	181	8	393	1.86	-0.18	91.2	19
LONGMONT 2ESE	82.3	49.8	66.0	-4.0	97	37	61	100	507	4.77	3.58	400.8	11
BOULDER	80.0	52.6	66.3	-3.2	94	42	55	103	516	3.08	1.77	235.1	16
DENVER WSFO AP	82.3	54.5	68.4	-3.0	95	48	35	148	551	2.33	0.81	153.3	7
EVERGREEN	76.2	42.9	59.5	-2.4	86	30	167	5	414	3.83	1.57	169.5	14
CHEESMAN	78.1	39.2	58.6	-4.9	88	26	189	1	441	3.39	0.81	131.4	15
LAKE GEORGE 8SW	72.7	42.6	57.7	-1.3	80	30	218	0	361	3.05	0.51	120.1	12
ANTERO RESERVOIR	71.9	36.7	54.3	-1.5	80	25	326	0	348	2.69	0.54	125.1	11
RUXTON PARK	67.4	34.8	51.1	-2.8	76	24	423	0	281	5.14	1.26	132.5	17
COLORADO SPRINGS	80.4	52.7	66.5	-2.1	92	39	53	106	517	3.37	0.34	111.2	15
CANON CITY 2SE	82.3	55.7	69.0	-2.1	93	44	29	159	587	4.83	2.97	259.7	14
PUEBLO WSO AP	86.7	54.2	70.5	-3.8	102	43	15	191	585	2.48	0.48	124.0	11
WESTCLIFFE	74.0	40.3	57.2	-3.8	84	28	236	0	383	4.42	1.76	166.2	12
WALSENBURG	82.2	53.7	68.0	-1.8	92	42	29	127	563	4.70	2.64	228.2	15
TRINIDAD FAA AP	85.5	53.9	69.7	-1.9	97	44	18	171	585	4.17	2.16	207.5	13

MOUNTAINS/INTERIOR VALLEYS

	Temperature						Degree Days			Precipitation			
Name	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
WALDEN	74.1	37.1	55.6	-0.9	86	20	283	0	382	0.58	-0.53	52.3	10
LEADVILLE 2SW	66.6	34.9	50.8	-1.8	75	25	435	0	267	3.80	1.90	200.0	17
SALIDA	79.1	45.2	62.1	-1.6	88	32	114	31	463	3.68	2.01	220.4	10
BUENA VISTA	77.5	43.0	60.3	-2.0	86	29	148	8	435	2.71	0.66	132.2	11
SAGUACHE	73.9	44.6	59.3	-2.2	83	33	172	2	382	2.71	1.17	176.0	15
HERMIT 7ESE	69.4	36.5	53.0	-1.3	79	24	366	0	310	3.20	0.86	136.8	9
ALAMOSA WSO AP	78.0	43.5	60.7	-1.7	86	32	131	6	444	1.97	0.85	175.9	12
STEAMBOAT SPRINGS	81.4	42.0	61.7	1.5	89	25	119	22	488	1.27	-0.21	85.8	13
YAMPA	75.0	47.4	61.2	1.8	82	33	116	8	406	1.42	-0.30	82.6	9
GRAND LAKE 1NW	72.1	36.0	54.0	-0.9	80	21	332	0	349	1.99	-0.21	90.5	18
GRAND LAKE 6SSW	71.4	38.2	54.8	-1.8	81	25	311	0	339	1.73	0.16	110.2	17
DILLON 1E	69.2	35.6	52.4	-2.4	77	21	381	0	310	2.40	0.65	137.1	16
CLIMAX	61.5	37.9	49.7	-0.1	70	27	469	0	188	2.28	-0.03	98.7	7
ASPEN 1SW	73.5	41.3	57.4	-3.1	83	29	228	0	370	1.75	-0.15	92.1	11
CRESTED BUTTE	70.5	37.4	53.9	-1.8	80	23	335	0	327	3.54	1.54	177.0	17
TAYLOR PARK	65.8	37.8	51.8	-2.3	74	26	401	0	249	3.10	1.29	171.3	14
TELLURIDE	76.2	41.1	58.7	0.2	88	26	189	1	410	2.70	-0.15	94.7	17
PAGOSA SPRINGS	79.3	42.6	61.0	-1.4	87	30	126	8	460	3.83	1.28	150.2	19
SILVERTON	68.6	37.7	53.2	-0.5	77	26	359	0	297	3.61	0.57	118.7	16
WOLF CREEK PASS 1	64.2	38.5	51.4	0.1	76	26	415	0	231	8.97	4.84	217.2	21

WESTERN VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
CRAIG 4SW	82.0	49.0	65.5	0.1	90	31	64	87	515	0.70	-0.75	48.3	7
HAYDEN	81.4	47.7	64.6	-0.2	90	32	70	66	500	0.81	-0.65	55.5	11
MEEKER NO. 2	86.3	47.8	67.0	1.7	95	31	44	117	537	0.83	-0.39	68.0	7
RANGELY 1E	88.2	55.4	71.8	1.1	98	38	23	241	627	1.18	0.34	140.5	6
EAGLE FAA AP	82.4	45.7	64.0	-0.2	91	28	73	50	500	0.73	-0.23	76.0	12
GLENWOOD SPRINGS	85.8	49.2	67.5	-0.5	96	35	49	133	543	1.13	-0.20	85.0	12
RIFLE	86.7	48.9	67.8	-0.9	96	34	31	125	541	0.60	-0.45	57.1	6
GRAND JUNCTION WS	88.7	61.5	75.1	-1.1	99	45	6	328	706	0.84	0.03	103.7	6
CEDAREDGE	85.8	50.0	67.9	-1.9	96	35	53	151	542	1.34	0.15	112.6	10
PAONIA 1SW	86.6	54.7	70.6	-0.1	97	41	30	213	603	1.82	0.60	149.2	11
COCHETOPA CREEK	76.8	41.0	58.9	-0.7	84	26	182	0	422	2.49	0.65	135.3	16
MONTROSE NO. 2	82.9	53.6	68.2	-1.8	92	39	43	148	572	1.71	0.60	154.1	9
URAVAN	92.3	58.9	75.6	0.7	101	42	6	341	688	0.93	-0.49	65.5	12
NORWOOD	79.5	49.4	64.4	0.0	88	38	69	58	486	1.90	0.12	106.7	8
YELLOW JACKET 2W	84.4	52.3	68.3	0.1	93	39	40	149	560	1.46	-0.29	83.4	9
CORTEZ	85.3	51.0	68.1	1.1	92	37	42	147	565	1.31	-0.17	88.5	9
DURANGO	81.6	50.7	66.1	-0.4	91	41	49	92	523	2.48	0.06	102.5	13
IGNACIO 1N	81.6	48.1	64.9	-1.4	90	34	68	69	501	2.14	0.33	118.2	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.

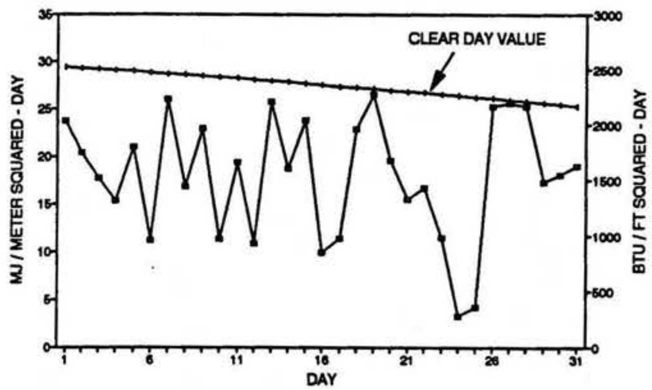
AUGUST 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days CLR	PC	CLDY	Percent Possible Sunshine	Average % of Possible
Colorado Springs	9	12	10	--	--
Denver	6	12	13	56%	72%
Fort Collins	7	11	13	--	--
Grand Junction	9	14	8	75%	77%
Limon	9	11	11	--	--
Pueblo	10	12	9	64%	78%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

Sunshine and solar radiation were again less than average over much of Colorado. The greatest differences from average were over eastern Colorado. For the entire summer, Denver recorded only 59% of possible sunshine compared to an average of 71%.

FT. COLLINS TOTAL HEMISPHERIC RADIATION
AUGUST 1992

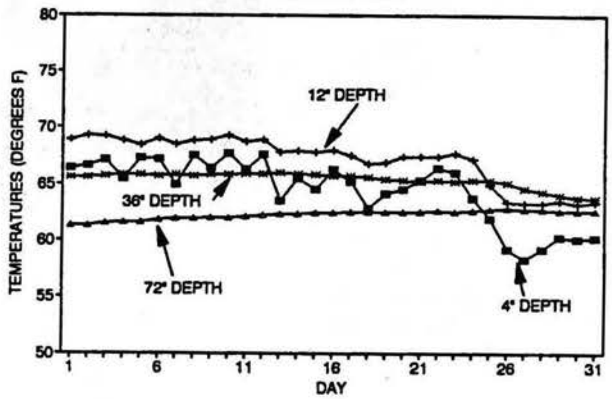


AUGUST 1992 SOIL TEMPERATURES

Near-surface soil temperatures stayed below average but reached their highest levels of the summer only to plummet again late in August as cold rain saturated the ground. Deeper soil temperatures remain close to average.

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 1992



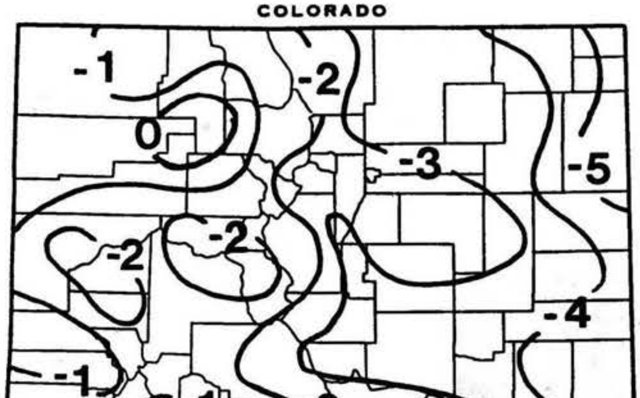
HATS OFF TO: *Orville and Helen Altenbern,* of Altenbern Ranch, DeBeque, Colo.

With great sadness we say goodbye to Mrs. Orville Altenbern (Helen) who passed away in July. She helped with the daily observations on the Altenbern Ranch since Orville was slowed by a leg injury several months ago. They were in their 50th year of dedicated service as volunteer weather observers. Son Max Altenbern took over the station in August. Altenbern family – thanks so much for what you have done.

AFTER A COLD SUMMER, WHAT LIES AHEAD?

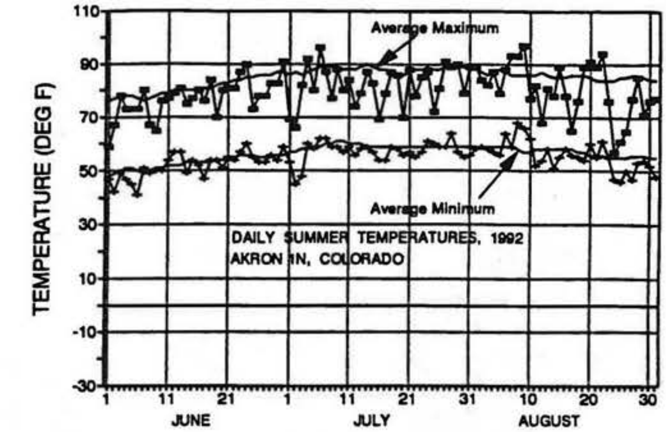
There have been colder summers than the one we just experienced here in Colorado in 1992 – but not many. The Eastern Plains were by far the most anomalous, while western Colorado was only a little cooler than average. This fits right in with the seasonal pattern for the entire country. Abnormal lack of summer heat was the rule over broad areas of the United States from the Rockies to New England. Nationally, this was the 3rd coolest summer on record. Only the far West and the southeastern coastal regions experienced temperatures near or above average for the summer. The core of the cool weather was centered over the northern and central plains states where summer temperatures were four to seven degrees F below average. Meanwhile, out West, it was a hot summer with June-August temperatures more than 2°F warmer than average over much of Washington, Oregon and parts of California.

COLORADO

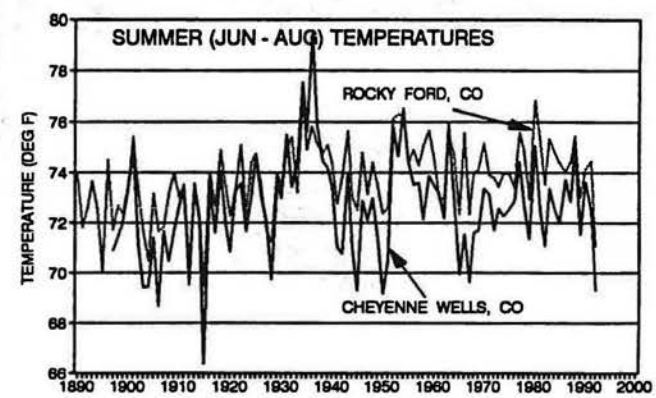


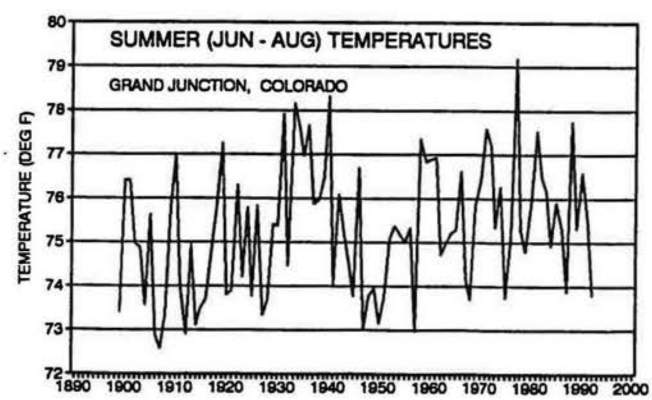
Summer 1992 Temperature Departures from 1961-1990 averages.

The summer of 1992 here in Colorado was characterized by abundant cloudcover, frequent precipitation, a large number of abnormally strong cold fronts and an absence of the typical one to two week heatwave episodes that often occur sometime each summer. There were only a handful of truly hot days all summer, and these were scattered randomly throughout the season. Colorado's traditional hot spot, Las Animas, after reaching the 100-degree mark already on April 30 and 101° on May 1, proceeded to reach the century mark only 7 times during June-August. In fact, they only hit 90° or higher 41 times, 26 days less than usual. Out at Akron, the longest stretch of days with maximum temperatures greater than 80° was just 4 days. Akron had a remarkable 21 days when the daily high temperature stayed below 75° and 12 days cooler than 70°F. Denver recorded only 58.7% of possible sunshine during the summer compared to an average of 71.3%. This was the cloudiest summer in Denver since 1945 and the 4th cloudiest summer during the past 100 years. Just for the record, Denver's cloudiest summers have been: 1912 (686 hours of sunshine), 1927 (727 hours), 1945 (752 hours), 1992 (780 hours), 1951 (785 hours) and 1915 (788 hours).



We pulled out historic temperature data for several locations in Colorado to see how 1992 compared. It is well to note that the last time Colorado experienced cool weather through the entire summer was back in the mid 1960s. There were a few cool summers in the 1940s and early 50s, nothing but hot summers in the 1930s and then a much higher frequency of cool summers from 1928 back to the beginning of recorded temperature history. Eastern and western Colorado are not always hot or cool at the same time, but some of the coolest summers affected the entire state.





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Summer (June-August) Temperature Rankings

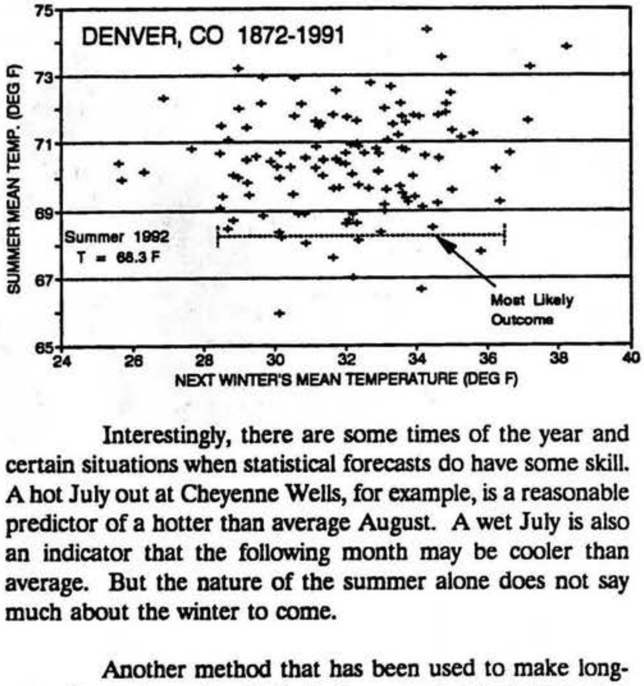
Station	Jun-Aug mean temp. (Deg F)	Departure from average	Rank
Akron 4E	66.8	-3.7	3rd coolest in 85 years. (coolest = 64.7° in 1915)
Burlington	68.1	-4.7	5th coolest in 89 years (coolest = 66.8° in 1915)
Cheyenne Wells	69.3	-3.3	5th coolest in 96 years (coolest = 66.4° in 1915)
Denver	68.3	-2.3	9th coolest in 121 years (coolest = 66.0° in 1967)
Durango	64.4	-1.4	33rd coolest in 99 years (coolest = 59.9° in 1928)
Grand Junction	73.8	-2.0	20th coolest in 93 years (coolest = 72.6° in 1907)

Beginning in August, our office was besieged by phone calls asking us what to expect for the winter. The cool summer and the episode of August snow in the mountains really got people worried – or at least curious. I had lots of information to offer, of course, but not many direct answers so I sidestepped the question as best I could. I gave vague answers about how warm recent winters have been and how summer is not a good indicator of what winters are normally like. My only strong statement was that I thought it extremely likely that winter would be markedly colder than the summer we had just enjoyed.

If the woolly bear caterpillar can make a winter forecast, then why can't experienced climatologists say anything sensible? Well, for one thing, anyone can make a forecast. But does anyone actually keep score? There have never been formal studies evaluating the success of the woolly bear, the skunk cabbage, carrots and onions, the hoarding squirrels or any other folklore forecasters. Personally, I love weather folklore, but I would never use it to make a winter forecast. Many private meteorologists across the country will offer, for a price of course, a customized long-range forecast for their clients. Most of these meteorologists will list off great long-range forecast successes, but they may not share their failures. Research climatologists, on the other hand, carefully evaluate skills from various long-range forecasting methods, but the results are not very encouraging, especially for our part of the country. Forecast methods that can perform 5% or more better than just flipping a coin are considered excellent for time periods of 30 to 90 days in advance. We are not aware of any techniques that currently achieve this accuracy for Colorado.

Many people have the perception that if we know what the weather has been, we should have a good idea of what lies ahead. This is based on the concept that weather patterns go in cycles. Its true, there are several important cycles – the day-night cycle, the annual cycle and wave motion in the atmosphere are obvious examples. There are some semi-predictable cycles that are evident in the tropical atmosphere-ocean system of which the best known is the El Nino circulation. Beyond that, cycles in weather patterns become quite vague and are rarely useful as simple predictors. In fact, some studies have suggested that the atmosphere behaves much closer to randomly than in any systematic cyclic manner. As a potential forecaster, that doesn't make me feel very confident either. There may be some cyclic processes at work, but they are imbedded in an extremely complex earth-atmosphere-ocean system where conditions are always changing, where everything effects everything else and where skillful long-range forecasts are nearly impossible.

The figure below provides a glimpse of why I don't get too excited about simple statistical long-range forecasting. Using Denver temperature data, the longest temperature record in Colorado (not totally consistent, however, due to several moves and changes in instrumentation – but that's a whole other story), the relationship between summer temperatures and the following winter can be shown. If there was a reasonable relationship between them, sufficient to aid in forecasting, one would note a pattern in the scattered points or some sort of linear relationship. Looking at that graph and knowing that the mean temperature for this past summer at Denver was 68.3°F, about all I can say is "we probably will have a normal winter."



Interestingly, there are some times of the year and certain situations when statistical forecasts do have some skill. A hot July out at Cheyenne Wells, for example, is a reasonable predictor of a hotter than average August. A wet July is also an indicator that the following month may be cooler than average. But the nature of the summer alone does not say much about the winter to come.

Another method that has been used to make long-range forecasts, again with limited success, is called the analog method. You evaluate the weather patterns of recent weeks or months and look for similar conditions from the past. Then you examine what came after those conditions and that becomes your forecast. As an example, let's look at some of the coldest summers on record for eastern Colorado – 1904, 1906, 1912, 1915, 1927, 1928, 1950, and 1967. What were winters like in Colorado following these cool summers? I'll begin with 1915 since it was the coolest summer ever recorded for the U.S. and appears to have been meteorologically similar to 1992. The other years will be listed chronologically.

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Summer of: **Followed By:**

1915 Following the remarkably cool summer, the fall, spring and much of the winter were all quite mild. Temperatures were warmer than average most months except for January which was snowy and extremely cold. Mountain snowpack accumulation was less than average.

1904 The fall and early winter were pleasant. Winter and early spring were fairly normal, but February was colder than normal. Snowpack accumulation was close to average.

1906 Autumn was unsettled with a few big storms. From December into April, temperatures were generally above average. Late spring was cold. Snowpack was fairly normal.

1912 Autumn was cool and the winter was colder than average with very cold temperatures in February. Precipitation was generally deficient, although September and February were wetter than average. Snowpack was less than average.

1927 A very wet September in southwest Colorado (possibly moisture from a hurricane) was followed by average or above temperatures and somewhat deficient precipitation for most of the fall, winter and early spring. December, however, was colder than average. Snowpack accumulation was below average to average.

1928 A mild autumn gave way to a long, cold and snowy winter culminating in an extremely cold February. Snowpack accumulation was above average.

1950 It was generally a mild autumn and winter and a cool spring, but an extreme coldwave in late January—early February set many records and killed fruit trees and other vegetation. Snowpack was below average to average across the mountains.

Does any pattern emerge here? It is difficult to say. It does appear that many of the months following cool summers were warmer than average, but 1912 and 1928 were exceptions. There were a number of extreme winter cold episodes in the following winters, but that is very much the nature of winter in our climate. Snowpack, as best we can estimate from the old reports, was generally near or below average for the years following cold summers (except 1928), but streamflow records for those years were not unusually low.

Would you make a huge economic decision based on this sample of 7 years? There are methods that refine this crude analog approach using El Nino information and other large-scale climate indicators. They offer promise, but not precision. In a few years I'll update you on progress.

In case there is not enough uncertainty in this business, this year has an even bigger "?". Last year's gigantic eruption of Mount Pinatubo in the Philippines spewed out incredible quantities of volcanic material into the upper atmosphere causing a measurable reduction of incoming solar radiation. Past research has shown quite convincingly that the earth's climate is influenced by volcanic activity with cool episodes (on a global scale) often following volcanic activity with a lag of one to three years. Many suggest that the cool summer of 1992 can be attributed, at least partially, to the eruption. There is also more scientific agreement than usual favoring the chances for a cooler than average winter, especially over interior continental areas (that's us).

That exhausts my knowledge on this subject, so this is a good time to stop. Let me add just one thing. I think we should all prepare for a windy winter. That's just a gut feeling.

READER SURVEY SUMMARY

Several months ago we enclosed a letter to all subscribers that included a set of questions. Many of you took the time to answer these questions and spent your own money to mail in your response. Thank you very much!

What we learned is that most of you would rather see more information, not less. You are especially eager to see more special features and in-depth analyses. You offered many suggestions for future topics and I will do my best to oblige. Your ideas were diverse ranging from "how to set up low cost weather stations" to "what does the El Nino mean for Colorado". Snow was an especially appealing topic. We will have great fun attacking all these topics.

You were most willing to part with some of the maps and data tables. That is tempting as we look for ways to control our costs. But these same pages contain what is the most essential information to a subset of our long-term subscribers. The precipitation maps become most valuable as historical documents. We find that the maps from 5 or more years ago are used more frequently than the maps from recent months.

Thanks again for your help as we plan for the future. We will continue to strive to produce a useful and educational product. Whether we can continue to provide it free to all subscribers remains uncertain.

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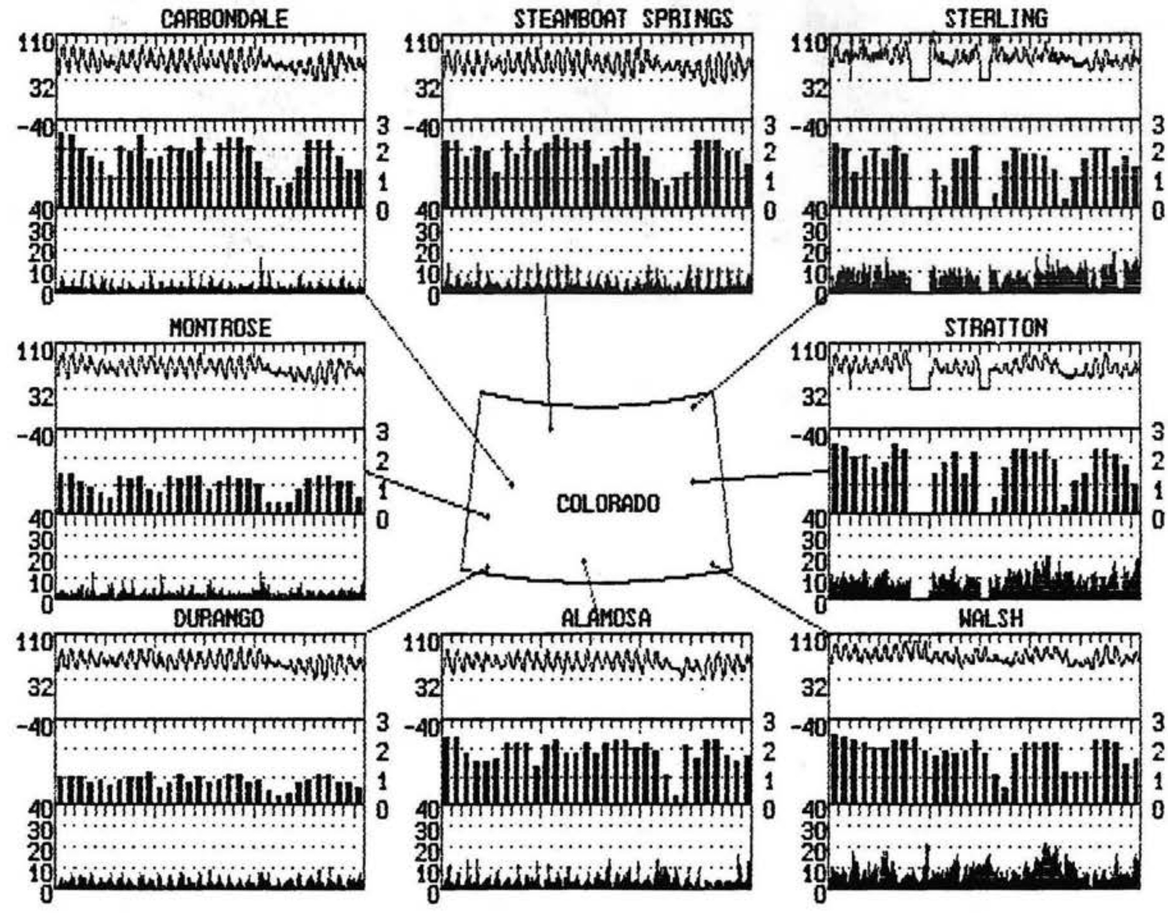
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature ('F)	58.8	60.6	62.3	65.4	58.3	67.2	63.2	69.6
monthly temperature extremes and time of occurence ('F day/hour)								
maximum:	82.2 21/15	85.6 19/15	92.8 2/16	90.3 2/17	88.3 9/15	113.7 11/ 9	93.9 8/15	95.9 9/14
minimum:	31.6 27/ 6	34.5 27/ 3	29.5 27/ 6	34.3 27/ 6	21.6 27/ 6	32.0 2/ 0	32.0 2/ 0	48.9 27/ 6
monthly average relative humidity / dewpoint (percent / 'F)								
5 AM	96 / 44	89 / 44	87 / 43	84 / 47	76 / 34	38 / 34	77 / 43	85 / 55
11 AM	52 / 48	50 / 50	33 / 38	47 / 51	26 / 31	22 / 23	52 / 45	56 / 56
2 PM	36 / 42	43 / 48	25 / 35	37 / 45	19 / 27	18 / 22	41 / 43	44 / 53
5 PM	40 / 40	47 / 46	27 / 34	36 / 44	21 / 28	16 / 18	41 / 41	44 / 52
11 PM	74 / 46	78 / 47	58 / 40	60 / 46	59 / 36	25 / 21	69 / 45	75 / 56
monthly average wind direction (degrees clockwise from north)								
day	175	198	202	227	215	133	129	125
night	150	99	166	156	106	157	171	195
monthly average wind speed (miles per hour)	3.75	2.77	2.07	2.59	3.02	6.12	7.94	8.19
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	344	460	586	501	464	207	87	52
3 to 12	384	284	157	237	263	487	547	557
12 to 24	16	0	1	2	5	50	110	131
> 24	0	0	0	0	0	0	0	0
monthly average daily total insolation (Btu/ft²·day)	1871	829	1817	1042	1908	1459	1705	1894
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	202	1	157	54	154	144	177	204
40-60%	89	1	100	91	85	72	92	95
20-40%	70	255	70	75	77	69	51	73
0-20%	46	154	46	184	37	83	50	43

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 1992

Volume 15 Number 12

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

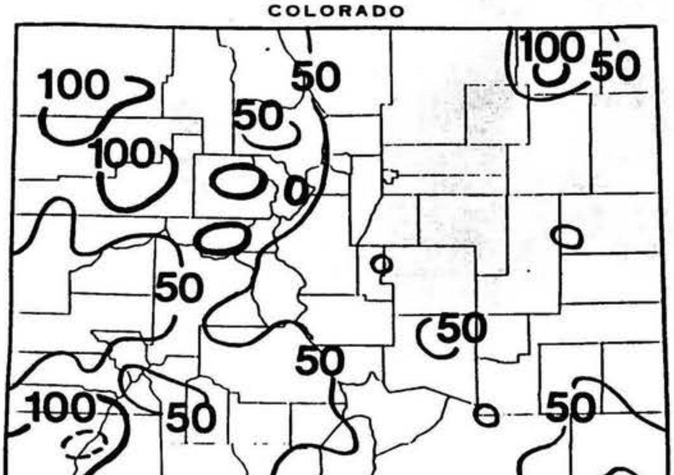
This report has been prepared each month since January 1977 with the support of the Colorado Agricultural Experiment Station and the College of Engineering

September in Perspective – Warm and Dry

The cool, damp weather pattern that characterized the summer came to a screeching halt and was replaced by warm and predominantly dry weather in September. The jet stream strengthened and dipped southward on several occasions during the month suggesting a continuation of the active weather of summer. However, most of these systems brought little moisture to the State and only briefly interrupted the prevailing warmth and sunshine.

Precipitation

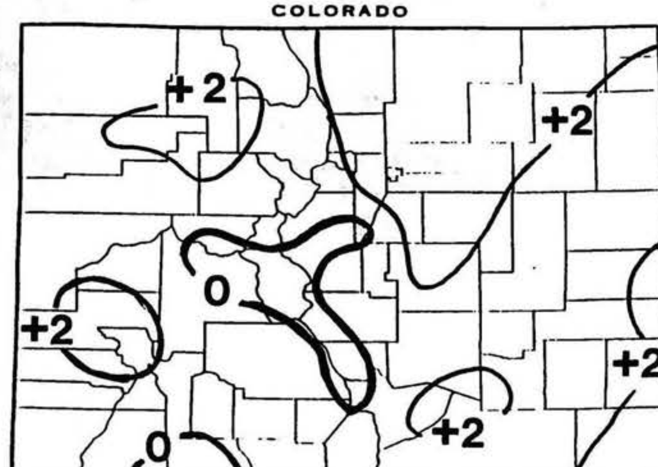
A few small pockets with above average precipitation were found in western Colorado in September, and a heavy storm late on August 31 made Sterling an isolated wet spot east of the mountains. Otherwise, the month was much drier than average for most locations. Most of the storm systems in September came from the Pacific and passed Colorado too quickly to tap any moisture from the Gulf of Mexico. The result was a clear line of demarkation with almost no precipitation falling east of the mountain crest.



September 1992 precipitation as a percent of the 1961-1990 average.

Temperatures

The early freeze that some Coloradans feared (due to the unusually cool summer) failed to materialize, and most of Colorado's major cropland and garden areas made it through September without a killing freeze. There were plenty of ups and downs in daily temperatures east of the mountains, while the Western Slope enjoyed more consistent temperatures. For the month as a whole, almost all of Colorado was warmer than average. Most areas were one or two degrees above average, but some parts of northeast Colorado was more than three degrees F warmer than usual. Slightly cooler than average temperatures were observed in parts of central and southwest Colorado.



Departure of September 1992 temperatures from the 1961-90 averages.

Inside This Issue

SEPTEMBER 1992 DAILY WEATHER

1-4 September 1st was cooler than average as a disturbance aloft crossed the State. Locally heavy storms that had developed on the 31st continued into the early morning over portions of eastern Colorado. Sterling reported 1.94". Some storms developed again during the day on the first. Eagle received 0.46". Warmer and mostly dry weather covered the State 2-3rd although a few scattered convective showers were noted on the 2nd. Clouds and winds increased on the 4th as a strong disturbance moved in from the west. Brief thunderstorms moved across parts of the mountains and Western Slope. Grand Junction reported a 64 mph wind gust. During the late evening, wind gusts to near 50 mph were reported along the Front Range. Some lightning was noted but little rain fell east of the mountains.

5-10 Colorado enjoyed dry weather. It was sunny but cool on the 5th. Clouds increased on the 6th as a Pacific cold front approached. Chilly air with some low clouds nosed into northeastern Colorado on the 7th, but much of the rest of the State was sunny and mild. The 8th was warm with temperatures in the 80s in many areas. A rainless cold front raced across northern Colorado early on the 9th accompanied by gusty winds. Almost no change in the mild, dry weather was noted from the mountains westward, but eastern Colorado cooled significantly with temperatures only rising into the 60s and 70s on the 9-10th despite bright sunshine.

11-13 After a chilly morning (23° at Fraser), high clouds moved in from the west and temperatures rose rapidly. Denver reached 90° on the 11th. Las Animas and Holly hit 100° and 102°F, respectively on the 12th. Late that day, another gusty, dry cold front pushed across northern Colorado. Winds gusted over 50 mph in parts of the northern Front Range, and a few snowflakes fell high in the mountains. The 13th was dry, breezy and still quite warm.

14-17 Low pressure developed off the California coast, and southwesterly winds over the West brought moisture into western Colorado and warm weather to the entire State. A few showers developed in southwest Colorado on the 14th. Storms were most numerous on the 15th with lighter and more scattered showers continuing across western Colorado 16-17th. A few spilled into eastern Colorado. In parts of northeastern Colorado temperatures rose above 80° each day 11-17th, the longest stretch of warm weather of the entire summer. Hollys' 103° on the 16th was the warmest temperature for the month. A strong cold front on the 17th then rushed across northern and eastern Colorado accompanied by strong winds, brief thunder and sprinkles.

18-21 Temperatures were much cooler east of the mountains on the 18th. Meanwhile, a weak but moist upper-level disturbance drifted toward Colorado. Rains began over southwest Colorado on the evening of the 18th and dropped more than 1" at several locations by midday on the 19th (1.02" at Cortez, 1.11" at Durango, and 1.80" at Wolf Creek Pass). Lighter rains fell elsewhere in western Colorado, but only a few showers crossed the mountains leaving most of eastern Colorado dry. An exception was a small portion of southeast Colorado. The Pueblo airport received 0.69" of rain from a thunderstorm on the 19th. Then a secondary disturbance triggered scattered storms on the 20th. Rifle recorded 0.91". Brief scattered showers damped parts of eastern Colorado on the 21st as winds aloft shifted to a northwesterly direction.

22-24 High pressure brought clear skies and above average temperatures to all of Colorado 22-23rd. Clouds and winds increased on the 24th in advance of a new Pacific cold front, but temperatures still managed to soar to record or near record levels at several locations. Denver's 89° reading set a new record for the date. Fort Morgan hit 90°F.

25-30 A strong cold front crossed Colorado early on the 25th bringing a dose of mountain snow and valley rains and even some nocturnal thunder to the Northern and Central mountains. Walden received 0.38" of moisture including an inch of snow – their first of the year. Winter Park got 3" of snow. Again, the moisture evaporated east of the mountains, and only a few sprinkles were reported. Skies cleared and temperatures dropped to their coldest levels of the month. Several mountain stations reported 18° on the morning of the 26th, and some valleys reported their first freeze of the fall. Except for another dry cool front late on the 27th, the remainder of the month was sunny and mild. With very low humidities, huge day-night temperature ranges were observed. Forty to 50-degree temperature swings were common. The most impressive report came from Browns Park Refuge in northwest Colorado on the 30th – a morning low of 23° and an afternoon high of 86°F. How do you dress for that?

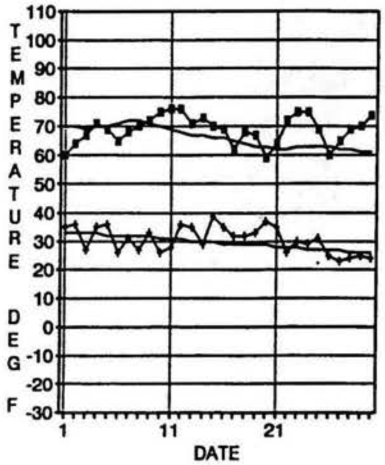
Weather Extremes

Highest Temperature	103°F	September 16	Holly
Lowest Temperature	14°F	September 26, 27	Antero Reservoir, Climax, Hermit, Bonham Reservoir
Greatest Total Precipitation	3.47"		Wolf Creek Pass 1E
Least Total Precipitation	0.00"		Evergreen, Eads, and 7 other eastern Colorado locations, also numerous Traces.
Greatest Total Snowfall	3"		Winter Park

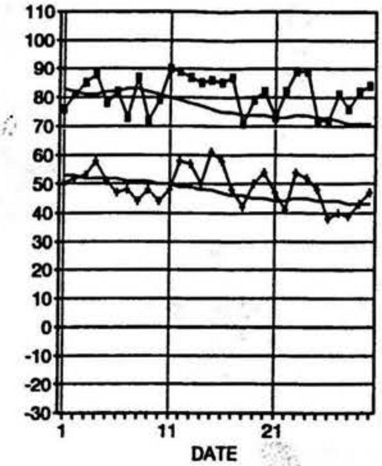
SEPTEMBER 1992 TEMPERATURE COMPARISON

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.)

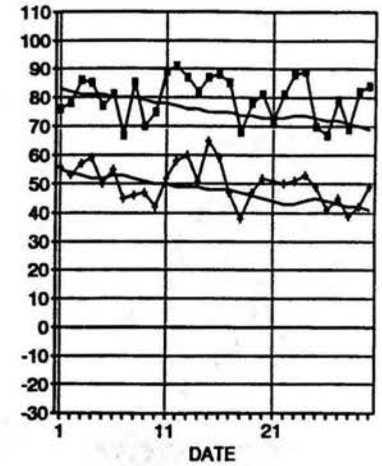
GRAND LAKE 1NW



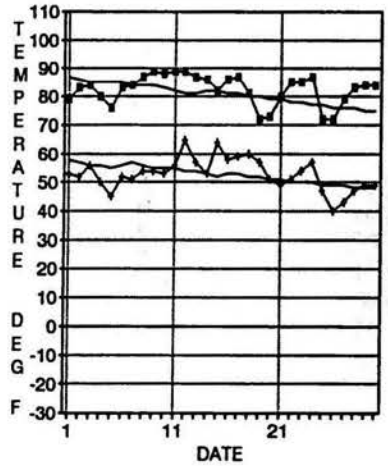
DENVER



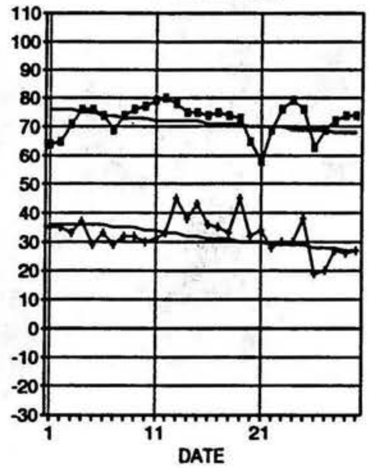
AKRON 1N



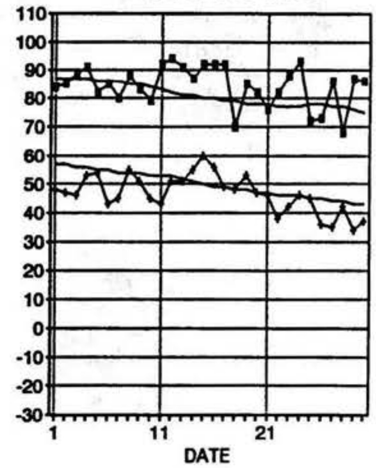
GRAND JUNCTION



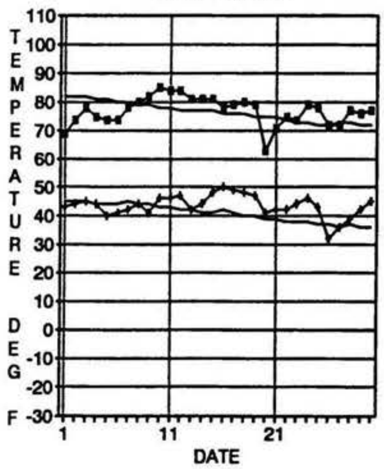
GUNNISON



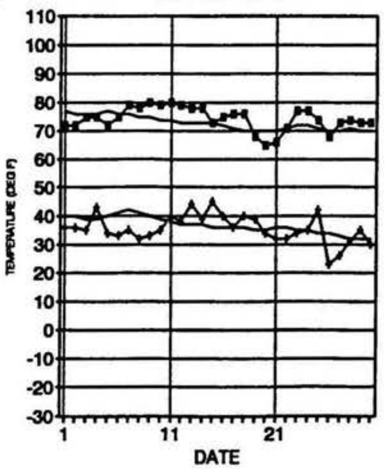
PUEBLO WSO



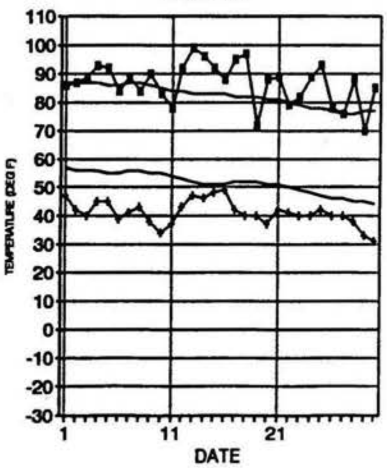
DURANGO



ALAMOSA



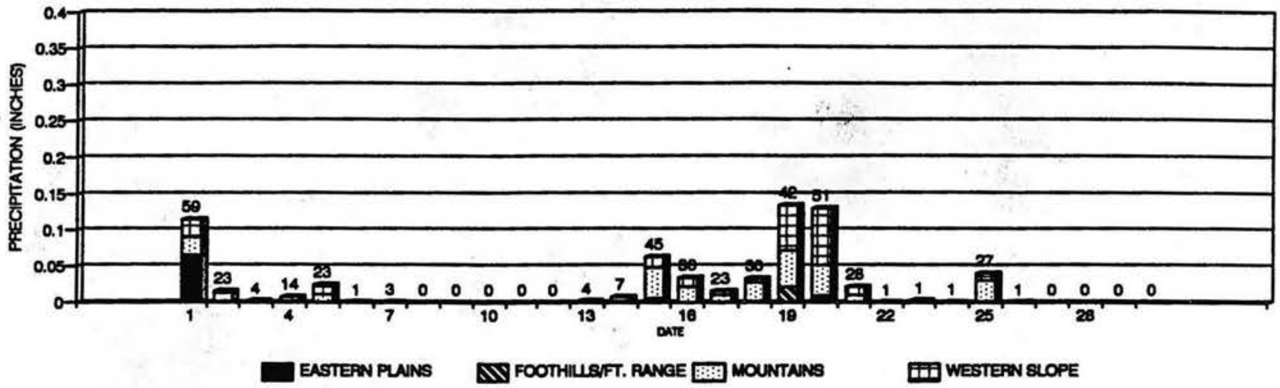
LAMAR



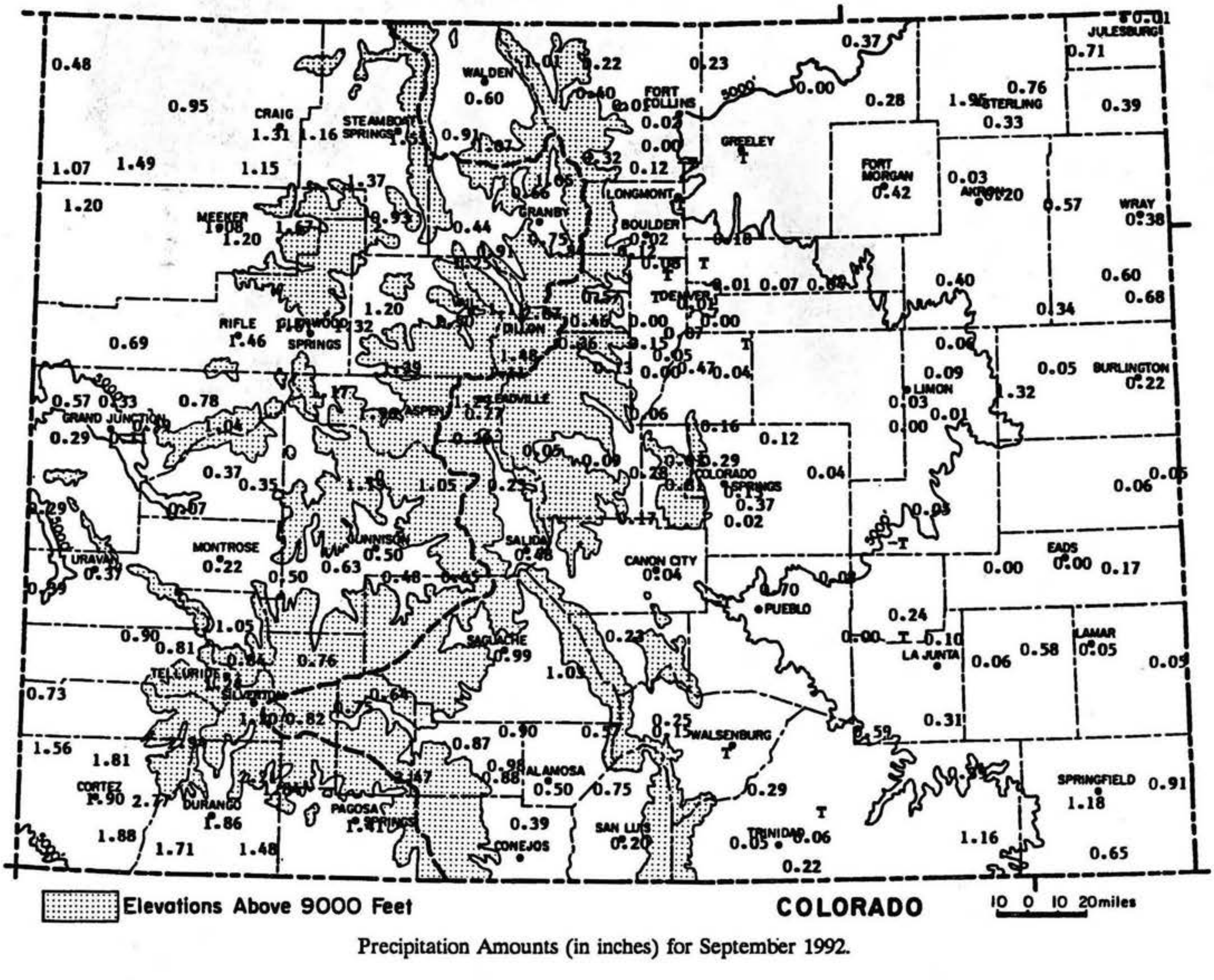
SEPTEMBER 1992 PRECIPITATION

The September daily distribution of precipitation changed markedly from the summer months when scattered storms developed almost every day. At this time of year, consecutive days with dry weather statewide is a common trait of our climate and is evident in this month's data. Most of the September precipitation fell early in the month and again in the episode September 14-20th. Some Septembers bring a large, widespread precipitation even to Colorado, but this did not occur this year. Overall, precipitation was well below average.

COLORADO DAILY PRECIPITATION - SEP 1992

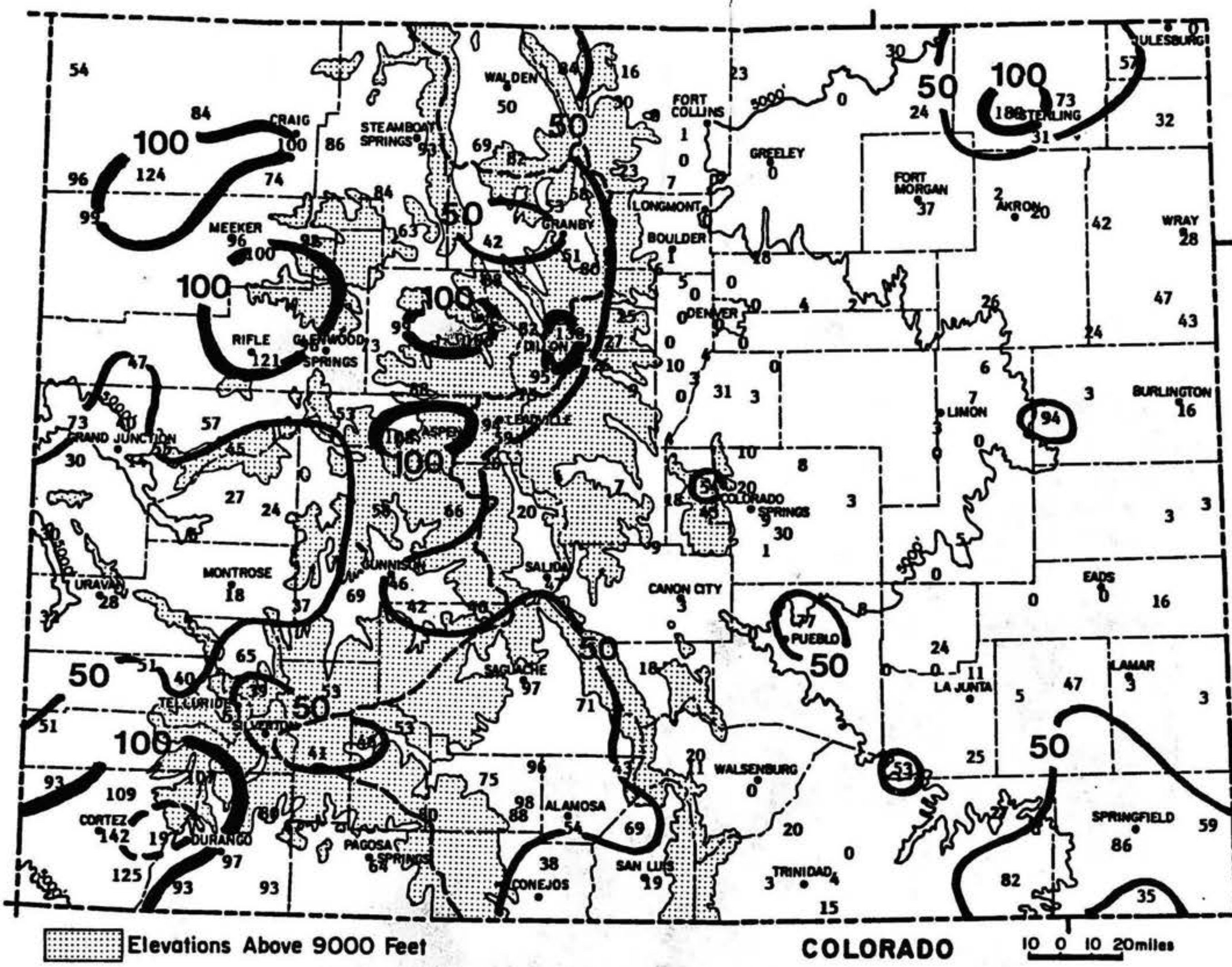


(due to differences in time of observation at official weather stations, precipitation may appear on more days than it actually fell)

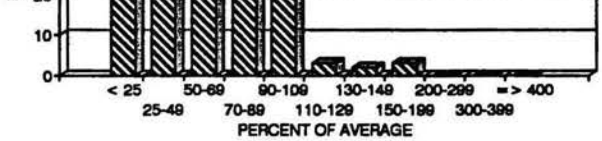


Precipitation Amounts (in inches) for September 1992.

SEPTEMBER 1992 PRECIPITATION COMPARISON



September 1992 Precipitation as a Percent of the 1961–90 average.



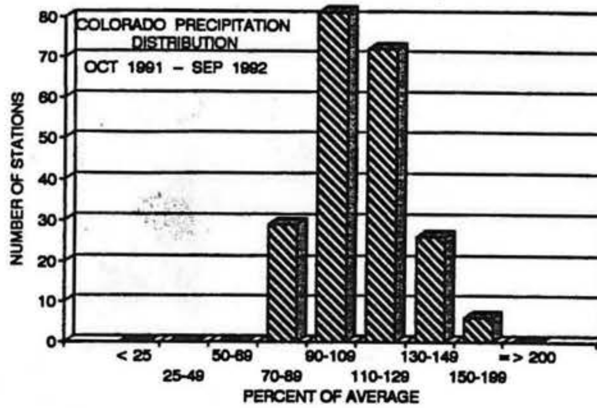
The majority of Colorado's weather stations received below average precipitation in September. 43% of the reporting sites received less than 25% of their average moisture. Historically, dry Septembers are fairly common. Most stations have had several occurrences in the past century with less than 0.10" of moisture.

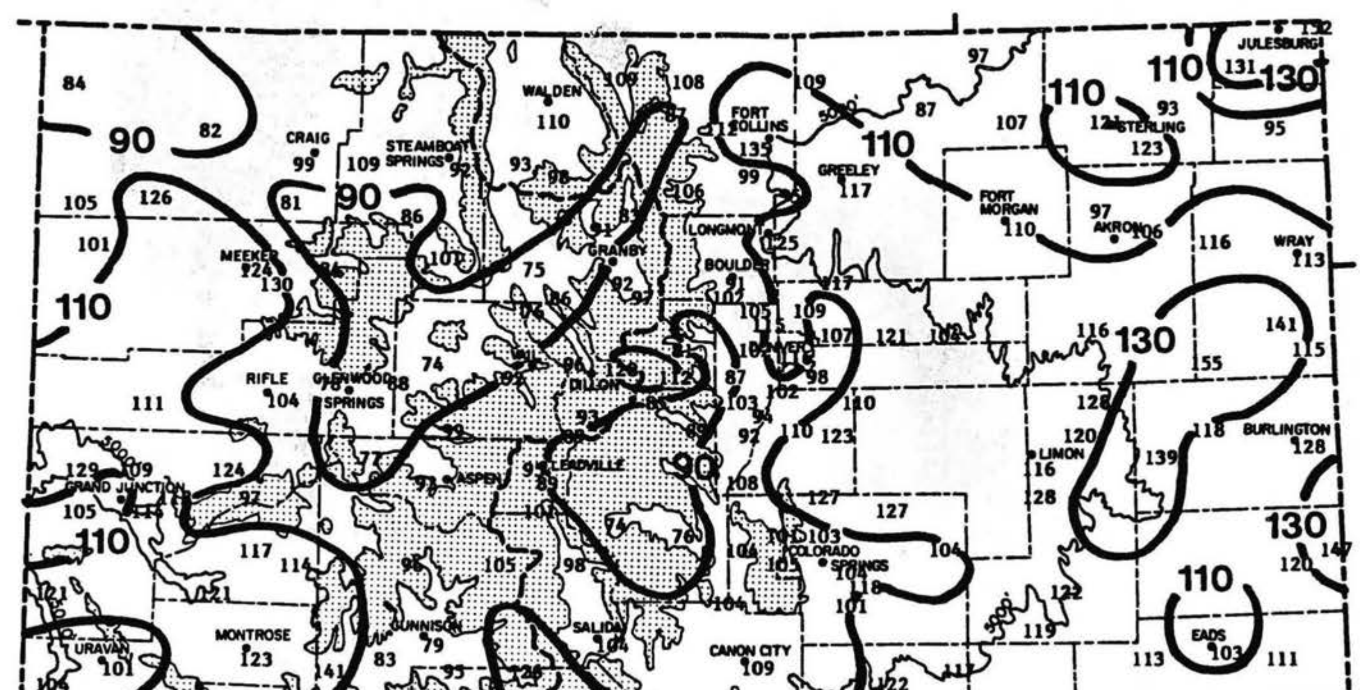
SEPTEMBER 1992 PRECIPITATION RANKING FOR SELECTED COLORADO CITIES

Station	Precip.	Rank
Denver	0.01"	3rd driest in 121 years of record (driest = <0.01" 1944 and 1892)
Durango	1.86"	47th wettest in 99 years of record (wettest = 7.36" in 1927)
Grand Junction	0.33"	24th driest in 101 years of record (driest = <0.01" in 1953, 1944, 1901, 1892)
Las Animas	0.06"	7th driest in 127 years of record (driest = <0.01" in 1983 and 8 prior yrs)
Pueblo	0.70"	57th wettest in 124 years of record (wettest = 4.50" in 1875)
Steamboat Springs	1.55"	40th wettest in 88 years of record (wettest = 8.15" in 1961)

1992 WATER YEAR PRECIPITATION

Our special feature this month – "A Review of the 1992 Water Year" (pages 10-12) – will be our complete wrap-up and evaluation of the 1992 water year. The dry September weather caused a slight expansion of drier than average water-year conditions across the State, but little overall change in the statewide pattern was noted. The year ended up wetter than average over nearly all of eastern Colorado. The San Luis Valley and portions of southwest Colorado were also quite wet. Drier than average conditions emerged early in the 1992 water year over the higher mountains and northwestern valleys from Silverton northward to Wyoming. These areas improved somewhat through the year but still ended up with only 80 to 95% of their average precipitation. Isolated valley locations such as Eagle, Kremmling and South Park received only about 75% of average for the year. Overall, no areas of Colorado were extremely dry for the year (less than 70% of average), 13% of the State was dry (70-89% of average), 39% was near average (90-110% of average) 33% was wet (111-130% of average) and 15% was very wet (>130% of average).





October 1991–September 1992 Precipitation as a Percent of the 1961-90 averages.

COMPARATIVE HEATING DEGREE DAY DATA FOR SEPTEMBER 1992

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	40	100	303	657	1074	1457	1519	1182	1035	732	453	165	8717
	91-92	33	51	280	630	1263	1849	1963	1459	1093	535	350	179	9685
	92-93	97	131	295										523
ASPEN	AVE	95	150	348	651	1029	1339	1376	1162	1116	798	524	262	8850
	91-92	104	112	335	610	1106	1369	1410	1124	980	660	487	351	8648
	92-93	249	228	361										838
BOULDER	AVE	0	6	130	357	714	908	1004	804	775	483	220	59	5460
	91-92	17	7	121	403	831	911	901	700	664	321	192	93	5161
	92-93	20	55	71										146
BUENA	AVE	47	116	285	577	936	1184	1218	1025	983	720	459	184	7734
VISTA	91-92	63	87	M	580	1056	1265	1246	1048	901	568	391	247	M
	92-93	107	148	305										560
BURLINGTON	AVE	6	5	108	364	762	1017	1110	871	803	459	200	38	5743
	91-92	13	14	106	462	903	1004	1021	751	639	360	173	61	5507
	92-93	5	39	74										118
CANON	AVE *	0	10	100	330	670	870	950	770	740	430	190	40	5100
CITY	91-92	8	0	105	379	800	945	870	688	604	331	167	63	4960
	92-93	2	29	73										104
COLORADO	AVE	8	25	162	440	819	1042	1122	910	880	564	296	78	6346
SPRINGS	91-92	16	16	145	453	954	1048	998	788	717	383	219	96	5833
	92-93	21	53	91										165
CORTEZ	AVE *	5	20	160	470	830	1150	1220	950	850	580	330	100	6665
	91-92	13	8	161	423	947	1227	1310	892	744	458	266	114	6563
	92-93	18	42	122										182
CRAIG	AVE	32	58	275	608	996	1342	1479	1193	1094	687	419	193	8376
	91-92	27	13	230	582	1080	1517	1556	1078	809	497	270	161	7820
	92-93	67	64	234										365
DELTA	AVE	0	0	94	394	813	1135	1197	890	753	429	167	31	5903
	91-92	0	2	88	383	832	1302	1486	874	625	273	86	29	5980
	92-93	6	M	71										M
DENVER	AVE	0	0	135	414	789	1004	1101	879	837	528	253	74	6014
	91-92	6	4	118	449	902	982	1022	714	673	309	158	35	5372
	92-93	10	35	58										103
DILLON	AVE	273	332	513	806	1167	1435	1516	1305	1296	972	704	435	10754
	91-92	316	321	521	788	1210	1447	1517	1306	1144	805	609	458	10442
	92-93	364	381	525										1270
DURANGO	AVE	9	34	193	493	837	1153	1218	958	862	600	366	125	6848
	91-92	6	2	152	379	940	1179	1305	935	745	430	267	123	6463
	92-93	34	49	139										222
EAGLE	AVE	33	80	288	626	1026	1407	1448	1148	1014	705	431	171	8377
	91-92	26	6	208	563	972	1358	1387	970	809	466	289	150	7204
	92-93	47	73	209										329
EVERGREEN	AVE	59	113	327	621	916	1135	1199	1011	1009	730	489	218	7827
	91-92	83	92	311	627	988	1078	1123	939	887	541	410	242	7321
	92-93	103	167	238										508
FORT	AVE	5	11	171	468	846	1073	1181	930	877	558	281	82	6483
COLLINS	91-92	11	1	145	457	891	1002	1029	736	681	356	193	56	5558
	92-93	22	55	87										164
FORT	AVE	0	6	140	438	867	1156	1283	969	874	516	224	47	6520
MORGAN	91-92	5	4	89	437	947	1025	1193	756	652	332	163	41	5644
	92-93	12	40	38										90
GRAND	AVE	0	0	65	325	762	1138	1225	882	716	403	148	19	5683
JUNCTION	91-92	0	2	37	304	815	1193	1390	788	608	195	53	8	5393
	92-93	0	6	25										31

* = 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	264	468	775	1128	1473	1593	1369	1318	951	654	384	10591
LAKE	91-92	220	255	427	739	1169	1468	1735	1354	1118	751	534	383	10153
6SSW	92-93	277	311	442										1030
GREELEY	AVE	0	0	149	450	861	1128	1240	946	856	522	238	52	6442
	91-92	8	5	119	450	925	1011	1088	724	665	310	181	37	5523
	92-93	14	43	59										116
GUNNISON	AVE	111	188	393	719	1119	1590	1714	1422	1231	816	543	276	10122
	91-92	131	151	371	698	1120	1597	1707	1167	940	661	452	292	9287
	92-93	208	M	M										M
LAS	AVE	0	0	45	296	729	998	1101	820	698	348	102	9	5146
ANIMAS	91-92	1	3	59	350	896	966	943	712	539	242	107	24	4842
	92-93	0	11	33										44
LEADVILLE	AVE	272	337	522	817	1173	1435	1473	1318	1320	1038	726	439	10870
	91-92	343	364	538	826	1245	1461	1471	1296	1186	852	656	495	10733
	92-93	383	435	536										1354
LIMON	AVE	8	6	144	448	834	1070	1156	960	936	570	299	100	6531
	91-92	19	14	171	503	1000	1095	1161	827	734	436	272	104	6336
	92-93	16	54	133										203
LONGMONT	AVE	0	6	162	453	843	1082	1194	938	874	546	256	78	6432
	91-92	12	6	133	489	936	1047	1124	786	730	391	201	60	5915
	92-93	20	61	77										158
MEEKER	AVE	28	56	261	564	927	1240	1345	1086	998	651	394	164	7714
	91-92	24	7	221	553	1003	1367	1490	1025	758	446	280	138	7312
	92-93	23	44	152										219
MONTROSE	AVE	0	10	135	437	837	1159	1218	941	818	522	254	69	6400
	91-92	0	0	135	404	901	1312	1385	911	683	324	176	48	6279
	92-93	15	43	87										145
PAGOSA	AVE	82	113	297	608	981	1305	1380	1123	1026	732	487	233	8367
SPRINGS	91-92	44	37	289	568	1116	1362	1477	1087	899	577	392	251	8099
	92-93	120	126	317										563
PUEBLO	AVE	0	0	89	346	744	998	1091	834	756	421	163	23	5465
	91-92	1	0	76	380	927	1014	958	759	608	309	125	41	5198
	92-93	0	15	58										73
RIFLE	AVE	6	24	177	499	876	1249	1321	1002	856	555	298	82	6945
	91-92	1	1	143	475	906	1185	1283	804	660	352	142	57	6009
	92-93	12	31	113										156
STEAMBOAT	AVE *	90	140	370	670	1060	1430	1500	1240	1150	780	510	270	9210
SPRINGS	91-92	127	141	394	742	1140	1626	1680	1126	863	595	383	263	9080
	92-93	160	119	316										595
STERLING	AVE	0	6	157	462	876	1163	1274	966	896	528	235	51	6614
	91-92	5	1	92	437	930	1028	1191	731	645	352	142	36	5590
	92-93	14	36	70										120
TELLURIDE	AVE	163	223	396	676	1026	1293	1339	1151	1141	849	589	318	9164
	91-92	175	163	339	595	1013	1264	1291	1057	946	565	450	285	8143
	92-93	180	189	313										682
TRINIDAD	AVE	0	0	86	359	738	973	1051	846	781	468	207	35	5544
	91-92	3	2	107	377	876	1004	946	774	642	289	186	50	5256
	92-93	0	18	61										79
WALDEN	AVE	198	285	501	822	1170	1457	1535	1313	1277	915	642	351	10466
	91-92	193	209	452	776	1217	1422	1547	1234	1025	700	500	349	9624
	92-93	270	283	433										986
WALSENBURG	AVE	0	8	102	370	720	924	989	820	781	501	240	49	5504
	91-92	6	5	90	337	818	915	870	717	634	309	163	60	4924
	92-93	5	29	54										88

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

SEPTEMBER 1992 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	75.8	42.3	59.1	1.1	86	24	189	19	400	0.37	-0.83	30.8	5
STERLING	82.9	47.0	64.9	3.2	93	34	70	78	495	1.95	0.92	189.3	2
FORT MORGAN	84.7	47.4	66.0	3.5	92	37	38	78	515	0.42	-0.71	37.2	2
AKRON FAA AP	79.4	50.0	64.7	2.8	91	38	81	81	481	0.03	-1.00	2.9	1
AKRON 4E	80.6	46.1	63.3	1.0	92	30	100	54	466	0.20	-0.78	20.4	3
HOLYOKE	78.1	49.1	63.6	0.9	90	36	99	66	460	0.39	-0.82	32.2	3
JOES	80.6	47.0	63.8	0.5	94	33	83	57	470	0.34	-1.06	24.3	1
BURLINGTON	80.5	48.8	64.6	1.1	95	34	74	72	482	0.22	-1.11	16.5	1
LIMON WSMO	77.3	44.9	61.1	1.2	89	33	133	20	420	0.03	-0.87	3.3	1
CHEYENNE WELLS	84.2	50.5	67.3	3.0	98	38	37	114	531	0.06	-1.69	3.4	2
EADS	83.4	49.2	66.3	1.0	96	38	58	104	508	0.00	-1.36	0.0	0
ORDWAY 21N	85.0	45.2	65.1	1.5	94	36	53	65	502	0.00	-0.95	0.0	0
ROCKY FORD 2SE	88.0	47.8	67.9	1.9	96	35	30	123	547	0.00	-0.97	0.0	0
LAMAR	86.8	41.0	63.9	-2.6	99	31	73	48	504	0.05	-1.28	3.8	1
LAS ANIMAS	87.0	50.6	68.8	1.3	100	38	33	154	550	0.06	-1.12	5.1	1
HOLLY	86.3	50.1	68.2	2.4	103	35	36	137	544	0.05	-1.59	3.0	1
SPRINGFIELD 7WSW	84.4	51.3	67.9	2.1	95	40	24	118	544	1.18	-0.19	86.1	4
TIMPAS 13SW	83.9	51.1	67.5	2.1	94	40	41	121	534	0.59	-0.51	53.6	2

FOOTHILLS/ADJACENT PLAINS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
FORT COLLINS	78.5	46.9	62.7	2.5	87	36	87	28	454	0.02	-1.28	1.5	2
GREELEY UNC	81.5	47.4	64.4	2.3	92	38	59	50	489	0.00	-1.10	0.0	0
ESTES PARK	71.7	40.8	56.2	2.7	78	28	257	1	337	0.32	-1.02	23.9	6
LONGMONT 2ESE	83.5	44.6	64.0	3.3	94	34	77	57	491	0.00	-1.34	0.0	0
BOULDER	79.4	49.4	64.4	3.4	89	36	71	58	483	0.02	-1.88	1.1	1
DENVER WSFO AP	81.4	49.0	65.2	2.9	90	38	58	74	497	0.01	-1.24	0.8	1
EVERGREEN	75.1	38.5	56.8	2.7	84	29	238	0	382	0.00	-1.41	0.0	0
CHEESMAN	76.4	32.2	54.3	-2.2	85	22	314	0	403	0.06	-1.25	4.6	1
LAKE GEORGE 8SW	68.9	35.5	52.2	0.4	77	26	375	0	292	0.09	-1.10	7.6	3
ANTERO RESERVOIR	67.7	29.3	48.5	-0.2	76	18	487	0	274	0.05	-0.97	4.9	1
RUXTON PARK	65.6	31.4	48.5	1.0	75	23	487	0	240	0.81	-0.97	45.5	2
COLORADO SPRINGS	78.3	47.4	62.8	2.2	88	35	91	32	439	0.13	-1.20	9.8	3
CANON CITY 2SE	79.8	48.1	63.9	1.3	88	35	73	50	474	0.04	-1.20	3.2	1
PUEBLO WSO AP	84.5	46.7	65.6	-0.0	94	34	58	82	512	0.70	-0.20	77.8	2
WESTCLIFFE	72.2	35.3	53.8	-0.3	79	21	327	0	341	0.23	-1.04	18.1	2
WALSENBURG	81.5	49.1	65.3	2.5	88	35	54	70	515	0.00	-1.19	0.0	0
TRINIDAD FAA AP	81.8	48.7	65.2	1.4	91	33	61	76	502	0.00	-1.23	0.0	0

MOUNTAINS/INTERIOR VALLEYS

Name	Temperature Max	Min	Mean	Dep	High	Low	Degree Days Heat	Cool	Grow	Precipitation Total	Dep	%Norm	# days
WALDEN	69.0	31.8	50.4	1.8	77	19	433	0	291	0.60	-0.59	50.4	5
LEADVILLE 2SW	63.1	30.6	46.8	0.4	70	23	536	0	203	0.77	-0.53	59.2	9
SALIDA	74.9	37.8	56.3	-0.3	82	24	254	0	380	0.48	-0.54	47.1	5
BUENA VISTA	72.3	36.9	54.6	-0.5	79	29	305	0	345	0.23	-0.90	20.4	5
SAGUACHE	72.1	37.6	54.8	0.7	79	31	298	0	338	0.99	-0.03	97.1	5
HERMIT 7ESE	69.0	27.9	48.4	0.8	76	18	489	0	294	0.75	-0.86	46.6	2
ALAMOSA WSO AP	74.4	35.6	55.0	0.3	80	23	295	0	373	0.50	-0.41	54.9	4
STEAMBOAT SPRINGS	74.4	34.1	54.3	2.1	84	25	316	0	375	1.55	-0.10	93.9	11
YAMPA	70.9	41.0	55.9	4.1	79	29	266	0	319	0.93	-0.53	63.7	9
GRAND LAKE 1NW	68.8	30.7	49.7	1.7	76	23	451	0	290	1.05	-0.73	59.0	13
GRAND LAKE 6SSW	68.0	32.1	50.0	0.6	76	23	442	0	278	0.66	-0.58	53.2	11
DILLON 1E	63.3	31.1	47.2	-0.6	72	23	525	0	210	1.11	-0.24	82.2	9
CLIMAX	58.5	32.0	45.2	2.0	68	18	585	0	137	1.11	-0.41	73.0	7
ASPEN 1SW	68.4	37.2	52.8	-0.2	76	26	361	0	283	1.96	0.16	108.9	14
CRESTED BUTTE	65.1	29.6	47.4	-0.9	73	19	525	0	237	1.19	-0.84	58.6	10
TAYLOR PARK	61.5	31.8	46.6	-0.4	69	22	545	0	181	1.05	-0.54	66.0	6
TELLURIDE	73.6	35.1	54.3	2.3	84	23	313	0	362	1.24	-1.18	51.2	8
PAGOSA SPRINGS	73.6	34.8	54.2	-0.7	81	24	317	0	361	1.41	-0.78	64.4	6
SILVERTON	65.2	30.0	47.6	0.4	73	24	514	0	238	1.20	-1.59	43.0	9
WOLF CREEK PASS 1	60.5	34.6	47.5	2.4	70	26	519	0	164	3.47	-0.85	80.3	8

WESTERN VALLEYS

Name	Temperature						Degree Days			Precipitation			
	Max	Min	Mean	Dep	High	Low	Heat	Cool	Grow	Total	Dep	%Norm	# days
CRAIG 4SW	73.4	40.5	56.9	0.2	83	31	234	0	357	1.31	0.01	100.8	11
HAYDEN	75.2	39.7	57.5	1.4	84	27	219	0	384	0.86	-0.48	64.2	9
MEEKER NO. 2	79.0	40.6	59.8	2.6	86	28	152	3	443	1.08	-0.04	96.4	10
RANGELY 1E	79.3	46.4	62.8	1.7	86	36	78	22	455	1.20	-0.01	99.2	5
EAGLE FAA AP	77.1	38.4	57.7	2.0	85	27	209	0	416	1.20	-0.01	99.2	9
GLENWOOD SPRINGS	77.5	41.8	59.6	0.4	85	31	153	0	420	1.61	-0.05	97.0	7
RIFLE	81.1	41.1	61.1	1.0	90	29	113	2	466	1.46	0.26	121.7	6
GRAND JUNCTION WS	82.5	52.9	67.7	0.9	89	40	25	114	546	0.33	-0.48	40.7	4
CEDAREDGE	81.4	43.6	62.5	0.8	89	31	83	16	476	0.37	-0.98	27.4	3
PAONIA 1SW	80.2	48.9	64.6	2.3	88	38	54	51	473	0.35	-1.09	24.3	4
DELTA	82.6	45.0	63.8	1.1	91	33	71	42	492	0.07	-0.97	6.7	2
COCHETOPA CREEK	72.7	32.5	52.6	1.0	80	19	365	0	347	0.48	-0.66	42.1	4
MONTROSE NO. 2	78.5	46.1	62.3	0.8	86	32	87	13	440	0.22	-0.95	18.8	2
URAVAN	85.5	49.2	67.3	1.5	94	38	27	104	540	0.37	-0.93	28.5	5
NORWOOD	75.0	43.3	59.1	2.2	82	30	171	4	388	0.90	-0.85	51.4	3
YELLOW JACKET 2W	78.4	45.4	61.9	1.3	86	35	97	11	432	1.56	-0.11	93.4	3
CORTEZ	78.6	43.3	60.9	1.5	87	31	122	8	436	1.90	0.57	142.9	5
DURANGO	77.0	43.4	60.2	1.3	85	32	139	2	412	1.86	-0.05	97.4	6
IGNACIO 1N	75.6	39.5	57.5	-0.7	83	30	215	0	391	1.48	-0.10	93.7	6

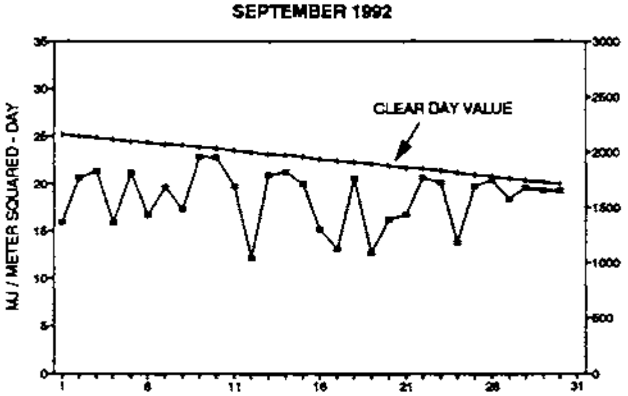
Data are received by the Colorado Climate Center for more locations than appear in these tables.
Please contact the Colorado Climate Center if additional information is needed.

SEPTEMBER 1992 SUNSHINE AND SOLAR RADIATION

	Number of Days			Percent Possible	Average % of
	CLR	PC	CLDY	Sunshine	Possible
Colorado Springs	13	13	4	–	–
Denver	13	13	4	76%	74%
Fort Collins	13	13	4	–	–
Grand Junction	16	9	5	83%	79%
Limon	11	14	5	–	–
Pueblo	16	13	1	93%	80%

CLR = Clear PC = Partly Cloudy CLDY= Cloudy

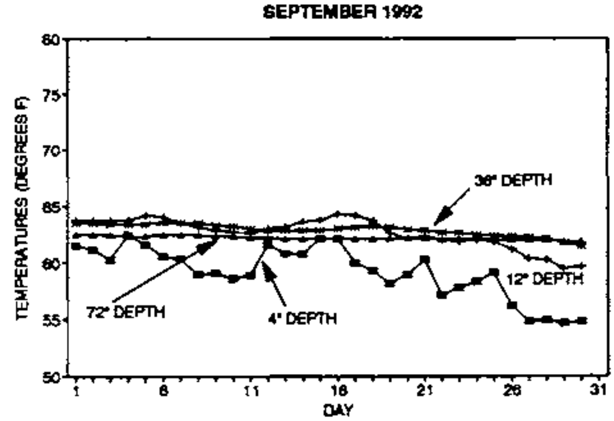
Sunshine and solar radiation were greater than average over much of Colorado. Sunshine was especially prevalent over southern Colorado. Historically, September is often a very sunny month.



SEPTEMBER 1992 SOIL TEMPERATURES

Near-surface soil temperatures declined reluctantly in September while deep soil temperatures remained near their peak for the summer. Overall, these values are quite typical for this time of 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.



HATS OFF TO: *Ronald Stauffer* of Buena Vista, Colorado

Mr. Stauffer has been taking the official weather observations in Buena Vista since 1977. Buena Vista is a place where storms often blow right over, but back on Halloween in 1986 Ron measured a 20" snowfall. Four months later a 19" storm hit. Thanks for your efforts, and keep up the fine work.

A REVIEW OF THE 1992 WATER YEAR

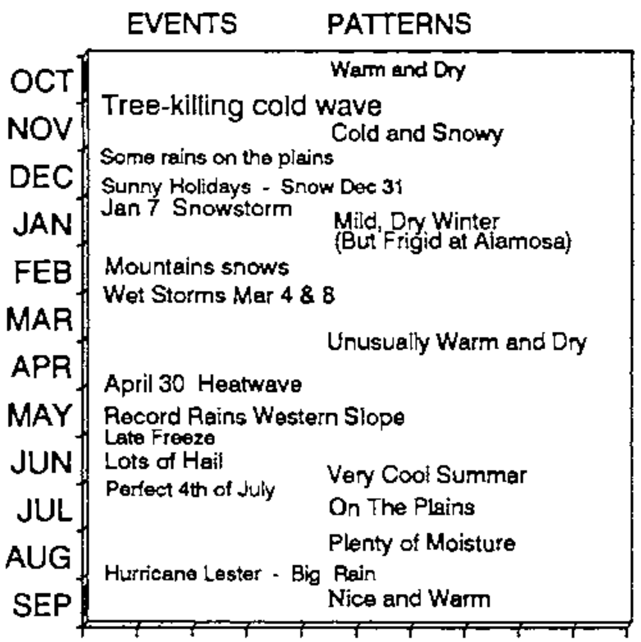
Significant Features

The year began 1 October 1991 and what a fine beginning it was. The first 3 weeks of October seemed like summer with lots of sunshine and temperatures in the 80s at lower elevations. After a brief transition through cooler and wetter autumn weather, winter hit with a vengeance. The coldest and snowiest weather for the entire winter for portions of eastern Colorado occurred during the unlikely period October 28 through November 3rd. Later we learned that this abrupt change to extreme cold took a terrible toll on Colorado in terms of Front Range and Eastern Plains vegetation. Many trees failed to drop their leaves until spring, and huge numbers of trees died or were badly damaged. The only other similar situation in recent memory occurred in October 1969 when subzero weather struck in mid month.

November continued cool and wet over most of the State. A major storm episode in mid-November accounted for most of the month's moisture and, in combination with the late October storm, helped get the winter recreation season in Colorado off to a great start. This proved to be a life saver for the industry as mountain precipitation became very sporadic for the remainder of the winter. It also proved to be the undoing of the San Luis Valley. Deep snowcover helped cold air collect in the valley creating a localized icebox that persisted until spring. For the State as a whole, the cold early-winter weather continued into the first week of December.

Little did we know at the time, but almost all of the worst winter weather was already behind us by December 3 (except in the San Luis Valley). From then until early March, storms were few, winds were light and there was a surprising and unusual lack of arctic air. One brief blast of wind and cold in mid January was the only time temperatures dipped below the zero mark east of the mountains for the remainder of winter. Denver only dropped below zero F once the entire winter (January 15) compared to an average of 9 days. There were a few significant winter storms, but none of them affected the entire State. It was also an unusual winter out on the Eastern Plains as lots of the November-February moisture came in the form of rain. The storm of January 7 over northeastern Colorado produced blizzard conditions and dropped locally very heavy precipitation for that normally-dry time of year. Mid-February storms that soaked California did contribute much-needed snowfall to the Colorado mountains.

1992 WATER YEAR HIGHLIGHTS



Just as mountain drought seemed inevitable, two spring storms hit Colorado in rapid succession in early March dropping as much moisture statewide in three days as had fallen during the entire previous 3 months. The storm of March 8-9 caught thousands of travellers by surprise and brought travel to a near stand-still for 18 hours along the Front Range urban corridor. More moisture fell late in March, but just as we expected our typical stormy spring weather, the weather pattern reverted to dry and mild.

The 1992 Growing Season

Warmer than average weather with very little moisture continued until late May east of the mountains. At the same time, a very unusual late-May surge of moisture brought record-breaking rains to southwest Colorado. Warm temperatures were conducive to a quick start for spring crops, but the lack of spring moisture east of the mountains gave a real scare to farmers and ranchers. The last frost occurred in late April across most low-elevation agricultural areas, but a surprise late-May coldwave brought destructive freezes to areas of extreme eastern Colorado.

The late-May cool spell established a trend that persisted until early September. One cold front after another dropped down from the north bringing much cooler than average conditions, especially east of the mountains. For eastern Colorado it ended up one of the 5 coolest summers in the past 100 years. Most other cool summers were in the early part of this century. Summer rainfall and cloudiness were also greater than average. In June, strong thunderstorms occurred almost every day in eastern Colorado. The frequency of hail (for which long-term records for comparison are not readily available) appeared to be as great as we have ever seen. Urban areas did not have the devastating storms that have characterized some recent years, but damage to crops was considerable. The cool, cloudy weather slowed crop development but also reduced water requirements. Most major watersheds had less than average streamflow as a result of the reduced winter snowpack and the dry spring. However,

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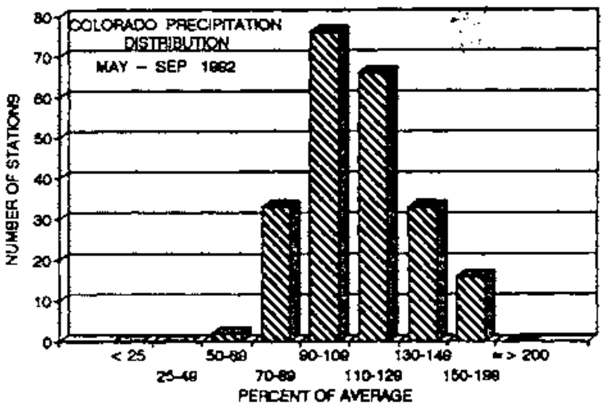
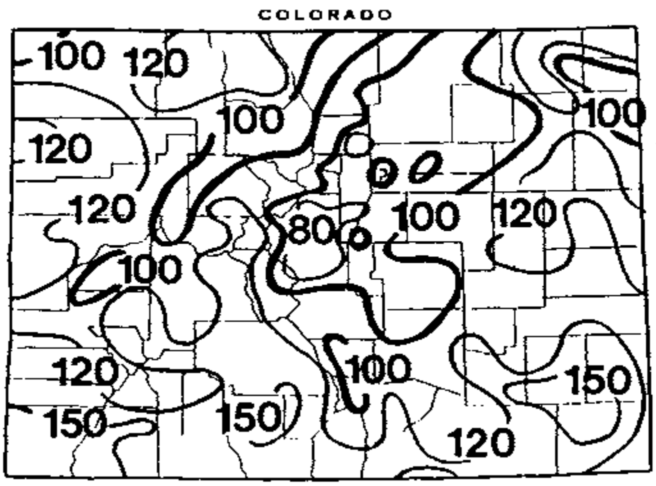
irrigation demands were noticeably reduced, and water supplies proved adequate in most areas. The culmination came August 23-25 when moisture left over from Pacific Hurricane Lester joined with an autumn-like Rocky Mountain storm system and produced widespread heavy rains and high-mountain snows. This ended up being the largest precipitation event of the year.

Some farmers wished for less rain and more sun to assist crop development. September came along and granted those wishes. Warmer than average temperatures, little rain and much sunshine allowed crops to mature properly. No early freeze occurred, and most crops yielded well.





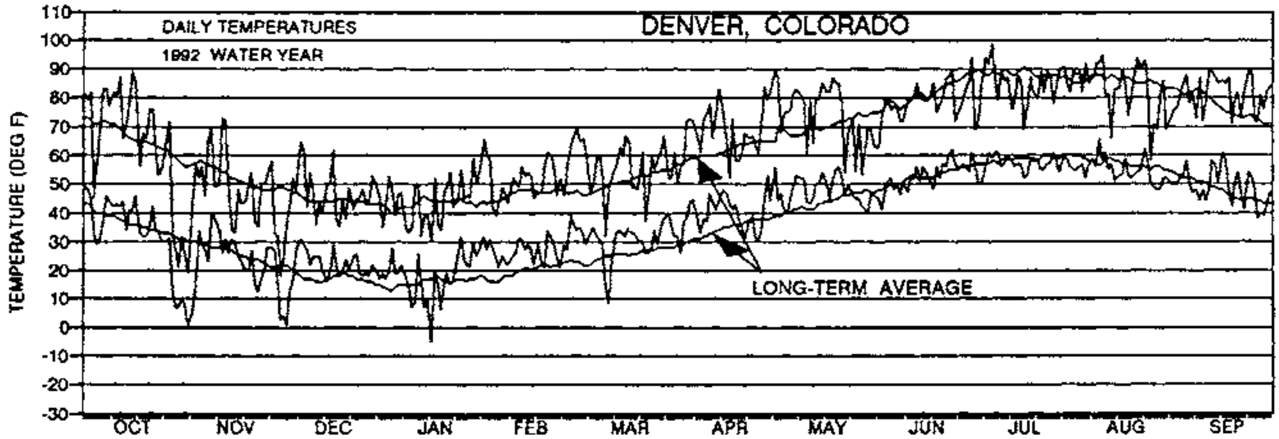
Precipitation for May-September 1992 as a percent of 1961-90 average.

Precipitation for the 1992 growing season May-September ranged from just 3.59" at Delta and 3.80" at Brown's Park Refuge to nearly 18" at Julesburg, 18.23" at Springfield 7WSW and a whopping 23.29" at Wolf Creek Pass. When compared to the 1961-1990 average (see figure on next page), most of the State was wetter than average with the only significant dry areas appearing in the South Platte Basin upstream from Fort Morgan and along a narrow band from Glenwood Springs northeastward to western Larimer County. Even these areas were only slightly below average. The most notable dry spots were South Park (<75% of average), where summer thunderstorm activity was markedly less than usual, and the immediate Boulder area (64% of average) where storms managed to miss them all summer until more than 2.33" fell August 23-25. Overall, 70% of Colorado's official reporting stations received above average growing season precipitation. Only 16% of State received less than 90% of average.

Temperature Summary

It was certainly an interesting and unique year in Colorado. Annual water-year temperatures, which probably have very little meaning but provide a basis for comparison, ended up near average over much of the State. Some areas of northern and eastern Colorado were more than one degree Fahrenheit above average. Alamosa ended up 3° cooler than average as a result or their localized extremely cold winter in combination with a cool summer. Except for the San Luis Valley, it would have been one of the warmer years on record in Colorado had it not been for the cool summer.

The graph below shows daily temperatures throughout the year at one example site. In addition to the destructive late-October coldwave, an interesting feature was the lack of polar air in mid-winter and a lack of any major summer heatwave. The result was a reduced annual temperature than normal in many locations. Fort Collins temperatures, for example, ranged from a low of -2°F on January 15 to a maximum of 94° in August. In most years, Fort Collins temperatures dip to at least -10° and rise into the upper 90s on a few days in summer. The combination of a mild winter, warm spring, warm September and cool summer made it a very comfortable year.



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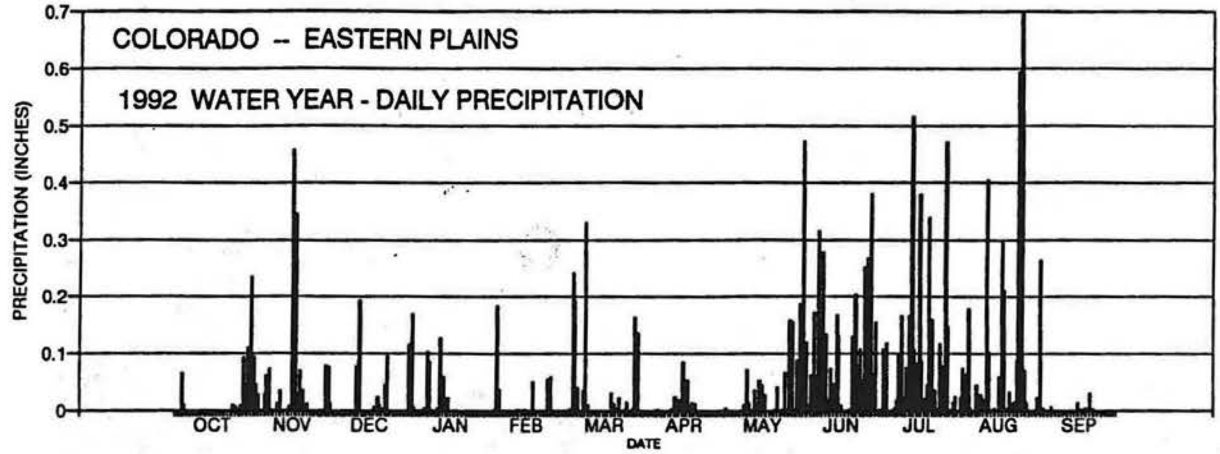
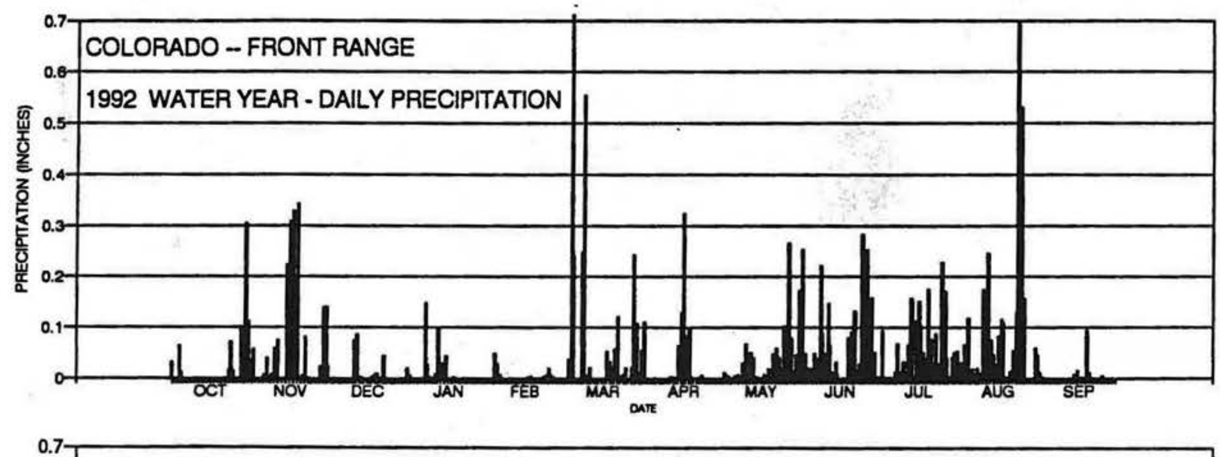
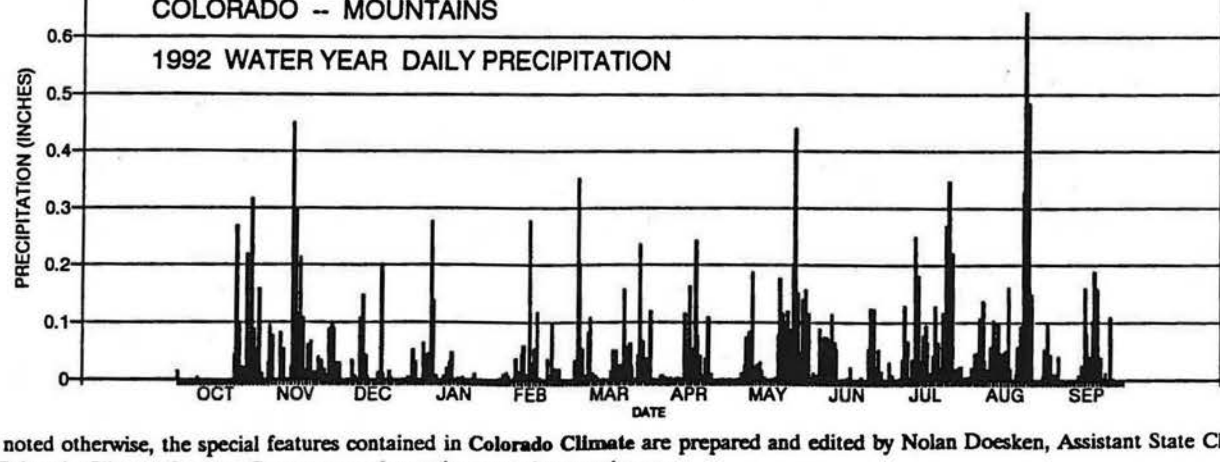
Precipitation Summary

The figures below show the daily distribution of precipitation through the year in four regions of the State. Very low precipitation was recorded at numerous sites in December, February, April, May and September. This was balanced by very wet monthly totals in portions of Colorado in November, March, and May-August. Total water-year precipitation at official National Weather Service cooperative stations ranged from a minimum of 7.14" at Browns Park Refuge to 47.60" at Wolf Creek Pass 1E. With respect to the 1961-1990 averages, the wettest site was Monte Vista Refuge. Their 13.32" water-year total was 185% of average. The driest site compared to average was the Eagle airport with 7.92", 74% of average. Numerous locations in eastern Colorado received more than 20.00" for the year.

Based on more than 200 reporting stations, water-year precipitation for 1992 was nearly 1.50" above average statewide. (Longterm average statewide precipitation is a little over 17".) In contrast, preliminary streamflow data for the major rivers in Colorado showed that water-year flows were at or below average. The Yampa River was one of the lowest in the State with only about 60% of the average flow. This demonstrates what happens when the seasonal distribution of precipitation varies. The relatively dry winter and late spring was largely responsible for the low streamflows, since the majority of runoff in Colorado originates as snowpack. The wet period from late May through August contributed greatly to the water-year precipitation surplus. Summer rains, even when excessive, contribute primarily to evapotranspiration and have only a small effect on streamflow.







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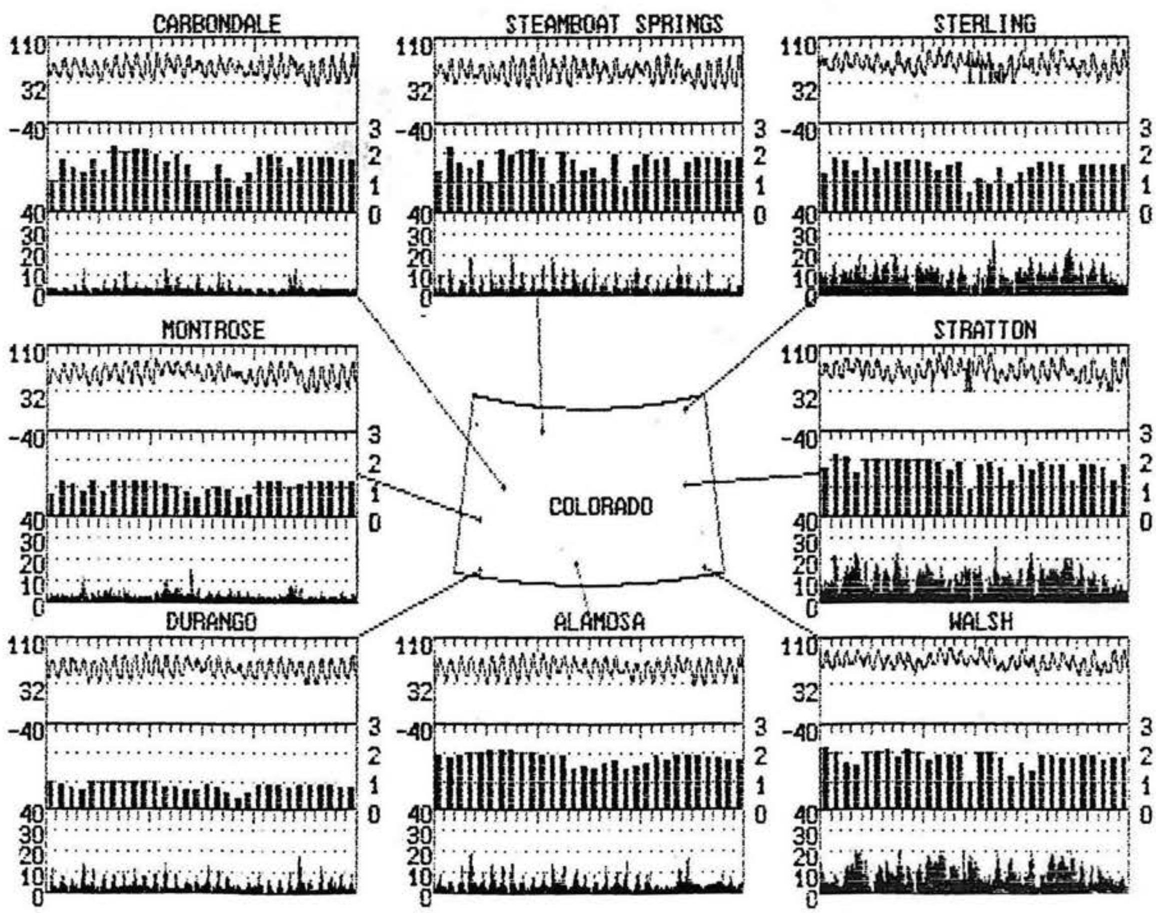
	Alamosa	Durango	Carbondale	Montrose	Steamboat Springs	Sterling	Stratton	Walsh
monthly average temperature (°F)	55.5	55.0	55.6	59.6	50.8	62.5	64.2	66.8
monthly temperature extremes and time of occurence (°F day/hour)								
maximum:	81.0 9/15	79.9 10/15	83.7 11/14	84.9 11/15	82.9 11/13	91.0 12/15	96.6 12/15	92.1 13/15
minimum:	24.4 26/ 6	28.9 26/ 7	27.7 26/ 6	30.4 26/ 6	21.4 27/ 6	32.0 15/12	32.0 11/22	41.7 27/ 1
monthly average relative humidity / dewpoint (percent / °F)								
5 AM	82 / 33	84 / 36	86 / 36	73 / 36	75 / 27	39 / 23	67 / 40	67 / 44
11 AM	30 / 32	40 / 40	35 / 33	35 / 39	23 / 24	20 / 27	27 / 36	33 / 42
2 PM	19 / 27	30 / 36	23 / 29	25 / 33	19 / 23	14 / 20	20 / 32	25 / 39
5 PM	20 / 25	28 / 32	23 / 28	25 / 32	18 / 21	14 / 19	21 / 30	24 / 37
11 PM	53 / 31	67 / 36	52 / 31	51 / 34	52 / 25	25 / 17	47 / 35	54 / 43
monthly average wind direction (degrees clockwise from north)								
day	176	235	231	254	236	182	127	146
night	161	101	164	161	116	212	212	200
monthly average wind speed (miles per hour)	4.30	3.56	2.20	2.85	3.46	8.01	9.94	9.14
wind speed distribution (hours per month for hourly average mph range)								
0 to 3	298	412	585	452	457	113	23	49
3 to 12	384	296	132	266	237	467	457	459
12 to 24	38	12	3	2	26	139	239	200
> 24	0	0	0	0	0	1	1	0
monthly average daily total insolation (Btu/ft²·day)	1802	817	1507	1075	1648	1458	1762	1782
"clearness" distribution (hours per month in specified clearness index range)								
60-80%	243	1	158	54	159	178	247	247
40-60%	80	0	81	78	80	77	65	66
20-40%	23	281	64	81	39	56	22	29
0-20%	7	79	17	112	20	29	7	8

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.



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