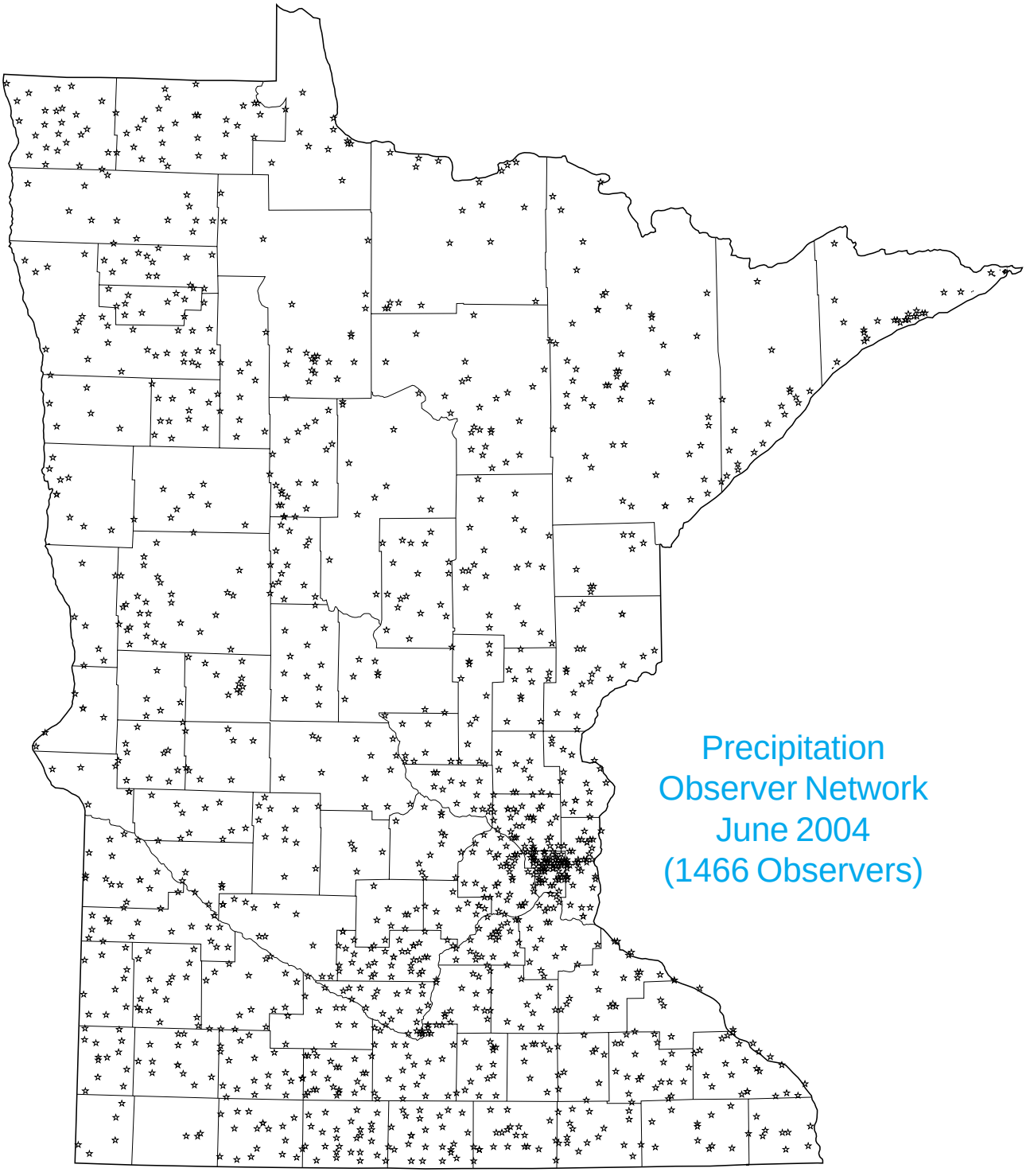
climatology



Precipitation
Observer Network
June 2004
(1466 Observers)

Introduction

The DNR Waters State Climatology Office exists to gather and analyze climate data for the benefit of the State of Minnesota and its citizens. A variety of organizations provide climate data. These organizations rely primarily on the efforts of volunteer observers. The data are consolidated into a unified database and climate information is distributed to many users.

A review of climate information can assist in explaining a prior event or condition. Climate information aids long-range planning efforts by characterizing what is typical or extreme, likely or unlikely. Users of climate information include government agencies (local, state, federal), academic institutions, media, private sector professionals and the general public. Specifically, engineers use temperature and precipitation data to design roads and storm sewers. Wildlife managers use temperature and snow depth information to research animal health and mortality. Agricultural specialists use temperature and precipitation data to determine the types of crops that will grow in Minnesota. Others who rely on climate information include hydrologists, foresters, meteorologists, attorneys, insurance adjusters, journalists and recreation managers.

Climate Data Sources:

Soil and Water Conservation Districts
National Weather Service
University of Minnesota
Department of Natural Resources
- *– Division of Forestry*
- *– Division of Parks*
- *– Division of Trails and Waterways*

State Climatology Office Back Yard Network
Metropolitan Mosquito Control District
Minnesota Association of Watershed Districts
Metropolitan Waste Control Commission
Minnesota Power and Light Company
Emergency Management Offices
County Environmental Services

"Normal"

The word *'normal'* in this chapter refers to a 30-year mathematical average of measurements made over the period 1971-2000. Many individuals tend to (erroneously) perceive 'normal' weather as what they should expect. Dr. Helmut E. Landsberg, former Director of Climatology for the U.S. Weather Bureau, summarized this misconception as follows: "The layman is often misled by the word. In his every-day language, the word 'normal' means something ordinary or frequent … When (the meteorologist) talks about 'normal,' it has nothing to do with a common event. For the meteorologist, the 'normal' is simply a point of departure or index which is convenient for keeping track of weather statistics."

Water Year 2003

October 1, 2002 -
September 30, 2003

Highlights

- Wet, cold October 2002
- Very dry November 2002-January 2003
- Deep frost problems February-March 2003
- Scattered rains April-May 2003
- Dry summer 2003
- Rainy September 2003

Autumn 2002

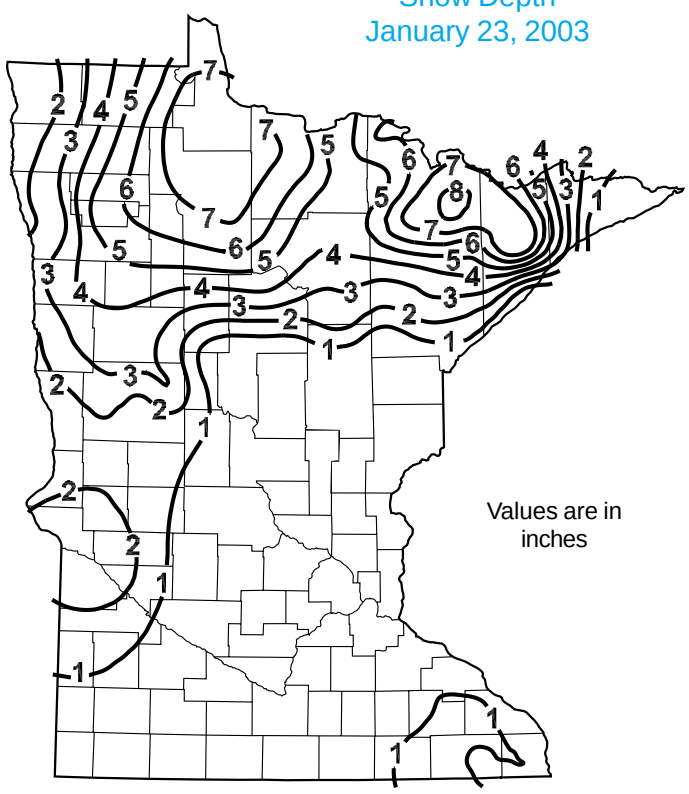
October 2002 was a damp and cold month, with precipitation totals well above normal for all but north central and northeastern Minnesota. Substantial rains across the southern two-thirds of the state, plus mid-month snow events over northern and central areas, pushed precipitation totals above historical averages by one to two inches.

A storm system moved through the midwest on October 20 and 21, leaving a band of heavy snow across central Minnesota. Snowfall totals ranging between six and eight inches were reported along a 20-mile wide band from Fergus Falls to Hinckley. This snow event, along with other lesser snow events, set new daily and monthly October snowfall records in some communities.

October temperatures across the state were the coldest since 1925. Mean monthly temperatures were five to eight degrees colder than the historical average, a pattern more typical of early to mid-November. Many daily low temperature records were set throughout the month.

Despite the early start of winter with snow and cold across the state, November 2002 was very dry with seasonal temperatures. Precipitation totals fell short of historical averages by one to two inches and, in many communities, this November was among the driest on record. Mean temperatures were within one degree of historical averages, although temperatures in the northeast were cooler, averaging around three degrees below normal.

Figure 1



Winter 2002-2003

Similar to November, December 2002 precipitation was quite light across much of Minnesota. Totals for the month fell short of historical averages by approximately one half inch in all but the northwest, where precipitation was near normal. In many communities, November plus December precipitation totals were among the driest on record. The only significant event of the month was a December 18 ice storm that created travel problems in central, north central and northeastern Minnesota.

Dry weather continued in January 2003, with precipitation totals generally less than a quarter inch in most locations, and short of the historical average by more than a half inch. This marked the third consecutive month of very light precipitation and, in the Twin Cities, the November through January total was the driest on record. Many communities were nearly devoid of snow cover until modest snowfalls covered the ground during the last week of the month (Figure 1).

The January thaw came early with temperatures 30 degrees or more above normal on January 7 and 8. A 60-degree temperature at Fairmont on the 7th was a new state record for the date.

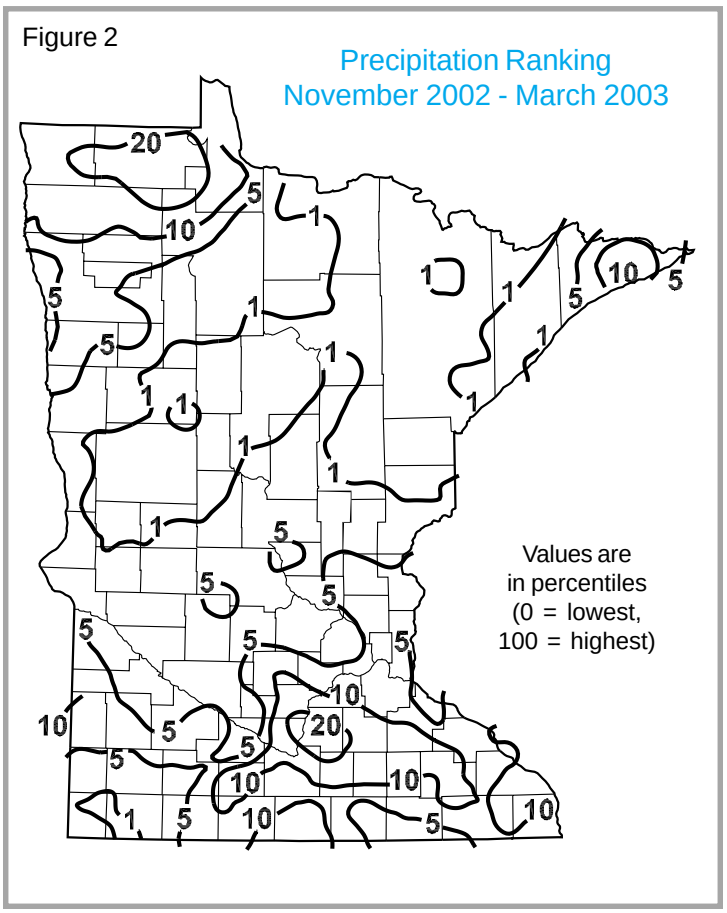
The real start of winter for central Minnesota was an early February storm that dropped six to ten inches of snow along a 50-mile wide band either side of a line from Montevideo to Forest Lake. The highest total was at Montevideo with 11 inches. Winds up to 63 mph in some areas reduced visibilities to near zero. The half inch of moisture associated with this event was the most precipitation received in these areas since mid-October of 2002. Snow was sparse across the rest of Minnesota for the month and precipitation totals in February were generally below normal for most of the state. Monthly totals averaged around a half inch statewide, which is approximately a quarter inch below the historical average.

While many places missed significant snow, and there were some brief intrusions of warm air, February was generally a cold month. Across Minnesota, monthly temperatures were from two to seven degrees below normal.

The dry spell that began in November 2002 intensified in March 2003, with precipitation rankings at (or near) the lowest on record for parts of west central and northeastern Minnesota (Figure 2). March precipitation fell short of normal by more than one inch in west central, central, and southwestern Minnesota, but was somewhat above normal in portions of the far northwest, south central, and southeast. Near the end of March, a spring storm dropped more than an inch of rain in some southeastern counties, and more than a foot of snow in north central and northeast Minnesota.

The absence of snow cover, coupled with some very cold temperatures in late winter, lead to widespread frozen septic tanks and water lines. Northern Minnesota was particularly hard hit where frost depths plummeted to six feet in some areas, the deepest since the mid 1980s. Ice damage to lakeshore property due to “ice jacking” was reported in some areas. Cold

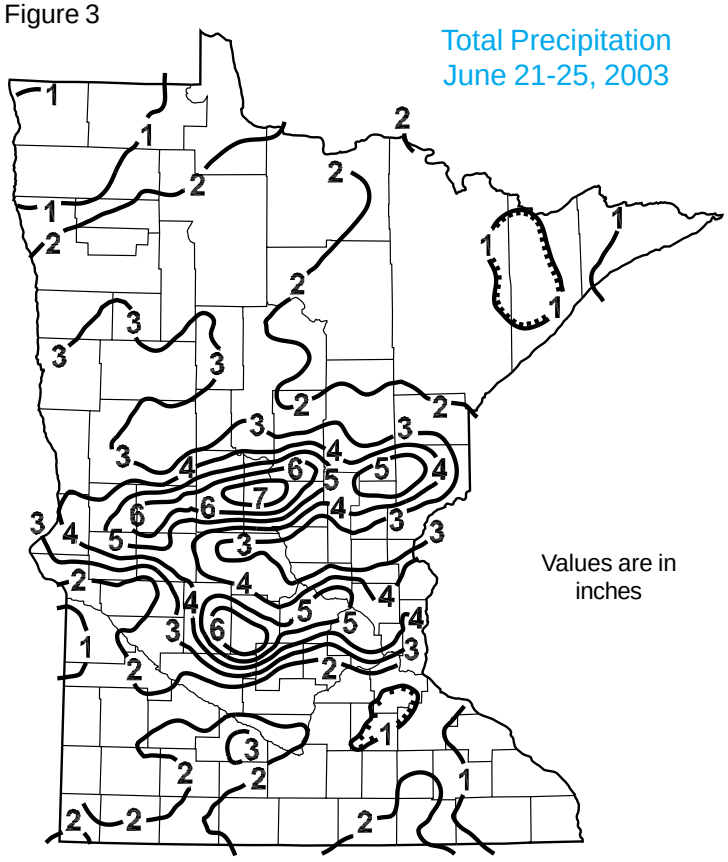
Figure 2



temperatures led to near complete ice cover on Lake Superior in early March for the first time since the winter of 1996-1997. Conversely, record-setting high temperatures were reported in many communities on March 14 through 17, and on March 24.

The winter 2002-2003 snowfall totals were below normal statewide, with amounts in the 30 to 37 inch range across much of the central and south, and in the 50 to 60 inch range across the far north and northeast. Lack of a substantial late winter snow pack significantly reduced runoff, and led to below average stream discharge in spring 2003.

Figure 3



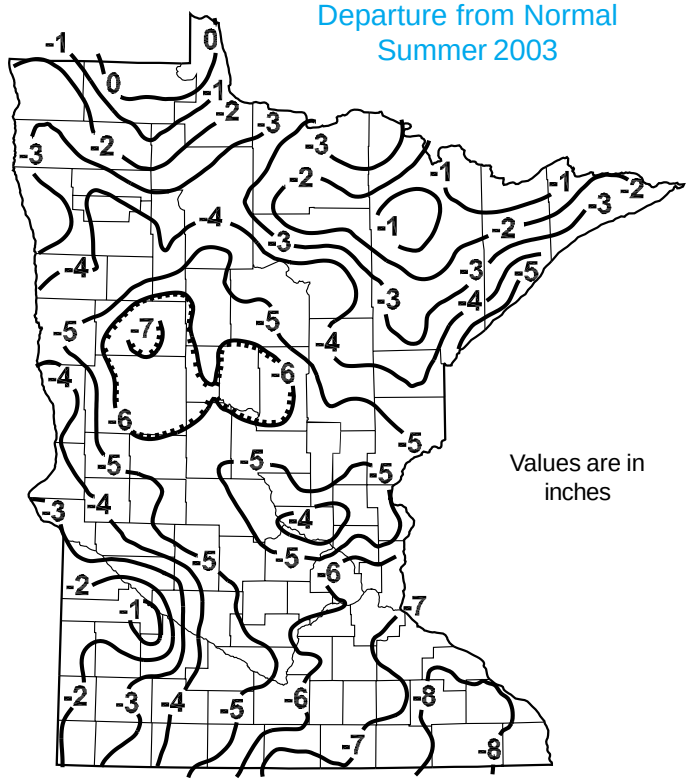
Spring 2003

April 2003 precipitation totals exceeded the historical average by more than one inch in central and far southwestern Minnesota. An April 7 snowstorm dropped a foot of snow at the Cities of Fairmont, Blue Earth and Winnebago. The City of Pipestone received over four inches of rain on April 15-17, and over seven inches for the month. While these few areas received some relief from the dry spell of the previous five months, precipitation totals were a half inch to an inch below normal across much of the southern third of the state. Most counties in the northern third of Minnesota reported below-average totals as well.

April temperatures were near to somewhat above normal across Minnesota, however, air temperatures varied a great deal from week to week and from place to place. On April 6, some northeastern communities awoke to below-zero temperatures, while mid-April temperatures topped 90 degrees in west central Minnesota. The warm temperatures were accompanied by extremely low relative humidity that led to many grass fires. Several communities set new all-time maximum temperature records on April 13, 14 and 15.

Rains helped to ease moisture deficits across much of the southern two thirds of Minnesota in May. However, precipitation deficits had impacted north central and northeastern counties, as well as scattered areas of southern Minnesota, since early 2002. By the end of May 2003, the U. S. Drought Monitor indicated that portions of north central and northeastern Minnesota were in the “D2 - Drought Severe” category, while most of the remainder of the northern third was classified “D1 - Drought Moderate” or “D0 - Abnormally Dry.” The NDMC index is a blend of science and subjectivity where intensity categories are based on six key indicators. May temperatures were more or less normal across the state.

Figure 4



Summer 2003

June 2003 rainfall totals varied widely across Minnesota. Monthly precipitation topped historical averages by one to six inches over portions of northwestern and central Minnesota. Heavy rains on June 21-25 exceeded six inches along a 30-mile wide band stretching from Traverse County to Pine County, and exceeded eight inches in some areas (Figure 3). Rainfall amounts also surpassed six inches in some areas of Kandiyohi, Renville, Meeker, Wright, Sherburne, Hennepin and Chisago Counties during the week, leading to numerous reports of urban and rural flooding. In addition to the downpours, the thunderstorms also spawned tornadoes, damaging winds and hail. A tornado damaged the City of Buffalo Lake in Renville County during the evening of June 24. Elsewhere across Minnesota, rainfall was near to somewhat below normal.

The monthly average temperature for June was one to two degrees below the historical average for most communities.

A persistent weather pattern in July 2003 produced geographically isolated thunderstorm complexes throughout the month. These clusters of thunderstorms were often short-lived, and led to above normal precipitation totals for a handful of communities, mainly in northern Minnesota. July rainfall was below normal in most communities, falling short of historical averages by a half to one and a half inches.

July temperatures were near to slightly cooler than normal across Minnesota, although for the fifth time in the past six summers, some areas experienced July dewpoints in the 80s. On July 26th, the combined influence of high temperatures and high dewpoints created heat index values at or near 110 degrees.

Persistent dryness continued for the rest of the summer of 2003. August finished as one of the driest ever, and was the driest since 1976. Rainfall totals were generally below one and a half inches, with many communities reporting less than one inch for the month. Precipitation totals fell short of the historical average by one and a half to three and a half inches.

Not only was August a dry month, but a hot one as well. Average monthly temperatures ranged from two to five degrees above normal, one of the warmest Augusts in the modern record.

No significant widespread rainfall events occurred during the seven-week period from mid-July through early September. Large areas of northwestern, west central, central, and southeastern Minnesota received less than one and a half inches of rain for the interval, short of normal by two to five inches. When compared with similar time periods in the historical database, mid-July through early September 2003 rainfall totals rank among the lowest on record, below the 5th percentile (1 out of 20 years) across large areas of Minnesota. Rainfall totals for many locations were at or below the 1st percentile, indicating that rainfall was near or below all-time minimum values for the period. The summer of 2003 was exceedingly dry across much of Minnesota, with departures from normal precipitation as high as eight inches in the southeast (Figure 4).

Early Autumn 2003

Some heavy rains brought relief to many areas during the four-day period from September 9 to September 12. A very slow moving cold front dropped from one to three inches of rain on southwestern, central, and northeastern Minnesota, while some areas of the southwest received over four inches. September rainfall totals in southwestern, northwestern, and northeastern counties exceeded normal by one to two inches, but were near normal across the central third of Minnesota. Rainfall totals in north central, south central, and southeastern communities fell short of normal by about one inch.

September 2003 began with the high heat that was common in August, but the second half of the month cooled considerably with monthly mean temperatures very close to historical averages. 90-degree temperatures were common over central and southern Minnesota during the first ten days of the month. International Falls recorded an 89-degree high in early September, then received an inch of snow on September 30.

Water Year 2003 Summary

Water Year 2003 (October 2002-September 2003) was overall one of the driest water years in a decade (Figure 5). A drought that began in November 2002 began to ease a bit in September 2003. However, many locations reported below-normal precipitation, with the most severe shortages in north central and the southeast (Figure 6).

Figure 5

Water Year Precipitation
October 2002 - September 2003

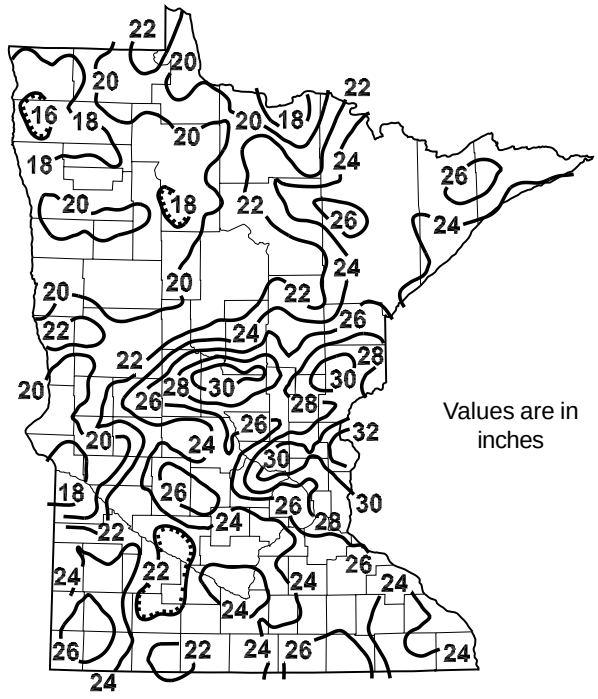
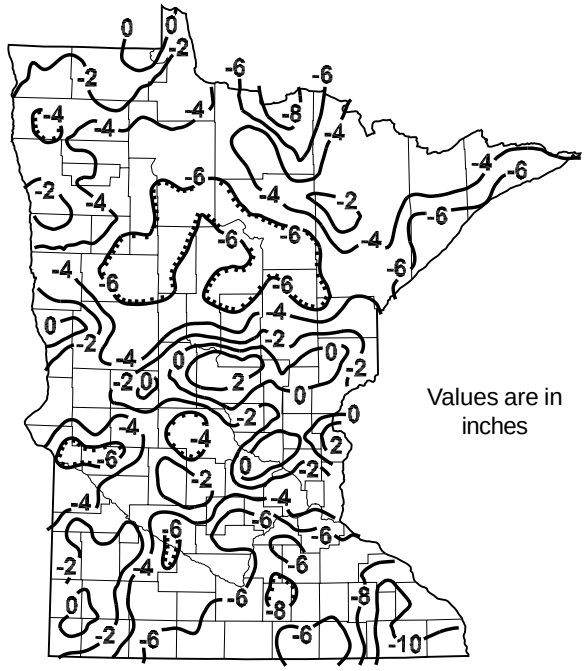


Figure 6

Water Year Precipitation
Departure from Normal
October 2002 - September 2003



Water Year 2003

October 1, 2003 - September 30, 2004

Highlights

- Dry October, November 2003
- Snowy December 2003 - January 2004
- Wet February 2004
- Mild March 2004
- Dry April 2004
- Exceedingly wet May 2004
- Cool summer 2004
- Very warm September 2004

Autumn 2003

Generally dry weather continued into October 2003. Precipitation totals fell short of normal by one to one and a half inches across nearly all of Minnesota, and continued a pattern of dryness that had persisted since mid-July. The largest single precipitation event of the month occurred at Ada (Norman County) when 1.07 inches of rain was reported on October 11. A winter storm brought accumulating snow to many northern communities on October 27 and 28 with four to eight inches reported in some areas.

The chilly conditions of September persisted for the first few days of October 2003. A hard freeze occurred in many central and southern locations on October 2 with temperatures in the upper 20s, even in the urban core of the Twin Cities. Just when it seemed winter was on the doorstep, 70 and 80 degree temperatures were observed from the 6th to the 10th, including 90s at Willmar and Glenwood on October 7th. All-time daily maximum temperature records were set during this warm spell and again in parts of Minnesota on October 19 and 20. Even though the month ended with a week of below normal temperatures, October temperatures were above normal by one to four degrees across the state.

November 2003 stayed rather dry with precipitation totals short of normal by one half to one inch in most counties. The most significant precipitation event of the month was a winter storm on November 22 and 23, when four or more inches of snow fell across most of the state. Eight to twelve inches of snow were reported along a 30-mile wide band from Yellow Medicine County to Lake County.

Temperatures were at or slightly below normal for the month. At the end of the first week, a host of record minimum temperatures were set, including a record low of minus 13 at International Falls on November 8th. Soil froze quickly during the first half of November, to a depth of five inches in some areas. Warmer mid-month temperatures allowed the soil to thaw a bit, although seasonal temperatures returned by the end of November.

Winter 2003-2004

While December 2003 was a snowy month, there was little moisture in the dry, powdery snow. December totals fell short of normal by a quarter to a half inch in approximately two thirds of Minnesota counties, and continued a pattern of dryness that began in mid-July 2003. Precipitation was near to somewhat above normal only in portions of northwestern, west central, and southern Minnesota. The most significant storm dropped up to eight inches of snow in the east central and southwest portions of the state.

December mean monthly temperatures across Minnesota were warmer than average, exceeding the norm by six to ten degrees in most communities. Records were set in some locations on December 27, 28, and 29 when maximums climbed above 40 and minimums remained in the upper 30s.

More typical winter weather visited Minnesota in January 2004. Snow and cold air were abundant, a switch from some of the balmy winters over the past seven years. Monthly snowfall totals ranged from one to three feet over much of southwest, central and northern Minnesota. Some locations along the north

shore saw snowfall totals of four feet while Rochester and vicinity received approximately nine inches for the month.

Despite the hefty amounts of snow, most was accompanied by very cold temperatures, so the snow-to-water ratio was very high. Precipitation totals fell short of historical averages by around a half inch in many places. Only in far northwestern and northeastern Minnesota did January precipitation meet or exceed normal. A large snowstorm on January 25 through 27 affected much of Minnesota over this three-day period, with the greatest amounts along the Lake Superior shore. Lake-enhanced snowfall totals topped two feet in some locations, and over 27 inches fell in Duluth, making this storm the third largest snow producer in the city's history.

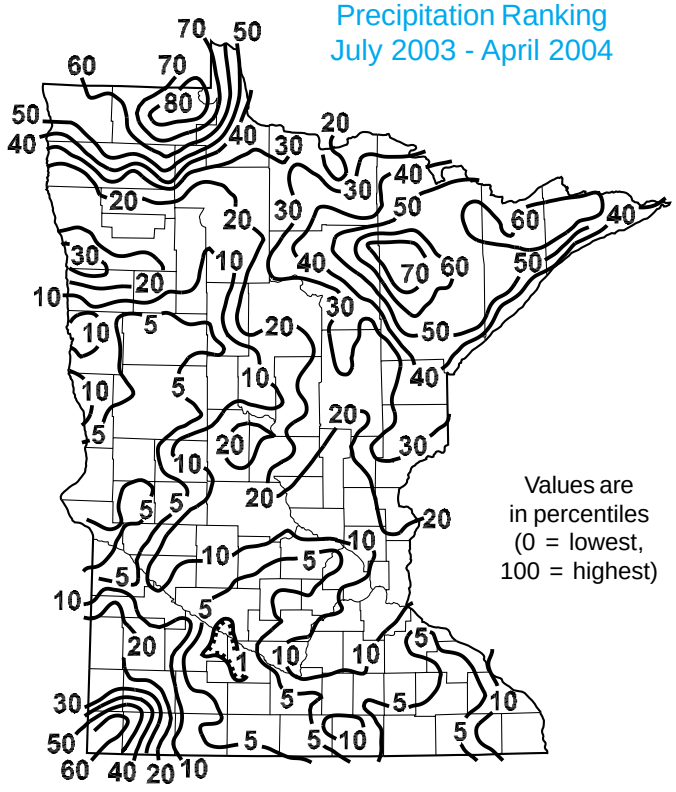
While some communities missed the heavy snow, everyone saw cold temperatures, although the first few days of January were deceptive with balmy temperatures well above normal, including 51 degrees at Canby. However, the statewide low for the month would be a hundred degrees lower, as the coldest air in seven years spread across Minnesota by the end of January. While nearly every community experienced at least one day of minus 20-degree temperatures or colder, the lowest reported was minus 50 at Fosston (Polk County) on January 30th. The early warmth at the beginning of the month balanced the mean monthly temperatures, which finished near normal over the south, while the north finished from three to seven degrees below normal.

A storm marked the beginning of February 2004 with snowfall amounts that ranged from three inches to a foot over southeastern Minnesota. It was a prolonged event that began late on January 30 and lasted until February 2. This storm, as well as other snows throughout the month, pushed the monthly average precipitation totals above normal for the first time since June 2003. While the abundant February snowfalls were of great benefit to the winter recreation industry, their impact on Minnesota's hydrologic systems was modest.

The first half of February continued the cold trend from January, but the second half of the month featured a warming trend. The Twin Cities saw its streak of 31 below-freezing days end on February 17. While that wasn't a record, it had been 19 years since a similar streak occurred. The latter half of February was unseasonably warm with daily temperatures climbing 10 to 15 degrees above normal. The perennial hot spot of Canby in Yellow Medicine County saw a 56-degree high. Mean monthly temperatures finished near or slightly above normal across the state.

A classic sloppy spring snowstorm brought some badly needed moisture to parts of the state on March 4 and 5, 2004. The storm dropped four to eight inches of snow on south central, southeastern, and east central Minnesota and was also responsible for heavy rains of an inch or more in the far southeast. Significant rain also fell on March 27 in the southern one third of the state and in far northwestern counties. Rainfall totals ranged from a half inch to just over an inch in these areas. The rain in the northwest coincided with a rapidly melting snow pack and led to some flooding along the Red River and its tributaries.

Figure 7



Spring came early, with March temperatures about one degree above normal in northern Minnesota, and three to five degrees above normal over southern parts of the state. The highest temperature for the month was 74 degrees at Worthington on the 24th.

Spring 2004

Despite some welcome rains, totals were generally a half inch to one and a half inches short of the historical average in April 2004. It was extremely dry in sections of west central and northwestern Minnesota, where monthly precipitation totals were less than 20 percent of normal. A series of thunderstorm complexes dropped a half inch to two inches of rain on April 18, south and east of a line from Worthington to Duluth. The thunderstorms also brought high winds, very large hail and at least two tornadoes.

The dry spell that began in July 2003 continued into April 2004. The ten-month period saw precipitation deficits of four to six inches over central Minnesota and eight to twelve inches over the southeast. Only in the far northeast and the far northwest did precipitation amounts approach normal. When compared with similar time periods, the July 2003 through April 2004 combined rainfall totals rank among the driest on record for many areas of western and southern Minnesota (Figure 7).

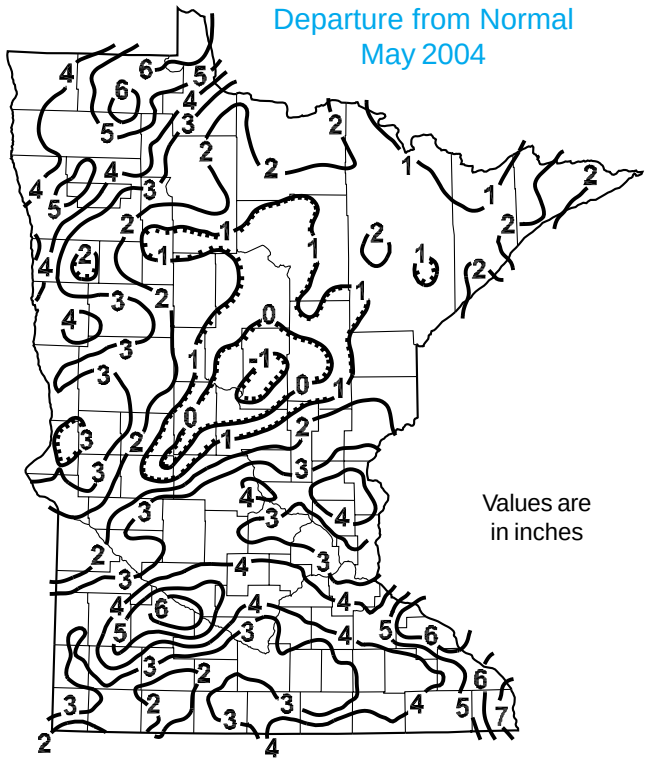
The parched landscape and warm temperatures in April contributed to the threat of grass and brush fires. Record heat was observed on April 28 with many communities reaching 90 degrees or above, setting dozens of maximum temperature records for that date. However, overall mean monthly temperatures were two to three degrees above normal in the southern two-thirds of Minnesota, and were near normal in the northern third of the state.

Precipitation totals across large sections of northwestern and southern Minnesota were three or more inches above normal for May 2004. Positive departures topped six inches in some areas (Figure 8), essentially nullifying the deficits built up over the previous ten months. When compared with other May rainfall totals in the historical database, those of May 2004 were at or near all-time record highs in some locations.

Significant weather events in May included heavy rain (and some snow) in northwest Minnesota on May 11 and 12. Precipitation totals for the event exceeded four inches over a large area, with overland and stream flooding reported in Roseau and Marshall Counties. One of the heaviest amounts of rain reported was 5.37 inches in Lake Township just west of Warroad.

During the second half of May, Minnesota was on the cool side of a boundary that separated hot and muggy air to the south from cool, cloudy and wet weather to the north. Monthly temperatures were quite cool, especially in northern Minnesota, where mean monthly temperatures were six or more degrees below normal. For some northern communities, it was among the coldest Mays on record. Elsewhere across the state, mean monthly temperatures were generally two to four degrees below the historical average. The cool weather significantly delayed crop growth and spring green-up, especially in the north.

Figure 8



Summer 2004

June 2004 saw a return to drier than normal conditions with rainfall generally one to three inches below normal in most communities. Rainfall totals for some north central locations were less than one inch, ranking among the driest on record. However, not all locations reported precipitation deficits. Portions of south central and southeastern Minnesota were extraordinarily wet, especially during the first half of the month.

Although June was relatively dry statewide, a few significant precipitation events were reported during the month. Very heavy rains fell across south central and southeastern Minnesota on June 8 and 9. A series of thunderstorm complexes dropped five or more inches of rain along a band that extended from just west of Mankato, to Rochester and southeast to Preston. Urban and rural flooding and road closures were common in these areas. Highway 169 was closed for a time due to mudslides that covered the road. Another mudslide was reported across Highway 250, just north of Lanesboro in Fillmore County.

On June 15 and 16, intense thunderstorms swamped portions of Pipestone and Murray Counties with more than four inches of rain in a short period of time and over areas that were already saturated in May. The highest total reported for this event was 6.35 inches in Cameron Township just north of Lake Wilson. Township roads were reported to be under water in Murray County.

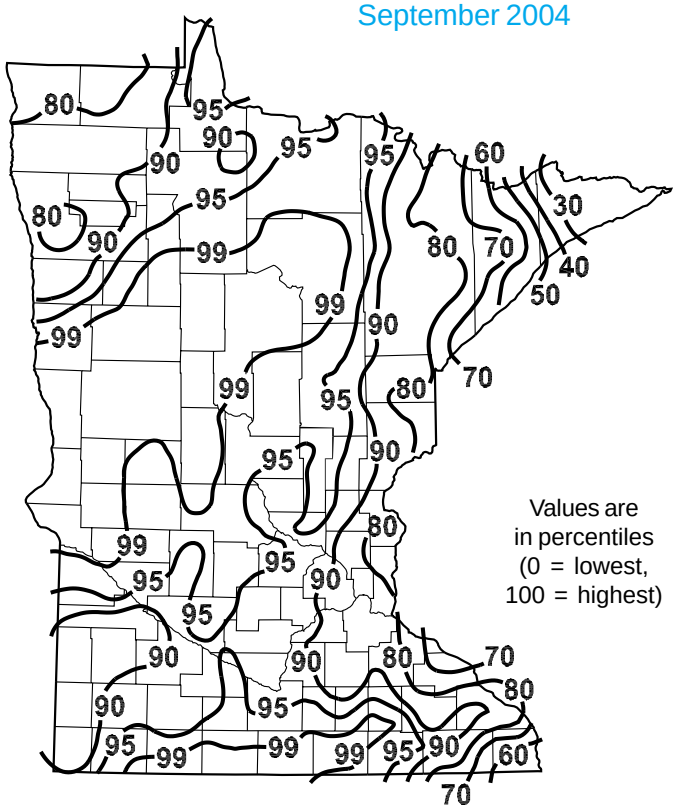
As was the case in May, June monthly mean temperatures were generally from three to five degrees below normal. In some northern communities, the May plus June mean temperature was among the coldest on record. Daily low temperature records were set throughout the month in many locations.

Rainfall totals across Minnesota were highly variable in July 2004. As is often the case during a midwestern summer, thunderstorm-delivered rainfall occurred in striped patterns that affect one locale, while leaving a neighboring community dry. The heaviest precipitation in July occurred in portions of south central Minnesota where rainfall totals topped historical averages by two to four inches. However, rainfall was short of average by one to two inches in some sections of the northeast.

Heavy rains were reported in a few communities in July, the most significant of which occurred in Freeborn County on July 5. Very heavy rains of two to five inches fell in the Albert Lea area, leading to street flooding and the temporary closure of some rural roads.

Continuing the cool temperatures that began in May and June, mean monthly temperatures in July were one to four degrees below normal. Daily minimum temperature records were set throughout the month in many locations.

Figure 9



August 2004 had many Minnesotans scratching their heads and wondering where the summer of 2004 went. Yet another cool, dry month summed up August with rainfall short of the historical average by one to two inches in many locations. Above-normal precipitation was reported only in some areas of northwest, south central and southwest Minnesota. The most intense rainfall event of August occurred on the 23rd and 24th over a small southwest area, where a stalled thunderstorm complex dropped more than six inches of rain on portions of Yellow Medicine, Lyon, and Lincoln Counties. The heaviest reported rainfall total was 8.75 inches near Porter in northeastern Lincoln County.

August was a cool month, with daily high temperatures below 60 degrees for parts of central and southern Minnesota on August 8. On August 10, 49 degrees was a record low maximum temperature at International Falls for the month of August. The continued cold temperatures sparked fears of reduced crop yields.

Early Autumn 2004

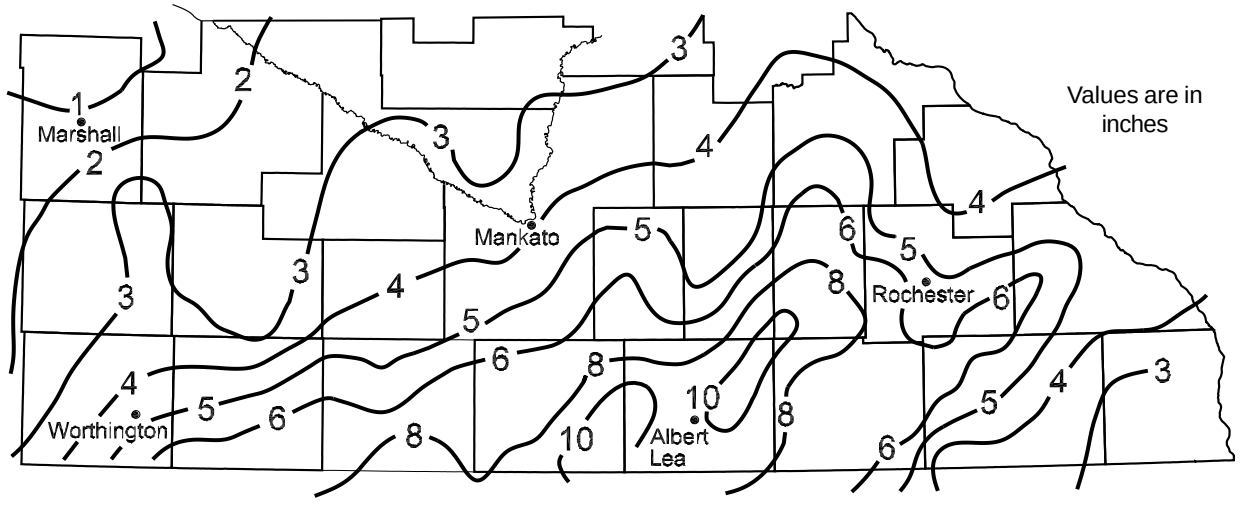
September 2004 was the opposite of August, much to the relief of farmers, with much warmer than normal temperatures and generous amounts of rain. Among the wettest Septembers in the modern climate record, many locations in southern, west central, and north central Minnesota received rainfall totals for the month that topped seven inches. Rainfall totals at many locations in the southern tier of counties exceeded ten inches with monthly rainfall totals of three or more inches above normal across large sections of the state. September rainfall totals were at, or near, all-time record high values in many communities (Figure 9).

In the southern tier of counties, rainfall totals were dominated by a single event. Extremely heavy rains on September 14 and 15 produced one of the most significant flash flood events in Minnesota's climate history (Figure 10). During this event, large sections of north central Iowa and south central Minnesota received more than eight inches of rain over a 36-hour period, which led to numerous reports of stream flooding, urban flooding, mudslides, and road closures. Austin reported very high to record high crests on the Cedar River and its tributaries. Two people died as a result of the event. A 20-year-old man, who was walking to work, was swept away by high water, and a 51-year-old man died of a heart attack while sandbagging.

Halting the generally cool weather that started in May and continued throughout the summer, September temperatures were very warm. Monthly mean temperatures topped normal by three to seven degrees and, for some communities, was among the warmest Septembers on record. In many locations, September temperatures were actually warmer than August temperatures, an occurrence seen only once before in the modern climate record.

Figure 10

Total Rainfall
September 14-15, 2004



Water Year 2004 Summary

Water Year 2004 (October 2003-September 2004) continued the drought that started in July 2003. Some areas received limited precipitation from month to month, but most of Minnesota remained on the dry side through April 2004. In May, rains fell statewide and erased the ten-month drought, although the summer of 2004 was cool with spotty rain. Paradoxically, September was warmer than August for most places in Minnesota, with generous amounts of rain.

Water Year 2004 was much wetter than the previous year (Figure 11). Most locations reported above-normal precipitation totals, although parts of the northeast remained below normal for the year (Figure 12).

Figure 11

Water Year Precipitation
October 2003 - September 2004

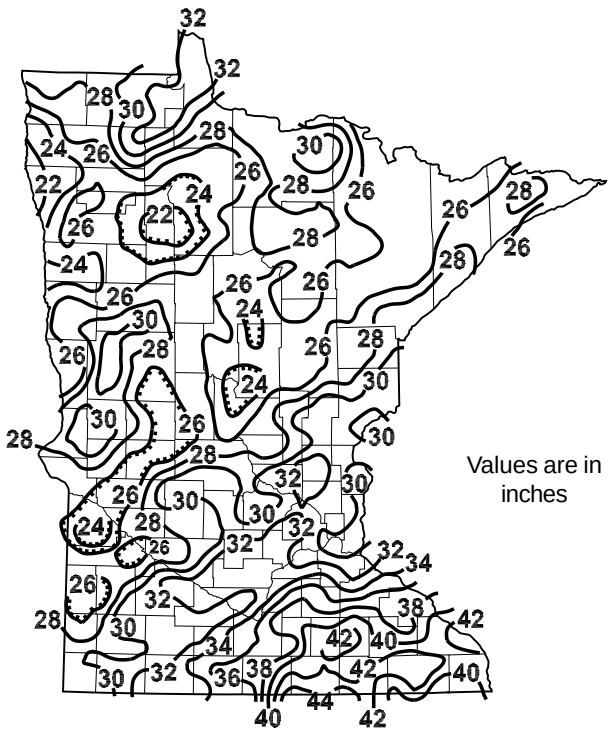


Figure 12

Water Year Precipitation
Departure from Normal
October 2003 - September 2004