Environment Group
Ecosystems Section
Climatology

# SASKATOON SRC CLIMATOLOGICAL REFERENCE STATION


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Enquiries concerning the SRC Climatological Reference Station (CRS), its data, measurement programs and publications, or becoming a sponsor are most welcome. For further information contact:

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## CLIMATE REFERENCE STATION SPONSORS, 1999

Cover photograph
Saskatoon tornado, west of the city, May 18, 1999
photo credit: Tom Dehod

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## WHAT IS THE CLIMATE REFERENCE STATION?

The Saskatchewan Research Council's Climate Reference Station (SRC CRS) at Saskatoon is classified as a principal climatological station with supplementary climatological observations (Environment Canada 1992). A reference climatological station's data are intended for the purpose of determining climatic trends. This requires long periods (not less than thirty years) of homogeneous records, where man-made environmental changes have been and/or are expected to remain at a minimum. Ideally the records should be of sufficient length to enable the identification of secular changes of climate (WMO 1988). At our principal station, hourly readings are taken of elements which include temperature, precipitation amount, humidity, wind, and atmospheric pressure. Our supplemental observations include rate of rainfall, soil temperature, bright sunshine and solar radiation. High quality and consistent climatological observations are maintained providing data sets to meet the current concerns of the effects of climatic change and increased variability.

### Purpose and Benefits

The purpose of the SRC CRS is to provide a record of the observed meteorological elements so that the climate of the area and its changes can be accurately documented and described. Climatological data have assumed new importance as a result of social and environmental issues in which climate is a dominant factor. Climatological information assists in realizing new technological opportunities and social changes. Climate information is necessary and valuable for use in areas such as agriculture, forestry, land use and facility placement, water and energy resources, health and comfort.

The CRS also allows us to:

- evaluate long term climate trends - early warning system for increased frequencies of extreme events such as drought, floods, *etc.;*
- determine the impacts of climate events on society, economy, health, and ecosystems. Examples include intense rainfall causing flooding and property damage and heat stress with its implications on health;
- do value-added research;
- be part of regional, national and global networks in an important agricultural and ecological area;
- facilitate development of additional programs - *e.g.* air quality, biodiversity, the Boreal Ecosystem Atmosphere Study (BOREAS) project, and climate change monitoring;
- have roles in various programs within SRC including spray drift work, BOREAS, and collaborative research (*e.g.* Western College of Veterinary Medicine and the College of Agriculture, University of Saskatchewan); and.
- provide climate data to governments, universities, insurance agencies, lawyers, agricultural sectors, chemical companies, schools, building science, construction firms, media, transportation studies, accident studies, wildlife studies and interested individuals.

The goals of the Climate Reference Station are first, to maintain the high quality of data gathered over its more than thirty years of existence at its current location and second, to continue to monitor a large variety of elements. These various elements combined with the long-term collection period as well as the stable location allow CRS to be a very valuable climate information collection station.

## CLIMATE REFERENCE STATION HISTORY

Meteorological observations were first taken at or near Saskatoon by the Royal Northwest Mounted Police in 1889 beginning with only temperatures recorded. There is some disagreement in the early records as to the exact location of the weather observing point, but the majority of the evidence indicates 52°15'N and 106°20'W, elevation 480 m above sea level as the most probable location. This would place it at Clark's Crossing on the South Saskatchewan River, approximately 16 km northeast of the centre of the City of Saskatoon. There was a settlement at Clark's Crossing at that time as well as ten to fifteen families on either side of the river at present day Saskatoon.

Little is known about the very early observers; however, the records do show that Major T.H. Keenan took the observations from March 1892 until March 1895, and Mr. George Will was the observer from January 1897 until April 1897. It is thought that Thomas H. Copeland was involved in the observational program from 1895 to May 1, 1901, at which time it was taken over by Mr. Eby, Sr. Mr. Eby, Sr. recorded the observations until his death in 1921, at which time his daughter, Miss E.S. Eby, continued to record the observations. Her brother, Mr. J.M. Eby, recorded the observations beginning in April 1931 until the station was closed October 31, 1942. The Eby station recorded temperature, precipitation and weather notes on fog, thunderstorms, winds and any unusual weather phenomena. Reports were made twice daily, morning and evening.

In 1916 a climatological station was established by the Physics Department of the University of Saskatchewan and continuous observations were kept twice daily until January 15, 1965. The long-time observer at this site was Mr. Sidney Cox. The Saskatchewan Research Council took over the program in the fall of 1963 at the newly established Climatological Reference Station at latitude 52°09'N, longitude 106°36'W and elevation 497 m asl *(Christiansen 1970; Environment Canada 1974).*

The long-time observer (16 years) at this present site was Mr. Joe Calvert, who retired from the program in August, 1983. Ray Begrand succeeded Mr. Calvert until September 1988 when Virginia Wittrock became the primary observer. Carol Beaulieu became the primary observer in 1992.

In the summer of 1992, the CRS began to be converted to an automated system of data collection with the installation of a Campbell Scientific Data Logger and automatic sensors. The following manual data collection duties were turned over to Environment Canada: evaporation, bright sunshine (Campbell-Stokes), snow survey, snow cover, and manual temperature and precipitation programs. Manual temperature, precipitation and snow cover readings at the site are still possible.

## SUMMARY

Data concerning temperature, precipitation, wind speed and direction, bright sunshine, solar radiation, and soil temperature, recorded at the Saskatchewan Research Council (SRC) Climatological Reference Station (CRS), (52°09'N, 106°36'W, 497 m asl) are presented for the year 1999 and compared with the long-term (*circa* 1900-1998) and standard-period (1961-1990) records.

The year 1999, especially the end, defied predictions. As a La Niña year, temperatures should have been cold (Jobin, 1999). The actual record was at odds with this prediction. The monthly mean maximum temperatures exceeded their normals eight out of the twelve months for a yearly average of 1.9°C above normal. For the monthly mean minimum temperatures, September failed to rise above its normal along with June and July which were 0.1°C below normal. The mean minimum temperature for the year was 2.5°C above normal. Although the entire year was warmer than usual, warm temperatures did not occur during the prime growing months of May, June and July. These months posted below normal values especially in the monthly maximum temperatures. The greatest deviation from the normals occurred in November and December with temperatures soaring between 5.2°C to 9.1°C above their normal values with the greatest deviation in the maximum value.

The monthly totals for growing degree-days (5°C base) were below average for the critical months of May, June, and July. August, which was above average, was the peak growing degree-day month instead of July. The frost free period began on May 10th (ten days earlier than usual), and lasted 140 days ending on September 26th (12 days later than usual). Growing degree-days value for the frost free period was 1432.2 (290.9 lower than last year). Heating degree-days also show a cool summer with May, June and July being below normal.

Cold spells (less than or equal to -30°C) occurred three times for a total of five days. All days were in January. Hot spells (greater than or equal to 30°C) occurred nine times for a total of nine days. August had six days with five occurring in the latter third of the month. Record maximum temperatures for the site were recorded four times during November and seven times in December with the longest duration of extreme temperatures equaling six days over the Christmas holidays.

Annual precipitation was under the 30-year average by 63.1 mm (82.5 % of normal). The cumulative precipitation value was below normal throughout the year. Precipitation for January to May was 66.3 % of normal. June to August brought the annual precipitation total to near normal with above normal monthly precipitation. However, the very dry fall and early winter with only 28.9 % of the expected moisture closed the year with an average of 17.5 % below the yearly normal. July won the precipitation honours for 1999. It was the rainiest month (86.4 mm) with the rainiest day (18.0 mm) and had the heaviest rainfall (10.6 mm). The total monthly amount was 155.1 % of normal for the month.

1999 was duller than last year by 37.2 hours. The annual bright sunshine for 1999 was 252.7 hours less than the 30-year average. March, September, November and December were above normal. With record temperatures, December registered 28 hours or a third over the normal value for bright sunshine. The cumulative total for May, June, July and August was 272.6 hours less than normal (77.4 % of normal). The year ended with 89.4 % of normal sunshine

Saskatoon experienced calmer than normal winds on average. All months reported lower than average wind speeds. However, the *Near Gale* (51-62 km/h) and *Gale* wind (63-75 km/h) frequency for wind gusts was high. Near Gale winds occurred 35 times and Gale winds occurred 9 times. On May 18th funnel clouds were visible west of the city. Two confirmed tornadoes touched down in late afternoon resulting in hail and copious amounts of rain on the west side of the city (Perreaux, 1999). The system tracked from NW to SE. CRS received 8.6 mm of rain during the storm period with the airport receiving 59.0 mm and Kernan Farm, University of Saskatchewan, SE of the city receiving 15.0 mm (Rybak, 1999). Funnel clouds were noted west of the city once again early evening of August 16th, although there were no reported tornado touchdowns.

Photo credit: Tom Dehod

## CLIMATE REFERENCE STATION OUTREACH, 1999

The climate station staff was very active in outreach activities in 1999. Presentations on *'How We Measure the Weather'* were conducted at the Climate Reference Station and as classroom presentations. The presentations were well received by students and staff with positive post-presentation feedback. Fourteen classes from twelve schools, including four rural schools, participated in the programme. Three hundred and fifty children plus field trip chaperones got a close look at the instruments used to measure temperature, precipitation, wind and radiation at present and in the past. Student volunteers enthusiastically helped demonstrate various instruments.

Photo credit: SRC staff

On October 5th, the Saskatchewan Research Council sponsored an open house at CRS for our guests and supporters. Although the day was cool with a breeze, it was well attended. Sponsor recognition plaques were unveiled and later mounted on the perimeter fence. After the unveiling, tours of the site were given, questions answered and coffee and doughnuts served. The open house received very favourable coverage in both the StarPhoenix and the Western Producer newspapers and on Global and CTV television.

## WEATHER EVENTS

### Temperature

| COLD SPELLS ( <=-30°C) | | HOT SPELLS (>=+30°C) | |
|---|---|---|---|
| Month | Day | Month | Day |
| January | 3, 6-8, 12 | July | 11, 21, 29 |
| | | August | 5, 20, 21, 24, 25, 30 |
| Total | 5 | Total | 9 |

Coldest day = January 7th at -34.3°C

Hottest day =August 25th at 33.9°C

### Frost Free Season

| YEAR | LAST SPRING FROST | FIRST FALL FROST | LENGTH OF SEASON (days) |
|---|---|---|---|
| 1993 | May 17 | Sept 14 | 119 |
| 1994 | May 9 | Oct 4 | 147 |
| 1995 | May 22 | Sept 19 | 119 |
| 1996 | May 12 | Sept 29 | 139 |
| 1997 | May 14 | Oct 5 | 143 |
| 1998 | May 13 | Sept 30 | 138 |
| 1999 | May 9 | Sept 27 | 140 |
| Normal | May 19 | Sept 15 | 118 |

### Precipitation

| WETTEST MONTHS | WETTEST DAYS | GREATEST RAINFALL EVENTS |
|---|---|---|
| July<br>86.4 mm | July 15<br>18.0 mm | July 8 = 10.6 mm in 30 min. |
| June<br>51.4 mm | July 8<br>18.0 mm | July 8 = 13.4 mm in 60 min. |
| August<br>45.2 mm | June 25<br>16.6 mm | July 7-8 = 18.4 mm in 3 hrs. |
| | | June 21 = 13.4 mm in 3 hrs |
| Tipping Bucket engaged from April 9 to October 31 | | July 15 - 13.8 mm in 6 hrs. |

### Unusual Occurrences

February 6 - rain
March 28 - thunderstorm
May 18 - Tornadoes NW of Saskatoon; pea-size hail
June 21 - severe thunderstorm
August 16 - funnel clouds west of Saskatoon
October 17 - thunderstorm
November 7, 8, 12, & 30 - record daily maximum temperatures
December 5, 24-28 - record daily maximum for temperatures
December 31 - only trace of snow on the ground

### Wind

| NEAR GALE 51- 62 km/h | | | | | | | | | | | | GALE 63 - 75 km/h | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan | 30 | 51.1 | SW | Jun | 29 | 58.0 | NNW | Sep | 7 | 55.0 | WNW | Apr | 13 | 71.4 | NW |
| Feb | 4 | 54.7 | SE | Jul | 6 | 56.4 | WNW | | 11 | 56.3 | NNW | | 14 | 65.8 | NW |
| | 6 | 58.0 | SE | | 13 | 52.1 | S | | 24 | 59.1 | WNW | May | 18 | 64.7 | NW* |
| Mar | 4 | 56.4 | E | | 15 | 52.9 | NNE | | 31 | 54.0 | WNW | Jun | 23 | 70.9 | WNW |
| | 27 | 55.8 | W | | 22 | 52.9 | WSW | Oct | 17 | 55.8 | NNW | Aug | 22 | 64.6 | WSW |
| | 28 | 52.6 | NW | | 25 | 52.3 | W | | 21 | 53.9 | NW | Sep | 29 | 64.8 | WNW |
| Apr | 12 | 60.3 | WSW | | 29 | 58.6 | WNW | | 24 | 58.5 | WNW | Oct | 31 | 65.0 | N |
| | 15 | 58.3 | N | Aug | 25 | 58.9 | NW | | 28 | 51.8 | SE | Nov | 4 | 64.2 | WNW |
| May | 5 | 58.3 | NW | | 29 | 53.7 | SSE | Nov | 13 | 51.9 | NW | Dec | 19 | 65.1 | NNW |
| | 23 | 55.1 | NW | | 31 | 55.3 | W | Dec | 16 | 57.9 | NW | | | | |
| | 25 | 51.9 | SE | | | | | | 18 | 56.7 | WSW | | | | |
| | 26 | 55.6 | WNW | | | | | | | | | | | | |
| | 28 | 62.2 | NW | | | | | | | | | | | | |
| | 31 | 53.6 | SW | | | | | | | | | | | | |

* tornado NW of Saskatoon

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## SASKATCHEWAN RESEARCH COUNCIL

# ANNUAL Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | 1999 | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE (1892-1999) |
|---|---|---|---|---|
| TEMPERATURE | Average annual maximum (°C) | 9.8 | 10.1 | 7.9 |
| | Extreme annual maximum (°C/date) | 33.9/Aug 25 | 39.7/Aug 06 | 41.0/June 1988 |
| | Average annual minimum (°C) | -1.4 | -1.5 | -3.9 |
| | Extreme annual minimum (°C/date) | -34.3/Jan07 | -33.2/Jan03 &13 | -50.0/Feb. 1893 |
| | Annual average (°C) | 4.2 | 4.3 | 2.0 |
| | Days with frost | 183 | 184 | 198 |
| | Growing degree-days (5°C base) | 1634.9 | 1977.2 | 1648.4 |
| | Heating degree-days (18°C base) | 5105.7 | 5219.0 | 5954.0 |
| | Cooling degree-days (18°C base) | 100.3 | 229.7 | 117.5 |
| PRECIPITATION | Annual total (mm) | 297.7 | 262.7 | 360.8 |
| | Greatest 24-hour (mm/date) | 23.8/July 15 | 34.4/June 19 | 99.4 June 1983 |
| | Days with recordable precipitation | 107 | 101 | 113 |
| WIND | Average annual speed (km/h) | 14.5 | 17.5 | 16.6 |
| | Peak Gust (direction/speed(km/h)/date) | NW71.4/April13 | NNW90.6/May 03 | W151/Aug1967/14 |
| RADIATION | Total bright sunshine (hours) | 2128.1 | 2165.3 | 2380.8 |
| | % of possible bright sunshine | 47.5 | 48.3 | 53.8 |
| | Number of days with bright sunshine | 328 | 312 | 320 |
| | Total global radiation (MJ/m$^2$) | 4465.3 | 4590.6 | 4391.9 |
| | Total diffuse radiation (MJ/m$^2$) | 1889.1 | 1753.6 | 1729.6 |

## FOR YOUR INFORMATION

**1999**

February and March - Global and Diffuse radiation sensors were re-calibrated and re-programmed . The diffuse reading for these months are high.
November 24 - datalogger down during afternoon. Maximum and Minium temperatures were compared with Saskatoon Meteorolgical Service. Radiation data is missing for the afternoon.

**1998**

Precipitation - October 10 & 11 snow fall value is combined because the Belfort gauge was not winterized and the collected snow was dumped into the gauge the morning of the 11th.

Diffuse - October 22 - November 3 values are high because of shade ring maladjustment.

**Normal and Extreme Values**

The normals for CRS are taken from the normals published by Environment Canada for the standard period 1961-1990. Normals used in SRC CRS Annual Summaries 1990-1996 were hand-calculated values determined before the official normals were published.
Extreme values are from the Saskatoon area weather stations and extend back to 1892. The earlier records from 1892 to 1901 have major gaps.

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | JANUARY 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | -12.0 | -13.5 | -12.4 | |
| | Extreme monthly maximum (°C/date) | | 5.4/30 | -0.1/27 | 7.0/1986/11 | 10.0/1931/30 |
| | Number of recording years | | | | 27 | 100 |
| | Average monthly minimum (°C) | | -20.9 | -22.2 | -22.6 | |
| | Extreme monthly minimum (°C/date) | | -34.3/07 | -33.2/03&13 | -43.9/1966/22&1969/29 | -48.9/1893/31 |
| | Number of recording years | | | | 27 | 100 |
| | Monthly average (°C) | | -16.4 | -17.8 | -17.4 | |
| | Days with frost | | 31 | 31 | 31 | |
| | Growing degree-days (5°C base) | | 0.0 | 0.0 | 0.0 | |
| | Heating degree-days (18°C base) | | 1067.3 | 1111.2 | 1114.8 | |
| | Cooling degree-days (18°C base) | | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | | 18.9 | 16.0 | 20.5 | |
| | Greatest 24-hour (mm/date) | | 2.9/01 | 2.1/02 | 15.4/1989/30 | 30.5/1893 /23 |
| | Number of recording years | | | | 27 | 100 |
| | Days with recordable precipitation | | 14 | 16 | 11 | |
| | Yearly total to date (mm) | | 18.9 | 16.0 | 20.5 | |
| WIND | Average monthly speed (km/h) | | 13.6 | 14.2 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | | SW51.1/30 | ESE47.1/03 | | W111.0/1986/11 |
| RADIATION | Total bright sunshine (hours) | | 94.7 | 87.0 | 104.6 | |
| | % of possible bright sunshine | | 36.6 | 33.6 | 40.4 | |
| | Number of days with bright sunshine | | 22 | 21 | 24 | |
| | Monthly total global radiation (MJ/m$^2$) | | 126.1 | 133.3 | 129.9 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 70.6 | 74.0 | 71.4 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | -8.0/-7.7 | -7.8/-7.2 | -8.8/-8.3 | |
| | | 20 cm/50 cm | -6.3/-5.5 | -5.5/-3.1 | -7.6/-3.8 | |
| | | 100 cm/150 cm | -1.0/1.2 | 0.8/2.4 | -0.2/1.8 | |
| | | 300 cm | 4.7 | 4.7 | 4.5 | |

## FOR YOUR INFORMATION

The New Year began with cold temperatures and snow. Five days, concentrated in the first part of the month, were below -30°C. To balance the cold, temperatures rose above 0°C on four occasions. The average temperatures for the mean, maximum and minimum were 0.4° to 1.7° above the 30 year normal. Precipitation was 1.6 mm below normal but Environment Canada reported 43.2 cmof snow, well above the normal snow fall indicating very dry snow (Environment Canada, 2000). Snow cover averaged a depth of 15 cm by the end of the month. The greatest snow fall, measured as water equivalent, was between the 11 and 13 when 4.5 mm fell. In the soil, frost had reached the 100 cm level but not the 150 cm level by month's end. Although we had 13 days of less than 1 hour of sunshine, the total for the month was only 9.9 hours less than usual.

January is infamous for its weird weather. During the 1997 January cold snap of -30° and more, Saskatoon graders and garbage trucks operators were sent home until it warmed up. The cold made their equipment very brittle which could have caused major breakdowns. Meanwhile, in Vancouver, torrential rains of about 65mm in 24 hours flooded homes and roads. In the interior, the TransCanada Highway was forced to close due to avalanches (Phillips, 1998).

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | FEBRUARY 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | -4.0 | -1.0 | -8.6 | |
| | Extreme monthly maximum (°C/date) | | 5.1/25 | 5.5/21 | 7.5/1988/26&1991/06 | 12.8/1931/19 |
| | Number of recording years | | | | 27 | 102 |
| | Average monthly minimum (°C) | | -13.2 | -8.8 | -18.3 | |
| | Extreme monthly minimum (°C/date) | | -26.9/04 | -23.2/02 | -41.1/1972/06 | -50.0 /1893/1 |
| | Number of recording years | | | | 27 | 102 |
| | Monthly average (°C) | | -8.6 | -4.9 | -13.7 | |
| | Days with frost | | 28 | 28 | 28 | |
| | Growing degree-days (5°C base) | | 0.0 | 0.0 | 0.0 | |
| | Heating degree-days (18°C base) | | 745.9 | 641.9 | 909.9 | |
| | Cooling degree-days (18°C base) | | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | | 3.5 | 5.2 | 14.6 | |
| | Greatest 24-hour (mm/date) | | 1.7/17 | 2.5/17 | 14.2/1979/13 | 30.0/1962/03 |
| | Number of recording years | | | | 27 | 102 |
| | Days with recordable precipitation | | 4 | 9 | 10 | |
| | Yearly total to date (mm) | | 22.4 | 21.2 | 35.1 | |
| WIND | Average monthly speed (km/h) | | 14.8 | 35.4 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | | SE58.0/06 | SE50.8/13 | | N106.0/1988/22 |
| RADIATION | Total bright sunshine (hours) | | 116.3 | 93.3 | 134.1 | |
| | % of possible bright sunshine | | 41.8 | 33.5 | 48.2 | |
| | Number of days with bright sunshine | | 23 | 17 | 25 | |
| | Monthly total global radiation (MJ/m$^2$) | | 204.5 | 176.2 | 210.1 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 149.9* | 92.9 | 105.3 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | -4.7/-4.0 | -3.6/-2.6 | -7.7/-7.3 | |
| | | 20 cm/50 cm | -2.7/-3.3 | -1.2/-1.9 | -6.8/-4.1 | |
| | | 100 cm/150 cm | -0.8/0.9 | 0.1/1.2 | -1.0/0.8 | |
| | | 300 cm | 3.1 | 3.3 | 3.3 | |

## FOR YOUR INFORMATION

The predicted cold effects of La Niña failed to materialize this month. Instead, temperatures registered above normal. The monthly mean and minimum averages were 5.1°C above normal while the mean maximum was 4.6°C above normal. Seven days recorded temperatures above freezing with as many days dipping to below -15°C. The warm temperatures should be evident in heating bills as the heating degree-days were 164 points below normal. February did not see much in the way of precipitation with only 3.5 mm recorded at the site. The winter season from December to February recorded 31.3 mm of precipitation; 25.1 mm or 44.5 % less than normal. Bright sunshine and radiation were near normal values with only 6 days receiving less than one hour of bright sunshine. Even though the snow cover was generally sparse, the soil temperatures in the upper 4 levels ranged from 4.1°C to 0.8°C above normal values. The lower levels recorded temperatures similar to seasonal values.

In February, 1966, Winnipeg experienced its coldest temperature ever at -45°C but that didn't stop the city's annual anti-mosquito campaigners. The officials began spraying thousands of hectares of bushland to control the nasty pests (Phillips, 1998). Were the mosquitoes flying around wearing tiny ear muffs and scarves?

*Eppley Pyranometer replaced on Feb. 9. Values between Feb 9 (1600h) and Feb 10 (1500h) are high.

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

## MARCH 1999

| | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | 0.9 | -1.2 | -2.1 | |
| | Extreme monthly maximum (°C/date) | 15.2/26 | 14.2/31 | 17.0/1986/27 | 22.8/1910/23 |
| | Number of recording years | | | 27 | 101 |
| | Average monthly minimum (°C) | -8.0 | -12.0 | -12.1 | |
| | Extreme monthly minimum (°C/date) | -21.7/07 | -30.1/10 | -38.9/1972/02 | -43.3/1897/14 |
| | Number of recording years | | | 27 | 101 |
| | Monthly average (°C) | -3.5 | -6.6 | -7.0 | |
| | Days with frost | 30 | 31 | 30 | |
| | Growing degree-days (5°C base) | 4.0 | 1.7 | 1.2 | |
| | Heating degree-days (18°C base) | 667.3 | 763.4 | 784.1 | |
| | Cooling degree-days (18°C base) | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | 5.8 | 5.9 | 19.9 | |
| | Greatest 24-hour (mm/date) | 1.5/04 | 3.3/18 | 32.0/1967/30 | 32.0/1967/30 |
| | Number of recording years | | | 27 | 96 |
| | Days with recordable precipitation | 11 | 8 | 9 | |
| | Yearly total to date (mm) | 28.2 | 27.1 | 55.0 | |
| WIND | Average monthly speed (km/h) | 15.8 | 11.6 | | 17.0 |
| | Peak Gust (direction/speed(km/h)/date) | E56.4/04 | N50.6/12 | | W93.0/1959/18 |
| RADIATION | Total bright sunshine (hours) | 182.5 | 202.9 | 174.6 | |
| | % of possible bright sunshine | 49.4 | 55.0 | 47.4 | |
| | Number of days with bright sunshine | 28 | 28 | 27 | |
| | Monthly total global radiation (MJ/m$^2$) | 388.7* | 416.6 | 362.4 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | 221.8* | 159.0 | 173.9 | |
| SOIL | Average temperature (°C) @ 9:00 am — 5 cm/10 cm | -2.8/-1.8 | -4.5/-3.2 | -3.4/-3.1 | |
| | 20 cm/50 cm | -1.0/-2.0 | -1.8/-1.9 | -2.8/-1.8 | |
| | 100 cm/150 cm | -0.2/0.6 | 0.2/1.1 | -0.6/0.4 | |
| | 300 cm | 2.4 | 2.6 | 2.5 | |

## FOR YOUR INFORMATION

March average temperatures were from 3° (ave. max.) to 4.1°C (ave. min.) above normal. On the 26th, a frost-free day occurred with a minimum temperature of only 2.7°C. Seventeen days recorded above zero temperatures with the majority after the 12th. On the 9th, there was 12 cm of snow on the ground, but by month's end it had melted. March was unusually dry with only 5.8 mm of precipitation falling over a total of 11 days. This contributed to a yearly deficit of 26.8 mm below normal. On the 28th, a thunderstorm rumbled over the city producing 0.2 mm of snow and rain. Bright sunshine values were 7.9 hours above normal with 7 days receiving less than one hour. Soil temperatures in the upper levels were warmer than usual with the lower levels about normal. Geese were observed at the site on March 9, but had been noted earlier in the city.

March is a month of great variability. It has brought floods one year and blizzards the next. In 1997 spring runoff inundated hundreds of thousands of acres of prime farmland in south-central Saskatchewan. Along the Moose Jaw river, 140 families left their homes during the worst flood in 45 years. The next year Calgarians experienced the worst mid-March snowfall in 113 years. Ranchers had to revert back to horse power to feed their stock (Phillips, 1998).

* Re-calibration of the radiation sensors were completed this month. The diffuse values are high due to reinstallation and reprogramming of the instrument.

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | APRIL 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | 12.7 | 15.3 | 9.9 | |
| | Extreme monthly maximum (°C/date) | | 22.8/24&25 | 29.2/29 | 30.6/1977/26 | 33.3/1952/28 |
| | Number of recording years | | | | 27 | 101 |
| | Average monthly minimum (°C) | | 0.9 | 0.2 | -2.0 | |
| | Extreme monthly minimum (°C/date) | | -5.9/02 | -7.4/15 | -27.8/1979/01 | -28.3/1893/05&1954/02 |
| | Number of recording years | | | | 27 | 101 |
| | Monthly average (°C) | | 6.8 | 7.8 | 4.0 | |
| | Days with frost | | 14 | 16 | 20 | |
| | Growing degree-days (5°C base) | | 84.5 | 106.5 | 54.8 | |
| | Heating degree-days (18°C base) | | 334.7 | 306.3 | 420.9 | |
| | Cooling degree-days (18°C base) | | 0.0 | 1.0 | 0.2 | |
| PRECIPITATION | Monthly total (mm) | | 11.5 | 13.0 | 20.3 | |
| | Greatest 24-hour (mm/date) | | 4.6/20 | 4.6/09 | 24.6/1985/19 | 30.2/1955/19 |
| | Number of recording years | | | | 27 | 101 |
| | Days with recordable precipitation | | 8 | 5 | 7 | |
| | Yearly total to date (mm) | | 39.7 | 40.2 | 75.3 | |
| WIND | Average monthly speed (km/h) | | 16.5 | 14.8 | | 18.0 |
| | Peak Gust (direction/speed(km/h)/date) | | NW71.4/13 | SE64.6/24 | | W108.0/1959/06 |
| RADIATION | Total bright sunshine (hours) | | 216.8 | 249.7 | 229.4 | |
| | % of possible bright sunshine | | 51.9 | 59.7 | 54.9 | |
| | Number of days with bright sunshine | | 27 | 29 | 27 | |
| | Monthly total global radiation (MJ/m$^2$) | | 496.2 | 526.4 | 492.2 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 172.5 | 160.1 | 178.5 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | 2.2/4.4 | 4.5/6.8 | 2.8/3.2 | |
| | | 20 cm/50 cm | 4.9/1.9 | 8.0/4.3 | 3.5/2.5 | |
| | | 100 cm/150 cm | 1.3/1.4 | 2.6/2.3 | 1.2/1.2 | |
| | | 300 cm | 2.3 | 2.6 | 2.2 | |

## FOR YOUR INFORMATION

April 1999, with average temperatures 2.8°C above normal, was warm but not as warm as last April when temperatures were 3.8°C above normal. Only three days were above 20°C. Sixteen days recorded no frost with the last frost recorded on April 23. This April, with only 11.5 mm of precipitation, was even drier than last year. The precipitation, slightly more than half of normal precipitation, fell over one more day than normal. The yearly total, similar to last year, is causing concern with the possibility of dry field conditions and blowing soil. The bright sunshine value was 12.6 hours below normal with seven days receiving less than one hour of bright sunshine.

April weather can change suddenly. In 1903, 76 men, women and children died when 82 million tonnes of limestone from Turtle Mountain roared down and obliterated the entrance to a coal mine, covered the valley below and nearby ranches and then swept across the valley to sideswipe the village of Frank, AB. Of the roughly 100 individuals living in the path of the slide; 23 escaped death. Three days earlier, 14 cm of snow had fallen and temperatures plunged from 22° to -9°C (Phillips, 1997; Frank Slide Interpretive Centre Web Site, May 1999). The sudden freezing of water-soaked limestone may have been the last straw and triggered the avalanche on the already unstable mountain side.

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | MAY 1999 | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | 16.8 | 21.8 | 18.5 | |
| | Extreme monthly maximum (°C/date) | 29.2/25 | 29.1/26 | 35.0/1988/30 | 37.2/1936/27 |
| | Number of recording years | | | 27 | 101 |
| | Average monthly minimum (°C) | 5.3 | 5.6 | 4.5 | |
| | Extreme monthly minimum (°C/date) | -1.6/07 | -4.8/01 | -10.0/1967/02 | -12.8/1907/06 |
| | Number of recording years | | | 27 | 101 |
| | Monthly average (°C) | 11.0 | 13.7 | 11.6 | |
| | Days with frost | 2 | 3 | 6 | |
| | Growing degree-days (5°C base) | 191.7 | 270.0 | 209.4 | |
| | Heating degree-days (18°C base) | 218.0 | 144.1 | 193.1 | |
| | Cooling degree-days (18°C base) | 2.5 | 11.1 | 7.0 | |
| PRECIPITATION | Monthly total (mm) | 39.2 | 10.4 | 43.7 | |
| | Greatest 24-hour (mm/date) | 12.8/18 | 5.8/18 | 39.9/1985/04 | 51.3/1909/30 |
| | Number of recording years | | | 27 | 101 |
| | Days with recordable precipitation | 12 | 5 | 9 | |
| | Yearly total to date (mm) | 78.9 | 50.6 | 119.0 | |
| WIND | Average monthly speed (km/h) | 16.9 | 14.8 | | 18.0 |
| | Peak Gust (direction/speed(km/h)/date) | NW64.7/18 | NNW90.6/03 | | SW132/1965/17 |
| RADIATION | Total bright sunshine (hours) | 176.4 | 295.0 | 285.7 | |
| | % of possible bright sunshine | 36.2 | 60.5 | 58.7 | |
| | Number of days with bright sunshine | 28 | 31 | 29 | |
| | Monthly total global radiation (MJ/m$^2$) | 534.1 | 693.9 | 586.3 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | 225.1 | 203.1 | 222.2 | |
| SOIL | Average temperature (°C) @ 9:00 am — 5 cm/10 cm | 8.2/10.2 | 11.8/13.9 | 10.1/10.6 | |
| | 20 cm/50 cm | 10.8/7.7 | 15.1/10.2 | 10.9/8.9 | |
| | 100 cm/150 cm | 6.1/4.8 | 7.3/5.8 | 5.9/4.4 | |
| | 300 cm | 3.4 | 3.9 | 3.1 | |

## FOR YOUR INFORMATION

Dull, dank, and cool all describe May 1999. Eight days of less than 1 hour of bright sunshine contributed to the low monthly total of bright sunshine hours of 176.4, 109.3 hours less than usual. The mean monthly temperature was 0.6°C below normal, with the mean maximum temperature 1.7°C below normal. The mean minimum temperature, however, was 0.8°C above its normal value. Only two days produced temperatures above 25°C compared with 10 days last year. With the cool weather, growing and cooling degree-days were below normal while heating degree-days were above. The frost-free period began on May 10, 10 days ahead of normal. The frost-free growing degree-days totalled 145.0 by month's end. Precipitation, falling as rain, snow and hail, was 4.5 mm less than normal. Tornadoes, visible from our office windows, were sighted late in the afternoon on the 18th. The storm produced a great variation in rainfall and hail occurrences around Saskatoon. The airport reported 59.0 mm of rain and 95 km/h winds from the NNW, while CRS recorded 8.6 mm of rain and 64.7 k/h winds from the NW. Kernan farm, southeast of the city, received about 15.0 mm of rain (Rybak, D. 1999; Environment Canada, 2000). Damage was reported to a few farm yards west of the city. On the east side of the river, people clutching cameras climbed the high road berme and traffic slowed to a crawl as viewers gawked at the strangely coloured swirling clouds.

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | JUNE 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | 20.8 | 21.3 | 22.6 | |
| | Extreme monthly maximum (°C/date) | | 28.7/19 | 28.7/25 | 41.0/1988/05 | 40.6/1988/05 |
| | Number of recording years | | | | 27 | 102 |
| | Average monthly minimum (°C) | | 9.1 | 8.8 | 9.2 | |
| | Extreme monthly minimum (°C/date) | | 3.3/27 | 0.5/02 | -3.3/1967/06 | -3.9/1903.0/09&1917/02 |
| | Number of recording years | | | | 27 | 102 |
| | Monthly average (°C) | | 15.0 | 15.1 | 15.9 | |
| | Days with frost | | 0 | 0 | 0 | |
| | Growing degree-days (5°C base) | | 298.6 | 302.8 | 327.3 | |
| | Heating degree-days (18°C base) | | 103.4 | 106.8 | 84 | |
| | Cooling degree-days (18°C base) | | 12.0 | 19.6 | 21.2 | |
| PRECIPITATION | Monthly total (mm) | | 66.4 | 51.4 | 63.6 | |
| | Greatest 24-hour (mm/date) | | 16.6/25 | 34.4/19 | 99.4/1983/24 | 99.4/1983/24 |
| | Number of recording years | | | | 27 | 102 |
| | Days with recordable precipitation | | 13 | 11 | 12 | |
| | Yearly total to date (mm) | | 145.3 | 102.0 | 182.6 | |
| WIND | Average monthly speed (km/h) | | 13.7 | 36.5 | | 17.0 |
| | Peak Gust (direction/speed(km/h)/date) | | WNW70.9/23 | S61.1/30 | | S117.0/1986/01 |
| RADIATION | Total bright sunshine (hours) | | 229.3 | 185.5 | 297.2 | |
| | % of possible bright sunshine | | 45.9 | 37.1 | 59.4 | |
| | Number of days with bright sunshine | | 28 | 28 | 29 | |
| | Monthly total global radiation (MJ/m$^2$) | | 610.4 | 572.5 | 638.7 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 230.7 | 251.1 | 228.1 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | 12.2/14.3 | 14.1/15.9 | 15.3/15.7 | |
| | | 20 cm/50 cm | 15.0/11.7 | 17.0/12.7 | 16.2/14.0 | |
| | | 100 cm/150 cm | 9.7/8.0 | 9.9/8.3 | 10.4/8.2 | |
| | | 300 cm | 5.2 | 5.8 | 5.2 | |

## FOR YOUR INFORMATION

June 1999 continued the cool temperature trend. Monthly averages were below normal with the average maximum the greatest at 1.8°C below normal value. Only five days reached maximum temperatures above 25°C. Daily average temperatures remained below 20°C except for three days. Soil temperatures were below normal for all levels. The growing degree-days were 28.7 below normal for the month. For the frost-free period of 52 days, the growing degree-day total was calculated to be 443.2. The monthly precipitation total was above normal for the first time this year. Two storms late in the month contributed slightly less than half of the total monthly rainfall. CRS recorded 13.4 mm of rain during the severe thunderstorm of June 21, but the airport only measured 0.5 mm (Environment Canada, 2000). With the rainfall occurring throughout the month, the monthly bright sunshine total was 67.9 hours less than usual.

If you ever hear of a meteorology convention nearby; be prepared for the worst. On June 6, 1968, 35 meteorologists congregated at the Alberta Hail Studies Centre in Penhold, AB. To the participants great delight storms pelted the base. Hail fell on farms west of the air base, leaving fields looking like winter and in the south, a small tornado formed. A perfect terrible day for a meteorological tour (Phillips, 1998).

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | JULY 1999 | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | 23.2 | 26.6 | 25.1 | |
| | Extreme monthly maximum (°C/date) | 30.8/21 | 36.3/10 | 38.5/1984/27 | 40.0/1919/17&1941/19&1946/30 |
| | Number of recording years | | | 27 | 102 |
| | Average monthly minimum (°C) | 11.4 | 12.9 | 11.5 | |
| | Extreme monthly minimum (°C/date) | 5.6/07 | 6.8/23 | 1.7/1967/02&1978/09 | -0.6/1918/25 |
| | Number of recording years | | | 27 | 102 |
| | Monthly average (°C) | 17.4 | 19.8 | 18.3 | |
| | Days with frost | 0 | 0 | 0 | |
| | Growing degree-days (5°C base) | 383.0 | 458.2 | 414.8 | |
| | Heating degree-days (18°C base) | 58.8 | 20.3 | 32.0 | |
| | Cooling degree-days (18°C base) | 38.8 | 75.5 | 43.9 | |
| PRECIPITATION | Monthly total (mm) | 86.4 | 36.8 | 55.7 | |
| | Greatest 24-hour (mm/date) | 23.8/15 | 15.0/01 | 45.5/1968/29 | 79.2/1946/03 |
| | Number of recording years | | | 27 | 102 |
| | Days with recordable precipitation | 14 | 9 | 11 | |
| | Yearly total to date (mm) | 231.7 | 138.8 | 238.3 | |
| WIND | Average monthly speed (km/h) | 13.7 | 12.6 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | WNW58.6/29 | SW63.7/11 | | E113.0/1955/05 |
| RADIATION | Total bright sunshine (hours) | 276.7 | 289.4 | 330.3 | |
| | % of possible bright sunshine | 55.1 | 57.7 | 65.8 | |
| | Number of days with bright sunshine | 30 | 31 | 30 | |
| | Monthly total global radiation (MJ/m$^2$) | 677.2 | 681.4 | 633.5 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | 234.8 | 240.2 | 216.5 | |
| SOIL | Average temperature (°C) @ 9:00 am — 5 cm/10 cm | 14.9/17.2 | 17.9/20.0 | 17.6/18.0 | |
| | 20 cm/50 cm | 18.0/14.5 | 21.3/126.5 | 18.8/16.8 | |
| | 100 cm/150 cm | 12.2/10.4 | 13.0/10.9 | 13.2/11.1 | |
| | 300 cm | 7.1 | 7.5 | 7.5 | |

## FOR YOUR INFORMATION

July was wet. Fourteen days received measurable precipitation cumulating in a monthly total of 86.4 mm; 30.7 mm above normal making July the fourth wettest at CRS. The wettest July was 1986 with 115.8 mm. The heaviest rainfall occurred on the 8th when 10.6 mm fell in 30 minutes. July temperatures were below normal, with the greatest deviation of 1.9°C seen in the average monthly maximum. Ten days registered temperatures above 27°C with 3 days above 30°C. Eight of those days occurred in the latter third of the month. Soil temperatures at the 5, 10 and 20 cm levels, recorded a decrease of 3.5°, 1.9° and 1.2° below normal during the 1600h observation time. Although the bright sunshine value was 53.6 hours below normal, only two days recorded less than an hour of bright sunshine. Both the global and diffuse radiation were above their normal values.

The heavy downpour on the night of July 24th created problems for those driving between Osler and Warman, SK when the rain was so heavy traffic either stopped or reduced speed to 40 km/h or less; at least for sensible drivers. Those with misplaced bravado passed slower moving vehicles even though it was impossible to see more than four car lengths ahead for oncoming traffic. Fortunately no accidents occurred (Beaulieu, 1999).

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | AUGUST 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | 25.4 | 28.9 | 24.3 | |
| | Extreme monthly maximum (°C/date) | | 33.9/25 | 39.7/06 | 39.7/1998/06 | 39.7/1998/06 |
| | Number of recording years | | | | 27 | 101 |
| | Average monthly minimum (°C) | | 11.6 | 13.1 | 10.1 | |
| | Extreme monthly minimum (°C/date) | | 5.4/01 | 8.2/20 | -2.8/1976/28 | -2.8/1976/28&1901/23 |
| | Number of recording years | | | | 27 | 101 |
| | Monthly average (°C) | | 18.5 | 21.0 | 17.2 | |
| | Days with frost | | 0 | 0 | 0 | |
| | Growing degree-days (5°C base) | | 419.6 | 497.4 | 379.6 | |
| | Heating degree-days (18°C base) | | 30.3 | 6.8 | 62.4 | |
| | Cooling degree-days (18°C base) | | 46.9 | 101.2 | 39.0 | |
| PRECIPITATION | Monthly total (mm) | | 41.4 | 45.2 | 35.3 | |
| | Greatest 24-hour (mm/date) | | 19.4/16 | 33.8/17 | 33.8/1998/17 | 84.3/1945/03 |
| | Number of recording years | | | | 27 | 101 |
| | Days with recordable precipitation | | 7 | 8 | 9 | |
| | Yearly total to date (mm) | | 273.1 | 184.0 | 273.6 | |
| WIND | Average monthly speed (km/h) | | 12.3 | 14.1 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | | WSW/64.6/22 | ESE/54.4/18 | | W/151.0/1967/14 |
| RADIATION | Total bright sunshine (hours) | | 253.4 | 294.9 | 295.2 | |
| | % of possible bright sunshine | | 55.9 | 65.1 | 65.2 | |
| | Number of days with bright sunshine | | 31 | 31 | 30 | |
| | Monthly total global radiation (MJ/m$^2$) | | 555.4 | 595.7 | 529.0 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 221.7 | 189.1 | 185.6 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | 14.9/17.2 | 17.9/20.1 | 16.4/16.8 | |
| | | 20 cm/50 cm | 18.2/15.4 | 21.7/17.6 | 17.9/16.8 | |
| | | 100 cm/150 cm | 13.5/11.9 | 14.5/12.6 | 14.1/12.4 | |
| | | 300 cm | 8.7 | 9.3 | 9.1 | |

## FOR YOUR INFORMATION

August, with temperatures slightly above normal, was considerably cooler than last year's scorcher. Five days were above 30°C compared with 12 days last year. It was the last half of the month, that Summer '99 finally felt like it had arrived with 7 days above 27°C. Growing degree-days were 40.0 above average but heating degree-days were less than half of normal. With no frost reported, the frost-free growing degree-days stand at 1245.9 for 113 days. Soil temperatures were generally slightly below average. Bright sunshine hours were down 41.8 hours even though only 2 days received less than an hour of sunshine. All days recorded some bright sunshine. The August 16th rainfall of 19.4 mm helped push the yearly total to within 0.5 mm of its normal. This weather system of very cold air in the upper levels of the atmosphere also produced cold-core funnel clouds west of Saskatoon (Adam 1999).

On August 4th, 1921, a tornado destroyed several large barns near Wynyard, SK pinning a farmer under one of the huge beams. He was rescued by his neighbours but pronounced dead by the local doctor. However, 13 hours later he regained consciousness much to the chagrin of the local newspaper editor who had run the obituary. The farmer lived to be almost 80 years old (Phillips 1998).

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | SEPTEMBER 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | 18.2 | 21.0 | 17.7 | |
| | Extreme monthly maximum (°C/date) | | 29.3/23 | 31.3/08&09 | 35.6 /1978 /04 | 35.6 /1978 /04 |
| | Number of recording years | | | | 27 | 101 |
| | Average monthly minimum (°C) | | 4.3 | 7.1 | 4.9 | |
| | Extreme monthly minimum (°C/date) | | -5.2/30 | -2.3/30 | -7.8 /1974 /30 | -11.1/1908/28 |
| | Number of recording years | | | | 27 | 101 |
| | Monthly average (°C) | | 11.2 | 14.1 | 11.3 | |
| | Days with frost | | 3 | 1 | 5 | |
| | Growing degree-days (5°C base) | | 190.4 | 273.0 | 197.1 | |
| | Heating degree-days (18°C base) | | 204.9 | 138.6 | 206.8 | |
| | Cooling degree-days (18°C base) | | 0.1 | 21.3 | 6.2 | |
| PRECIPITATION | Monthly total (mm) | | 10.4 | 26.0 | 32.9 | |
| | Greatest 24-hour (mm/date) | | 8.8/11 | 11.6/19 | 29.6/1980/03 | 44.2 /1931/12 |
| | Number of recording years | | | | 27 | 101 |
| | Days with recordable precipitation | | 6 | 8 | 9 | |
| | Yearly total to date (mm) | | 283.5 | 210.0 | 306.5 | |
| WIND | Average monthly speed (km/h) | | 14.1 | 13.0 | | 17.0 |
| | Peak Gust (direction/speed(km/h)/date) | | WNW64.8/29 | SE51.9/07 | | W148/1967/22 |
| RADIATION | Total bright sunshine (hours) | | 219.0 | 200.1 | 184.4 | |
| | % of possible bright sunshine | | 57.7 | 52.8 | 48.6 | |
| | Number of days with bright sunshine | | 29 | 27 | 27 | |
| | Monthly total global radiation (MJ/m$^2$) | | 412.1 | 381.5 | 351.8 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 127.6 | 119.9 | 127.6 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | 8.7/11.3 | 11.8/13.9 | 10.5/11.2 | |
| | | 20 cm/50 cm | 13.1/12.5 | 16.1/14.5 | 12.5/13.3 | |
| | | 100 cm/150 cm | 12.2/11.5 | 13.5/12.6 | 12.5/11.9 | |
| | | 300 cm | 9.7 | 10.3 | 9.9 | |

## FOR YOUR INFORMATION

September posted near seasonal temperature values for 1999. The averages varied less than a degree from the 30-year normal. Only the 16th and 23rd saw temperatures above 26°C. Although frost was noted at grass level on September 1st, it was not officially recorded until the 27th ending the frost-free growing season with 140 days. (The last spring frost was on May 9th.) This is 22 days more than average. Normally, the frost-free period is between May 19th and September 14th. Soil temperatures were near their seasonal values except for the 5 cm level which was 1.8°C below normal. Precipitation was below normal by 22.5 mm or 68.4%; much drier than last year. Bright sunshine was only absent for 1 day with the total bright sunshine 34.6 hours greater than normal. *Near gale* winds (51-62 km/h) occurred on the 1st, 7th, 11th and 24th with *gale* winds (63-75 km/h) occurring on the 29th.

September in Saskatchewan can vary from one extreme to the other with precipitation type. On the 12th of September, 1993 after a two day heavy snowfall which flattened crops, a state of emergency for farmers was declared. The Porcupine Plain area reported 30 cm of snow on the ground. But in 1986 around Consul, rain created problems when 157.5 mm fell in a 48-hour period (Phillips 1995).

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

## OCTOBER 1999

| | | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | 11.6 | 10.2 | 10.9 | |
| | Extreme monthly maximum (°C/date) | | 20.9/24 | 23.6/07 | 28.5/1984/08 | 32.2/1943/05 |
| | Number of recording years | | | | 27 | 99 |
| | Average monthly minimum (°C) | | -0.6 | 0.4 | -1.3 | |
| | Extreme monthly minimum (°C/date) | | -7.2/01 | -6.5/31 | -21.5/1984/30&31 | -25.6/1919/26 |
| | Number of recording years | | | | 28 | 99 |
| | Monthly average (°C) | | 5.5 | 5.3 | 4.8 | |
| | Days with frost | | 20 | 14 | 19 | |
| | Growing degree-days (5°C base) | | 50.6 | 67.6 | 61.5 | |
| | Heating degree-days (18°C base) | | 387.5 | 393.7 | 406.5 | |
| | Cooling degree-days (18°C base) | | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | | 4.0 | 37.7 | 17.5 | |
| | Greatest 24-hour (mm/date) | | 2.6/31 | 29.1a | 36.7/1984/16 | 41.7/1969/03 |
| | Number of recording years | | | | 27 | 99 |
| | Days with recordable precipitation | | 3 | 10 | 6 | |
| | Yearly total to date (mm) | | 287.5 | 247.7 | 324.0 | |
| WIND | Average monthly speed (km/h) | | 13.9 | 14.0 | | 17.0 |
| | Peak Gust (direction/speed(km/h)/date) | | N65.0/31 | SE59.8/02 | | NW138/1967/16 |
| RADIATION | Total bright sunshine (hours) | | 133.3 | 121.0 | 160.7 | |
| | % of possible bright sunshine | | 40.4 | 36.7 | 48.8 | |
| | Number of days with bright sunshine | | 29 | 22 | 27 | |
| | Monthly total global radiation (MJ/m$^2$) | | 230.2 | 203.3 | 239.1 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 132.1 | 143.5b | 92.6 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | 3.2/5.3 | 3.6/5.0 | 4.1/4.5 | |
| | | 20 cm/50 cm | 7.1/7.7 | 7.1/7.8 | 6.0/8.0 | |
| | | 100 cm/150 cm | 8.9/9.3 | 9.5/10.2 | 9.2/9.7 | |
| | | 300 cm | 9.3 | 10.0 | 9.5 | |

## FOR YOUR INFORMATION

We can only hope that the old proverb "the last Sunday of the month indicates the weather of the next month" , is not true (Lalonde 1994). Hallowe'en was very unpleasant with 65 km/h north winds accompanied by rain, snow and ice pellets. The rest of the month was extremely dry with less than one quarter of the expected precipitation. On the 17th, a brief thunderstorm produced 1.2 mm of rain and one clap of thunder. Temperatures for the month were less than 1ºC above normal. However, the growing degree-day value was 17.7% less than normal and the heating degree-day value was 5% less than normal. Soil temperatures were within 1°C of their normal values with the exception of the 20cm level which recorded an average of 1.1°C greater than normal. Although bright sunshine occurred 2 days more than usual, it was totally absent for 2 and for 4 days, it was less than one hour.

Hallowe'en heralded in the winter weather but what kind of winter will we have? David Phillips, "Canadian Weather Trivia Calendar" creator, says the forecast is for warmer than normal but if it is a normal winter, people will feel it is more brutal than it actually is because of what they have become used to in the past two winters (Robinson 1999). Proverbs say "If trees hang onto their leaves, the coming winter will be cold" and "As high as the weeds, so the winter's snow will be" (Lalonde 1994). So to insure a mild winter, shake the leaves off your trees and mow your weeds!

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**SASKATCHEWAN RESEARCH COUNCIL**

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | NOVEMBER 1999 | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | 5.1 | 0.0 | -1.5 | |
| | Extreme monthly maximum (°C/date) | 19.3/07 | 10.5/26 | 19.4/1975/04 | 21.7/1903/03 |
| | Number of recording years | | | 28 | 100 |
| | Average monthly minimum (°C) | -5.4 | -7.2 | -10.6 | |
| | Extreme monthly minimum (°C/date) | -17.0/28 | -19.7/17 | -33.5/1985/24 | -39.4/1893/30 |
| | Number of recording years | | | 28 | 100 |
| | Monthly average (°C) | -0.1 | -3.6 | -6.0 | |
| | Days with frost | 26 | 29 | 29 | |
| | Growing degree-days (5°C base) | 12.5 | 0.0 | 2.8 | |
| | Heating degree-days (18°C base) | 544.4 | 648.5 | 721.5 | |
| | Cooling degree-days (18°C base) | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | 2.8 | 6.1 | 15.5 | |
| | Greatest 24-hour (mm/date) | 1.8/25 | 2.3/16 | 19.3/1978/04 | 27.9/1938/01 |
| | Number of recording years | | | 28 | 100 |
| | Days with recordable precipitation | 4 | 5 | 8 | |
| | Yearly total to date (mm) | 290.3 | 253.8 | 339.5 | |
| WIND | Average monthly speed (km/h) | 14.1 | 13.9 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | WNW64.2/04 | SW50.6/26 | | W100.0/1976/17 |
| RADIATION | Total bright sunshine (hours) | 118.0* | 57.2 | 100.9 | |
| | % of possible bright sunshine | 44.6* | 21.7 | 38.1 | |
| | Number of days with bright sunshine | 28 | 22 | 22 | |
| | Monthly total global radiation (MJ/m$^2$) | 131.9* | 110.1 | 123.7 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | 58.3* | 72.1 | 73.6 | |
| SOIL | Average temperature (°C) @ 9:00 am — 5 cm/10 cm | -1.0/0.7 | -0.7/0.3 | -2.2/-1.7 | |
| | 20 cm/50 cm | 2.7/4.1 | 2.4/3.0 | -0.5/2.8 | |
| | 100 cm/150 cm | 6.3/7.3 | 5.9/7.1 | 5.4/6.8 | |
| | 300 cm | 8.1 | 8.5 | 8.1 | |

## FOR YOUR INFORMATION

November's temperatures were not a reliable indicator that the winter months were approaching. The mean maximum was 6.6°C and the mean minimum was 5.2°C warmer than usual. The average mean for the month, at -0.1°C, was 5.9°C higher than normal. Only the years 1987 (max. 5.3°C), 1992 (min. -5.0°C) and 1981 (mean 0.4°C) recorded variables warmer than this November's. Only 4 days did not have above zero temperatures. On the 7th, the temperature came within a tenth of a degree of the monthly maximum record for CRS. The mild temperatures are reflected in 177.1 heating degree-days less than normal. Upper level soil temperatures also are considerably warmer than usual. The site registered 6.4% above normal bright sunshine with at least 118 hours recorded.* Five days received less than 1 hour of bright sunshine. With only 3 days recording precipitation, the total for November was 2.8 mm making this the fifth driest November for CRS. The driest year was 1974 when only a trace was recorded.

With the dry weather and lack of snow, 'black blizzards' can developed. On November 13, 1933, dust from the prairies blew to the Atlantic Coast. Black rain fell in New York State and brown snow fell in Vermont (Phillips 1987).

*Datalogger was not recording for the afternoon of the 24th due to the instillation of new equipment.

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## SASKATCHEWAN RESEARCH COUNCIL

# Monthly Weather Summary

Latitude 52°09'N Saskatoon Longitude 106°36'W

CRS estbd. 1963

| | DECEMBER 1999 | | 1999 VALUE | 1998 VALUE | NORMAL(1961-1990) OR EXTREME VALUE FOR CRS | EXTREME FOR SASKATOON STATIONS |
|---|---|---|---|---|---|---|
| TEMPERATURE | Average monthly maximum (°C) | | -0.7 | -8.1 | -9.8 | |
| | Extreme monthly maximum (°C/date) | | 8.4/27 | 7.8/13 | 9.5/1987/07 | 14.4/1939/05 |
| | Number of recording years | | | | 28 | 100 |
| | Average monthly minimum (°C) | | -11.3 | -16.3 | -19.3 | |
| | Extreme monthly minimum (°C/date) | | -29.1/20 | -30.5/21 | -42.2/1973/31 | -43.9/1892/22 |
| | Number of recording years | | | | 28 | 100 |
| | Monthly average (°C) | | -6.0 | -12.2 | -14.5 | |
| | Days with frost | | 29 | 31 | 31 | |
| | Growing degree-days (5°C base) | | 0.0 | 0.0 | 0.0 | |
| | Heating degree-days (18°C base) | | 743.2 | 937.4 | 1004.8 | |
| | Cooling degree-days (18°C base) | | 0.0 | 0.0 | 0.0 | |
| PRECIPITATION | Monthly total (mm) | | 7.4 | 8.9 | 21.3 | |
| | Greatest 24-hour (mm/date) | | 2.7/03 | 3.0/18 | 14.5/1973/23 | 28.4/1936/02 |
| | Number of recording years | | | | 28 | 100 |
| | Days with recordable precipitation | | 11 | 7 | 12 | |
| | Yearly total to date (mm) | | 297.7 | 262.7 | 360.8 | |
| WIND | Average monthly speed (km/h) | | 14.8 | 15.1 | | 16.0 |
| | Peak Gust (direction/speed(km/h)/date) | | NNW65.1/19 | NNE68.0/18 | | W121/1955/12 |
| RADIATION | Total bright sunshine (hours) | | 111.7 | 89.3 | 83.7 | |
| | % of possible bright sunshine | | 46.1 | 36.8 | 34.5 | |
| | Number of days with bright sunshine | | 25 | 25 | 23 | |
| | Monthly total global radiation (MJ/m$^2$) | | 98.5 | 99.7 | 95.2 | |
| | Monthly total diffuse radiation (MJ/m$^2$) | | 44.0 | 48.5 | 54.3 | |
| SOIL | Average temperature (°C) @ 9:00 am | 5 cm/10 cm | -4.8/-3.6 | -6.7/-5.9 | -7.1/-6.5 | |
| | | 20 cm/50 cm | -1.7/-0.1 | -3.7/-1.2 | -5.5/-1.6 | |
| | | 100 cm/150 cm | 3.0/4.6 | 3.0/4.8 | 1.9/3.9 | |
| | | 300 cm | 6.6 | 6.8 | 6.3 | |

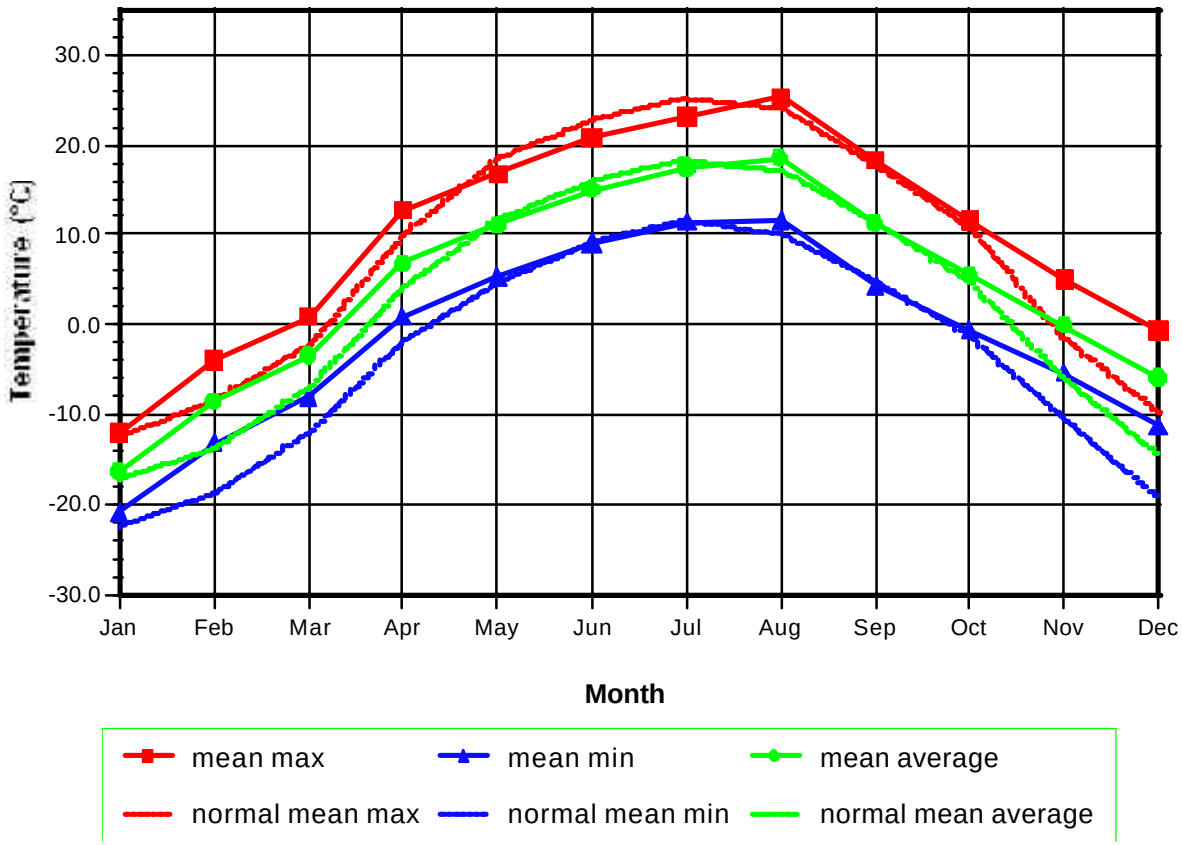
## FOR YOUR INFORMATION

"Different" best describes December's weather with the unseasonably warm temperatures continuing through to month's end. In fact, on the 28th and 29th, temperatures did not fall below zero and rain fell instead of snow. The average temperature for the month was 8.5°C above normal with the average maximum 9.1°C above and the average minimum 8.0°C above normal. The unusual mild air temperatures produced warm soil temperatures even though the ground was unprotected with a snow cover. The soil temperatures ranged from 3.8°C in the upper levels to 0.3°C in the lower. Precipitation for the month was a third of normal. The annual total was 63.1 mm or 17.5 % less than normal. Bright sunshine was 28 hours more than usual which encouraged people to be outside on the golf courses and in the parks enjoying the Wyoming-type temperatures (Wood 1996).

This is not the only mild December in recent times. In 1997, a merchant in St. Albert, AB, concerned that his daughter would be unable to enjoy winter during the holidays without snow, trucked in 5 trailer loads of the white stuff scraped from the local hockey rink and dumped them in front of his store. Surprised shoppers enjoyed the wintry sight especially the three snowman (Phillips, 1998).

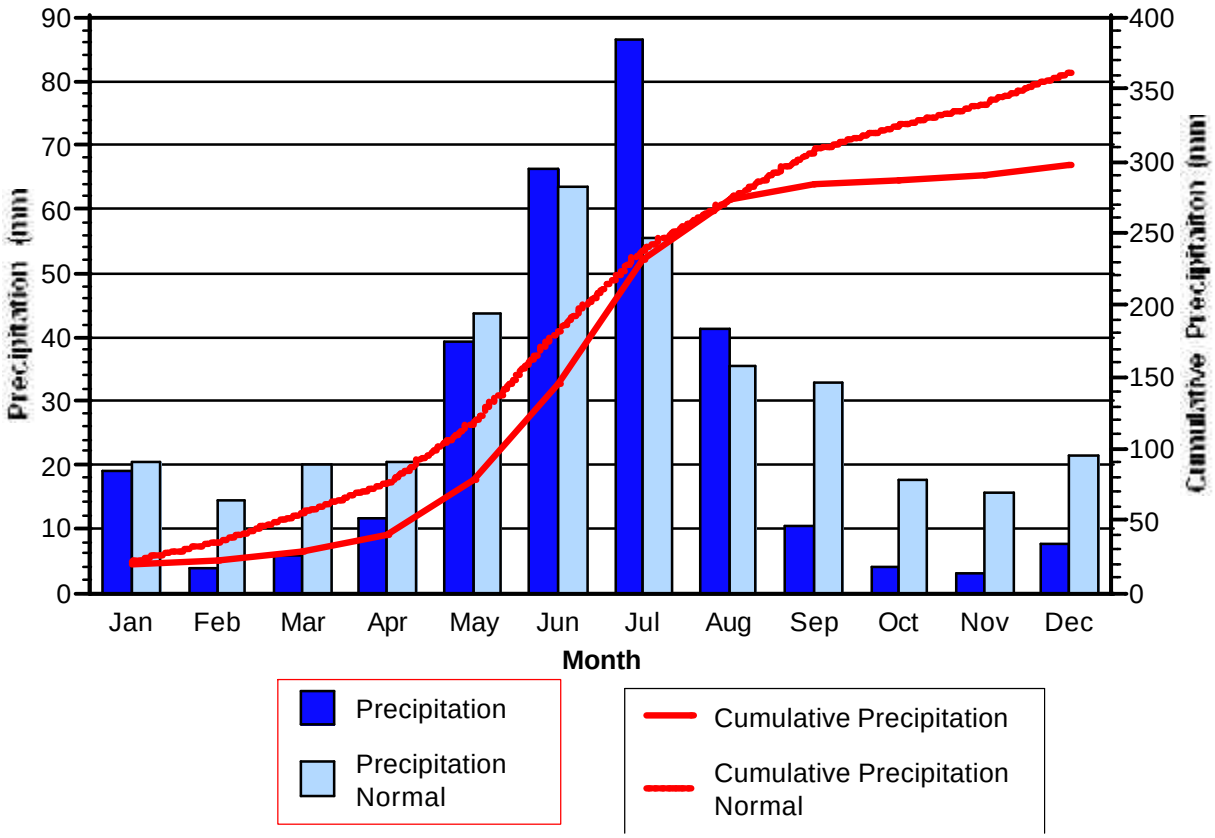
# Monthly Average Temperatures, 1999

| MONTH | MEAN MAXIMUM TEMPERATURE (°C) | | MEAN MINIMUM TEMPERATURE (°C) | | MEAN AVERAGE TEMPERATURE (°C) | |
|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Normal |
| January | -12.0 | -12.4 | -20.9 | -22.6 | -16.4 | -17.4 |
| February | -4.0 | -8.6 | -13.2 | -18.9 | -8.6 | -13.7 |
| March | 0.9 | -2.1 | -8.0 | -12.1 | -3.5 | -7.0 |
| April | 12.7 | 9.9 | 0.9 | -2.0 | 6.8 | 4.0 |
| May | 16.8 | 18.5 | 5.3 | 4.5 | 11.0 | 11.6 |
| June | 20.8 | 22.6 | 9.1 | 9.2 | 15.0 | 15.9 |
| July | 23.2 | 25.1 | 11.4 | 11.5 | 17.4 | 18.3 |
| August | 25.4 | 24.3 | 11.6 | 10.1 | 18.5 | 17.2 |
| September | 18.2 | 17.7 | 4.3 | 4.9 | 11.2 | 11.3 |
| October | 11.6 | 10.9 | -0.6 | -1.3 | 5.5 | 4.8 |
| November | 5.1 | -1.5 | -5.4 | -10.6 | -0.1 | -6.0 |
| December | -0.7 | -9.8 | -11.3 | -19.3 | -6.0 | -14.5 |
| Average | 9.8 | 7.9 | -1.4 | -3.9 | 4.2 | 2.0 |



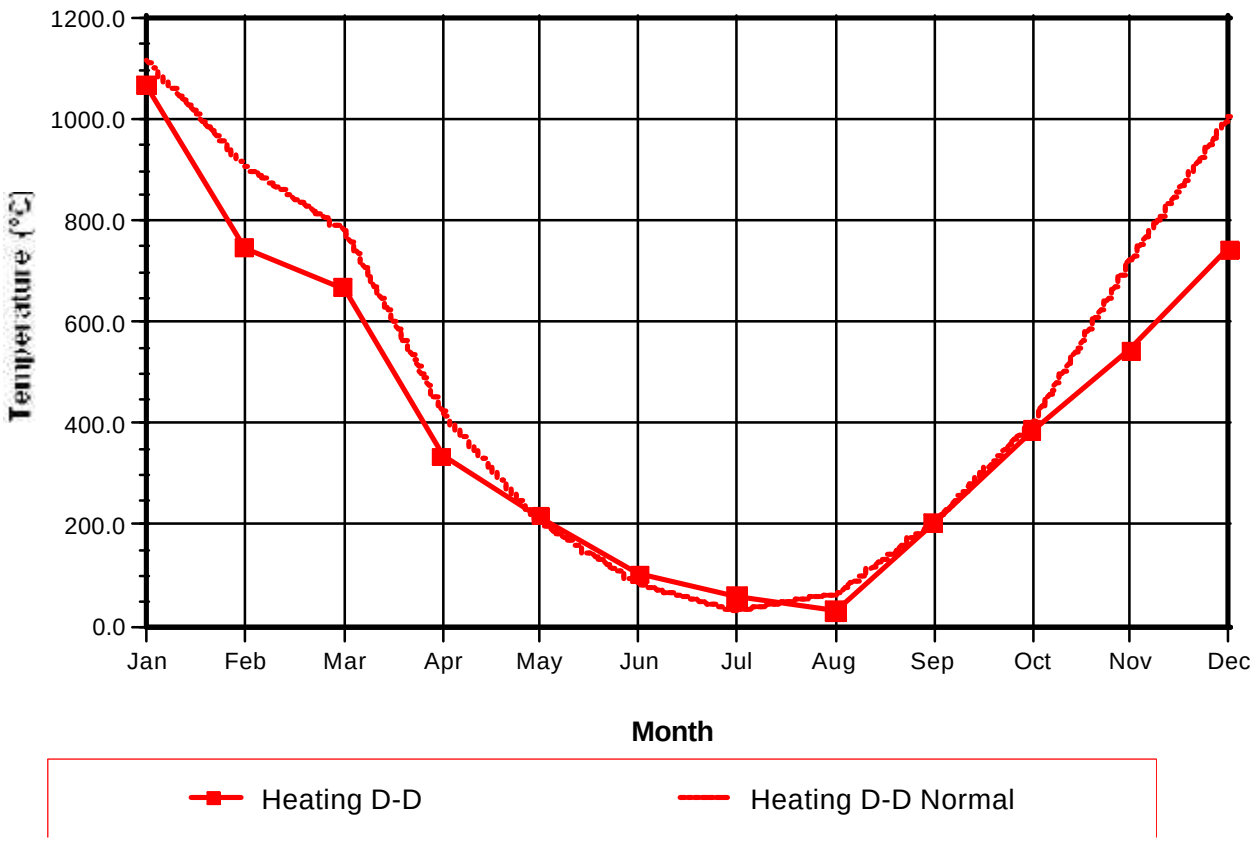
# Monthly Precipitation, 1999

| MONTH | PRECIPITATION (mm) | | CUMULATIVE PRECIPITATION (mm) | |
|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal |
| January | 18.9 | 20.5 | 18.9 | 20.5 |
| February | 3.5 | 14.6 | 22.4 | 35.1 |
| March | 5.8 | 19.9 | 28.2 | 55.0 |
| April | 11.5 | 20.3 | 39.7 | 75.3 |
| May | 39.2 | 43.7 | 78.9 | 119.0 |
| June | 66.4 | 63.6 | 145.3 | 182.6 |
| July | 86.4 | 55.7 | 231.7 | 238.3 |
| August | 41.4 | 35.3 | 273.1 | 273.6 |
| September | 10.4 | 32.9 | 283.5 | 306.5 |
| October | 4.0 | 17.5 | 287.5 | 324.0 |
| November | 2.8 | 15.5 | 290.3 | 339.5 |
| December | 7.4 | 21.3 | 297.7 | 360.8 |
| Total | 297.7 | 360.8 | | |



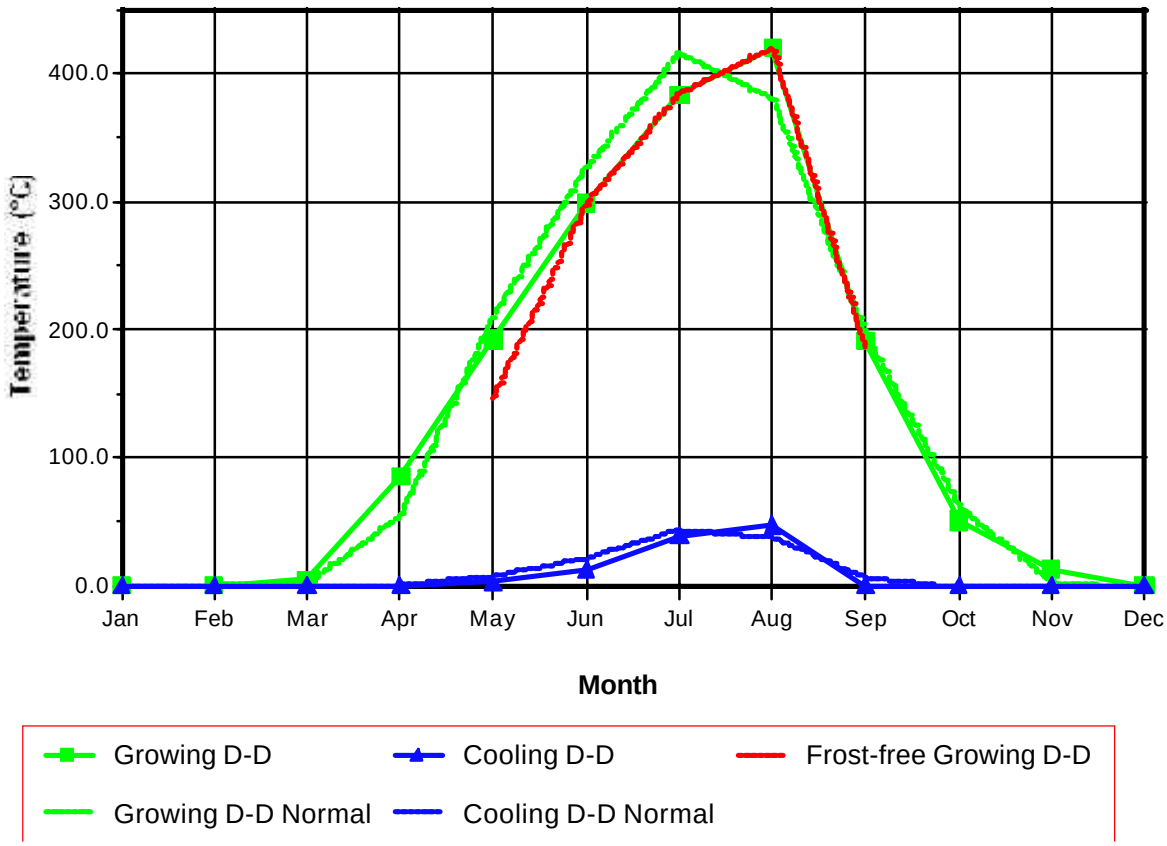
# Monthly Heating Degree-Days (D-D), 1999

| MONTH | HEATING DEGREE-DAYS Base 18°C | |
|---|---|---|
| | 1999 | Normal |
| January | 1067.3 | 1114.8 |
| February | 745.9 | 909.9 |
| March | 667.3 | 784.1 |
| April | 334.7 | 420.9 |
| May | 218.0 | 206.9 |
| June | 103.4 | 84.0 |
| July | 58.8 | 32.0 |
| August | 30.3 | 62.4 |
| September | 204.9 | 206.2 |
| October | 387.5 | 406.5 |
| November | 544.4 | 721.5 |
| December | 743.2 | 1004.8 |
| Total | 5105.7 | 5954.0 |



# Monthly Growing and Cooling Degree-Days (D-D), 1999

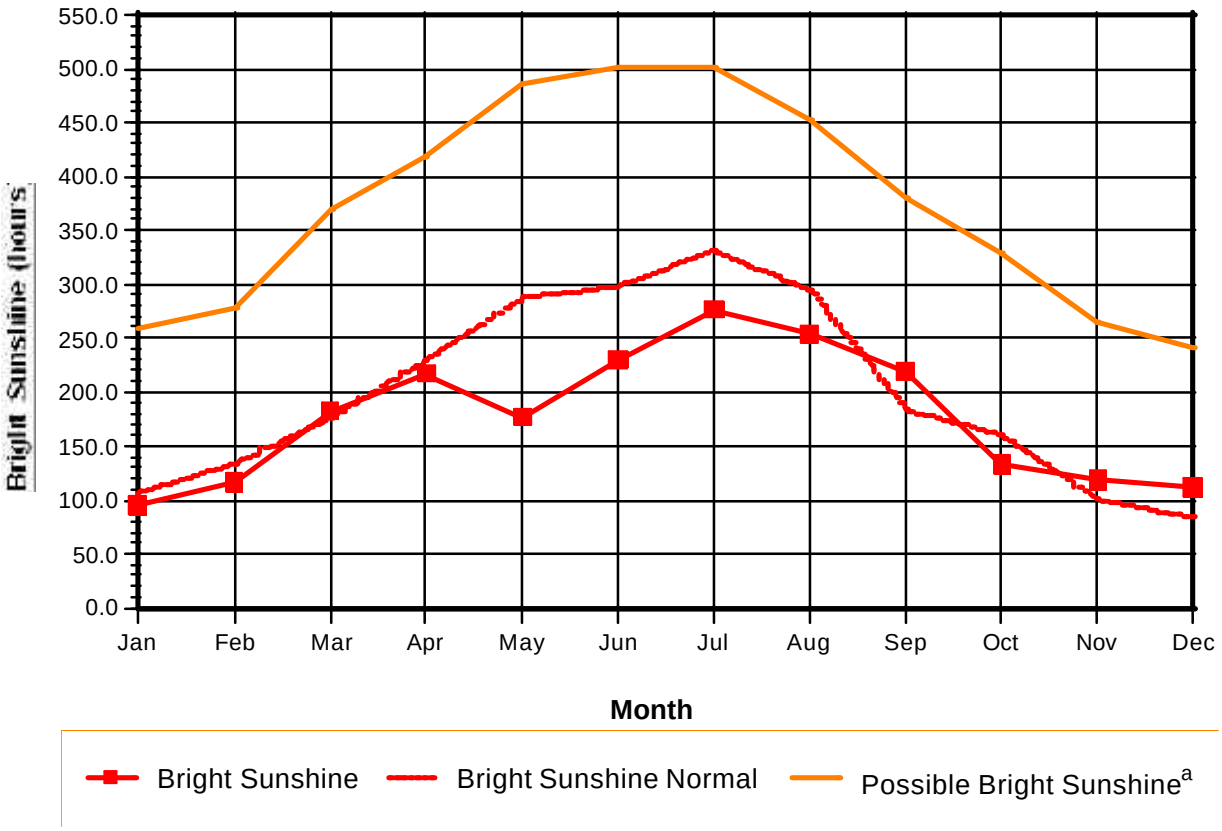
| MONTH | GROWING DEGREE-DAYS Base 5°C | | COOLING DEGREE-DAYS Base 18°C | | FROST-FREE GROWING D-D Base 5°C | |
|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Cumulative |
| January | 0.0 | 0.0 | 0.0 | 0.0 | | |
| February | 0.0 | 0.0 | 0.0 | 0.0 | | |
| March | 4.0 | 1.2 | 0.0 | 0.0 | | |
| April | 84.5 | 54.8 | 0.0 | 0.2 | | |
| May | 191.7 | 209.4 | 2.5 | 7.0 | 145.0 | 145.0 |
| June | 298.6 | 327.3 | 12.0 | 21.2 | 298.6 | 443.6 |
| July | 383.0 | 414.8 | 38.8 | 43.9 | 383.0 | 826.6 |
| August | 419.6 | 379.6 | 46.9 | 39.0 | 419.6 | 1246.2 |
| September | 190.4 | 197.1 | 0.1 | 6.2 | 186.0 | 1432.2 |
| October | 50.6 | 61.5 | 0.0 | 0.0 | | |
| November | 12.5 | 2.7 | 0.0 | 0.0 | | |
| December | 0.0 | 0.0 | 0.0 | 0.0 | | |
| Total | 1634.9 | 1648.4 | 100.3 | 117.5 | 1432.2 | |



# Monthly Bright Sunshine, 1999

| MONTH | BRIGHT SUNSHINE (hours) | | | |
|---|---|---|---|---|
| | 1999 | Normal | Possible* | % of Possible |
| January | 94.7 | 104.6 | 258.8 | 36.6 |
| February | 116.3 | 134.1 | 278.4 | 41.8 |
| March | 182.5 | 174.6 | 368.7 | 49.5 |
| April | 216.8 | 229.4 | 417.8 | 51.9 |
| May | 176.4 | 285.7 | 487.1 | 36.2 |
| June | 229.3 | 297.2 | 500.1 | 45.9 |
| July | 276.7 | 330.3 | 502.2 | 55.1 |
| August | 253.4 | 295.2 | 453.1 | 55.9 |
| September | 219.0 | 184.4 | 379.8 | 57.7 |
| October | 133.3 | 160.7 | 329.8 | 40.4 |
| November | 118.0 | 100.9 | 264.5 | 44.6 |
| December | 111.7 | 83.7 | 242.4 | 46.1 |
| Total | 2128.1 | 2380.8 | 4482.7 | 47.5 |

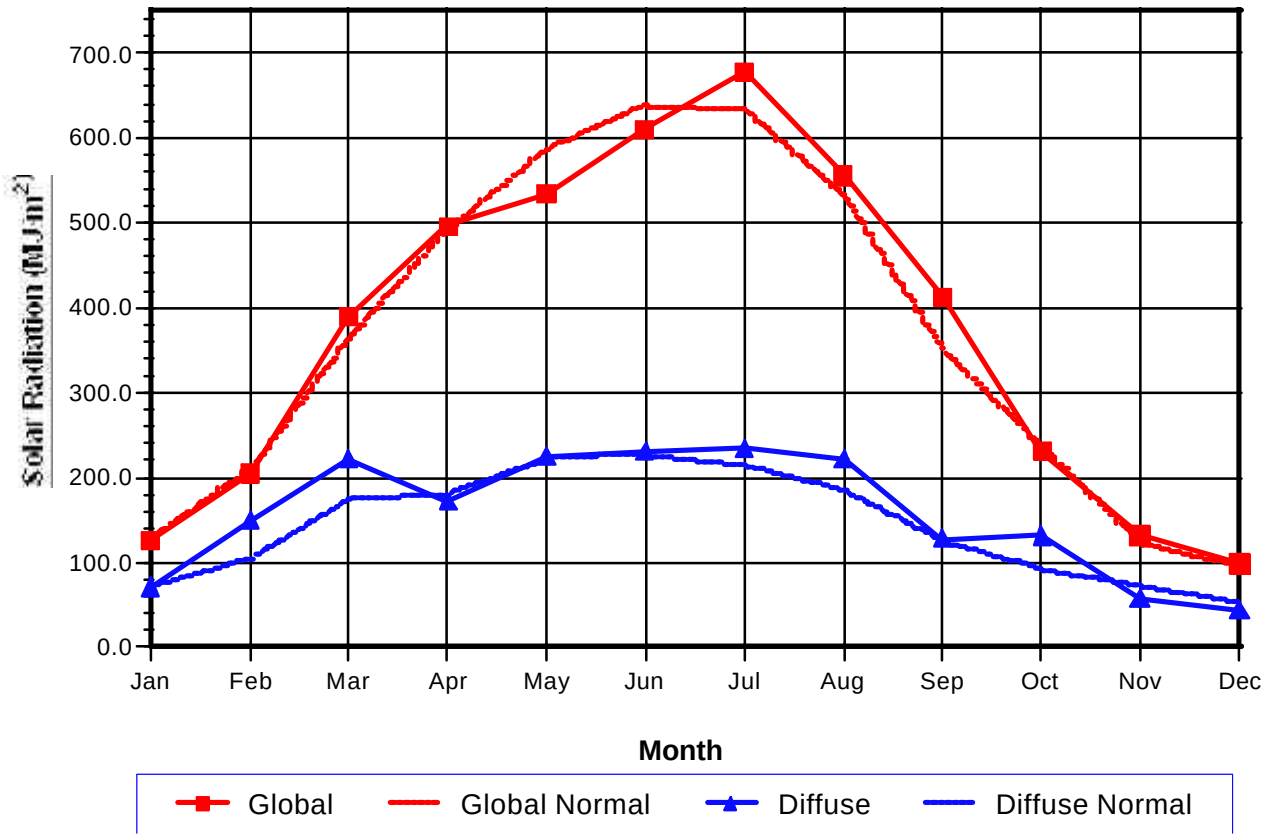
* possible Bright Sunshine hours calculated from National Research Council of Canada, Hertzberg Institute of Astrophysics sunrise/sunset table for 1999



# Monthly Global and Diffuse Solar Radiation, 1999

| MONTH | **GLOBAL RADIATION ($MJ/m^2$) | | **DIFFUSE RADIATION ($MJ/m^2$) | |
|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal |
| January | 126.1 | 129.9 | 70.6 | 71.4 |
| February | 204.5 | 210.1 | 149.9 | 105.3 |
| March | 388.7 | 362.4 | 221.8 | 173.9 |
| April | 496.2 | 492.2 | 172.5 | 178.5 |
| May | 534.1 | 586.3 | 225.1 | 222.2 |
| June | 610.4 | 638.7 | 230.7 | 228.1 |
| July | 677.2 | 633.5 | 234.8 | 216.5 |
| August | 555.4 | 529.0 | 221.7 | 185.6 |
| September | 412.1 | 351.8 | 127.6 | 127.6 |
| October | 230.2 | 239.1 | 132.1 | 92.6 |
| November | 131.9 | 123.7 | 58.3 | 73.6 |
| December | 98.5 | 95.2 | 44.0 | 54.3 |
| Total | 4465.3 | 4391.9 | 1889.1 | 1729.6 |

** Global and Diffuse radiation sensors were re-calibrated during February and March



# Daily Global and Diffuse Solar Radiation (MJ/m$^2$), 1999

| DATE | JAN | | FEB | | MAR | | APR | | MAY | | JUN | | JULY | | AUG | | SEPT | | OCT | | NOV | | DEC | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | G | D | G | D | G | D | G | D | G | D | G | D | G | D | G | D | G | D | G | D | G | D | G | D |
| 1 | 2.9 | 2.6 | 6.1 | 1.3 | 9.9 | 5.5 | 18.6 | 4.4 | 9.9 | 7.5 | 8.1 | 7.1 | 24.6 | 10.4 | 24.1 | 5.9 | 12.9 | 8.5 | 7.2 | 6.4 | 7.3 | 2.7 | 3.9 | 0.8 |
| 2 | 3.3 | 1.1 | 5.2 | 3.5 | 9.3 | 9.6 | 21.5 | 2.2 | 24.7 | 3.6 | 16.6 | 8.8 | 13.2 | 11.5 | 23.4 | 5.7 | 17.8 | 5.9 | 7.7 | 4.5 | 6.3 | 4.0 | 3.8 | 1.3 |
| 3 | 5.9 | 1.1 | 6.6 | 4.1 | 12.1 | 8.3 | 18.4 | 3.8 | 10.9 | 8.1 | 6.5 | 6.0 | 12.2 | 7.8 | 24.3 | 4.1 | 14.1 | 7.9 | 8.5 | 5.2 | 6.8 | 2.9 | 1.6 | 1.7 |
| 4 | 3.3 | 1.5 | 4.6 | 2.7 | 7.5 | 10.0 | 12.8 | 11.6 | 16.8 | 9.9 | 20.7 | 7.7 | 20.9 | 11.1 | 24.9 | 4.3 | 12.4 | 5.5 | 5.8 | 4.4 | 3.1 | 2.9 | 6.2 | 1.1 |
| 5 | 2.2 | 2.1 | 10.2 | 1.8 | 8.8 | 11.0 | 16.6 | 9.2 | 19.5 | 9.5 | 24.0 | 6.5 | 26.9 | 7.1 | 20.5 | 7.0 | 19.3 | 2.7 | 10.0 | 4.1 | 6.7 | 2.1 | 2.1 | 2.2 |
| 6 | 6.5 | 1.3 | 7.8 | 1.8 | 12.8 | 7.0 | 14.1 | 8.7 | 27.0 | 2.8 | 23.8 | 8.4 | 30.0 | 4.1 | 17.3 | 12.0 | 18.7 | 3.0 | 8.5 | 5.5 | 5.4 | 3.3 | 3.8 | 0.8 |
| 7 | 2.9 | 2.3 | 7.3 | 1.9 | 10.8 | 12.1 | 20.2 | 3.3 | 26.6 | 2.8 | 15.7 | 7.8 | 22.0 | 5.9 | 23.7 | 7.7 | 6.3 | 6.0 | 4.9 | 4.1 | 6.5 | 1.5 | 2.5 | 2.0 |
| 8 | 4.6 | 1.8 | 6.2 | 4.9 | 6.2 | 8.8 | 20.3 | 2.9 | 17.1 | 8.1 | 6.3 | 5.6 | 22.5 | 7.1 | 13.9 | 8.8 | 18.3 | 4.6 | 6.5 | 5.1 | 5.7 | 2.1 | 1.4 | 1.5 |
| 9 | 4.0 | 1.3 | 7.1 | 2.3 | 11.7 | 9.2 | 10.5 | 7.0 | 11.6 | 10.1 | 15.3 | 9.3 | 27.8 | 8.5 | 21.8 | 8.7 | 18.8 | 2.2 | 10.5 | 3.8 | 4.2 | 3.2 | 3.8 | 1.4 |
| 10 | 3.2 | 2.6 | 6.6 | 6.5 | 10.6 | 12.7 | 17.5 | 5.4 | 4.1 | 3.7 | 27.2 | 6.4 | 28.7 | 5.5 | 9.8 | 10.7 | 17.2 | 3.8 | 12.0 | 1.8 | 3.3 | 2.9 | 2.0 | 1.9 |
| 11 | 3.5 | 2.8 | 10.6 | 2.8 | 11.9 | 9.9 | 17.1 | 5.3 | 6.5 | 5.7 | 15.4 | 11.1 | 28.5 | 5.3 | 20.4 | 9.0 | 4.6 | 4.5 | 5.1 | 4.5 | 4.9 | 2.0 | 3.9 | 1.2 |
| 12 | 5.0 | 2.1 | 8.7 | 4.1 | 8.7 | 11.5 | 18.7 | 6.4 | 13.0 | 9.3 | 19.2 | 5.9 | 23.0 | 9.1 | 10.8 | 8.8 | 17.0 | 3.9 | 7.2 | 4.6 | 5.0 | 1.5 | 3.6 | 1.8 |
| 13 | 3.1 | 2.8 | 6.3 | 5.5 | 14.0 | 12.0 | 17.4 | 6.4 | 18.3 | 11.8 | 27.0 | 6.7 | 24.4 | 5.5 | 8.2 | 8.6 | 17.2 | 4.0 | 5.8 | 4.1 | 5.3 | 1.4 | 2.6 | 1.5 |
| 14 | 3.0 | 2.7 | 7.3 | 5.4 | 13.1 | 9.3 | 18.8 | 6.1 | 9.1 | 6.8 | 28.9 | 6.3 | 21.8 | 12.5 | 19.3 | 11.7 | 17.9 | 2.0 | 10.5 | 3.1 | 5.3 | 1.8 | 4.0 | 1.2 |
| 15 | 3.7 | 2.0 | 4.5 | 6.1 | 15.3 | 4.2 | 23.1 | 2.4 | 9.7 | 8.4 | 27.7 | 6.9 | 3.8 | 4.2 | 12.8 | 12.3 | 17.8 | 2.2 | 6.4 | 5.2 | 5.4 | 1.8 | 4.8 | 1.1 |
| 16 | 4.7 | 1.3 | 5.0 | 6.8 | 4.9 | 6.8 | 23.6 | 2.5 | 6.8 | 5.8 | 28.2 | 5.5 | 14.4 | 11.2 | 7.4 | 8.6 | 17.4 | 2.2 | 9.2 | 5.0 | 5.3 | 1.5 | 1.8 | 1.7 |
| 17 | 2.3 | 2.2 | 4.2 | 5.7 | 17.5 | 4.9 | 13.9 | 9.5 | 19.1 | 9.6 | 30.2 | 3.2 | 18.6 | 9.4 | 12.7 | 9.6 | 13.5 | 5.3 | 6.7 | 5.6 | 0.8 | 0.8 | 3.9 | 1.2 |
| 18 | 2.5 | 2.4 | 5.9 | 7.9 | 13.5 | 9.3 | 23.7 | 2.4 | 16.8 | 7.2 | 21.1 | 12.2 | 17.4 | 12.1 | 22.9 | 6.1 | 7.5 | 6.3 | 7.7 | 6.5 | 1.3 | 1.3 | 1.3 | 1.3 |
| 19 | 5.3 | 1.3 | 5.4 | 7.3 | 16.6 | 4.1 | 11.1 | 9.3 | 5.6 | 4.6 | 24.6 | 8.0 | 22.7 | 8.6 | 18.1 | 11.2 | 8.3 | 6.9 | 5.2 | 4.7 | 2.6 | 2.4 | 3.5 | 1.0 |
| 20 | 4.2 | 2.5 | 6.4 | 7.9 | 16.7 | 3.8 | 4.0 | 3.8 | 15.8 | 10.8 | 28.2 | 5.7 | 28.4 | 4.7 | 21.4 | 8.1 | 16.4 | 2.0 | 7.5 | 6.4 | 3.3 | 2.2 | 3.0 | 1.9 |
| 21 | 3.2 | 3.2 | 6.0 | 8.3 | 17.4 | 3.7 | 13.3 | 8.4 | 8.8 | 7.8 | 14.5 | 8.8 | 27.7 | 4.9 | 21.5 | 7.5 | 11.8 | 5.7 | 9.9 | 9.4 | 4.0 | 1.7 | 2.8 | 2.0 |
| 22 | 2.1 | 2.0 | 7.0 | 6.7 | 18.1 | 3.9 | 22.7 | 6.8 | 16.0 | 9.8 | 26.3 | 8.0 | 27.6 | 4.8 | 11.5 | 8.8 | 11.3 | 4.4 | 6.9 | 6.4 | 4.5 | 1.2 | 1.5 | 1.6 |
| 23 | 3.6 | 3.5 | 7.6 | 8.2 | 17.3 | 3.8 | 24.8 | 2.4 | 22.6 | 7.7 | 18.2 | 8.7 | 26.6 | 6.2 | 22.6 | 2.7 | 14.7 | 2.7 | 9.4 | 1.6 | 6.2 | 1.2 | 4.9 | 1.0 |
| 24 | 6.8 | 1.4 | 10.2 | 7.3 | 17.2 | 4.0 | 21.8 | 4.1 | 21.2 | 9.4 | 27.7 | 7.1 | 19.7 | 6.7 | 21.1 | 4.1 | 10.0 | 5.0 | 8.0 | 2.6 | 0.8 | 0.1 | 3.7 | 0.9 |
| 25 | 5.7 | 1.3 | 8.8 | 7.7 | 15.5 | 6.2 | 22.5 | 2.5 | 29.1 | 2.8 | 5.3 | 4.7 | 8.6 | 7.9 | 20.8 | 4.9 | 7.3 | 4.9 | 7.5 | 2.7 | 2.7 | 1.6 | 2.9 | 1.4 |
| 26 | 3.8 | 3.3 | 8.1 | 9.8 | 12.8 | 5.2 | 7.9 | 6.9 | 28.3 | 4.7 | 10.8 | 7.3 | 25.9 | 5.5 | 21.8 | 3.2 | 11.2 | 3.4 | 7.3 | 4.3 | 3.4 | 2.4 | 2.5 | 2.3 |
| 27 | 3.1 | 2.9 | 12.4 | 5.3 | 16.6 | 4.9 | 18.0 | 7.9 | 28.7 | 4.7 | 21.3 | 13.3 | 24.2 | 7.0 | 21.4 | 2.5 | 13.1 | 3.2 | 8.5 | 1.4 | 5.0 | 1.3 | 3.3 | 1.6 |
| 28 | 5.9 | 1.7 | 12.4 | 6.3 | 12.5 | 5.0 | 6.2 | 5.5 | 28.8 | 4.9 | 23.3 | 11.0 | 26.3 | 5.1 | 21.1 | 2.5 | 14.4 | 2.0 | 3.6 | 3.3 | 3.8 | 1.4 | 3.5 | 1.3 |
| 29 | 5.5 | 4.0 | | | 17.1 | 4.0 | 7.6 | 7.0 | 21.3 | 13.3 | 23.1 | 8.6 | 26.6 | 5.1 | 10.0 | 8.4 | 11.4 | 3.9 | 6.4 | 2.6 | 4.4 | 1.2 | 2.9 | 1.1 |
| 30 | 4.5 | 4.5 | | | 6.7 | 6.1 | 9.5 | 8.4 | 28.1 | 5.9 | 25.2 | 8.1 | 13.5 | 10.0 | 19.4 | 3.9 | 13.5 | 3.0 | 8.2 | 1.6 | 2.6 | 1.9 | 3.5 | 0.9 |
| 31 | 5.8 | 3.0 | | | 5.6 | 5.0 | | | 12.3 | 8.0 | | | 18.7 | 10.0 | 6.5 | 4.3 | | | 1.6 | 1.6 | | | 3.5 | 1.3 |
| TOTAL | 126.1 | 70.6 | 204.5 | 149.9 | 388.7 | 221.8 | 496.2 | 172.5 | 534.1 | 225.1 | 610.4 | 230.7 | 677.2 | 234.8 | 555.4 | 221.7 | 412.1 | 127.6 | 230.2 | 132.1 | 131.9 | 58.3 | 98.5 | 44.0 |

COMMENTS: G= Global Radiation D= Diffuse Radiation

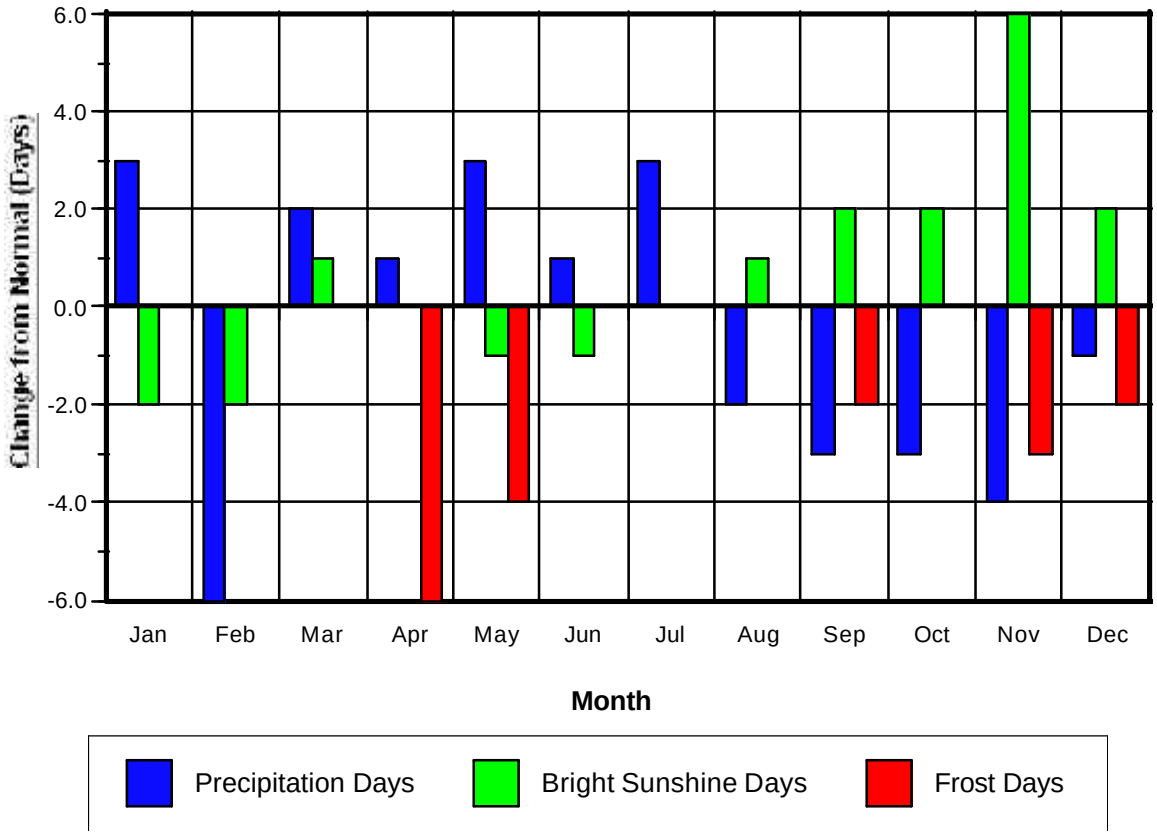
Feb 9 - Diffuse sent for calibration; using instrument borrowed from the University of Saskatchewan

March 15-18 - On March 15 at 1600h the recalibrated instrument for the global was installed. Tthe new calibration co-effient entered into the program on the March 16 at 1730 h. The new calibration for the recalibrated diffuse instrument was re-entered on 18 at 0800.

November 24 - datalogger down in the afternoon; data incomplete.

# Number of Days for Frost, Precipitation & Bright Sunshine, 1999

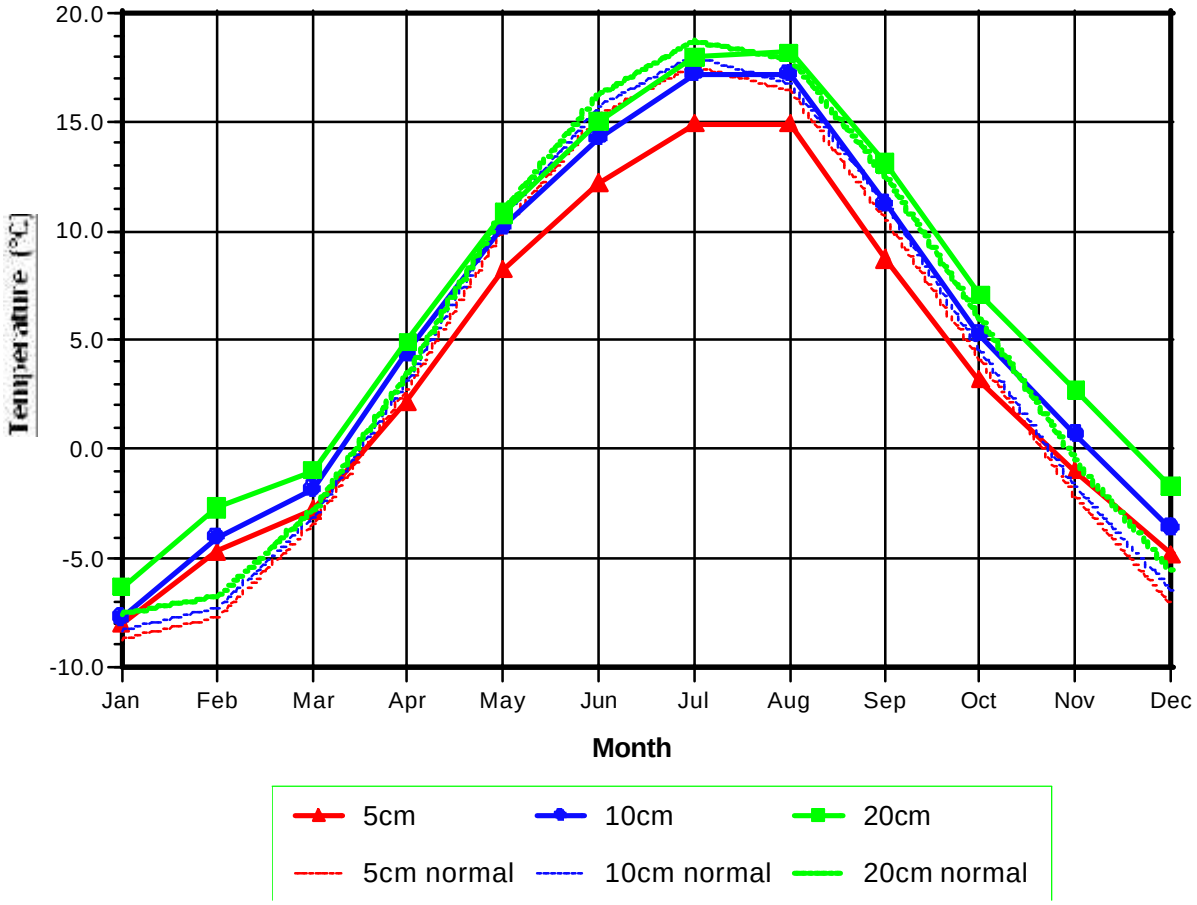
| MONTH | NUMBER OF FROST DAYS | | NUMBER OF PRECIPITATION DAYS | | NUMBER OF BRIGHT SUNSHINE DAYS | |
|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Normal |
| January | 31 | 31 | 14 | 11 | 22 | 24 |
| February | 28 | 28 | 4 | 10 | 23 | 25 |
| March | 30 | 30 | 11 | 9 | 28 | 27 |
| April | 14 | 20 | 8 | 7 | 27 | 27 |
| May | 2 | 6 | 12 | 9 | 28 | 29 |
| June | 0 | 0 | 13 | 12 | 28 | 29 |
| July | 0 | 0 | 14 | 11 | 30 | 30 |
| August | 0 | 0 | 7 | 9 | 31 | 30 |
| September | 3 | 5 | 6 | 9 | 29 | 27 |
| October | 20 | 20 | 3 | 6 | 29 | 27 |
| November | 26 | 29 | 4 | 8 | 28 | 22 |
| December | 29 | 31 | 11 | 12 | 25 | 23 |
| Total | 183 | 200 | 107 | 113 | 328 | 320 |



# Soil Temperatures at 0900 hours, 1999

(5 to 20 cm depths)

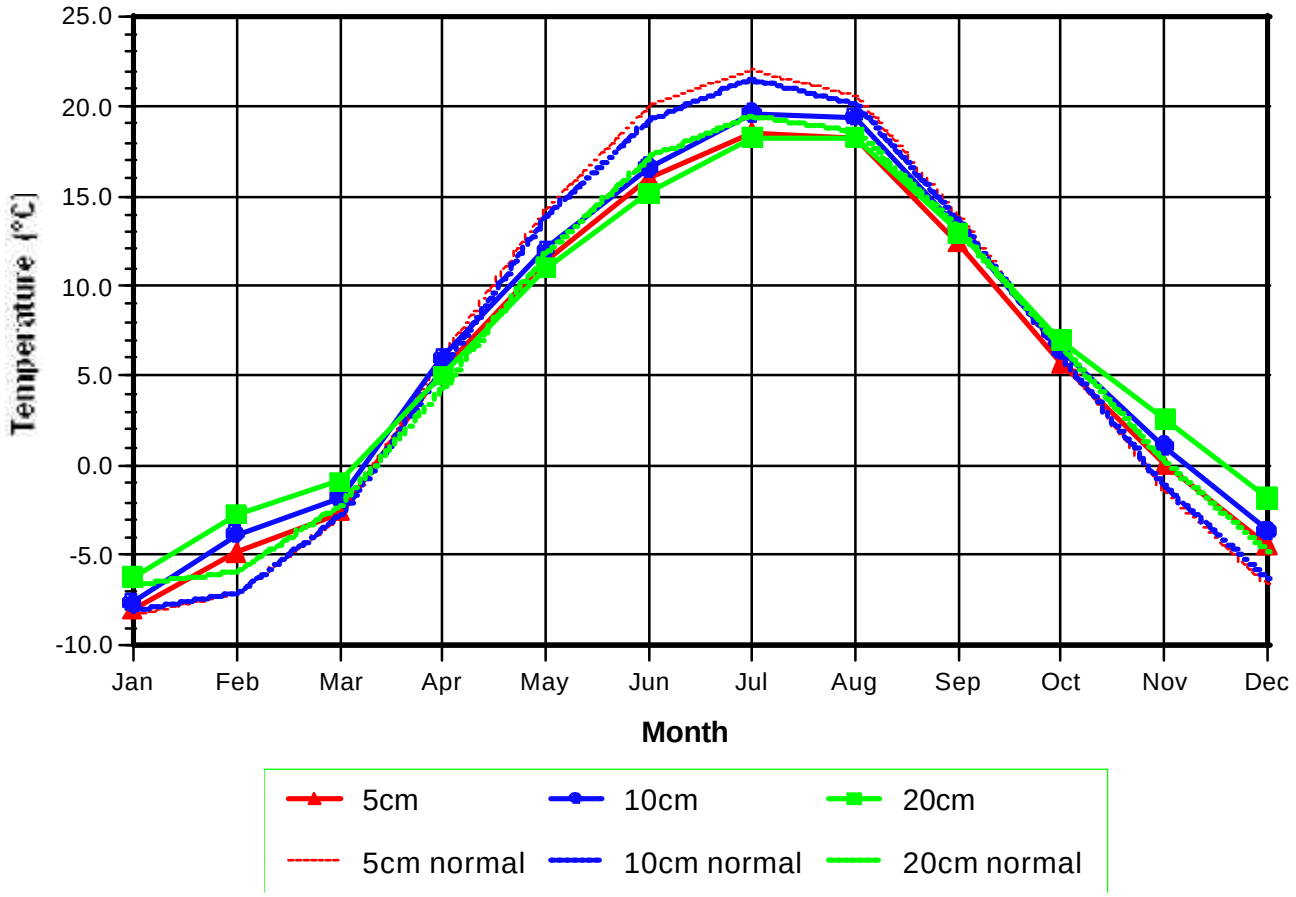
| MONTH | 5cm (°C) 0900h | | 10cm (°C) 0900h | | 20cm (°C) 0900h | |
|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Normal |
| January | -8.0 | -8.8 | -7.7 | -8.3 | -6.3 | -7.6 |
| February | -4.7 | -7.7 | -4.0 | -7.3 | -2.7 | -6.8 |
| March | -2.8 | -3.4 | -1.8 | -3.1 | -1.0 | -2.8 |
| April | 2.2 | 2.8 | 4.4 | 3.2 | 4.9 | 3.5 |
| May | 8.2 | 10.1 | 10.2 | 10.6 | 10.8 | 10.9 |
| June | 12.2 | 15.3 | 14.3 | 15.7 | 15.0 | 16.2 |
| July | 14.9 | 17.6 | 17.2 | 18.0 | 18.0 | 18.8 |
| August | 14.9 | 16.4 | 17.2 | 16.8 | 18.2 | 17.9 |
| September | 8.7 | 10.5 | 11.3 | 11.2 | 13.1 | 12.5 |
| October | 3.2 | 4.1 | 5.3 | 4.5 | 7.1 | 6.0 |
| November | -1.0 | -2.2 | 0.7 | -1.7 | 2.7 | -0.5 |
| December | -4.8 | -7.1 | -3.6 | -6.5 | -1.7 | -5.5 |



# Soil Temperatures at 1600 hours, 1999

(5 to 20 cm depths)

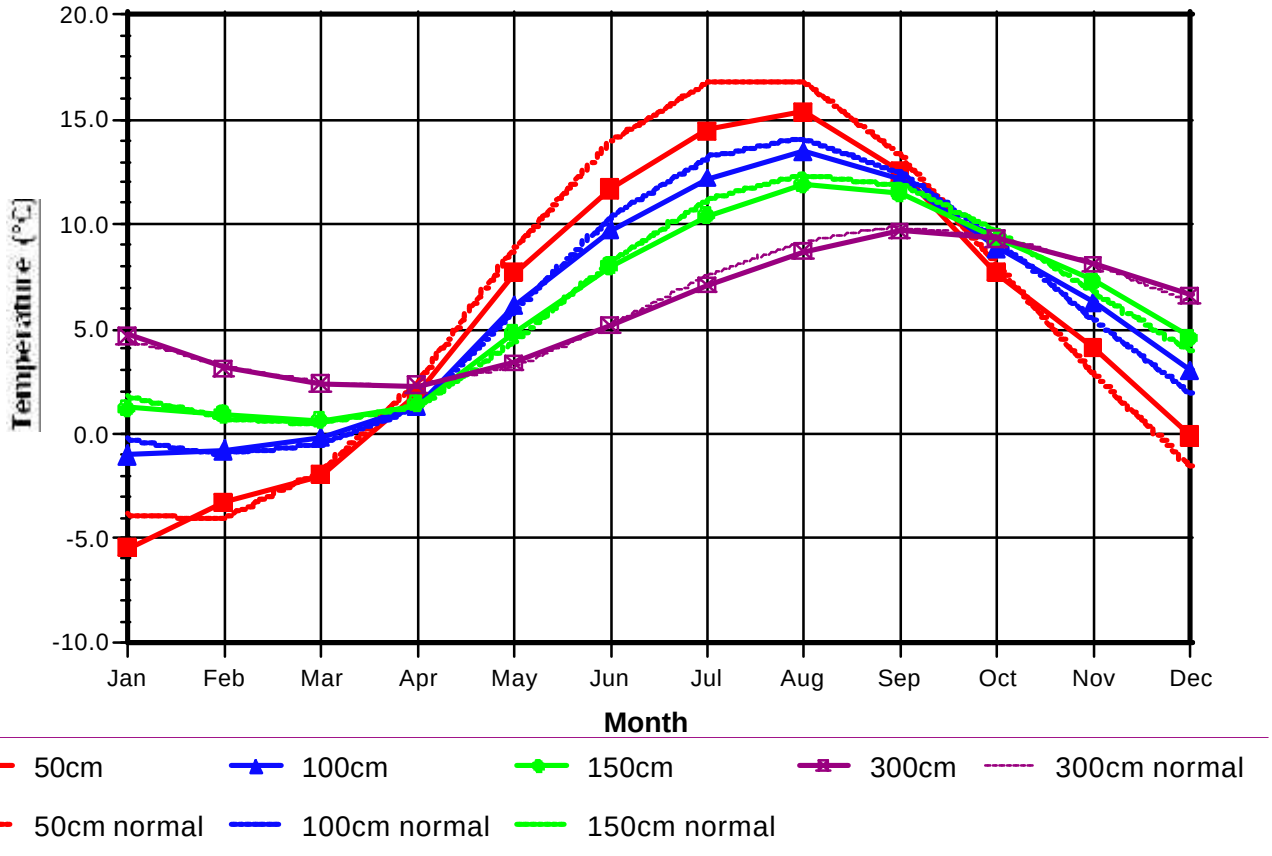
| MONTH | 5 cm (°C) 1600h | | 10 cm (°C) 1600h | | 20 cm (°C) 1600h | |
|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Normal |
| January | -8.0 | -8.4 | -7.6 | -8.1 | -6.2 | -6.8 |
| February | -4.8 | -7.1 | -3.8 | -7.1 | -2.7 | -5.9 |
| March | -2.6 | -2.9 | -1.8 | -2.7 | -0.9 | -2.2 |
| April | 5.3 | 6.0 | 6.0 | 5.4 | 5.0 | 4.2 |
| May | 11.4 | 14.2 | 12.0 | 13.8 | 11.0 | 11.8 |
| June | 16.0 | 20.0 | 16.6 | 19.2 | 15.2 | 17.1 |
| July | 18.5 | 22.1 | 19.6 | 21.5 | 18.3 | 19.5 |
| August | 18.3 | 20.6 | 19.4 | 20.2 | 18.3 | 18.6 |
| September | 12.4 | 13.9 | 13.1 | 13.6 | 13.0 | 13.1 |
| October | 5.7 | 6.1 | 6.4 | 6.2 | 7.0 | 6.6 |
| November | 0.1 | -1.4 | 1.1 | -1.1 | 2.6 | 0.2 |
| December | -4.4 | -6.6 | -3.6 | -6.3 | -1.8 | -4.8 |



# Soil Temperatures at 0900 hours, 1999

(50 to 300 cm depths)

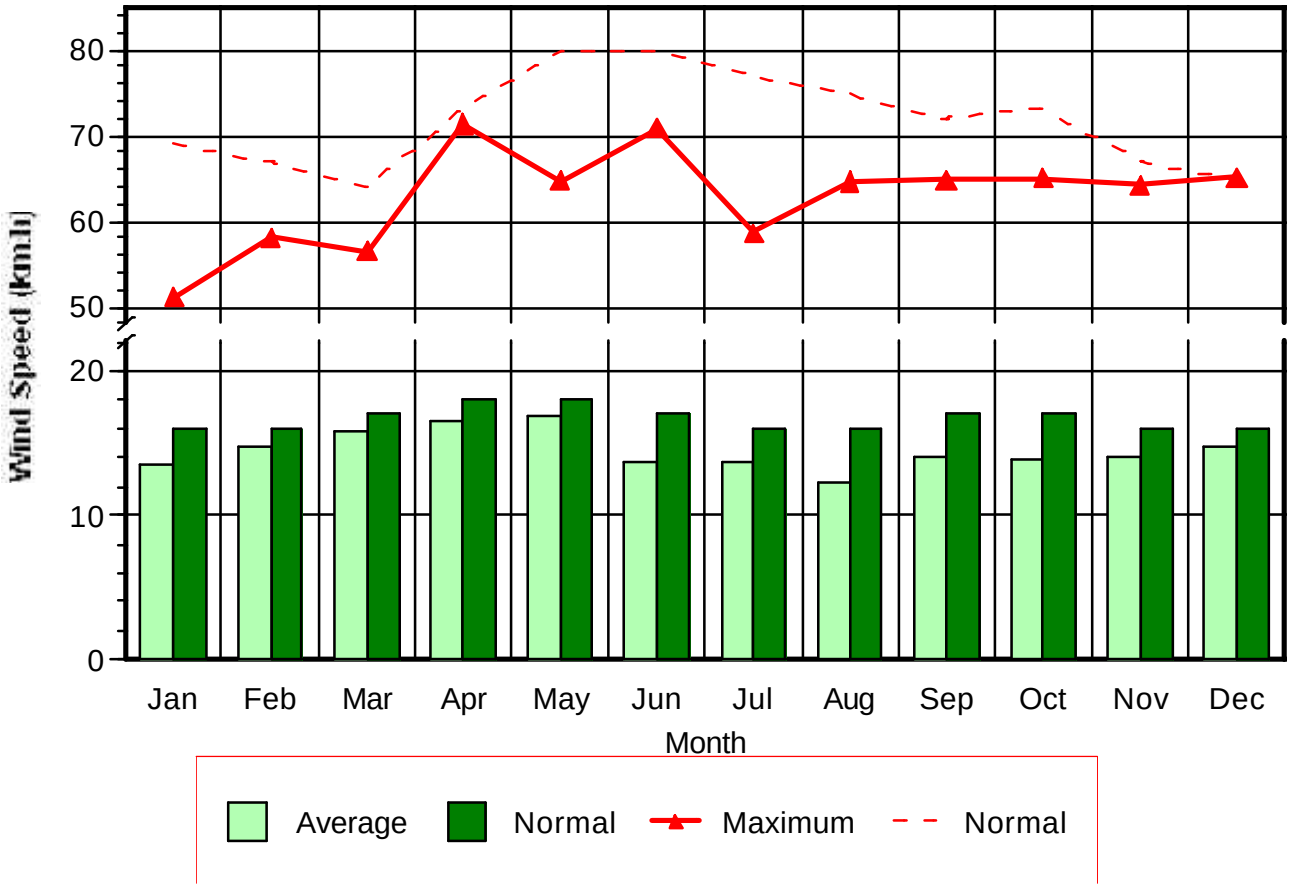
| MONTH | 50cm (°C) 0900h | | 100cm (°C) 0900h | | 150cm (°C) 0900h | | 300cm (°C) 0900h | |
|---|---|---|---|---|---|---|---|---|
| | 1999 | Normal | 1999 | Normal | 1999 | Normal | 1999 | Normal |
| January | -5.5 | -3.8 | -1.0 | -0.2 | 1.2 | 1.8 | 4.7 | 4.5 |
| February | -3.3 | -4.1 | -0.8 | -1.0 | 0.9 | 0.8 | 3.1 | 3.3 |
| March | -2.0 | -1.8 | -0.2 | -0.6 | 0.6 | 0.4 | 2.4 | 2.5 |
| April | 1.9 | 2.5 | 1.3 | 1.2 | 1.4 | 1.2 | 2.3 | 2.2 |
| May | 7.7 | 8.9 | 6.1 | 5.9 | 4.8 | 4.4 | 3.4 | 3.1 |
| June | 11.7 | 14.0 | 9.7 | 10.4 | 8.0 | 8.2 | 5.2 | 5.2 |
| July | 14.5 | 16.8 | 12.2 | 13.2 | 10.4 | 11.1 | 7.1 | 7.5 |
| August | 15.4 | 16.8 | 13.5 | 14.1 | 11.9 | 12.4 | 8.7 | 9.1 |
| September | 12.5 | 13.3 | 12.2 | 12.5 | 11.5 | 11.9 | 9.7 | 9.9 |
| October | 7.7 | 8.0 | 8.9 | 9.2 | 9.3 | 9.7 | 9.3 | 9.5 |
| November | 4.1 | 2.8 | 6.3 | 5.4 | 7.3 | 6.8 | 8.1 | 8.1 |
| December | -0.1 | -1.6 | 3.0 | 1.9 | 4.6 | 3.9 | 6.6 | 6.3 |



# Monthly Wind Speed, 1999

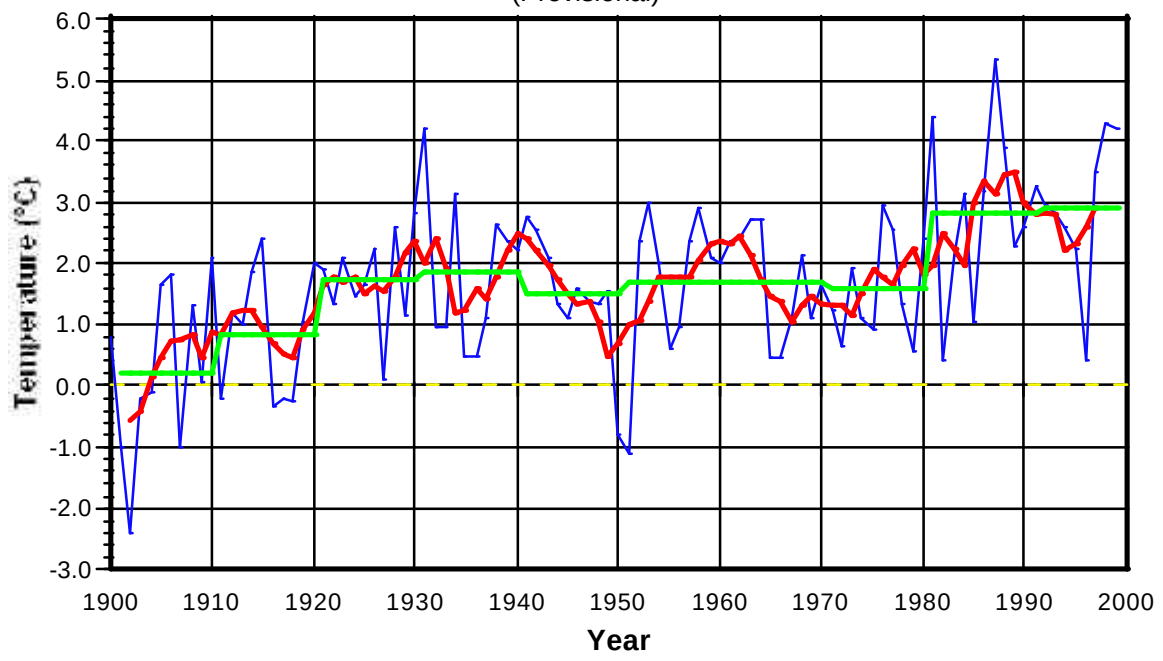
| MONTH | AVERAGE (km/h) | | MAXIMUM GUST (km/h) | | |
|---|---|---|---|---|---|
| | 1999 | Normal* | Direction | 1999 | Normal* |
| January | 13.6 | 16.0 | SW | 51.1 | 69.0 |
| February | 14.8 | 16.0 | SE | 58.0 | 67.0 |
| March | 15.8 | 17.0 | E | 56.4 | 64.0 |
| April | 16.5 | 18.0 | NW | 71.4 | 73.0 |
| May | 16.9 | 18.0 | NW | 64.7 | 80.0 |
| June | 13.7 | 17.0 | WNW | 70.9 | 80.0 |
| July | 13.7 | 16.0 | WNW | 58.6 | 77.0 |
| August | 12.3 | 16.0 | WSW | 64.6 | 75.0 |
| September | 14.1 | 17.0 | WNW | 64.8 | 72.0 |
| October | 13.9 | 17.0 | N | 65.0 | 73.0 |
| November | 14.1 | 16.0 | WNW | 64.2 | 67.0 |
| December | 14.8 | 16.0 | NNW | 65.1 | 65.0 |

*1961-90 Normals used are for the Saskatoon Airport provided by Environment Canada

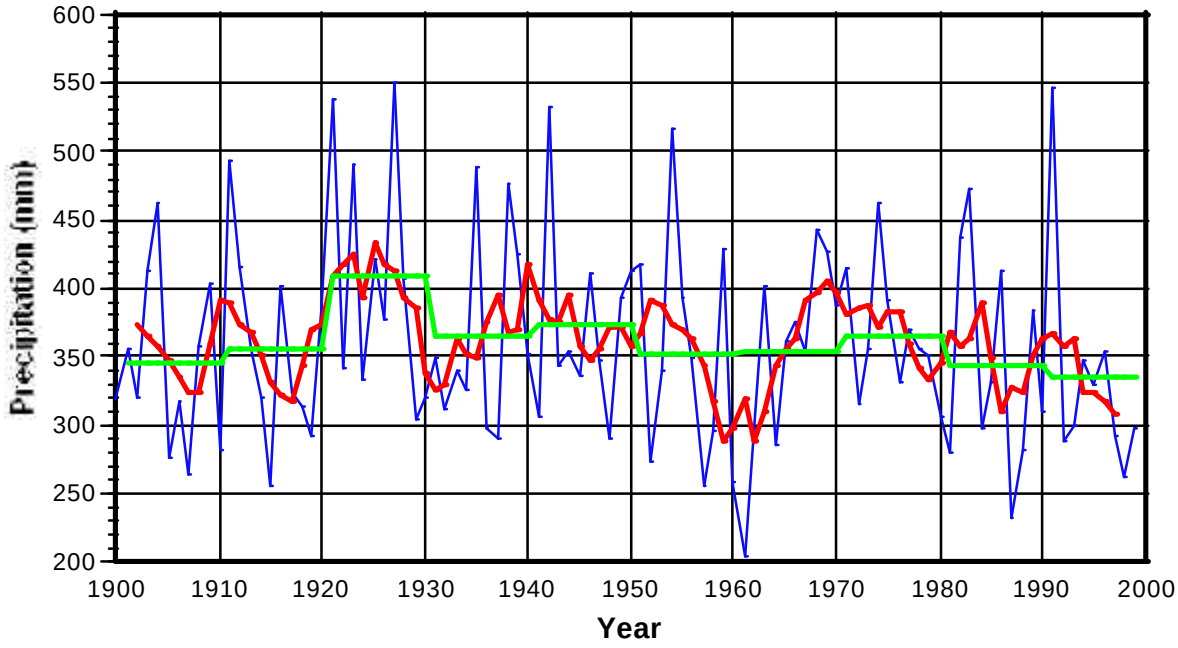


## Average Annual Temperature and Precipitation Time Series for Saskatoon, 1900-1999

(Provisional)




Mean Temperature — 5 Year Mean Temperature — Decade Temperature Average




Precipitation — 5 Year Mean Precipitation — Decade Precipitation Average

# Sunrise and Sunset at Saskatoon, 1999

(local time in hours and minutes)

| 1999 | JANUARY | | FEBRUARY | | MARCH | | APRIL | | MAY | | JUNE | | JULY | | AUGUST | | SEPTEMBER | | OCTOBER | | NOVEMBER | | DECEMBER | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 1 | 9:15 | 17:05 | 8:47 | 17:54 | 7:53 | 18:46 | 6:42 | 19:40 | 5:37 | 20:32 | 4:52 | 21:17 | 4:50 | 21:30 | 5:27 | 20:57 | 6:18 | 19:55 | 7:07 | 18:45 | 8:01 | 17:38 | 8:52 | 16:58 |
| 2 | 9:15 | 17:06 | 8:46 | 17:56 | 7:51 | 18:48 | 6:39 | 19:42 | 5:35 | 20:33 | 4:51 | 21:18 | 4:51 | 21:30 | 5:29 | 20:56 | 6:19 | 19:52 | 7:09 | 18:42 | 8:03 | 17:36 | 8:54 | 16:58 |
| 3 | 9:15 | 17:07 | 8:44 | 17:57 | 7:48 | 18:49 | 6:37 | 19:44 | 5:33 | 20:35 | 4:50 | 21:19 | 4:51 | 21:30 | 5:30 | 20:54 | 6:21 | 19:50 | 7:10 | 18:40 | 8:05 | 17:35 | 8:55 | 16:57 |
| 4 | 9:15 | 17:08 | 8:42 | 17:59 | 7:46 | 18:51 | 6:35 | 19:45 | 5:31 | 20:37 | 4:50 | 21:20 | 4:52 | 21:29 | 5:32 | 20:52 | 6:22 | 19:48 | 7:12 | 18:38 | 8:07 | 17:33 | 8:57 | 16:57 |
| 5 | 9:14 | 17:10 | 8:41 | 18:01 | 7:44 | 18:53 | 6:33 | 19:47 | 5:29 | 20:38 | 4:49 | 21:21 | 4:53 | 21:29 | 5:34 | 20:50 | 6:24 | 19:45 | 7:14 | 18:35 | 8:09 | 17:31 | 8:58 | 16:56 |
| 6 | 9:14 | 17:11 | 8:39 | 18:03 | 7:42 | 18:55 | 6:30 | 19:49 | 5:28 | 20:40 | 4:48 | 21:22 | 4:54 | 21:28 | 5:35 | 20:49 | 6:26 | 19:43 | 7:15 | 18:33 | 8:10 | 17:29 | 8:59 | 16:56 |
| 7 | 9:14 | 17:12 | 8:37 | 18:05 | 7:40 | 18:57 | 6:28 | 19:51 | 5:26 | 20:42 | 4:48 | 21:23 | 4:55 | 21:27 | 5:37 | 20:47 | 6:27 | 19:41 | 7:17 | 18:31 | 8:12 | 17:28 | 9:00 | 16:55 |
| 8 | 9:13 | 17:14 | 8:35 | 18:07 | 7:37 | 18:58 | 6:26 | 19:52 | 5:24 | 20:43 | 4:47 | 21:24 | 4:56 | 21:27 | 5:38 | 20:45 | 6:29 | 19:38 | 7:19 | 18:29 | 8:14 | 17:26 | 9:02 | 16:55 |
| 9 | 9:13 | 17:15 | 8:34 | 18:09 | 7:35 | 19:00 | 6:23 | 19:54 | 5:22 | 20:45 | 4:47 | 21:25 | 4:57 | 21:26 | 5:40 | 20:43 | 6:31 | 19:36 | 7:21 | 18:26 | 8:16 | 17:24 | 9:03 | 16:55 |
| 10 | 9:12 | 17:16 | 8:32 | 18:11 | 7:33 | 19:02 | 6:21 | 19:56 | 5:21 | 20:46 | 4:47 | 21:26 | 4:58 | 21:25 | 5:42 | 20:41 | 6:32 | 19:34 | 7:22 | 18:24 | 8:18 | 17:23 | 9:04 | 16:54 |
| 11 | 9:11 | 17:18 | 8:30 | 18:12 | 7:30 | 19:04 | 6:19 | 19:57 | 5:19 | 20:48 | 4:46 | 21:26 | 4:59 | 21:24 | 5:43 | 20:39 | 6:34 | 19:31 | 7:24 | 18:22 | 8:19 | 17:21 | 9:05 | 16:54 |
| 12 | 9:11 | 17:19 | 8:28 | 18:14 | 7:28 | 19:05 | 6:17 | 19:59 | 5:17 | 20:50 | 4:46 | 21:27 | 5:00 | 21:24 | 5:45 | 20:37 | 6:36 | 19:29 | 7:26 | 18:20 | 8:21 | 17:20 | 9:06 | 16:54 |
| 13 | 9:10 | 17:21 | 8:26 | 18:16 | 7:26 | 19:07 | 6:14 | 20:01 | 5:16 | 20:51 | 4:46 | 21:28 | 5:01 | 21:23 | 5:46 | 20:35 | 6:37 | 19:27 | 7:27 | 18:17 | 8:23 | 17:18 | 9:07 | 16:54 |
| 14 | 9:09 | 17:22 | 8:24 | 18:18 | 7:24 | 19:09 | 6:12 | 20:03 | 5:14 | 20:53 | 4:45 | 21:28 | 5:02 | 21:22 | 5:48 | 20:33 | 6:39 | 19:24 | 7:29 | 18:15 | 8:25 | 17:17 | 9:08 | 16:54 |
| 15 | 9:08 | 17:24 | 8:22 | 18:20 | 7:21 | 19:11 | 6:10 | 20:04 | 5:12 | 20:54 | 4:45 | 21:29 | 5:04 | 21:21 | 5:50 | 20:31 | 6:40 | 19:22 | 7:31 | 18:13 | 8:27 | 17:15 | 9:09 | 16:54 |
| 16 | 9:07 | 17:26 | 8:20 | 18:22 | 7:19 | 19:13 | 6:08 | 20:06 | 5:11 | 20:56 | 4:45 | 21:29 | 5:05 | 21:20 | 5:51 | 20:29 | 6:42 | 19:20 | 7:33 | 18:11 | 8:28 | 17:14 | 9:10 | 16:55 |
| 17 | 9:07 | 17:27 | 8:18 | 18:24 | 7:17 | 19:14 | 6:06 | 20:08 | 5:09 | 20:57 | 4:45 | 21:30 | 5:06 | 21:19 | 5:53 | 20:27 | 6:44 | 19:17 | 7:34 | 18:09 | 8:30 | 17:12 | 9:10 | 16:55 |
| 18 | 9:06 | 17:29 | 8:16 | 18:26 | 7:14 | 19:16 | 6:04 | 20:09 | 5:08 | 20:59 | 4:45 | 21:30 | 5:07 | 21:17 | 5:55 | 20:25 | 6:45 | 19:15 | 7:36 | 18:06 | 8:32 | 17:11 | 9:11 | 16:55 |
| 19 | 9:04 | 17:30 | 8:14 | 18:27 | 7:12 | 19:18 | 6:01 | 20:11 | 5:07 | 21:00 | 4:45 | 21:31 | 5:09 | 21:16 | 5:56 | 20:23 | 6:47 | 19:13 | 7:38 | 18:04 | 8:33 | 17:10 | 9:12 | 16:55 |
| 20 | 9:03 | 17:32 | 8:12 | 18:29 | 7:10 | 19:19 | 5:59 | 20:13 | 5:05 | 21:02 | 4:45 | 21:31 | 5:10 | 21:15 | 5:58 | 20:21 | 6:49 | 19:10 | 7:40 | 18:02 | 8:35 | 17:09 | 9:12 | 16:56 |
| 21 | 9:02 | 17:34 | 8:10 | 18:31 | 7:07 | 19:21 | 5:57 | 20:15 | 5:04 | 21:03 | 4:46 | 21:31 | 5:11 | 21:14 | 5:59 | 20:19 | 6:50 | 19:08 | 7:42 | 18:00 | 8:37 | 17:08 | 9:13 | 16:56 |
| 22 | 9:01 | 17:36 | 8:08 | 18:33 | 7:05 | 19:23 | 5:55 | 20:16 | 5:03 | 21:05 | 4:46 | 21:31 | 5:13 | 21:12 | 6:01 | 20:17 | 6:52 | 19:06 | 7:43 | 17:58 | 8:39 | 17:06 | 9:13 | 16:57 |
| 23 | 9:00 | 17:37 | 8:06 | 18:35 | 7:03 | 19:25 | 5:53 | 20:18 | 5:01 | 21:06 | 4:46 | 21:31 | 5:14 | 21:11 | 6:03 | 20:14 | 6:54 | 19:03 | 7:45 | 17:56 | 8:40 | 17:05 | 9:14 | 16:57 |
| 24 | 8:59 | 17:39 | 8:04 | 18:37 | 7:00 | 19:26 | 5:51 | 20:20 | 5:00 | 21:07 | 4:46 | 21:31 | 5:15 | 21:10 | 6:04 | 20:12 | 6:55 | 19:01 | 7:47 | 17:54 | 8:42 | 17:04 | 9:14 | 16:58 |
| 25 | 8:57 | 17:41 | 8:02 | 18:38 | 6:58 | 19:28 | 5:49 | 20:21 | 4:59 | 21:09 | 4:47 | 21:31 | 5:17 | 21:08 | 6:06 | 20:10 | 6:57 | 18:59 | 7:49 | 17:52 | 8:43 | 17:03 | 9:15 | 16:59 |
| 26 | 8:56 | 17:43 | 7:59 | 18:40 | 6:56 | 19:30 | 5:47 | 20:23 | 4:58 | 21:10 | 4:47 | 21:31 | 5:18 | 21:07 | 6:08 | 20:08 | 6:59 | 18:56 | 7:51 | 17:50 | 8:45 | 17:02 | 9:15 | 16:59 |
| 27 | 8:55 | 17:45 | 7:57 | 18:42 | 6:53 | 19:32 | 5:45 | 20:25 | 4:57 | 21:11 | 4:48 | 21:31 | 5:20 | 21:05 | 6:09 | 20:06 | 7:00 | 18:54 | 7:52 | 17:48 | 8:47 | 17:01 | 9:15 | 17:00 |
| 28 | 8:53 | 17:46 | 7:55 | 18:44 | 6:51 | 19:33 | 5:43 | 20:26 | 4:56 | 21:13 | 4:48 | 21:31 | 5:21 | 21:04 | 6:11 | 20:03 | 7:02 | 18:52 | 7:54 | 17:46 | 8:48 | 17:01 | 9:15 | 17:01 |
| 29 | 8:52 | 17:48 | | | 6:49 | 19:35 | 5:41 | 20:28 | 4:55 | 21:14 | 4:49 | 21:31 | 5:23 | 21:02 | 6:13 | 20:01 | 7:04 | 18:49 | 7:56 | 17:44 | 8:50 | 17:00 | 9:15 | 17:02 |
| 30 | 8:50 | 17:50 | | | 6:46 | 19:37 | 5:39 | 20:30 | 4:54 | 21:15 | 4:49 | 21:31 | 5:24 | 21:01 | 6:14 | 19:59 | 7:05 | 18:47 | 7:58 | 17:42 | 8:51 | 16:59 | 9:15 | 17:03 |
| 31 | 8:49 | 17:52 | | | 6:44 | 19:39 | | | 4:53 | 21:16 | | | 5:26 | 20:59 | 6:16 | 19:57 | | | 8:00 | 17:40 | | | 9:15 | 17:04 |

National Research Council, Canada, Hertzberg Institute of Astrophysics

Sunrise/set = corresponds to the upper limb of the sun appearing at the horizon

# Sunrise and Sunset at Saskatoon, 2000

(local time in hours and minutes)

| 2000 | JANUARY | | FEBRUARY | | MARCH | | APRIL | | MAY | | JUNE | | JULY | | AUGUST | | SEPTEMBER | | OCTOBER | | NOVEMBER | | DECEMBER | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set | Rise | Set |
| 1 | 9:15 | 17:05 | 8:48 | 17:53 | 7:51 | 18:47 | 6:40 | 19:42 | 5:35 | 20:33 | 4:51 | 21:18 | 4:51 | 21:30 | 5:29 | 20:56 | 6:19 | 19:53 | 7:08 | 18:43 | 8:03 | 17:37 | 8:54 | 16:58 |
| 2 | 9:15 | 17:06 | 8:46 | 17:55 | 7:49 | 18:49 | 6:38 | 19:43 | 5:34 | 20:35 | 4:51 | 21:19 | 4:51 | 21:30 | 5:30 | 20:54 | 6:20 | 19:51 | 7:10 | 18:41 | 8:05 | 17:35 | 8:55 | 16:57 |
| 3 | 9:15 | 17:07 | 8:44 | 17:57 | 7:47 | 18:51 | 6:35 | 19:45 | 5:32 | 20:36 | 4:50 | 21:20 | 4:52 | 21:29 | 5:32 | 20:53 | 6:22 | 19:48 | 7:12 | 18:38 | 8:06 | 17:33 | 8:56 | 16:57 |
| 4 | 9:15 | 17:08 | 8:43 | 17:59 | 7:45 | 18:53 | 6:33 | 19:47 | 5:30 | 20:38 | 4:49 | 21:21 | 4:53 | 21:29 | 5:33 | 20:51 | 6:24 | 19:46 | 7:13 | 18:36 | 8:08 | 17:32 | 8:58 | 16:56 |
| 5 | 9:15 | 17:09 | 8:41 | 18:01 | 7:42 | 18:54 | 6:31 | 19:48 | 5:28 | 20:39 | 4:49 | 21:22 | 4:54 | 21:28 | 5:35 | 20:49 | 6:25 | 19:44 | 7:15 | 18:34 | 8:10 | 17:30 | 8:59 | 16:56 |
| 6 | 9:14 | 17:11 | 8:39 | 18:03 | 7:40 | 18:56 | 6:29 | 19:50 | 5:26 | 20:41 | 4:48 | 21:23 | 4:55 | 21:28 | 5:36 | 20:47 | 6:27 | 19:41 | 7:17 | 18:31 | 8:12 | 17:28 | 9:00 | 16:55 |
| 7 | 9:14 | 17:12 | 8:38 | 18:04 | 7:38 | 18:58 | 6:26 | 19:52 | 5:24 | 20:43 | 4:48 | 21:24 | 4:56 | 21:27 | 5:38 | 20:45 | 6:29 | 19:39 | 7:18 | 18:29 | 8:14 | 17:26 | 9:01 | 16:55 |
| 8 | 9:13 | 17:13 | 8:36 | 18:06 | 7:36 | 19:00 | 6:24 | 19:54 | 5:23 | 20:44 | 4:47 | 21:25 | 4:57 | 21:26 | 5:40 | 20:43 | 6:30 | 19:37 | 7:20 | 18:27 | 8:15 | 17:25 | 9:03 | 16:55 |
| 9 | 9:13 | 17:15 | 8:34 | 18:08 | 7:33 | 19:02 | 6:22 | 19:55 | 5:21 | 20:46 | 4:47 | 21:26 | 4:58 | 21:25 | 5:41 | 20:42 | 6:32 | 19:34 | 7:22 | 18:25 | 8:17 | 17:23 | 9:04 | 16:55 |
| 10 | 9:12 | 17:16 | 8:32 | 18:10 | 7:31 | 19:03 | 6:19 | 19:57 | 5:19 | 20:48 | 4:46 | 21:26 | 4:59 | 21:25 | 5:43 | 20:40 | 6:34 | 19:32 | 7:24 | 18:22 | 8:19 | 17:22 | 9:05 | 16:54 |
| 11 | 9:12 | 17:17 | 8:30 | 18:12 | 7:29 | 19:05 | 6:17 | 19:59 | 5:18 | 20:49 | 4:46 | 21:27 | 5:00 | 21:24 | 5:44 | 20:38 | 6:35 | 19:30 | 7:25 | 18:20 | 8:21 | 17:20 | 9:06 | 16:54 |
| 12 | 9:11 | 17:19 | 8:28 | 18:14 | 7:26 | 19:07 | 6:15 | 20:00 | 5:16 | 20:51 | 4:46 | 21:28 | 5:01 | 21:23 | 5:46 | 20:36 | 6:37 | 19:27 | 7:27 | 18:18 | 8:23 | 17:18 | 9:07 | 16:54 |
| 13 | 9:10 | 17:20 | 8:26 | 18:16 | 7:24 | 19:09 | 6:13 | 20:02 | 5:14 | 20:52 | 4:45 | 21:28 | 5:02 | 21:22 | 5:48 | 20:34 | 6:38 | 19:25 | 7:29 | 18:16 | 8:24 | 17:17 | 9:08 | 16:54 |
| 14 | 9:09 | 17:22 | 8:25 | 18:18 | 7:22 | 19:10 | 6:11 | 20:04 | 5:13 | 20:54 | 4:45 | 21:29 | 5:03 | 21:21 | 5:49 | 20:32 | 6:40 | 19:23 | 7:31 | 18:13 | 8:26 | 17:16 | 9:09 | 16:54 |
| 15 | 9:09 | 17:24 | 8:23 | 18:19 | 7:19 | 19:12 | 6:08 | 20:06 | 5:11 | 20:55 | 4:45 | 21:29 | 5:04 | 21:20 | 5:51 | 20:30 | 6:42 | 19:20 | 7:32 | 18:11 | 8:28 | 17:14 | 9:09 | 16:55 |
| 16 | 9:08 | 17:25 | 8:21 | 18:21 | 7:17 | 19:14 | 6:06 | 20:07 | 5:10 | 20:57 | 4:45 | 21:30 | 5:06 | 21:19 | 5:53 | 20:28 | 6:43 | 19:18 | 7:34 | 18:09 | 8:30 | 17:13 | 9:10 | 16:55 |
| 17 | 9:07 | 17:27 | 8:19 | 18:23 | 7:15 | 19:16 | 6:04 | 20:09 | 5:08 | 20:58 | 4:45 | 21:30 | 5:07 | 21:18 | 5:54 | 20:26 | 6:45 | 19:16 | 7:36 | 18:07 | 8:31 | 17:12 | 9:11 | 16:55 |
| 18 | 9:06 | 17:28 | 8:17 | 18:25 | 7:13 | 19:17 | 6:02 | 20:11 | 5:07 | 21:00 | 4:45 | 21:30 | 5:08 | 21:16 | 5:56 | 20:23 | 6:47 | 19:13 | 7:38 | 18:05 | 8:33 | 17:10 | 9:12 | 16:55 |
| 19 | 9:05 | 17:30 | 8:15 | 18:27 | 7:10 | 19:19 | 6:00 | 20:12 | 5:06 | 21:01 | 4:45 | 21:31 | 5:10 | 21:15 | 5:57 | 20:21 | 6:48 | 19:11 | 7:39 | 18:03 | 8:35 | 17:09 | 9:12 | 16:56 |
| 20 | 9:04 | 17:32 | 8:13 | 18:29 | 7:08 | 19:21 | 5:58 | 20:14 | 5:04 | 21:03 | 4:46 | 21:31 | 5:11 | 21:14 | 5:59 | 20:19 | 6:50 | 19:09 | 7:41 | 18:01 | 8:36 | 17:08 | 9:13 | 16:56 |
| 21 | 9:03 | 17:33 | 8:11 | 18:31 | 7:06 | 19:23 | 5:56 | 20:16 | 5:03 | 21:04 | 4:46 | 21:31 | 5:12 | 21:13 | 6:01 | 20:17 | 6:52 | 19:06 | 7:43 | 17:59 | 8:38 | 17:07 | 9:13 | 16:57 |
| 22 | 9:01 | 17:35 | 8:08 | 18:33 | 7:03 | 19:24 | 5:53 | 20:18 | 5:02 | 21:06 | 4:46 | 21:31 | 5:14 | 21:11 | 6:02 | 20:15 | 6:53 | 19:04 | 7:45 | 17:56 | 8:40 | 17:06 | 9:14 | 16:57 |
| 23 | 9:00 | 17:37 | 8:06 | 18:34 | 7:01 | 19:26 | 5:51 | 20:19 | 5:00 | 21:07 | 4:46 | 21:31 | 5:15 | 21:10 | 6:04 | 20:13 | 6:55 | 19:02 | 7:46 | 17:54 | 8:41 | 17:04 | 9:14 | 16:58 |
| 24 | 8:59 | 17:39 | 8:04 | 18:36 | 6:59 | 19:28 | 5:49 | 20:21 | 4:59 | 21:08 | 4:47 | 21:31 | 5:17 | 21:09 | 6:06 | 20:11 | 6:57 | 18:59 | 7:48 | 17:52 | 8:43 | 17:03 | 9:15 | 16:58 |
| 25 | 8:58 | 17:40 | 8:02 | 18:38 | 6:56 | 19:29 | 5:47 | 20:23 | 4:58 | 21:10 | 4:47 | 21:31 | 5:18 | 21:07 | 6:07 | 20:08 | 6:58 | 18:57 | 7:50 | 17:50 | 8:45 | 17:03 | 9:15 | 16:59 |
| 26 | 8:56 | 17:42 | 8:00 | 18:40 | 6:54 | 19:31 | 5:45 | 20:24 | 4:57 | 21:11 | 4:48 | 21:31 | 5:19 | 21:06 | 6:09 | 20:06 | 7:00 | 18:54 | 7:52 | 17:48 | 8:46 | 17:02 | 9:15 | 17:00 |
| 27 | 8:55 | 17:44 | 7:58 | 18:42 | 6:52 | 19:33 | 5:43 | 20:26 | 4:56 | 21:12 | 4:48 | 21:31 | 5:21 | 21:04 | 6:11 | 20:04 | 7:02 | 18:52 | 7:54 | 17:46 | 8:48 | 17:01 | 9:15 | 17:01 |
| 28 | 8:54 | 17:46 | 7:56 | 18:44 | 6:49 | 19:35 | 5:41 | 20:28 | 4:55 | 21:14 | 4:49 | 21:31 | 5:22 | 21:03 | 6:12 | 20:02 | 7:03 | 18:50 | 7:55 | 17:44 | 8:49 | 17:00 | 9:15 | 17:02 |
| 29 | 8:52 | 17:48 | 7:53 | 18:45 | 6:47 | 19:36 | 5:39 | 20:29 | 4:54 | 21:15 | 4:49 | 21:31 | 5:24 | 21:01 | 6:14 | 20:00 | 7:05 | 18:47 | 7:57 | 17:43 | 8:51 | 16:59 | 9:15 | 17:03 |
| 30 | 8:51 | 17:50 | | | 6:45 | 19:38 | 5:37 | 20:31 | 4:53 | 21:16 | 4:50 | 21:30 | 5:25 | 20:59 | 6:15 | 19:57 | 7:07 | 18:45 | 7:59 | 17:41 | 8:52 | 16:58 | 9:15 | 17:03 |
| 31 | 8:49 | 17:51 | | | 6:42 | 19:40 | | | 4:52 | 21:17 | | | 5:27 | 20:58 | 6:17 | 19:55 | | | 8:01 | 17:39 | | | 9:15 | 17:04 |

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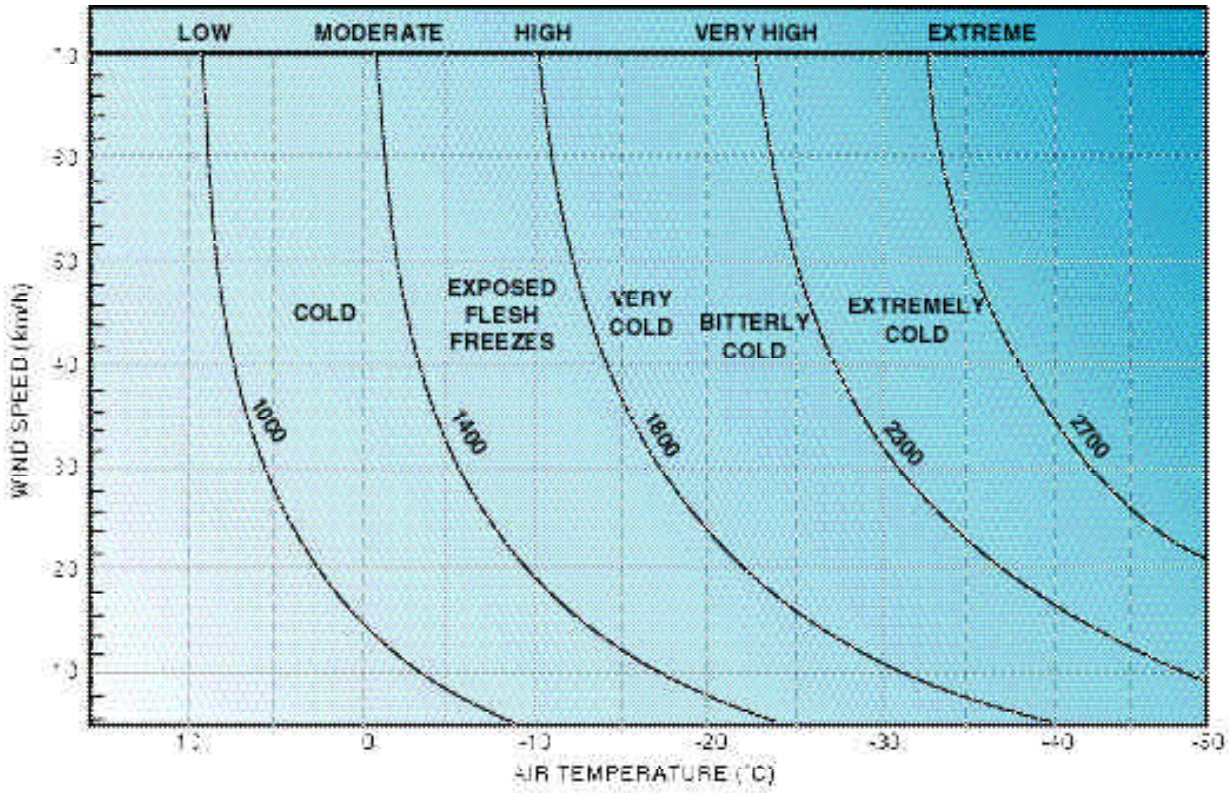
Sunrise/set = corresponds to the upper limb of the sun appearing at the horizon

# Windchill Factor
(watts/m$^2$)




**Windchill Formula**
WC = windchill in Watts per square metre
u = wind speed in km/h
T = temperature in °C

**Precise Formula***
$WC = (12.12 + 6.114\sqrt{u} - 0.3222 \times u)(33-T)$

**Rounded Version***
$WC = (12 + 6\sqrt{u} - 0.3 \times u)(33-T)$

**Equivalent Temperature***
$ET = 33 - ((12 + 6\sqrt{u} - 0.3 \times u)(33-T) / 27.8))$

**Quick and Dirty Formula****
$-(\frac{1}{3} u) + T$ = wind chill in °C

| Wind Chill | Equivalent Temperature °C | |
|---|---|---|
| 700 | -3 | Conditions considered comfortable when dressed for skiing |
| 1200 | -11 | Conditions no longer pleasant for outdoor activities on overcast days |
| 1400 | -18 | Conditions no longer pleasant for outdoor activities on sunny days |
| 1600 | -25 | Freezing of exposed skin begins for most people |
| 2300 | -50 | Conditions for walking become dangerous. Exposed skin freezes in 1-3 minutes. Warm winter clothing essential with facial protection. |
| 2700 | -56 | Exposed flesh freezes within 30 seconds |

# Beaufort Scale for Wind Speed

| Beaufort Number | km/h | Beaufort Description | Standard Specification* | Revised Specification** |
|---|---|---|---|---|
| 0 | <2 | Calm | Smoke rises vertically. | Too calm. People get edgy. Smoke from the BBQ rises straight up, attracting buzzards. |
| 1 | 2 - 5 | Light Air | Direction of wind shown by smoke drift but not by wind vanes. | Leaves on trees don't move. Smoke from BBQ rises at slight angle. |
| 2 | 6 - 11 | Light Breeze | Wind felt on face; leaves rustle; ordinary vane moved by wind. | Leaves on trees move. |
| 3 | 12 - 19 | Gentle Breeze | Leaves and small twigs in constant motion; wind extends light flag. | Oriental wind chimes get on your nerves. |
| 4 | 20 - 29 | Moderate | Wind raises dust and loose paper; small branches are moved. | Leaves fly all over your yard. |
| 5 | 30 - 39 | Fresh | Small trees begin to sway, crested wavelets form on inland waters. | Leaves fly over to your neighbour's yard. He yells at you but you claim you can't hear him over the wind chimes. |
| 6 | 40 - 50 | Strong | Large branches in motion; whistling heard in overhead wires; umbrellas used with difficulty. | Difficult to walk. Smoke from BBQ blows horizontally, right into your eyes. |
| 7 | 51 - 62 | Near Gale | Whole trees in motion; inconvenience felt when walking against wind. | Trees move moderately. Uncle asks, "Windy enough for you?" Cheeks flap when you yawn. Aluminum patio furniture on the move. |
| 8 | 63 - 75 | Gale | Breaks twigs off trees; wind generally impedes progress. | Clothes blow off clothesline. BBQ blown over - smoke from burning deck blows horizontally. Trees move rapidly. |
| 9 | 76 - 87 | Strong Gale | Slight structural damage occurs. | Trees move slowly - across your lawn. Uncle says, "Windy? This is nothing. When I was young..." Your favourite toque blows off. |
| 10 | 88 - 102 | Storm | Seldom experienced inland; trees uprooted; considerable structural damage occurs. | Your favourite shirt blows off. Neighbour's gas BBQ comes through your window. Your newly sodded lawn is now someone else's newly sodded lawn. |
| 11 | 103 - 117 | Violent Storm | Very rarely experienced; widespread damage. | You regret not hiring a pro to build your chimney. Uncle claims, "I've seen worse!" and is carried off by wind. People in trailer parks appear on tonight's news. Your underwear blows off. |
| 12 | 118 and greater | Hurricane | | Your underwear blows off while you're indoors. People from trailer parks fly past your house. Your nose hairs whistle even when you're not breathing. You can't close your eyes. Even if you wanted to. |

*Cole, 1980
**Smith, 1995

## INSTRUMENTS USED AT SASKATOON SRC CRS AND GLOSSARY OF TERMS

**BEAUFORT WIND SCALE** was developed by Admiral Sir Francis Beaufort in 1805 and adopted by the British Navy in 1838. It consisted of 13 degrees of wind strength , from calm to hurricane, based upon the effects of various wind strengths upon the amount of canvas carried by the fully rigged frigates of the period. Over the years it has been modified as needed and in 1946 the scale values were defined by ranges of the windspeed as measured at a height of 10 meters above the surface for each Force Number. In effect, this transformed the Beaufort Wind Force Scale in the Beaufort Wind Speed Scale. This scale is still the standard scale for visual observations of the wind. (Heidorn, 1998)

**BRIGHT SUNSHINE** is the unobstructed direct radiation from the sun, as opposed to the shading of a location by clouds or by other obstructions.

*Number of Days* is the total number of days when at least 0.1 of an hour of bright sunshine was recorded.

*Percentage Possible* refers to the ratio of measured bright sunshine hours to total possible daylight hours in a given period, expressed as a percentage.

*Possible daylight hours* are taken from the sunrise/set tables provided by the National Research Council of Canada, Herzberg Institute of Astrophysics, Victoria, BC.

*Total* is the sum of the daily bright sunshine values in hours and tenths of hours as measured by an automated sunshine recorder using voltaic cells.

**DEGREE-DAY** is an index for various temperature related calculations

*Cooling* (CDD) The cooling requirement to achieve a stipulated comfort value in an indoor environment. For most purposes, a temperature of greater than 18°C is considered uncomfortable and supplementary cooling is required. On a specific day, the amount by which 18°C is less than the daily average temperature defines the number of cooling degree-days for that day.

Mathematically:
CDD = (T - 18°C), for that day, where T = daily mean temperature in °C
if T is equal to or less than 18°C, CDD = 0.
Monthly and annual values of CDD are obtained by summing daily values.

*Extreme Cooling* (XCDD) The cooling requirement to achieve a stipulated comfort value in an indoor environment. For most purposes, a temperature of greater than 18°C is considered uncomfortable and supplementary cooling is required. A temperature of greater than 24°C has been used as an index of potential heat stress. On a specific day, the amount by which 24°C is less than the daily average temperature defines the number of extreme cooling degree-days for that day. Mathematically:

XCDD = (T - 24°C), for that day, where T = daily mean temperature in °C
if T is equal to or less than 24°C, XCDD = 0.
Monthly and annual values of XCDD are obtained by summing daily values.

*Growing* (GDD) The growing requirement in order for plant growth to proceed. The air temperature must exceed a critical value appropriate to the plant species in question. For many members of the grass family, including most commercial cereals grown on the prairies, a base temperature of 5.0°C has been established. On a specified day, the difference between the daily average temperature and the 5.0°C base temperature defines the number of growing degree-days.

Mathematically:
GDD = (T - 5.0°C), for that day, where T = daily mean temperature in °C
if T is equal to or less than 5.0°C, GDD = 0.
Daily GDD values are summed to provide totals for the appropriate month, growing season or year.

*Heating* (HDD) The heating requirement to achieve a stipulated comfort value in an indoor environment. For most purposes, a temperature of less than 18°C is considered uncomfortable and supplementary heating is required. On a specific day, the amount by which 18°C exceeds the daily average temperature defines the number of heating degree-days for that day.

Mathematically:
HDD = (18°C - T), for that day, where T = daily mean temperature in °C
if T is equal to or greater than 18°C, HDD = 0.
Monthly and annual values of HDD are obtained by summing daily values.

**EXTREME** is the highest or lowest value of a particular element recorded during the period in question.

**EXTREME ALL YEARS** Temporal comparisons at a point are also of value in some types of climatic studies. Therefore, it is desirable to produce the maximum length of reliable climatic record to carry out studies over a period of time. Data are drawn from the following data sets:

Saskatoon, SRC:1963 to 1997
Saskatoon, University of Saskatchewan:1916 to 1963
Saskatoon, City:1892 to 1915.

Station locations, exposures and measurement procedures were subject to change during this time period. Data presented in this column are <u>not adjusted</u> and users are cautioned accordingly.

**FROST** is recorded on each occasion when the daily minimum temperature is equal to or less than 0°C.

**NORMAL VALUE (1961-1990)** In climatology it is often useful to make spatial comparisons of particular element values over a common time period. At an interior continental site such as Saskatoon, a period of 30 years is required to produce statistically stable estimates of the more variable elements. To facilitate spatial comparisons, the World Meteorological Organization recommends the standard normal (average) period January 1st, 1961 to December 31st, 1990 for data analysis. Data derived from CRS conform to this standard, except where noted. The normals for CRS are taken from the normals published by Environment Canada for the standard period. Normals used in SRC CRS annual summaries 1990 - 1996 were hand-calculated values determined before the official normals were published.

**NUMBER OF RECORDING YEARS** Due to missing observations, faulty instrument calibration, lost records, *etc.*, only partial data are available especially during the period 1892 - 1915. The number of years of useful record is therefore cited.

**PRECIPITATION** (Ppt)

*Day* is recorded on occasions when the amount of precipitation in a 24-hour period equals or exceeds 0.2 mm water. An asterisk (*) appearing in the average column denotes the occurrence of measurable precipitation on one or more occasions, and that the calculated 30-year average amounts to less than a trace. The so-called climatological day, beginning at 9 a.m. standard time on the date of reference and ending at 9 a.m. the next morning, was employed in record keeping up to January 1994. On February 1, 1994, after consultation with Environment Canada, record keeping was changed to the 24-hour period of 0000 hours - 2400 hours to conform to their reporting of climatological statistics.

*Total* is the sum of the daily recorded precipitation. The snowfall component of precipitation is recorded as an equivalent amount of liquid water. For particulars on precipitation measurement procedures and instruments, the reader is referred to the Environment Canada publication "*Manual of Climatological Observation*'s", 2nd Ed., January, 1978. The notation "T" in this column refers to a trace of precipitation (less than 0.2 mm water equivalent). As of August 7, 1993, total precipitation was measured using the Belfort weighing gauge for the winter season and the tipping bucket during frost-free period.

**SOIL TEMPERATURE** under a short grass surface with normal snow accumulation, is measured according to procedures outlined in the Environment Canada publication "*Soil Temperature*" January l, 1976. Depths below surface at which soil temperature measurements are made are: 5 cm, 10 cm, 20 cm, 50 cm, 100 cm, 150 cm and 300 cm. Since soil temperature is affected by profile structure and water content, extrapolation of the measured data is difficult.

**SOLAR RADIATION**

*Diffuse - Total* is radiation reaching the earth's surface after having been scattered from the direct solar beam. The instrument used is an Eppley pyranometer with a shade ring (See SOLAR RADIATION-Global- Total).

*Global - Total* is the sum of the direct solar and diffuse radiation during the period in question. Measurements are carried out on a horizontal surface near ground level and integrated over the whole celestial dome, summing the diffuse and direct components of the solar beam. The temperature-compensated Eppley pyranometer is used. The standard metric unit of measurement is the megajoule per square metre ($MJ/m^2$). (To facilitate comparison with past years' data: 1.0 $MJ/m^2 = 23.895$ langleys). Comparison is provided with a provisional average based on 16 years of data (l975-1990).

**SPELLS - Temperature** spells are defined as a sequence of days when the daily maximum temperature is higher than or equal to 30°C (hot spell) or the daily minimum temperature is lower than or equal to -30°C (cold spell).

**SUNRISE/SUNSET** times have been included in this report. They have been acquired from the National Research Council, Canada, Herzberg Institute of Astrophysics.

**TEMPERATURE**

*Average Annual* is the average of the daily average temperatures in degrees Celsius (°C) for one year.

*Average Daily* is defined as the arithmetic mean of the daily maximum temperature in degrees Celsius (°C) and the daily minimum temperature in degrees Celsius (°C) for the day in question.

*Average Maximum* is the average of the daily maximum temperatures in degrees Celsius (°C) average over the appropriate time periods. For details concerning measurement procedures, the reader is referred to the Environment Canada publication, " *Manual of Climatological Observations"*, 2nd Ed., January, 1978.

*Average Minimum* is the average of the daily minimum temperatures in degrees Celsius (°C) averaged over the appropriate time periods. Refer to TEMPERATURE-Average Maximum concerning measurement procedures.

*Average Monthly* is the average of the daily average temperatures in degrees Celsius (°C) for the month under consideration.

**WIND CHILL FACTOR** is a cooling rate based on air temperature and wind speed. It is an approximate indication of the cooling rate of exposed flesh and whether or not protective covering is necessary. It was devised by P. A. Siple while in the Antarctica in 1941 by measuring the time required for the freezing of 250 grams of water at various wind speeds and air temperatures. Due to the unfortunate use of wind chill temperatures, people are often misled to believe that objects will cool down to the given wind chill temperature if left outside. This is not correct as an object will not cool to a lower temperature than its surrounding air temperature. Wind chill is simply a measure of the **rate** at which heat is lost. It is how cold it *feels* not how cold it is. (Maybank, 1970)

**WIND SPEED**

*Average* (Avg) is the average of the hourly wind speeds for the period in question measured in kilometres per hour (km/h). Average hourly wind speeds are obtained from a RM Young Wind Monitor anemometer at a height of 10 m.

*Peak Gust* refers to the highest instantaneous value recorded by the anemometer system for the period of reference, irrespective of direction and/or duration. Comparison is with published data for Saskatoon Airport.

*see also* **Beaufort Wind Scale**

## BIBLIOGRAPHY

Adam, B., 1999. *Funnel Clouds Sighted in Area.* Star Phoenix, Saskatoon, SK., August 17, 1999.

Beaulieu, C. R., 1999. Personal observation, June 1999.

Christiansen, E.A. (Ed.), 1970. *Physical Environment of Saskatoon, Canada*. Saskatchewan Research Council, Saskatoon, SK, in cooperation with National Research of Canada, Ottawa, ON.

Cole, F. W., 1980. *Introduction to Meteorology.* John Wiley & Sons, Inc., Toronto, ON.

Environment Canada, Atmospheric Environment Service (AES), 2000. *1999 Annual Meteorological Summary, Saskatoon Airport, SK, Saskatoon*. AES, Saskatoon, SK.

Environment Canada, Atmospheric Environment Service (AES), 1975. *1974 Annual Meteorological Summary, Saskatoon Airport, SK, Saskatoon*. AES, Saskatoon, SK.

Environment Canada, Atmospheric Environment Service, (AES),1992. *AES Guidelines for Co-operatiave Climatological Autostation.* Environment Canada, Downsview, ON.

Environment Canada, Atmospheric Environment Service (AES), 1993. *Canadian Climate Normals 1961-1990*. Canadian Climate Centre, Downsview ON.

Environment Canada, Atmospheric Environment Service (AES), 1982. *Canadian Climate Normals 1951-1980*. Canadian Climate Centre, Downsview ON.

Environment Canada, Atmospheric Environment Service (AES), 1978. *Manual of Climatological Observations*, 2nd Ed. AES, Downsview, ON.

Environment Canada, Atmospheric Environment Service (AES), 1976. *Soil Temperature*. AES, Downsview, ON.

*Frank Slide Interpretive Centre Web Site*, May 1999. http//www.frankslide.com.

Heidorn, K., 1998. *The Weather Legacy of Admiral Sir Francis Beaufort* in Weather People and History. Spectrum Educational Enterprises, Victoria, BC. http//www.islandnet.com/~see/weather/history/beaufort.html.

Jobin, B., 1999. *La Niña Talks Tough, but Fails to Deliver.* Star Phoenix, Saskatoon, SK., March 3, 1999

LaLonde, S. B., 1994. *Never Sell Your Hen on a Rainy Day, A Handbook of Weather Signs, Rhymes and Reasons.* Duck Creek Publications, Kelvington, SK.

Maybank, J. & S. C. McKercher, 1970. *Winter Wind Chill.* Saskatchewan Research Council Report P.70-7 3M - Oct. 1970. Saskatoon, SK.

National Research Council of Canada, Herzberg Institute of Astrophysics, 1998. *Sunrise -Sunset Tables for Saskatoon 1999 and 2000*. National Research Council of Canada, Herzberg Institute of Astrophysics, Victoria, BC.

Huschke, R.E. (Ed.), 1959. *Glossary of Meteorology.* American Meteorological Society, Boston, MA.

Perreaux, L.,1999. *Tornado Warning Issued after Twister Touches Down.* Star Phoenix, Saskatoon, SK., May 19, 1999.

Phillips, D. W., 1993. *The Day Niagara Falls Ran Dry!: Canadian Weather Facts and Trivia.* Key Porter Books Ltd., Toronto, ON.

Phillips, D. W., 1997. *1998 Canadian Weather Trivia Calendar.* Fifth House Ltd., Calgary AB.

Phillips, D. W., 1998. *1999 Canadian Weather Trivia Calendar.* Fifth House Ltd., Calgary AB.

Phillips, D. W., 1995. *1996 Canadian Weather Trivia Calendar.* Fifth House Ltd., Calgary AB.

Phillips, D. W. , 1996. *Weather Flashes. Canada's Weather Trivia Mini-magazine.* Fifth House Ltd., Calgary AB.

Phillips, D. W., 1987. *1988 Canadian Weather Trivia Calendar.* Canadian Government Publishing Centre, Ottawa, ON.

Robinson, A., 1999. *Warmer than Normal Winter Predicted.* Star Phoenix, Saskatoon, SK., October 6, 1999.

Rybak, D., 1999. *Personal Communication*. Saskatchewan Enviromental Services Centre, Saskatoon, SK.

Smith, Steve and Rick Green, 1995. *The Red Green Book: the wit and wisdom of Possum Lodge - plus 100 pages of filler*. Macmillan Canada, Toronto, ON.

Wood, R. A., (Ed.) 1996. *The Weather Almanac, 7th Ed.* Gale Research, Detroit, MI.

World Meteorological Organization, (WMO) 1988. *Technical Regulations: General Meteorological Standards and Recommended Practices, 1988 ed., Suppl. No. 2 (IV. 1996), WMO - No. 49.* Geneva, Switzerland.