Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canadian Climate Normals 1981-2010

Canada

"Climate averages", "climate means" or "climate normals" are all interchangeable terms. They refer to arithmetic calculations based on observed climate values for a given location over a specified time period. Climate normals are often used to classify a region's climate and make decisions for a wide variety of purposes involving basic habitability, agriculture and natural vegetation, energy use, transportation, tourism, and research in many environmental fields. Normals are also used as a reference for seasonal monitoring of climate temperature and precipitation for basic public interest, and for monitoring drought or forest fires risk. Real-time values, such as daily temperature, are often compared to a location's "climate normal" to determine how unusual or how great the departure from "average" they are.

The World Meteorological Organization (WMO) recommends that countries prepare climate normals for the official 30-year normals periods ending in 1930, 1960 and 1990, for which the WMO World Climate Normals are published. In addition, WMO recommends the updating of climate normals at the end of every decade as provided here for 1981 to 2010.

1.0 Calculation method

There are many ways to calculate "climate normals"; the most useful ones adhere to accepted standards. The WMO considers thirty years long enough to eliminate year-to-year variations. Thus the WMO climatological standard period for normal calculations are computed over a 30 year period of consecutive records, starting January 1st and ending December 31st. In addition, the WMO established that normals should be arithmetic means calculated for each month of the year from daily data with a limited number of allowable missing values. For normals values representing averages, such as temperature, a month was not used if more than 3 consecutive days or more than a total of 5 days were missing. This rule is referred to as the "3 and 5 rule" established as a guideline for completeness by the WMO. Furthermore, its corresponding year-month mean should not be computed and should be considered missing. For normals values representing totals, such as precipitation, degree-days, or days with, an individual month was required to be 100% complete in order for it to be included in the normals calculation.

First, the average or total, as appropriate for the element, for all individual months was calculated for all locations. Normals values were then calculated as the mean for each month from all the individual months in the period that sufficiently fulfilled the requirement for completeness for 1981 to 2010. With the exception of the annual standard deviation (see calculations below), the annual normal value was calculated as the mean or total of monthly normals values only for stations where means or totals for every month of the year were available.

APPENDIX A lists the specific type of calculation, applicable period, and completeness requirements for each normals and extremes element.

NOTE: The "3 and 5 rule" is extracted from "Calculation of Monthly and Annual 30 Year Standard Normals", Prepared by a meeting of experts, Washington, D.C., USA, March 1989. WMO-TD/No. 341 (WCDP-No. 10), Page 5.

2.0 Normals code

Once the qualifying months were determined, the "3/5" rule was also applied to the number of months used to calculate average mean or average total within the thirty-year period. For instance, the "normal" value of a monthly element, such as normal maximum temperature for May, can have no more than 3 consecutive or 5 total missing months of May between 1981 and 2010.

A normal code was assigned for each month according to the completeness criteria presented in Table 1. With the exception of the annual standard deviation calculated for mean temperature, the monthly code that represented the least degree of completeness was assigned to the annual normal code for that element and location.

Table 1: Normal Codes table for the 1981 to 2010 Canadian Climate Normals

Normal Code	**Number of years with complete months required in the 1981-2010 period**
A*	WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for both temperature and precipitation)
A	WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for either temperature or precipitation)
B	At least 25 years
C	At least 20 years
D	At least 15 years
E	At least 10 years
F	At least 5 years
G	< 5 years

Note that stations with a normal code of "A" in both temperature and precipitation are designated as meeting the WMO standard for normals calculation.

While normals for all available elements for all stations were calculated, only elements with a normals code of at least Class D, or 15 years are currently available through the Historical Climate Data website.

3.0 Uncertainty due to shorter period

Apart from any uncertainty due to site, instrument, or observing program changes, or general representativeness of the observing site with the surrounding region, the normals for most locations will have some uncertainty due to the fact that the observations are not complete for the 30-year period.

4.0 Standard deviation calculations

Standard deviations of mean daily temperatures (°C) are calculated from the same data used to calculate the mean for each month. Calculation of annual standard deviation differs from other annual element calculations in that it represents the mean standard deviation calculated from annual means for a given station rather than the mean standard deviation of monthly means. The same "3 and 5" rule for data completeness was applied to the annual standard deviation as was applied to the individual monthly standard deviations. The normal code for the annual standard deviation was assigned according to the qualifications outlined in Table 1 rather than representing the least degree of completeness for all months.

5.0 Climate extremes

Besides the monthly averages and totals, extremes for selected elements by month including the daily maximum and minimum temperature, and the daily rainfall, snowfall, and total precipitation, and the dates of occurrence, were compiled and provided along with the normals elements. Extremes are compiled from the entire period of record of each location and not restricted to just the 1981-2010 normals period. In each case, the first or oldest date of occurrence is recorded below the extreme value. Values which occur more than once are identified with a (+). Bolded values and dates indicate the extreme for the year. Because no completeness requirements apply, no normals codes are assigned to extreme elements.

6.0 Support information

During the calculation of normals and extremes, additional support information was tabulated. These include for both means and extremes: total number of available years, number of missing years, total count of observations and percent possible observations used. The first year and last year used within the normals period for elements for which means were calculated are available. The first year and last year used for element for which extremes were determined are available.

7.0 Data adjustments

No explicit corrections or adjustments were made to normals values to account for any variations in siting, instruments, or observing procedures. To the degree that these confounding influences can affect trends in temperature and precipitation, these normals values should not be used to draw precise conclusions about changes in climate.

All normal values are derived from data in the National Archive System of Environment and Climate Change Canada (ECCC). While considerable effort is made to ensure the accuracy of these data, no guarantee can be given that they are error free.

8.0 Data and observing stations

The normals elements of greatest interest are the daily values of maximum, minimum and mean temperature (°C), rainfall (mm), snowfall (cm) and total precipitation (mm). For principal stations, additional daily elements such as peak wind gusts and elements based on hourly elements such as wind, sunshine, and solar radiation are also available. Generally the network of volunteer stations is limited to basic daily temperature and precipitation observations.

The climate day at first order or primary observing sites is defined by the 24-hour period ending at 0600 UTC (Universal Time Coordinate). The climate at volunteer observing sites ends at around 8:00 am local time and can vary somewhat from location to location.

As in many other countries, observing practices have evolved through the current normals period, and continue to evolve. Observations at one time almost exclusively taken and recorded by human observers are increasingly being automated. Some principal stations in the Meteorological Services Canada (MSC) network were automated during the 1990's. As this occurred, the only precipitation observations available were daily total precipitation (mm) from an automatic weighing precipitation gauge. The observations from these stations in these years (mostly the late 1990's) were not used for the normals calculations since daily rainfall and snowfall observations were not available.

8.1 Temperature

Temperature measurements are made from self-registering maximum and minimum thermometers set in a louvered, wooden shelter. The shelter is mounted on a stand so that the thermometers are approximately 1.5 m above ground, which is usually a level, grassy surface.

At most climatological stations, maximum temperature is the highest temperature recorded in a 24-hour period ending in the morning of the next day. The minimum values are for a period of the same length, beginning in the evening of the previous day. Mean temperature is the average of the two.

At most principal stations, the climatological day begins at 0600 UTC and ends at the onset of 0600 UTC on the following day. These times are equivalent or close to midnight local standard time for most of Canada.

8.2 Rainfall, snowfall, and precipitation

Rain, drizzle, freezing rain, freezing drizzle and hail are usually measured using the standard Canadian rain gauge, a cylindrical container 40 cm high and 11.3 cm in diameter. The precipitation is funneled into a plastic graduate which serves as the measuring device.

Snowfall is the measured depth of newly fallen snow, measured using a snow ruler. Measurements are made at several points which appear representative of the immediate area, and then averaged. "Precipitation" in the tables is the water equivalent of all types of precipitation.

At most ordinary stations the water equivalent of snowfall is computed by dividing the measured amount by ten. At principal stations it is usually determined by melting the snow that falls into Nipher gauges. These are precipitation gauges designed to minimize turbulence around the orifice, and to be high enough above the ground to prevent most blowing snow from entering. The amount of snow determined by this method normally provides a more accurate estimate of precipitation than using the "ten-to-one" rule. Even at ordinary climate stations the normals precipitation values will not always be equal to rainfall plus one tenth of the snowfall. Missing observations is one cause of such discrepancies.

Precipitation measurements are usually made four times daily at principal stations. At ordinary sites they are usually made once or twice per day. Rainfall, snowfall and precipitation amounts given in the tables represent the average accumulation for a given month or year.

8.3 Snow depth

Snow cover is the depth of accumulated snow on the ground, measured at several points which appear representative of the immediate area, and then averaged. End-of-month values are given in the tables.

8.4 Number of days with specified parameters

These elements give the average number of days per month or year on which a specific meteorological event or parameter threshold occurs. In the case of rainfall and precipitation, 0.2 mm or more must occur before a "day with" is counted. The corresponding figure for snowfall is 0.2 cm.

8.5 List of days with parameters and thresholds

Days with Maximum Temperature

- ≤ 0°C
- > 0°C
- > 10°C
- > 20°C
- > 30°C
- > 35°C

Days with Minimum Temperature

- > 0°C
- ≤ 2°C
- ≤ 0°C
- < -2°C
- < -10°C
- < -20°C
- < -30°C

Days with Rainfall

- ≥ 0.2 mm
- ≥ 5 mm
- ≥ 10 mm
- ≥ 25 mm

Days with Snowfall

- ≥ 0.2 cm
- ≥ 5 cm
- ≥ 10 cm
- ≥ 25 cm

Days with Precipitation

- ≥ 0.2 mm
- ≥ 5 mm
- ≥ 10 mm
- ≥ 25 mm

Days with Snow Depth

- ≥ 1 cm
- ≥ 5 cm
- ≥ 10 cm
- ≥ 20 cm

8.6 Degree-Days

Degree-days for a given day represent the number of degrees Celsius that the mean temperature is above or below a given base. For example, heating degree-days are the number of degrees below 18°C. If the temperature is equal to or greater than 18, then the number of heating degrees will be zero. Normals represent the average accumulation for a given month or year.

Values above or below the base of 18°C are used primarily to estimate the heating and cooling requirements of buildings and fuel consumption. A temperature base of 24°C is sometimes used as an index of extreme cooling degree-days of as an index of potential heat stress. Values above 5°C are frequently called growing degree-days, and are used in agriculture as an index of crop growth.

8.7 Soil temperature

Soil temperature measurements provide climatology of soil thermal characteristics such as the depth of frost penetration into the soil and the duration that the soil remains frozen. It is of interest to hydrologists because it affects surface runoff, infiltration and snowmelt and to agriculturalists because it affects seed germination.

Measurements of soil temperature are made in accordance with the WMO recommendations at the standard depths of 5, 10, 20, 50, 100, 150 and 300 cm. They are measured daily as close as possible to 08:00 LST and again at the shallowest depth at 16:00 LST.

8.8 Evaporation

Evaporation refers to the calculated lake evaporation occurring from a small natural open water-body having negligible heat storage and very little heat transfer at its bottom and sides. It represents the water loss from ponds and small reservoirs but not from lakes that have large heat storage capacities. Lake evaporation is calculated using the observed daily values of pan evaporative water loss, the mean temperatures of the water in the pan and of the nearby air, and the total wind run over the pan.

Lake Evaporation normals for the 1981 to 2010 period were calculated as means of daily means for a given station. This in effect is a measure of the rate of evaporation per day rather than a measure of total evaporation as was calculated in the 1961 to 1990 normals. To make the 1981 to 2010 lake evaporation normal values comparable to previous calculations, multiply the 1981 to 2010 value by the number of days for a given month to obtain an equivalent estimate.

8.9 Frost and freezing-free period

Freezing occurs whenever temperatures fall to 0°C or lower. Frost data normals are based on the occurrence of freezing temperatures as recorded from minimum thermometers. The "Freezing-free Period" is defined as the number of days between the last occurrence of frost in spring and first occurrence of frost in the fall for a given year. For the purpose of these calculations, "spring" is defined as days <u>on or before</u> July 15, "fall" is defined as days <u>after</u> July 15 and freezing or frost occurs on any day where the daily minimum temperature (T_{min}) is observed to be less than or equal to 0°C.

"Freezing-free" elements are calculated only for stations where daily minimum temperature observations are 100% complete from the period of July 15 to the last occurrence of T_{min} less than or equal to 0°C in "spring", and from July 15 to the first occurrence of T_{min} less than or equal to 0°C in "fall". At least one complete period must occur within 1981 to 2010.

Frost normals (average date of last Spring frost, average date of first Fall frost and average length of frost-free period) for the 1981-2010 period were calculated as means of the Julian days and represent the last "spring" frost, first "fall" frost and frost-free length.

Probability statistics are only generated for stations with at least 10 years of data. These statistics outline the probability of an event occurring either before or after a specified date. For example, a date of May 15th given for the 10th percentile of the "Probability of last temperature in spring of 0°C or lower on or after indicated dates", implies that there is a 10% likelihood that the last spring frost occurred on either May 15th or later. Similarly a date of August 15th given for the 10th percentile of the "probability of first temperature in fall of 0°C or lower on or before indicated dates", implies that there is a 10% likelihood that the first fall frost occurred on either August 15th or earlier. Finally, a station with 100 days given for the 10th percentile of the "probability of frost-free period equal to or less than indicated period (days)", implies that there is a 10% likelihood that the frost-free period for the station is 100 days or less. Calculations for probability of spring freezing at x%, fall freezing at x% and freezing-free period at x% were completed using the same methodology. These statistics are calculated for the entire period of record for a station.

8.10 Hourly Data

Some climate elements are observed on an hourly rather than a daily basis. For these elements, the "3 and 5" rule for completeness is inapplicable given the comprehensive volume of data. Instead, to qualify for inclusion, hourly elements must have at least 90% of all available hours for a month complete where means or "days with" statistics are calculated. As with daily elements, where average totals are calculated, the record required 100% complete data. The monthly mean was then assigned an annual code following the completeness requirements outlined in Table 1.

Hourly elements include: hourly wind speed and direction, bright sunshine, humidex, wind chill, humidity, pressure, radiation, visibility and cloud amount.

8.10.1 Wind

Most principal climatological stations are equipped with a standard type U2A anemometer, taking one or (since 1985) two-minute mean speeds values at each observation. At other wind-measuring sites, values are usually obtained from autographic records of U2A or 45B anemometers. Averaging periods at these sites may vary from one minute to an hour.

In observing, wind speed is measured in m/s or nautical miles per hour and converted to kilometers per hour. The extreme gust speed is the instantaneous peak wind observed from the anemometer dials, or abstracted from a continuous chart recording. A value of zero denotes calm or no wind.

Conversion factors: 1 nautical mile = 1852 meters or 1.852 km
therefore 1 knot = 1.852 km/h and 1 km/h = 0.54 knot

Wind direction measured by U2A's is recorded to the nearest ten degrees, while those from the 45B are provided to 8 points of the compass. All wind directions are defined as the direction from which the wind blows with respect to true or geographic north. For example, an easterly wind is blowing from the east, not toward the east. A wind direction observation represents the average direction over the two minutes period ending at the time of observation.

The calculation of most frequent wind direction has been updated in the 1981-2010 normals. Most frequent wind direction is based on the total number of occurrences of each of 36 possible directions (in 10's of degrees) for each month converted into one of 8 compass directions. For each of the 8 compass directions the total counts for these 10's of degrees are added together. The direction with the highest summed amount is the most frequent wind direction. The most frequent wind direction for the year is simply deduced as the summed direction with the highest total occurrence count for all months. The 8 compass directions are determined from the chart given below.

Table 2: 8 points, range and 10's of deg

8 points	Direction/Range	10's of Degrees
N	336-025	34 35 36 01 02
NE	026-065	03 04 05 06
E	066-115	07 08 09 10 11
SE	116-155	12 13 14 15
S	156-205	16 17 18 19 20
SW	206-245	21 22 23 24
W	246-295	25 26 27 28 29
NW	296-335	30 31 32 33

NOTE: Wind speed and direction are greatly affected by proximity to the ground and by the presences of obstacles such as hills, buildings and trees. It tends to increase in speed and veer with height above ground. For meteorological purposes, the standard exposure of anemometer cups is at a height of 10 meters above the ground surface.

8.10.2 Bright Sunshine

Bright sunshine observations are made using the Campbell-Stokes sunshine recorder. It consists of a glass sphere that is 10 cm in diameter, mounted concentrically in a portion of a spherical bowl. The sun's rays are focused by the glass sphere on a card held in position by a pair of grooves in the bowl. The focused rays scorch the card or burn a trace right through it. The card size used depends on the length of the day and is available in three classes corresponding to the time of the year equinox, summer or winter solstice.

Cards are changed daily so that the duration of sunshine for each hour of the day can be scaled. It is important to note that the amount of "bright sunshine" is less than the amount of "visible sunshine" because the sun's rays are not intense enough to record especially just after sunrise and towards sunset. The number of tenths of hours of sunshine is counted, as indicated by the burn on the card, and the total is recorded.

8.10.3 Humidex

Humidex is an index to indicate how hot or humid the weather feels to the average person. It is derived by combining temperature and humidity values into one number to reflect the perceived temperature. For example, a humidex of 40 means that the sensation of heat when the temperature is 30 degrees and the air is humid feels more or less the same as when the temperature is 40 degrees and the air is dry.

The standard Humidex formula used by ECCC is:

Humidex = (air temperature) + h
Where
h = (0.5555) * (e - 10.0);
e = vapour pressure in hPa (mbar), given by:
e = 6.11 * exp [5417.7530 * ((1/273.16) - (1/dewpoint))]

Dew point is expressed in Kelvins (temperature in K = temperature in °C + 273.16) and 5417.7530 is a rounded constant based on the molecular weight of water, latent heat of evaporation, and the universal gas constant.

8.10.4 Wind chill

Wind chill is an index to indicate how cold the weather feels to the average person. It is derived by combining temperature and wind velocity values into one number to reflect the perceived temperature. For example, if the outside temperature is -10°C and the wind chill is -20, it means that your face will feel more or less as cold as it would on a calm day when the temperature is -20°C.

In the previous normals, wind chill was calculated when the temperature of the air was ≤ 10°C and the reported wind speed was ≥ 5 km/h. The first equation listed below was used for these calculations. In the 1981-2010 normals there are two Wind Chill formulas used by ECCC. The first equation is used when the temperature of the air is ≤ 0°C and the reported wind speed is ≥ 5 km/h. The second equation is used when the temperature of the air is ≤ 0°C and the reported wind speed is > 0 km/h but < 5 km/h.

The standard Wind Chill formula for ECCC is:

1. $W = 13.12 + 0.6215 \times T_{air} - 11.37 \times V_{10m}^{0.16} + 0.3965 \times T_{air} \times V_{10m}^{0.16}$
2. $W = T_{air} + [(-1.59 + 0.1345 \times T_{air})/5] \times V_{10m}$

Where
W is the wind chill index, based on the Celsius temperature scale
T_{air} is the air temperature in degrees Celsius (°C), and
V_{10m} is the wind speed at 10 meters (standard anemometer height), in kilometers per hour (km/h).

8.10.5 Humidity

Vapour pressure is the pressure exerted by the water present in an air parcel. This pressure is one of the partial pressures that make up the total pressure exerted by an air parcel. The vapour pressure increases as the amount of water vapour increases.

Relative humidity is the ratio of the actual amount of water vapour present in a given parcel of air to the maximum amount that the parcel is capable of holding at a given temperature. It is usually expressed as a percentage. It is derived from either dry bulb and wet bulb temperatures or, in the case of a Dewcel remote temperature sensing unit, from dry bulb temperature and dew point values, with the aid of psychrometric tables.

Relative humidity changes with the air temperature even though the actual amount of water vapour present in an air parcel may remain constant. When a parcel of air is heated, without the addition or removal of water vapour, the relative humidity decreases and conversely, if the parcel is cooled under the same conditions, the relative humidity increases.

The closer the dew point temperature is to the dry bulb temperature, the higher the relative moisture content of the air. At 100% relative humidity the dew point temperature and the dry bulb temperature are the same. When the dry bulb/dew point difference is small, some of the internal water vapour condenses to form liquid water droplets either as fog or clouds.

8.10.6 Pressure

Pressure is the weight of a column of air of unit cross-sectional area extending from the level of the observing station vertically to the outer limit of the atmosphere. The standard instrument for the measurement of atmospheric pressure is the mercury barometer, in which the air pressure is balanced against the weight of a column of mercury in a glass tube that contains a vacuum.

Station Pressure (kPa) is the atmospheric pressure in kiloPascal (kPa) at the station elevation. Atmospheric pressure is the force per unit area exerted by the atmosphere as a consequence of a mass of air in a vertical column from the elevation of the observing station to the top of the atmosphere.

Sea level pressure is the weight of a column of air of unit cross-sectional area extending from sea level vertically to the outer limit of the atmosphere. It is directly measured at stations situated at sea level, but is calculated at other stations by adding to the station pressure, the equivalent weight of an air column extending from the station elevation down to sea level. Mean sea level pressure is computed so that the barometric pressures at stations of different elevations can be compared at a common level for analysis purposes.

8.10.7 Solar radiation

Solar radiation is the measurement of radiant energy from the sun, on a horizontal surface. There are several standardized components of independent measurements. Each component is assigned a different identifying number referred to as Radiation Fields (RF). The standard metric unit of radiation measurement is the Mega Joule per square meter (MJ/m^2).

Components measured and used by MSC:

RF1: **Global Solar Radiation** – the total incoming direct and diffuse short-wave solar radiation received from the whole dome of the sky on a horizontal surface.

RF2: **Sky Radiation (Diffuse)** – the portion of the total incoming short-wave solar radiation received on a horizontal surface that is shielded from the direct rays of the sun by means of a shade ring.

RF3: **Reflected Solar Radiation** – the portion of the total incoming short-wave radiation that has been reflected from the Earth's surface and diffused by the atmospheric layer between the ground and the point of observation onto a horizontal surface.

RF4: **Net Radiation** – the resultant of downward and upward total (solar, terrestrial surface, and atmospheric) radiation received on a horizontal surface.

8.10.8 Visibility

Visibility in kilometers (km) is the distance at which objects of suitable size can be seen and identified. Precipitation, fog, haze or other obstructions such as blowing snow or dust can reduce atmospheric visibility.

8.10.9 Cloud amount

A cloud in the atmosphere is a visible collection of minute particle matter, such as water droplets and/or ice crystals, in the air. Condensation nuclei, such as smoke or dust particles, form a surface around which water vapour can condense and create clouds.

9.0 APPENDIX A

Table 3 shows the calculation, period of record and completeness required for each normal and extreme element.

Table 3: Normals Calculation for the 1981 to 2010 Canadienne Climate Normals including element by Group, type of Calculation, period used and completeness

Element by Group	**Type of calculation**	**Period used**	**Completeness required**
Temperature (°C)			
Mean daily temperature (°C)	mean	*Normal	3 and 5 rule
StdDev mean monthly temperature (°C)	stddev	*Normal	3 and 5 rule
Mean daily max temperature (°C)	mean	*Normal	3 and 5 rule
Extreme maximum daily max temperature (°C)	maximum	period of record	all available values
Mean daily min temperature (°C)	mean	*Normal	3 and 5 rule
Extreme minimum daily min temperature (°C)	minimum	period of record	all available values
Precipitation			
Total rainfall (mm)	total	*Normal	100% complete
Total snowfall (cm)	total	*Normal	100% complete
Total precipitation (mm)	total	*Normal	100% complete
Extreme daily rainfall (mm)	maximum	period of record	all available values
Extreme daily snowfall (cm)	maximum	period of record	all available values
Extreme daily precipitation (mm)	maximum	period of record	all available values
Mean daily snow depth (cm)	mean	*Normal	3 and 5 rule
Median daily snow depth (cm)	median	*Normal	3 and 5 rule
Extreme daily snow depth (cm)	maximum	period of record	all available values
Mean month end snow depth (cm)	mean	*Normal	all available values
Days with ...			
For all specified parameters including: Maximum temperature (°C) Minimum temperature (°C) Rainfall (mm) Snowfall (cm) Precipitation (mm) Snow depth (cm)	total	*Normal	100% complete

Element by Group	Type of calculation	Period used	Completeness required
Wind			
Mean of hourly wind speed (km/h)	mean	*Normal	90% of hours
Most frequently occurring wind direction (deg true)		*Normal	90% of hours
Direction of extreme of hourly wind speed (deg true)		period of record	all available values
Extreme of hourly wind speed (km/h)	maximum	period of record	all available values
Extreme of daily max gust (km/h)	maximum	period of record	all available values
Direction of extreme of daily max gust (deg true)		period of record	all available values
Days with wind ≥ 28 knots	total	*Normal	100% complete
Days with wind ≥ 34 knots	total	*Normal	100% complete
Degree days (°C)			
Specified temperature thresholds	total	*Normal	100% complete
Soil temperature (°C)			
Mean of soil temperature at specified depths and times	mean	*Normal	3 and 5 rule
Evaporation (mm)			
Mean of daily lake evaporation (mm)	mean	*Normal	3 and 5 rule
Bright sunshine			
Total hours bright sunshine	total	*Normal	100% complete
Days with measurable bright sunshine	total	*Normal	100% complete
Extreme daily bright sunshine hours	maximum	*Normal	all available values
Percent of daylight hours based on civil sunrise/sunset	percentage	*Normal	100% complete
Humidex			
Extreme maximum humidex value (°C)	maximum	period of record	all available values
Days with humidex value ≥ 30	total	*Normal	90% complete
Days with humidex value ≥ 35	total	*Normal	90% complete
Days with humidex value ≥ 40	total	*Normal	90% complete
Wind chill			
Extreme minimum wind chill value (°C)	minimum	period of record	all available values
Days with wind chill value < -20	total	*Normal	90% complete
Days with wind chill value < -30	total	*Normal	90% complete
Days with wind chill value < -40	total	*Normal	90% complete
Humidity			

Element by Group	Type of calculation	Period used	Completeness required
Mean of hourly vapour pressure (kPa)	mean	*Normal	90% of hours
Mean of 0600 LST relative humidity (%)	mean	*Normal	90% complete
Mean of 1500 LST relative humidity (%)	mean	*Normal	90% complete
Pressure			
Mean of hourly station pressure (kPa)	mean	*Normal	90% of hours
Mean of hourly mean sea level pressure (kPa)	mean	*Normal	90% complete
Radiation			
Total hourly global solar radiation RF1 (MJ/m^2)	total	*Normal	100% complete
Total hourly diffuse solar radiation RF2 (MJ/m^2)	total	*Normal	100% complete
Total hourly reflected solar radiation RF3 (MJ/m^2)	total	*Normal	100% complete
Total hourly net radiation RF4 (MJ/m^2)	total	*Normal	100% complete
Extreme Daily global solar radiation RF1 (MJ/m^2)	maximum	period of record	all available values
Extreme daily diffuse solar radiation RF2 (MJ/m^2)	maximum	period of record	all available values
Extreme daily reflected solar radiation RF3 (MJ/m^2)	maximum	period of record	all available values
Extreme daily net radiation RF4 (MJ/m^2)	maximum	period of record	all available values
Visibility			
Hours with visibility < 1 km	total	*Normal	100% of hours
Hours with visibility 1 to 9 km	total	*Normal	100% complete
Hours with visibility > 9 km	total	*Normal	100% complete
Cloud Amount			
Hours with total cloud opacity 0 to 2 tenths	total	*Normal	100% of hours
Hours with total cloud opacity 3 to 7 tenths	total	*Normal	100% complete
Hours with total cloud opacity 8 to 10 tenths	total	*Normal	100% complete
Frost			
Average date of last spring frost	mean	*Normal	100% complete
Average date of first fall frost	mean	*Normal	100% complete

Element by Group	Type of calculation	Period used	Completeness required
Average length of frost-free period in days	mean	*Normal	100% complete
Freezing-Free			
Probability of spring freezing at specified parameters	probability	period of record	100% complete
Probability of fall freezing at specified parameters	probability	period of record	100% complete
Probability of freezing-free period at specified parameters	probability	period of record	100% complete

*Normal indicates that all available data between 1981 and 2010 which qualified under the appropriate completeness rule for this element was used.