Climate Reference Station
Conservation Learning Center
RM of Prince Albert #461
ANNUAL SUMMARY 2013

S. Dunn
C. Beaulieu
V. Wittrock
Saskatchewan Research Council
Air and Climate

SRC Publication No. 13000-1E14
March 2014
Revised March 2015

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COVER PHOTOGRAPH
Conservation Learning Center Climate Reference Station
Photo credit: Virginia Wittrock
July 2012

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

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Saskatchewan Research Council web site: http://www.src.sk.ca
Monthly data sheets and annual summaries: http://blog.src.sk.ca/environment/crs-weather-summaries/

SASKATCHEWAN RESEARCH COUNCIL

Climate Reference Station Supporters, 2013

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Climate Reference Station History

The Saskatchewan Research Council's Climate Reference Station (CRS) at the Conservation Learning Centre (CLC) is situated approximately 16km east of Macdowall, approximately 11km north of St. Louis and 18 km south of Prince Albert, Saskatchewan. The oldest recordings of meteorological data in the area are south of the North Saskatchewan River at Prince Albert beginning in 1884 and lasting until 1942. In 1953, the present day Prince Albert station was established at the airport north of the river and east of the city. Other nearby stations recording intermittent data were at MacDowall (1914-2003) and Hoey (south of St. Louis) (1986-2012) with MacDowall recording both precipitation and temperature and Hoey only recording precipitation.

The SRC Climate Reference Station at CLC was established in 2011 and began producing a full array of climate data January 2012. The array consists of temperature, precipitation, humidity, barometric pressure, wind, solar radiation, and soil moisture and temperature. The site is a self-contained unit with power generated from solar panels while the data is retrieved from the data logger by an internet connection via the cellular network.

Activities Associated with the CRS at CLC in 2013

The CLC is a research and demonstration farm. Its outreach program for grades 3 to 11 students,science clubs or other interested groups offers hands-on activities related to soil, water, air, and wildlife habitat.[1] The SRC Climate Reference Station is included in the program exposing participants to the CRS's suite of instruments. The station emphasizes the importance of climate in the practical world of farming and ecology.

Important events in 2013 included installation of new data logger (missing data 19-20 March, 29 April to 2 May); design of an automated shadow band for the diffuse radiation sensor and extensive trouble shooting to enable the use of the 150cm soil temperature probes. Bright Sunshine malfunction resulted in missing data for January, February, November & December.

The 2013 field day at CLC occurred on July 18th. Virginia Wittrock gave an on-site presentation to approximately 50 participants explaining the importance of the CRS, potential usages of the data as well as how the data had been utilized since it's installation in 2011.

[1] Conservation Learning Centre 2011

2012 Field Day
Photo credit: Virginia Wittrock
July 2012

2012 Field Day
Photo credit: Virginia Wittrock
July 2012

What is the Climate Reference Station?

The Saskatchewan Research Council's Climate Reference Station (SRC CRS) at the Conservation Learning Centre is classified as a principal climatological station with supplementary climatological observations.[1] A reference climatological station's data are intended for the purpose of determining climatic trends which require long periods (not less than thirty years) of homogeneous records, where man-made environmental changes have been or are expected to remain at a minimum. As the Climate Reference Station is in its infancy, data for trend analyses are not available. At the station, half-hourly readings are taken of elements which include temperature, precipitation amount, humidity, wind, and atmospheric pressure. Our supplemental observations include rainfall intensity, soil temperature, soil moisture, snow depth, bright sunshine and solar radiation. High quality and consistent climatological observations are maintained which will provide data sets to meet the current concerns of the effects of climatic change and increased variability.

Purpose and Benifits

The purpose of the SRC CRS is to provide a record of observed meteorological elements in order 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. It is necessary and valuable for areas such as agriculture, forestry, land use and facility placement, water and energy resources, health and comfort.

The CRS will allows us to:

- Evaluate long term climate trends after operating for a standard period - 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 - e.g. intense rainfall causing flooding and property damage, heat stress with its implications for health;
- Conduct 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, and climate change monitoring;
- Have roles in various programs within SRC and collaborative research with other agencies
- Provide climate data to accident studies, agricultural sectors, authors, building science, chemical companies, construction firms, governments, insurance agencies, lawyers, media, recreation facilities, schools, tourism groups, transportation studies, universities, wildlife studies, and interested individuals.

Goals

The goals of the Climate Reference Station are first, to gather high quality of data at its current location and, second, to monitor a large variety of elements. These various elements combined with a long-term collection period as well as the stable location will allow CRS to be an extremely valuable climate information collection station.

[1]*Environment Canada 1992*

SRC Publication No. 13000-1E14

Summaries for 2013

Overview

Data including temperature, precipitation, wind speed and direction, bright sunshine, solar radiation, soil temperature and moisture was recorded during 2013 by the Saskatchewan Research Council (SRC) at the Climate Reference Station (CRS), at the Conservation Learning Centre (CLC) (53.03ºN, 105.77°W) located in the Rural Municipality of Prince Albert #461, Saskatchewan.

This report summarizes the second full year of operation at the Conservation Learning Center. The site ran relatively well with the exception of a few instrumental problems. The data logger malfunctioned March 19-30, April 29 - May 2. As well the Bright Sunshine Recorder had an instrument malfunction in January-February and November-December.

The winter of 2012/2013 will be remembered as the winter that wouldn't end. Minimum temperatures were below zero starting 21 October 2012 and did not become positive again until 26 April 2013. The maximum temperature went above zero five times between 20 November 2012 and 1 April 2013. This consistent cold resulted in the snow pack at the CLC CRS reaching a depth of 83cm on 12 April 2013. Maximum temperatures reached above 30°C on seven occasions; three occasions in July, one in August and three in September. Minimum temperatures below -30°C occurred on thirty-one occasions, fifteen of these days were in December. The first day when the minimum temperature was above the freezing point was on April 26th. The frost-free season of 131 continuous frost-free days, started on May 11th and ended on September 18th. October 12th was the last day of 2013 when minimum temperatures were above the freezing point..

Total precipitation for the year was 340mm with 59% occurring in June and July. This value is only 56% of the total precipitation received last year (2012). The biggest storm event was shared between July 6th and July 15th where the 15th recorded the greatest 1 hour and 2 hour totals of 11.6mm and 11.8mm. July 6th received the largest volumes in the 6 hour (15.6mm) and 12 hour (28.6mm) periods, as well as recorded the largest volume received in one daily measuring 29mm. The driest month was October with 5.6mm. By the end of April, measurable snow-on-the-ground was absent. The permanent winter snow pack became established on November 2nd. The end of December snow depth measurement was over 40cm.

Average wind speeds were between 10 and 13 km/h with the winds from northwest slightly stronger. While the predominating direction was from the west or northwest origins. The strongest wind at 61.5 km/h occurred on December 16th. February had the highest percentage of calm occurrences with gusts never exceeding 30.0 km/h.

The cool December temperatures, combined with the moderate wind speeds resulted in extreme wind chills. High risk to very high risk wind chills were calculated for 17 out of the 31 days. December 2012 had four days of high risk with no days calculated as having very high risk.

The deep snow pack resulted in the soil not freezing very deep nor did the frozen soils last very long into the spring. The soil froze down to the 50cm level by April but the frost line did not reach 100cm. In 2012, the frost line went down to the 150cm level.

CLC land
photo credit: V. Wittrock
July 2012

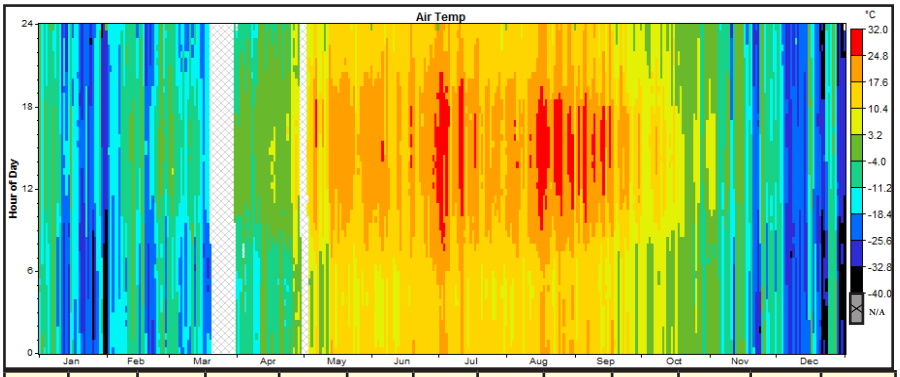
Noted 2013 Temperature Events	
Cold Spell (less than or equal to -30°C)	
Date	Temperature (°C)
January 11	-31.2
January 12	-31.6
January 14	-32.4
January 21	-33.1
January 23	-30.5
January 24	-34.1
January 25	-35.8
January 29	-32.9
January 30	-35.0
January 31	-39.5
February 18	-31.6
February 19	-32.9
November 20	-31.5
November 21	-31.5
November 22	-33.5
November 23	-33.6
December 7	-32.9
December 8	-30.6
December 9	-30.9
December 10	-30.9
December 11	-32.2
December 14	-31.4
December 19	-30.4
December 20	-33.8
December 21	-37.8
December 22	-36.8
December 23	-35.7
December 28	-37.8
December 29	-37.8
December 30	-37.2
December 31	-39.9
Hot Spell (Greater than or equal to 30°C)	
July 1	30.1
July 2	31.0
July 11	30.3
August 16	30.8
September 2	30.0
September 5	32.3
September 13	30.3
Last Spring Frost	
11-May	-2.4
First Fall Frost	
20-Sep	-1.4
Frost-free Season Length	
131 Days	

Temperature 2013

	Average Maximum (°C)	Average Minimum (°C)	Average Mean (°C)	2013 Extreme Values (°C)		Growing Degree-days	Heating Degree-days	Cooling Degree-days	Extreme Cooling Degree-days
	2013	2013	2013	Max/Date	Min/Date	base 5°	base 18°	base 18°	base 24°
January	-12.0	-24.0	-18.1	3.2/15	-39.5/31	0	1117.8	0	0
February	-7.7	-18.4	-13.1	2.4/16	-32.9/19	0	873.4	0	0
March	Datalogger Failure			3.8/02*	-28.1/18*	0*	591.1*	0*	0*
April**	2.9	-8.8	-2.9	15.3/27	-17.6/10	3.9	586.2	0	0
May**	20.7	7.2	14.0	27.0/06	-2.4/11	260.0	117.0	0	0
June	21.0	11.1	16.0	26.7/30	6.7/03	331.3	67.9	9.2	0
July	22.9	11.9	17.4	31.0/02	7.2/14	385.3	50.5	32.8	0
August	24.6	12.1	18.4	30.8/16	6.1/08	415.6	31.2	43.8	0
September	21.6	7.5	14.6	32.3/05	-1.4/20	287.3	118.1	15.4	0
October	8.4	-1.5	3.4	19.2/07	-10.9/29	31.2	451.1	0	0
November	-4.7	-15.0	-9.9	8.5/01	-33.6/23	0	836.8	0	0
December	-16.5	-27.2	-21.9	2.7/27	-39.9/31	0	1236.1	0	0
Average	7.4	-4.1	1.6		Total Sum	1714.6	6007.2*	101.2	0.0

*based on 19 days of data for March
** April data based on 28 days of data
***May data based on 29 days of data

Hourly Temperatures



Daily Maximum

DLF = Datalogger failure

2013	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	-0.1	-17.5	-1.9	2.0	DLF	20.6	30.1	22.6	24.2	10.0	8.5	-4.1
2	-0.6	-12.2	3.8	-0.9		21.5	31.0	22.1	30.0	8.6	8.3	-5.8
3	1.6	-16.4	-4.1	2.8	16.7	21.6	26.7	24.0	21.7	8.5	2.7	-12.3
4	-5.2	-13.9	-5.9	1.6	18.1	24.1	28.2	25.7	28.3	11.3	-0.2	-18.6
5	-4.8	-11.1	-6.4	-1.0	22.9	25.6	25.4	26.2	32.3	12.9	-7.0	-19.5
6	-4.9	-16.9	-10.4	-2.0	27.0	20.7	18.2	19.8	22.9	14.7	-7.0	-25.8
7	-1.3	-8.2	-8.4	-4.3	15.2	23.9	22.4	18.8	22.8	19.2	-0.2	-23.5
8	-5.4	-7.9	-11.3	-2.6	11.3	18.8	20.4	20.3	25.9	16.4	-3.2	-21.6
9	-7.0	-3.5	-7.0	3.7	19.1	18.5	24.8	17.6	27.4	10.6	-2.4	-18.3
10	-9.0	-4.9	-3.6	-0.6	10.1	13.5	27.3	23.6	24.9	16.9	-9.3	-18.4
11	-18.0	-2.3	-2.5	-0.6	13.8	17.9	30.3	25.2	20.3	12.8	-7.7	-22.3
12	-15.9	2.4	-7.0	0.9	25.4	21.6	22.8	24.7	25.8	8.6	0.3	-21.5
13	-16.4	-4.5	-3.1	1.0	25.0	22.3	19.2	24.6	30.3	11.4	2.6	-24.3
14	-12.9	-4.1	-6.7	1.9	22.7	16.2	21.5	25.8	18.3	11.8	-0.3	-22.5
15	3.2	-6.1	-13.6	3.3	21.2	15.8	24.1	28.4	20.9	15.9	3.0	-0.2
16	-9.6	2.4	-16.9	7.1	23.3	15.7	21.8	30.8	26.8	8.9	-2.6	-0.9
17	-16.1	-0.6	-12.3	5.5	22.2	19.6	26.0	27.3	24.7	7.6	-11.4	-14.6
18	-16.3	-15.1	-10.9	2.8	23.1	26.1	24.9	27.7	11.7	5.9	-9.5	-16.3
19	-17.5	-18.5	Data logger failure	3.2	23.6	22.9	17.9	25.7	13.2	7.5	-9.7	-22.7
20	-23.9	-16.0		1.1	23.1	17.3	19.3	21.0	18.9	2.3	-17.4	-22.8
21	-21.4	-13.1		0.0	22.0	13.9	17.8	20.4	24.4	-0.1	-18.2	-29.0
22	-15.1	-7.7		2.4	20.1	20.0	22.5	27.3	19.0	3.1	-20.2	-25.0
23	-22.5	-4.0		11.4	20.8	20.5	23.6	29.3	22.1	1.9	-5.8	-11.5
24	-21.1	-0.7		2.4	17.1	24.3	21.9	28.8	20.4	5.6	2.9	-7.4
25	-19.2	-1.3		9.0	19.0	21.5	19.8	29.6	11.6	5.5	-0.6	-6.2
26	-11.4	-2.3		9.8	20.7	21.4	20.1	22.0	10.3	6.5	-7.1	-0.5
27	-11.7	-6.1		15.3	22.6	25.0	20.5	23.5	14.2	2.5	-4.4	2.7
28	-8.4	-6.3		6.4	23.7	25.7	24.2	27.0	17.7	-3.0	-10.0	-18.1
29	-10.3	-6.3		DLF	24.9	25.9	18.6	28.0	22.5	2.7	-6.8	-25.8
30	-26.5				22.2	26.7	17.9	28.9	15.2	5.6	-8.7	-26.6
31	-25.8		1.6		22.9		20.8	17.2	0.0	8.0		-29.3

Temperature 2013

Daily Minimum

DLF = Datalogger failure

2013	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	-17.6	-25.9	-6.7	-14.5	DLF	11.0	17.5	11.2	8.8	4.8	-1.6	-12.0
2	-14.4	-19.7	-16.5	-12.6		7.7	16.7	9.4	11.6	2.9	-4.6	-15.8
3	-12.6	-20.0	-9.3	-8.5	3.1	6.7	17.1	7.8	10.7	0.3	-0.2	-20.4
4	-17.1	-16.8	-16.9	-14.4	-1.0	6.8	15.7	10.2	10.5	-1.9	-7.1	-25.8
5	-15.0	-17.1	-21.1	-7.3	4.3	7.6	13.9	13.4	14.1	0.5	-11.0	-28.8
6	-10.6	-21.4	-24.7	-5.0	7.4	9.7	12.5	11.8	11.9	5.4	-13.9	-28.1
7	-13.4	-18.3	-19.3	-13.4	4.1	8.7	11.8	10.1	11.9	5.5	-10.4	-32.9
8	-15.8	-16.1	-26.5	-17.0	-0.5	11.6	10.0	6.1	13.6	1.9	-5.3	-30.6
9	-22.1	-20.3	-20.0	-16.1	0.7	11.0	10.1	12.0	12.9	0.9	-9.3	-30.9
10	-18.0	-9.5	-20.4	-17.6	1.2	8.5	13.8	9.3	10.9	0.8	-27.3	-30.9
11	-31.2	-11.6	-20.1	-4.8	-2.4	7.4	17.2	9.3	7.4	3.3	-28.8	-32.2
12	-31.6	-7.2	-26.0	-2.3	3.1	8.5	12.8	9.7	4.1	0.6	-9.9	-24.4
13	-29.7	-6.2	-15.1	-7.7	10.6	14.3	10.6	11.0	9.0	-2.8	-2.6	-27.1
14	-32.4	-18.9	-15.0	-11.1	11.0	12.1	7.2	12.4	7.6	-1.1	-6.0	-31.4
15	-12.9	-23.8	-23.4	-5.7	6.7	11.4	11.3	13.7	3.4	-3.2	-2.7	-22.5
16	-23.0	-11.2	-26.8	-8.0	11.9	11.4	11.1	16.7	9.7	-1.2	-11.5	-14.6
17	-20.9	-15.1	-21.5	-11.9	11.4	9.8	10.5	17.4	10.8	-1.2	-20.5	-25.9
18	-18.6	-31.6	-28.1	-7.9	9.8	11.0	15.1	15.0	6.6	-0.6	-24.5	-24.6
19	-28.4	-32.9	Data	-12.6	11.0	15.3	11.5	14.0	1.7	-0.5	-17.4	-30.4
20	-29.9	-28.2	logger	-1.7	10.7	11.6	9.3	11.7	-1.4	-4.2	-31.5	-33.8
21	-33.1	-29.9	failure	-9.4	7.7	11.5	11.6	9.2	6.1	-3.6	-31.5	-37.8
22	-23.0	-21.6		-11.9	10.5	11.5	9.4	6.4	7.7	-2.4	-33.5	-36.8
23	-30.5	-18.3		-11.3	5.7	12.1	10.7	12.0	3.7	-3.0	-33.6	-35.7
24	-34.1	-12.9		-6.6	8.5	12.0	11.6	17.0	5.6	-5.9	-6.0	-11.9
25	-35.8	-13.1		-7.4	9.9	14.0	9.1	13.6	5.7	-1.4	-16.3	-13.7
26	-29.0	-16.2		1.7	11.4	14.3	9.2	15.6	7.3	-3.8	-22.5	-12.0
27	-23.9	-25.5		0.8	8.9	13.1	10.8	14.2	2.4	-6.8	-14.5	-18.1
28	-12.5	-11.8		-1.1	10.4	13.8	13.3	13.6	-1.1	-10.6	-12.6	-37.8
29	-32.9	-11.8		DLF	9.8	12.5	9.5	14.3	6.6	-10.9	-14.4	-37.8
30	-35.0				10.9	15.1	8.2	14.9	4.3	-4.1	-20.0	-37.2
31	-39.5		-13.6		11.9		9.6	12.8		-5.1		-39.9

Daily Mean

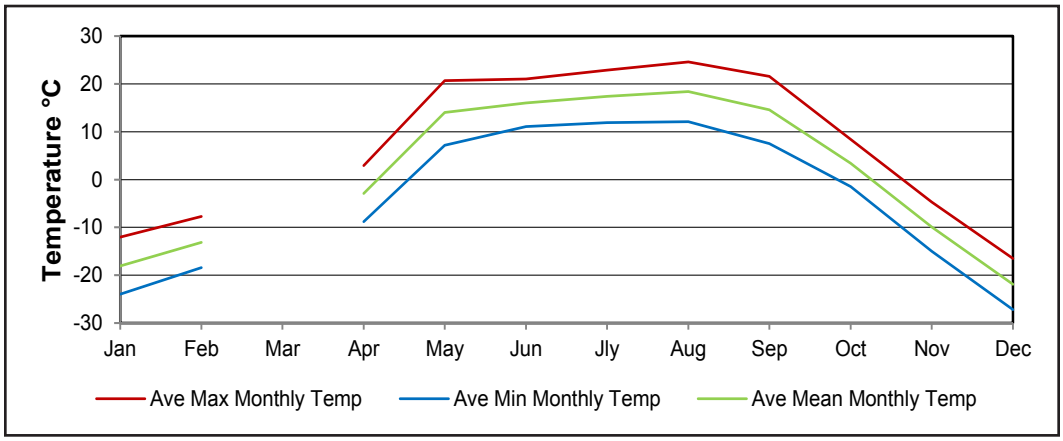
DLF = Datalogger failure

2013	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	-8.9	-21.7	-4.3	-6.3	DLF	15.8	23.8	16.9	16.5	7.4	3.5	-8.1
2	-7.5	-16.0	-6.4	-6.8		14.6	23.9	15.8	20.8	5.8	1.9	-10.8
3	-5.5	-18.2	-6.7	-2.9	9.9	14.2	21.9	15.9	16.2	4.4	1.3	-16.4
4	-11.2	-15.4	-11.4	-6.4	8.6	15.5	22.0	18.0	19.4	4.7	-3.7	-22.2
5	-9.9	-14.1	-13.8	-4.2	13.6	16.6	19.7	19.8	23.2	6.7	-9.0	-24.2
6	-7.8	-19.2	-17.6	-3.5	17.2	15.2	15.4	15.8	17.4	10.1	-10.5	-27.0
7	-7.4	-13.3	-13.9	-8.9	9.7	16.3	17.1	14.5	17.4	12.4	-5.3	-28.2
8	-10.6	-12.0	-18.9	-9.8	5.4	15.2	15.2	13.2	19.8	9.2	-4.3	-26.1
9	-14.6	-11.9	-13.5	-6.2	9.9	14.8	17.5	14.8	20.2	5.8	-5.9	-24.6
10	-13.5	-7.2	-12.0	-9.1	5.7	11.0	20.6	16.5	17.9	8.9	-18.3	-24.7
11	-24.6	-7.0	-11.3	-2.7	5.7	12.7	23.8	17.3	13.9	8.1	-18.3	-27.3
12	-23.8	-2.4	-16.5	-0.7	14.3	15.1	17.8	17.2	15.0	4.6	-4.8	-23.0
13	-23.1	-5.4	-9.1	-3.4	17.8	18.3	14.9	17.8	19.7	4.3	0.0	-25.7
14	-22.7	-11.5	-10.9	-4.6	16.9	14.2	14.4	19.1	13.0	5.4	-3.2	-27.0
15	-4.9	-15.0	-18.5	-1.2	14.0	13.6	17.7	21.1	12.2	6.4	0.2	-11.4
16	-16.3	-4.4	-21.9	-0.5	17.6	13.6	16.5	23.8	18.3	3.9	-7.1	-7.8
17	-18.5	-7.9	-16.9	-3.2	16.8	14.7	18.3	22.4	17.8	3.2	-16.0	-20.3
18	-17.5	-23.4	-19.5	-2.6	16.5	18.6	20.0	21.4	9.2	2.7	-17.0	-20.5
19	-23.0	-25.7	Data	-4.7	17.3	19.1	14.7	19.9	7.5	3.5	-13.6	-26.6
20	-26.9	-22.1	logger	-0.3	16.9	14.5	14.3	16.4	8.8	-1.0	-24.5	-28.3
21	-27.3	-21.5	failure	-4.7	14.9	12.7	14.7	14.8	15.3	-1.9	-24.9	-33.4
22	-19.1	-14.7		-4.8	15.3	15.8	16.0	16.9	13.4	0.4	-26.9	-30.9
23	-26.5	-11.2		0.0	13.3	16.3	17.2	20.7	12.9	-0.6	-19.7	-23.6
24	-27.6	-6.8		-2.1	12.8	18.2	16.8	22.9	13.0	-0.2	-1.6	-9.7
25	-27.5	-7.2		0.8	14.5	17.8	14.5	21.6	8.7	2.1	-8.5	-10.0
26	-20.2	-9.3		5.8	16.1	17.9	14.7	18.8	8.8	1.4	-14.8	-6.3
27	-17.8	-15.8		8.1	15.8	19.1	15.7	18.9	8.3	-2.2	-9.5	-7.7
28	-10.5	-9.1		2.7	17.1	19.8	18.8	20.3	8.3	-6.8	-11.3	-28.0
29	-21.6	-9.1		DLF	17.4	19.2	14.1	21.2	14.6	-4.1	-10.6	-31.8
30	-30.8				16.6	20.9	13.1	21.9	9.8	0.8	-14.4	-31.9
31	-32.7		-6.0		17.4		15.2	15.0		1.5		-34.6

Temperature 2013

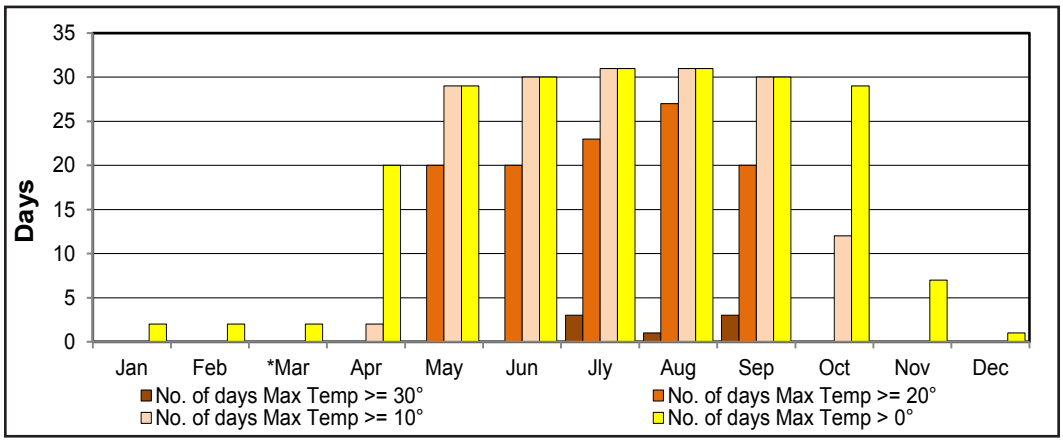
Monthly Comparison

*March Missing Data
April based on 28 days of data
May based on 29 days of data



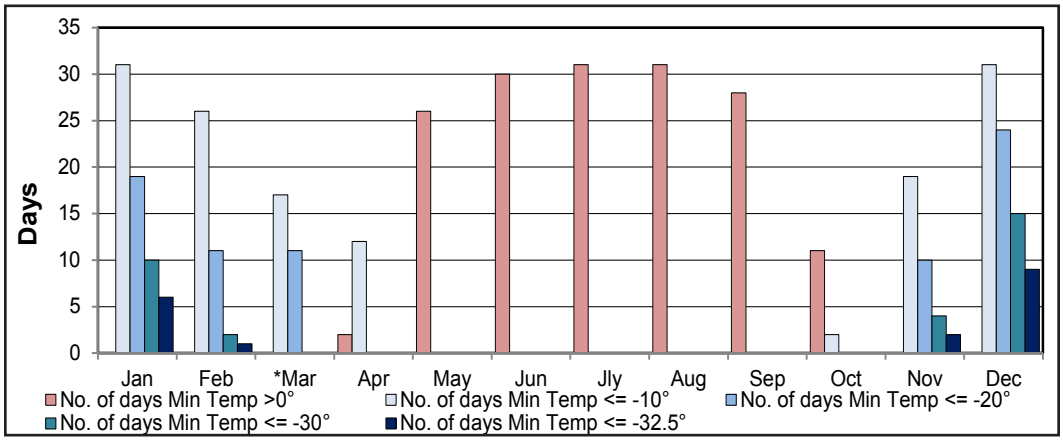
Maximum temperature relative to a set points

*March based on 19 days of data
April based on 28 days of data
May based on 29 days of data



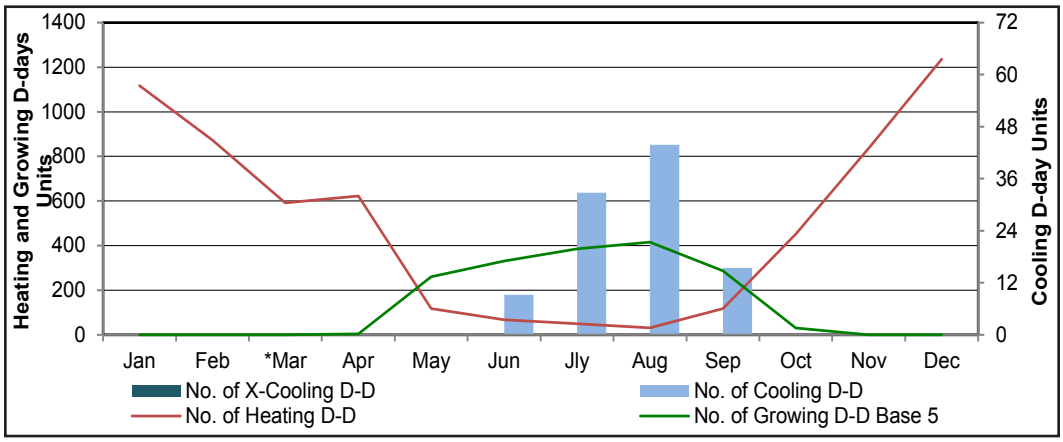
Minimum temperature relative to set points

*March based on 19 days of data
April based on 28 days of data
May based on 29 days of data



Degree-days Monthly

*March based on 19 days of data
April based on 28 days of data
May based on 29 days of data



SRC Publication No. 13000-1E14

Precipitation 2013

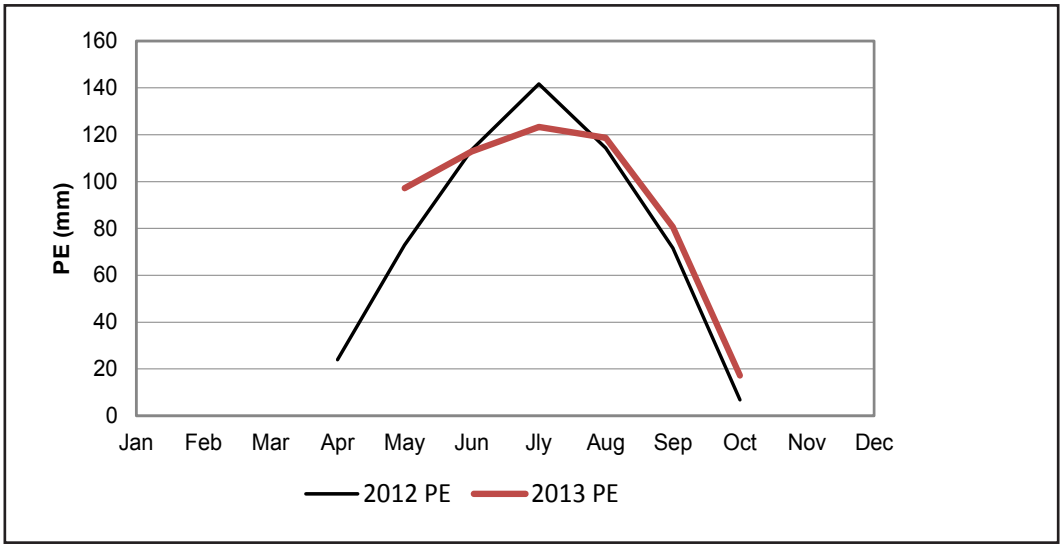
Extreme Precipitation Events*		
Period	Date	Amount
0.5 Hour	July 15	10.8mm
0.5 Hour	July 6	3.8mm
1 Hour	July15	11.6mm
1 Hour	July 24	7.8mm
2 Hours	July 15	11.8mm
2 Hours	July 6	10.2mm
6 Hours	July 6	15.6mm
6 Hours	June 14	15.4mm
12 Hours	July 6	28.6mm
12 Hours	June 8	27.8mm
24 Hours	June 13-14	39.4mm
Daily	July 6	29mm
Daily	June 8	25.4mm
More than one day	June 13-15	51.8mm
Longest wet spell*	November 2-9	8 Days
Longest dry spell	September 9-23	15 Days

* Weighing Gauge Value

Ranking By Driest Month			
Amount (mm)		**% of Possible Days**	
October	5.6	October	12.9
*August	5.8	*May[1]	12.9
*May[1]	6.8	April[1]	13.3
February	8.3	*August	16.2
*September	13.4	*September	23.3
April[1]	14.9	February	28.6
December	15.1	January	32.3
January	26.0	December	45.2
November	34.6	November	46.6
*July	77.2	*July	48.4
*June	124.6	*June	53.3

**Tipping Bucket value*
***March Data missing due to insufficent data;*
[1]April based on 28 days of data; May based on 29 days of data

Potential Evapotranspiration (PE) using the Thornthwaite Method[1]



Month	2012 PE (mm)	2013 PE (mm)
Jan		
Feb		
Mar		
Apr	24.0	
May	73.0	97.1
Jun	113.6	112.9
Jly	141.7	123.3
Aug	114.4	118.7
Sep	71.5	80.6
Oct	6.8	17.2
Nov		
Dec		
Total	545.0	549.9

[1]Thornthwaite and Mather 1955
Thornthwaite 1948

Weighing Gauge and tipping bucket
photo credit: V. Wittrock
July 2012

Precipitation 2013

Month	AMOUNT (mm)		Month end Snow-on-Ground (cm)	Days with Measurable Precipitation	
	Individual 2013	Cumulative 2013		Individual 2013	Cumulative 2013
January	26.0	26.0	56	10	10
February	8.3	34.3	64	8	18
March*	7.7	42.0	76	3	21
April	14.9	56.9	52	4	25
May	6.8	63.7	0	4	29
June	124.6	188.3	0	16	45
July	77.2	265.5	0	15	60
August	5.8	271.3	0	4	64
September	13.4	284.7	0	7	71
October	5.6	290.3	0	4	75
November	34.6	324.9	24	14	89
December	15.1	340.0	40	14	103
Total	340.0			103	

*March values based on 19 days of data; April based on 28 days; May based on 29 days

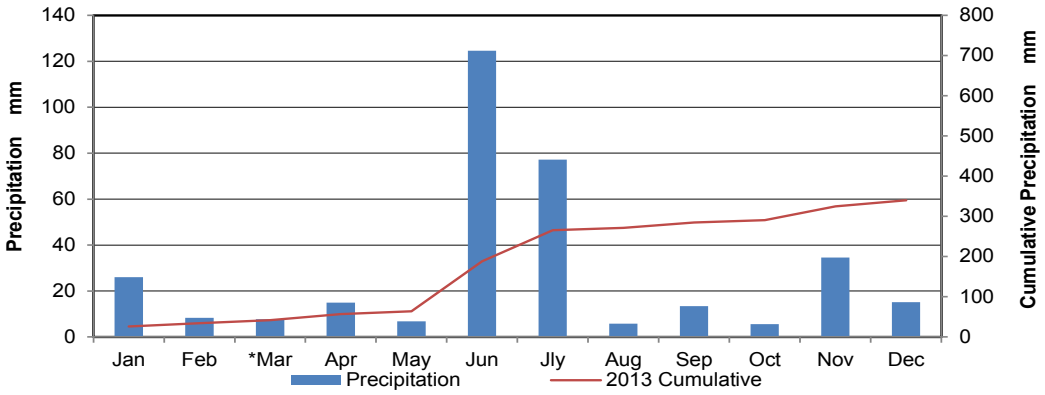
Daily Precipitation Values

DLF = datalogger failure

2013	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	0.6	0.2	0.0	0.4	DLF	0.0	0.0	0.0	0.4	0.0	0.6	0.3
2	0.0	0.5	0.0	0.0		0.0	0.0	0.0	0.0	1.7	0.0	0.0
3	0.0	1.2	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	16.8	0.3
4	0.0	3.6	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.6	0.4
5	0.0	0.0	0.0	5.2	0.0	0.0	0.6	4.2	0.0	0.0	0.4	0.0
6	1.0	0.0	0.0	0.0	0.0	5.2	29.0	0.2	0.0	0.0	0.2	0.2
7	0.2	0.0	3.1	0.0	0.0	0.0	2.2	0.0	0.0	0.0	1.3	0.0
8	0.9	0.0	0.0	0.0	0.0	26.8	0.2	0.0	0.6	0.0	2.0	0.0
9	0.0	0.9	0.0	0.0	0.0	1.6	0.0	0.2	0.2	0.0	1.1	0.0
10	0.0	0.9	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.2	0.6
11	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
13	0.0	0.0	0.0	0.0	0.0	18.8	0.0	0.0	0.0	0.0	0.0	2.7
14	0.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.0	0.0	1.5	0.7
15	0.0	0.0	3.2	0.0	0.0	11.0	12.8	0.0	0.0	0.0	0.0	2.9
16	1.8	0.0	0.0	0.0	3.8	0.8	0.0	0.0	0.0	0.2	0.0	0.0
17	3.9	0.7	1.4	0.0	0.4	0.4	0.0	0.0	0.0	0.0	1.9	0.0
18	1.6	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	Data logger failure	0.0	0.0	5.8	0.0	0.0	0.0	0.9	6.6	0.0
20	0.0	0.0		3.2	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0		0.0	0.0	9.4	10.2	0.0	0.0	2.8	0.0	0.0
22	0.0	0.0		0.0	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.2
23	0.0	0.0		0.0	0.0	0.2	2.2	0.0	0.0	0.0	0.2	0.0
24	8.8	0.0		0.0	2.4	0.0	10.0	0.2	0.0	0.0	0.0	0.6
25	0.0	0.0		0.0	0.0	4.4	0.4	0.0	0.8	0.0	0.0	4.3
26	0.0	0.0		0.0	0.0	9.2	0.2	0.0	6.2	0.0	0.0	0.0
27	6.7	0.0		0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
28	0.0	0.3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0
29	0.0	0.0		DLF	0.0	0.0	0.6	0.0	2.4	0.0	0.0	0.0
30	0.5				0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0
31	0.0		0.0		0.0		0.0	1.0		0.0		0.0
Total	26.0	8.3	7.7	14.9	6.8	124.6	77.2	5.8	13.4	5.6	34.6	15.1

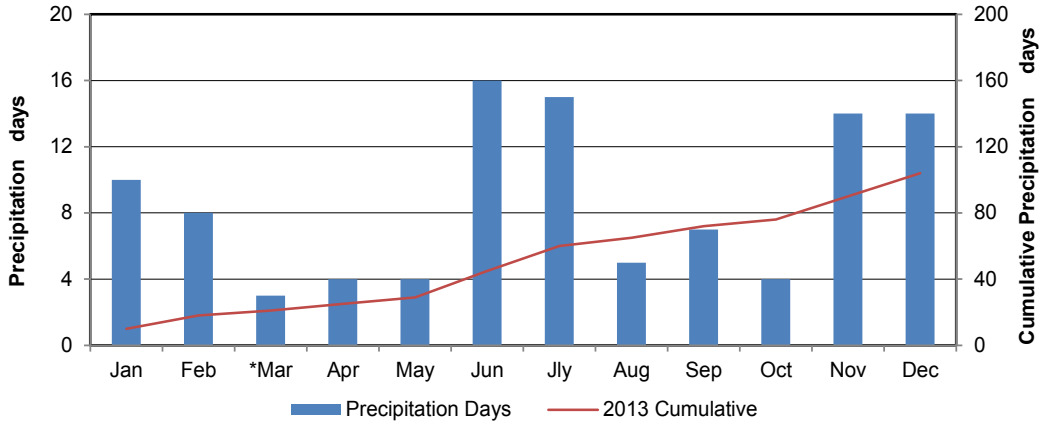
St. Louis bridge across S. Sask River south of CLC site photo credit: CR Beaulieu October 2011

Precipitation 2013



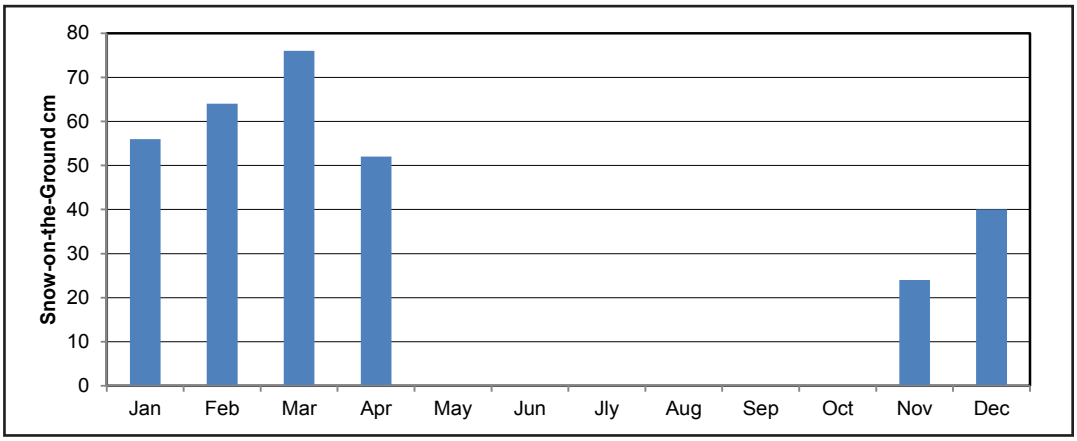
Monthly

*March based on 19 days of data
April based on 28 days of data
May based on 29 days of data



Monthly Days

*March based on 19 days of data
April based on 28 days of data
May based on 29 days of data



End of the Month Snow-on-the-Ground

Radiation 2013

Sunrise & Sunset Tables for Conservation Learning Center, 2013 & 2014[1]

2013	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	9:17	16:57	8:46	17:48	7:49	18:42	6:36	19:39	5:29	20:33	4:42	21:21	4:41	21:33	5:20	20:57	6:13	19:51	7:05	18:39	8:02	17:31	8:55	16:49
2	9:17	16:58	8:45	17:50	7:47	18:44	6:33	19:41	5:27	20:35	4:41	21:22	4:41	21:33	5:22	20:55	6:15	19:49	7:07	18:37	8:04	17:29	8:57	16:48
3	9:17	16:59	8:43	17:52	7:45	18:46	6:31	19:43	5:25	20:36	4:41	21:23	4:42	21:32	5:24	20:54	6:17	19:47	7:09	18:34	8:06	17:27	8:58	16:48
4	9:17	17:00	8:41	17:54	7:43	18:48	6:29	19:44	5:23	20:38	4:40	21:24	4:43	21:32	5:25	20:52	6:18	19:44	7:10	18:32	8:08	17:25	8:59	16:47
5	9:16	17:01	8:39	17:55	7:40	18:50	6:26	19:46	5:21	20:40	4:39	21:25	4:44	21:31	5:27	20:50	6:20	19:42	7:12	18:30	8:10	17:23	9:01	16:47
6	9:16	17:03	8:38	17:57	7:38	18:51	6:24	19:48	5:19	20:42	4:39	21:26	4:45	21:30	5:29	20:48	6:22	19:40	7:14	18:27	8:12	17:21	9:02	16:46
7	9:15	17:04	8:36	17:59	7:36	18:53	6:22	19:50	5:17	20:43	4:38	21:27	4:46	21:30	5:30	20:46	6:24	19:37	7:16	18:25	8:13	17:20	9:03	16:46
8	9:15	17:06	8:34	18:01	7:33	18:55	6:19	19:52	5:15	20:45	4:37	21:28	4:47	21:29	5:32	20:44	6:25	19:35	7:18	18:23	8:15	17:18	9:04	16:46
9	9:14	17:07	8:32	18:03	7:31	18:57	6:17	19:53	5:14	20:47	4:37	21:28	4:48	21:28	5:34	20:42	6:27	19:32	7:19	18:20	8:17	17:16	9:06	16:45
10	9:13	17:08	8:30	18:05	7:29	18:59	6:15	19:55	5:12	20:48	4:37	21:29	4:49	21:27	5:35	20:40	6:29	19:30	7:21	18:18	8:19	17:15	9:07	16:45
11	9:13	17:10	8:28	18:07	7:26	19:01	6:12	19:57	5:10	20:50	4:36	21:30	4:50	21:26	5:37	20:38	6:30	19:28	7:23	18:16	8:21	17:13	9:08	16:45
12	9:12	17:12	8:26	18:09	7:24	19:03	6:10	19:59	5:08	20:52	4:36	21:31	4:51	21:25	5:39	20:36	6:32	19:25	7:25	18:13	8:23	17:11	9:09	16:45
13	9:11	17:13	8:24	18:11	7:21	19:04	6:08	20:01	5:07	20:53	4:36	21:31	4:53	21:24	5:41	20:34	6:34	19:23	7:27	18:11	8:25	17:10	9:10	16:45
14	9:10	17:15	8:22	18:13	7:19	19:06	6:05	20:02	5:05	20:55	4:36	21:32	4:54	21:23	5:42	20:32	6:36	19:20	7:28	18:09	8:26	17:08	9:11	16:45
15	9:09	17:16	8:20	18:15	7:17	19:08	6:03	20:04	5:03	20:57	4:35	21:32	4:55	21:22	5:44	20:30	6:37	19:18	7:30	18:06	8:28	17:07	9:12	16:45
16	9:08	17:18	8:18	18:17	7:14	19:10	6:01	20:06	5:02	20:58	4:35	21:33	4:57	21:21	5:46	20:28	6:39	19:15	7:32	18:04	8:30	17:05	9:12	16:45
17	9:07	17:20	8:16	18:19	7:12	19:12	5:59	20:08	5:00	21:00	4:35	21:33	4:58	21:20	5:47	20:26	6:41	19:13	7:34	18:02	8:32	17:04	9:13	16:46
18	9:06	17:22	8:14	18:21	7:09	19:14	5:56	20:10	4:59	21:01	4:35	21:33	4:59	21:19	5:49	20:23	6:42	19:11	7:36	18:00	8:34	17:03	9:14	16:46
19	9:05	17:23	8:12	18:23	7:07	19:15	5:54	20:11	4:57	21:03	4:35	21:34	5:01	21:17	5:51	20:21	6:44	19:08	7:38	17:58	8:36	17:01	9:15	16:46
20	9:04	17:25	8:10	18:25	7:05	19:17	5:52	20:13	4:56	21:04	4:36	21:34	5:02	21:16	5:53	20:19	6:46	19:06	7:40	17:55	8:37	17:00	9:15	16:47
21	9:03	17:27	8:07	18:27	7:02	19:19	5:50	20:15	4:55	21:06	4:36	21:34	5:03	21:15	5:54	20:17	6:48	19:03	7:41	17:53	8:39	16:59	9:16	16:47
22	9:01	17:29	8:05	18:29	7:00	19:21	5:47	20:17	4:53	21:07	4:36	21:34	5:05	21:13	5:56	20:15	6:49	19:01	7:43	17:51	8:41	16:58	9:16	16:48
23	9:00	17:31	8:03	18:31	6:57	19:23	5:45	20:19	4:52	21:09	4:36	21:34	5:06	21:12	5:58	20:12	6:51	18:58	7:45	17:49	8:42	16:56	9:17	16:48
24	8:59	17:32	8:01	18:33	6:55	19:25	5:43	20:20	4:51	21:10	4:37	21:34	5:08	21:10	5:59	20:10	6:53	18:56	7:47	17:47	8:44	16:55	9:17	16:49
25	8:57	17:34	7:59	18:34	6:53	19:26	5:41	20:22	4:49	21:12	4:37	21:34	5:09	21:09	6:01	20:08	6:55	18:54	7:49	17:45	8:46	16:54	9:17	16:50
26	8:56	17:36	7:56	18:36	6:50	19:28	5:39	20:24	4:48	21:13	4:38	21:34	5:11	21:07	6:03	20:05	6:56	18:51	7:51	17:43	8:47	16:53	9:17	16:50
27	8:54	17:38	7:54	18:38	6:48	19:30	5:37	20:26	4:47	21:14	4:38	21:34	5:12	21:06	6:05	20:03	6:58	18:49	7:53	17:41	8:49	16:52	9:18	16:51
28	8:53	17:40	7:52	18:40	6:45	19:32	5:35	20:28	4:46	21:16	4:39	21:34	5:14	21:04	6:06	20:01	7:00	18:46	7:55	17:39	8:51	16:51	9:18	16:52
29	8:51	17:42			6:43	19:34	5:33	20:29	4:45	21:17	4:39	21:34	5:16	21:02	6:08	19:59	7:02	18:44	7:56	17:37	8:52	16:51	9:18	16:53
30	8:50	17:44			6:41	19:35	5:31	20:31	4:44	21:18	4:40	21:33	5:17	21:01	6:10	19:56	7:03	18:42	7:58	17:35	8:54	16:50	9:18	16:54
31	8:48	17:46			6:38	19:37			4:43	21:19			5:19	20:59	6:12	19:54			8:00	17:33			9:18	16:55

2014	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	9:18	16:56	8:47	17:47	7:50	18:42	6:36	19:39	5:29	20:32	4:42	21:20	4:41	21:33	5:20	20:58	6:13	19:52	7:05	18:40	8:02	17:31	8:55	16:49
2	9:17	16:57	8:45	17:49	7:48	18:44	6:34	19:40	5:27	20:34	4:42	21:21	4:41	21:33	5:22	20:56	6:15	19:50	7:06	18:37	8:04	17:29	8:56	16:49
3	9:17	16:59	8:43	17:51	7:45	18:45	6:32	19:42	5:25	20:36	4:41	21:22	4:42	21:32	5:23	20:54	6:16	19:47	7:08	18:35	8:05	17:27	8:58	16:48
4	9:17	17:00	8:42	17:53	7:43	18:47	6:29	19:44	5:23	20:38	4:40	21:24	4:43	21:32	5:25	20:52	6:18	19:45	7:10	18:33	8:07	17:25	8:59	16:47
5	9:16	17:01	8:40	17:55	7:41	18:49	6:27	19:46	5:21	20:39	4:39	21:25	4:44	21:31	5:27	20:50	6:20	19:43	7:12	18:30	8:09	17:24	9:00	16:47
6	9:16	17:02	8:38	17:57	7:39	18:51	6:24	19:48	5:19	20:41	4:39	21:26	4:45	21:31	5:28	20:48	6:21	19:40	7:14	18:28	8:11	17:22	9:02	16:47
7	9:15	17:04	8:36	17:59	7:36	18:53	6:22	19:49	5:18	20:43	4:38	21:26	4:46	21:30	5:30	20:47	6:23	19:38	7:15	18:25	8:13	17:20	9:03	16:46
8	9:15	17:05	8:34	18:01	7:34	18:55	6:20	19:51	5:16	20:45	4:38	21:27	4:47	21:29	5:32	20:45	6:25	19:35	7:17	18:23	8:15	17:18	9:04	16:46
9	9:14	17:07	8:32	18:03	7:31	18:57	6:17	19:53	5:14	20:46	4:37	21:28	4:48	21:28	5:33	20:43	6:27	19:33	7:19	18:21	8:17	17:17	9:05	16:46
10	9:14	17:08	8:31	18:05	7:29	18:58	6:15	19:55	5:12	20:48	4:37	21:29	4:49	21:27	5:35	20:41	6:28	19:31	7:21	18:18	8:19	17:15	9:07	16:45
11	9:13	17:10	8:29	18:07	7:27	19:00	6:13	19:57	5:10	20:50	4:36	21:30	4:50	21:27	5:37	20:39	6:30	19:28	7:23	18:16	8:20	17:13	9:08	16:45
12	9:12	17:11	8:27	18:09	7:24	19:02	6:10	19:58	5:09	20:51	4:36	21:30	4:51	21:26	5:38	20:37	6:32	19:26	7:24	18:14	8:22	17:12	9:09	16:45
13	9:11	17:13	8:25	18:11	7:22	19:04	6:08	20:00	5:07	20:53	4:36	21:31	4:52	21:25	5:40	20:34	6:33	19:23	7:26	18:12	8:24	17:10	9:10	16:45
14	9:10	17:14	8:23	18:13	7:20	19:06	6:06	20:02	5:05	20:55	4:36	21:32	4:54	21:24	5:42	20:32	6:35	19:21	7:28	18:09	8:26	17:09	9:11	16:45
15	9:10	17:16	8:21	18:15	7:17	19:08	6:04	20:04	5:04	20:56	4:35	21:32	4:55	21:22	5:44	20:30	6:37	19:18	7:30	18:07	8:28	17:07	9:11	16:45
16	9:09	17:18	8:18	18:17	7:15	19:10	6:01	20:06	5:02	20:58	4:35	21:33	4:56	21:21	5:45	20:28	6:39	19:16	7:32	18:05	8:30	17:06	9:12	16:45
17	9:08	17:19	8:16	18:19	7:12	19:11	5:59	20:07	5:01	20:59	4:35	21:33	4:58	21:20	5:47	20:26	6:40	19:14	7:34	18:03	8:32	17:04	9:13	16:46
18	9:06	17:21	8:14	18:20	7:10	19:13	5:57	20:09	4:59	21:01	4:35	21:33	4:59	21:19	5:49	20:24	6:42	19:11	7:35	18:00	8:33	17:03	9:14	16:46
19	9:05	17:23	8:12	18:22	7:08	19:15	5:55	20:11	4:58	21:03	4:35	21:34	5:00	21:18	5:50	20:22	6:44	19:09	7:37	17:58	8:35	17:02	9:14	16:46
20	9:04	17:25	8:10	18:24	7:05	19:17	5:52	20:13	4:56	21:04	4:36	21:34	5:02	21:16	5:52	20:19	6:46	19:06	7:39	17:56	8:37	17:00	9:15	16:47
21	9:03	17:26	8:08	18:26	7:03	19:19	5:50	20:15	4:55	21:06	4:36	21:34	5:03	21:15	5:54	20:17	6:47	19:04	7:41	17:54	8:39	16:59	9:16	16:47
22	9:02	17:28	8:06	18:28	7:00	19:20	5:48	20:16	4:53	21:07	4:36	21:34	5:05	21:14	5:56	20:15	6:49	19:01	7:43	17:52	8:40	16:58	9:16	16:48
23	9:00	17:30	8:04	18:30	6:58	19:22	5:46	20:18	4:52	21:09	4:36	21:34	5:06	21:12	5:57	20:13	6:51	18:59	7:45	17:49	8:42	16:57	9:16	16:48
24	8:59	17:32	8:01	18:32	6:56	19:24	5:44	20:20	4:51	21:10	4:37	21:34	5:08	21:11	5:59	20:11	6:52	18:57	7:47	17:47	8:44	16:56	9:17	16:49
25	8:58	17:34	7:59	18:34	6:53	19:26	5:42	20:22	4:50	21:11	4:37	21:34	5:09	21:09	6:01	20:08	6:54	18:54	7:48	17:45	8:45	16:55	9:17	16:50
26	8:56	17:36	7:57	18:36	6:51	19:28	5:39	20:24	4:49	21:13	4:37	21:34	5:11	21:08	6:03	20:06	6:56	18:52	7:50	17:43	8:47	16:54	9:17	16:50
27	8:55	17:38	7:55	18:38	6:48	19:30	5:37	20:25	4:47	21:14	4:38	21:34	5:12	21:06	6:04	20:04	6:58	18:49	7:52	17:41	8:49	16:53	9:18	16:51
28	8:53	17:40	7:52	18:40	6:46	19:31	5:35	20:27	4:46	21:15	4:39	21:34	5:14	21:04	6:06	20:01	6:59	18:47	7:54	17:39	8:50	16:52	9:18	16:52
29	8:52	17:41			6:44	19:33	5:33	20:29	4:45	21:17	4:39	21:34	5:15	21:03	6:08	19:59	7:01	18:45	7:56	17:37	8:52	16:51	9:18	16:53
30	8:50	17:43			6:41	19:35	5:31	20:31	4:44	21:18	4:40	21:33	5:17	21:01	6:09	19:57	7:03	18:42	7:58	17:35	8:53	16:50	9:18	16:54
31	8:48	17:45			6:39	19:37			4:43	21:19			5:18	20:59	6:11	19:54			8:00	17:33			9:18	16:55

[1] National Research Council, Canada, Hertzberg Institute of Astrophysics

Radiation 2013

	Bright Sunshine Hours			Bright Sunshine Days			
Month	**2013 # of Hours**	**Possible hours***	**% of Possible hrs**	**2013 # of Days**	**With 1 or > hours**	**With 5 or > hours**	**With 10 or > hours**
Jan	Instrument failure	254.6	Instrument failure				
Feb		277.0					
Mar		369.8					
[1]Apr	243.4	421.4	57.8	24.0	23.0	23.0	14.0
[2]May	339.1	492.9	68.8	30.0	30.0	27.0	22.0
Jun	230.5	506.5	45.5	28.0	24.0	20.0	12.0
Jly	334	507.2	65.9	30.0	30.0	28.0	17.0
Aug	333	455.2	73.1	31.0	30.0	29.0	21.0
Sep	281.9	379.2	74.3	28.0	27.0	26.0	18.0
Oct	146.7	326.8	44.9	27.0	25.0	16.0	4.0
Nov	Instrument failure	259.4	Instrument failure				
Dec		236.4					
Total	1908.6	4486.5	42.5	198.0	189.0	169.0	108.0

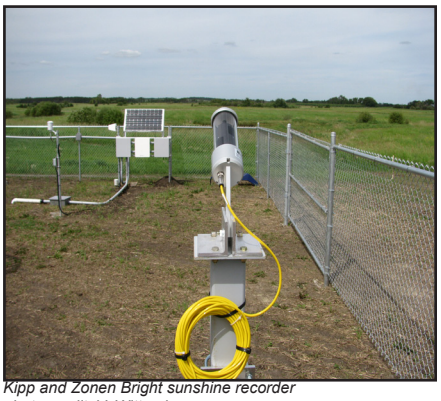
* National Research Council, Canada, Hertzberg Institute of Astrophysics
[1]Missing 2 days of data
[2]Missing one day of data

Global and Diffuse Radiation (MJ/m²)

2013	January		February		March		April		May		June		July		August		September		October		November		December	
Date	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse	Global	Diffuse
1	1.3	1.2	4.6	4.1	10.1	7.3	17.4	8.5	DLF		25.4	11.9	28.9	3.7	30.2	3.4	22.0	4.5	4.3	3.8	5.8	1.5	2.1	1.9
2	2.8	2.0	6.0	3.6	13.9	2.4	17.5	11.6	11.7	8.3	29.3	5.1	27.9	5.1	27.0	6.8	21.3	5.4	5.3	4.7	6.8	2.3	2.7	2.6
3	3.9	1.4	4.5	4.2	6.5	6.0	20.0	9.1	19.9	6.6	30.1	4.5	20.7	6.9	24.5	6.4	21.8	6.3	11.2	4.2	0.7	0.7	3.1	2.3
4	2.4	2.3	4.8	4.5	11.9	7.8	21.6	4.8	26.3	4.1	30.4	3.8	26.8	6.0	25.6	4.7	19.9	7.7	9.3	3.7	3.7	3.6	3.2	2.4
5	3.0	1.9	5.7	4.1	14.2	3.0	12.4	10.9	25.7	6.4	29.8	4.3	15.3	9.1	18.5	9.1	19.7	7.6	10.3	4.5	4.1	3.9	5.5	1.3
6	2.7	2.5	5.1	4.7	14.9	3.4	10.3	9.2	26.6	3.7	19.2	7.6	3.8	3.3	23.3	7.7	12.1	8.7	12.1	1.4	4.7	3.2	2.8	2.6
7	2.3	2.2	4.9	4.5	9.0	8.1	20.7	7.1	25.0	8.0	22.0	8.9	20.5	8.2	21.0	9.0	17.4	10.1	8.4	5.6	6.4	1.9	4.6	2.0
8	2.7	2.6	4.9	4.4	13.1	5.2	21.6	6.5	26.9	5.7	6.5	5.4	25.9	8.9	21.2	8.0	18.3	9.1	8.6	2.8	1.7	1.6	4.6	1.2
9	2.0	1.9	5.0	4.4	16.0	3.3	23.3	3.4	24.2	7.8	14.8	10.9	27.0	7.7	12.0	9.8	15.4	9.0	9.6	2.8	3.4	3.0	3.7	1.3
10	2.2	2.1	4.8	4.3	13.9	7.5	20.9	12.0	23.7	7.3	13.3	9.3	30.0	4.2	24.4	4.0	17.3	10.7	6.9	4.4	6.8	1.2	4.6	1.1
11	3.4	3.0	7.7	6.8	12.0	7.7	12.1	10.8	28.2	4.2	16.0	10.9	30.8	4.9	25.0	4.1	20.8	13.1	10.4	2.4	6.9	2.1	3.3	1.9
12	5.1	2.5	8.6	6.9	16.9	3.9	14.8	13.1	18.9	13.2	21.5	8.9	29.7	4.6	25.5	4.7	19.3	4.2	8.4	4.5	6.0	1.5	1.8	1.7
13	5.6	2.6	5.3	4.8	13.9	5.2	19.9	14.1	27.1	3.8	5.6	4.5	11.8	8.1	22.1	7.5	18.9	1.8	5.6	4.7	4.4	3.3	1.9	1.8
14	3.1	2.6	7.3	5.7	12.6	6.5	24.1	5.8	26.6	5.3	5.1	4.4	28.9	3.7	23.3	5.6	19.6	1.9	9.9	4.9	3.5	2.9	2.1	2.0
15	2.5	2.4	5.9	5.1	10.8	9.1	22.5	11.1	24.7	5.3	9.4	8.1	21.8	6.9	23.5	4.5	18.9	1.8	9.8	5.7	3.3	2.8	2.7	1.8
16	2.8	2.6	7.9	4.8	17.2	5.4	23.4	6.4	16.2	7.4	9.1	7.9	30.3	4.7	24.0	5.1	17.3	2.4	5.5	4.8	3.7	3.5	3.1	1.3
17	2.8	2.6	5.3	4.9	12.0	10.0	25.4	4.9	27.5	4.5	19.9	11.3	30.2	4.8	25.7	3.0	17.6	2.0	5.6	4.7	3.2	3.0	2.0	1.9
18	2.7	2.5	10.4	6.3	15.5	7.5	19.2	14.2	25.8	5.7	26.6	7.6	19.8	6.5	19.4	7.7	5.0	4.5	5.3	4.2	2.5	2.3	3.5	0.9
19	4.5	1.3	9.5	5.7	Data logger failure		25.9	6.1	26.4	7.0	19.2	13.1	13.6	9.1	22.4	4.5	15.7	3.4	3.2	3.0	2.2	2.2	3.8	1.3
20	5.0	1.5	9.8	7.3			8.9	7.8	25.8	7.5	6.4	5.3	21.8	10.8	18.2	7.2	17.4	1.5	4.5	4.2	6.0	1.7	3.9	1.0
21	5.0	2.5	11.5	4.3			23.2	10.4	24.7	9.4	8.2	7.1	8.9	7.0	18.0	6.5	15.7	3.3	1.3	1.1	3.8	2.3	3.4	1.9
22	5.1	1.4	10.5	4.5			25.6	6.2	26.5	7.7	17.1	9.2	21.5	7.0	24.3	3.0	7.3	5.1	3.0	2.6	7.2	1.3	5.3	1.0
23	4.2	3.2	10.8	4.1			23.6	9.6	28.5	4.6	16.6	11.7	19.1	7.6	21.0	5.4	13.5	5.3	3.3	3.1	3.4	2.6	1.9	1.8
24	3.2	2.9	9.6	3.9			25.4	8.1	11.6	8.7	29.2	5.8	18.8	8.7	21.0	5.9	16.1	1.5	7	2.6	4.5	1.0	2.4	2.1
25	4.9	2.7	8.4	5.4			22.9	10.0	14.1	10.0	10.3	7.8	25.7	7.0	21.8	5.6	2.1	1.9	7.6	2.5	3.6	2.1	2.4	2.2
26	6.0	1.3	11.1	8.8			18.9	13.3	13.5	10.1	13.3	7.8	25.1	6.4	11.3	8.7	1.6	1.4	4.1	3.3	3.7	2.9	3.4	2.0
27	2.8	2.6	12.7	5.5			22.3	7.8	21.5	11.1	29.3	3.9	27.6	6.0	19.1	9.3	11.6	5.0	4.8	3.5	2.0	1.9	1.6	1.5
28	2.9	2.6	7.3	6.7			25.9	5.4	28.7	12.5	29.0	5.1	25.2	6.6	21.7	7.4	15.0	1.5	6.9	2.6	2.7	2.5	2.4	2.1
29	7.1	2.2					DLF		22.0	13.9	27.3	6.4	16.2	9.3	19.0	9.8	12.8	4.1	7.3	1.6	2.1	2.0	3.3	1.9
30	5.1	3.6							28.1	7.2	23.9	10.5	25.9	7.3	17.3	6.0	10.8	3.4	5.5	3.3	3.0	2.1	4.7	1.2
31	12.0	6.7			35.6	6.8			53.8	14.9			42.5	16.6	22.8	10.9			10.8	5.8			7.9	3.5
Total	121.1	75.4	209.9	144.3	270	116.1	569.7	248.2	730.2	231.9	563.8	229	722	216.7	674.1	201.3	462.2	148.2	215.8	113	121.8	68.9	103.7	55.5

DLF- Data logger failure

Diffuse radiation sensor
photo credit: M. Taylor
3 April 2013

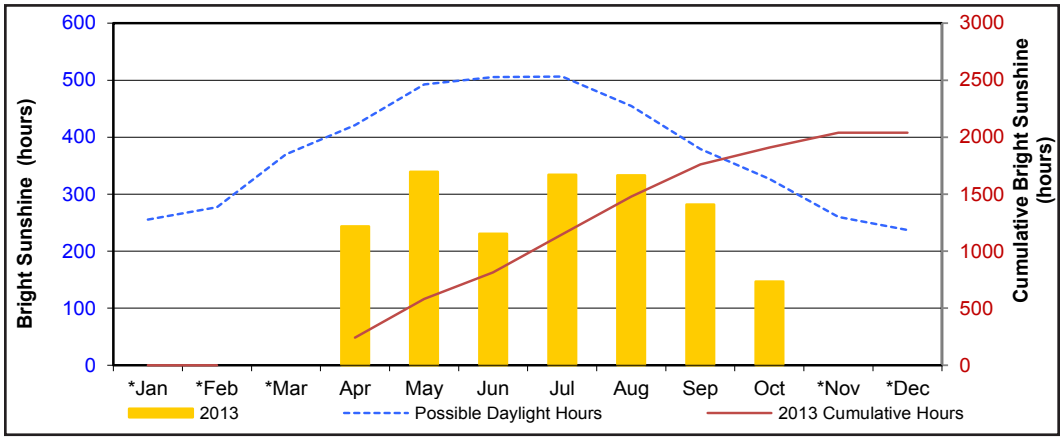


Kipp and Zonen Bright sunshine recorder
photo credit: V. Wittrock
July 2012

Radiation 2013

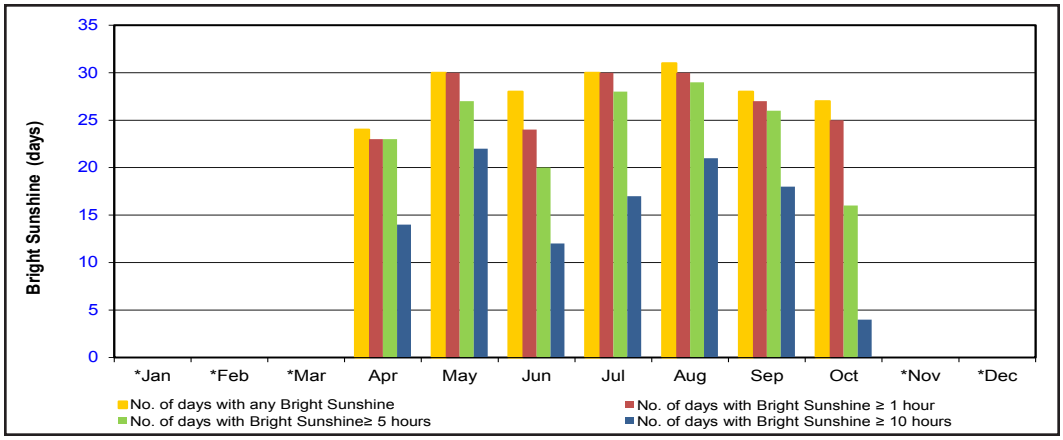
Bright Sunshine Hours

*Jan-Mar, Nov-Dec Missing Data



Bright Sunshine Days

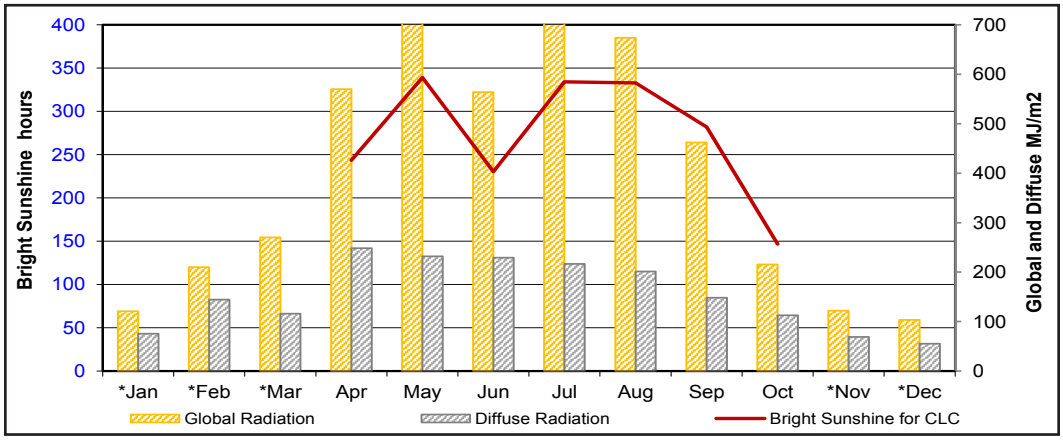
*Jan-Mar, Nov-Dec Missing Data



Monthly Comparison Bright Sunshine Hours, Global & Diffuse Radiation

*Bright sunshine Instrument error
Jan-Mar, Nov-Dec Missing Data

Data logger failure Mar 19-30; April 29-May2



Wind 2013

	Average	Highest instantaneous Wind Speed		
	(km/h)	Speed (km/h)	Direction	Day
January	12.3	32.4	NNW	15
February	11.0	30.0	WNW	2
March*	DLF	31.8	NNW	11
April*	12.1	57.9	WNW	21
May*	12.6	52.5	N	9
June	12.0	40.9	E	20
July	10.6	35.4	WNW	11
August	8.5	31.1	WSW	30
September	11.1	36.4	SSW	29
October	11.6	38.0	WNW	25
November	12.5	47.7	NNW	25
December	11.9	61.5	WNW	16

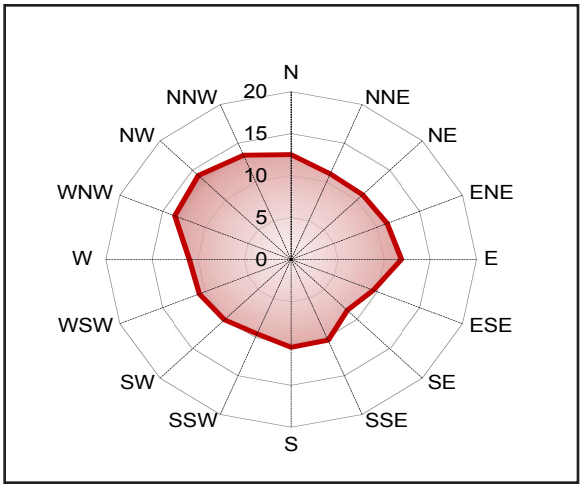
* Data incomplete for March 19-30, April 29- May 2
DLF= Data logger failure

Extreme Daily Winds (km/h)		
Date	Wind Speed/ Direction	Beaufort Designation*
April 21	57.9 WNW	Near Gale
May 9	52.5 N	Near Gale
Dec 16	61.5 WNW	Gale

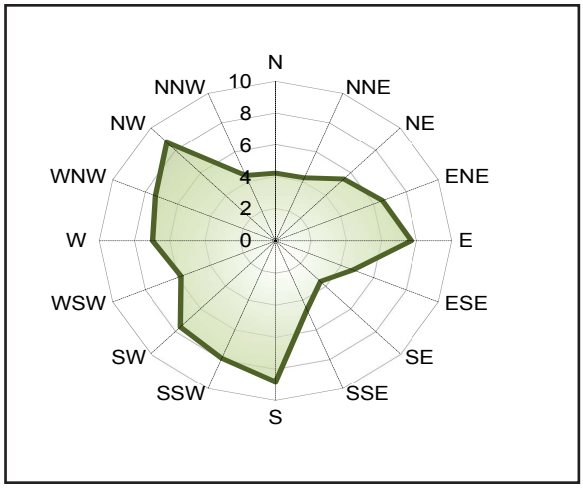
Beaufort Wind Scale*	
High wind,Near Gale	50-61 km/h
Gale	62-74 km/h
Strong Gale	75-88 km/h
Storm, Whole Gale	89-102 km/h
Violent Storm	103-117 km/h
Hurricane Force	> 118 km/h

*Environment Canada, Meteorological Service of Canada, 2014. Beaufort Wind Scale Table.

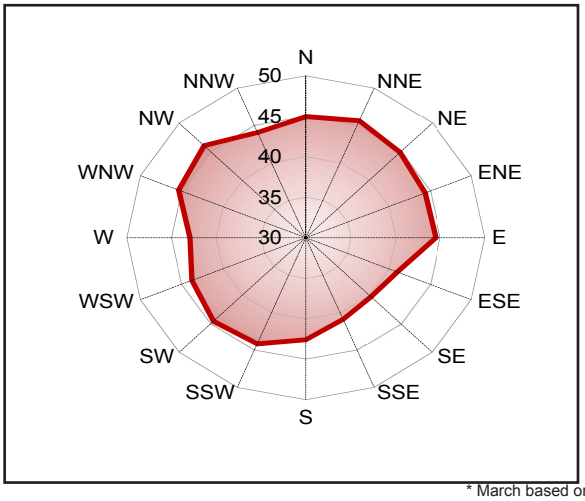
Annual Average Wind Speed (km/h)*



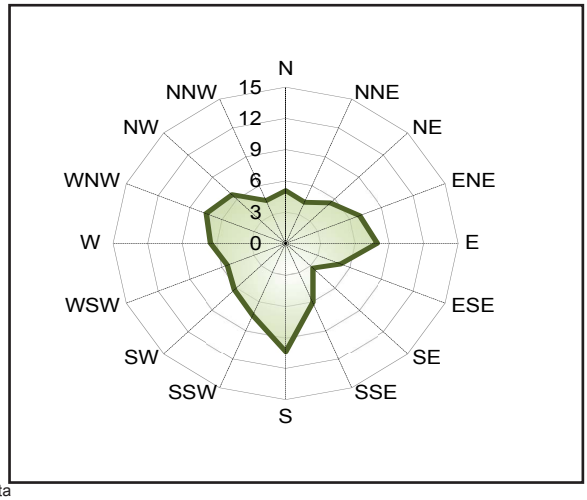
Annual Average Wind Frequency %*



Annual Average Maximum Wind Gusts Speed km/h*



Annual Average Maximum Wind Gusts Frequency %*

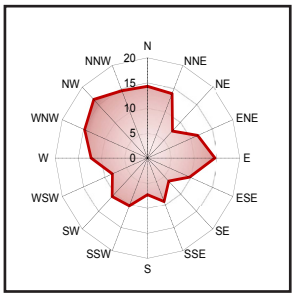


* March based on 19 days of data
*Excludes maximum ½ hour winds < 31 km/h

Wind 2013

Average Wind Speed by Direction (km/h)

JANUARY



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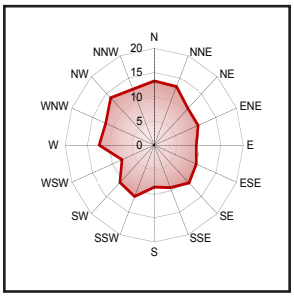
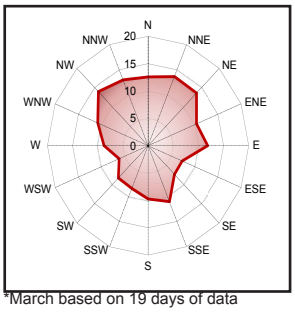
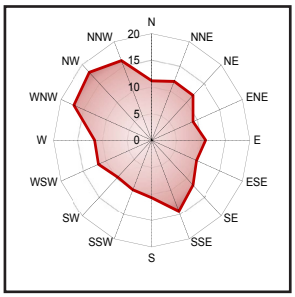


*MARCH



*March based on 19 days of data

APRIL



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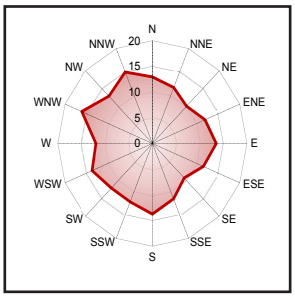
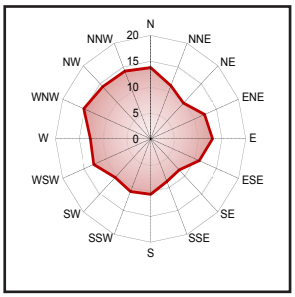


JUNE



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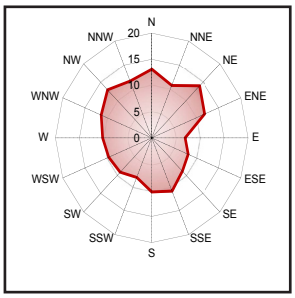
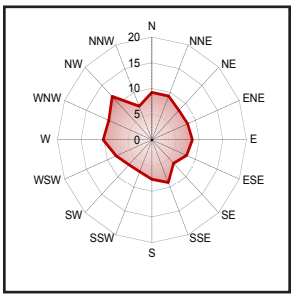


AUGUST



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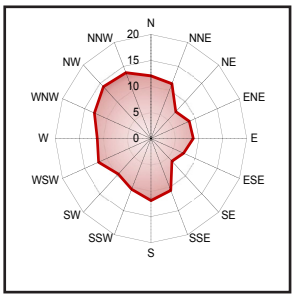

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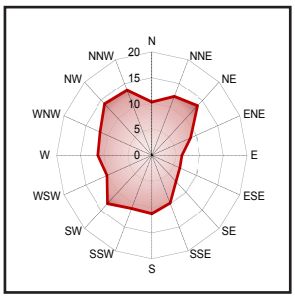
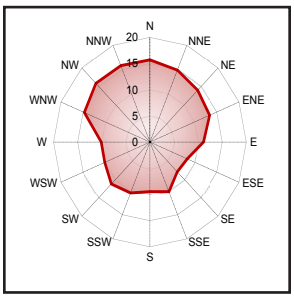


NOVEMBER



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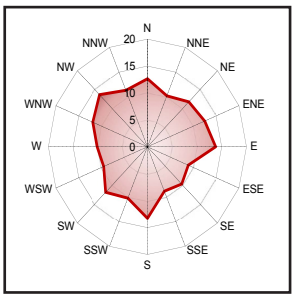
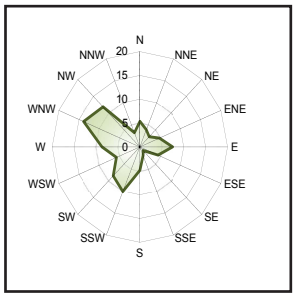


SRC Publication No. 13000-1E14

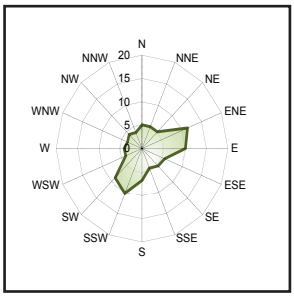
Wind 2013

Average Wind Frequency by Direction (%)

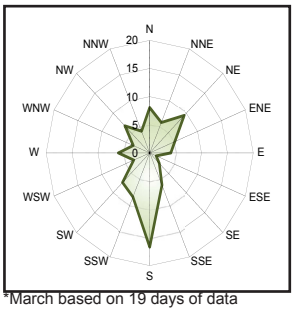
JANUARY



FEBUARY

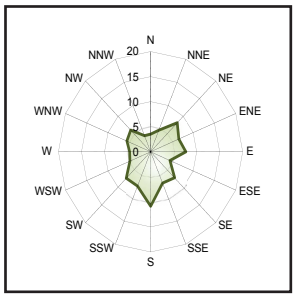


***MARCH**



*March based on 19 days of data

APRIL



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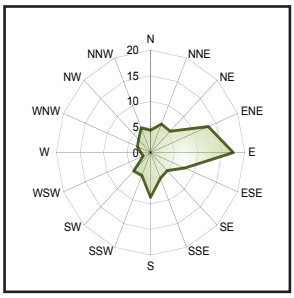

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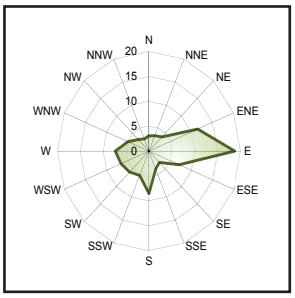
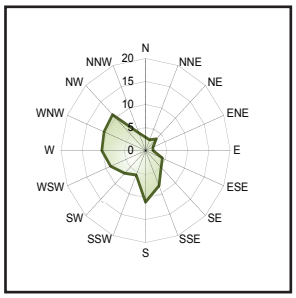
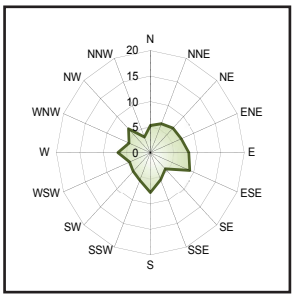


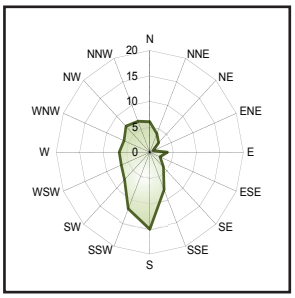
JULY



AUGUST



SEPTEMBER



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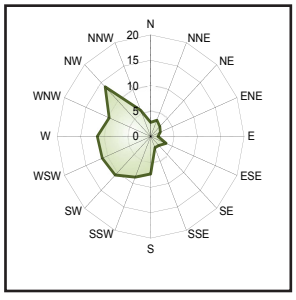

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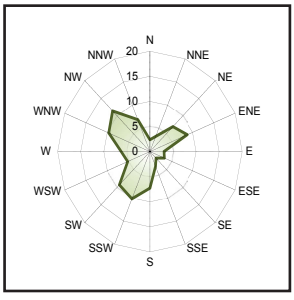

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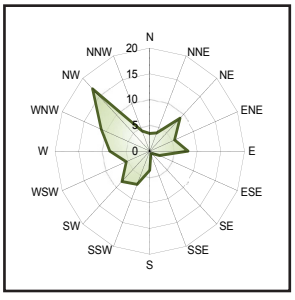


Wind 2013

Windchill Calculation Chart[1]												
	5°	0°	-5°	-10°	-15°	-20°	-25°	-30°	-35°	-40°	-45°	-50°
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-31	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-45	-51	-57	-64	-70
30	0	-7	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-70	-76
55	-2	-9	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-37	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-59	-66	-73	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

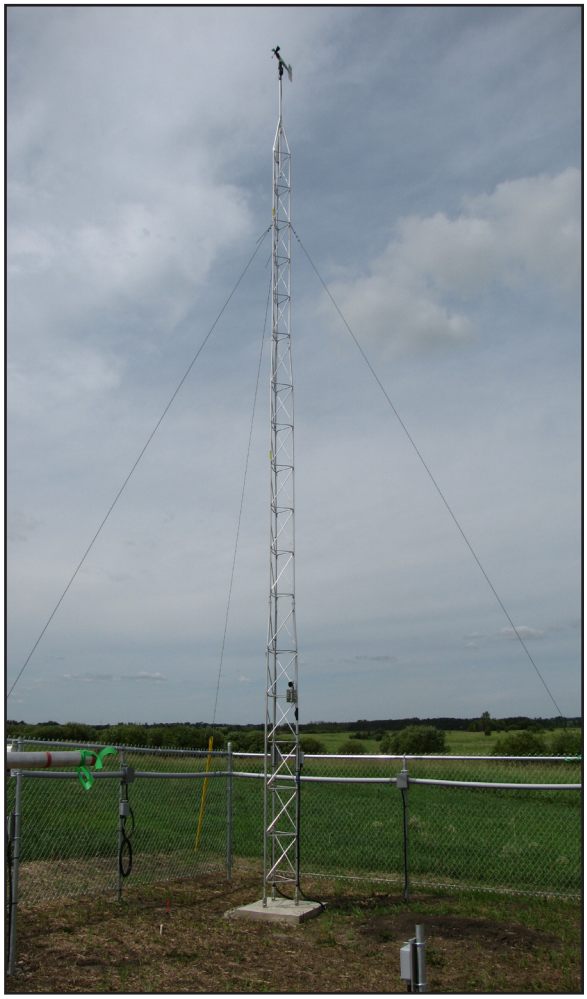
Approximate Thresholds		
-10	Low	Risk of hypothermia if outside for long periods without adequate protection
-28	Risky	Risk of frostnip/frostbite on extremities. Exposed skin can freeze in 10-30 minutes.
-40	High Risk	High risk of frostbite. Exposed skin can freeze in 5-10 minutes.
-48	Very High Risk	Serious risk of frostbite. Exposed skin can freeze in 2-5 minutes.
-55	Extreme Risk	Outdoor conditions hazrdous. Exposed skin can freeze in 2 minutes or less.

1: Environment Canada, 2013

Maximum Daily Wind Chill Value When Temperature < 0°C												
	JAN	FEB	MAR	APR	MAY	JUN	JLY	AUG	SEP	OCT	NOV	DEC
1	-26	-36	-14		DLF					-1	-5	-17
2	-24	-28	-20							-2	-8	-25
3	-21	-27	-15							-5	-6	-29
4	-22	-26	-24							-3	-15	-34
5	-20	-27	-26								-17	-40
6	-17	-33	-29								-21	-40
7	-19	-28	-24							-1	-16	-44
8	-24	-22	-32							-3	-12	-42
9	-26	-27	-26							-2	-18	-41
10	-29	-18	-27							-1	-35	-42
11	-40	-20	-27							-5	-37	-44
12	-41	-13	-31							-6	-16	-36
13	-40	-12	-19							-5	-8	-40
14	-40	-23	-24							-8	-11	-39
15	-22	-28	-32							-5	-9	-34
16	-30	-17	-36							-5	-20	-24
17	-29	-25	-32							-5	-25	-32
18	-29	-39	-35							-5	-28	-35
19	-36	-42	-33							-7	-29	-39
20	-44	-32	DLF							-7	-40	-42
21	-44	-32								-6	-40	-45
22	-32	-29								-9	-41	-48
23	-41	-25								-10	-41	-47
24	-44	-20								-5	-13	-19
25	-44	-20								-9	-25	-21
26	-38	-20								-15	-29	-18
27	-27	-30								-17	-20	-30
28	-19	-19								-19	-22	-47
29	-45			DLF						-11	-20	-49
30	-46									-9	-26	-48
31	-51		-17							-9		-51

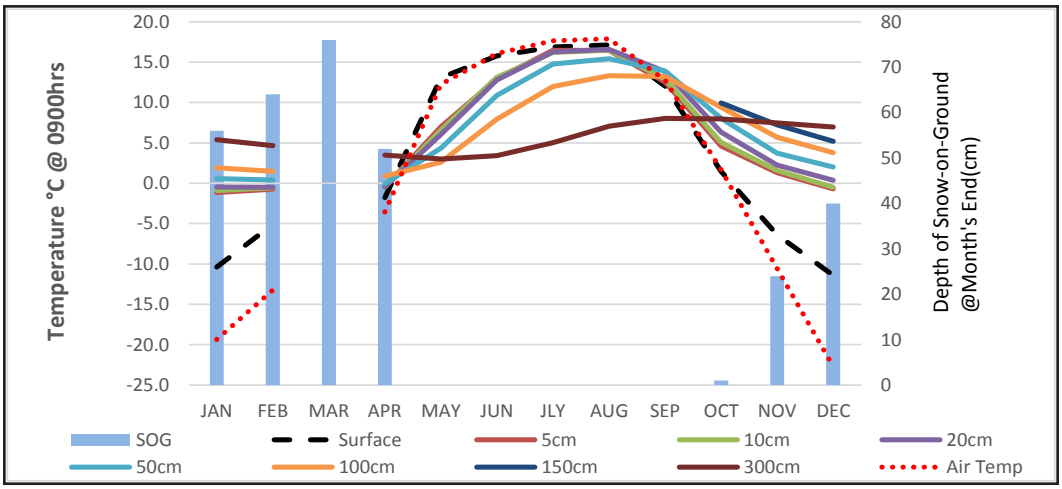
DLF = Data logger failure

Wind tower
photo credit: V. Wittrock
July 2012



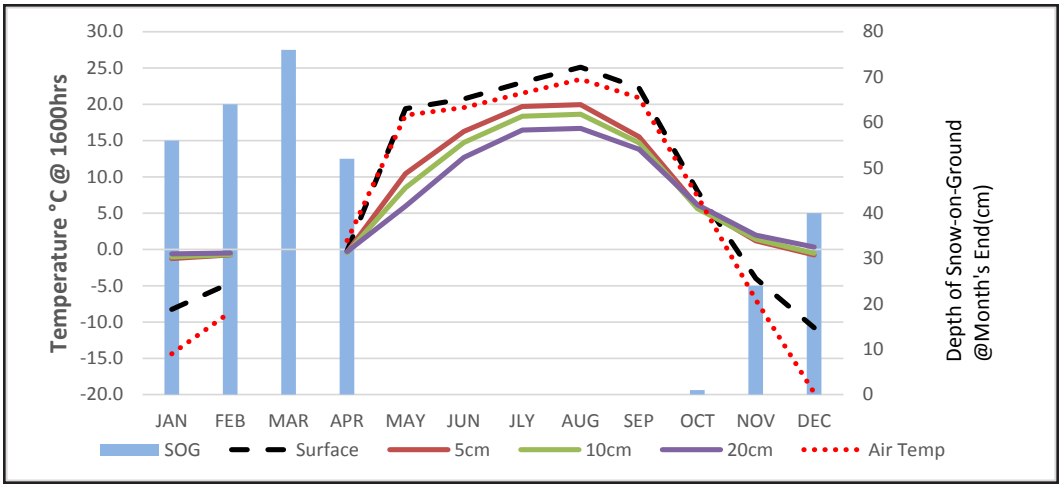
Soil Temperatures and Depth of Snow-on-the-Ground at Month's End

	Mean Air Temp @ 0900h (°C)	SOIL TEMPERATURES @ 0900 (°C)								Mean Air Temp @ 1600h (°C)	SOIL TEMPERATURES @ 1600 (°C)				SOG at Month's end (cm)
		Surface	5cm	10cm	20cm	50cm	100cm	150cm	300cm		Surface	5cm	10cm	20cm	
JAN	-19.4	-10.4	-1.1	-0.9	-0.5	0.6	1.9	N/A	5.4	-14.4	-8.3	-1.3	-1.0	-0.6	56
FEB	-13.2	-5.1	-0.8	-0.6	-0.5	0.4	1.5	N/A	4.6	-8.7	-4.6	-0.8	-0.7	-0.5	64
MAR	Data logger failure														76
APR	-3.5	-1.8	-0.5	-0.5	-0.4	-0.1	0.9	N/A	3.5	1.2	-0.2	-0.4	-0.5	-0.3	52
MAY	12.3	13.1	7.0	6.6	6.1	4.4	2.6	N/A	3.0	18.5	19.4	10.4	8.5	6.0	0
JUN	16.1	15.8	12.9	13.1	12.8	10.9	7.9	N/A	3.4	19.5	20.7	16.3	14.7	12.7	0
JLY	17.7	16.9	16.5	16.2	16.3	14.8	12.0	N/A	5.0	21.5	23.0	19.7	18.4	16.4	0
AUG	17.9	17.1	16.4	16.5	16.6	15.4	13.3	N/A	7.1	23.4	25.1	20.0	18.6	16.7	0
SEP	12.8	12.0	12.5	12.9	13.8	13.9	13.2	N/A	8.0	20.9	22.2	15.5	14.7	13.8	0
OCT	1.7	1.5	4.6	5.0	6.3	8.0	9.4	9.9	8.0	7.3	8.1	6.0	5.6	6.2	0
NOV	-10.6	-6.4	1.3	1.6	2.3	3.7	5.7	7.3	7.5	-7.0	-4.0	1.2	1.4	2.0	24
DEC	-22.7	-11.4	-0.7	-0.5	0.4	2.0	3.8	5.2	7.0	-19.8	-10.8	-0.7	-0.5	0.3	40



Monthly Soil Temperatures @ 0900hrs (9:00am)

SOG = Snow on ground
150 cm soil depth sensor data unavailable (Jan-Sep)
Mar = data logger failure



Monthly Soil Temperatures @ 1600hrs (4:00pm)

SOG = Snow on ground
150 cm soil depth sensor data unavailable (Jan-Sep)
Mar = data logger failure

Instruments used at Climate learning center and Glossary of Terms

(Unless otherwise stated, source for definitions of terms is Environment Canada, 1978)

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 (Force Numbers) were defined by ranges of wind speed as measured at a height of 10 meters above the surface. In effect, this transformed the 'Beaufort Wind Force Scale' into the 'Beaufort Wind Speed Scale'. This scale is the current 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 atmospheric obstructions. Number of Days is defined as 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 the 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) is 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 than18°C, CDD = 0. Monthly and annual values of CDD are obtained by summing daily values.

Growing (GDD) is the growing requirement in order for plant growth to proceed. The air temperature must ex ceed 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) is 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 > 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.

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

NORMAL VALUE (1981-2010) 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 the Climate Learning Centre, 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 of thirty years. The period of operation at CLC is not yet long enough to produce normals.

(Environment Canada, 1993, 2002, 2004a)

POTENTIAL EVAPOTRANSPIRATION (Thornthwaite Method) is the amount of water which will be lost from a surface completely covered with vegetation if there is sufficient water in the soil at all times for the use of the vegetation. It is computed by means of an empirical formula involving mean monthly temperature and average length of day.

Mathematically:PET = mTa where PET = Potential of Evapotranspiration; m = % of day length for the month as compared to the year;T = Temperature °C when T is less than or equal to 0; otherwise T = O; and a = yearly heat index. *(Thornthwaite and Mather, 1955)*

PRECIPITATION

Day is recorded on occasions when the amount of precipitation in a 24-hour period of 0000 hours - 2400 hours 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.

Measurable precipitation is when the amount equals or exceeds 0.2 mm of water or water equivalent.

Dry day is when no measurable precipitation is recorded.

Total is the sum of the daily recorded precipitation. The snowfall component of precipitation is recorded as an equivalent amount of liquid water. The notation “T” refers to a trace of precipitation (less than 0.2 mm water equivalent). A weighing gauge is used for the winter season and a tipping bucket during frost-free period.

SEASONS Meteorologists prefer to divide the year into four 3-month periods based primarily on temperature. Thus winter is defined as December (previous year), January, and February (DJF); spring as March, April and May (MAM); summer as June, July and August (JJA); and fall as September, October and November (SON). *(Lutgens and Tarbuck, 1992)*

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/m2).

SPELLS

Temperature spells are defined as 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).

Precipitation spells, for this report, are defined as when more than one day is (wet spell) or is not (dry Spell) measured.

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.

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 describes a sensation, the way we feel as a result of the combined cooling effect of temperature and wind. This feeling can't be measured using an instrument, so a mathematical formula was developed in 1939 that related air temperature and wind speed to the cooling sensation. This formula was revised in 2001 by a team of scientists and medical experts from Canada and the U.S. with the Canadian Department of National Defence contributing human volunteers. The new index is based on the loss of heat from the face. *(Environment Canada 2004b)*

WAVES Temperature waves are defined as a sequence of three or more days when the daily maxiumum/minimum temperatures are higher/lower than, or equal to, a set temperature. For a heat wave the temperature is 32°C. *(Environment Canada 2005)*

WIND SPEED

Average 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. See also **Beaufort Wind Scale**

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