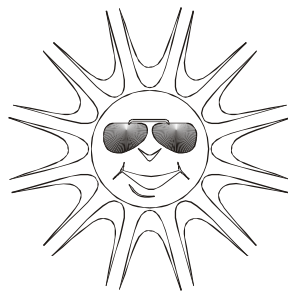




Smithsonian Tropical Research Institute

2019 Meteorological Summary for
the San Lorenzo/Fort Sherman
Canopy Crane

Prepared by: Steven Paton



Introduction

This is the 7th in a series of yearly reports summarising the past year's Smithsonian Tropical Research Institute's Physical Monitoring Program on the Fort Sherman/San Lorenzo (FTS) Canopy Access Crane. This report is not meant to be exhaustive in its coverage in that it summarizes only some of the most 'important' or interesting parameters available. Any comments on how future yearly summaries could be improved would be appreciated. Additional copies of this report, reports from previous years, and downloadable data from the FTS and other research locations, can be obtained from:

http://biogeodb.stri.si.edu/physical_monitoring/research/sherman

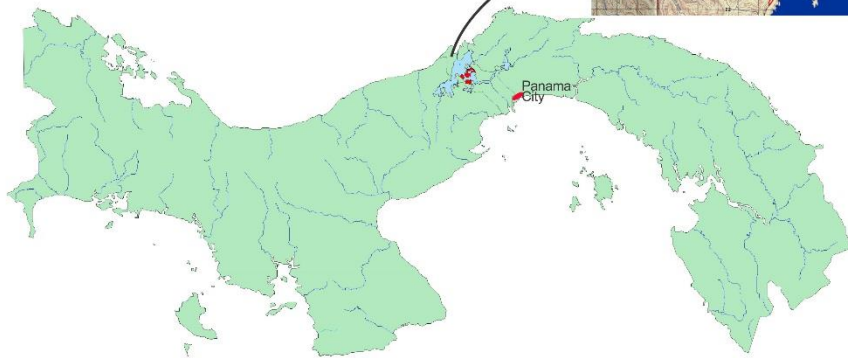
Setting

Established in 1997, the FTS canopy crane (9.281031°, -79.974518°) is located approximately 11 km South West from the city of Colon, in the middle the Parque Natural San Lorenzo (formerly known as Fort Sherman) and is surrounded by 300-year old, low-land tropical rainforest. The crane is 52 meters tall with a radius of 54 meters, and can reach approximately 240 species of trees and lianas. The crane stands in a 6-hectare plot where all 22,400 trees with a bole size of 1 cm in dbh or greater have been identified, measured and mapped. Structurally, the forest can be characterized as including 3,338 stems per hectare (greater than 1 cm dbh) and a total basal area of almost 32 m² per hectare with the tallest trees being 45 m tall.



Republic of Panama

Ft. Sherman/San Lorenzo
Canopy Access Crane



The station receives an average of 3360.0mm of rain per year. The meteorological year is divided into two parts: a pronounced dry season (approximately from mid-December to the end of April), and a wet season (May to mid-December). On average, only 655mm of rain falls during the dry season. Relative humidity, soil moisture, air pressure, solar radiation, evapotranspiration, wind speed and direction all show marked wet/dry season differences. On the other hand, temperature varies relatively little throughout the year.



All data are collected using electronic sensors. All sensors are located at the top of the crane, with the exception of the anemometer which is located to the side of vertical shaft approximately 3m below the boom.

This report summarises the following data:

- Relative humidity
- Air temperature
- Rainfall
- Wind speed and direction
- Solar radiation

Rainfall

Rainfall was collected by a rain gauge located on the counter weight of the crane boom. Tipping buckets generate 'events' for every 0.254 mm of rainfall recorded. There are several large gaps in the data for the years 2003, 2005-7, and 2010. Missing data have been estimated from the Panama Canal Authority's "Gatun West" rain gauge station. This station is located 5.3 km SE of the FTS crane (see image on previous page). The correlation r^2 between the two station's monthly rainfall is 0.926

The daily rainfall data for 2019 are shown on page 5.

Page 6 shows the monthly totals for 2019. The graph on the same page compares this year's monthly totals with the average monthly totals (\pm SD) for the period 1997 to 2019.

Page 8 shows yearly rainfall totals for all year since 1997. Time series graph and frequency histograms are presented for these data.



Pages 8 and 9 show an analysis of rainfall ‘events’ (*storms*). For convenience, and again somewhat arbitrarily, I have defined a storm as any continuous period of rain separated by at least an hour from any other rainfall. Since this analysis required the timing of rainfall events, tipping bucket data were used. As a result, the absolute size of rainfall events should be considered as only an estimate since they will tend to disproportionately underestimate the size of storms - larger storms will be more underestimated than smaller ones. Keeping this in mind, the tables and graphs on this page compare the maximum storm size and the average storm size and duration per month for the period 1997 to 2018 and for the year 2019.

Relative Humidity

Data were also collected on top of the crane boom, at 15- minute intervals by dataloggers attached to Campbell Sci. CS215 temperature/humidity sensors (Viasala HMP 35/45 sensors prior to 2010).

The average monthly relative humidity data are shown in tabular and graphical form on pages 10.

Air Temperature

Shaded air temperature data were also collected on top of the crane boom at 15-minute intervals by dataloggers attached to Campbell Sci. CS215 electronic temperature/humidity sensors (Viasala HMP 35/45 sensors prior to 2010). The monthly average, maximum and minimum temperatures are shown in tabular and graphical form on page 11 to 13, respectively.



Solar Radiation

Until July 13, 2016 global solar radiation was measured on top of the crane boom using two Li-Cor LI200SB pyranometers attached to a datalogger. On that date one of the sensors was replaced with a Kipp&Zonen SPLite2 pyranometer. 15-minute interval total (MJm^{-2}), maximum and minimum ($\text{J m}^{-2} \text{ s}^{-1}$) are collected.



Page 14 shows the Daily Global Radiation values. Page 15 shows total monthly Global Radiation. Page 16 shows total monthly Photosynthetically Active Radiation (PAR) collected on the crane from 1997 to 2007.

Wind Speed and Direction

15-minute interval average, maximum and minimum wind speed plus average wind direction was recorded by a Model 05103 Young Anemometer approximately three meters below the crane boom and two meters from the central column on the north side (exposed to the predominately northerly winds).



Page 17 shows average and maximum daily wind speeds. Page 18 shows daily average wind direction. The angles indicated in the table and graph on this page represent the direction into which the wind was predominately blowing on a given day. Pages 19 to 21 show the monthly average wind speed, average daily maximum wind speed and average wind directions for the year.

Times Series

Graphs showing the monthly averages for the entire period of record for Humidity, Air Temperature, Rainfall, Wind Speed and Solar Radiation can be found on pages 22 to 27.

Daily Patterns

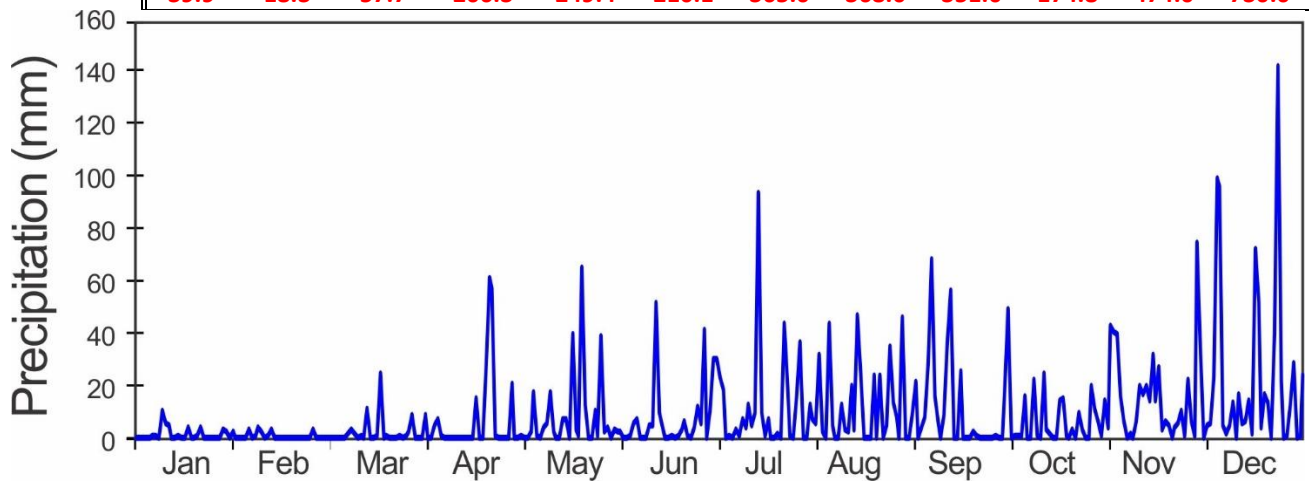
Pages 28 and 29 show the daily patterns for Humidity, Air Temperature, Rainfall, Wind Speed and Solar Radiation.

Rainfall data from the ACP

The Panama Canal Authority (ACP) maintains a network of meteorological stations throughout the Panama Canal. Rainfall data from the station known as Gatun West (9.263337° N, -9.929035° W) has been used to supplement the rainfall data collected at the FTS station.

2019 Daily Rainfall (mm)

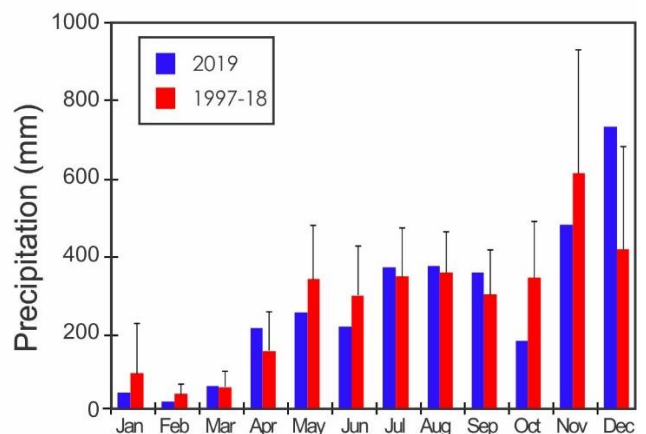
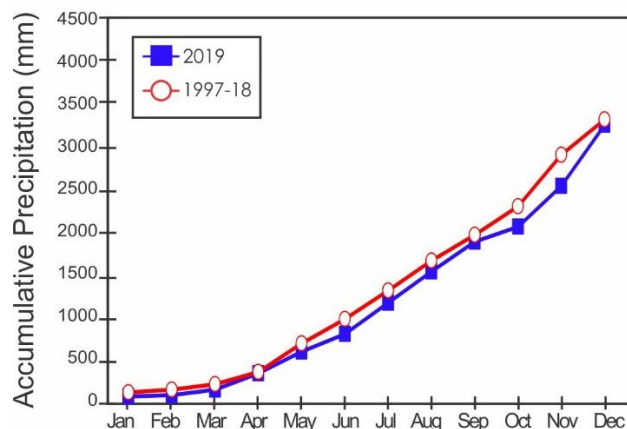
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0.0	0.0	0.0	8.9	0.5	2.3	30.0	5.8	21.3	0.3	43.4	4.8
2	0.0	0.0	0.0	0.0	0.0	0.0	22.9	32.0	0.3	1.0	40.9	5.3
3	0.0	0.0	0.3	0.0	0.0	0.0	18.5	2.5	3.8	0.5	40.1	23.4
4	0.0	0.0	0.0	4.8	2.3	1.0	0.0	0.3	7.9	0.8	16.0	100.3
5	0.0	3.0	0.0	7.4	17.5	5.8	0.8	44.2	28.7	16.3	6.4	96.5
6	0.8	0.3	0.3	0.5	0.5	7.1	0.0	4.8	68.8	0.3	0.3	4.6
7	0.5	0.5	0.0	0.0	0.3	0.0	3.0	0.3	16.3	0.0	1.8	1.3
8	0.0	4.3	1.3	0.0	4.1	0.0	1.0	0.0	5.3	22.1	0.0	5.1
9	10.4	2.5	3.0	0.0	5.6	0.0	7.4	12.4	0.0	0.8	6.4	13.2
10	5.8	0.0	1.5	0.0	17.8	4.6	4.1	3.0	8.4	0.3	20.1	0.0
11	4.8	0.8	0.3	0.0	2.5	5.1	12.7	2.5	36.6	24.9	16.5	17.0
12	0.0	2.8	1.0	0.0	0.3	52.3	4.6	19.8	56.4	3.3	19.8	5.3
13	0.0	0.3	0.0	0.0	0.0	9.7	9.9	3.0	0.3	1.5	14.0	6.1
14	0.8	0.3	10.9	0.0	6.9	5.8	94.7	47.5	0.0	0.0	32.3	14.2
15	0.3	0.0	0.0	0.0	7.4	0.0	9.4	24.6	25.4	0.0	14.7	1.5
16	0.0	0.0	0.3	0.0	0.0	0.0	0.5	0.0	0.0	14.0	27.2	72.6
17	4.3	0.0	0.8	15.2	40.1	0.8	7.1	0.0	0.0	15.5	2.8	52.3
18	0.0	0.0	24.4	0.0	2.8	0.3	0.3	0.0	0.3	0.5	6.4	3.6
19	0.0	0.0	0.0	0.0	0.8	0.5	0.3	24.1	2.0	0.0	5.1	16.5
20	0.8	0.0	0.5	28.2	65.3	3.0	1.8	0.3	1.0	3.3	0.3	13.7
21	3.6	0.0	0.0	61.7	12.4	6.4	0.0	23.6	0.0	0.3	3.8	0.3
22	0.0	0.0	0.0	57.7	0.0	1.0	43.9	0.0	0.3	9.1	5.6	40.4
23	0.0	0.0	0.3	0.5	0.0	0.0	19.6	4.6	0.0	3.3	10.7	143.5
24	0.0	0.0	0.8	0.0	10.7	4.1	0.5	35.1	0.0	0.0	0.8	21.6
25	0.0	3.3	0.3	0.0	0.5	12.2	0.0	13.5	0.0	0.0	22.4	0.0
26	0.0	0.0	1.0	0.3	39.1	5.6	15.7	7.9	0.5	20.1	6.4	1.0
27	0.0	0.3	2.5	0.0	2.5	41.7	36.8	0.0	0.0	10.9	1.0	12.7
28	3.3	0.0	8.4	20.8	3.8	0.0	0.0	46.7	0.0	6.1	74.9	28.5
29	2.3		0.0	0.3	0.3	10.2	0.0	0.0	18.0	1.0	34.0	0.3
30	0.0		0.0	0.0	3.0	30.7	12.7	0.0	49.5	14.5	0.3	0.5
31	2.3		0.0		2.5		6.9	9.4		4.3		23.9
	39.9	18.3	57.7	206.3	249.4	210.1	365.0	368.0	351.0	174.8	474.0	730.0



Monthly Rainfall (mm)¹

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1997	63.0	20.0	5.7	22.9	194.5	168.2	206.1	335.8	265.9	187.2	216.5	33.5	1719.4
1998	29.1	36.8	39.2	502.5	302.2	250.4	514.1	360.6	102.7	260.4	268.4	533.6	3200.0
1999	88.2	61.1	119.7	128.6	273.9	291.0	391.0	396.2	258.1	204.8	511.4	699.4	3423.6
2000	89.7	54.2	6.8	118.5	435.1	595.9	159.6	248.1	150.5	575.1	253.3	658.0	3344.8
2001	92.6	2.8	168.0	52.0	181.4	137.3	283.3	403.7	446.3	376.7	581.6	388.6	3114.2
2002	188.0	20.3	73.7	233.7	172.7	140.9	288.2	546.5	306.4	389.1	622.0	101.0	3082.5
2003	40.5	12.7	2.5	198.1	251.8	249.9	330.8	524.3	393.8	252.3	656.6	583.0	3496.3
2004	39.6	74.1	38.8	154.8	640.2	307.5	357.1	494.8	146.1	374.0	375.9	373.4	3376.3
2005	121.9	33.0	53.3	287.0	320.0	157.5	243.8	467.4	396.2	177.8	612.1	215.9	3086.1
2006	50.8	45.7	109.2	88.9	264.2	81.3	629.8	146.2	307.6	265.6	485.1	360.7	2835.1
2007	10.2	20.3	55.9	144.0	323.0	227.0	202.5	287.0	318.3	699.6	970.9	264.4	3523.1
2008	33.0	63.2	42.3	99.4	548.7	309.7	415.6	333.1	156.3	309.7	845.7	133.5	3290.2
2009	71.0	47.0	48.1	163.0	205.5	272.6	278.3	370.9	268.3	294.9	742.0	80.2	2841.8
2010	31.9	16.0	48.0	76.0	110.0	333.0	166.0	353.0	210.2	709.6	615.4	1075.0	3744.1
2011	205.4	114.2	68.4	154.1	326.9	436.3	490.2	281.5	221.0	298.4	973.4	627.5	4197.3
2012	21.8	21.8	131.9	227.6	339.6	284.2	355.5	209.5	368.3	370.5	1506.3	542.2	4379.3
2013	10.7	49.4	41.5	99.7	586.7	341.9	408.9	420.1	211.9	290.1	206.3	302.6	2969.9
2014	53.0	28.7	45.4	141.6	431.1	457.1	150.9	414.0	182.9	428.5	520.1	312.8	3166.0
2015	59.4	35.5	16.7	61.6	386.0			337.6	464.8	268.5	229.4	156.0	
2016	58.9	53.2	10.4	68.3	254.6	283.2	411.0	142.8	431.0	269.0	1158.0	436.4	3576.6
2017	35.7	10.4	14.7	32.0	511.0	329.0	474.9	295.1	255.8	253.0	539.5	737.1	3488.1
2018	634.5	7.4	41.4	137.2	368.1	547.6	378.5	332.7	554.5	337.8	625.8	96.8	4062.2
2019	39.9	18.3	57.7	206.3	249.4	210.1	365.0	368.0	351.0	174.8	474.0	730.0	3244.4
mean	89.9	36.8	53.9	147.7	333.8	291.4	341.0	350.8	294.3	337.7	608.3	410.5	3325.5
sd	128.7	25.9	42.7	102.7	138.8	129.4	125.4	105.7	117.3	146.8	320.6	267.7	541.1
min	10.2	2.8	2.5	22.9	110.0	81.3	150.9	142.8	102.7	174.8	206.3	33.5	1719.4
max	634.5	114.2	168.0	502.5	640.2	595.9	629.8	546.5	554.5	709.6	1506.3	1075.0	4379.3
Rank*	15	18	7	5	18	17	10	10	8	23	17	3	13

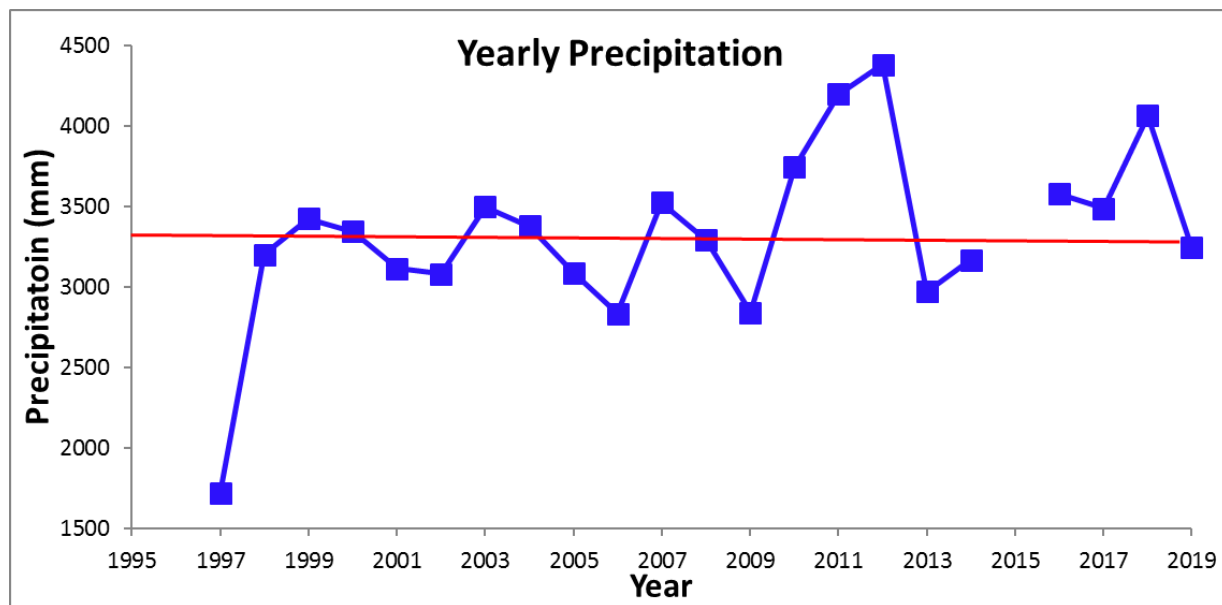
* Rank of most year, 1 = wettest



¹ Monthly totals in green have been estimated from the Gatun West station of the Panama Canal Authority

Yearly Rainfall (mm) at 'El Claro' - Rain Gauge

Year	Rain	Year	Rain	Year	Rain
1997	1719.4	2005	3476.9	2013	2969.9
1998	3200.0	2006	2891.3	2014	3166.0
1999	3416.0	2007	3342.8	2015	2193.5
2000	3342.2	2008	3288.2	2016	3579.4
2001	2759.1	2009	2841.8	2017	3488.1
2002	3089.8	2010	3476.5	2018	4062.2
2003	3497.8	2011	4197.3	2019	3244.4
2004	3203.8	2012	4379.3		

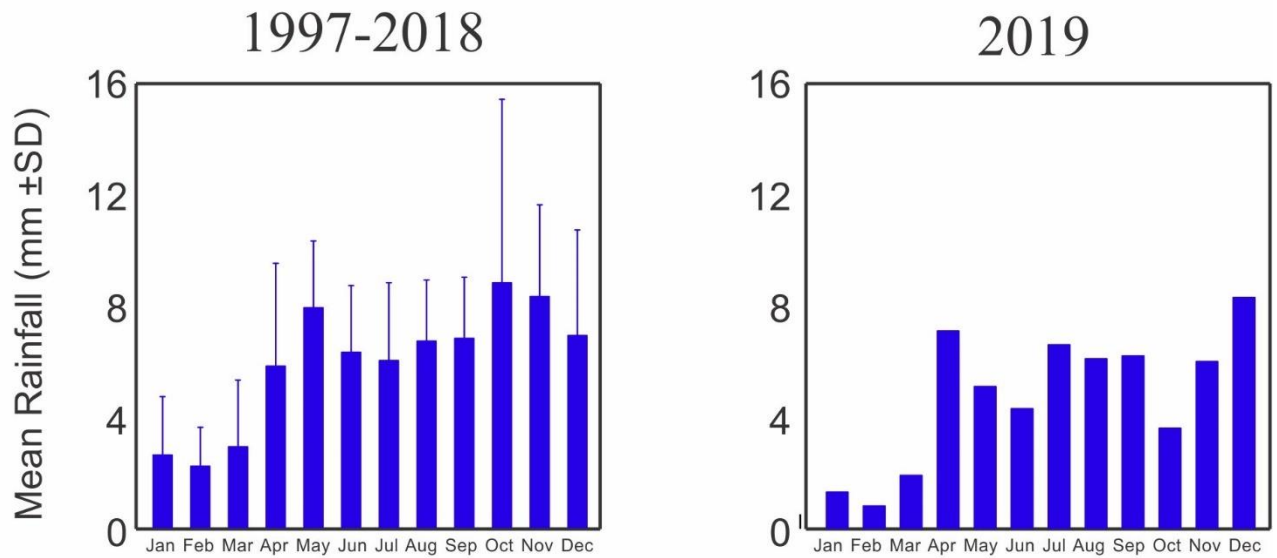


Storm Analysis

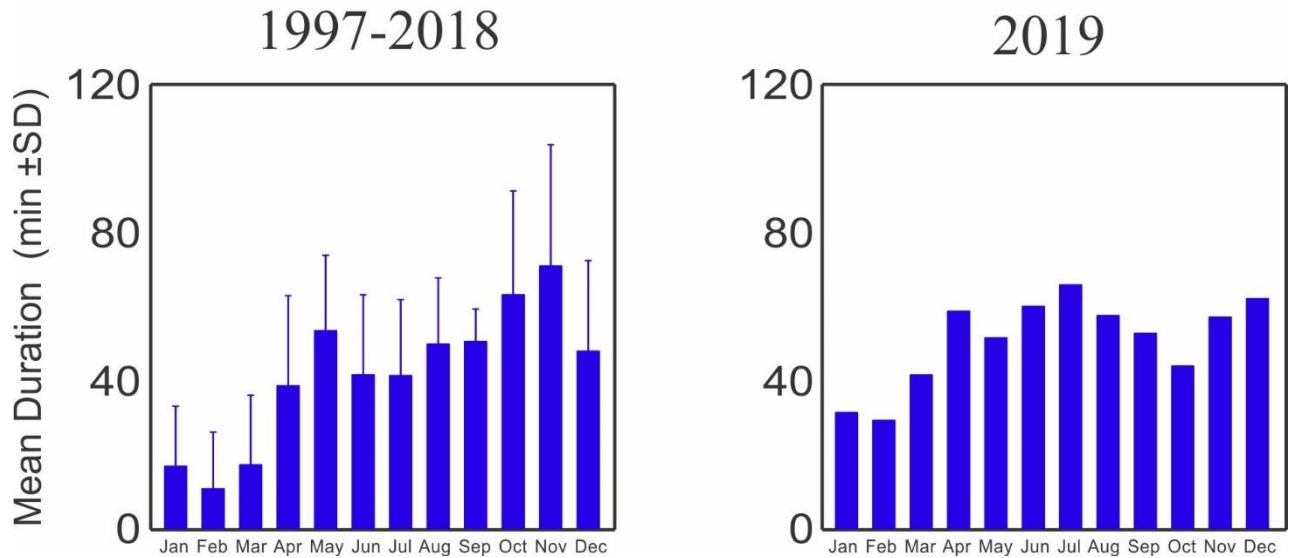
	Max. Rainfall per Storm (mm)			Storm Duration (min.)		
	1997-2018		2019	1997-2018		2019
	Mean	S.D.		Mean	S.D.	
January	18.9	21.7	9.9	35.6	15.3	31.3
February	12.5	16.3	3.0	28.8	12.2	29.2
March	18.2	22.3	24.4	33.7	15.1	41.5
April	42.7	34.0	84.6	53.6	20.8	58.7
May	76.8	51.9	65.0	63.9	16.3	51.5
June	59.9	34.2	40.4	55.7	17.7	60.0
July	63.1	38.7	57.4	55.4	16.6	65.8
August	63.5	33.8	46.7	60.6	14.5	57.5
September	57.6	23.4	49.5	62.5	7.1	52.7
October	73.9	73.7	24.9	72.0	22.4	43.9
November	103.4	69.9	66.3	78.1	26.2	57.1
December	76.5	66.8	117.6	59.6	20.0	62.1

	Av. Rainfall per Storm (mm)		
	1997-2018		2019
	Mean	S.D.	
January	2.8	2.2	1.3
February	2.1	1.4	0.8
March	2.8	2.4	1.9
April	5.7	3.6	7.1
May	7.9	2.3	5.1
June	6.4	2.3	4.3
July	5.9	2.8	6.6
August	6.7	2.2	6.1
September	6.9	2.2	6.2
October	8.7	6.5	3.6
November	8.3	3.2	6.0
December	6.7	3.8	8.3

Average Monthly Storm Size



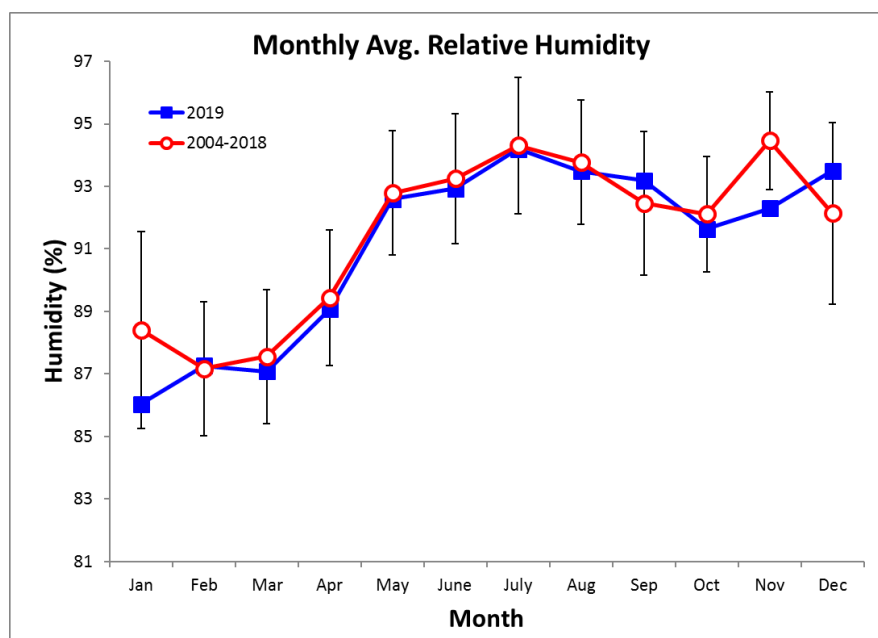
Average Monthly Storm Duration



Relative Humidity (%)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997						91.6	94.1	95.4	95.7	95.1	97.0	92.9
1998	92.1	90.9	89.5	92.0	96.5	97.5	98.3	98.0	95.2	95.7	97.3	98.6
1999	94.5	93.0	94.1	92.1	91.6	94.4	94.6	94.9	93.2	93.1	94.5	95.7
2000	89.3	87.3	85.8	89.4	93.8	94.7	94.2	95.2	92.6	95.5	93.4	94.0
2001	89.7	88.4	90.5	92.1	94.0	94.5	96.7	97.1	95.7	95.4	97.1	97.7
2002	95.3	91.5	93.1	94.0	96.1	96.7	98.2	98.5	96.8	97.8	98.6	93.4
2003	86.0	86.3	90.2								95.4	93.7
2004	86.1	84.9	85.8	89.3	93.7	94.1	94.8	95.6	91.3	91.5	93.1	88.9
2005	90.2	85.9	88.9	90.3	94.5	90.0	89.2	92.5	92.8	90.1	94.2	88.5
2006	88.7	86.1	87.2	89.4	93.0	92.8	94.5	93.3	93.8	92.9	94.0	93.7
2007	87.6	86.8	87.0	90.3	94.5	94.2	95.1	91.8	90.1	90.3	93.9	90.9
2008	83.9	84.9	83.2	84.5	88.7	92.0	92.6	90.7	88.8	88.8	94.6	88.6
2009	87.5	86.9	85.8	86.7	91.8	90.6	93.6	94.1	91.7	91.7	95.3	90.7
2010	87.2	88.9	89.4	88.4	89.3	91.5	92.1	92.7	91.2	94.5	93.9	94.6
2011	93.4	89.5	87.1	89.6	91.9	94.0	94.1	91.9	89.6	90.7	96.3	94.9
2012	87.1	86.9	89.3	91.2	93.5	92.6	96.1	94.6	94.3	94.0	98.2	96.2
2013	88.5	88.0	91.0	90.8	92.9	94.8	96.2	95.1	93.7	93.8	92.9	91.4
2014	90.7	90.1	88.8	92.9	95.1	97.5	97.1	96.8	95.3	95.5	96.5	96.5
2015	91.1	91.4	89.6	92.8	96.5	95.8	97.3	97.5	97.3	93.6	93.0	93.7
2016	87.1	87.5	88.7	89.2	93.0	93.1	91.1	91.1	90.5	90.2	93.4	90.0
2017	83.9	82.8	83.6	86.8	91.5	90.4	95.1	93.6	91.5	92.1	95.3	94.5
2018	95.6	86.9	88.4	90.0	92.3	95.6	96.0	95.7	94.6	92.5	94.7	87.7
2019	86.0	87.3	87.1	89.1	92.6	92.9	94.2	93.5	93.2	91.6	92.3	93.5
mean	88.4	87.2	87.6	89.4	92.8	93.2	94.3	93.8	92.5	92.1	94.5	92.1
sd	3.2	2.1	2.2	2.2	2.0	2.1	2.2	2.0	2.3	1.8	1.6	2.9
min	83.9	82.8	83.2	84.5	88.7	90.0	89.2	90.7	88.8	88.8	92.3	87.7
max	95.6	91.4	91.0	92.9	96.5	97.5	97.3	97.5	97.3	95.5	98.2	96.5

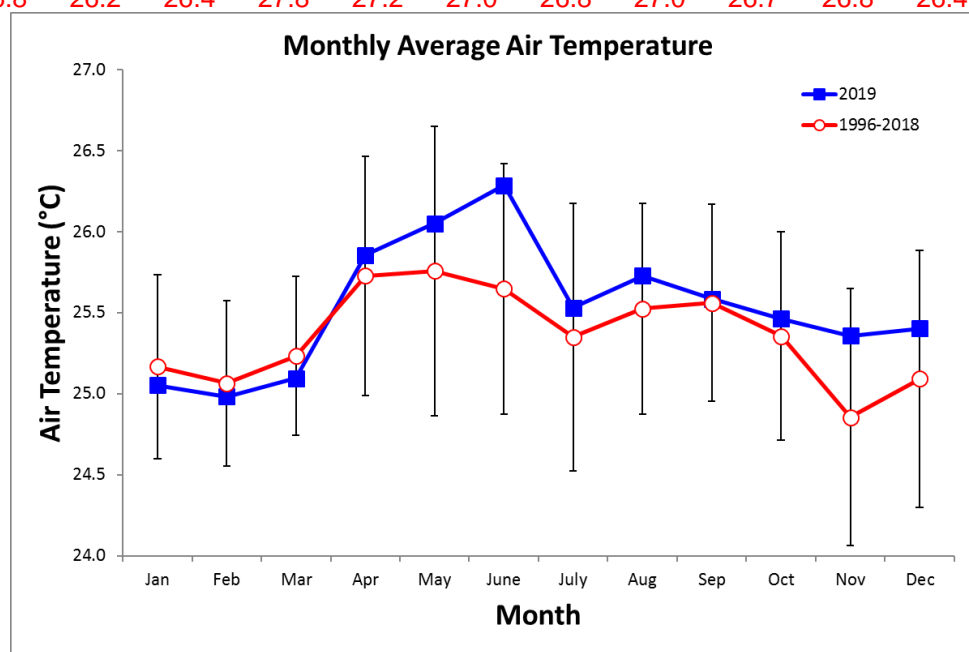
Notes: Change in Sensor type in Dec of 2003 resulted in a significant drop in recorded Humidity
Analysis only includes 2004 to the present



Monthly Average of Daily Maximum & Minimum Temperatures (°C)

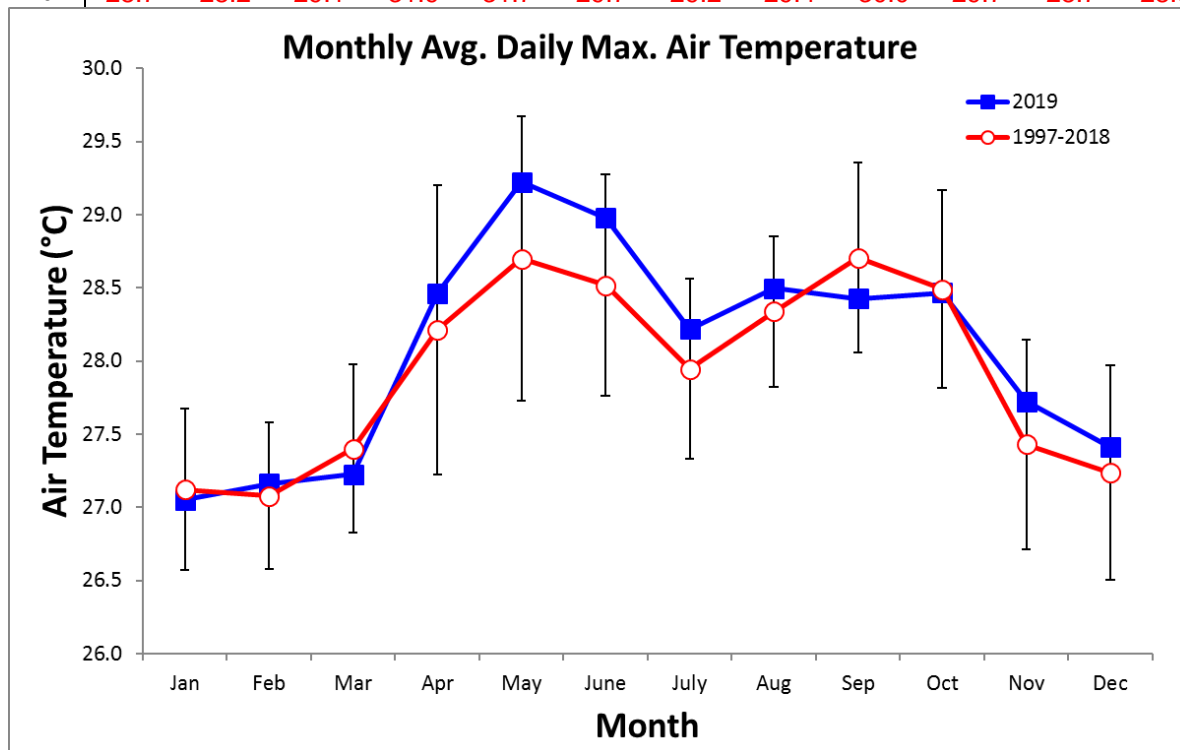
Monthly Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				27.8	27.2	25.6	25.9	25.8	25.4	25.7	25.1	25.5
1998	25.4	25.5	25.8	26.1	26.2	25.8	25.2	25.3	25.7	25.4	25.0	24.4
1999	25.0	24.4	24.7	25.1	25.3	24.8	24.8	24.6	24.7	24.6	24.2	24.6
2000	25.2	25.2	25.3	25.8	26.2	26.2	26.1	26.4	26.3	26.0	26.3	25.8
2001	25.7	25.6	25.5	26.3	26.7	27.0	26.4	27.0	26.4	26.8	26.0	26.6
2002	26.8	26.1	26.1	26.5	27.2	27.0	26.8	26.8	26.7	26.3	26.4	26.7
2003	26.2	26.2	26.4	26.6	26.7	26.3	26.4	26.5	26.7	26.4	25.3	24.8
2004	25.0	25.2	25.3	25.3	25.2	25.2	24.5	24.6	24.9	25.0	24.4	24.9
2005	24.5	24.3	25.2	25.5	25.3	25.9	25.9	24.9	24.6	24.7	23.7	24.7
2006	24.8	24.5	24.6	24.5	24.3	24.6	24.2	24.6	24.4	24.2	23.3	23.9
2007	24.8	24.5	24.7	24.5	23.6	23.8	23.0	25.2	25.5	25.0	24.6	24.7
2008	25.0	24.8	25.0	25.5	25.4	25.4	24.9	25.1	25.6	25.3	24.1	24.9
2009	24.7	24.5	24.5	25.2	25.4	25.6	25.4	25.1	25.7	25.2	24.7	25.4
2010	25.2	25.4	25.6	26.2	26.4	25.6	25.3	25.2	25.1	24.5	23.8	23.2
2011	24.2	24.7	24.6	24.9	25.5	25.3	25.1	25.4	25.5	24.7	24.3	24.5
2012	25.1	24.8	25.2	25.6	26.0	26.2	25.6	25.6	25.7	25.2	24.7	25.1
2013	25.5	25.3	25.6	26.2	25.9	25.8	25.7	25.4	25.9	25.3	25.4	25.5
2014	25.1	24.9	25.2	25.6	25.6	25.6	26.0	25.3	25.4	25.2	24.9	24.9
2015	25.4	25.0	24.9	25.6	25.6	26.1	25.3	25.4	25.5	25.9	25.6	26.1
2016	25.7	25.6	25.7	26.3	26.5	26.1	25.2	25.8	25.5	25.4	24.4	25.1
2017	25.0	25.0	25.1	25.2	24.3	24.4	24.6	25.9	26.2	26.1	24.9	25.0
2018	24.5	25.0	25.3	25.7	25.8	25.5	25.5	25.4	25.2	25.1	25.1	25.7
2019	25.1	25.0	25.1	25.9	26.1	26.3	25.5	25.7	25.6	25.5	25.4	25.4
mean	25.2	25.1	25.2	25.7	25.8	25.6	25.4	25.5	25.6	25.4	24.9	25.1
sd	0.6	0.5	0.5	0.7	0.9	0.8	0.8	0.7	0.6	0.6	0.8	0.8
min	24.2	24.3	24.5	24.5	23.6	23.8	23.0	24.6	24.4	24.2	23.3	23.2
max	26.8	26.2	26.4	27.8	27.2	27.0	26.8	27.0	26.7	26.8	26.4	26.7



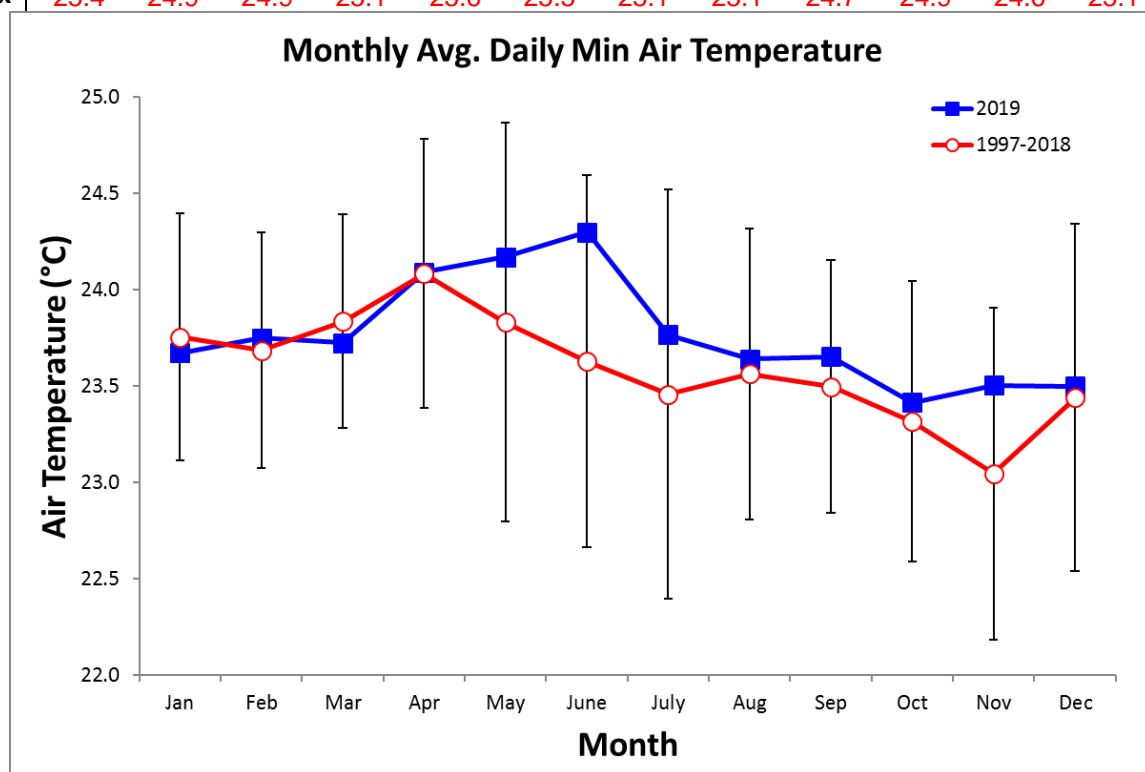
Monthly Average of Daily Maximum Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				31.9	31.7	28.8	28.4	28.4	28.0	28.6	27.8	27.4
1998	27.3	27.7	27.9	28.3	28.7	28.3	27.6	28.0	29.1	28.5	27.5	26.6
1999	26.9	26.3	26.6	27.2	27.9	27.5	27.5	27.9	28.2	27.7	26.7	26.8
2000	27.2	27.1	27.3	27.9	28.7	28.6	28.4	29.0	29.4	28.5	28.7	27.8
2001	27.6	27.3	27.5	28.0	29.3	29.2	28.7	29.4	29.3	29.7	28.4	28.6
2002	28.7	27.9	27.9	28.5	29.8	29.7	29.2	29.2	29.9	29.2	28.6	28.6
2003	28.0	28.2	29.1	29.1	29.0	29.3	28.5	28.9	30.0	29.6	27.8	26.9
2004	27.3	27.0	27.6	27.9	27.8	26.9	26.8	28.5	28.3	26.9	26.9	
2005	26.2	26.3	27.5	27.5	28.4	29.6	28.7	27.9	28.0	29.0	26.5	27.0
2006	27.0	26.5	26.6	27.0	27.5	27.9	27.6	27.6	27.5	27.7	26.6	26.7
2007	26.7	26.8	27.0	27.4	27.2	27.3	26.6	28.5	29.0	28.9	27.5	27.0
2008	26.8	27.0	27.4	28.1	28.4	28.0	27.6	28.4	29.2	28.7	26.6	27.1
2009	26.6	26.4	26.6	27.4	28.0	28.7	27.7	27.4	28.4	28.4	27.1	27.6
2010	27.3	27.6	27.9	28.9	29.6	28.8	28.4	28.9	29.0	27.3	26.5	25.2
2011	26.4	26.9	26.7	27.2	28.5	28.3	28.0	28.0	28.8	28.1	26.7	26.6
2012	27.0	26.8	27.2	28.3	29.0	29.1	27.8	28.5	28.2	28.3	26.8	27.2
2013	27.4	27.4	27.7	28.6	28.8	28.6	28.2	28.1	29.1	28.1	28.2	27.7
2014	27.0	27.0	27.5	28.0	28.2	27.9	28.2	27.8	28.2	28.4	27.4	27.1
2015	27.1	27.1	27.0	28.0	27.6	28.7	27.3	27.8	28.2	29.0	28.5	28.0
2016	27.7	27.5	28.0	29.1	29.7	29.7	27.7	28.3	28.2	28.7	26.9	27.2
2017	27.0	27.3	27.3	28.2	28.1	28.0	27.5	28.8	29.5	29.1	27.6	27.0
2018	26.4	26.8	27.4	28.3	29.0	28.0	28.0	28.2	28.3	28.6	27.7	27.9
2019	27.1	27.2	27.2	28.5	29.2	29.0	28.2	28.5	28.4	28.5	27.7	27.4
mean	27.1	27.1	27.4	28.2	28.7	28.5	27.9	28.3	28.7	28.5	27.4	27.2
sd	0.6	0.5	0.6	1.0	1.0	0.8	0.6	0.5	0.6	0.7	0.7	0.7
min	26.2	26.3	26.6	27.0	27.2	26.9	26.6	27.4	27.5	26.9	26.5	25.2
max	28.7	28.2	29.1	31.9	31.7	29.7	29.2	29.4	30.0	29.7	28.7	28.6



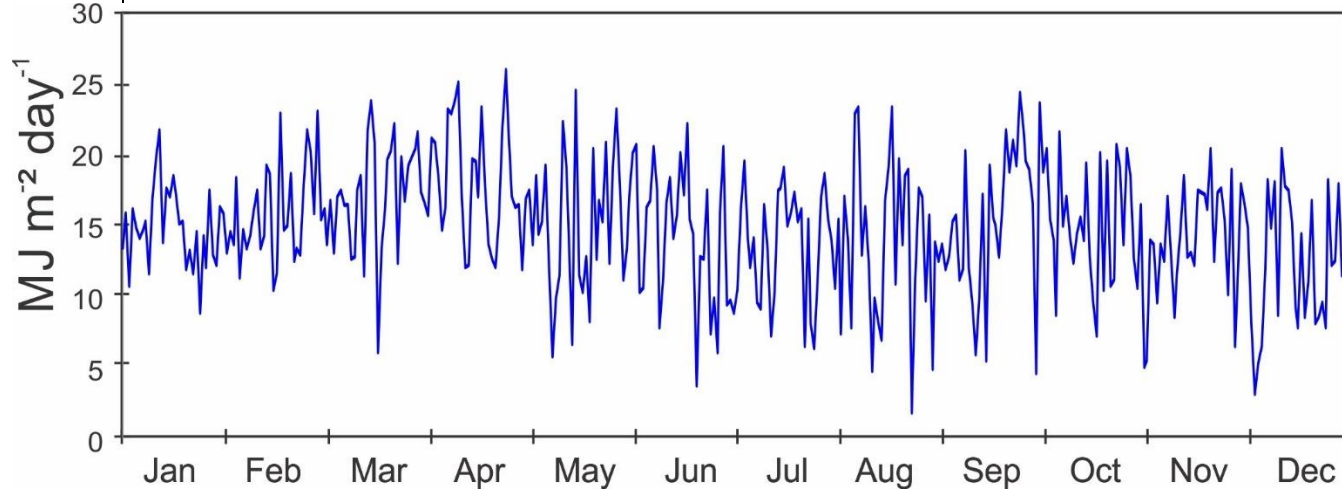
Monthly Average of Daily Minimum Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				24.7	24.7	23.6	24.1	24.0	23.5	23.7	23.3	23.6
1998	23.8	24.2	24.4	24.7	24.4	24.1	23.3	23.5	23.6	23.3	23.2	22.8
1999	23.5	23.0	23.3	23.7	23.5	22.8	22.5	22.2	22.5	22.8	22.2	23.1
2000	23.8	23.8	24.0	24.4	24.4	24.5	24.6	24.7	24.4	24.2	24.5	24.2
2001	24.2	24.6	24.3	25.1	25.1	25.5	24.8	25.0	24.2	24.9	24.3	25.0
2002	25.4	24.8	24.9	24.9	25.6	25.3	25.1	25.1	24.7	24.4	24.6	25.1
2003	24.9	24.9	24.9	24.9	25.0	24.3	24.8	24.6	24.7	24.6	23.5	23.2
2004	23.5	23.8	23.9	23.8	23.5	23.2	22.9	22.7	22.9	22.8	22.7	23.2
2005	23.1	22.7	23.7	24.0	23.3	23.6	23.5	22.8	22.4	22.3	21.8	22.7
2006	23.0	22.9	23.2	22.7	22.2	22.5	21.8	22.4	22.1	21.8	20.9	21.6
2007	23.3	22.9	22.9	22.4	21.1	21.1	20.2	23.2	23.2	22.9	22.9	23.0
2008	23.6	23.3	23.5	23.9	23.5	23.7	23.0	22.9	23.4	23.3	22.5	23.1
2009	23.3	23.1	23.1	23.6	23.7	23.5	23.6	23.4	23.7	23.1	23.1	24.0
2010	23.7	24.2	24.1	24.5	24.6	23.3	23.3	23.1	23.0	22.6	21.9	21.5
2011	22.8	23.2	23.1	23.4	23.5	23.1	23.1	23.4	23.6	22.9	22.6	23.1
2012	23.8	23.5	23.9	23.9	24.1	24.1	23.8	23.7	23.7	23.3	23.1	23.5
2013	24.5	23.7	24.2	24.8	24.1	23.7	23.8	23.4	23.7	23.2	23.4	23.7
2014	23.8	23.6	23.8	24.2	23.9	23.7	24.4	23.4	23.4	23.1	22.9	23.3
2015	24.1	23.5	23.5	24.3	24.0	24.5	23.9	23.7	23.6	23.6	23.8	25.0
2016	24.4	24.2	24.5	24.7	24.3	23.6	23.4	23.9	23.5	23.4	22.7	23.4
2017	23.4	23.5	23.6	23.3	21.8	22.0	22.6	23.9	24.0	23.9	23.2	23.5
2018	23.0	23.9	24.0	24.1	23.8	23.5	23.6	23.5	23.1	23.0	23.4	24.1
2019	23.7	23.8	23.7	24.1	24.2	24.3	23.8	23.6	23.7	23.4	23.5	23.5
mean	23.8	23.7	23.8	24.1	23.8	23.6	23.4	23.6	23.5	23.3	23.0	23.4
sd	0.7	0.6	0.6	0.7	1.1	1.0	1.1	0.8	0.7	0.8	0.9	0.9
min	22.8	22.7	22.9	22.4	21.1	21.1	20.2	22.2	22.1	21.8	20.9	21.5
max	25.4	24.9	24.9	25.1	25.6	25.5	25.1	25.1	24.7	24.9	24.6	25.1



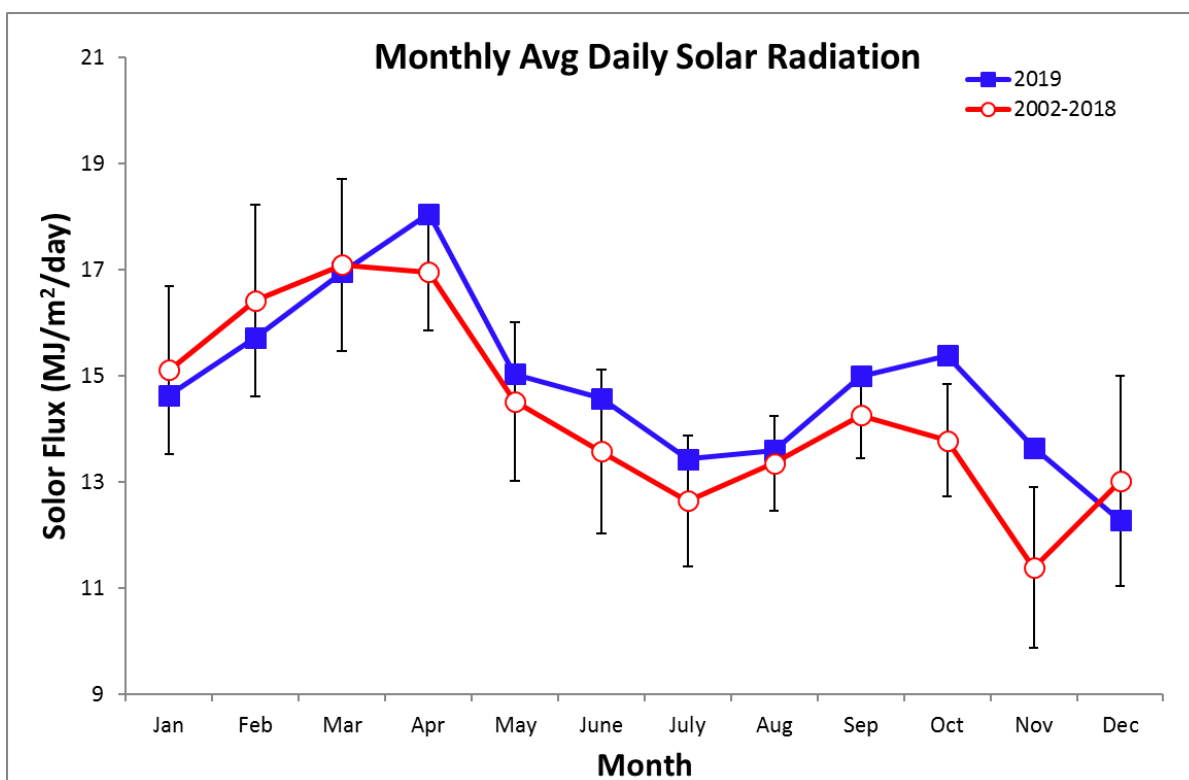
2019 Daily Total Radiation (MJ m⁻² day⁻¹)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	12.8	13.0	15.4	16.6	16.8	17.0	9.6	10.6	12.4	23.6	4.9	16.5
2	15.8	14.5	16.2	15.7	17.4	20.1	8.9	15.5	13.7	18.7	5.5	14.8
3	10.7	13.6	13.6	21.1	13.6	20.6	10.4	7.4	11.9	20.3	13.9	8.1
4	16.1	18.3	16.7	20.9	18.4	10.2	16.1	17.0	12.8	15.4	13.6	3.0
5	14.7	11.3	13.0	18.3	14.4	10.5	19.5	14.1	15.2	14.0	9.6	5.2
6	14.0	14.6	17.0	14.7	15.3	16.3	14.0	7.7	15.7	8.7	13.6	6.5
7	14.7	13.4	17.4	16.3	19.2	16.7	12.1	22.8	11.2	21.5	12.4	11.9
8	15.2	14.3	16.5	23.1	12.1	20.5	14.1	23.3	11.8	15.0	16.9	18.2
9	11.6	15.9	16.4	22.9	5.8	17.5	9.5	12.9	20.2	17.0	12.7	14.8
10	16.8	17.4	12.6	23.7	9.8	7.7	9.1	16.2	12.0	14.2	8.5	18.1
11	19.7	13.3	12.8	25.0	11.4	10.9	16.5	12.3	9.5	12.3	11.6	8.7
12	21.7	14.3	17.5	17.0	22.3	16.6	13.2	4.7	5.8	14.4	14.5	20.3
13	13.7	19.2	18.5	12.0	19.1	18.3	7.2	9.8	9.8	15.5	18.5	17.7
14	17.6	18.6	11.5	12.2	14.2	14.1	10.3	8.2	17.1	13.9	12.8	17.5
15	17.0	10.4	21.8	19.6	6.6	15.7	17.5	7.0	5.5	19.3	13.1	15.3
16	18.5	11.6	23.7	19.5	24.4	20.1	17.5	16.7	19.1	12.7	12.1	9.2
17	17.3	22.9	20.8	17.0	11.5	17.1	19.1	19.0	15.6	9.5	17.5	7.8
18	15.0	14.6	6.0	23.3	10.2	22.1	15.0	23.2	14.9	7.3	17.3	14.4
19	15.2	14.9	13.3	17.7	12.8	15.3	15.9	10.8	12.8	20.0	17.2	8.5
20	11.9	18.7	16.1	13.6	8.2	14.4	17.3	19.7	16.4	10.4	16.2	11.0
21	13.1	12.5	19.7	12.6	20.4	3.7	15.3	13.6	21.6	19.5	20.3	16.7
22	11.6	13.3	20.2	12.0	12.7	12.7	16.1	18.5	18.8	10.7	12.5	8.1
23	14.5	12.8	22.1	15.6	16.6	12.6	6.5	18.9	21.0	11.2	17.3	8.5
24	8.8	17.7	12.3	22.0	15.3	17.4	15.5	1.8	19.2	20.7	17.6	9.5
25	14.2	21.7	19.7	26.0	20.8	7.4	8.1	11.3	24.4	19.1	15.3	7.8
26	12.0	20.3	16.8	22.0	12.3	9.8	6.3	17.5	21.8	13.6	10.2	18.2
27	17.4	15.9	19.2	16.9	19.2	6.0	11.1	17.1	19.5	20.3	19.0	12.2
28	12.9	23.0	19.8	16.3	23.2	15.8	17.0	9.6	19.0	18.5	6.5	12.5
29	12.1		20.3	16.5	17.8	20.5	18.6	15.7	16.6	12.6	10.6	17.8
30	16.3		21.6	11.9	11.1	9.4	15.4	4.8	4.6	10.6	17.9	11.4
31	15.9		17.3		13.3		14.0	13.7		16.4		11.4



Monthly Average Total Daily Solar Radiation ($\text{MJ m}^{-2} \text{ day}^{-1}$)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2002									15.3	12.7	10.7	13.9
2003	13.6	14.6	17.2	16.1	11.6	12.4	10.4	11.6	13.9	13.6	10.7	10.3
2004	14.7	16.4										
2005												
2006												
2007							14.8	13.2	14.2	14.5	10.8	13.0
2008	16.8	16.3	18.7	18.5	15.4	11.0	10.9	12.7	14.0	13.3	9.8	15.1
2009	14.3	15.4	18.1	17.3	14.2	15.0	12.3	12.3	13.7	12.8	9.7	14.0
2010	13.3	13.0	13.9	16.6	16.3	14.2	14.4	14.5	15.1	12.0	11.6	8.5
2011	13.4	17.5	18.3	17.1	16.4	13.8	13.5	14.5	14.9	13.3	10.1	11.0
2012	17.1	16.7	15.6	15.9	15.3	14.3	11.7	12.9	13.1	12.9	8.8	12.0
2013	16.2	17.0	14.4	16.4	13.4	12.6	12.0	13.4	14.4	13.5	13.7	14.6
2014	14.6	15.8	17.3	14.5	14.2	11.3	12.9	12.7	14.0	13.1	13.3	12.7
2015	16.4	15.7	17.3	16.5	12.1	15.6	12.7	13.2	13.3	14.9	12.8	13.3
2016	15.5	16.3	17.3	18.1	15.5	15.1	12.1	13.9	13.2	15.2	11.3	15.0
2017	18.1	19.3	19.6	17.9	13.7	14.7	12.5	14.8	15.8	15.1	12.4	13.9
2018	13.0	20.3	17.6	17.4	15.6	11.9	13.6	13.7	14.1	14.6	11.6	15.9
2019	14.6	15.7	17.0	18.1	15.0	14.6	13.4	13.6	15.0	15.4	13.6	12.3
mean	15.1	16.4	17.1	17.0	14.5	13.6	12.6	13.4	14.3	13.8	11.4	13.0
sd	1.6	1.8	1.6	1.1	1.5	1.6	1.2	0.9	0.8	1.1	1.5	2.0
min	13.0	13.0	13.9	14.5	11.6	11.0	10.4	11.6	13.1	12.0	8.8	8.5
max	18.1	20.3	19.6	18.5	16.4	15.6	14.8	14.8	15.8	15.4	13.7	15.9

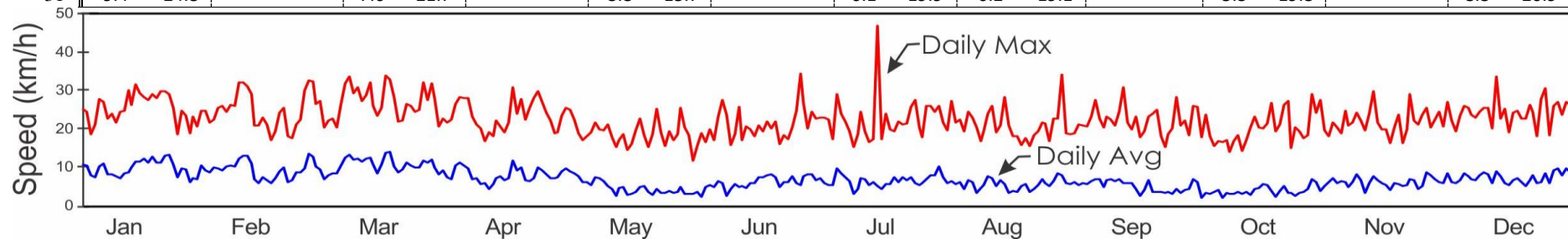


Monthly Average Daily PAR (Mol m⁻² day⁻¹)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997									27.5	33.6	31.4	34.5
1998	36.4	37.4	40.0	37.1	27.7	26.5	25.3	23.5	29.1	27.3	23.2	21.0
1999	36.9	35.0	35.6	24.2	21.8	22.0	34.9	42.0	43.3	41.4	36.2	25.2
2000	42.1	37.6	42.4	38.7	31.3	28.3	27.8	26.7	28.4	24.5	29.0	20.6
2001	31.4	32.8	35.9	39.6	40.7	35.1	31.7	32.2	32.9	35.1	29.1	23.6
2002	32.1	36.7	36.2	37.6	37.2	27.9	24.0	21.5	37.7	28.9	24.6	31.7
2003	32.0	33.6	38.2	36.6	27.5	28.9	24.2	26.2	31.2	30.6	24.4	22.8
2004	32.9	36.8	34.9	34.0	29.2	26.6	25.3	22.8	30.5	28.2	23.6	25.3
2005	30.3	33.7	33.1	27.9	23.9	28.4	31.4	26.6	27.4	33.4	23.9	31.3
2006	31.7	30.1	33.8	37.2	29.5	28.9	25.1	26.5	22.2	24.8	20.1	24.9
2007	28.5	28.9	31.4	29.0	26.2							
mean	33.4	34.3	36.2	34.2	29.5	28.1	27.7	27.5	31.0	30.8	26.5	26.1
sd	4.0	3.0	3.3	5.3	5.8	3.4	4.0	6.2	5.9	5.2	4.8	4.8
min	28.5	28.9	31.4	24.2	21.8	22.0	24.0	21.5	22.2	24.5	20.1	20.6
max	42.1	37.6	42.4	39.6	40.7	35.1	34.9	42.0	43.3	41.4	36.2	34.5

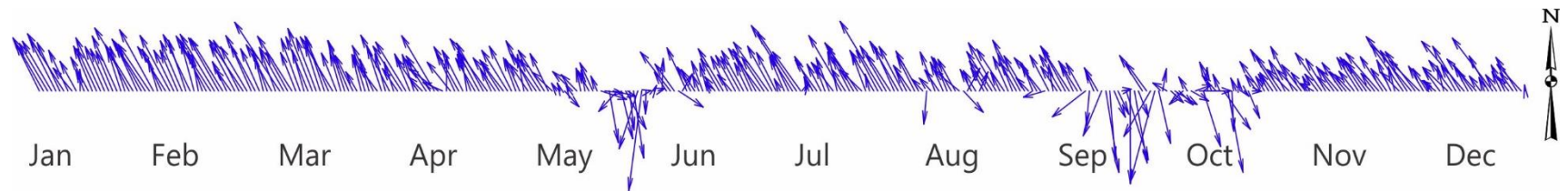
2019 Daily Average Wind Speed (km/h)

	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.	
	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1	10.7	25.4	8.9	21.7	7.1	20.5	7.0	22.7	8.5	22.5	2.4	18.9	5.9	23.0	6.5	27.5	5.4	21.2	2.3	17.9	6.3	18.1	6.3	22.3
2	10.6	24.5	10.0	22.5	8.1	22.4	10.5	26.5	7.9	19.0	5.1	16.7	5.5	22.5	5.8	21.7	6.1	21.1	3.5	23.7	7.2	21.8	6.0	19.5
3	8.2	18.7	9.9	25.5	8.5	22.7	11.3	28.3	6.3	17.2	5.5	20.1	5.5	17.5	6.3	22.5	5.8	20.8	3.1	18.4	6.1	20.6	6.8	23.4
4	7.7	21.2	9.3	26.2	8.5	20.5	10.6	28.0	6.4	18.2	5.1	17.3	9.7	29.3	4.6	19.5	6.4	23.4	3.8	15.7	6.7	19.1	8.5	26.0
5	10.4	27.9	10.4	24.6	10.6	26.6	9.9	28.1	5.6	19.1	6.5	23.4	8.6	24.0	6.8	24.6	7.1	27.6	4.3	16.9	6.3	24.9	7.9	25.6
6	11.1	27.1	10.6	26.5	12.7	31.8	7.2	23.4	7.7	21.7	6.1	27.7	7.6	22.0	6.3	23.1	7.0	22.9	2.3	16.8	5.1	21.0	7.1	23.9
7	8.4	22.7	10.4	26.0	13.5	33.6	7.3	21.4	7.3	20.0	2.7	23.8	6.6	19.5	3.6	20.5	5.1	20.5	3.6	17.2	6.2	21.8	6.7	23.0
8	8.4	24.1	12.5	32.2	12.2	29.3	5.9	20.1	6.6	19.8	4.6	16.0	3.3	15.5	4.7	16.9	6.7	23.3	3.2	14.2	8.4	24.3	8.1	24.5
9	7.8	21.8	13.1	32.1	12.5	31.0	6.0	17.0	5.4	21.2	5.7	18.8	4.6	18.8	5.4	19.6	7.1	22.6	3.4	16.8	6.8	22.3	8.9	25.7
10	7.3	24.5	13.2	31.3	11.6	27.4	4.6	19.1	4.4	17.9	5.0	25.9	7.2	24.5	7.8	24.0	6.5	21.1	3.9	18.5	3.5	19.9	8.3	25.6
11	8.6	24.7	11.1	29.2	12.4	28.8	5.7	18.3	2.9	15.4	5.4	17.3	7.0	19.5	7.2	26.0	7.1	24.5	3.3	14.3	6.0	24.0	6.0	20.4
12	8.9	30.1	7.1	21.1	12.7	32.2	7.3	22.3	4.7	17.3	4.8	20.7	5.5	16.7	5.3	19.1	6.1	31.0	3.7	17.3	7.7	29.9	9.0	33.8
13	10.1	26.3	6.0	21.1	10.9	26.1	7.8	20.7	5.0	18.8	6.0	20.0	6.4	17.4	6.9	21.1	6.1	21.8	3.1	20.5	6.8	21.7	7.8	22.8
14	11.5	31.6	7.5	23.0	8.7	23.7	6.9	19.2	3.1	14.7	6.2	18.1	5.3	47.0	5.9	28.3	6.0	20.0	4.5	23.4	6.0	20.1	6.1	25.4
15	11.7	29.5	6.9	21.3	10.8	25.7	7.4	21.8	3.3	16.2	7.5	21.0	4.6	17.5	3.5	21.0	4.6	23.3	4.7	20.5	5.4	19.9	5.5	19.3
16	12.4	28.3	6.1	17.2	13.9	33.9	12.0	30.8	3.9	19.9	7.7	19.6	5.7	24.1	3.9	18.1	2.8	18.0	5.7	20.3	4.3	16.4	6.7	24.2
17	11.5	27.7	7.3	19.5	14.3	33.0	9.4	24.1	5.1	22.8	8.1	21.9	5.9	20.1	3.8	18.1	4.1	19.5	5.6	21.5	6.0	20.4	7.4	24.8
18	12.9	29.2	9.1	24.3	10.4	28.3	10.1	27.8	5.2	18.6	8.3	20.3	7.6	19.4	5.4	16.0	6.9	23.4	4.1	26.7	5.7	23.9	6.4	22.8
19	11.3	28.1	10.2	25.5	8.9	22.0	6.8	22.5	3.7	15.3	7.6	21.9	6.4	22.1	5.9	17.6	3.7	24.1	2.6	19.6	5.4	16.4	5.4	22.8
20	11.3	29.9	6.4	18.2	9.6	22.3	6.7	25.6	3.1	18.7	5.0	16.2	7.5	21.3	3.7	15.8	3.7	25.2	3.9	21.3	5.5	20.0	6.9	26.4
21	13.2	30.0	6.8	17.7	11.4	26.7	7.3	28.2	4.6	25.4	6.3	18.6	6.8	21.5	4.5	18.4	3.9	18.2	5.2	26.3	7.0	29.1	8.1	24.6
22	13.4	29.1	8.8	21.2	10.5	26.0	10.1	29.9	3.4	19.3	6.2	17.5	7.6	25.9	5.6	19.4	3.4	15.5	3.6	27.3	6.9	22.2	6.2	18.1
23	10.9	25.5	8.9	22.5	10.1	24.7	9.3	27.2	3.6	15.6	7.7	20.6	6.1	27.7	7.0	21.7	3.8	18.7	3.5	15.2	4.6	21.2	6.2	27.8
24	7.6	18.8	9.9	30.2	10.2	25.2	8.3	24.2	4.0	19.6	6.1	24.8	5.6	20.6	6.0	21.6	3.1	20.2	2.9	20.5	5.2	23.7	8.5	30.7
25	9.8	24.8	13.6	32.7	11.9	32.1	7.2	22.2	3.5	17.2	5.7	34.5	6.1	18.0	5.4	17.0	4.5	28.5	3.5	19.5	8.9	25.7	6.2	18.6
26	9.7	23.6	12.9	32.4	11.3	27.7	7.3	19.0	3.7	18.8	7.8	26.9	7.1	26.2	6.5	22.8	3.6	21.0	3.7	17.7	8.0	20.5	9.3	26.1
27	6.4	18.9	10.4	26.5	12.1	31.9	7.5	19.3	5.1	25.5	8.3	20.2	8.1	26.1	8.5	22.9	4.2	22.3	4.6	18.5	7.0	22.4	9.7	27.2
28	7.4	23.3	9.7	27.2	10.0	28.2	9.2	23.5	3.1	20.6	8.3	24.6	8.0	24.6	8.1	34.3	4.5	18.5	7.1	29.3	6.4	24.5	8.2	23.7
29	7.1	20.8			8.4	20.9	10.0	25.5	3.3	18.4	6.7	22.8	10.4	26.2	6.1	18.9	7.1	26.1	6.4	24.3	6.1	20.8	9.9	27.2
30	10.7	24.7			9.3	22.7	9.1	25.0	3.3	11.9	7.2	23.0	7.6	21.7	5.8	18.8	6.3	25.8	4.1	27.7	8.5	27.0	8.8	26.3
31	9.4	24.8			7.6	21.7			3.8	15.7			6.1	19.9	6.2	19.1			5.3	19.8			8.3	26.9



2019 Average Daily Wind Direction (°)

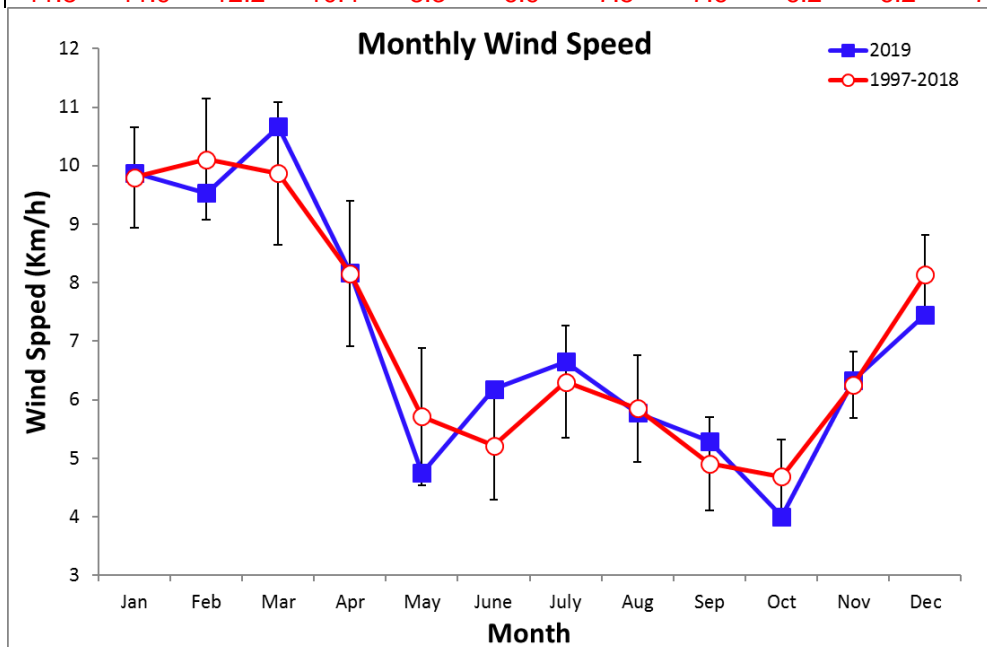
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	342.5	342.2	312.3	317.9	347.0	81.4	260.7	261.7	253.3	113.6	235.3	310.3
2	349.2	347.8	347.0	353.0	345.2	53.4	291.2	266.9	267.9	124.7	235.6	276.5
3	328.1	343.6	341.1	339.5	321.8	269.6	277.9	231.3	238.3	106.7	236.9	288.9
4	328.2	337.2	346.6	345.5	331.9	328.1	349.7	280.4	254.7	310.9	282.9	243.6
5	329.0	338.4	350.8	3.3	311.8	233.9	292.1	248.2	230.2	225.4	276.7	238.7
6	346.0	343.5	343.7	267.0	350.8	227.9	240.3	228.3	249.8	108.1	265.2	256.5
7	315.6	333.9	350.9	336.5	344.0	103.0	292.1	107.9	221.8	105.7	290.4	267.1
8	327.8	339.7	338.9	300.3	351.9	54.2	164.5	11.6	237.9	94.3	12.0	320.8
9	330.0	344.9	341.9	326.1	222.5	256.3	199.9	307.6	246.4	251.6	30.2	15.0
10	324.9	347.9	335.7	349.9	194.1	230.5	237.9	0.3	262.5	207.4	197.0	17.3
11	356.1	334.1	355.7	13.9	278.2	254.8	251.6	352.4	239.7	152.3	220.3	279.7
12	356.7	317.6	356.8	0.5	283.8	235.9	266.2	20.1	276.1	115.1	235.2	22.9
13	347.9	301.4	347.3	342.9	270.6	282.1	273.2	306.0	238.2	110.3	246.1	337.5
14	352.2	310.9	327.7	331.8	227.9	322.8	240.6	235.7	248.4	101.9	243.3	261.5
15	348.0	319.3	359.5	329.1	115.1	17.0	227.0	193.3	211.6	321.9	246.5	272.0
16	348.3	329.9	11.9	356.5	304.8	6.3	250.4	128.1	118.2	258.3	267.1	263.0
17	337.5	343.1	1.6	354.3	243.9	349.8	278.4	44.6	254.9	238.7	250.9	241.3
18	347.7	332.8	333.1	4.0	233.2	350.8	8.8	0.3	231.9	200.6	263.5	234.4
19	346.1	341.4	347.2	326.9	180.7	358.3	345.6	250.9	137.9	112.5	252.1	254.2
20	333.9	301.1	354.8	301.8	110.5	358.1	326.6	244.0	113.0	109.3	258.3	249.2
21	342.7	338.8	1.2	272.0	107.0	244.9	325.3	230.9	105.1	103.0	306.2	16.9
22	347.8	354.0	343.6	18.0	129.0	346.7	312.8	260.1	98.3	220.0	253.8	16.8
23	346.7	339.1	333.5	339.0	117.4	355.8	233.3	336.3	112.6	211.5	290.2	259.2
24	313.1	348.3	334.7	346.1	116.3	285.1	240.1	257.2	103.4	97.0	279.3	247.4
25	337.3	9.0	5.4	329.5	100.7	250.0	257.7	240.8	111.1	108.2	355.1	341.1
26	342.6	2.5	335.2	322.0	117.5	337.4	240.4	254.1	111.4	81.2	316.2	18.9
27	313.5	350.9	336.3	313.2	140.8	315.9	253.8	350.4	110.1	253.2	351.2	354.2
28	290.8	348.7	322.9	349.5	107.3	351.7	323.5	22.3	147.1	226.0	23.6	5.7
29	299.0		340.8	359.4	123.9	253.1	350.2	291.5	247.7	222.6	265.8	358.6
30	355.7		348.6	359.5	180.9	241.5	322.1	268.1	216.1	279.5	2.1	335.8
31	333.0		321.6		263.0		282.2	263.4		251.6		321.4



Average Monthly Wind Speed (km/h) and Direction (°)

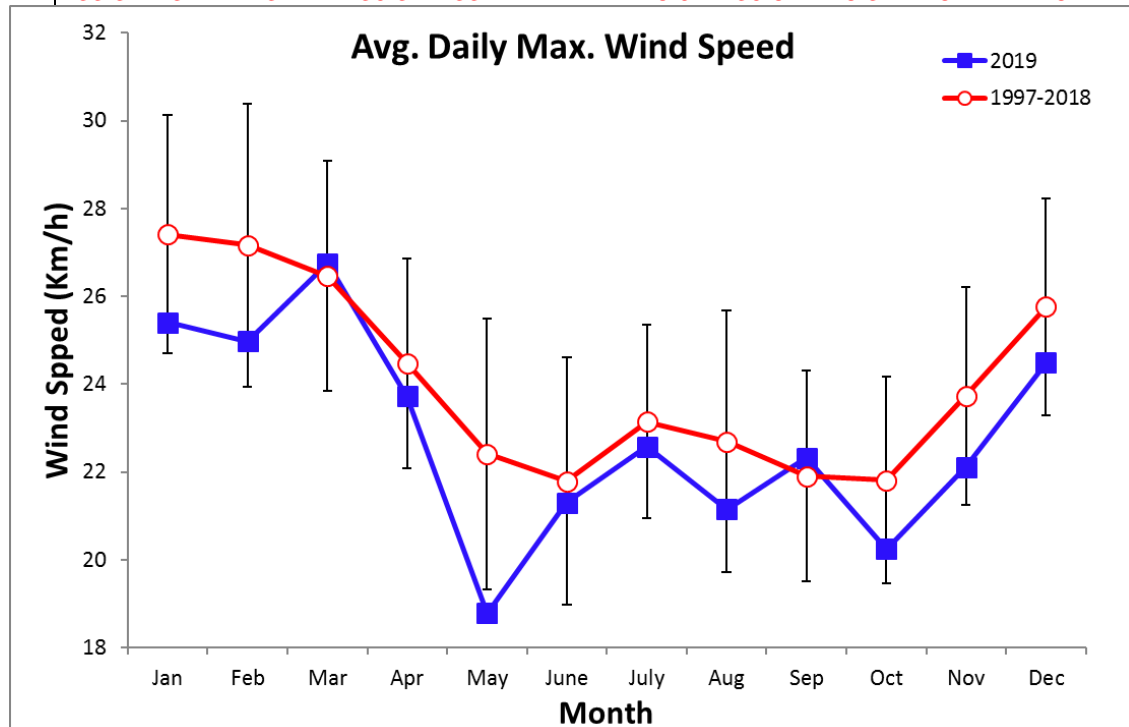
Monthly Average Wind Speed

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				5.3	8.3	5.6	7.5	7.6	6.0	5.6	5.6	8.5
1998	9.8	8.8	10.5	9.4		5.0	6.5	5.5	4.9	5.4	6.1	7.6
1999	10.0	11.0	10.8	9.1	6.0	3.8	6.3	5.2	4.2	4.9		7.9
2000	8.5	10.8			5.5	5.9	6.8	6.7	4.5	6.2	6.7	8.3
2001	9.8	11.5	8.4	10.4	6.0	6.9	6.2	6.4	5.1	4.9	6.4	7.5
2002	9.5	11.0	11.0	10.3	7.7	4.8	6.6	6.9	4.9			10.0
2003	10.3	9.7	7.3	7.8	5.4	5.1	6.3	5.9	4.7		6.3	8.0
2004	10.2	10.2	12.2	8.9	6.4	6.1	6.2	6.4	4.7	4.8	6.9	9.3
2005	11.5	11.1	7.7		3.0	3.1	5.0	5.6	5.7	4.1	6.6	7.7
2006	9.8	10.7	10.8	7.3	5.7	4.9	5.5	5.8	5.6	5.1	6.7	7.8
2007	11.8	9.5	10.0	7.0	5.4	5.3	6.2	4.6	5.4	4.9	7.1	7.8
2008	10.6	9.4	9.6	9.1	6.0	5.4	5.6	5.0	4.2	4.5	6.2	8.4
2009	10.1	11.7	10.8	9.2	6.1	5.1	7.0	6.7	6.2	4.8	6.3	8.3
2010	9.2	8.7	8.6	7.3	5.0	3.9	3.7	3.7	2.9	5.1	6.1	8.6
2011	8.5	9.4	9.2	7.3	5.5	4.3	4.5		4.0	3.5	6.6	7.4
2012	10.5	9.9	10.9	6.3	4.7	5.1	7.2	4.8	5.7	4.7	7.2	8.0
2013	10.3	9.6	9.9	8.2	6.0	5.3	6.5	5.9	4.2	4.6	5.4	8.2
2014	8.9	9.5	9.0	8.7	6.4	6.4	7.4	6.1	4.8	4.3	6.8	7.2
2015	9.0	8.3	10.4	8.6	7.3	6.5	7.3	7.0	5.9	4.8	5.2	7.9
2016	8.8	11.1	9.0	7.8	5.8	4.9	6.6	5.5	5.2	3.7	5.4	9.1
2017	9.6	9.2	10.3	7.4	4.0	4.5	6.1	5.1	3.8	4.3	6.1	8.8
2018	9.1	11.9	10.1	7.7	4.6	5.8	7.5	6.6	5.1	4.3	5.6	7.5
2019	9.9	9.5	10.7	8.2	4.7	6.2	6.6	5.8	5.3	4.0	6.3	7.5
mean	9.8	10.1	9.9	8.2	5.7	5.2	6.3	5.9	4.9	4.7	6.3	8.1
sd	0.9	1.0	1.2	1.2	1.2	0.9	1.0	0.9	0.8	0.6	0.6	0.7
min	8.5	8.3	7.3	5.3	3.0	3.1	3.7	3.7	2.9	3.5	5.2	7.2
max	11.8	11.9	12.2	10.4	8.3	6.9	7.5	7.6	6.2	6.2	7.2	10.0



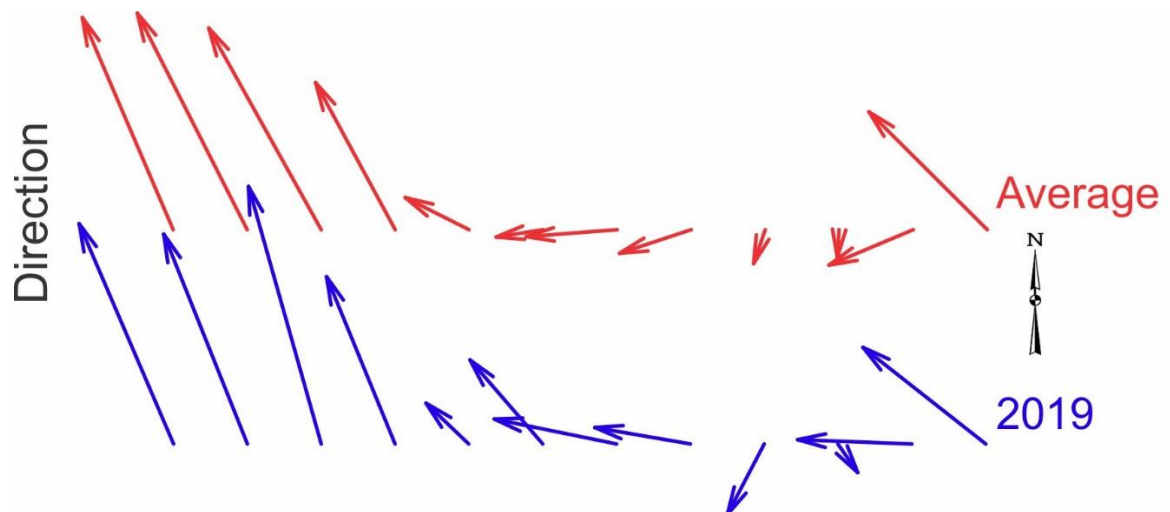
Monthly Average Daily Maximum Wind Speed

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				27.6	33.4	27.2	28.9	30.6	28.3	26.4	27.6	29.0
1998	26.0	19.1	21.7	20.5		14.6	17.2	15.1	16.6	16.1	17.7	18.3
1999	21.8	22.2	22.1	25.2	19.9	17.2	24.3	22.7	22.4	25.2		29.1
2000	27.6	30.6			22.8	23.0	24.9	24.8	21.9	25.2	24.4	28.5
2001	28.7	31.2	25.7	29.4	24.4	25.2	24.0	25.1	23.8	23.2	26.1	27.1
2002	28.1	31.4	30.6	30.3	26.9	22.0	24.3	25.8	22.3			28.6
2003	32.4	28.2	26.8	26.1	22.4	25.1	24.8	24.4	22.7		25.2	27.5
2004	28.9	29.4	32.7	26.3	23.4	25.8	26.1	26.2	24.7	22.7	25.9	28.9
2005	33.3	30.9	24.0		21.3	22.6	22.9	24.1	25.3	24.4	26.2	25.9
2006	28.2	30.3	30.2	24.7	24.1	22.5	23.9	24.0	24.6	23.8	26.7	25.8
2007	32.1	27.1	28.0	24.6	23.4	26.0	23.3	20.8	21.1	22.4	25.3	25.1
2008	29.4	26.3	24.9	23.0	21.8	20.1	21.9	20.8	21.3	21.2	24.4	25.3
2009	27.0	30.5	27.9	24.9	20.3	21.6	23.1	22.2	21.8	20.6	22.3	24.3
2010	25.8	24.7	24.7	22.6	22.0	20.5	19.9	20.5	20.6	22.8	23.4	26.7
2011	25.2	25.8	25.5	23.0	19.9	21.2	21.3		20.0	20.1	23.9	24.0
2012	27.6	26.9	28.0	22.4	20.4	20.7	23.3	20.5	20.9	21.5	24.6	24.4
2013	27.0	25.8	26.3	23.0	22.4	20.9	22.3	22.7	18.9	20.4	20.8	24.7
2014	24.7	25.4	25.1	23.6	21.2	21.4	23.4	21.9	21.6	20.4	23.3	25.0
2015	26.6	24.0	27.1	24.3	22.2	21.3	22.4	22.0	21.3	19.9	19.8	22.6
2016	24.4	28.3	24.7	24.0	22.3	20.2	22.0	20.7	21.1	19.9	25.0	25.9
2017	26.0	24.9	26.5	22.3	19.7	20.1	21.9	21.0	19.4	21.2	23.1	27.3
2018	26.9	29.9	26.6	22.7	20.1	20.8	23.7	22.2	20.9	20.6	20.8	24.2
2019	25.4	25.0	26.8	23.7	18.8	21.3	22.6	21.1	22.3	20.2	22.1	24.5
mean	27.4	27.2	26.5	24.5	22.4	21.8	23.1	22.7	21.9	21.8	23.7	25.8
sd	2.7	3.2	2.6	2.4	3.1	2.8	2.2	3.0	2.4	2.4	2.5	2.5
min	21.8	19.1	21.7	20.5	18.8	14.6	17.2	15.1	16.6	16.1	17.7	18.3
max	33.3	31.4	32.7	30.3	33.4	27.2	28.9	30.6	28.3	26.4	27.6	29.1

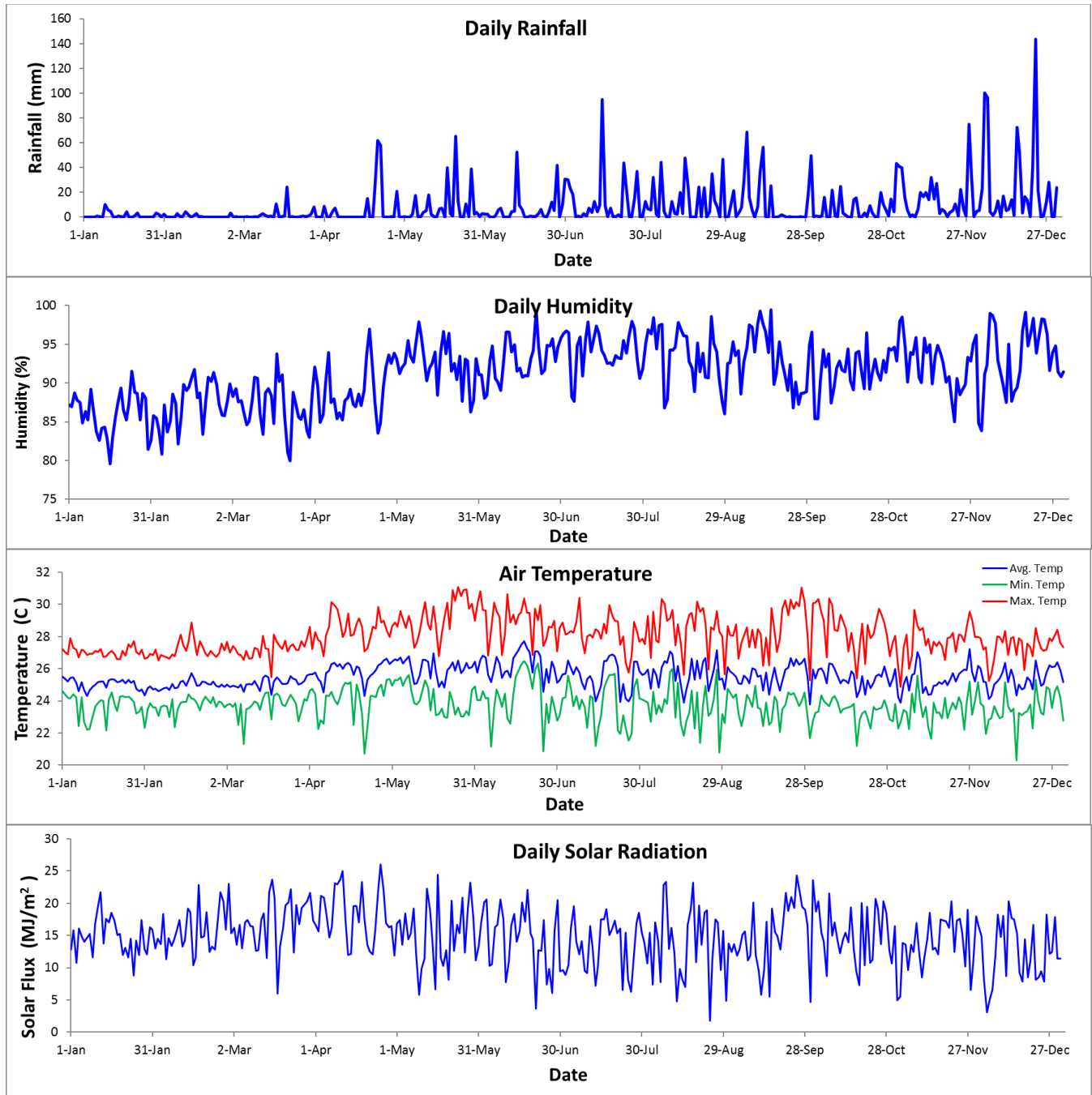


Monthly Average Wind Direction

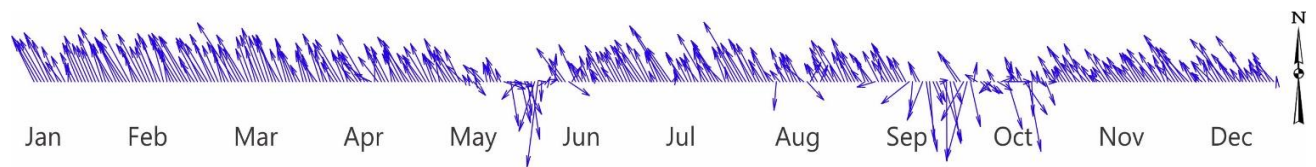
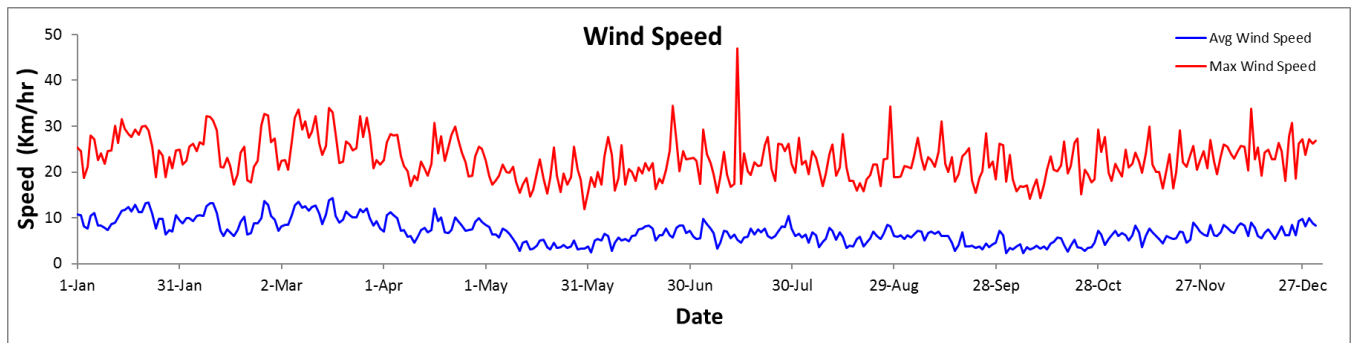
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
1997				147.0	188.7	207.8	276.3	251.7	200.2	242.1	159.3	272.2
1998	278.8	286.8	293.6	349.9		297.7	275.1	260.5	160.1	181.2	258.9	283.1
1999	356.6	308.9	285.2	295.0	228.6	166.4	203.3	169.2	98.7	98.6	169.8	252.6
2000	304.9	308.1		292.3	272.7	227.2	263.0	240.9	109.5	216.0	237.3	275.6
2001	306.7	314.5	293.2	314.2	255.3	302.9	231.4	234.6	167.6	180.4	203.6	242.9
2002	305.7	313.4	310.9	314.9	342.6	1.9	249.5	243.7	181.7			
2003												
2004												
2005												
2006												
2007		270.1	269.4	272.1	187.6	224.4	215.2	202.0	228.7	106.0	259.5	332.2
2008	340.8	325.4	329.6	325.0	353.7	264.0	237.6	204.4	118.2	115.9	237.2	337.3
2009	338.7	345.1	6.0	1.3	327.8	319.5	301.7	293.5	296.3	217.3	281.1	339.0
2010	348.7	352.6	342.0	8.7	77.3	217.6	183.6	188.2	137.7	264.9	275.5	340.2
2011	359.4	21.4	12.8	341.5	3.3	217.7	237.7		184.6	161.1	244.5	315.5
2012	1.8	352.3	352.7	306.6	265.6	250.5	282.4	238.7	252.5	212.9	285.7	304.7
2013	356.6	350.6	347.3	339.9	300.8	238.9	258.0	240.3	166.9	233.3	292.1	350.6
2014	337.5	338.0	337.3	337.1	315.9	283.8	321.2	269.6	241.5	158.5	255.2	308.9
2015	357.5	337.1	347.9	345.3	326.5	339.4	297.1	292.2	256.5	217.8	246.4	325.4
2016	340.1	346.1	344.6	344.1	273.9	258.0	267.2	266.8	236.6	155.4	218.3	353.8
2017	354.0	349.5	349.4	337.9	213.5	209.8	258.1	252.6	158.7	199.0	230.6	318.8
2018	317.0	358.4	338.7	335.0	319.4	255.3	291.3	274.0	250.3	181.8	277.7	338.2
2019	336.7	338.2	344.2	337.7	313.4	319.0	281.4	279.7	207.6	145.4	272.1	308.1
mean	336.7	333.0	330.8	331.5	296.5	261.1	265.6	251.7	198.7	183.7	247.2	314.8



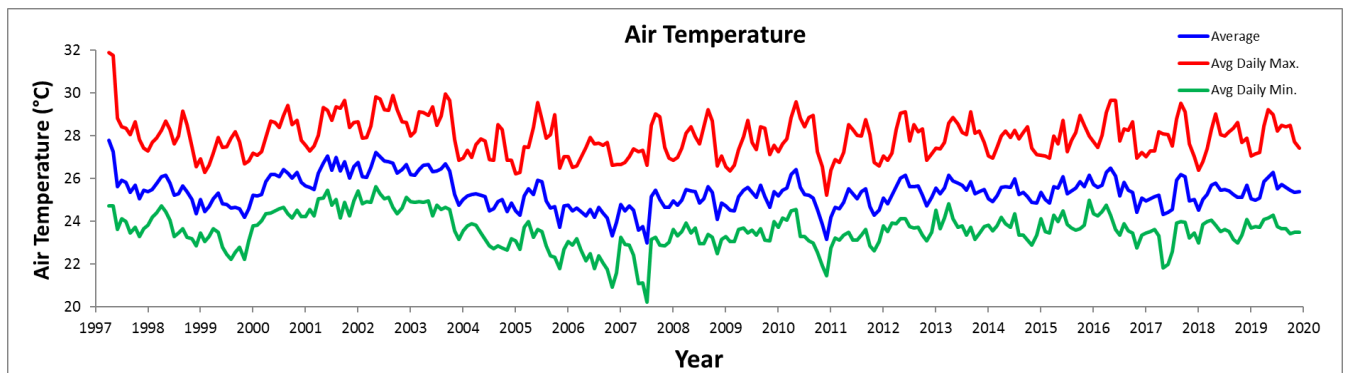
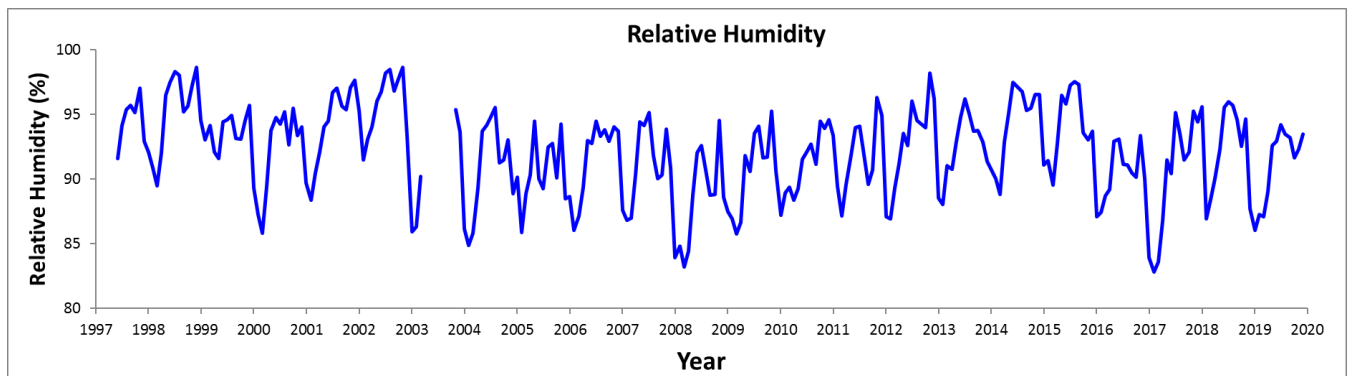
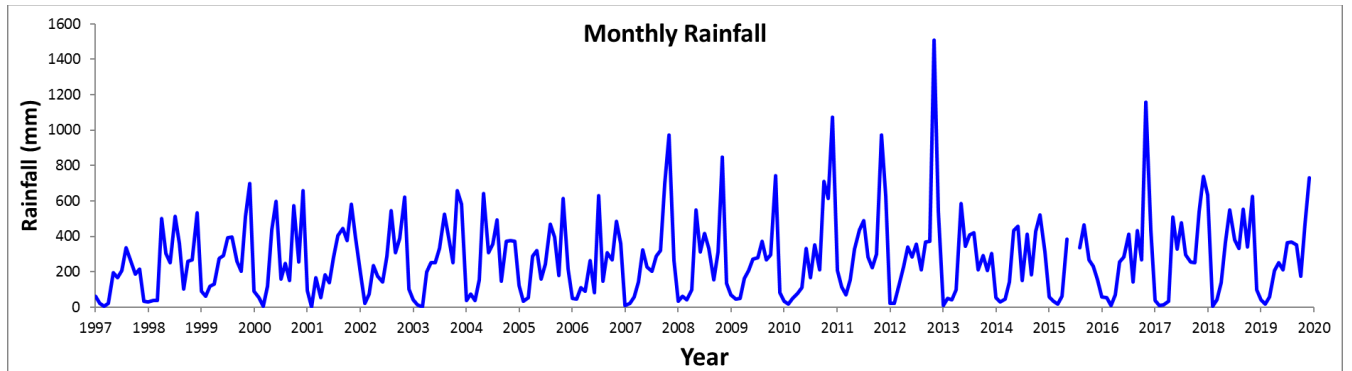
Time Series – Daily 2019



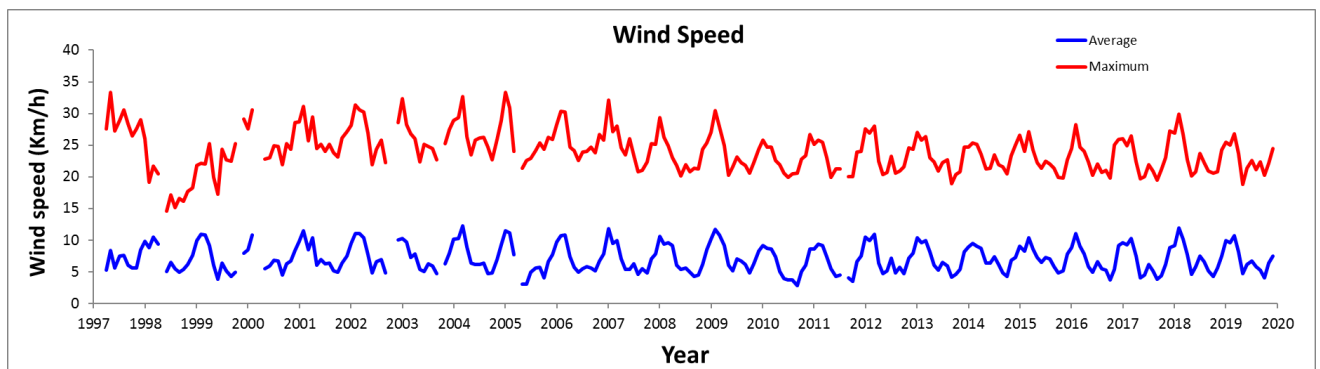
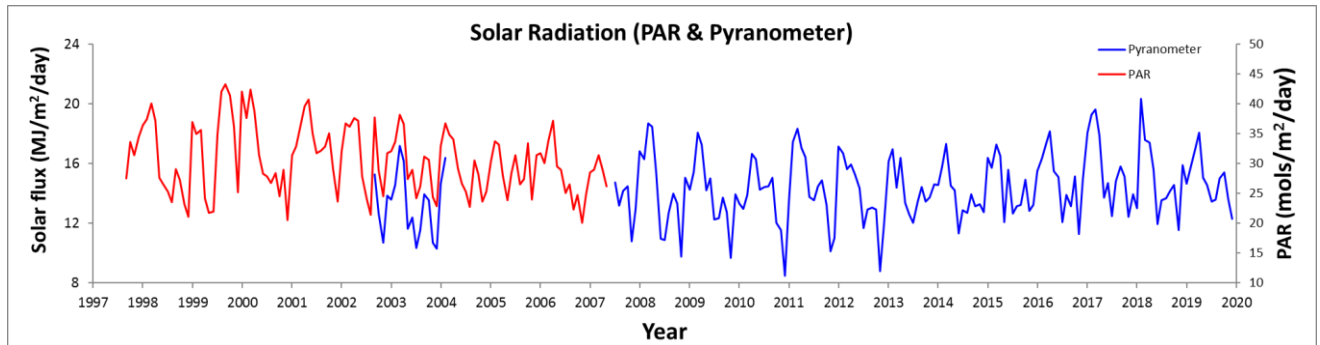
Time Series – Daily 2019



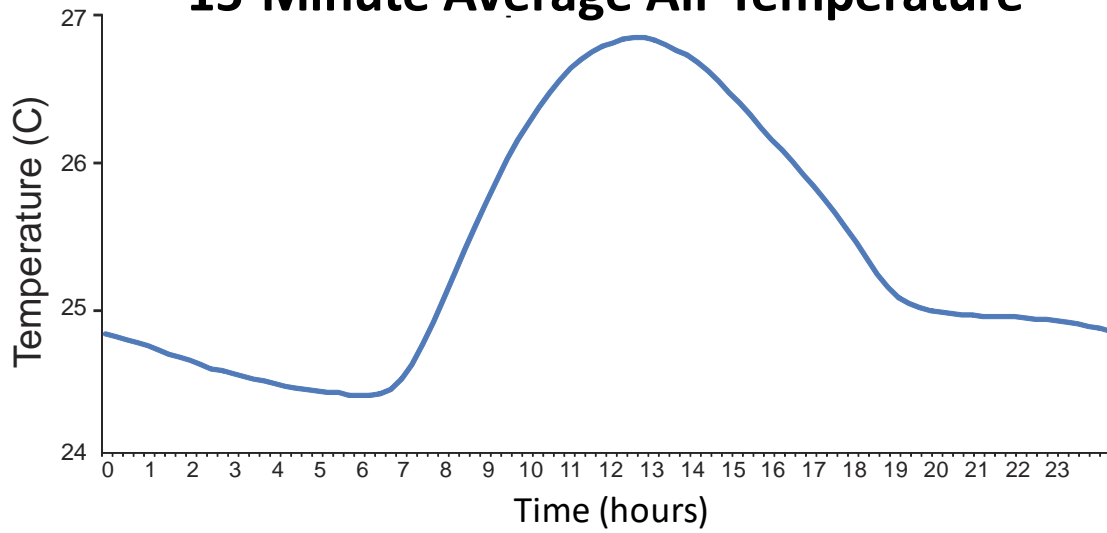
Time Series – Monthly



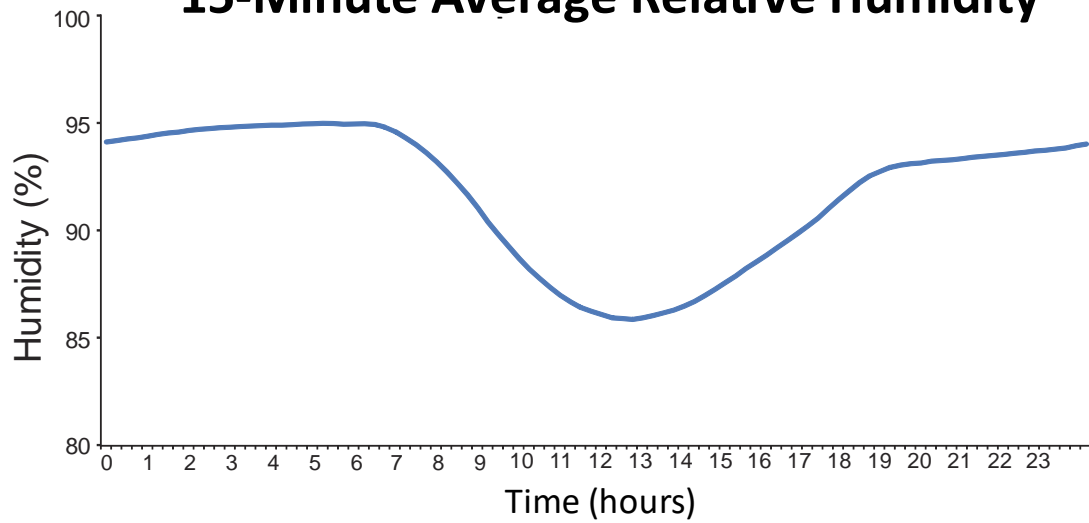
Time Series – Monthly



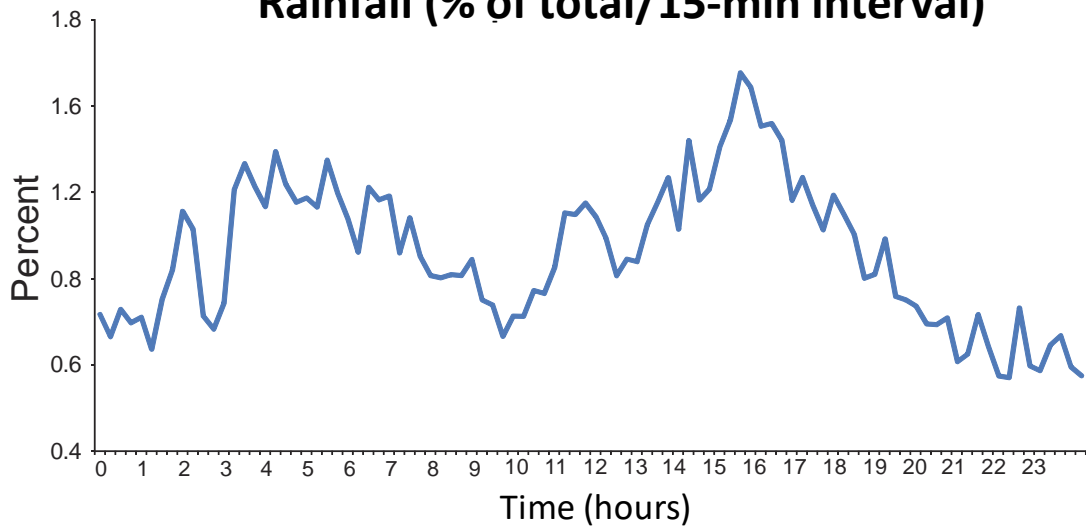
15-Minute Average Air Temperature



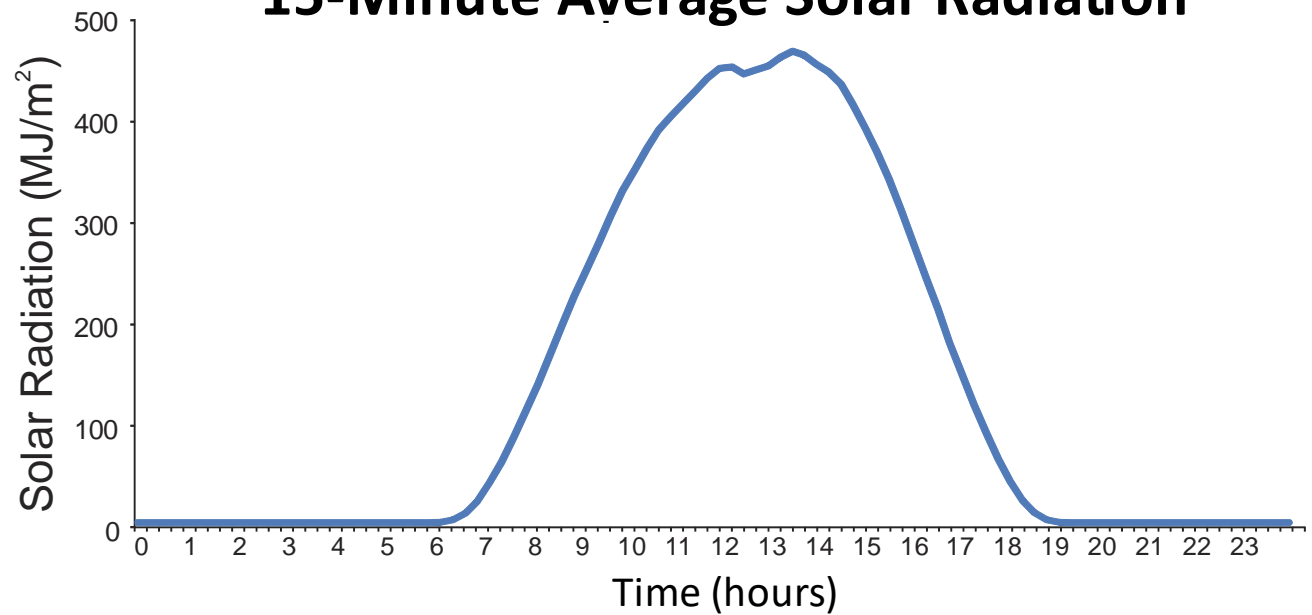
15-Minute Average Relative Humidity



Rainfall (% of total/15-min interval)



15-Minute Average Solar Radiation



15-Minute Average Wind Speed

