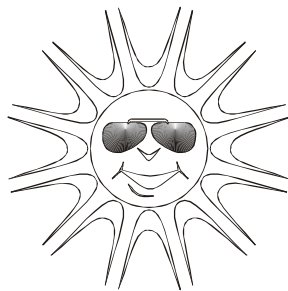




Smithsonian Tropical Research Institute

2019 Meteorological Summary for the Punta Culebra Nature Center

Prepared by: Steven Paton



Introduction

This is the 6th of a series of yearly reports summarising the past year's Smithsonian Tropical Research Institute's Physical Monitoring Program at the Punta Culebra Nature Center (PCNC). 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 PCNC and other research locations, can be obtained from:

biogeodb.stri.si.edu/physical_monitoring/research/culebra

Setting

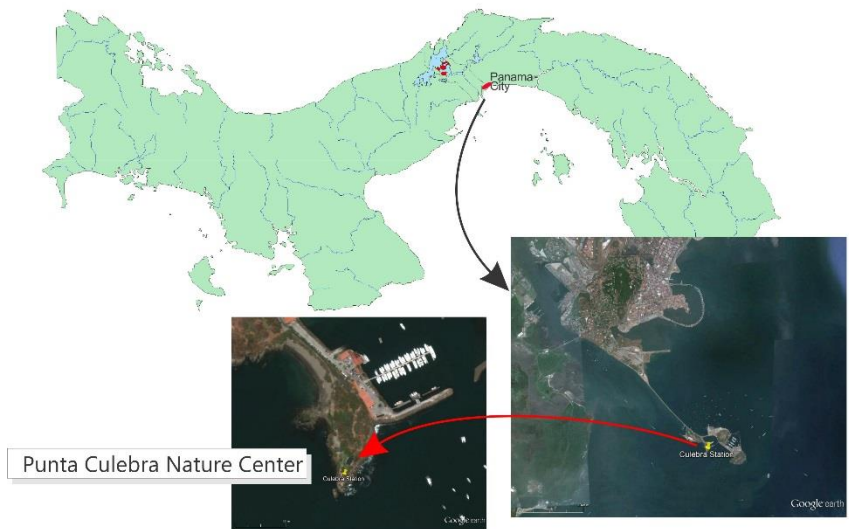
Established in 2010, the PCNC meteorological station (8.910718°, -79.528919°) is located at the South Western edge of Panama City, at the end of the Amador Causeway, at the southern end of Punta Culebra. The station consists of a standard 6m triangular tower that was erected in March of 2010. In addition, a manual rain gauge located at the entrance to the PCNC has been in operation since July of 2004.

The PCNC occupies a territory of approximately 1 1/2 hectares and offers visitors an open-air museum focusing mainly on marine science and education, conservation and interpretation of marine coastal environments. In addition to the surrounding marine environment, the PCNC also has one of the few remaining patches of tropical dry forest in the area.



The station receives an average of 1558.4 mm 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 139mm 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 and recorded every 15 minutes.

Republic of Panama

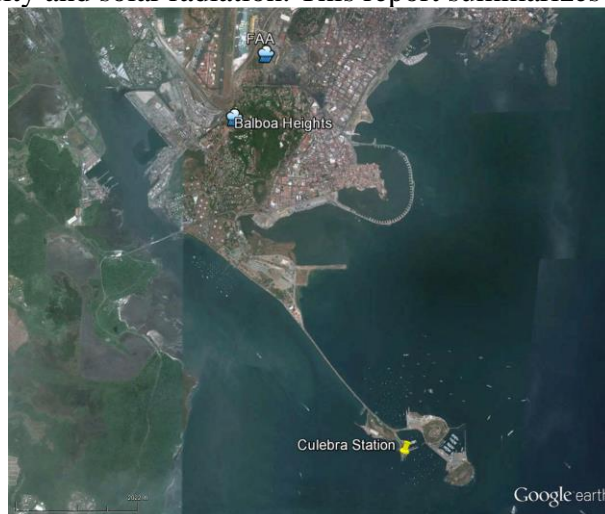


Produced by Stream Poles for the Smithsonian Tropical Research Institute
Last revised: Feb. 05, 2015

This report summarises the following data:

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

The Autoridad del Canal de Panamá (ACP) (Panama Canal Authority in English) maintains two nearby stations: Albrook Airbase (FAA) and Balboa Heights (HTS) – located 6.9 and 6.1km NNW of the PCNC tower, respectively. Both stations record precipitation, while the HTS station also records wind, air temperature, relative humidity and solar radiation. This report summarizes the data from these stations.



Rainfall

Rainfall was collected by a tipping bucket rain gauge located at approximately 3m on the tower. Tipping buckets generate 'events' for every 0.254 mm of rainfall recorded. Rainfall was also collected using a manual rain gauge. The gauge was read an average of 8.5 times per month.

The daily rainfall data for 2019 are shown on page 6.

Page 7 shows the monthly totals for the period 2004 to 2019 using data from that manual rain gauge that have been prorated using tipping bucket data so that totals collected after several days (such as weekends) are distributed according to the data registered by the tipping bucket. The graph on the same page compares this year's monthly totals with the average monthly totals (\pm SD) for the period 2010 to 2018.



Page 8 shows yearly rainfall totals for all years since 2005. Time series graph and frequency histograms are presented for these data.

Pages 9 and 10 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 1995 to 2018 and for the year 2019.

Relative Humidity

Relative Humidity was measured by a Campbell Sci. CS215 temperature/humidity sensors located at approximately 3m (Viasala HMP 35/45 sensors prior to 2010).

The average monthly relative humidity data are shown in tabular and graphical form on pages 11.

Air Temperature

Air temperature was measured by a Campbell Sci. CS215 temperature/humidity sensors (Viasala HMP 35/45 sensors prior to 2010) located at approximately 3m. The monthly average, maximum and minimum temperatures are shown in tabular and graphical form on page 12 to 14, respectively.

Solar Radiation

Until Mar 2016, Global solar radiation was measured by two Li-Cor LI200SB pyranometers located near the top of the tower (~6m). After that date, one of the sensors has been a Kipp&Zonen SPLite2 pyranometer. 15-minute interval average intensity, maximum and minimum (W/m^2) were recorded.

Page 15 shows the Daily Global Radiation values. Page 16 shows monthly daily average total Global Radiation.

Wind Speed and Direction

Wind speed and direction was measured by a Model 05103 Young Anemometer located at the very top of the tower (6m).

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, monthly average daily maximum wind speed and monthly average directions, respectively.



Marine Monitoring

Temperature, salinity and pH readings are made 3-5 times per week in the morning at three locations on Naos Island: the Naos Station marine tanks, the STRI Naos Dock, and the ACP Naos Dock.

Measurements are made with a YSI Professional Pro handheld sensor with the following sensors:

- YSI model Pro1001A pH sensor
- YSI model 5560 Conductivity/Temperature sensor

Monthly averages are found on pages 23 to 28.



Times Series

Graphs showing the daily averages for 2019 and the monthly averages for the entire period of record for Humidity, Air Temperature, Rainfall, Wind Speed and Solar Radiation can be found on pages 29 to 32.

Daily Patterns

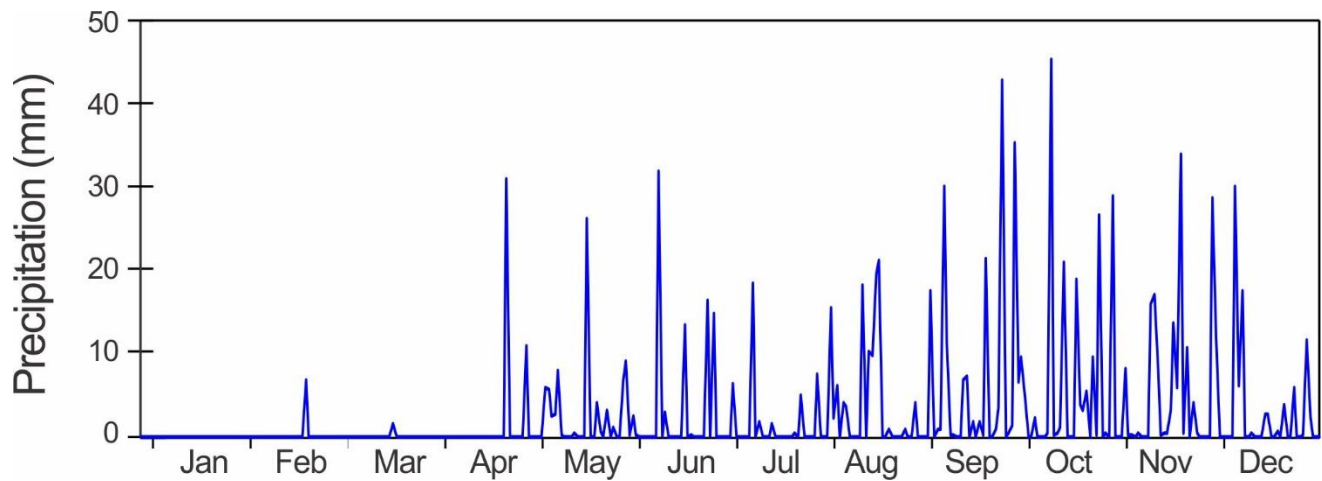
Pages 33 and 34 show the daily patterns for Humidity, Air Temperature, Rainfall, Wind Speed and Solar Radiation.

ACP Stations

The Autoridad del Canal de Panamá (ACP) (Panama Canal Authority in English) maintains two nearby stations: Albrook Airbase (FAA) and Balboa Heights (HTS). The stations are located at Lat/Long 8.968889°, -79.549444° and 8.959444°, -79.554167° respectively. Data were collected hourly. No information is available regarding instrumentation. A summary of rainfall, wind speed and direction and air temp for these stations is shown on pages 27-33. Relative humidity, air pressure and solar radiation data were also collected at the FAA station, but not reported here due to obvious problems with the data (the data are, however, available in the associated Excel spreadsheet).

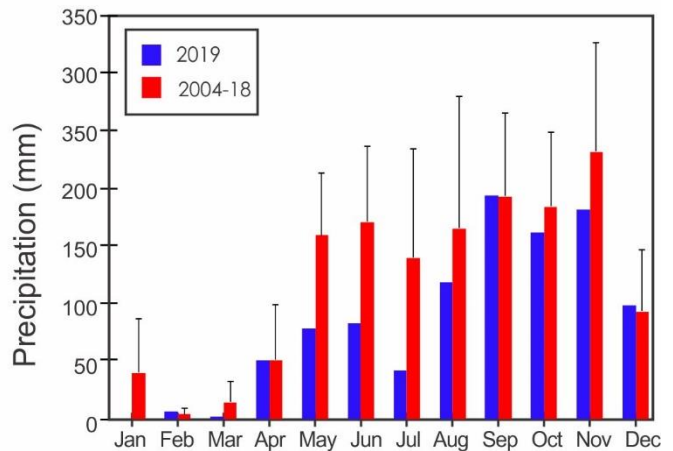
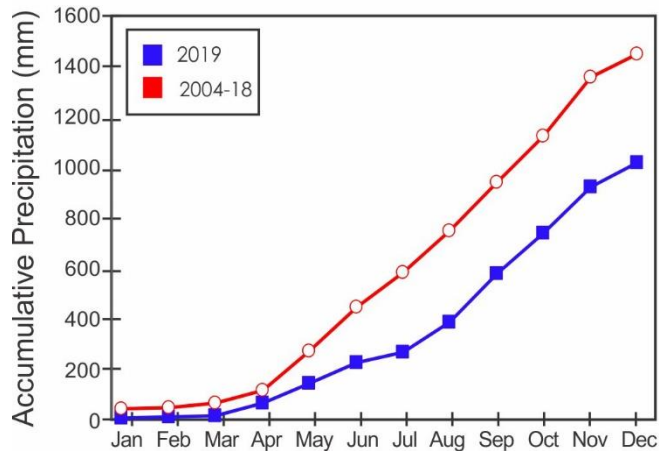
2019 Daily Rainfall (mm) - Electronic

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	5.1	8.4	0.0
2	0.0	0.0	0.0	0.0	0.0	2.6	0.0	15.5	17.5	0.0	0.3	0.0
3	0.0	0.0	0.0	0.0	0.0	0.3	6.5	2.4	0.0	0.0	0.3	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	1.0	2.3	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	30.2
6	0.0	0.0	0.0	0.0	6.1	0.0	0.0	4.2	30.2	0.0	0.0	6.4
7	0.0	0.0	0.0	0.0	5.7	0.0	0.0	3.8	11.4	0.0	0.0	17.5
8	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.3	0.5	0.0	0.0
9	0.0	0.0	0.0	0.0	2.9	0.0	18.5	0.0	0.3	45.5	16.0	0.0
10	0.0	0.0	0.0	0.0	8.0	32.0	0.0	0.0	0.0	0.3	17.3	0.5
11	0.0	0.0	0.0	0.0	0.3	0.0	2.0	0.0	0.0	0.5	8.1	0.0
12	0.0	0.0	0.0	0.0	0.0	3.0	0.0	18.3	6.9	1.3	0.3	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	21.1	0.5	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	0.0	0.0	0.5	2.8
15	0.0	0.0	0.0	0.0	0.6	0.0	1.8	10.0	2.0	0.0	3.3	2.8
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	0.0	0.0	13.7	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3	2.0	19.1	6.1	0.0
18	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.0	0.3	4.1	34.0	0.8
19	0.0	0.0	0.0	0.0	26.2	0.0	0.0	0.0	21.6	3.3	0.5	0.0
20	0.0	0.0	1.8	0.0	0.0	0.3	0.0	1.0	0.0	5.6	10.9	4.1
21	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	4.2	0.0	0.5	0.0	1.0	9.7	4.3	0.0
23	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	3.6	0.3	0.5	6.1
24	0.0	0.0	0.0	31.0	0.0	0.0	5.1	0.0	42.9	26.7	0.0	0.0
25	0.0	0.0	0.0	0.0	3.4	16.5	0.0	1.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.0	0.3
27	0.0	0.0	0.0	0.0	1.2	15.0	0.0	0.0	1.5	0.0	0.0	11.7
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	35.3	29.0	28.7	2.3
29	0.0		0.0	0.0	0.0	0.0	7.6	0.0	6.6	0.0	11.9	0.0
30	0.0		0.0	11.0	7.0	0.0	0.0	0.0	9.7	0.0	0.0	0.0
31	0.0		0.0		9.3		0.0	0.0		0.0		0.0
	0.0	6.9	1.8	42.0	78.6	83.6	42.0	118.1	203.0	174.5	166.1	85.4



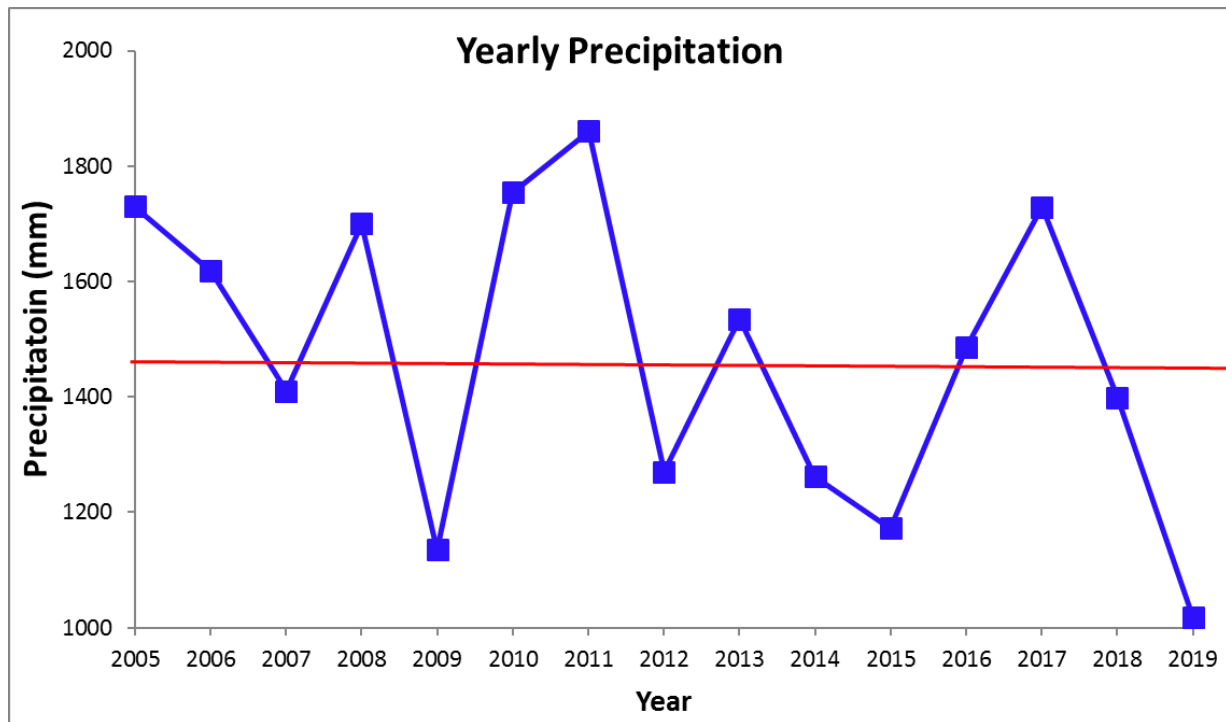
Monthly Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2004							207.5	134.6	245.5	234.0	302.3	32.8	
2005	18.3	3.2	22.6	77.2	178.0	330.8	227.6	162.0	308.4	180.8	115.3	105.6	1729.8
2006	14.0	3.1	42.8	79.1	157.8	325.2	174.6	181.6	142.9	179.8	261.2	56.4	1618.5
2007	2.0	0.8	0.0	46.7	256.8	135.8	188.0	179.8	187.5	117.8	163.8	131.7	1410.7
2008	8.4	45.6	4.5	32.2	137.4	195.2	74.2	323.9	163.8	231.4	320.0	163.8	1700.4
2009	12.6	6.5	0.0	7.2	135.0	244.6	115.4	84.4	73.8	170.5	276.5	8.7	1135.2
2010	2.5	2.0	16.5	138.4	141.7	277.3	246.9	364.1	132.5	98.3	156.7	177.5	1754.4
2011	63.0	10.5	33.2	120.8	211.0	63.0	345.7	204.3	192.5	92.5	424.4	99.5	1860.4
2012	81.2	8.5	0.0	66.0	105.5	188.8	132.7	51.0	72.8	253.5	193.0	117.5	1270.5
2013	0.0	0.0	0.4	5.1	143.5	193.4	76.6	208.2	344.8	283.3	193.1	86.8	1535.1
2014	11.1	13.0	1.0	14.3	226.9	117.7	64.0	45.4	217.6	242.9	150.1	158.2	1262.3
2015	79.6	1.0	33.3	23.9	128.2	176.5	61.3	87.6	207.5	162.6	179.5	31.0	1172.0
2016	8.6	0.0	0.0	14.3	251.5	216.9	116.5	119.0	134.7	205.3	374.2	45.8	1486.7
2017	18.5	0.3	50.6	10.5	159.2	176.3	159.5	349.2	224.6	200.9	269.7	110.1	1729.4
2018	136.0	1.5	9.4	69.5	146.4	218.9	154.0	106.31	212.4	139.7	194.9	9.65	1398.6
2019	0.0	6.9	1.8	51.0	78.6	83.6	42.0	118.1	194.0	161.8	182.1	98.3	1018.2
Mean	40.1	4.4	14.6	51.4	159.3	171.2	139.9	165.3	193.3	184.1	231.8	93.4	1448.8
sd	47.0	4.9	18.3	47.4	54.6	65.6	94.6	114.5	72.1	64.6	94.7	53.1	275.2
Min	0.0	0.0	0.0	5.1	78.6	63.0	42.0	45.4	72.8	92.5	150.1	9.7	1018.2
Max	136.0	13.0	50.6	138.4	251.5	277.3	345.7	364.1	344.8	283.3	424.4	177.5	1860.4
Rank	15	5	10	8	16	15	17	12	8	13	12	9	15



Yearly Rainfall (mm) - Manual

Year	Rain	Year	Rain	Year	Rain
2005	1729.8	2010	1754.4	2015	1172.0
2006	1618.5	2011	1860.4	2016	1486.7
2007	1410.7	2012	1270.5	2017	1729.4
2008	1700.4	2013	1535.1	2018	1398.6
2009	1135.2	2014	1262.3	2019	1018.2

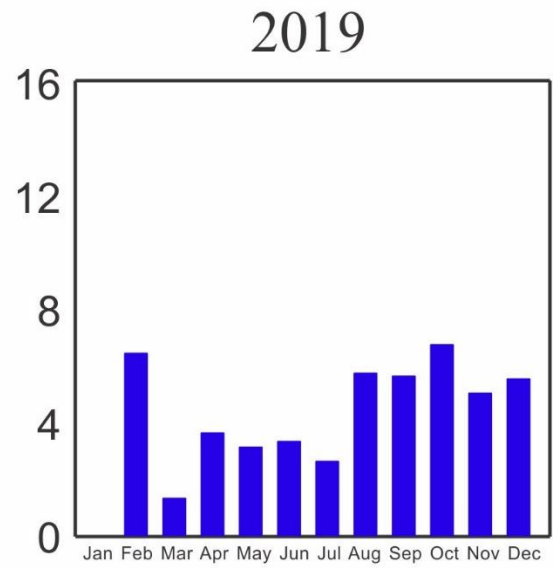
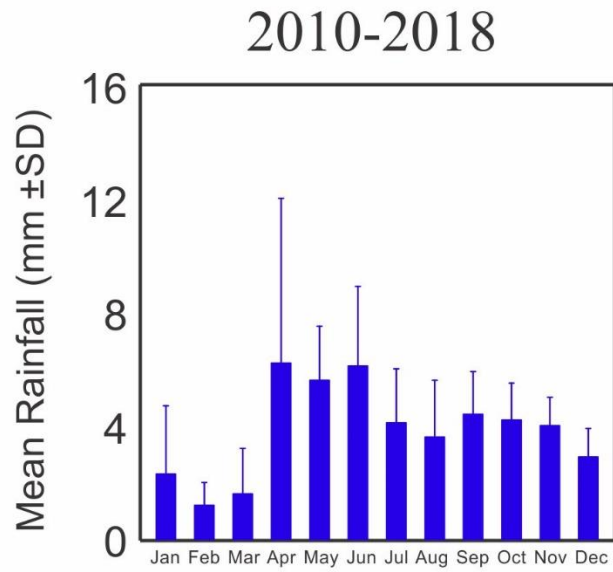


Storm Analysis

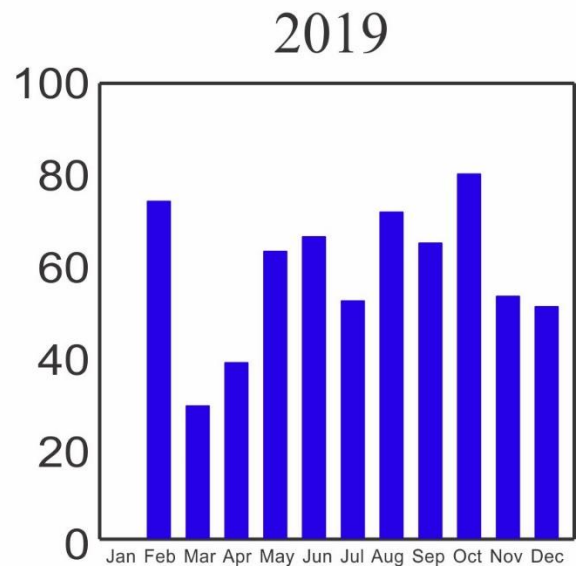
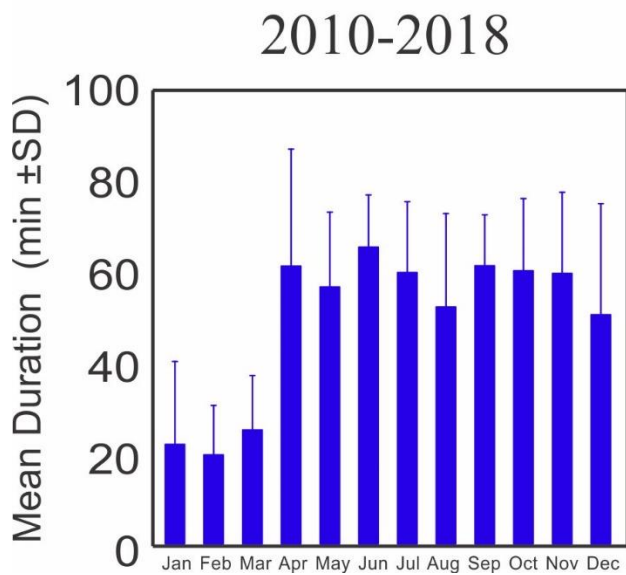
	Max. Rainfall per Storm (mm)			Storm Duration (min.)		
	2006-2018		2019	2006-2018		2019
	Mean	S.D.		Mean	S.D.	
January	17.6	20.5		24.6	17.8	
February	3.8	3.8	6.4	19.0	9.6	74.0
March	8.0	10.1	1.3	29.5	14.0	29.0
April	20.7	20.1	19.6	57.8	24.7	38.5
May	47.3	19.7	16.8	56.9	14.4	63.0
June	42.8	16.9	13.2	66.3	13.8	66.2
July	35.4	19.0	13.0	61.1	14.0	52.1
August	36.1	31.3	27.7	58.1	22.0	71.6
September	52.9	34.2	42.4	64.8	12.0	64.8
October	44.7	16.0	29.0	61.7	14.9	80.0
November	39.4	9.9	34.0	60.8	15.8	53.1
December	31.0	15.5	30.2	50.8	21.2	50.8

	Av. Rainfall per Storm (mm)		
	2006-2018		2019
	Mean	S.D.	
January	3.1	2.7	
February	1.0	0.8	6.4
March	2.8	3.3	1.3
April	5.5	5.3	3.6
May	5.2	1.8	3.1
June	5.9	2.6	3.3
July	4.2	1.7	2.6
August	4.3	2.7	5.7
September	5.1	2.0	5.6
October	4.5	1.3	6.7
November	4.8	1.7	5.0
December	3.2	1.1	5.5

Average Monthly Storm Size

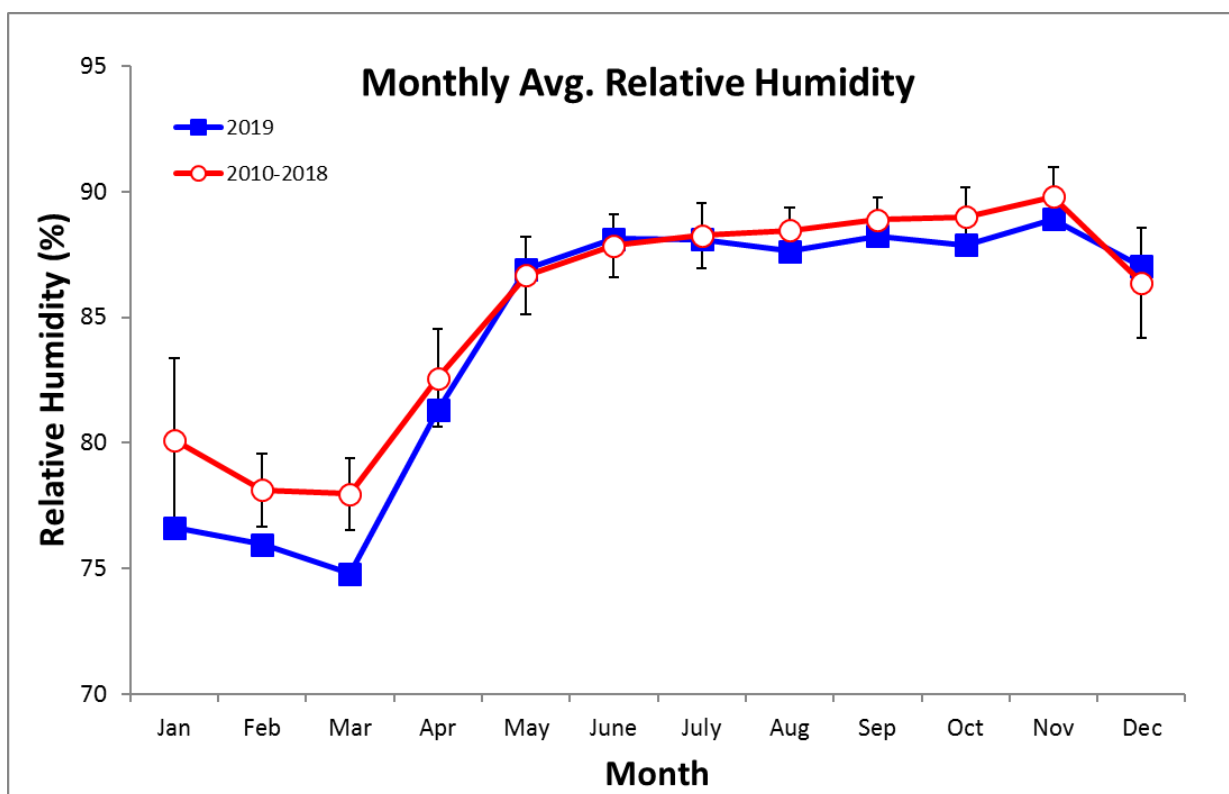


Average Monthly Storm Duration



Relative Humidity (%)

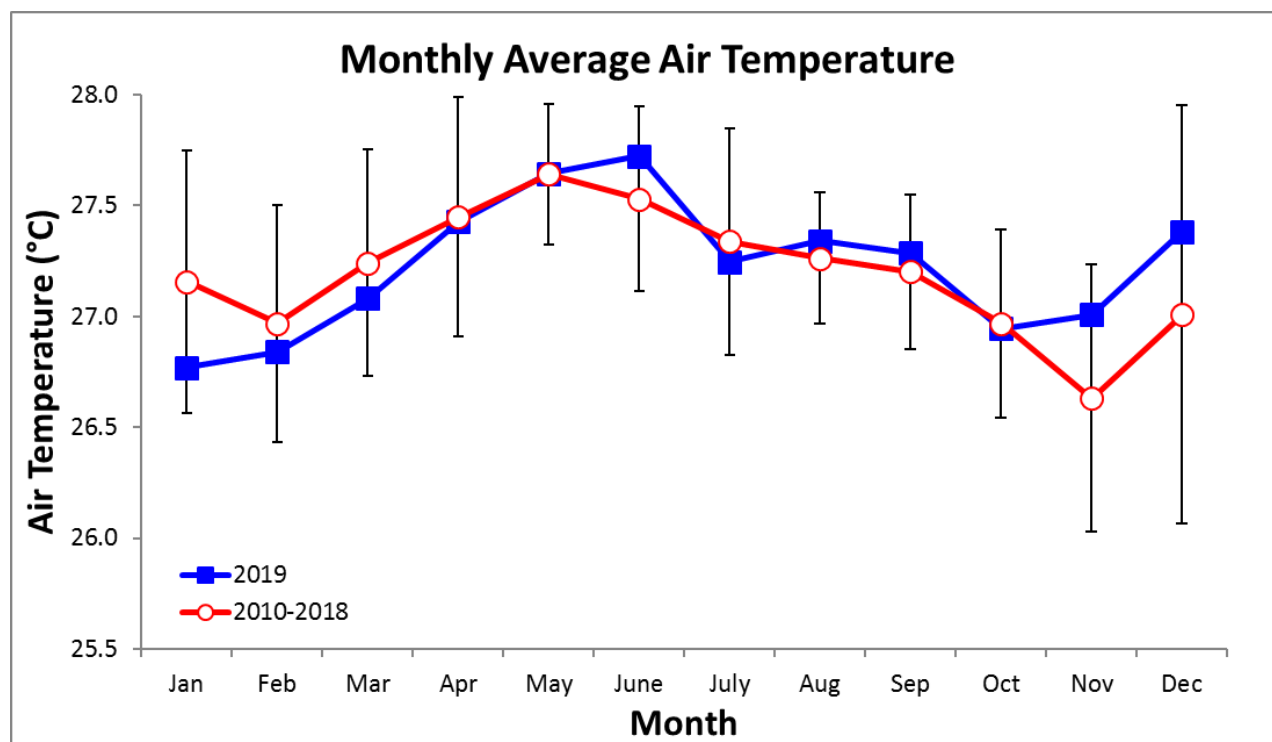
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			76.5	81.3	83.3	87.2	88.5	88.0	87.4	89.3	88.8	87.8
2011	84.1	80.4	79.1	83.3	85.9	87.9	89.1	88.6	88.8	87.9	91.2	87.6
2012	78.7	77.5	78.6	85.1	87.4	85.3	87.1	87.4	87.7	88.0	89.0	87.5
2013	77.2	78.3	79.6	82.1	86.4	88.9	89.0	89.3	89.4	90.7	89.2	85.9
2014	80.5	78.5	78.3	81.8	87.6	88.5	86.2	87.8	88.8	88.8	88.8	87.4
2015	78.6	78.4	77.3	82.4	85.7	86.3	86.9	88.1	90.1	89.7	90.3	85.3
2016	79.3	76.0	78.9	79.1	87.1	88.2	89.2	88.8	89.2	90.0	91.6	87.1
2017	79.4	79.6	78.6	84.1	89.3	89.4	90.6	90.4	90.0	90.2	91.3	87.6
2018	86.6	78.6	77.9	85.4	87.0	88.7	87.9	88.4	89.2	87.5	89.0	80.5
2019	76.6	76.0	74.8	81.3	86.9	88.1	88.1	87.6	88.2	87.9	88.9	87.0
mean	80.1	78.1	78.0	82.6	86.7	87.9	88.3	88.5	88.9	89.0	89.8	86.4
sd	3.2	1.5	1.4	1.9	1.5	1.3	1.3	0.9	0.9	1.1	1.2	2.2
min	76.6	76.0	74.8	79.1	83.3	85.3	86.2	87.4	87.4	87.5	88.8	80.5
max	86.6	80.4	79.6	85.4	89.3	89.4	90.6	90.4	90.1	90.7	91.6	87.8



Monthly Average, Maximum & Minimum Temperatures (°C)

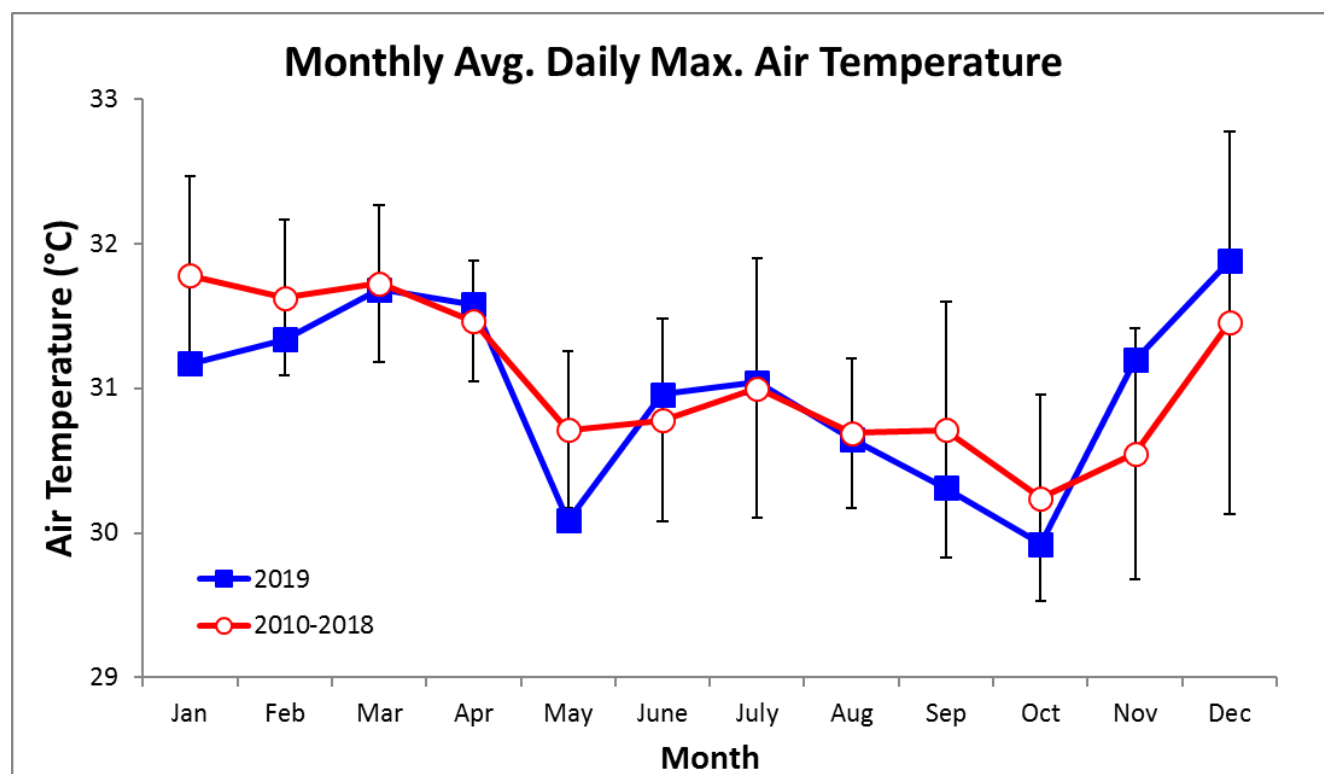
Monthly Average Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			28.1	28.1	28.3	27.2	26.7	27.0	26.9	26.4	25.8	25.0
2011	26.3	26.6	26.4	26.7	27.4	27.2	26.8	27.0	26.9	26.4	25.8	26.2
2012	26.8	26.5	26.7	26.7	27.3	27.9	27.6	27.4	27.5	27.1	26.5	27.1
2013	27.6	27.0	27.4	27.9	27.6	27.5	27.4	27.1	27.4	27.0	27.2	27.5
2014	27.5	27.3	27.6	28.0	27.7	27.7	28.2	27.3	27.1	27.2	27.0	27.1
2015	27.8	27.5	27.2	27.9	28.1	28.4	28.1	28.0	27.9	27.8	27.6	28.7
2016	28.0	28.0	27.8	27.5	27.5	27.2	26.8	27.3	26.9	26.7	26.1	26.9
2017	27.0	26.4	27.1	27.4	27.6	27.4	27.2	27.1	27.4	27.2	26.4	26.8
2018	26.6	26.6	27.1	26.8	27.3	27.1	27.3	27.1	26.8	26.9	26.9	27.4
2019	26.8	26.8	27.1	27.4	27.6	27.7	27.2	27.3	27.3	26.9	27.0	27.4
mean	27.2	27.0	27.2	27.4	27.6	27.5	27.3	27.3	27.2	27.0	26.6	27.0
sd	0.6	0.5	0.5	0.5	0.3	0.4	0.5	0.3	0.3	0.4	0.6	0.9
min	26.3	26.4	26.4	26.7	27.3	27.1	26.7	27.0	26.8	26.4	25.8	25.0
max	28.0	28.0	28.1	28.1	28.3	28.4	28.2	28.0	27.9	27.8	27.6	28.7



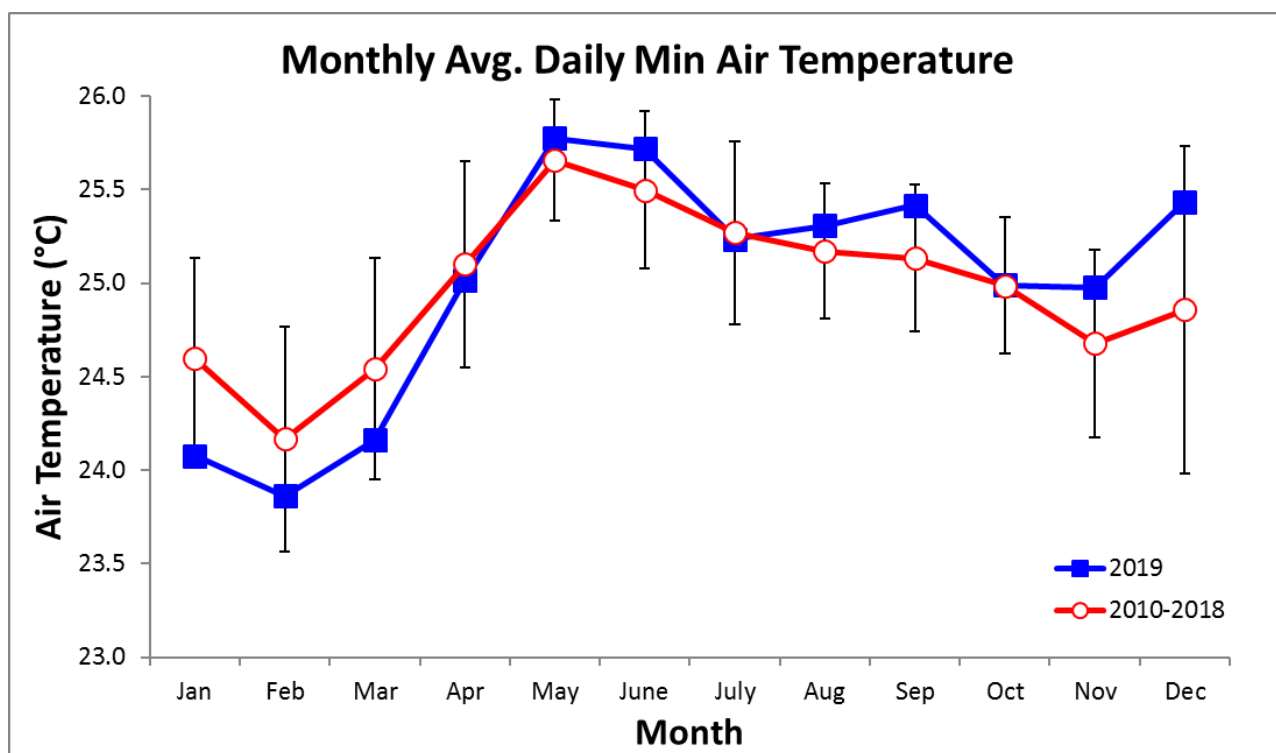
Monthly Average of Daily Maximum Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			32.1	31.7	31.4	29.9	29.4	30.0	29.2	29.6	29.5	28.4
2011	30.9	31.4	30.9	30.9	30.7	30.0	29.9	30.3	30.0	29.1	29.4	30.5
2012	31.6	31.3	30.9	30.8	30.7	31.4	31.6	30.6	32.1	30.6	31.3	31.8
2013	32.5	31.5	31.3	31.8	30.6	30.6	31.1	30.5	30.9	31.1	31.5	32.9
2014	32.3	32.2	32.4	32.0	31.4	31.4	32.4	31.4	31.1	30.4	31.2	31.6
2015	32.7	32.1	31.7	31.8	31.5	32.0	31.7	31.7	32.0	31.5	31.1	33.1
2016	32.3	32.5	32.4	31.4	30.5	30.6	30.5	30.4	30.5	29.8	29.4	31.3
2017	31.4	30.8	32.0	31.6	30.2	30.0	30.7	30.5	30.2	30.5	30.1	31.1
2018	31.1	31.6	31.8	31.0	30.1	30.9	31.6	30.9	30.9	29.9	30.9	31.9
2019	31.2	31.3	31.7	31.6	30.1	31.0	31.0	30.6	30.3	29.9	31.2	31.9
mean	31.8	31.6	31.7	31.5	30.7	30.8	31.0	30.7	30.7	30.2	30.5	31.5
sd	0.7	0.5	0.5	0.4	0.5	0.7	0.9	0.5	0.9	0.7	0.9	1.3
min	30.9	30.8	30.9	30.8	30.1	29.9	29.4	30.0	29.2	29.1	29.4	28.4
max	32.7	32.5	32.4	32.0	31.5	32.0	32.4	31.7	32.1	31.5	31.5	33.1



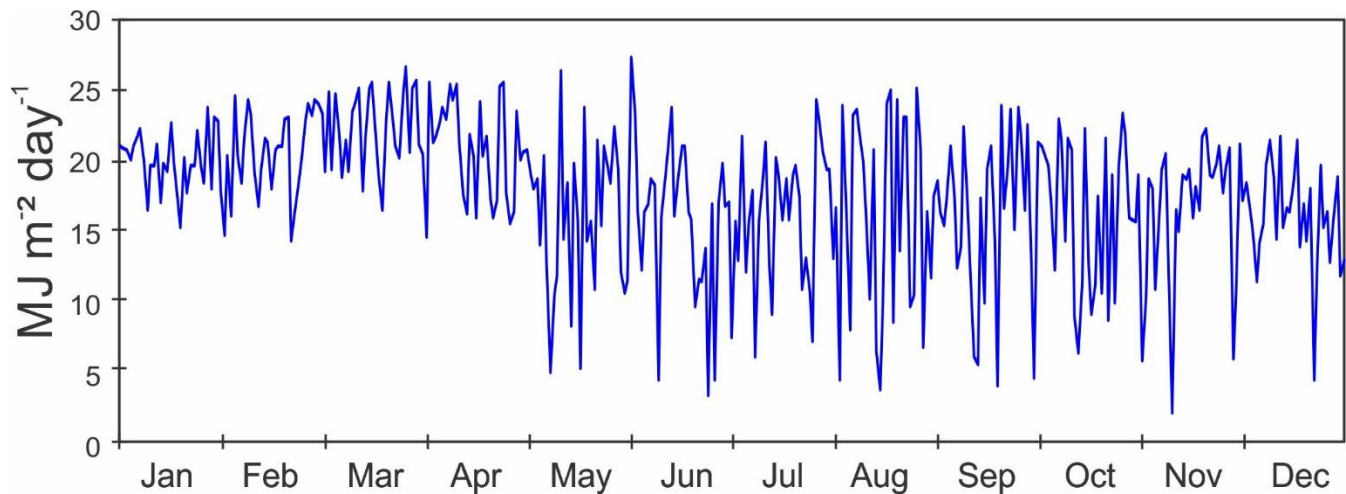
Monthly Average of Daily Minimum Temperature

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			25.8	25.7	26.2	25.1	24.7	24.8	25.0	24.6	24.0	23.1
2011	23.9	24.0	23.7	24.3	25.2	25.3	24.6	24.9	24.7	24.5	24.0	24.1
2012	24.2	23.8	24.2	24.4	25.3	26.0	25.4	25.3	25.4	24.9	24.9	25.0
2013	24.9	24.0	24.9	25.7	25.7	25.4	25.4	24.9	25.2	25.1	25.1	25.2
2014	24.9	24.5	24.7	25.6	25.6	25.8	26.0	25.3	24.9	25.0	24.9	25.0
2015	25.3	24.9	24.4	25.6	26.1	26.2	26.0	26.0	25.9	25.7	25.5	26.5
2016	25.4	25.3	25.1	25.1	25.6	24.9	24.8	25.3	24.8	24.7	24.2	24.7
2017	24.3	23.6	24.3	25.1	25.6	25.5	25.2	25.0	25.4	25.4	24.4	24.6
2018	24.4	23.6	24.3	24.4	25.5	25.1	25.4	25.0	24.7	24.9	24.9	24.9
2019	24.1	23.9	24.2	25.0	25.8	25.7	25.2	25.3	25.4	25.0	25.0	25.4
mean	24.6	24.2	24.5	25.1	25.7	25.5	25.3	25.2	25.1	25.0	24.7	24.9
sd	0.5	0.6	0.6	0.5	0.3	0.4	0.5	0.4	0.4	0.4	0.5	0.9
min	23.9	23.6	23.7	24.3	25.2	24.9	24.6	24.8	24.7	24.5	24.0	23.1
max	25.4	25.3	25.8	25.7	26.2	26.2	26.0	26.0	25.9	25.7	25.5	26.5



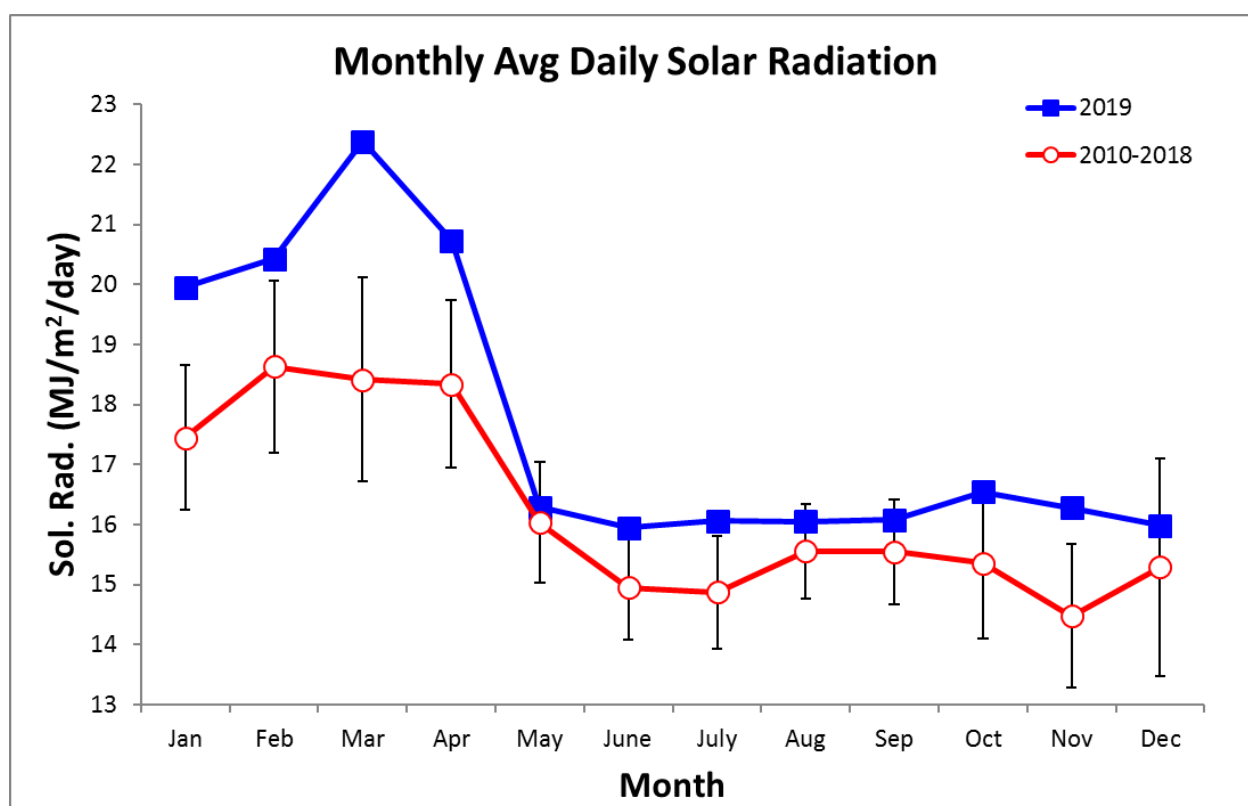
2019 Daily Total Radiation (MJ m⁻² day⁻¹)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	21.1	14.8	24.0	20.5	20.6	11.4	17.0	13.1	18.6	21.2	5.9	17.2
2	20.8	20.3	23.4	14.6	20.7	27.3	7.5	16.6	16.3	21.0	10.4	18.4
3	20.7	16.0	19.2	25.5	18.9	23.2	15.6	4.4	15.4	20.5	18.7	16.3
4	20.0	24.6	24.9	21.3	18.1	16.4	13.0	23.9	17.3	19.6	18.1	14.9
5	21.0	20.4	19.4	21.6	18.8	12.3	21.7	16.4	21.0	17.2	11.0	11.4
6	21.8	18.4	24.8	22.7	14.1	16.3	12.1	8.0	17.4	12.2	15.9	14.2
7	22.3	21.6	21.8	23.8	20.4	16.9	15.4	23.2	12.4	23.0	19.4	15.6
8	20.1	24.3	18.9	22.9	12.7	18.7	17.9	23.6	13.9	21.5	20.5	19.7
9	16.5	23.3	21.4	25.5	5.1	18.3	6.1	22.0	22.3	14.3	9.6	21.4
10	19.7	19.1	19.2	24.3	10.5	4.5	15.8	20.0	16.9	21.6	2.2	18.8
11	19.6	16.8	23.5	25.4	11.9	16.0	18.7	16.3	12.4	20.8	16.4	14.4
12	21.2	19.4	24.0	21.3	26.4	18.8	21.2	10.3	6.1	9.0	15.0	21.7
13	17.1	21.6	25.2	17.6	14.4	20.6	12.6	20.8	5.6	6.4	19.0	15.3
14	19.8	21.3	17.9	16.3	18.4	23.7	9.2	6.6	17.3	11.4	18.7	16.6
15	19.2	18.0	21.6	21.9	8.3	16.1	20.2	3.8	10.0	22.2	19.4	16.4
16	22.7	20.8	25.1	20.3	19.7	18.9	19.0	9.7	19.3	12.4	15.9	18.2
17	19.9	21.0	25.6	16.0	15.9	21.0	15.8	24.0	20.9	9.2	18.2	21.4
18	17.1	21.1	21.8	24.2	5.3	21.0	18.7	24.9	14.3	11.2	16.6	13.9
19	15.3	22.9	19.2	20.4	23.8	16.3	15.8	8.5	4.1	17.4	21.7	16.9
20	20.3	23.0	16.5	21.7	14.3	15.9	19.0	24.2	23.9	10.6	22.2	14.4
21	17.7	14.3	22.9	17.3	15.6	9.7	19.6	13.6	16.6	21.6	19.0	18.0
22	19.7	16.5	25.5	15.9	10.9	11.6	17.4	23.0	19.7	8.7	18.8	4.5
23	19.6	18.5	23.0	17.2	21.5	11.4	11.0	23.0	23.6	19.0	19.8	12.0
24	22.1	20.1	21.0	25.3	15.4	13.8	13.1	9.6	15.2	9.9	21.1	19.7
25	19.6	22.7	20.2	25.5	21.1	3.5	10.7	10.5	23.8	19.6	17.8	15.3
26	18.4	24.0	24.7	17.7	19.5	16.9	7.2	25.1	21.9	23.4	19.4	16.4
27	23.7	23.2	26.6	15.6	18.4	4.5	24.3	20.7	16.6	21.9	20.9	12.9
28	18.0	24.3	20.7	16.3	22.4	17.1	22.9	6.8	22.6	16.0	6.0	16.1
29	23.0		25.1	23.5	19.3	19.8	20.6	16.4	12.5	15.8	10.6	18.9
30	22.8		25.7	20.1	12.1	16.8	19.4	11.7	4.6	15.6	21.2	11.8
31	17.9		21.2		10.7		19.4	17.4		19.0		12.9



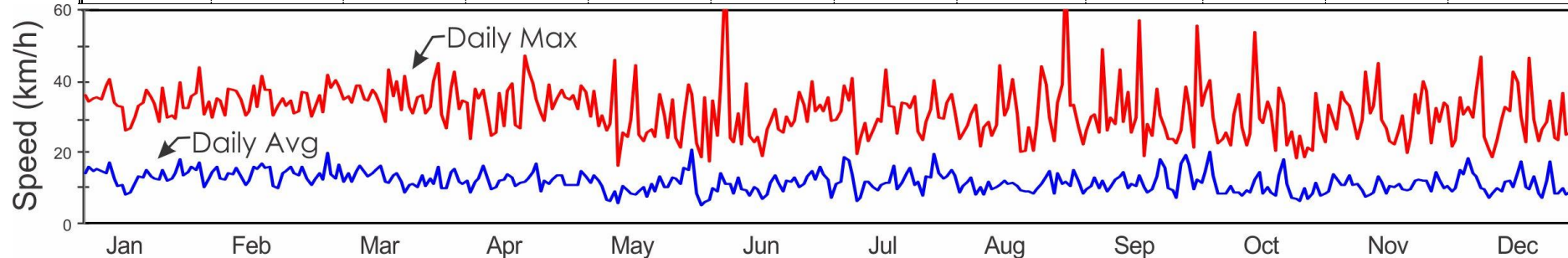
Monthly Average Total Daily Solar Radiation ($\text{MJ m}^{-2} \text{ day}^{-1}$)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			18.3	17.6	18.0	14.9	14.6	16.7	15.4	13.7	14.2	13.1
2011	16.1	18.3	18.3	17.8	16.3	14.3	14.1	16.3	15.1	14.5	13.2	13.5
2012	17.2	17.9	17.4	17.9	15.8	16.0	14.6	15.6	14.8	14.9	13.9	14.5
2013	17.6	18.2	16.2	17.1	14.5	14.2	14.6	15.0	14.0	14.4	15.4	14.8
2014	17.0	16.8	17.7	16.0	15.6	13.7	15.7	14.5	16.1	15.1	15.6	14.5
2015	16.7	17.4	19.3	18.5	14.7	16.2	15.5	14.9	15.4	15.4	13.6	16.4
2016	17.7	17.8	17.7	19.5	16.1	15.3	13.9	14.6	16.0	15.6	12.7	15.7
2017	18.5	20.5	17.3	19.9	16.7	14.5	13.4	15.6	15.4	15.3	14.4	15.0
2018	16.2	20.4	19.6	18.3	16.3	14.5	16.2	16.3	17.3	18.2	15.6	19.5
2019	20.0	20.4	22.4	20.7	16.3	15.9	16.1	16.1	16.1	16.5	16.3	16.0
mean	17.4	18.6	18.4	18.3	16.0	15.0	14.9	15.6	15.5	15.4	14.5	15.3
sd	1.2	1.4	1.7	1.4	1.0	0.9	0.9	0.8	0.9	1.3	1.2	1.8
min	16.1	16.8	16.2	16.0	14.5	13.7	13.4	14.5	14.0	13.7	12.7	13.1
max	20.0	20.5	22.4	20.7	18.0	16.2	16.2	16.7	17.3	18.2	16.3	19.5



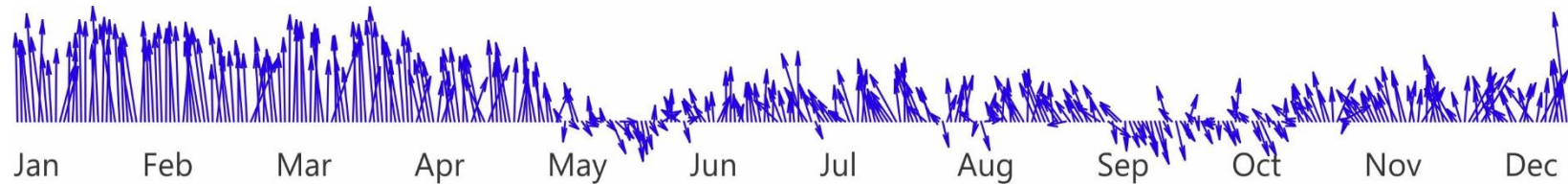
2019 Daily Average Wind Speed (km/h)

	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	14.3	36.2	14.4	29.7	19.9	41.8	15.3	42.9	10.9	32.2	6.0	35.5	12.5	35.4	13.7	31.5	8.5	22.2	14.4	36.8	13.8	29.1	10.1	23.6
2	15.9	34.3	16.0	35.2	13.8	38.2	11.7	32.4	14.8	38.7	6.6	17.4	7.3	28.9	8.9	23.9	9.8	26.2	20.3	40.3	12.8	26.4	15.2	35.5
3	14.9	35.2	12.8	34.8	12.8	40.3	11.2	34.7	13.4	36.9	10.0	34.7	11.3	29.4	10.6	25.2	10.7	30.2	13.6	29.7	11.0	36.9	13.8	30.7
4	15.3	35.6	12.5	30.3	16.6	38.4	12.3	34.1	11.6	30.0	9.0	24.7	11.9	31.7	11.7	27.8	13.0	30.7	8.5	22.7	11.0	34.7	18.4	32.9
5	14.9	35.0	14.2	37.9	11.9	35.0	8.8	23.8	13.7	37.4	14.2	39.0	18.9	38.8	13.1	30.7	10.0	25.5	8.5	23.9	13.6	33.2	14.2	29.9
6	14.1	38.8	13.8	37.8	14.2	35.7	11.9	37.8	12.1	27.5	11.1	70.7	17.8	34.6	8.1	33.3	12.0	49.0	8.4	25.8	10.8	29.7	13.4	37.4
7	17.3	40.6	15.7	37.3	11.9	34.1	12.7	35.4	10.5	30.3	11.3	24.2	13.8	40.9	10.2	21.6	9.2	26.1	10.6	22.1	11.1	24.0	10.1	47.0
8	12.7	33.9	13.4	34.9	14.8	38.8	16.4	37.5	6.6	26.4	8.5	23.0	6.6	19.6	8.3	27.2	10.3	29.7	8.9	30.7	9.3	29.1	9.8	24.4
9	10.6	33.1	10.8	30.5	16.2	39.0	12.5	30.1	6.4	27.9	13.1	30.9	7.4	23.7	11.9	28.7	12.5	28.1	8.8	36.3	7.7	42.8	7.4	20.8
10	10.9	32.7	12.0	31.7	14.4	34.9	9.7	24.7	9.2	46.2	9.8	22.4	11.8	28.3	9.6	24.6	13.4	43.4	7.9	27.2	8.3	30.9	8.5	18.8
11	8.3	26.4	16.0	38.9	13.2	34.5	10.4	25.7	5.9	16.4	9.5	39.4	11.9	23.2	10.3	27.6	14.6	28.7	9.3	21.9	8.9	33.1	10.1	23.5
12	8.8	26.8	15.4	32.9	14.3	37.6	12.0	36.7	10.5	25.6	7.9	24.7	10.2	26.1	10.9	44.4	10.1	37.2	8.8	25.3	13.4	45.3	9.1	29.4
13	11.6	30.1	16.8	41.5	15.1	36.3	12.3	27.5	9.4	24.3	10.3	22.9	9.4	29.5	12.0	30.6	11.3	25.7	12.3	53.8	11.8	29.3	11.9	32.7
14	13.2	33.2	15.7	37.8	16.2	33.2	13.9	37.4	8.6	29.2	9.6	24.5	10.9	28.7	11.3	32.5	10.6	29.7	14.5	29.5	8.6	26.7	12.1	31.5
15	12.9	34.0	16.0	37.5	11.8	28.5	12.9	39.5	8.3	44.5	7.0	18.9	11.7	43.3	11.6	40.6	13.7	57.2	8.6	28.4	10.5	23.3	10.2	42.6
16	15.0	37.7	10.6	30.5	11.4	43.3	10.7	27.8	9.1	25.2	8.2	26.4	11.4	33.1	10.7	30.7	10.4	19.1	10.2	34.4	10.3	22.2	14.4	39.7
17	13.2	35.4	9.9	33.0	13.6	36.0	11.5	26.7	10.3	23.3	11.5	28.6	16.4	32.7	9.5	20.1	8.7	27.9	8.9	31.5	11.3	26.5	17.5	30.2
18	12.7	33.8	14.2	35.3	14.2	39.9	11.7	47.1	7.7	25.6	13.7	32.3	9.6	25.4	9.2	20.5	9.7	24.6	8.0	20.4	9.8	30.5	10.2	22.8
19	12.3	28.5	14.8	33.0	11.8	31.8	12.8	43.2	11.1	26.4	11.5	26.6	11.6	34.0	9.2	27.0	13.2	38.0	13.6	38.3	9.3	19.8	9.7	46.7
20	15.2	38.2	16.1	34.7	8.9	41.4	14.6	39.4	9.1	24.5	9.1	25.6	14.1	33.8	8.5	20.5	18.0	30.5	18.1	33.6	9.6	24.1	13.4	29.1
21	12.2	29.7	14.2	31.1	11.0	32.7	16.8	35.0	13.3	36.5	12.1	30.2	15.6	32.6	9.6	27.8	15.8	26.7	11.3	22.1	12.1	36.4	8.4	23.3
22	12.6	30.3	13.6	31.7	11.1	31.2	9.3	30.9	10.3	30.5	11.8	27.3	11.0	35.9	11.3	44.2	9.9	23.8	7.3	25.9	12.3	30.9	7.4	26.4
23	14.1	29.4	15.9	36.9	10.3	35.4	12.2	28.9	10.4	24.2	13.0	28.9	11.9	26.0	13.4	39.0	9.4	23.8	6.9	18.3	12.2	40.0	12.0	28.8
24	18.2	39.9	12.8	36.6	13.5	36.2	11.1	39.1	12.9	35.0	10.3	37.2	7.8	23.5	14.8	29.8	7.2	22.5	6.4	24.6	12.1	37.3	17.4	34.8
25	13.6	32.6	10.8	30.1	10.7	31.1	12.3	32.2	12.6	24.1	11.3	33.4	13.4	28.8	8.5	23.2	16.9	26.3	10.0	18.8	9.1	22.5	8.5	24.1
26	14.6	32.5	12.5	32.5	12.8	32.9	13.7	35.2	11.2	21.4	13.3	28.6	13.0	32.1	14.1	33.9	19.4	38.5	7.1	21.3	14.6	32.5	8.6	23.5
27	16.1	35.7	14.2	36.2	11.2	40.0	13.6	37.7	15.7	29.1	14.8	40.0	19.5	40.4	11.3	39.2	16.6	33.3	8.5	20.6	12.4	28.5	10.1	36.7
28	15.2	36.7	12.3	31.2	15.9	45.2	10.8	35.4	15.0	39.2	12.3	31.5	14.2	29.7	11.7	70.2	9.7	21.3	11.6	36.8	10.0	34.1	8.3	25.2
29	17.3	44.0			9.9	30.6	10.9	34.8	20.8	36.5	16.0	33.5	12.8	29.6	10.6	33.0	12.6	55.6	8.0	26.7	10.7	33.2	9.1	25.5
30	10.4	30.8			9.9	27.0	10.8	36.2	8.6	22.6	14.0	31.7	13.2	34.1	15.1	33.4	11.4	33.0	8.5	22.8	9.0	21.6	12.1	27.2
31	12.8	34.2			14.6	38.2			5.2	18.7			15.1	36.3	12.2	27.5			9.1	33.3			11.9	24.7



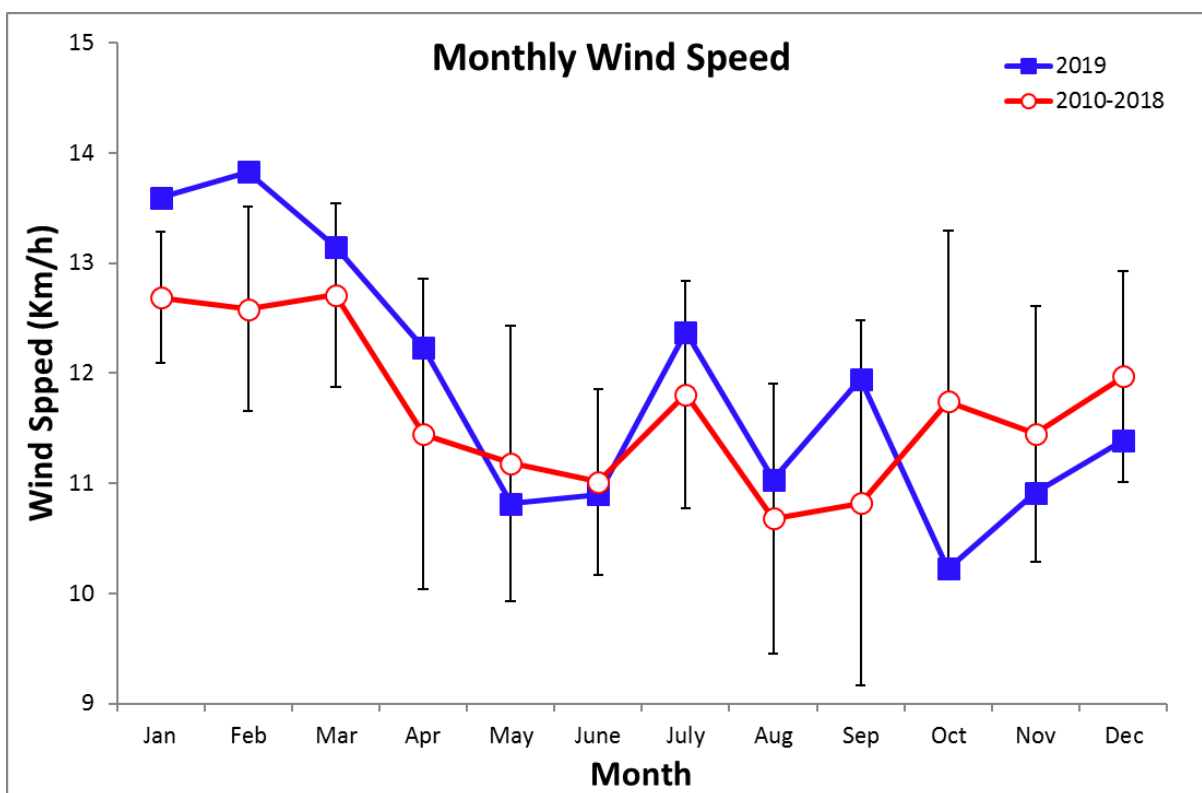
2019 Average Daily Wind Direction (°)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	322.7	316.4	315.4	317.2	314.2	35.5	322.2	321.9	304.5	221.4	316.1	304.1
2	318.7	321.1	319.8	328.2	322.0	78.4	323.3	322.4	330.1	201.9	313.2	313.7
3	317.8	323.7	319.5	334.5	313.7	2.6	326.7	314.6	319.1	161.2	322.1	315.1
4	318.0	326.4	316.7	314.8	316.4	316.2	324.4	322.7	309.6	13.9	302.9	308.8
5	322.6	326.9	329.1	304.4	316.0	310.9	316.6	319.3	258.8	290.6	322.8	311.0
6	324.8	332.5	331.3	315.2	323.7	312.4	314.8	305.6	321.5	122.3	304.3	303.9
7	315.9	324.4	336.6	313.9	301.5	113.6	313.0	187.6	346.1	112.3	311.5	317.9
8	324.4	337.8	328.2	318.2	317.4	41.5	36.0	306.5	314.6	123.9	310.7	315.1
9	308.8	345.0	329.5	296.8	328.2	325.6	333.6	330.5	318.0	236.4	325.1	312.0
10	320.5	331.5	330.1	286.1	126.2	320.1	321.5	314.3	320.6	316.9	289.7	296.7
11	358.4	320.2	334.0	0.7	325.5	316.4	313.4	326.6	316.0	111.5	311.4	312.1
12	328.3	316.5	333.0	309.0	302.5	328.3	321.9	328.6	324.1	76.7	314.0	338.3
13	321.6	317.6	326.9	324.3	304.5	330.1	330.4	318.8	316.7	90.2	316.8	301.9
14	327.9	319.6	318.0	319.9	342.4	338.3	329.5	320.4	320.1	155.2	307.6	311.2
15	325.2	317.2	328.9	322.6	345.9	315.2	310.9	298.3	242.5	358.1	312.5	318.3
16	324.9	323.7	337.2	347.1	319.8	312.4	340.2	125.8	187.7	328.0	308.1	317.2
17	326.4	313.6	333.8	330.5	325.0	319.0	318.6	39.6	328.6	307.2	313.3	307.9
18	326.8	321.0	327.7	317.9	327.7	318.2	315.9	321.5	318.5	328.2	308.2	320.3
19	327.7	322.8	323.3	320.7	102.6	324.3	322.3	317.5	211.5	134.0	305.0	312.9
20	325.9	315.1	318.4	320.2	94.7	307.4	318.8	33.4	166.3	164.5	310.7	305.6
21	333.7	317.8	339.7	313.0	165.1	320.1	314.2	319.6	173.5	176.6	316.0	312.0
22	333.1	326.0	334.8	323.2	98.8	320.6	302.6	317.0	147.0	328.1	315.1	328.0
23	322.3	321.5	336.3	314.8	233.7	320.5	330.6	315.9	145.1	345.1	312.4	320.2
24	317.4	326.3	325.3	316.4	160.3	324.6	336.7	319.3	83.4	127.1	308.0	311.2
25	325.4	339.4	311.2	310.9	140.9	325.8	318.2	322.8	154.1	148.1	310.5	314.2
26	320.2	331.0	334.1	316.2	170.2	320.5	321.3	315.2	179.8	91.7	307.4	326.0
27	316.0	320.4	336.9	323.1	167.3	311.9	317.8	326.5	165.1	314.1	315.3	321.5
28	314.9	330.4	322.0	330.8	205.8	315.1	319.0	329.8	149.1	312.9	312.9	310.4
29	320.1		334.1	326.1	191.2	313.1	316.0	319.9	315.6	317.3	325.7	312.6
30	335.9		314.3	345.0	181.6	320.2	326.0	320.7	312.0	317.0	337.6	316.8
31	325.0		316.0		79.9		319.3	318.7		313.3		306.3



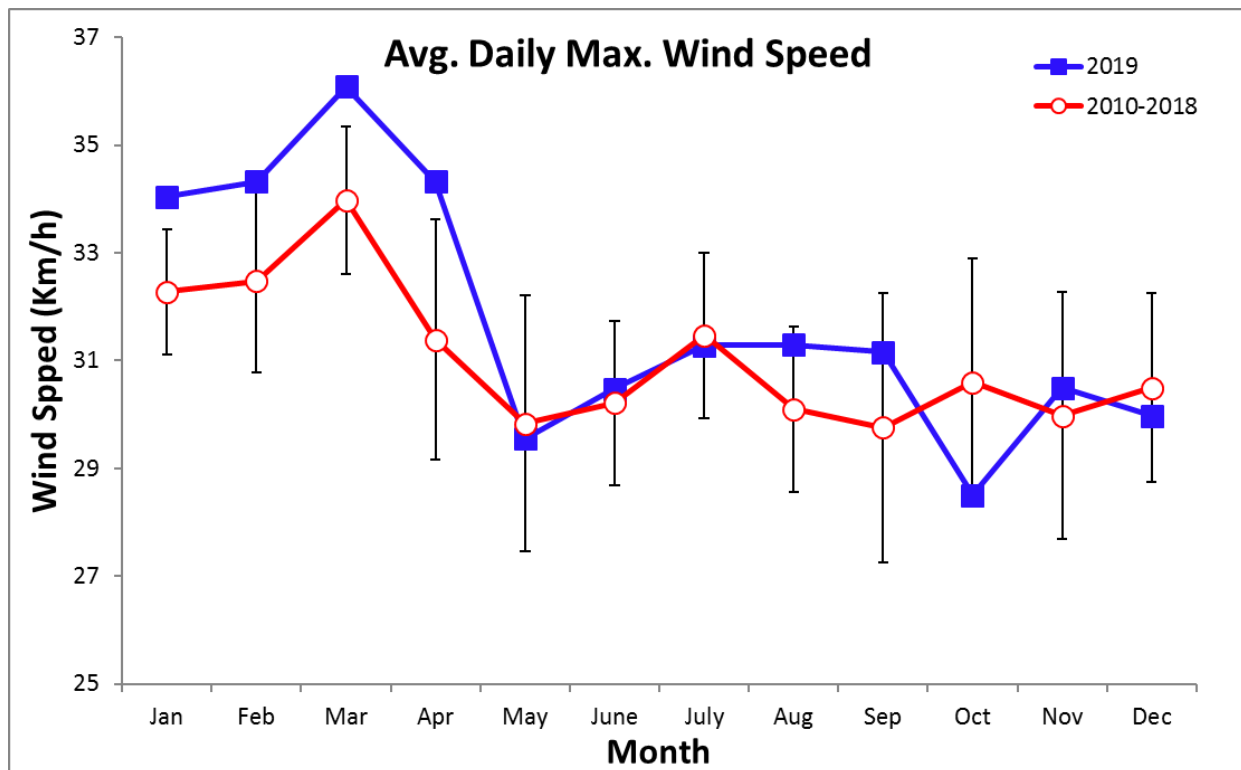
Average Monthly Wind Speed (km/h)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			14.3	11.8	13.6	11.5	10.7	10.4	14.9	11.1	13.1	13.9
2011	13.0	11.7	11.6	11.1	10.5	12.7	10.9	9.4	9.3	14.0	10.9	11.8
2012	11.7	12.3	12.8	11.1	10.2	10.9	12.4	10.4	10.6	12.8	13.2	11.8
2013	12.7	12.3	12.6	12.5	11.8	10.6	10.9	10.5	9.5	9.5	9.9	10.4
2014	12.8	13.4	12.6	12.8	10.8	11.3	12.7	11.2	9.9	11.9	10.7	12.0
2015	12.1	13.0	13.0	12.1	12.7	11.9	13.9	13.0	11.5	10.1	10.5	12.5
2016	13.1	13.7	13.3	11.9	11.3	9.9	11.8	11.0	10.6	11.5	12.4	11.0
2017	12.1	11.6	11.3	11.0	10.9	10.3	11.1	8.5	10.2	12.7	12.3	12.4
2018	13.1	11.3	12.5	7.9	9.2	10.1	11.3	11.5	9.7	13.6	10.6	12.5
2019	13.6	13.8	13.2	12.2	10.8	10.9	12.4	11.0	11.9	10.2	10.9	11.4
mean	12.7	12.6	12.7	11.4	11.2	11.0	11.8	10.7	10.8	11.7	11.4	12.0
sd	0.6	0.9	0.8	1.4	1.3	0.8	1.0	1.2	1.7	1.5	1.2	1.0
min	11.7	11.3	11.3	7.9	9.2	9.9	10.7	8.5	9.3	9.5	9.9	10.4
max	13.6	13.8	14.3	12.8	13.6	12.7	13.9	13.0	14.9	14.0	13.2	13.9



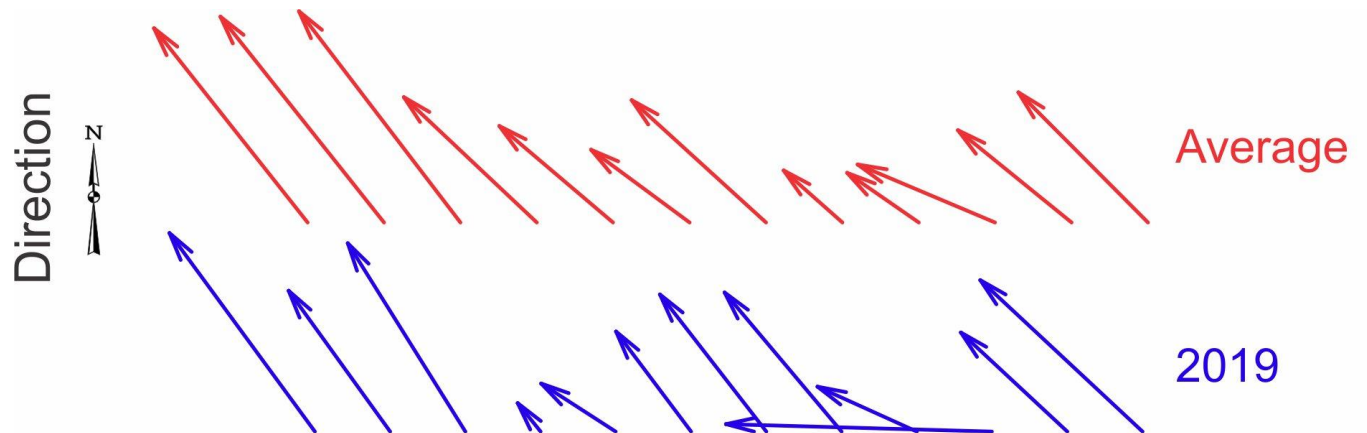
Average Monthly Max. Wind Speed (km/h)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			35.9	30.7	32.1	30.0	29.6	28.6	34.3	30.7	31.2	33.7
2011	32.1	31.1	32.8	31.9	27.5	32.0	31.3	29.3	27.0	34.3	28.5	29.9
2012	30.2	32.2	34.5	30.9	29.1	30.4	32.7	29.1	31.6	33.3	33.8	31.1
2013	31.7	32.2	32.4	32.7	30.6	31.5	29.1	29.9	27.6	27.4	26.3	28.1
2014	32.2	33.2	32.6	32.5	30.8	30.3	33.1	29.3	29.5	32.2	28.3	30.6
2015	32.1	33.2	34.6	33.4	34.5	31.5	33.8	33.5	31.3	28.1	28.9	30.2
2016	33.9	35.3	34.7	30.3	29.3	30.8	32.0	28.9	30.8	29.3	32.0	28.1
2017	31.7	30.7	32.9	31.0	29.2	27.5	30.2	29.8	26.4	30.5	32.2	32.5
2018	32.7	30.1	33.3	26.2	25.8	27.7	31.7	31.4	27.9	31.7	28.2	31.0
2019	34.0	34.3	36.1	34.3	29.6	30.5	31.3	31.3	31.2	28.5	30.5	30.0
mean	32.3	32.5	34.0	31.4	29.8	30.2	31.5	30.1	29.8	30.6	30.0	30.5
sd	1.2	1.7	1.4	2.2	2.4	1.5	1.5	1.5	2.5	2.3	2.3	1.8
min	30.2	30.1	32.4	26.2	25.8	27.5	29.1	28.6	26.4	27.4	26.3	28.1
max	34.0	35.3	36.1	34.3	34.5	32.0	33.8	33.5	34.3	34.3	33.8	33.7



Average Monthly Wind Direction

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010			325.7	308.5	254.3	291.5	289.3	241.2	185.4	303.9	298.5	316.8
2011	314.9	316.4	322.9	312.0	309.2	274.4	307.8	308.9	314.5	237.6	311.9	317.2
2012	323.9	322.9	323.6	312.5	310.1	302.3	313.3	307.5	313.3	288.0	313.0	313.9
2013	321.8	318.5	321.7	314.9	310.3	308.1	313.1	312.2	264.9	307.8	316.3	311.5
2014	315.9	315.7	318.7	317.0	314.3	314.7	314.7	313.8	321.2	277.9	318.6	317.4
2015	326.9	322.5	323.8	315.7	318.7	317.5	315.5	318.3	313.6	315.4	314.5	317.9
2016	324.1	330.2	322.8	308.6	308.2	307.9	309.8	310.2	309.3	271.1	286.7	309.7
2017	322.2	318.2	322.2	304.4	276.0	306.5	305.9	312.9	246.5	271.3	297.1	318.4
2018	312.7	319.5	320.1	310.7	314.8	319.2	318.8	320.0	325.7	290.0	322.6	321.3
2019	323.7	324.2	328.0	321.1	302.7	323.1	322.2	319.9	294.3	271.6	312.9	313.0
mean	320.5	321.0	322.2	312.0	308.9	308.7	312.4	312.7	306.7	289.0	309.2	316.1



Average Monthly SST

STRI Pier

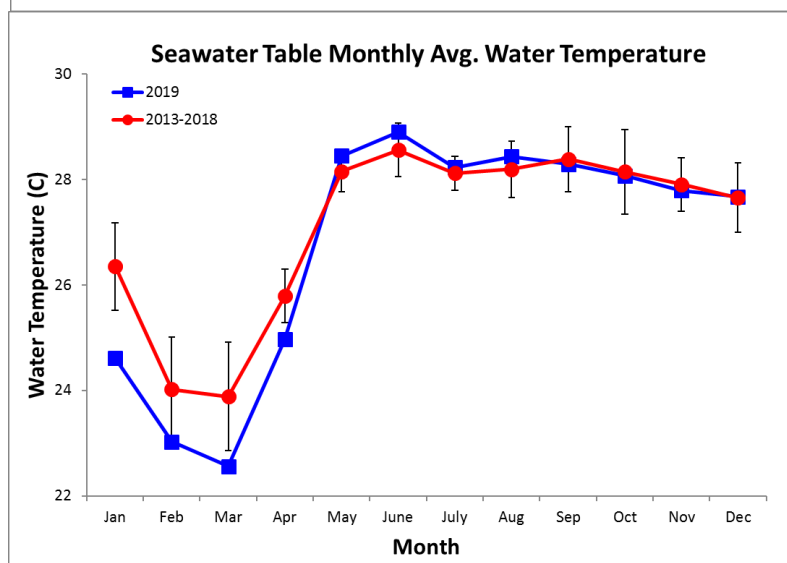
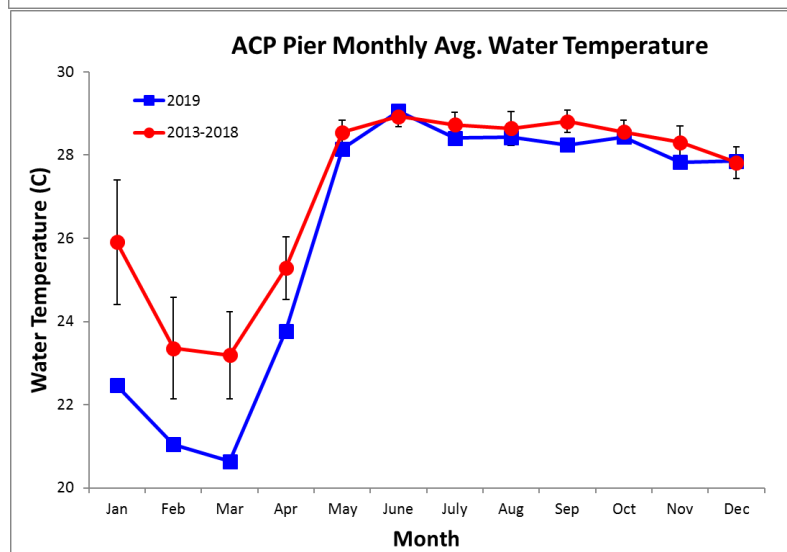
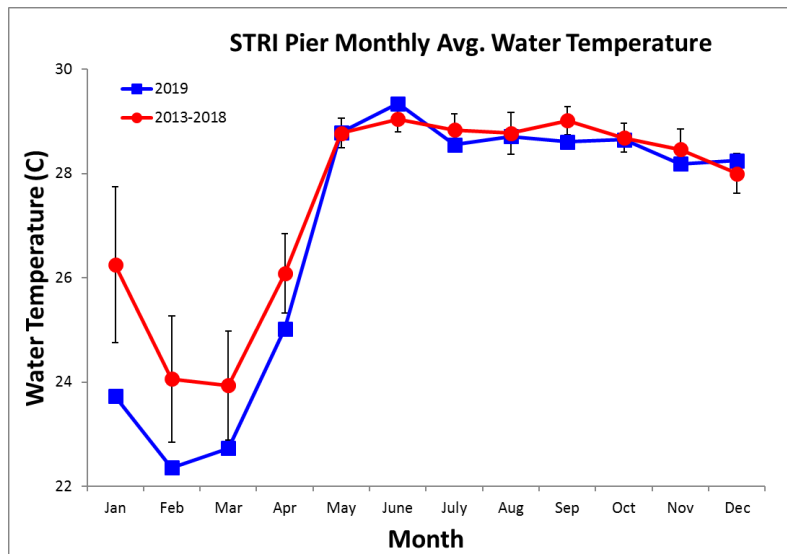
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2012												27.9
2013	26.4	23.8	24.3	26.8	28.4	29.0	28.8	28.5	29.1	28.4	28.7	28.4
2014	26.4	24.7	25.5	25.6	28.8	29.0	29.2	29.0	29.2	29.1	29.0	28.3
2015	27.5	25.6	23.6	26.4	28.7	29.2	29.2	29.4				
2016												
2017						29.2	28.7	28.8	29.3	28.7	28.0	27.4
2018	27.2	23.8	23.5	26.6	29.2	28.6	28.5	28.2	28.9	28.5	28.5	27.7
2019	23.7	22.4	22.7	25.0	28.8	29.3	28.6	28.7	28.6	28.7	28.2	28.2
mean	26.3	24.1	23.9	26.1	28.8	29.0	28.8	28.8	29.0	28.7	28.5	28.0
sd	1.5	1.2	1.0	0.8	0.3	0.2	0.3	0.4	0.3	0.3	0.4	0.4
min	23.7	22.4	22.7	25.0	28.4	28.6	28.5	28.2	28.6	28.4	28.0	27.4
max	27.5	25.6	25.5	26.8	29.2	29.3	29.2	29.4	29.3	29.1	29.0	28.4

ACP Pier

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2012												27.9
2013	26.4	23.8	24.3	26.8	28.4	29.0	28.8	28.5	29.1	28.4	28.7	28.4
2014	26.4	24.7	25.5	25.6	28.8	29.0	29.2	29.0	29.2	29.1	29.0	28.3
2015	27.5	25.6	23.6	26.4	28.7	29.2	29.2	29.4				
2016												
2017							28.6	28.6	28.9	28.4	27.8	27.0
2018	26.7	21.6	21.9	23.9	28.7	28.5	28.2	28.0	28.6	28.4	28.2	27.4
2019	22.5	21.0	20.6	23.8	28.2	29.1	28.4	28.4	28.2	28.4	27.8	27.9
mean	25.9	23.4	23.2	25.3	28.5	28.9	28.7	28.6	28.8	28.6	28.3	27.8
sd	2.0	2.0	1.9	1.4	0.3	0.3	0.4	0.5	0.4	0.3	0.5	0.5
min	22.5	21.0	20.6	23.8	28.2	28.5	28.2	28.0	28.2	28.4	27.8	27.0
max	27.5	25.6	25.5	26.8	28.8	29.2	29.2	29.4	29.2	29.1	29.0	28.4

Seawater Tanks

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2012												27.8
2013	26.1	23.6	24.1	26.6	27.9	28.6	28.3	27.8	28.2	26.9	27.9	27.8
2014	26.3	25.0	25.5	25.6	27.8	28.6	28.0	28.7	28.8	28.6	28.5	27.9
2015	27.0	25.6	22.9	25.6	28.0	28.6	28.1	28.4	29.0	29.3	28.7	28.8
2016	27.0	24.4	23.9	25.6	28.1	29.0	28.5	28.6	28.7	28.5	27.8	27.7
2017	26.8	23.1	24.8	26.1	28.9	28.8	28.3	28.3	28.6	28.2	27.5	27.0
2018	26.7	23.5	23.5	26.1	28.0	27.5	27.5	27.2	27.1	27.3	27.3	26.6
2019	24.6	23.0	22.6	25.0	28.5	28.9	28.2	28.4	28.3	28.1	27.8	27.7
mean	26.4	24.0	23.9	25.8	28.2	28.6	28.1	28.2	28.4	28.1	27.9	27.7
sd	0.8	1.0	1.0	0.5	0.4	0.5	0.3	0.5	0.6	0.8	0.5	0.7
min	24.6	23.0	22.6	25.0	27.8	27.5	27.5	27.2	27.1	26.9	27.3	26.6
max	27.0	25.6	25.5	26.6	28.9	29.0	28.5	28.7	29.0	29.3	28.7	28.8



Average Monthly pH

STRI Pier

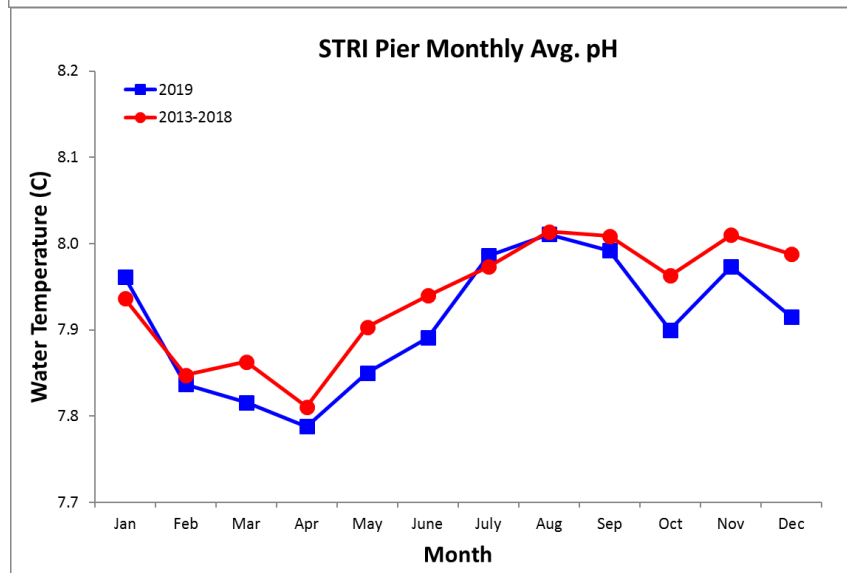
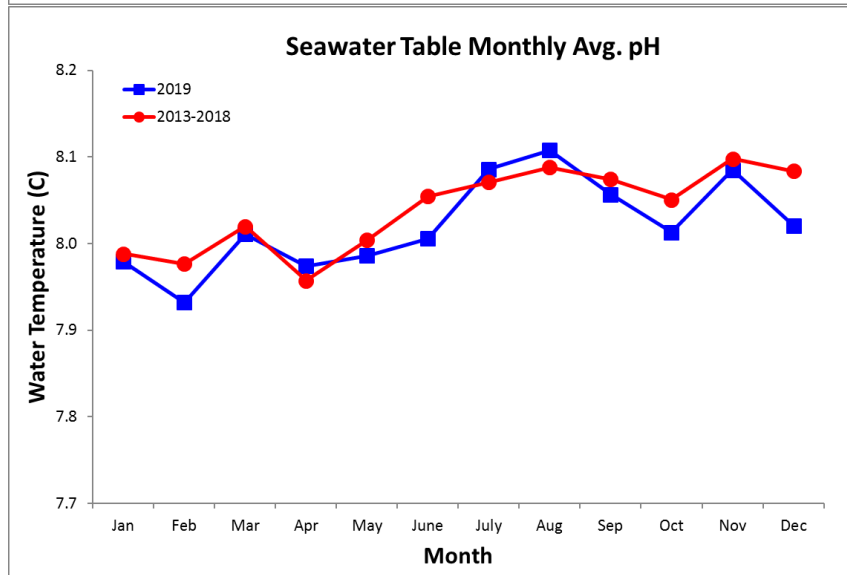
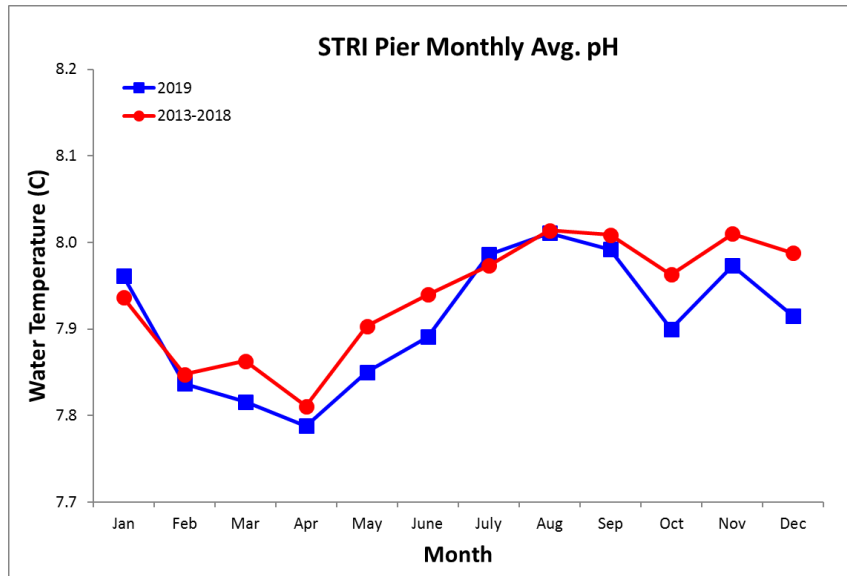
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017						8.15	8.09	8.10	8.10	8.10	8.11	8.11
2018	8.00	8.03	8.03	7.94	8.02	8.02	8.04	8.06	8.07	8.04	8.10	8.13
2019	7.98	7.93	8.01	7.97	7.99	8.01	8.09	8.11	8.06	8.01	8.09	8.02
mean	7.99	7.98	8.02	7.96	8.00	8.05	8.07	8.09	8.07	8.05	8.10	8.08
min	7.98	7.93	8.01	7.94	7.99	8.01	8.04	8.06	8.06	8.01	8.09	8.02
max	8.00	8.03	8.03	7.97	8.02	8.15	8.09	8.11	8.10	8.10	8.11	8.13

ACP Pier

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017						8.12	8.01	8.00	8.06	8.07	8.05	8.03
2018	7.96	7.87	7.90	7.82	7.99	7.94	8.00	8.00	8.02	8.01	8.07	8.09
2019	7.85	7.80	7.80	7.85	7.91	8.00	8.05	8.06	8.09	8.01	8.03	7.97
mean	7.90	7.83	7.85	7.83	7.95	8.01	8.02	8.02	8.06	8.03	8.05	8.03
min	7.85	7.80	7.80	7.82	7.91	7.94	8.00	8.00	8.02	8.01	8.03	7.97
max	7.96	7.87	7.90	7.85	7.99	8.12	8.05	8.06	8.09	8.07	8.07	8.09

Seawater Tanks

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017						8.05	8.01	8.00	8.01	8.01	8.01	8.00
2018	7.91	7.86	7.92	7.84	7.96	7.90	7.93	8.03	8.03	7.99	8.05	8.06
2019	7.96	7.84	7.82	7.79	7.85	7.89	7.99	8.01	7.99	7.90	7.97	7.92
mean	7.94	7.85	7.86	7.81	7.90	7.94	7.97	8.01	8.01	7.96	8.01	7.99
min	7.91	7.84	7.82	7.79	7.85	7.89	7.93	8.00	7.99	7.90	7.97	7.92
max	7.96	7.86	7.92	7.84	7.96	8.05	8.01	8.03	8.03	8.01	8.05	8.06



Average Monthly Salinity

STRI Pier

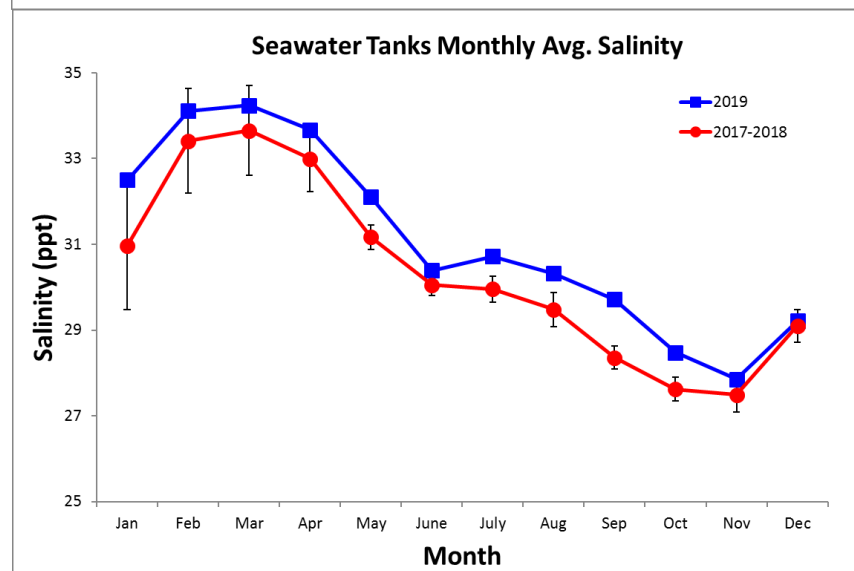
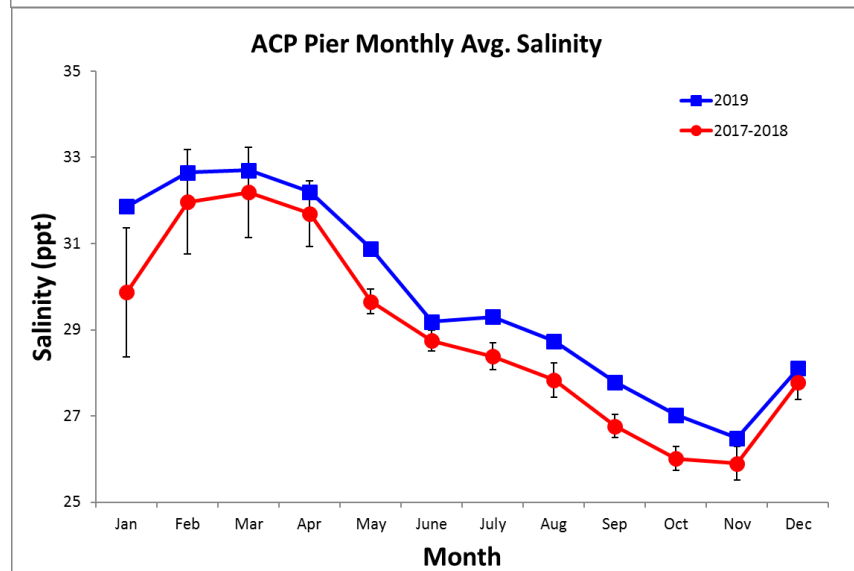
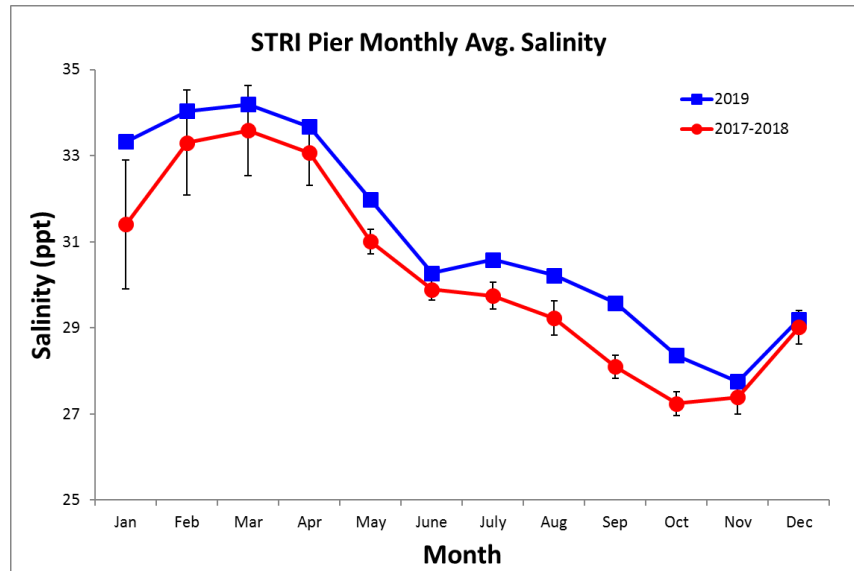
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017						30.0	29.5	27.8	26.6	26.1	27.2	28.3
2018	29.5	32.6	33.0	32.5	30.0	29.4	29.2	29.6	28.1	27.3	27.2	29.5
2019	33.3	34.0	34.2	33.7	32.0	30.3	30.6	30.2	29.6	28.4	27.8	29.2
mean	31.4	33.3	33.6	33.1	31.0	29.9	29.7	29.2	28.1	27.2	27.4	29.0
sd	2.7	1.0	0.9	0.9	1.4	0.5	0.7	1.2	1.5	1.1	0.3	0.6
min	29.5	32.6	33.0	32.5	30.0	29.4	29.2	27.8	26.6	26.1	27.2	28.3
max	33.3	34.0	34.2	33.7	32.0	30.3	30.6	30.2	29.6	28.4	27.8	29.5

ACP Pier

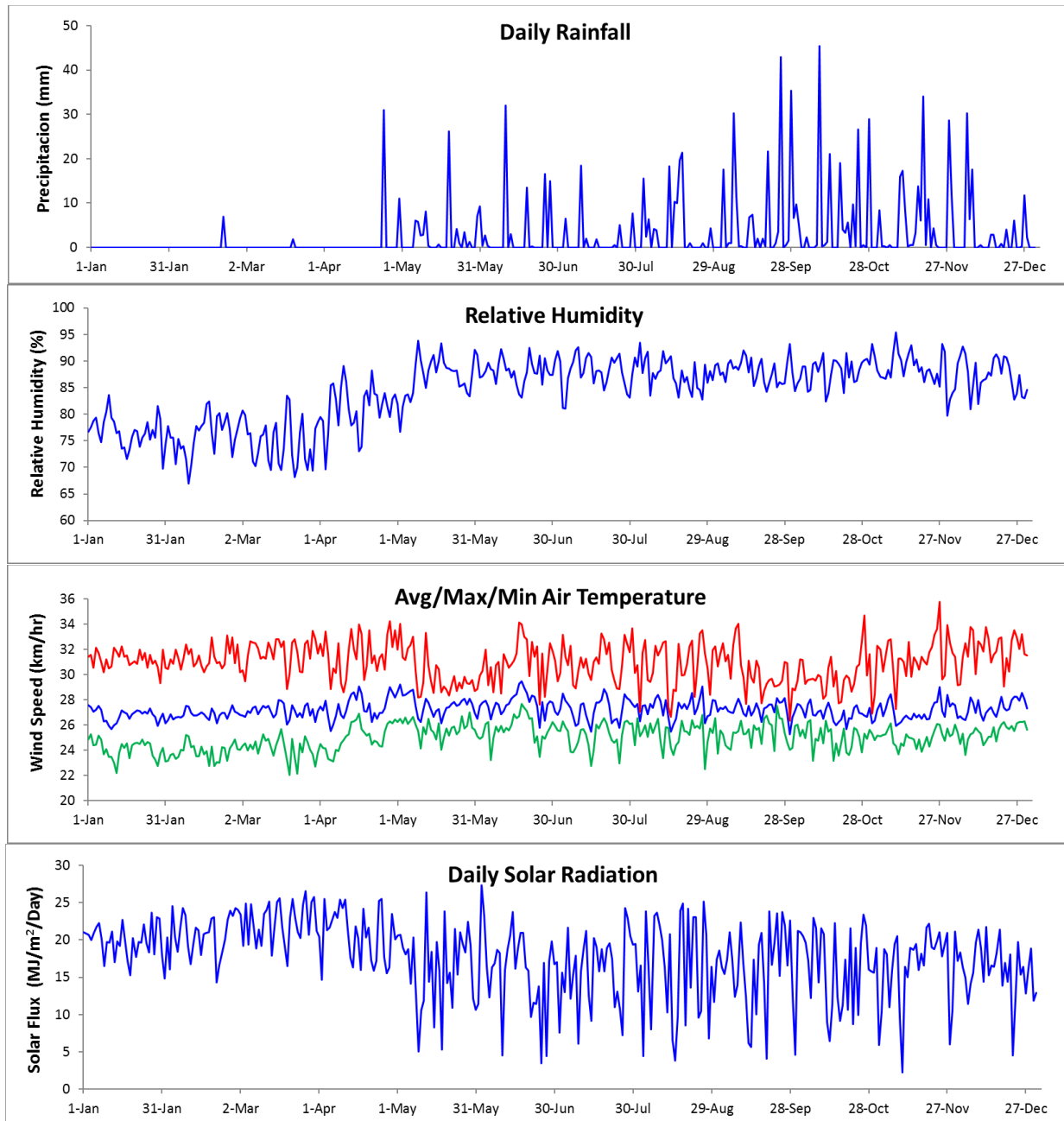
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017							28.5	26.9	25.8	25.5	25.6	26.9
2018	27.9	31.3	31.7	31.2	28.4	28.3	27.4	27.9	26.7	25.5	25.7	28.3
2019	31.9	32.7	32.7	32.2	30.9	29.2	29.3	28.7	27.8	27.0	26.5	28.1
mean	29.9	32.0	32.2	31.7	29.7	28.7	28.4	27.8	26.8	26.0	25.9	27.8
sd	2.8	1.0	0.7	0.7	1.7	0.6	1.0	0.9	1.0	0.9	0.5	0.8
min	27.9	31.3	31.7	31.2	28.4	28.3	27.4	26.9	25.8	25.5	25.6	26.9
max	31.9	32.7	32.7	32.2	30.9	29.2	29.3	28.7	27.8	27.0	26.5	28.3

Seawater Tanks

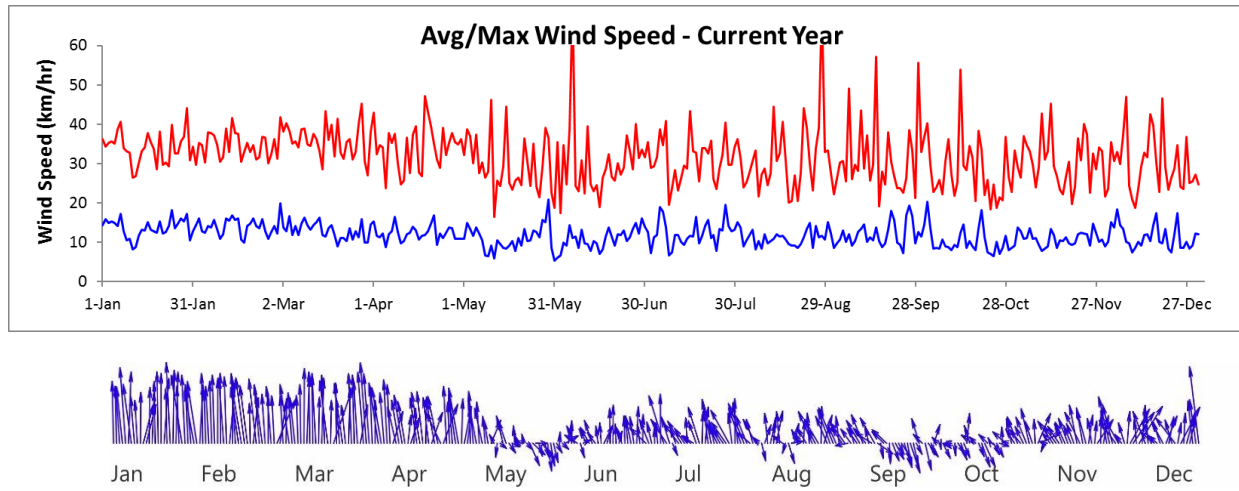
Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2017						30.1	29.7	28.1	26.7	26.9	27.2	28.4
2018	29.4	32.7	33.1	32.3	30.2	29.7	29.5	30.0	28.6	27.5	27.4	29.7
2019	32.5	34.1	34.2	33.7	32.1	30.4	30.7	30.3	29.7	28.5	27.9	29.2
mean	31.0	33.4	33.7	33.0	31.2	30.1	30.0	29.5	28.4	27.6	27.5	29.1
sd	2.2	1.0	0.8	1.0	1.3	0.3	0.7	1.2	1.5	0.8	0.3	0.7
min	29.4	32.7	33.1	32.3	30.2	29.7	29.5	28.1	26.7	26.9	27.2	28.4
max	32.5	34.1	34.2	33.7	32.1	30.4	30.7	30.3	29.7	28.5	27.9	29.7



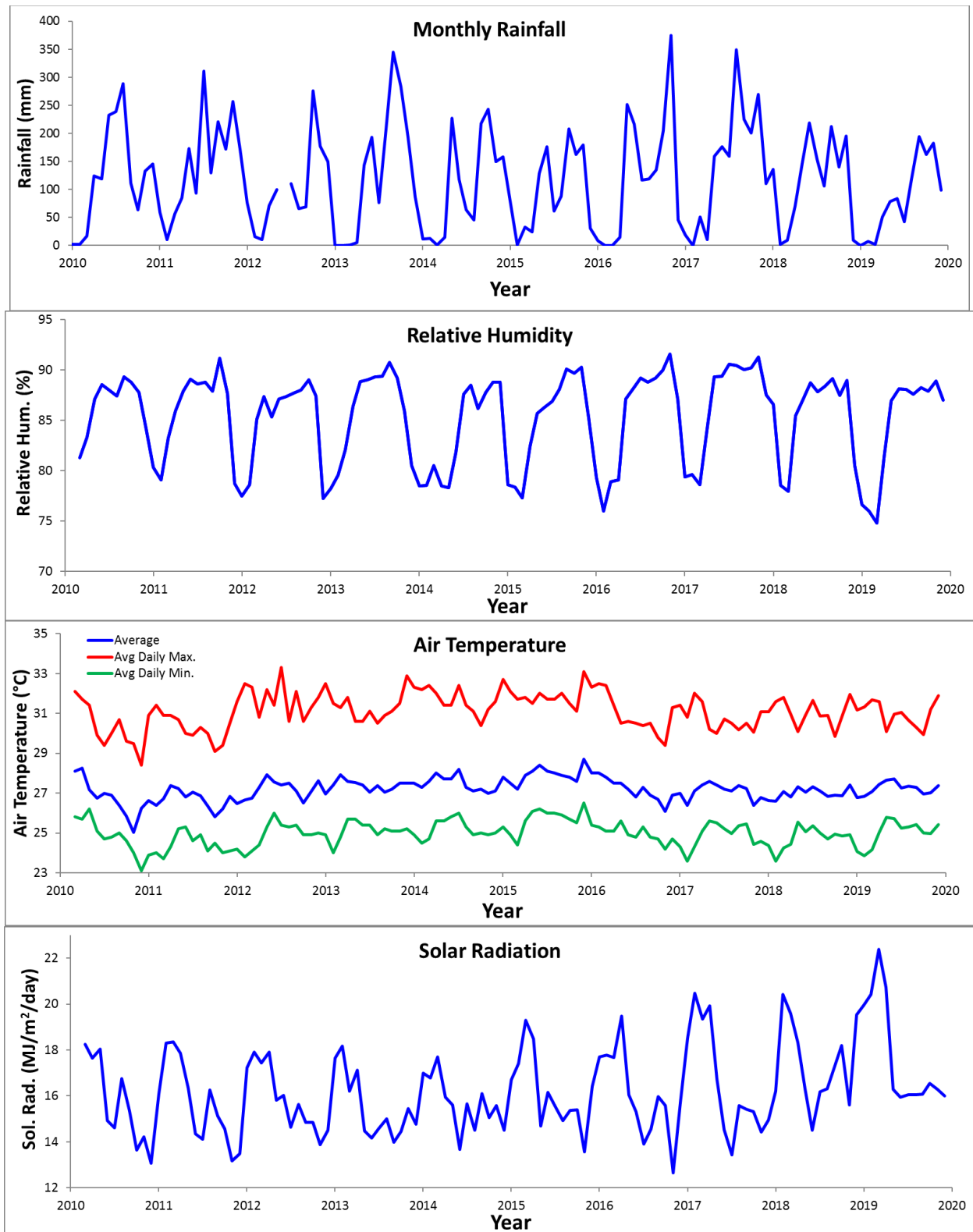
Time Series – Daily, 2019



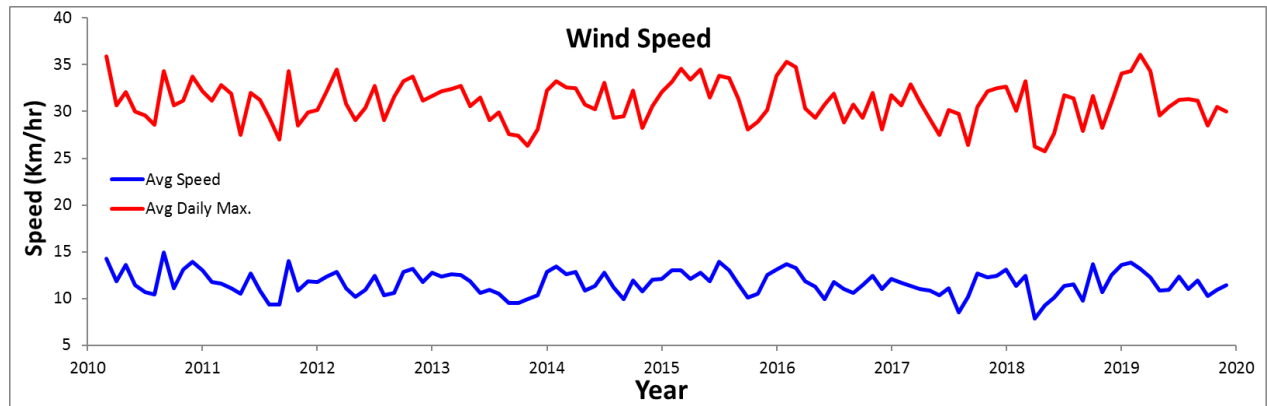
Time Series – Daily, 2019



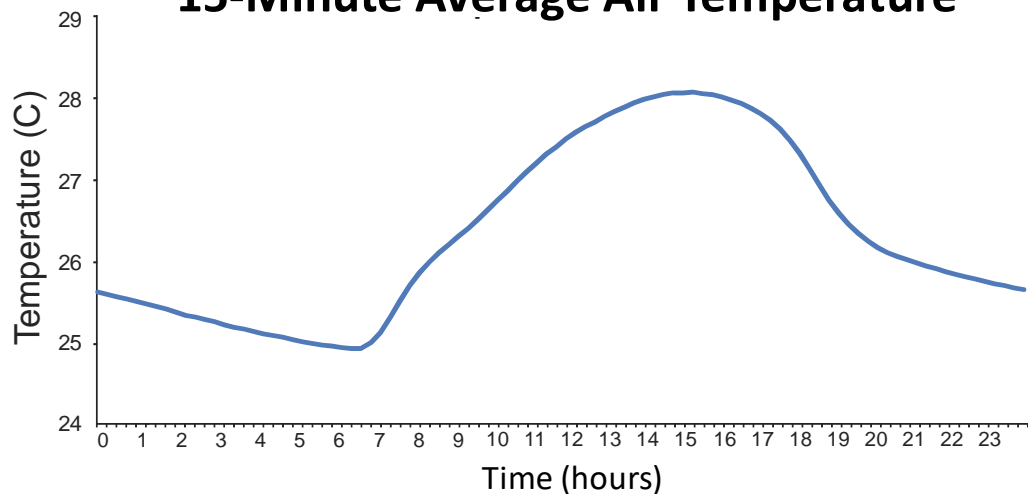
Time Series – Monthly



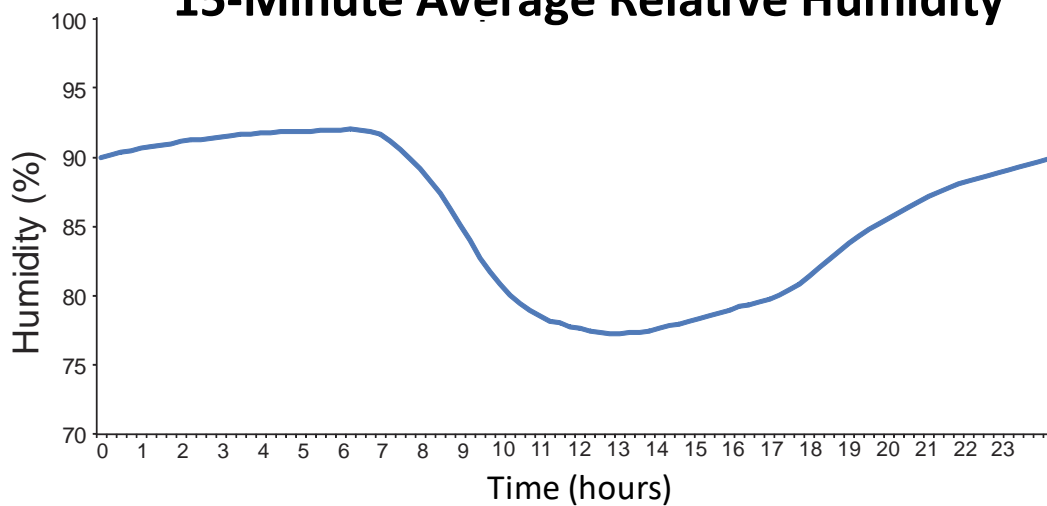
Time Series – Monthly



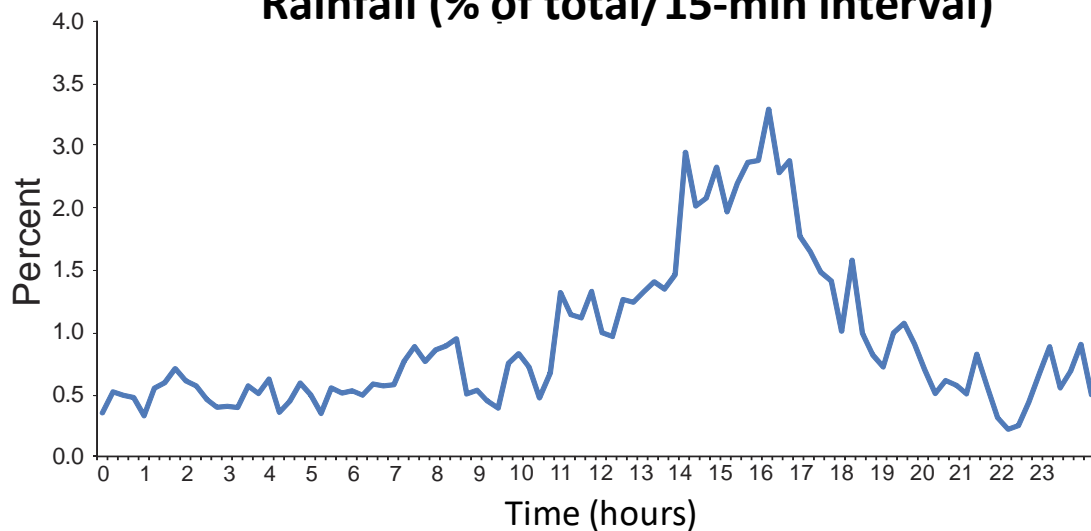
15-Minute Average Air Temperature



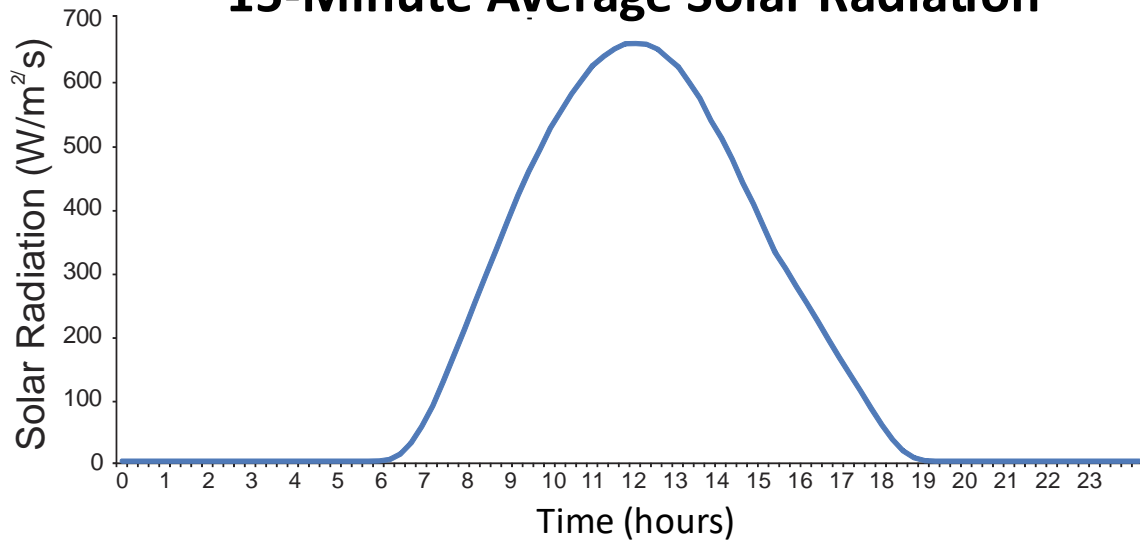
15-Minute Average Relative Humidity



Rainfall (% of total/15-min interval)



15-Minute Average Solar Radiation



15-Minute Average Wind Speed

