

ACE Basin National Estuarine Research Reserve

Meteorological Metadata Report

January – December 2017

Latest Update: 11/08/2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

SCDNR/Marine Resources Division	ACE Basin NERR field station
217 Fort Johnson Road	15717 Bennett's Point Road
Charleston, SC 29422	Green Pond, SC 29441
(843) 953-9300	(843) 844-8822

Contact Persons:

Dr. Denise Sanger, Research Coordinator

Contact: Sangerd@dnr.sc.gov (843) 953-9074

Saundra Upchurch, Reserve Biologist

Contact: UpchurchS@dnr.sc.gov (843) 953-9223

2) Entry verification

a) Data Input Procedures:

Meteorological data is recorded in 15-minute intervals and stored in a Campbell Scientific CR1000 data logger. ACE staff uses a data storage card to serve as a back-up for the CR1000 data logger. The program that controls the sampling, schedule, and storage of data by the CR1000 is provided by CDMO.

The CR1000 is interfaced with the Campbell Scientific's LoggerNet software. ACE staff downloads and troubleshoots LoggerNet programs with a direct connection to the weather station, using a laptop computer and a 9-pin serial cable. The GOES satellite system also uploads all 15-minute meteorological data summaries to a NOAA server every hour. These multiple methods of data retrieval ensure that all measured parameters are reported.

b) QA/QC Procedures:

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from LoggerNet in comma-delimited format and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is processed in Microsoft Excel using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. Outliers, suspect data, erroneous data, and other data flagged by the NERRQAQC macro are evaluated based on monthly field logs and NOAA historical data for the area. For more information on QAQC flags and QAQC codes, see Sections 11 and 12.

Amanda Fornal, Denise Sanger, and Saundra Upchurch were responsible for the above tasks during 2017 Q1. Denise Sanger, Saundra Upchurch, and Kim Sitta were responsible for the above tasks during 2017 Q2, Q3 and Q4.

3) Research objectives –

The principal objective of the Weather Monitoring Program is to record long-term meteorological data for the ACE Basin NERR in order to observe any environmental changes or trends over time.

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the Bennett's Point station on 06/30/2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B01E672. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QA/QC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QA/QC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at <http://cdmo.baruch.sc.edu>.

Data were collected in Eastern Standard Time (EST) for the entire year.

The 15 minute Data are collected in the following formats for the CR1000:

Averages from 5-second data:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb),

Wind Speed (m/s), Wind Direction (degrees) and Battery Voltage (volts)

Maximum and Minimum Air Temperature (°C) and their times from 5-second data (these data are available from the Reserve)

Maximum Wind Speed (m/s) and time from 5-second data

Wind Direction Standard Deviation (degrees)

Totals:

Precipitation (mm), PAR (millimol/m²), and Cumulative Precipitation (mm)
(Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.)

In-situ weather conditions are measured to verify the accuracy of the readings by the sensors, using a Kestrel 500 hand-held. After downloading data, sensors on the weather station are inspected for damage or debris. If any problems are found, it is repaired and/or cleaned. Tree limbs and other shrubs are cut back to prevent obstruction of the sensors. Sensors are removed and sent back to Campbell Scientific for calibration according to the following guidelines:

- Temperature/Humidity- yearly recalibration
- Rain Gauge- yearly recalibration (in house)
- Wind Speed/Direction- every 1-2 years recalibration
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000- every 5 years

Data collected underwent the QA/QC process described in 2b.

5) Site location and character –

The ACE Basin National Estuarine Research Reserve (NERR) is located on the Southeastern Atlantic coast of the United States, including portions of Charleston, Colleton and Beaufort Counties in South Carolina. The study area encompasses the Ashepoo, Combahee, and South Edisto River basins, which empty into St. Helena Sound. Diverse estuarine wetlands provide extensive and complex habitat types for fish and wildlife. The NERR consists of approximately 92,000 acres of tidal marshes. Of this, 65,600 acres are salt marshes, 13,600 acres are brackish marshes and 12,100 acres are freshwater marshes. Interspersed within these three tidal marsh zones are approximately 26,000 acres

of managed wetlands, marsh impoundments, and hammock islands. St. Helena Sound comprises approximately 23,870 acres of open coastal marine and estuarine waters.

The weather station is located at the Bennett's Point field station on Mosquito Creek, a navigable tributary off of the Ashepoo River. The weather station's latitudinal and longitudinal coordinates are: 32.55934 N and -80.45456 W and is located at sea level elevation. The station is approximately 90 m from the creek (800 m from the Ashepoo River) in a grassy field, 80 m to the southwest of the field station. The closest wind obstructions are oak trees, 25 m to the south and southwest of the weather station and 70 m from a public paved road. The closest SWMP water quality station, Mosquito Creek, is approximately 1655 m from the weather station.

The Campbell Scientific data logger and the barometric sensor (sensor body at 1.5 m and sensor tube at 1.0 m) are enclosed in a Campbell Scientific enclosure box with moisture/humidity indicators and 4 desiccant packets. A 6.1 m (15 foot) galvanized steel tower elevates the sensors above potential barriers and enhances the performance of each sensor. The PAR sensor and anemometer are attached to a cross-bar at the top of the tower at a height of 6.1 m and the temperature/relative humidity sensor is attached approximately half way up the tower at a height of 3.35 m. The solar panel is attached to a 2.5 m long arm, and is oriented to the east at approximately 47-degrees. The tipping bucket rain gauge (1.3 m height) is located 2.5 m to the southeast of the box on a concrete level platform. The sensors are wired to the CR1000 data logger following protocol in the CDMO Manual, with minor changes made in order to facilitate the function of upgraded sensors. A new larger enclosure box and solar panel were necessary with the installation of the GOES telemetry system.

SWMP Station Timeline:

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
ACEBPMET	Bennett's Point	P	32° 33' 33.64 N, 80° 27' 16.41 W	03/01/2001 -	NA	NA

6) Data collection period –

Weather data have been collected at the ACE Basin NERR Bennett's Point weather station since the station became operational in March 2001. Data has been collected for the first quarter (~January – March), second quarter (~April – June), third quarter (~July – September), and fourth quarter (~September – December) of 2017.

File Start Date and Time	File End Date and Time
12/12/2016 11:45	01/09/2017 12:15
01/09/2017 12:30	02/06/2017 12:00
02/06/2017 12:15	03/03/2017 10:15
03/03/2017 14:45	03/04/2017 01:00
03/04/2017 01:15	04/10/2017 10:15
04/10/2017 11:15	05/03/2017 10:15
05/03/2017 12:15	05/31/2017 21:30
05/30/2017 20:15	06/12/2017 17:00
06/12/2017 17:15	07/13/2017 10:45
07/13/2017 11:00	08/11/2017 09:15
08/11/2017 09:30	09/25/2017 12:45
09/25/2017 13:00	10/31/2017 11:45

10/31/2017 12:00	12/01/2017 11:45
12/01/2017 12:00	12/13/2017 12:30
12/13/2017 12:45	01/11/2018 11:30

7) Distribution –

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program, is as follows

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: <http://www.nerrsdata.org/> ; accessed 12 October 2016.

NERR meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects –

The NERR Water Quality Monitoring Project is a study which records long-term water quality data for the ACE Basin in order to observe any changes or trends in water quality over time. The six sampling sites are in separate tributaries of the South Edisto and Ashepoo Rivers. Two sites represent an urban or "treatment" site, and two sites represent pristine areas within the Reserve. A salinity gradient is also observed between these six sites:

Edisto Island – approximately 14 kilometers from the weather station, GPS coordinates: 32.50399 N and -80.32470 W. In January 2015, Edisto Island station replaced Big Bay station as a primary station, and it is one km upstream of the Big Bay station (See the 2014 metadata report for a description of the Big Bay station). It is located on the dock of the Edisto Interpretive Center at Edisto Beach State Park.. The Edisto Island station is bordered by *Spartina alterniflora* marsh, and American oyster (*Crassostrea virginica*) forms a reef along the creek bank.

St. Pierre Creek - approximately 9 kilometers from the weather station, GPS coordinates: 32.52800 N and -80.36144 W. The station is surrounded by a wide expanse of *Spartina alterniflora* marsh. Extensive mud flats and oyster reefs fringe the banks. Development in the immediate area is sparse, and this creek is subject to light boat traffic.

Fishing Creek – approximately 8 kilometers from the weather station, GPS coordinates: 32.63593 N and -80.36556 W. The station is near Jehossee Island, a protected USFWS property, and is surrounded

by extensive *Spartina cynosuroides* marsh and vast mud flats. The upland area is characterized by slash pine, live oak, and cabbage palmetto.

Mosquito Creek – approximately 2 kilometers from the weather station, GPS coordinates: 32.5558 N and -80.4380 W. The station is surrounded by agriculture fields and impounded wetlands. A public boat landing and a commercial seafood business with three commercial shrimp boats and a fueling station are located about 0.8 km (0.5 mi) downstream of the monitoring station.

Grove Plantation – approximately 12 kilometers from the weather station, GPS coordinates: 32.6637 N and -80.4130 W. The station is in the South Edisto River located at the Grove Plantation unit of the ACE Basin National Wildlife Refuge, which is owned and managed by the US Fish and Wildlife Service (USFWS). The station is surrounded by tidal freshwater fringe marsh and managed wetlands (aka “waterfowl impoundments”). The upland area is dominated by pine-mixed hardwood forest that is characterized by several species of oaks and pines.

Jehossee Island – approximately 9 kilometers from the weather station, GPS coordinates: 32.6209 N and -80.3965 W. The station is in the South Edisto River proper. It is located at the Jehossee Island unit of the ACE Basin National Wildlife Refuge, which is owned and managed by the US Fish and Wildlife Service (USFWS). The station is surrounded by *Spartina cynosuroides* fringe marsh and managed wetlands (aka “waterfowl impoundments”). The upland area is dominated by inland maritime forest that is characterized by slash pine, live oak, and cabbage palmetto.

Measurements for all sites are taken every fifteen minutes over an approximate two-week or four-week collection period (depending upon fouling previously experienced and future fouling rate expected).

In July 1997, the Reserve staff initiated nutrient monitoring study. The objective of the study is to ascertain the annual and tidal fluctuations in nutrient levels near our two data logger sites. Nutrient levels are measured during a complete tidal cycle each month, and the samples are analyzed for ammonia, nitrite & nitrate, orthophosphate, and chlorophyll a concentrations. In January of 2002, the nutrient monitoring protocol (NUT) was added to the NERR System Wide Monitoring Program (SWMP).

The results from these studies and additional studies conducted in the ACE Basin can be obtained by contacting the Reserve.

II. Physical Structure Descriptors

9) Sensor specifications –

Parameter: Temperature and Relative Humidity

Units: Temperature- Celsius; Relative Humidity- %

Model #: HMP45C

Operating Temperature: -40 to +60 °C

Temperature Measurement Range: -40 to +60 °C

Temperature Accuracy: $\pm 2\%$ °C @ 20 °C

Relative Humidity Measurement Range: 0 - 100% non-condensing

RH Accuracy: $\pm 2\%$ RH (0 - 90%) and $\pm 3\%$ (90 - 100%)

Uncertainty of calibration: $\pm 1.2\%$ RH

Serial Number: E3010019

Date of Last Calibration: 02/02/2016

Previous Calibrations: 05/03/2013, 01/28/2010

Dates of Sensor Use: 04/18/2016-03/03/2017

Serial Number: D3520073
Date of last calibration: 03/13/2014
Previous Calibrations:
Date of sensor Use: 07/23/2014 - 04/18/2016

Serial Number: A1710045
Date of last calibration: 01/28/2017
Previous Calibrations: N/A
Date of sensor Use: 03/03/2017-current as of 12/31/2017

Parameter: Barometric Pressure

Units: millibars (mb)
Model #: PTB101B
Calibrated Range: 26" - 32" (Standard)
Supply Voltage: 12 VDC at 12 mA
Accuracy: ± 0.7 of span
Operating Temperature Range: -22 to +55 °C

Serial Number: Y0930012
Date of last calibration: 05/13/2013
Previous Calibrations: 02/10/2010, 06/21/2007
Date of sensor Use: 02/27/2014 - 04/18/2016

Serial Number: A195003
Date of last calibration: 02/29/2016
Previous Calibrations: 02/27/2012, 10/16/2008
Date of sensor Use: 04/18/2016-current as of 12/31/2017

Parameter: Wind speed and Wind direction

Units: Wind speed- meter per second (m/s); wind direction- degrees
Model #: 3001-L RM Young Wind Sentry Set (1)
Model #: 3002-L RM Young Wind Sentry Set (2)
Wind Speed Sensor Type: 12 cm diameter 4-blade helicoids propeller molded of polypropylene
Range: 0-50 m/s (112 mph); gust survival 60 m/s (134 mph)
Accuracy: ± 0.5 m/s (1.1 mph)
Wind Direction Sensor Type: balanced vane, 16 cm turning radius
Range: 360° mechanical, 355° electrical
Accuracy: $\pm 5^\circ$

Serial Number: 2365M3 (2)
Date of last calibration: 02/07/2016
Previous Calibrations: 03/02/2013, 10/31/2008
Date of sensor Use: 04/18/2016-03/03/2017

Serial Number: N/A (1)
Date of last calibration: 01/31/2017
Previous Calibrations: 02/04/2010, 06/21/2007, 05/06/2013
Date of sensor Use: 03/03/2017-current as of 12/31/2017

Parameter: Photosynthetic Active Radiation (PAR)

LI-COR Quantum Sensor

Units: mmol m⁻² (total flux)

Model #: LI-190

Serial #: Q31559

Stability: < ± 2% change over a 1 year period

Operating Temperature: -20 to +65 °C

Sensitivity: Typically 30 µA per 100 klux

Light Spectrum Wavelength: 400 to 700 nanometers

Calibration Factor: 264.70 µmol m⁻² s⁻¹ per mV

Date of last calibration: 04/28/2016

Date of sensor use: 05/06/2016 to 03/03/2017

Multiplier History and Calibration Dates and Dates Installed:

LI-COR sensor 1 (SN# Q35240)

Calibrated 07/2005 – Installed Aug. 22, 2005 – multiplier 1.36

Calibrated 10/2008 – Installed Sept. 30, 2009 – multiplier 2.18

Calibrated 02/2012 – Installed Mar. 16, 2012 – multiplier 3.12

Retired 03/03/2016

LI-COR sensor 2 (SN# Q31559)

Calibrated 09/2002 – Installed May 3, 2003 – multiplier 1.27

Calibrated 06/2007 – Installed Apr. 22, 2008 – multiplier 1.34

Calibrated 02/2010 – Installed Dec. 9, 2010 – multiplier 1.38

Calibrated 05/2013 – Installed Feb. 27, 2014 – multiplier 1.54

Calibrated 04/2016 – Installed May 06, 2016- multiplier 1.54

Apogee Quantum Sensor

Units: mmol m⁻² (total flux)

Model #SQ110

Stability: < ± 2% change over 1 yr

Sensitivity: 0.2mV per µmol s⁻¹ m⁻²

Operating Temperature: -40°C to 70°C; Humidity 0 to 100%

Light spectrum waveband: 410 to 655 nm

Temperature dependence: 0.06 ± 0.06% per °C

Cosine Response: 45° zenith angle: ± 2%; 75° zenith angle: ± 5%

Date of last calibration: 02/01/2017 (New)

Date of sensor use: 03/03/2017 - current as of 12/31/2017

Multiplier History and Calibration Dates and Dates Installed:

Apogee SQ110 sensor 1 (SN# 22346)

Installed Mar. 03, 2017-current – multiplier 0.025

Parameter: Precipitation

Units: millimeters (mm)

Tipping Bucket Rain Gauge

Texas Electronics

Model #: TR-525I

SN: 23864-399

Calibration: 0.01 inch per tip

Accuracy: ± 3% (Rates of 1 to 6 inches per hour)

Date of last calibration: 04/10/2017

Previous Calibrations: 04/28/16, 02/27/2014, 12/09/2012, 06/07/2012, 05/24/2012, 02/20/2012, 02/07/2011, 03/08/2010, 07/18/2006

Storage Module

Model # SM4M

Storage capacity: 2 million low-resolution data values

Program storage: stores up to 8 programs with a total capacity of 128 KB

Processor: Hitachi H8S

Operating system: 64 KB, flash memory based, user downloadable

Operating range: Temp: -35 to +65 °C

Baud rates: 9600, 76800

Power requirements: 5 ± 0.3 VDC @ 100 mA

The CR1000 has 2 MB of Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM is available for program storage (16K), operating system use, and data storage. Additional storage is available by using a compact flash card in the optional CFM100 Compact Flash Module

Serial Number: 005202

Date of last calibration: 01/30/2012

Previous Calibrations: None, purchased in 2006

Dates of datalogger use: 06/29/2006 - 03/16/2012, 03/03/2017 - current as of 12/31/2017 (internal battery replaced 05/03/2017)

Serial Number: 46152

Date of last calibration: None, purchased in 2012

Previous Calibrations: N/A

Dates of datalogger use: 03/16/2012 - 03/03/2017

CR1000 Firmware Version: CR1000_OS_31.02

Last update: 04/10/2017

CR1000 Program Version: ACEBPMET_V5.5.1_050317 (current)

ACEBPMET_V5.5_041017

ACEBPMET_V5.5_030217

ACEBPMET_V5.5_050616

ACEBPMET_V5.5_022714

10) Coded variable definitions –

Sampling station:	Sampling site code:	Station code:
Bennett's Point	BP	acebpmet

11) QAQC flag definitions –

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is above or below sensor range, or missing. All remaining data are then flagged 0, as passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range

-4	Outside Low Sensor Range
-3	Data Rejected due to QAQC
-2	Missing Data
-1	Optional SWMP supported parameter
0	Passed Initial QAQC Checks
1	Suspect Data
2	<i>Open - reserved for later flag</i>
3	<i>Open - reserved for later flag</i>
4	Historical Data: Pre-Auto QAQC
5	Corrected Data

12) QAQC code definitions –.

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the CR1000, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an * below) can be applied to the entire record in the F_Record column.

General Errors

GIM	Instrument malfunction
GIT	Instrument recording error, recovered telemetry data
GMC	No instrument deployed due to maintenance/calibration
GMT	Instrument maintenance
GPD	Power down
GPF	Power failure / Low battery
GPR	Program reload
GQR	Data rejected due to QA/QC checks
GSM	See metadata

Sensor Errors

SDG	Suspect due to sensor diagnostics
SIC	Incorrect calibration constant, multiplier or offset
SIW	Incorrect wiring
SMT	Sensor maintenance
SNV	Negative value
SOC	Out of calibration
SQR	Data rejected due to QAQC checks
SSD	Sensor drift
SSN	Not a number / unknown value
SSM	Sensor malfunction
SSR	Sensor removed

Comments

CAF	Acceptable calibration/accuracy error of sensor
CCU	Cause unknown
CDF	Data appear to fit conditions
CML	Snow melt from previous snowfall event
CRE*	Significant rain event
CSM*	See metadata
CVI*	Possible vandalism/tampering
CWE*	Significant weather event

13) Other remarks/notes –

Data are missing due to equipment or associated specific sensors not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NaNs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Small negative PAR values are within range of the LI-COR sensor and are due to normal errors in the sensor and the CR1000 data logger. The maximum signal noise error for the LI-COR sensor is +/- 2.214 mmol/m² over a 15 minute interval.

After 04/10/2017 11:15, Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3> (SQR).

Please note that the 3001 MET One Wind Set has an offset of 0.2 and does not record values of 0.

Data recorded for all parameters (with the exception of cumulative precipitation) at the midnight timestamp (00:00) are the 15 minute averages and totals for the 23:45-23:59 time period of the previous day. Cumulative precipitation data at the midnight timestamp (00:00) are the sum of raw (unrounded) precipitation data from 00:00 to 23:59 of the previous day. Summing each individual 15-minute total precipitation value from the same period will result in small differences from cumulative precipitation due to rounding. It is especially important to note how data at the midnight timestamp are recorded when using January 1st and December 31st data. **Note: Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.**

All Parameters Blanket Statement for Bennett’s Point Weather Station

Table 1 lists significant weather events from the National Hurricane Center administered by the National Oceanic and Atmospheric Administration (NOAA). All events listed have impacted the South Carolina coast in 2017.

Table 1: Significant weather events in 2017.

Significant Weather Event	Date Started	Date Ended	Max Wind Speed	Min. Pressure
Hurricane Irma AL112017	August 30, 2017	September 11, 2017	NA	NA

Hurricane Irma:

Hurricane Irma was a category 5 hurricane that moved along the west coast of Florida with rainfall and storm surge along the SC coast. The impact of Hurricane Irma was observed at the Bennett’s Point meteorological station in Green Pond, South Carolina during the following times:

Data collected from 09/11/2017 at 00:00 to 09/13/2017 at 00:00 are flagged for a significant weather event. All parameters were affected therefore the F_Record column is coded as {CWE} {CSM}.

Passed Initial QAQC Checks (Flag <0>)

None

Rejected Data (Flag <-3>)

Data were missing for all parameters from 03/03/2017 at 10:30 to 03/04/2017 at 01:00 from CR1000 download. A replacement CR1000 was installed with what has been determined as a low internal battery. The external battery charged the computer and the CR1000 was able to begin to store data at 01:15 on 03/04/2017. Telemetered data was available starting at 03/03/2017 at 14:45 through 03/04/2017 at 01:00. The first record for the telemetered data (03/03/2017 at 14:45) and the first record of the CR1000 retaining data (03/04/2017 at 01:15) were flagged and coded as <-3> [GIT] (CSM) and <-3> (CSM), respectively, due to uncertainty related to the averaging of 5 second readings.

Data are missing for all parameters from 04/10/2017 at 10:30 to 04/10/2017 at 11:00 and 05/03/2017 at 10:30 to 05/03/2017 at 12:45. The CR1000 was powered down for maintenance and to replace an internal battery and upload a new program, respectively. The first record (04/10/2017 at 11:15 and 05/03/2017 at 13:00) after power was reapplied were flagged and coded as <-3> [GPR] (CSM), due to uncertainty related to the averaging of 5 second readings.

Data were rejected for all parameters on 05/03/2017 at 14:30 due to errors in averaging the 5-second readings. In an attempt to fix an error with the clock on LoggerNet, power was pulled from both the CR1000 and the battery at 14:20. Rejected data are flagged and coded as <-3> [GPD](CSM)

Suspect Data (Flag <1>)

Data were missing from the CR1000 log for all parameters from 03/03/2017 at 10:30 to 03/04/2017 at 01:00. The CR1000 was replaced with what has been determined as a low internal battery. The external battery charged the CR1000 and the CR1000 was able to begin to store data at 01:15 on 03/04/2017. Telemetered data was available starting at 03/03/2017 at 15:00 through 03/04/2017 at 01:00 which was used to replace the missing logged values. Telemetered data are flagged and coded as <1> [GIT] (CSM).

Missing Data (Flag <-2>)

Data are missing for all parameters from 03/03/2017 at 10:30 to 03/03/2017 at 14:30. The CR1000 was replaced with what has been determined as a low internal battery. The external battery charged the CR1000 and the CR1000 was able to begin to store data at 01:15 on 03/04/2017. Telemetered data was available starting on 03/03/2017 at 14:45 which was used to replace the missing logged values. Missing data are flagged and coded as <-2> [GMC] (CSM).

Data are missing for all parameters from 04/10/2017 at 10:30 to 04/10/2017 at 11:00. The CR1000 was powered down for maintenance. The missing data are flagged and coded as <-2> [GMC] (CSM).

Data are missing for all parameters from 05/03/2017 at 10:30 to 05/03/2017 at 12:45. The CR1000 internal battery was replaced and a new program was uploaded. Missing data are flagged and coded as <-2> [GMC] (CSM).

Corrected Data (Flag <5>)

The CR1000 internal battery was replaced and a new program was uploaded which resulted in missing data from 05/03/2017 at 10:30 to 05/03/2017 at 12:45. When power was reapplied, the time stamp was incorrect which results in six records being collected at the wrong time. These values were moved down by 45 minutes to correct their time. The first record was flagged and coded as <-3> [GPR] (CSM) as detailed above. Five records from 05/03/2017 at 13:15 to 05/03/2017 at 14:15 were flagged and coded as <5> [GPR] (CSM). In addition, the time was corrected for MaxTempT, MinTempT, and

MaxWSpdT during this period(max and min air temperature are not in the data set but are available from the Reserve).

Temperature/Relative Humidity

Passed Initial QAQC Checks (Flag <0>)

During 2017 the CDMO discovered an incorrect line in the CR1000 programming. If RHumidity>100 And RHumidity<108 Then RHumidity=100. A decision was made by the DMC during 2006 to discontinue correcting >100 RH values to 100. This change was never made in our program and has remained in each updated version until it was removed during 2017. By correcting all values >100 during data collection we may have missed erroneous values that could have indicated a problem with the RH sensor. CSM coding was added to all RH data from 2007 until the programming change in 2017 on 04/10/2017 at 10:15.

Rejected Data (Flag <-3>)

None

Suspect Data (Flag <1>)

None

Missing Data (Flag <-2>)

None

Barometric Pressure

Passed Initial QAQC Checks (Flag <0>)

None

Rejected Data (Flag <-3>)

None

Suspect Data (Flag <1>)

None

Missing Data (Flag <-2>)

None

Wind Speed/Direction

Passed Initial QAQC Checks (Flag <0>)

None

Rejected Data (Flag <-3>)

None

Suspect Data (Flag <1>)

None

Missing Data (Flag <-2>)

None

Total Precipitation

Passed Initial QAQC Checks (Flag <0>)

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to tipping issue with cover or from a loose wire. The loose wire was found on 12/13/2017; however, the rain gauge continued to malfunction. The data from 12/01/2017 at 00:15 to 12/02/2017 at 00:00 and 12/13/2017 at 12:30 to 12/20/2017 at 14:45 was flagged and coded as <0> (CSM) as we are confident no rain fell on these days from other measurements (nearby weather site and onsite manual rain gauge).

Rejected Data (Flag <-3>)

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to tipping issue with cover or from a loose wire. The loose wire was found on 12/13/2017; however, the rain gauge continued to malfunction. Rainfall was reported at a nearby location (Charleston Airport on 12/06 (0.12 in), 12/07 (0.53 in), 12/08 (0.3 in), 12/09 (0.13 in), 12/20 (0.09 in), 12/21 (0.07 in), 12/24 (0.1 in), 12/27 (0.01 in), and 12/29 (0.05 in); Green Pond on 12/23 (0.05 in), 12/28 (0.08 in) and 12/31 (0.02 in)) and rainfall from the onsite manual gauge measured 1.35 in from 12/04 to 12/08; 0.95 in from 12/08 to 12/11 at 14:48; 0.1 in from 12/11 to 12/13 at 12:12, 0.0 in from 12/13 to 12/20 at 14:50, and 0.98 from 12/20/2017 to 1/08/2018. Therefore, data for the following dates and times were rejected and flagged and coded as <-3> [SQR] (CSM).

12/06/2017 at 00:15 to 12/10/2017 at 00:00
12/11/2017 at 15:00 to 12/13/2017 at 12:15
12/20/2017 at 15:00 to 12/22/2017 at 00:00
12/23/2017 at 00:15 to 12/25/2017 at 00:00
12/27/2017 at 00:15 to 12/30/2017 at 00:00
12/31/2017 at 00:15 to 12/31/2017 at 23:45

Suspect Data (Flag <1>)

Total precipitation recorded on 07/02/2017 at 17:45 is flagged and coded as <1> [GSM] (CDF) because of the extremely high precipitation values recorded during this time. Our onsite manual rain gauge was not checked daily, however between 06/20/2017 at 14:10 to 07/05/2017 at 09:40 precipitation measured 6.84 inches. When summing precipitation values recorded from our rain gauge, it is comparable (6.66 in); therefore, instead of rejecting the data, it is marked as suspect.

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to tipping issue with cover or from a loose wire. The loose wire was found on 12/13/2017, however the rain gauge continued to malfunction. The data for the following time periods were flagged and coded as <1> (CSM). No rain fell at two nearby weather sites (Charleston Airport and Green Pond, SC) but the onsite manual rain gauge was not checked daily.

12/02/2017 at 00:15 to 12/04/2017 at 14:00
12/04/2017 at 14:30 to 12/06/2017 at 00:00
12/10/2017 at 00:15 to 12/11/2017 at 14:45
12/22/2017 at 00:15 to 12/23/2017 at 00:00
12/25/2017 at 00:15 to 12/27/2017 at 00:00
12/30/2017 at 00:15 to 12/31/2017 at 00:00

Missing Data (Flag <-2>)

None

Corrected Data (Flag <5>)

The rain bucket accidentally tipped during site maintenance. No rain fell while the technicians were onsite. The data was corrected to a 0 reading for 03/03/2017 at 10:00. The data was flagged and coded as <5> [SMT] (CSM).

The rain bucket accidentally tipped during site maintenance. A very small amount of rain was in the bucket that was lost. The data was corrected to a 0 reading for 06/20/2017 at 13:15. The data was flagged and coded as <5> [SMT] (CSM).

The rain bucket accidentally tipped during site maintenance. No rain fell while the technicians were onsite. The data was corrected to a 0 reading for 12/04/2017 at 14:15. The data was flagged and coded as <5> [SMT] (CSM).

Total PAR

Passed Initial QAQC Checks (Flag <0>)

PAR data for 2017 dataset is commented due to elevated nighttime PAR readings. Moisture intrusion into the spliced wires of the PAR cable occurred during May and also more than likely occurred with the passing of Hurricane Irma in September. As a result, elevated nighttime PAR readings occurred during September. The high nighttime values were rejected. Daytime PAR values are comparable to 2016 values and therefore, the daytime values are not considered suspect. Instead, daytime PAR data from 9/15/2017 through the end of the year are coded with CSM unless otherwise flagged as rejected or suspect.

Rejected Data (Flag <-3>)

PAR data for 2017 dataset is commented due to elevated nighttime PAR readings when the LI-COR sensor was deployed. The LI-COR sensor was switched to an Apogee on 03/03/2017, however elevated nighttime PAR readings still occurred. Moisture seeping into the LI-COR sensor and/or moisture seeping into the LI-COR and Apogee sensor cable is thought to be the cause for the elevated nighttime PAR, however it is still under investigation. Since the range of error for the LI-COR sensor is ± 2.214 mmol/m², time points that fall between one half hour past sunset and one half hour before sunrise that have values greater than 2.214 mmol/m² are rejected. All Apogee night time PAR readings beginning 09/14/2017 19:15 were rejected. Data are flagged and coded as <-3> (CSM). Note that <http://www.sunrisesunset.com> was used to determine sunrise and sunset times using Green Pond, South Carolina as a city of reference.

On 03/03/2017 at 14:45, the LI-COR sensor was replaced with an Apogee sensor. The transformer that was in the wiring for the LICOR was left in place for the Apogee resulting in erroneous values until it was removed on 03/08/2017. Therefore, the data for Total PAR from 03/03/2017 at 14:45 to 03/08/2017 at 13:30 was rejected and flagged and coded as <-3> [SIW] (CSM).

Negative PAR readings were recorded intermittently starting on 05/23/2017. The wiring of the PAR Apogee sensor was assessed on 05/25/2017. Water was evident within the spliced wires. The wires were dried and re-taped. Rainfall was recorded in the early morning of 05/22/2017 which may have initiated this issue. The data from 05/22/2017 at 0:00 to 05/25/2017 at 15:30 were rejected and flagged and coded as <-3> [SSM] (CSM).

Suspect Data (Flag <1>)

PAR data for 2017 dataset is commented due to elevated nighttime PAR readings. Moisture seeping into the LI-COR sensor and/or sensor cable is thought to be the cause for the elevated nighttime PAR, however it is still under investigation. Since the range of error for the LI-COR sensor is ± 2.214

mmoles/m², time points that fall between one half hour before sunrise and one half hour past sunset that have values greater than 0 mmoles/m² but less than 2.214 mmoles/m², are marked as suspect. Data are flagged <1> (CSM). Those data values appear satisfactory; however, data users should be aware of possible data inconsistencies. Negative PAR readings from the LI-COR sensor are commented and flagged as <1> (CAF), while negative readings from the Apogee sensor are commented and flagged as <1>(CSM). Note that <http://www.sunrisesunset.com> was used to determine sunrise and sunset times using Green Pond, South Carolina as a city of reference.

Missing Data (Flag <-2>)

None

Cumulative Precipitation

Passed Initial QAQC Checks (Flag <0>)

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to a tipping issue with the cover or from a loose wire. The loose wire was found on 12/13/2017, however the rain gauge continued to malfunction. The data from 12/01/2017 at 00:15 to 12/02/2017 at 00:00 and 12/14/2017 at 00:15 to 12/20/2017 at 14:45 was flagged as <0> (CSM) as we are confident no rain fell on this day from other measurements (nearby weather site and onsite manual rain gauge).

Rejected Data (Flag <-3>)

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to a tipping issue with a cover or from a loose wire. The loose wire was found on 12/13/2017; however, the rain gauge continued to malfunction. Rainfall was reported at a nearby location (Charleston Airport on 12/06 (0.12 in), 12/07 (0.53 in), 12/08 (0.3 in), 12/09 (0.13 in), 12/20 (0.09 in), 12/21 (0.07 in), 12/24 (0.1 in), 12/27 (0.01 in), and 12/29 (0.05 in); Green Pond on 12/23 (0.05 in), 12/28 (0.08 in) and 12/31 (0.02 in)) and rainfall from the onsite manual gauge measured 1.35 in from 12/04 to 12/08; 0.95 in from 12/08 to 12/11 at 14:48; 0.1 in from 12/11 to 12/13 at 12:12, and 0.0 in from 12/13 to 12/20 at 14:50; and 0.98 from 12/20/2017 to 1/08/2018. Therefore, data for the following dates and times were rejected and flagged as <-3> [SQR] (CSM).

12/06/2017 at 00:15 to 12/10/2017 at 00:00
12/11/2017 at 15:00 to 12/14/2017 at 00:00
12/20/2017 at 15:00 to 12/22/2017 at 00:00
12/23/2017 at 00:15 to 12/25/2017 at 00:00
12/27/2017 at 00:15 to 12/30/2017 at 00:00
12/31/2017 at 00:15 to 12/31/2017 at 23:45

Suspect Data (Flag <1>)

Total precipitation recorded on 07/02/2017 at 17:45 is flagged and coded as <1> [GSM] (CDF) because of the extremely high precipitation values recorded during this time. Cumulative precipitation data are flagged and coded as <1> [GSM](CDF) from 17:45 through the end of the day at 07/03/2017 00:00. Our onsite manual rain gauge was not checked daily, however between 06/20/2017 at 14:10 to 07/05/2017 at 09:40 precipitation measured 6.84 inches. When summing precipitation values recorded from our rain gauge, it is comparable (6.66 in); therefore, instead of rejecting the data, they are marked as suspect.

The rain gauge up to 12/01/2017 at 00:15 was recording rainfall similar to our manual rain gauge. After this date, the rain gauge was found to be malfunctioning either due to tipping issue with cover or from a loose wire. The loose wire was found on 12/13/2017, however the rain gauge continued to

malfunction. The data for the following time periods were flagged as <1> (CSM). No rain fell at two nearby weather sites (Charleston Airport and Green Pond, SC) but the onsite manual rain gauge was not checked daily.

12/02/2017 at 00:15 to 12/04/2017 at 14:00
12/05/2017 at 00:15 to 12/06/2017 at 00:00
12/10/2017 at 00:15 to 12/11/2017 at 14:45
12/22/2017 at 00:15 to 12/23/2017 at 00:00
12/25/2017 at 00:15 to 12/27/2017 at 00:00
12/30/2017 at 00:15 to 12/31/2017 at 23:45

Missing Data (Flag <-2>)

None

Corrected Data (Flag <5>)

The rain bucket accidentally tipped during site maintenance. No rain fell while the technicians were onsite. The data was corrected to a 0 reading for 03/03/2017 at 10:00 to 03/03/2017 at 10:15. The data was flagged <5> [SMT] (CSM).

The rain bucket accidentally tipped during site maintenance. A small amount of rain was in the bucket that was lost. The data was corrected to a 1.0 reading for 06/20/2017 at 13:15 and 0.254 was subtracted for the rest of the day (06/20/2017 at 13:15 to 06/21/2017 at 00:00). The data was flagged <5> [SMT] (CSM).

The rain bucket accidentally tipped during site maintenance. No rain fell while the technicians were onsite. The data was corrected to a 0 reading for 12/04/2017 at 14:15 to 12/05/2017 at 00:00. The data was flagged <5> [SMT] (CSM). This occurs during the time when cumulative precipitation was flagged as <1> (CSM), see above. Corrected data are considered suspect.

14) Station History

Bennett's Point:

2001 - Station became active with CR10X data logger. No data collected until **March** due to battery issues. Data collection stopped in **June**. PC208W software used to download data. Parameters measured are: temperature, humidity, barometric pressure, rainfall, wind speed and direction and PAR. Sensors are located on 3-meter galvanized poles on top of control box.

2002 - Data collection resumed in **January**

2002 - NADP – National Atmospheric Deposition Program – began in **January**

2003 - All new sensors installed on **May 3** and old ones sent back to be calibrated

2003 - A 15-foot galvanized tower installed on which the sensors are positioned

2005 - All newly calibrated sensors installed on **August 22**

2006 - CR10X datalogger replaced with the CR1000 datalogger and PC208W software replaced with LoggerNet Software on **June 29**

2006 - NL115 Ethernet cable installed to allow for downloading data and troubleshooting problems from Charleston office

2006 - GOES satellite telemetry equipment installed to view real-time weather data

2006 - Rain tipping bucket calibrated on **July 18**

2006 - NL115 Ethernet cable cut by workers in **December**

2007 - NL115 Ethernet cable destroyed by squirrels and lost connection in **September**

2007 - NADP (National Atmospheric Deposition Program) ended in **December**

2008 - New CR1000 program with Cumulative Precipitation parameter uploaded in **March**

2008 - All newly calibrated sensors installed on **April 22**
 2009 - All newly calibrated sensors installed on **September 30**
 2010 - Rain tipping bucket calibrated on **January 1**
 2010 - Rain tipping bucket calibrated on **March 18**
 2010 - Newly calibrated sensors (except Temp/RH) installed on **December 9**
 2012 - Newly calibrated sensors installed on **March 16**
 2012 - New CR1000 datalogger installed on **March 16**
 2012 - Rain bucket calibrated on **June 7**
 2012 - Rain bucket calibrated on **December 19**
 2013 - Barometric pressure calibrated on **May 16**
 2013 - Newly calibrated Temp/RH sensor installed on **July 31**
 2014 - Newly calibrated sensors (except Temp/RH) installed on **February 27**
 2014 - Rain bucket calibrated on **February 27**
 2014 - Rain bucket calibrated on **March 31**
 2014 - Newly calibrated Temp/RH sensor installed on **July 23**
 2015 - New battery installed on **November 25**
 2016 - Newly calibrated sensors (except PAR) installed on **April 18**
 2016 - Newly calibrated PAR sensor installed on **May 6**
 2017 - Newly calibrated CR1000 datalogger installed on **March 3**
 2017 - Newly calibrated sensors (except LiCor PAR and Barometric Pressure) installed on **March 3**
 2017 - LiCor PAR sensor was replaced with an Apogee PAR sensor on **March 3**
 2017 - New CR1000 program (ACEBPMET_V5.5_030217) uploaded on **March 3**
 2017 - Rain bucket calibrated on **April 10**
 2017 - New Campbell OS V31.02 uploaded on **April 10**
 2017 - New CR1000 program (ACEBPMET_V5.5_041017) uploaded on **April 10**
 2017 - New CR1000 program (ACEBPMET_V5.5.1_050317) uploaded on **May 3**