

ACE Basin (ACE) NERR Meteorological Metadata

January - December 2018

Latest Update: 01/16/2020

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

SCDNR/Marine Resources Division
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ACE Basin NERR field station
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Contact Persons:

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Kimberly Sitta, SWMP Biologist

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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) Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from LoggerNet in a 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 opened in Microsoft Excel and processed 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. For more information on QAQC flags and QAQC codes, see Sections 11 and 12.

Kim Sitta was responsible for all of the above tasks during 2018.

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 QAQC process detailed in Section 2 above. The “real-time” telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC 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 ($\mu\text{mol}/\text{m}^2$), 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 37231.1 ha (92,000 ac) of tidal marshes. Of this, 26547.4 ha (65,600 ac) are salt marshes, 5503.7 ha (13,600 ac) are brackish marshes and 4896.7 ha (12,100 ac) are freshwater marshes. Interspersed within these three tidal marsh zones are approximately 10521.8 ha (26,000 ac) of managed wetlands, marsh impoundments, and hammock islands. St. Helena Sound comprises approximately 9659.8 ha (23,870 ac) 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 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 (295.3 ft) from the creek (800 m [2624.7 ft] from the Ashepoo River) in a grassy field, 80 m (262.5 ft) to the southwest of the field station. The closest wind obstructions are oak trees, 25 m (82.0 ft) to the south and southwest of the weather station and 70 m (229.7

ft) from a public paved road. The closest SWMP water quality station, Mosquito Creek, is approximately 1655 m (5429.8 ft) from the weather station.

The Campbell Scientific data logger and the barometric sensor (sensor body at 1.5 m [4.92 ft] and sensor tube at 1.0 m (3.28 ft) 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 (20.0 ft) and the temperature/relative humidity sensor is attached approximately half way up the tower at a height of 3.35 m (10.9 ft). The solar panel is attached to a 2.5 m (8.2 ft) long arm and is oriented to the east at approximately 47-degrees. The tipping bucket rain gauge (1.3 m [4.27 ft] height) is located 2.5 m (8.2 ft) 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.

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. The end times below marked with an asterisk (*) coincide with the last actual reading in that deployment so the times will not be in consecutive order with the following deployment start time. The gap and overlap between the end time of one deployment and the begin time of the next deployment is attributed to either missing or rejected data due to in field maintenance, battery failure, or collector error.

File Start Date and Time	File End Date and Time
12/13/2017 12:45	01/11/2018 11:30
01/11/2018 11:45	02/06/2018 11:30
02/06/2018 11:45	03/07/2018 14:15
03/07/2018 14:30	04/05/2018 09:30
04/05/2018 10:30	04/12/2018 10:00*
04/12/2018 13:45	04/27/2018 09:15*
04/27/2018 11:00	05/24/2018 09:45
05/24/2018 10:00	06/26/2018 11:45*
06/26/2018 12:15	07/30/2018 11:15
07/30/2018 07:00	08/23/2018 11:45
08/23/2018 11:45	09/26/2018 10:15
09/26/2018 10:30	10/25/2018 09:15
10/25/2018 09:30	11/27/2018 10:30
11/27/2018 10:45	01/02/2019 11:00

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.nerrdata.org/> ; accessed 12 October 2018.

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.nerrdata.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 km (8.70 mi) 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 km (5.59 mi) 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 fringes the banks. Development in the immediate area is sparse, and this creek is subject to light boat traffic.

Fishing Creek – approximately 8 km (4.97 mi) 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 km (1.24 mi) 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 km (7.46 mi) 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 km (5.59 mi) 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: D3520073

Date of last calibration: 03/13/2014

Previous Calibrations: N/A

Date of Sensor Use: 07/23/2014 - 04/18/2016

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: A1710045

Date of last calibration: 01/28/2017

Previous Calibrations: N/A

Date of Sensor Use: 03/03/2017-04/12/2018

Model #: EE181

Operating Temperature: -40°C to +60 °C

Temperature Measurement Range: -40°C to +60°C

Temperature Accuracy: $\pm 2\%$ °C @ 23°C

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

RH Accuracy: -15 to 40 °C: $\leq 90\%$ RH $\pm (1.3 + 0.003 \cdot \text{RH reading}) \% \text{ RH}$

-15 to 40 °C: $> 90\%$ RH $\pm 2.3\% \text{ RH}$

-25 to 60 °C: $\pm (1.4 + 0.01 \cdot \text{RH reading}) \% \text{ RH}$

-40 to 60 °C: $\pm (1.5 + 0.015 \cdot \text{RH reading}) \% \text{ RH}$

Temperature dependence of RH measurement: typically, 0.03% RH/°C

Serial Number: 17101600008188

Date of Last Calibration: 03/12/2018; New

Previous Calibrations: N/A

Dates of Sensor Use: 04/12/2018- current as of 12/31/2018

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 – 06/26/2018

Model #: PTB110

Calibrated Range: 500 mb to 1100 mb

Supply Voltage: 12 VDC at 12 mA

Accuracy: ± 0.3 mb @ 20 °C

± 0.6 mb @ 0 to 40 °C

± 1 mb @ -20 to 45 °C

± 1.5 mb @ -40 to 60 °C

Stability: ± 0.1 mb per year

Serial Number: N0650251; New

Date of last calibration: 05/23/2018

Previous Calibrations: N/A

Date of Sensor Use: 06/26/2018- current as of 12/31/2018

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- 04/27/2018

Model #: R.M. Young 5103 Wind Monitor
Wind Speed Sensor Type: 18 cm diameter 4-blade propeller molded of polypropylene
Range: 0-100 m/s (134 mph); gust survival 100 m/s (224 mph)
Accuracy: ± 0.3 m/s (± 0.6 mph) or 1% of reading
Wind Direction Sensor Type: balanced vane, 38 cm turning radius
Range: 360° mechanical, 355° electrical
Accuracy: $\pm 3^\circ$

Serial Number: WM158630
Date of last calibration: 12/21/17; New
Previous Calibrations: N/A
Date of Sensor Use: 04/27/2018 - current as of 12/31/2018

Parameter: Photosynthetic Active Radiation (PAR)

LI-COR Quantum Sensor
Units: mmol m⁻² (total flux)
Model #: LI-190
Stability: $< \pm 2\%$ change over a 1-year period
Operating Temperature: -20 to +65 °C
Sensitivity: Typically, 30 μ A per 100 klux
Light Spectrum Wavelength: 400 to 700 nanometers
Calibration Factor: 264.70 μ mol m⁻² s⁻¹ per mV
Date of last calibration: 04/28/2016
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
Retired 03/03/2017

Apogee Quantum Sensor

Units: mmols 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%

Multiplier History and Calibration Dates and Dates Installed:

Serial Number: 22346 (1)

Date of last calibration: 02/01/2017; New

Previous Calibrations: N/A

Date of Sensor Use: 03/03/2017 – 04/12/2018 – multiplier 0.025

Serial Number: 25319 (2)

Date of last calibration: 02/01/2018; New

Previous Calibrations: N/A

Date of Sensor Use: 04/12/2018 – current as of 12/31/2018 – multiplier 0.025

Parameter: Precipitation

Units: millimeters (mm)

Tipping Bucket Rain Gauge

Texas Electronics

Model #: TR-525I

Calibration: 0.01 inch per tip

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

Previous Calibrations:

Serial Number: 23864-399

Date of last calibration: 04/10/2017

Previous Calibrations: 04/28/2016, 02/27/2014, 12/09/2012, 06/07/2012, 05/24/2012, 02/20/2012, 02/07/2011, 03/08/2010, 07/18/2006

Date of Sensor Use: 04/10/2017- 04/27/2018

Serial Number: 74041

Date of last calibration: 06/26/2018

Previous Calibrations: 09/11/2017 (New)

Date of Sensor Use: 04/27/2018- current as of 12/31/2018

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 12/31/2018 (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_CR1000_5.5.1_062618
ACEBPMET_CR1000_5.5.1_042718
ACEBPMET_CR1000_5.5.1_040218
ACEBPMET_5.5.1_050317
ACEBPMET_5.5_041017
ACEBPMET_5.5_030217
ACEBPMET_5.5_050616
ACEBPMET_5.5_022714

10) Coded variable definitions –

[Instructions/Remove: List the sampling station, sampling site code, and station code used in the data.]

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 recorded for all parameters (except for 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.**

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 $\pm 2.214 \mu\text{moles}/\text{m}^2$ over a 15-minute interval. These values are automatically flagged and coded as <1> (CAF). LI-COR sensor was replaced with an Apogee sensor on March 3, 2017.

After an edit to the CR1000 program was made on 04/10/2017 11:15, Relative Humidity data greater than 100 are within range of the sensor accuracy of $\pm 3\%$ 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 (see updated sensor information below).

All Parameters Blanket Statement for Bennett's Point Weather Station

The South Carolina coast experienced a significant cold weather event from 01/01/2018 at 00:15 to 01/08/2018 at 00:00 with snow falling on 01/03/2018. The F_Record column was coded as {CWE}{CSM} for this time period.

The data collected from 09/13/2018 at 09:15 to 09/18/2018 at 02:30 were flagged due to a significant weather event. Hurricane Florence made landfall in Wilmington, NC at 07:15 on September 14 as a category 1 hurricane, and was downgraded to a tropical storm by the time it entered South Carolina around 09:00 pm on the 14th. The ACE Basin weather station in Bennett's Point recorded the changes in the daily pattern in wind direction as the storm moved toward the coast, made landfall on Friday, travelled along a west-southwesterly path in South Carolina until Saturday, and then turned northward toward upstate South Carolina and into the Ohio Valley by Monday. Changes in air temperature, relative humidity, wind speed, and PAR was observed after Florence made landfall. The F_Record column is coded as {CWE}{CSM}.

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Data are rejected for all parameters for 04/03/2018 at 10:15, 10:30, and 11:00 due to powering down the CR1000 to troubleshoot connectivity issues with Loggernet. Loggernet would not connect to the CR1000 and the

datalogger was powered on and off and battery power was tested using a voltmeter. No rain fell while technicians were onsite. Data were rejected for this period and flagged and coded as <-3> [GPD] (CSM) due to uncertainty related to the averaging of 5 second readings.

Data are rejected for all parameters for 04/12/2018 at 13:45 to 14:30 due to a program reload and powering down the CR1000 to troubleshoot the Barometric Pressure sensor. A new Temp/RH and PAR sensor was also installed on this date. Power was restored and the new program was installed at 14:24. Data were rejected for this period and flagged as <-3> [GPR] (CSM) and <-3> [GPD] (CSM) due to uncertainty related to the averaging of 5 second readings. **Note: The HMP – 45C was replaced with an EE181-L Temperature and Relative Humidity Probe. Unlike past sensors used at this station, the EE181-L caps relative humidity values at 100%.**

Data are rejected for all parameters for 04/27/2018 at 11:00. Data were rejected for this period and flagged as <-3> [GPR] (CSM) due to uncertainty related to the averaging of 5 second readings following a program reload after installing a new wind sensor.

Data are rejected for all parameters for 06/26/2018 at 12:15. The CR1000 was powered down to install the new barometric pressure sensor and upload a new program. Data were rejected for this period and flagged as <-3> [GPR] (CSM) due to uncertainty related to the averaging of 5 second readings.

Data are rejected for all parameters for 8/23/2018 at 11:45. Data were rejected for this period and flagged and coded as <-3> [GPD] (CSM) due to uncertainty related to the averaging of 5 second readings from rebooting the CR1000.

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Data are missing for all parameters on 04/03/2018 at 10:45 as the CR1000 was powered down to troubleshoot connectivity issues and unable to collect and transmit data for the 15 minute reading. The data were flagged and coded as <-2> [GPD](CSM).

Data are missing, <-2> (CSM) for all parameters on 04/05/2018 at 09:45 to 10:15 due to an error when downloading the data.

Data are missing for all parameters on 04/12/2018 at 10:15 to 13:30 and 04/27/2018 at 09:30 to 10:45 as the CR1000 was powered down to swap sensors. The data are flagged and coded as <-2> [GPD](CSM). Although precipitation data are missing it should be noted that no rain fell when the technicians were onsite.

Data are missing for all parameters on 06/26/2018 12:00 due to a power down to install a new barometric pressure sensor.

Data are missing for all parameters on 8/19/2018 at 16:45 to 8/23/2018 at 11:30. The CR1000 stopped transmitting and collecting data likely due to a lightning storm that occurred in the area. The nearby field station lost power and likely affected the CR1000. The CR1000 was rebooted on 8/23/2018 at 11:44 and therefore the data are flagged and coded as <-2> [GIM] (CSM) during this time period.

Corrected Data (Flag <5>)

Temperature/Relative Humidity

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Barometric Pressure

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Data are rejected from 04/12/2018 at 14:45 to 04/27/2018 at 09:15. The barometric sensor was going to be swapped, however the new sensor would not power on and the old sensor could not be reinstalled due to a missing part. The barometric pressure sensor was reinstalled on 04/27/2018. The data are flagged and coded as <-3> [SSR] (CSM).

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Wind Speed/Direction

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Wind direction data were rejected from 04/12/2018 at 14:45 to 04/27/2018 at 09:15. The wind sensor was going to be swapped, however technicians found it could not be installed until a new part was ordered. The old sensor was reinstalled; however, wind direction was not functioning correctly. The new wind sensor was installed on 04/27/2018. Both wind direction and wind direction standard deviation data are flagged and coded as <-3> [SSM] (CSM). Note: Unlike the wind sensor that was remove, the newly installed R.M. Young 5103 wind sensor does not have an offset of 0.2.

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

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 until the electrical connections on the rain gauge were cleaned and reconnected on 01/11/2018. The rain gauge recorded 0.5 mm of rain on 01/10/2018, consistent with the local weather station (0.02 in; 0.5mm). The rain gauge recorded 0.3 mm of rain on 01/11/2018 and the onsite manual rain gauge recorded 0.03 in (0.8 mm) of rain from 01/08/2018 to 01/11/2018 at 11:17 consistent with the recorded rain fall. The data from 01/10/18 at 00:15 to 01/11/2018 at 12:30 was flagged as <0> (CSM).

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 until the electrical

connections on the rain gauge were cleaned and reconnected on 01/11/2018. Rainfall was reported at a nearby location (Green Pond, SC) on 12/31 (0.02 in), 01/03 (0.55 in), and 01/08 (trace), and rainfall from the onsite manual gauge measured 0.98 in from 12/20/2017 at 14:50 to 01/08/18. Therefore, data for the following dates and times were rejected and flagged as <-3> [SQR] (CSM).

01/01/2018 at 00:00

01/03/2018 at 00:15 to 01/04/2018 at 00:00

01/08/2018 at 00:15 to 01/09/2019 at 00:00

Suspect Data (Flag <1>)

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 until the electrical connections on the rain gauge were cleaned and reconnected on 01/11/2018. No rain fell at nearby weather site (Green Pond, SC) but the onsite manual rain gauge was not checked daily. The data for the following time periods were flagged as <1> (CSM).

01/01/2018 at 00:15 to 01/03/2018 at 00:00

01/04/2018 at 00:15 to 01/08/2018 at 00:00

01/09/2018 at 00:15 to 01/10/2018 at 00:00

Missing Data (Flag <-2>)

Corrected Data (Flag <5>)

The rain bucket accidentally tipped during site maintenance or the CR1000 was powered down to troubleshoot connectivity issues. No rain fell while the technicians were onsite. The data were corrected to a 0 reading and were flagged <5> [SMT] (CSM) for the following times:

01/11/2018 at 12:45; 02/06/2018 at 11:45; 04/03/2018 at 10:30.

Data were corrected on 04/27/2018 at 11:00 to a 0; however, that time stamp was rejected due to the program reload. No precipitation fell and any tips were due to maintenance.

The rain bucket was tipped during yearly calibration or the CR1000 was powered down to troubleshoot. No rain fell while the technicians were onsite. The data were corrected to a 0 for 06/26/2018 at 10:30 to 11:45. The data were flagged <5> [SMT] (CSM).

Total PAR

Passed Initial QAQC Checks (Flag <0>)

PAR data from 1/01/2018 at 00:00 to 4/12/2018 at 10:00 is commented due to sporadic elevated nighttime PAR readings that likely occurred as a result of moisture intrusion into the spliced wires of the PAR cable. Daytime PAR values are comparable to 2017 values and therefore, the daytime values are not considered suspect. Instead, daytime PAR data are coded with CSM unless otherwise flagged as rejected and the PAR sensor was swapped out with a new sensor 4/12/2018.

Rejected Data (Flag <-3>)

Moisture seeping into the Apogee sensor cable is thought to be the cause for the elevated nighttime PAR. Time points that fall between one half hour past sunset and one half hour before sunrise were rejected. Data are flagged and coded as <-3> (CSM) between 01/01/2018 00:00 and 04/12/2018 10:00 when elevated nighttime values were recorded. Note that <http://www.sunrisesunset.com> was used to determine sunrise and sunset times using Green Pond, South Carolina as a city of reference.

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

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 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 until the electrical connections on the rain gauge were cleaned and reconnected on 01/11/2018. The rain gauge recorded 0.5 mm of rain on 01/10/2018, consistent with the local weather station (0.02 in; 0.5mm). The rain gauge recorded 0.3 mm of rain on 01/11/2018 and the onsite manual rain gauge recorded 0.03 in (0.8 mm) of rain from 01/08/2018 to 01/11/2018 at 11:17 consistent with the recorded rain fall. The data from 01/10/18 at 00:15 to 01/11/2018 at 12:30 were flagged as <0> (CSM).

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 until the electrical connections on the rain gauge were cleaned and reconnected on 01/11/2018. Rainfall was reported at a nearby location (Green Pond, SC) on 12/31 (0.02 in), 01/03 (0.55 in), and 01/08 (trace), and rainfall from the onsite manual gauge measured 0.98 in from 12/20/2017 at 14:50 to 01/08/18. Therefore, data for the following dates and times were rejected and flagged as <-3> [SQR] (CSM).

01/01/2018 at 00:00

01/03/2018 at 00:15 to 01/04/2018 at 00:00

01/08/2018 at 00:15 to 01/09/2019 at 00:00

Suspect Data (Flag <1>)

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 until the electrical connections on the rain gauge were cleaned and reconnected on 01/11/2018. No rain fell at nearby weather site (Green Pond, SC) but the onsite manual rain gauge was not checked daily. The data for the following time periods were flagged as <1> (CSM).

01/01/2018 at 00:15 to 01/03/2018 at 00:00

01/04/2018 at 00:15 to 01/08/2018 at 00:00

01/09/2018 at 00:15 to 01/10/2018 at 00:00

Missing Data (Flag <-2>)

Corrected Data (Flag <5>)

The rain bucket accidentally tipped during site maintenance. No rain fell while the technicians were onsite. The data were corrected to a 0.3 reading to reflect rainfall from earlier in the day for 01/11/2018 at 12:45 to 01/12/2018 at 00:00. The data were 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 were corrected to a 0.0 reading for 02/06/2018 at 11:45 to 02/07/2018 at 00:00. The data were flagged and coded as <5> [SMT] (CSM).

The rain bucket accidentally tipped during site maintenance or the CR1000 was powered down to troubleshoot connectivity issues. No rain fell while the technicians were onsite. The data were corrected to a 0 reading for 04/03/2018 at 10:30 to 04/04/2018 at 00:00. The data were flagged <5> [SMT] (CSM).

Data were corrected on 04/27/2018 at 11:00 to 04/28/2018 at 00:00 No rain fell while the technicians were onsite and any precipitation recorded was due to maintenance. The data were corrected from 1.016 to 0 and flagged <5> [SMT] (CSM).

The rain bucket was tipped during yearly calibration. No rain fell while the technicians were onsite; however, 0.508 mm of rainfall was recorded prior to maintenance. The data were corrected to a 0.508 reading for 06/26/2018 at 10:30 to 06/27/2018 at 00:00. The data were flagged <5> [SMT] (CSM).

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_5.5_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_5.5_041017) uploaded on **April 10**

2017 - New CR1000 program (ACEBPMET_5.5.1_050317) uploaded on **May 3**

2018 – New Temp/RH and PAR sensor installed on **April 12**

2018 – New CR1000 program (ACEBPMET_5.5.1_040218) uploaded on **April 12**

2018 – New wind sensor and rain gauge installed on **April 27**

2018 – New CR1000 program (ACEBPMET_5.5.1_042718) uploaded on **April 27**

2018 – New barometric pressure sensor installed and rain bucket field calibrated on **June 26**

2018 – New CR1000 program (ACEBPMET_5.5.1_062618) uploaded on **June 26**