

ACE Basin (ACE) NERR Meteorological Metadata

January – December 2022

Latest Update: 10/01/2025

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

SCDNR/Marine Resources Division
217 Fort Johnson Road
Charleston, SC 29422
(843) 953-9300

ACE Basin NERR field station
15717 Bennett's Point Road
Green Pond, SC 29441
(843) 844-8822

Contact Persons:

Dr. Denise Sanger, Research Coordinator

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

Sandra Upchurch, Research 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/CR1000X data logger. ACE staff uses a data storage card to serve as a back-up for the CR1000/CR1000X data logger. The program that controls the sampling, schedule, and storage of data by the CR1000/CR1000X is provided by CDMO.

The CR1000/CR1000X 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/CR1000X data logger to a personal computer with Windows 7 or newer operating system. 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.

Anna Turano, Jessica Kinsella, and Denise Sanger were responsible for all of the above tasks during 2022 Q1, Q2, Q3. Taylor Lawrence, Jessica Kinsella, and Denise Sanger were responsible for all of the above tasks during 2022 Q4

3) Research objectives –

The meteorological long-term monitoring program at the ACE Reserve began on March 2, 2001. The principal objective of the program is to record long-term meteorological data for the ACE Basin NERR in order to observe any environmental changes or trends over time. The weather station is located at the Bennett's Point field station on Mosquito Creek, a navigable tributary of the Ashepoo River. A Campbell electronic data logger is programmed to monitor temperature, relative humidity, barometric pressure, wind speed and direction, rainfall, and Photosynthetically Active Radiation (PAR). The logger is programmed to record the parameters at fifteen-minute intervals.

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 at 0:01:10 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 data are downloaded monthly, and in-situ weather conditions are measured with a Kestrel 500 hand-held during the 15-minute reading prior to the download. The in-situ readings are used to verify the accuracy of the readings by the sensors. 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.

The 15-minute data are collected in the following formats for the **CR1000/CR1000X**:

Averages from 5-second data:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), 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 (millimoles/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.)

Sensors are removed and sent back to Campbell Scientific for calibration according to the following guidelines:

- Temperature/Humidity- yearly recalibration
- Precipitation Gauge- yearly recalibration
- Wind Speed/Direction- yearly or every 2 years (depending on the sensor) recalibration
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000/CR1000X-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 McKenzie 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 pressure 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/CR1000X 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 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
12/28/2021 14:15	01/24/2022 13:00
01/24/2022 13:15	03/01/2022 14:30
03/01/2022 14:45	03/29/2022 10:15
03/29/2022 11:00	04/26/2022 10:15
04/26/2022 10:30	05/04/2022 09:00
05/04/2022 17:30	06/06/2022 14:30
06/06/2022 14:45	06/29/2022 14:15
06/29/2022 14:30	07/31/2022 15:15
07/31/2022 15:30	08/23/2022 12:15
08/23/2022 14:30	10/04/2022 15:45
10/04/2022 16:00	11/09/2022 16:30
11/09/2022 16:45	11/28/2022 9:45
11/28/2022 10:00	01/03/2023 12:30

7) Distribution –

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 processed 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 2022.

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, two sites represent pristine areas within the Reserve, and two sites expands ACE monitoring into the oligohaline and limnetic zones of the South Edisto River.

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. As of November 8th, 2022, a telemetry system was added to the station. The Edisto Island station is bordered by *Spartina alterniflora* marsh, and American oyster (*Crassostrea virginica*) forms a reef along the creek bank. In 2022, the mean depth at the station was 2.6972 m (8.766 ft), and the mean salinity was 30.37 practical salinity units (psu). Edisto Island station is designated as a "treatment" site because of its proximity to developed areas.

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. In 2022, the mean depth at the station was 2.489 m (8.166 ft), and the mean salinity was 8.63 psu. The Fishing Creek monitoring station is designated as a "control" site because there is no development in the immediate area, and boat traffic is relatively light in the creek.

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. In 2022, the mean depth at the station was 3.994 m (13.104 ft), and the mean salinity was 16.52 psu. The Mosquito Creek station is designated as a "treatment" site because of the land use practices in the surrounding area. Agriculture fields and impounded wetlands are found upstream of the monitoring station.

St. Pierre Creek - approximately 9 km (5.59 mi) from the weather station, GPS coordinates: 32.52800 N and -80.36144 W. The station has a telemetry system. 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. In 2022, the mean depth at the station was 1.925 m (6.316 ft), and the mean salinity was 29.40 psu. The St. Pierre Creek station is designated as a "control" site because development in the immediate area

was sparse when the station was established on March 3, 1995, and the tributary is subject to relatively light boat traffic.

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 has a telemetry system. 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. During years of normal rainfall, the salinity at this station generally is below 1 psu, but it will increase if rainfall is low. In 2022, the average depth at the station was 3.432 m (11.260 ft), and the mean salinity was 0.241 psu.

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 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. During years of normal rainfall, the salinity at this station generally is between 5 and 10 psu, and it will increase if rainfall is low. In 2022, the average depth at the station was 4.787 m (15.705 ft), and the mean salinity was 8.21 psu.

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 the 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 were measured at two stations during a complete tidal cycle each month. In January of 2002, the nutrient monitoring protocol (NUT) was added to the NERR System Wide Monitoring Program (SWMP). Nutrient levels are now measured at one station during a complete tidal cycle each month, and surface grabs samples are collected from the primary stations once a month during an ebb tide. Nutrient samples are analyzed for ammonia, nitrite & nitrate, orthophosphate, and chlorophyll a concentrations.

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

Temp/RH sensor 1 (Serial Number: D3520073)

Date of last calibration: 03/13/2014

Previous Calibrations: N/A

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

Retired: 04/18/2016

Temp/RH sensor 2 (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
Retired: 03/03/2017

Temp/RH sensor 3 (Serial Number: A1710045)
Date of last calibration: 01/28/2017
Previous Calibrations: N/A
Date of Sensor Use: 03/03/2017-04/12/2018
Retired: 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 $\pm (1.3 + 0.003 \cdot \text{RH reading})\%$ RH
 -15 to 40 °C: $> 90\%$ RH $\pm 2.3\%$ RH
 -25 to 60 °C: $\pm (1.4 + 0.01 \cdot \text{RH reading})\%$ RH
 -40 to 60 °C: $\pm (1.5 + 0.015 \cdot \text{RH reading})\%$ RH

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

Note: This sensor caps relative humidity values at 100%, measured values >100% are altered to 100%

Temp/RH sensor 1 (Serial Number: 17101600008188)
Dates of Last Calibration: 02/04/2020
Previous Calibrations: 03/22/2017 (purchased 03/12/2018)
Dates of Sensor Use: 03/18/2020 – 03/29/2021
Retired: 03/02/2022

Temp/RH sensor 2 (Serial Number: 1841160000234D)
Dates of Last Calibration: 03/17/2021
Previous Calibrations: 10/16/2018 (purchased 03/01/2019)
Dates of Sensor Use: 04/04/2019 – 03/18/2020, 03/29/2021 – 05/04/2022

Temp/RH sensor 3 (Serial Number: 21281600077814)
Dates of Last Calibration: 07/16/2021
Previous Calibrations: N/A (purchased 03/02/2022)
Dates of Sensor Use: 05/04/2022 – current as of 12/31/2022

Parameter: Barometric Pressure

Units: millibars (mb)

Model #: PTB110
Operating 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
Operating Temperature Range: -40 to +60 °C

Barometric Pressure sensor 1 (Serial Number: N0650251)

Date of last calibration: 02/07/2022

Previous Calibrations: 05/23/2018 (purchased 5/29/2018)

Date of Sensor Use: 06/26/2018 – 09/23/2020, 05/04/2022 – current as of 12/31/2022

Barometric Pressure sensor 2 (Serial Number: R1510517)

Date of last calibration: 04/08/2019

Previous Calibrations: N/A (purchased 02/2020)

Date of Sensor Use: 09/23/2020 – 05/04/2022

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: $\pm 5^\circ$

Wind Speed/Direction sensor 1 (Serial Number: 2365M3)

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

Retired: 03/03/2017

Wind Speed/Direction sensor 2 (Serial Number: N/A)

Date of last calibration: 01/31/2017

Previous Calibrations: 02/04/2010, 06/21/2007, 05/06/2013

Date of Sensor Use: 03/16/2012 – 02/27/2014, 03/03/2017– 04/27/2018

Retired: 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: $\pm 3^\circ$

Wind Speed/Direction sensor 1 (Serial Number: WM158630)

Date of last calibration: 02/09/2022

Previous Calibrations: 12/21/2017 (purchased 03/12/2018)

Date of Sensor Use: 04/27/2018 – 03/18/2020, 05/04/2022 – current as of 12/31/2022

Wind Speed/Direction sensor 2 (Serial Number: WM166288)

Date of last calibration: 12/20/2018

Previous Calibrations: N/A (purchased 02/07/2019)

Date of Sensor Use: 03/18/2020 – 05/04/2022

Parameter: Photosynthetic Active Radiation (PAR)

LI-COR Quantum Sensor

Units: mmol m⁻² (total flux)

Model #: LI-190

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

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 03, 2003 – multiplier 1.27

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

Calibrated 02/2010 – Installed Dec. 09, 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: 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%

Set multiplier of 0.025

Calibration Dates and Dates Installed:

Apogee sensor 1 (Serial Number: 22346)

Date of last calibration: 01/15/2020

Previous Calibrations: 02/01/2017 (purchased 2/21/2017)

Dates of Sensor Use: 03/18/2020 – 05/04/2022, 03/03/2017 – 04/12/2018

Apogee sensor 2 (Serial Number: 25319)

Date of last calibration: 02/17/2022

Previous Calibrations: 02/01/2018 (purchased 3/20/2018)

Date of Sensor Use: 04/12/2018 – 03/18/2020, 05/04/2022 – current as of 12/31/2022

Parameter: Precipitation

Units: millimeters (mm)

Tipping Bucket Rain Gauge

Texas Electronics

Model #: TR-5251

Calibration: 0.01 inch per tip (0.254 mm per tip)
Accuracy: $\pm 3\%$ (Rates of 1 to 6 inches per hour/25 to 152 mm per hour)
Previous Calibrations:

Rain Gauge 1 (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: 07/27/2006 – 04/27/2018

Rain Gauge 2 (Serial Number: 74041)

Date of last calibration: 05/20/2022

Previous Calibrations: 04/23/2021; 03/18/2020; 04/04/2019; 06/26/2018; 09/11/2017

Date of Sensor Use: 04/27/2018 – current as of 12/31/2022

Datalogger

CR1000

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

CR1000 logger 1 (Serial Number: 005202)

Date of last calibration: 01/30/2012

Previous Calibrations: 06/01/2006

Dates of datalogger use: 06/29/2006 – 03/16/2012, 03/03/2017 - 05/04/2022 (internal battery replaced 05/03/2017)

Retired: 05/04/2022

CR1000 logger 2 (Serial Number: 46152)

Date of last calibration: 2012

Previous Calibrations: N/A (purchased 01/23/2012)

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

Retired: 05/04/2022

CR1000 Firmware Version: CR1000_OS_31.02

Last update: 04/10/2017

CR1000 Program Version: ACEBPMET_CR1000_5.5.2_031720

ACEBPMET_CR1000_5.5.1_062618

ACEBPMET_5.5.1_042718

ACEBPMET_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

Transmitter: Campbell Scientific, Inc. HDR GOES Transmitter
Model Number: TX312
Serial Number: 1338
Date Installed: 06/30/2006
Retired: 05/04/2022

CR1000X

PN #31932

Storage capacity:

Program storage: 4 MB SRAM +72 MB flash (storage expansion of up to 16 GB with removable microSD flash memory card)

Processor: Renesas RX63N (32-bit with hardware FPU, running at 100MHz)

Operating system:

Operating range: Temp: -40° to +70°C

Baud rates: 1200

Power requirements: 10 to 18 Vdc input

CR1000X logger 1 (Serial Number: 13916)

Date of last calibration: N/A

Previous Calibrations: N/A (purchased 2020)

Dates of datalogger use: 05/04/2022 – current as of 12/31/2022

CR1000X logger 2 (Serial Number: 13915)

Date of last calibration: 11/20/2019

Previous Calibrations: N/A (purchased 2020)

Dates of datalogger use: inactive

CR1000X Firmware Version: CR100X_OS_5.02

CR1000X Program Version: ACEBPMET_CR1000X_V6.0.2_042822.CR1X

Transmitter: Campbell Scientific, Inc. HDR GOES Transmitter
Model Number: TX321
Serial Number: 2335
Date Installed: 05/04/2022

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 *Open - reserved for later flag*
- 3 *Open - reserved for later flag*
- 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/CR1000X, 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
CVT*	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. The missing data are flagged as <-2>.

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 +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3> (SQR).

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.**

The F_Record column is coded with {CSM} from May 4th at 00:15 to August 24th at 00:00. The battery began to fail shortly after installation resulting in intermittent data collection. The power failures continued on and off until August 23rd when a new battery was installed. We should have placed the new battery on a trickle charger prior to installation. The data appear to be accurate during times when we did not flag it as suspect or rejected, however, it is important to note that much of it was collected with a failing battery.

CDMO edit 10/01/2025 for PAR Sensor Drift

There were noticeable changes in PAR values following the swap to a freshly calibrated sensor (assumed to be accurate), SN22346, on 04/16/2024. Apogee reported a -11.2 % post cal drift for the sensor that was installed from 05/04/2022 to 04/16/2024 (SN25319). Acceptable drift is +/- 2% for this sensor. All PAR data 1 year prior to the sensor swap, from 04/16/2023 to 04/16/2024 are flagged and coded as <1> [SSD] (CSM). PAR data for the remainder of this deployment, 05/04/2022 – 04/16/2023, are flagged and coded <0> (CSM) and users should note that drift for that period may have exceeded acceptable limits as well. If users are comfortable assuming that drift was linear (in a real world environment it is unlikely to be entirely linear), these data may be ‘corrected’ for assumed linear drift at the user’s discretion using manufacturer’s instructions.

All Parameters Blanket Statement for Bennett’s Point Weather Station

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Data for all parameters (except total precipitation, and cumulative precipitation) were rejected for 05/04/2022 at 17:30. The CR1000 was powered down and new equipment (i.e., new telemetry box, CR1000X, TX321, GPS, swapping of sensors and external battery) was installed. The values are flagged and coded as <-3> [GMT] (CSM) due to uncertainty related to the averaging of 5 second readings. No rain fell while the technicians were on site.

Data for all parameters (except total precipitation and cumulative precipitation) were rejected on 05/05/2022 at 12:45 and 14:45. The CR1000X was powered down to try and calibrate the rain gauge. After the calibration was attempted, the power was turned back on. The values are flagged and coded as <-3> [GPD] (CSM) due to uncertainty related to the averaging of 5 second readings. No rain fell while the technicians were on site.

On 07/28/2022 at 5:00 and from 08/11/2022 at 00:15 to 08/23/2022 at 07:30, data were rejected following periods of missing data or if the battery values fell below 9.6 V (9.64 used as cutoff for flagging as rejected). The uncertainty related to the averaging of 5 second readings was the reasoning. The external battery was replaced on August 23rd. The values are flagged and coded as <-3> [GPF] (CSM).

Data for all parameters were rejected on 08/23/2022 at 13:00. The CR1000X was powered down to replace the battery. The value is flagged and coded as <-3> [GPD] (CSM) due to uncertainty related to the averaging of 5 second readings. No rain fell while the technicians were on site.

Suspect Data (Flag <1>)

Data for all parameters from 03/03/2022 00:15 – 05/04/2022 09:00 are flagged as suspect due to an out of calibration CR1000, {CSM}, <1> [SOC].

Data for all parameters on 03/29/2022 at 10:30 and 10:45 were flagged as suspect due to being recovered from telemetry. The records were missing from the files downloaded from the CR1000. The cause for the missing records is unknown but thought to be associated with malfunction during data download on 3/29/2022. The values are flagged and coded as <1> [GIT] (CSM).

From 05/05/2022 04:15 – 06:15 (BP, Wind, and PAR), 07/28/2022 at 03:15 to 06:15 (excluding 05:00), 07/29/2022 04:00, and 08/10/2022 at 21:15 to 08/23/2022 at 12:15, values recorded during the periods in between the gaps of data or below 9.6 V (rejected - see above; 9.64 used as cutoff for flagging as rejected) were considered suspect, <1>[GPF](CSM). There was also a chance that even though the data appear to be accurate, battery voltage drops over the 15 minute interval could have resulted in missing 5-second reading that are used to calculate averages and totals. Although the battery was replaced on 08/23/2022 13:00, data were suspect at 12:30 and from 13:15 until 08/23/2022 14:15 due to the use of telemetry data to replace missing logger data. Those values are flagged as <1> [GIT] (CSM).

Missing Data (Flag <-2>)

Data for all parameters were missing from 05/04/2022 at 09:15 to 17:15. The CR1000 was powered down and new equipment (i.e., new telemetry box, CR1000X, TX321, GPS, swapping of sensors and external battery) was installed. The values are flagged and coded as <-2> [GPD] (CSM). No rain fell while the technicians were on site. Following the station refresh and the air temperature/relative humidity sensor swap (SN 1841160000234D replaced with SN 21281600077814) on 05/04/2022 and the wiring correction on 05/05/2022 there was a noticeable drop in relative humidity values. There was also a drop in PAR values following the sensor swap. CSM has been added to both relative humidity and PAR coding for the remainder of year to highlight the decrease in values.

Data for all parameters were missing from 05/05/2022 at 12:00 to 12:30 and 13:45 to 14:30. The site was powered down to try and calibrate the rain gauge. The values are flagged and coded as <-2> [SMT] (CSM).

There are periods of missing data from 08/12/2022 at 08:30 to 08/23/2022 at 06:15 due to battery failure. The values are flagged and coded as <-2> [GPF] (CSM).

The CR1000X was turned off on 08/23/2022 from 12:36 to 12:48 to replace the battery. The 12:45 value is flagged and coded as <-2> [GMT] (CSM).

Corrected Data (Flag <5>)

Temperature/Relative Humidity

Passed Initial QAQC Checks (Flag <0>)

Following the station refresh and the air temperature/relative humidity sensor swap (SN 1841160000234D replaced with SN 21281600077814) on 05/04/2022 and the wiring correction on 05/05/2022 there was a noticeable drop in

relative humidity values. CSM has been added to relative humidity coding for the year following the wiring correction to highlight the drop.

Rejected Data (Flag <-3>)

Data for temperature and relative humidity were rejected from 05/04/2022 at 17:30 to 05/05/2022 at 11:45. During the refresh of the site with new CR1000X, the temperature/relative humidity sensor was incorrectly wired resulting in negative values. The values are flagged and coded as <-3> [SIW] (CSM).

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Barometric Pressure

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Wind Speed/Direction

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Total Precipitation

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Suspect Data (Flag <1>)

The rainfall data (except where otherwise flagged) from 05/04/2022 at 17:30 to 05/20/2022 at 10:00 was considered suspect due to incomplete calibration. Technician tried to calibrate the rain gauge on 05/04/2022 and 05/05/2022 but a correct calibration could not be obtained. A crack was found in the pipet resulting in some water loss. The other rain gauge was within 10 mm of the weather station rain gauge. The data was considered suspect and not rejected. The values are flagged and coded as <1> [SIC] (CSM). Although coded with SIC, these data are also considered suspect due to power failure when other parameters are flagged as suspect and coded as GPF.

Missing Data (Flag <-2>)

Corrected Data (Flag <5>)

The rainfall data from 05/20/2022 at 10:15 to 10:45 and 13:00 to 13:30 was recorded as rainfall during calibration. No rain fell while the technicians were onsite. The data were corrected to a 0.0 reading. The values are flagged and coded as <5> [SMT] (CSM).

Total PAR

Passed Initial QAQC Checks (Flag <0>)

Following the station refresh on 05/04/2022 there was a noticeable drop in PAR values. Reasons for this were originally attributed to the battery problems. **See above for CDMO edits made in October 2025.** Once the PAR sensor installed in 2022 was removed and sent in for calibration, Apogee reported a post cal drift of -11.2%. 0 CSM was used for coding from 05/04/2022 17:45 through the end of the year.

Rejected Data (Flag <-3>)

Suspect Data (Flag <1>)

Missing Data (Flag <-2>)

Cumulative Precipitation

Passed Initial QAQC Checks (Flag <0>)

Rejected Data (Flag <-3>)

Beginning on 08/11/2022 at 00:15 and continuing through 08/24/2022 at 00:00, cumulative precipitation values recorded were rejected due to the gaps of data when the battery was below 9.6 V. Although the battery was replaced on 08/23/2022 13:00, data were rejected through the end of the day since a significant portion of data were collected when battery volts fell below 9.6. The values are flagged and coded as <-3> [GPF] (CSM).

Suspect Data (Flag <1>)

The rainfall data from 05/04/2022 at 17:30 to 05/20/2022 at 10:00 was considered suspect due to incomplete calibration. Technician tried to calibrate the rain gauge on 05/04/2022 and 05/05/2022 but a correct calibration could not be obtained. A crack was found in the pipet resulting in some water loss. The other rain gauge was within 10 mm of the weather station rain gauge. Therefore, the data was considered suspect and not rejected. The values are flagged and coded as <1> [SIC] (CSM).

Missing Data (Flag <-2>)

Corrected Data (Flag <5>)

The rainfall data from 05/20/2022 at 10:15 to 05/21/2022 at 00:00 was recorded as rainfall during calibration. No rain fell while the technicians were onsite. The data were corrected to a 0.0 reading. The values are flagged and coded as <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 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**
2019 - New Temp/RH sensor installed, and rain gauge field calibrated on **April 4**
2020 - New Temp/RH, Wind sensor, and PAR sensor installed, and rain gauge calibrated on **March 18**
2020 - New CR1000 program (ACEBPMET_5.5.2_031720) uploaded on **March 18**
2020 - New barometric pressure sensor installed on **September 23**
2021 - New external battery installed on **January 28**
2021 - Newly calibrated Temp/RH sensor installed on **March 29**
2021 - Rain bucket calibrated on **April 23**
2021 - New external battery installed on **June 30**
2022 - System refresh-new box installed with CR1000X (ACEBPMET_CR100X_V6.0.2_042822.CR1X), external battery newly calibrated PAR, Wind, and barometric sensors as well as new Temp/RH sensor installed on **May 4**
2022 - Rain bucket calibrated on **May 20**
2022 - Replaced ground rod on **July 29**
2022 - Replaced antenna on **August 16**
2022 - Replaced external battery on **August 23**