

Sapelo Island (SAP) NERR Meteorological Metadata
January – December 2022
Latest Update: 09/05/2023

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

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2) Entry verification –

Data are uploaded from the CR1000x data logger to a personal computer with a Windows 7 or newer operating system. Files are exported from LoggerNet in a .dat tab-delimited format, converted to a comma-delimited format in Microsoft Excel, 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. Ivanna Knox is responsible for all data management.

3) Research objectives –

The principal objectives are to record meteorological information for the Sapelo Island NERR's site that can be used 1) as a reference for meteorological data for research projects on the reserve, 2) to give meteorological context for our fifteen minute SWMP water quality data, and other long term environmental monitoring projects at the Reserve, 3) to observe and characterize important events such as storms, heat and cold waves, droughts, and heavy rainfalls, and 4) to detect trends and characterize climate variability over the long-term

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the Marsh Landing station on 02/15/2007 and transmits data to the NOAA GOES satellite, NESDIS ID #3B036592. The

transmissions are scheduled hourly at 0:04:40 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 are reported in Eastern Standard Time (EST) for the 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), 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 visually inspected on a monthly basis and are removed and recalibrated by the manufacturer on the following schedule:

- Temperature/Humidity- yearly recalibration
- Rain Gauge- yearly recalibration
- Wind Speed/Direction- yearly or every 2 years (depending on the sensor)
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000x-every 5 years

5) Site location and character –

The site is located at N 31deg 25.068’, W 081deg 17.721’, about 15 feet above sea level. All sensors are mounted on a 10m-aluminum tower located in the northern corner of the Marsh Landing parking lot on the southwest corner of the island. The parking lot surface is approximately a meter above the surrounding marsh. The heights of the sensors on the tower are as follows:

Temperature and relative humidity	2m
Barometric pressure	1m
PAR	3m
Precipitation gauge	6m
Wind sensor	10m

It is bordered with salt marsh to the north and south with transition into pine forest occurring 1/2 mi to the east. On the immediate west lie the Duplin River and the ferry dock, which is also the location of our lower Duplin and Marsh Landing Water Quality sampling sites. The station is well exposed to all winds and weather with little blockage and no shading. This region is subject to multiple severe weather phenomena partially due to the proximity to the ocean. These phenomena include severe summer thunderstorms, which can cause drastic, localized drops in pressure, temperature, and heavy rains; powerful fall and winter frontal systems carrying prolonged strong winds (usually NNE), drastic and sudden drops in temperature and pressure, and long, steady rains; and finally the late summer and early

fall hurricanes. It must be noted that due to the remote location and proximity to the ocean our weather patterns can vary greatly from those on the mainland, particularly temperatures which tend to moderate due to our being surrounded by water. The nearest sites for comparison is the Grays Reef NOAA weather Buoy located about 20nm east of Sapelo Island and Glynco airport located approx. 30 mi to the SSE.

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
ML	Active	Marsh Landing	N 31deg 25.068', W 081deg 17.721'	02/15/2007-current	NA	NA

6) Data collection period –

January 1, 2022 00:15 – December 31, 2022 23:45

File Start Date and Time	File End Date and Time
10/21/2021 00:00	01/13/2022 11:45
01/13/2022 00:00	03/04/2022 11:45
03/04/2022 18:30	08/18/2022 12:30
08/18/2022 12:45	10/21/2022 08:00
08/18/2022 12:45	12/16/2022 11:45
12/16/2022 15:45	01/19/2023 13:00

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 SWMP program in place on Sapelo also includes water quality and nutrient datasets collected along with this meteorological data. As part of the SWMP long-term monitoring program, SAP NERR also collects 15-minute water quality data and monthly grab and diel samples for nutrient/pigment data which may be correlated with this meteorological dataset. These data are available at www.nerrsdata.org.

Sapelo Island has a long history of maintaining research. In 1953, the University of Georgia Marine Institute (UGAMI) was formed and the island became a working laboratory for many. The research continues today with SAP NERR and UGAMI creating a unique partnership with much of the current research being done facilitated by SAP NERR and UGAMI together. Given UGAMI's long history on Sapelo, a bibliographic list of over 800 articles of current and previous research can be found on the UGAMI website: <http://www.uga.edu/ugami> and on the Sapelo Island NERR site: <http://www.sapelonerr.org>.

II. Physical Structure Descriptors

9) Sensor specifications –

Parameter: Temperature

Units: Celsius

Sensor type: PT100 RTD, IEC 751 1/3 Class B, with calibrated signal conditioning

Model #: HC2-S3 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: ± 0.1 °C @ 23°C

SN 61115039

Date of Last Calibration: 10/10/2019

Dates of Sensor Use: 11/08/2021- 09/22/2022

SN 60780595

Date of Last Calibration: 08/18/2022

Dates of Sensor Use: 9/26/2022 – current as of 12/31/2022

Parameter: Relative Humidity

Units: Percent

Sensor type: ROTRONIC® Hygromer IN-1

Model #: HC2-S3 Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy at 23°C: $\pm .8\%$ RH

Temperature dependence of RH measurement: $\pm 3\%$ (-40 to 60C)

SN 61115039

Date of Last Calibration: 10/10/2019

Dates of Sensor Use: 11/08/2021- 09/26/2022

SN 60780595

Date of Last Calibration: 08/18/2022

Dates of Sensor Use: 9/26/2022 – current as of 12/31/2022

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-106 (PTB110)
Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +60°C;
Humidity: non-condensing
Accuracy: ± 0.3 mb at +20°C, ± 0.6 mb at 0°C to 40°C, ± 1 mb at -20°C to +45°C, ± 1.5 mb at -40°C to +60°C
Stability: ± 0.1 mb per year
SN: M4930097
Date of Last Calibration: 12/14/2016
Dates of Sensor Use: 05/08/2018 – 09/26/2022

SN: H0870031
Date of Last Calibration: 08/18/2022
Dates of Sensor Use: 9/26/2022 – current as of 12/31/2022

Parameter: Wind speed

Units: meter per second (m/s)
Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene
Model #: R.M. Young 05103 Wind Monitor
Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)
Accuracy: ± 0.3 m/s
SN: WM171993
Date of Last Calibration: 9/05/2019
Dates of Sensor Use: 10/21/2020 – 12/16/2022

SN: WM171991
Date of Last Calibration: 09/22/2022
Dates of Sensor Use 12/16/2022 – current as of 04/26/2023

Parameter: Wind direction

Units: degrees
Sensor type: balanced vane, 38 cm turning radius
SN: WM171993
Date of Last Calibration: 9/05/2019
Dates of Sensor Use: 10/21/2020 – 12/16/2022

SN: WM171991
Date of Last Calibration: 09/22/2022
Dates of Sensor Use 12/16/2022 – current as of 04/26/2023

Parameter: Photosynthetically Active Radiation (PAR) Model changed in Q4

Units: mmol m⁻² (total flux)
Sensor type: anodized aluminum with cast acrylic diffuser
Model #SQ110 Apogee Quantum Sensor
Light spectrum waveband: 410 to 655 nm
Temperature dependence: 0.06 $\pm$ 0.06% per °C
Stability: $<\pm 2\%$ change over 1 yr
Operating Temperature: -40°C to 70°C; Humidity 0 to 100%
Cosine Response: 45° zenith angle: $\pm 2\%$; 75° zenith angle: $\pm 5\%$
Sensitivity: 0.2mV per $\mu\text{mol s}^{-1} \text{m}^{-2}$
Multiplier: 0.025
SN: SQ-110_22481

Last Calibration: 03/03/2017
Dates of Sensor Use: 05/05/2018 – 12/16/2022

Replaced with CS310
Units: mmol m⁻² (total flux)
Sensor type: Quantum Sensor; high stability silicon photodiode (blue enhanced) in anodized aluminum case with acrylic diffuser
Model: CS310 or SQ- 500 series
Light spectrum waveband: 389 to 692 nm $\pm$ 5 nm
Temp dependence: -0.11 $\pm$ 0.04% per °C
Stability: < $\pm$ 2% change over a 1-year period
Operating Temp: -40° to +70°C
Cosine Response: $\pm$ 5% (at 75° zenith angle)
Sensitivity: 0.01 mV per μ mol m⁻² s⁻¹
Multiplier: 0.05
SN: SQ-500-SS_3904
Last of Last Calibration: May 26, 2022
Dates of Sensor Use: 12/16/2022 – current as of 4/26/2023

Parameter: Precipitation

Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TE525
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
SN: 50994-412
Date of Last calibration: 09/27/2022, previous calibration 03/01/2017
Dates of Sensor Use: 3/1/2017 – current as of 12/31/2022

Datalogger:

CR1000:

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 (4 MB optional upgrade) 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.

SN: 66489
Date Calibrated: 07/14/2014 New at installation
Dates of Logger Use: 05/05/2015 – 03/04/2022

CR1000 Firmware Version (s): CR1000.Std.27; date unknown

CR1000 Program Version(s): SAPMLMET_CR1000_6.1_101620.CR1

CR1000X:

The CR1000X has a total onboard memory of 128 MB of flash and 4MB of battery backed SRAM. There is 8 MB of flash memory reserved for loading the operating system and 1MB of flash reserved for configuration settings. SRAM is used for the CRBasic program operating memory, communication memory, and data storage, with 72 MB of flash for extended data storage. Additional data storage expansion is available with a removable microSD flash memory card of up to 16 GB.

SN: 13925

Date Calibrated: New at installation

Date Installed: 03/04/2022 – current as of 12/31/2022

CR1000x Firmware Version (s): CR1000X.Std.05.01; date unknown

CR1000X Program Version(s): SAPMLMET_CR1000x_6.0.0_010522.CR1X

GOES Transmitter:

Model Number: TX312

Serial Number: 1339

Date Installed: 2021

10) Coded variable definitions –

Sampling station:	Sampling site code:	Station code:
Marsh Landing	ML	sapmlmet

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, 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.

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>.

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 were considered suspect due to the out of calibration CR1000, <1> [SOC] with the F_Record coded as {CSM}. The logger was considered out of calibration 05/05/2020 until 03/04/2022 11:45. Any suspect flagging below is included in the suspect flagging and coding for the out of calibration logger if dates overlapped. Individual sensors that were out of calibration have an additional (CSM) code added to the parameter flag column.

In addition to the out of calibration CR1000, the following sensors are also considered out of calibration during 2022.

Barometric Pressure (SN M49300097) out of calibration 01/01/2022 – 09/26/2022 10:15. Data are flagged and coded as <1>[SOC](CSM) until 09/18/2022 08:30 when the sensor malfunctioned and then data were rejected, <-3> [SSM](CSM), through 09/26/2022 10:15. The sensor was replaced on 09/26/2022 10:30, <-3>[SMT](CSM).

PAR (SN SQ-11022481) out of calibration 01/01/2022 – 12/16/2022 09:30, <1>[SOC](CSM).

Precipitation gauge (SN 50994-412) considered out of calibration 01/01/2022 – 09/27/2022 08:45, <1>[SOC](CSM)

All data are missing or rejected beginning 03/04/2022 12:00 until 03/07/2022 12:30, <-2> or <-3> [GMC](CSM). The out of calibration CR1000 was removed and was replaced by a new logger, a CR1000X. All parameters are rejected on 03/07/2022 12:45 due to being an incomplete 15 minutes of 5-second data, <-3>[GPR](CSM).

Following the installation of the new logger, barometric pressure values dropped to below the lower limit of the sensor range from 03/07/2022 12:45 - 16:30 and were rejected, <-3> [SSM](CSM).

Barometric pressure values dropped suddenly on 09/09/2022 23:15. All BP data were rejected 09/09/2022 23:15 – 09/10/2022 08:15. <-3>[SSM](CSM).

Barometric pressure data dropped below the lower limit of the sensor range on 09/18/2022 08:30 and remained low until 09/26/2022 10:15, <-3>[SSM](CSM). The sensor was replaced on 09/26/2022 10:30, <-3> [SMT](CSM) and data began recording accurately at 10:45.

In August 2022, Ivanna Knox took over position as SWMP Manager. Sensors were sent off for calibration in August and September of 2022 and were received between September and October 2022.

Between September 26 and September 27, Temperature/Relative Humidity, Barometric Pressure, and Precipitation Gauges were replaced with calibrated instruments. Air temperature and relative humidity were rejected for sensor maintenance from 09/26/2022 10:30 until 09/27/2022 08:45 and barometric pressure was rejected on 09/26/2022 10:30, <-3>[SMT](CSM). Total precipitation values on 09/26/2022 10:30 and cumulative precipitation values from 10:30 through the end of the day were corrected back to 0.0. No precipitation was falling during maintenance and those were most likely false tips. Corrected data are considered suspect. Although no specific date or time was recorded for the precipitation gauge calibration, it is believed to have occurred on 09/27/2022 around 09:00 (and most likely done offline); however, no data tips were recorded and no data were rejected, (CSM).

Precipitation recorded on 10/13/2020 00:30 are considered suspect, <1> (CSM), as the value recorded exceeded the 15-minute upper range for that sensor. It is unknown whether or not those data

represented the 15-minute total from 00:15 – 00:30 or if the sensor was blocked and the value recorded was from previous days' rainfall. Cumulative values are considered suspect until the end of the day.

The weather station was powered down on 12/16/2022 09:45 in order to replace the wind sensor and the out of calibration PAR sensor, <-2> [GPD](CSM). The station was briefly powered on from 11:30 – 11:45 with all parameters rejected at 11:30 due to an incomplete 15 minutes of 5-second data. Wind parameters were rejected due to maintenance 11:45, <-3> [SMT](CSM) while PAR was rejected due to incorrect wiring, <-3> [SIW](CSM). A leveling platform was also added to the precipitation gauge while the station was down for maintenance. The station was powered down again from 12:00 - 15:30 with all data rejected at 15:45 due to the power down.

The new PAR sensor was installed with incorrect wiring and needed an updated PAR multiplier in the code. This was remedied in April 2023 but for the remainder of 2022, the PAR data points are rejected from 12/16/2022 16:00 - 12/31/2022 23:45, <-3> [SIW](CSM).