

Sapelo Island (SAP) NERR Meteorological Metadata
Months and year the documentation covers: January – December 2024
Latest Update: 4/30/2025

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO (cdmosupport@baruch.sc.edu) or reserve with any additional questions.

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 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. Dylan Bedortha is responsible for all data collection and 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 15-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 02/05/2007 and transmits data to the NOAA GOES satellite, NESDIS ID #3B036592. The transmissions are scheduled hourly at 4m:40s after the hour 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 collected from the station via laptop monthly. A log is filled out at each collection to check station data against local conditions to ensure quality, document any changes in sensors, and complete and document regular maintenance of the station.

Include the following or similar data collection information:

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

Averages from 5-second data:

Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts)

Maximum and Minimum 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, replaced, and recalibrated by the manufacturer (except for the precipitation gauge) following the recommended frequency as laid out below:

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Precipitation Gauge- yearly recalibration (calibration done in-house)
- Wind Speed/Direction- every 2 years recalibration
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000X - every 5 years recalibration

5) Site location and character –

The site is located at 31°25'04.3" N, 81°17'43.4" W, approximately 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 one meter above the surrounding marsh. The site is bordered with salt marsh to the north and south with transition into pine forest occurring 1/2 mi to the east. To the immediate west lies the Duplin River and the ferry dock, which is also the location of our Lower Duplin Water Quality sampling site. The meteorological station is well exposed to all winds and weather with little blockage and no shading. This region is subject to multiple severe weather events partially due to its proximity to the ocean. These events 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 National Weather Service/NOAA sites for comparison are the Grays Reef NOAA weather Buoy located about 20nm east of Sapelo Island, Glynco airport located approximately 14 miles to SW, and St. Simon's Island Airport located approximately 16 miles SSW. St. Simon's Airport data is used as the check source for monthly logs.

Station measurements

Tower and sensor heights	Height (<i>meters</i>)	Notes
Tower	10m	
Platform (<i>if applicable</i>)	N/A	
Temperature/Relative Humidity	2m from ground	
Barometric Pressure	1.2m (height in the enclosure)	sensor opening $\frac{3}{4}$ m from ground via tube
Wind	10m from ground	
PAR	2.5m from ground	$\frac{3}{4}$ m distance from the tower
Precipitation gauge	2m from ground	$\frac{3}{4}$ m distance from the tower

SWMP station timeline

Station code	SWMP status	Station name	Location	Active dates	Reason decommissioned	Notes
ML	P	Marsh Landing	31°25'04.3" N 81°17'43.4" W	2/15/2007 - present	NA	NA

6) Data collection period –

File start date and time	File end date and time
1/1/2024 00:00	12/31/2024 23:45

Below is a breakdown of raw files that were combined to form this annual dataset.

Raw File start date and time	Raw File end date and time
12/8/2023 11:15	1/11/2024 11:30
1/11/2024 11:45	2/2/2024 12:30
2/2/2024 12:45	3/4/2024 12:15
3/4/2024 12:30	4/1/2024 12:30
4/1/2024 12:45	5/1/2024 10:15
5/1/2024 10:30	6/3/2024 9:45
6/3/2024 10:00	7/1/2024 9:15
7/1/2024 9:30	8/1/2024 10:00
8/1/2024 10:15	8/9/2024 10:00

8/9/2024 10:15	9/4/2024 9:15
9/4/2024 9:30	10/3/2024 12:00
10/3/2024 12:15	11/6/2024 10:45
11/6/2024 11:00	11/20/2024 9:30
11/20/2024 11:15	11/21/2024 10:00
11/21/2024 10:15	12/6/2024 11:00
12/6/2024 11:15	1/3/2025 10:45

All data is reported in Eastern Standard Time (EST).

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 2024.

Also include the following excerpt in the metadata which will address how and where the data can be obtained.

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 –

Sapelo Island has a long history of maintaining research. In 1953, the University of Georgia Marine Institute (UGAMI) was formed on Sapelo 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>.

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.

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

Serial number, dates of calibration and use:

SN: 20072700

Last calibration: 10/14/2024

In service: 12/6/2024 – present

SN: 60780595

Last calibration: 12/11/2023

In service: 2/15/2024 – 12/6/2024

SN: 20072700

Last calibration: 2/16/2023

In service: 8/17/2023 – 2/15/2024

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: $\pm 0.8\%$ RH with standard configuration settings

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

Serial number, dates of calibration and use:

SN: 20072700

Last calibration: 10/14/2024

In service: 12/6/2024 – present

SN: 60780595

Last calibration: 12/11/2023

In service: 2/15/2024 – 12/6/2024

SN: 20072700

Last calibration: 2/16/2023

In service: 8/17/2023 – 2/15/2024

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 $+20^{\circ}\text{C}$, ± 0.6 mb at 0°C to 40°C , ± 1 mb at -20°C to $+45^{\circ}\text{C}$, ± 1.5 mb at -40°C to $+60^{\circ}\text{C}$

Stability: ± 0.1 mb per year

Serial number, dates of calibration and use:

SN: J0560059

Last calibration: 6/7/2024

In service: 8/15/2024 – present

SN: H0870031

Last calibration: 8/18/2022

In service: 9/26/2022 – 8/15/2024

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 - 100 m/s (224 mph)

Accuracy: ± 0.3 m/s or 1% or reading

Multiplier: 0.0980

Serial number, dates of calibration and use:

SN: WM171993

Last calibration: 7/19/2024

In service: 9/20/24 – present

SN: WM171991

Last calibration: 9/22/2022

In service: 12/16/2022 – 9/20/2024

Parameter: Wind direction

Units: degrees

Model #: R. M. Young 5103 Wind Monitor

Sensor type: balanced vane, 38 cm turning radius

Range: 360° mechanical, 355° electrical

Accuracy: ± 3 degrees

Serial number, dates of calibration and use:

SN: WM171993

Last calibration: 7/19/2024

In service: 9/20/24 – present

SN: WM171991

Last calibration: 9/22/2022

In service: 12/16/2022 – 9/20/2024

Parameter: Photosynthetically Active Radiation (PAR)

Units: mmols m^{-2} (total flux)

Sensor type: Quantum Sensor; high stability silicon photodiode (blue enhanced) in anodized aluminum case with acrylic diffuser

Model: CS310 (SQ-500)
Light spectrum waveband: 389 to 692 nm
Temperature dependence: $-0.11 \pm 0.04\%/^{\circ}\text{C}$
Stability: $< \pm 2\%$ change over a 1-year period
Operating temperature: -40 to 70°C
Cosine Response: $\pm 5\%$ at 75° zenith angle
Sensitivity: 0.01 mV per $\mu\text{mol}/\text{m}^2/\text{s}$
Multiplier: 0.5 (this does not change) – *include*
Serial number, dates of calibration and use:
SN: CS310_4074
Last calibration: 2/26/2024
In service: 4/29/2024 – present

SN: CS310_3904
Last calibration: 5/26/2022
In service: 4/14/2023 – 4/29/2024

Parameter: Precipitation (**specify if heated rain gauge**)
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: $\pm 1.0\%$ up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Serial number, dates of calibration and use:
SN: 70981-1016
Last calibration: 9/4/2024
In service: 9/5/2024 – present

SN: 91816-0822
Last calibration: 9/7/2023
In service: 9/12/2023 – 9/5/2024

For a list of historical sensor information, calibration history, and deployment, please reach out to the reserve.

Datalogger:

CR1000X:

The CR1000X has a total onboard memory of 128 MB of flash and 4MB of battery backed SRAM. There are 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.

Serial number: 64733
Date CR1000X installed: 11/20/2024
Date CR1000X calibrated: 10/29/2024
CR1000X firmware version (s): CR1000X.std.08.01
CR1000X program version(s):
sapmlmet_CR1000X_6.0.1_112224.CR1X → in use from 11/22/2024 – present
sapmlmet_CR1000X_6.0.1_102824.CR1X → in use from 11/20/2024 – 11/22/2024

Serial number: 13925
Date CR1000X installed: 3/4/2022
Date CR1000X calibrated: 11/21/2019
CR1000X firmware version: CR1000X.std.05.01
CR1000X program version: sapmlmet_CR1000X_6.0.0_041423.CR1X

GOES transmitter:

Model number: TX325
Serial number: 300003041
Date installed: 11/20/2024
In service: 11/20/2024 - present

Model number: TX321-G
Serial number: 2363
Date installed: 8/22/2023
In service: 8/22/2023 – 11/20/2024

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/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.

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 negative PAR values in this dataset have been flagged as suspect. These small negative values (-0.1, -0.2) occur at night when the readings should be zero. These negative nighttime PAR values do not seem to affect regular data collection from this sensor. All PAR values above 0.0 during nighttime hours in this dataset have also been flagged as suspect. These slightly elevated values are not due to sunlight and intermittently show up in the dataset. Similar to the negative PAR values, these slightly elevated nighttime values do not seem to affect regular data collection from this sensor.

Q1:

On 1/9/24 at 15:15 a wind gust of 30.5 m/s was recorded by the MET station. This high value lines up with an intense line of storms passing through the area that day. Value was flagged <5>(CWE).

The temperature/relative humidity sensor was replaced on 2/15/24 between 12:15 – 12:30 standard time.

Q2:

Routine maintenance/cleaning done on precipitation gauge and PAR sensor on 4/1/24 at 12:45. Values rejected.

The PAR sensor was replaced on 4/29/24 between 10:15 – 10:45 standard time. PAR values during this time are flagged as rejected due to maintenance.

An extender arm was added to the rain gauge on 5/23/24. The gauge had been attached directly to the weather tower leaving it vulnerable to bird droppings fouling the funnel. The extender puts the gauge approximately 2.5' away from the tower to prevent bird interference. The gauge maintained the same height from the ground.

On 5/28/24, once back on the island after the holiday weekend, it was observed that the rain gauge extender had tipped over. Looking at wind data from the previous few days, the best guess as to when the tip over occurred was on 5/25/24 between 16:45– 23:00 but it is impossible to tell exactly. All rain data from 5/24 16:00 – 5/28 10:00 is flagged as suspect, and value at 5/28 09:00 is rejected due to maintenance. Precipitation values at 5/24/24 19:15 – 19:45 and 5/25/24 16:45 – 17:00 were the only values affected by this flagging and this could very well have occurred before the rain gauge extender arm was knocked over. Flagging out of an abundance of caution. The extender arm was adjusted and secured in a more stable fashion.

The telemetry transmissions for the meteorological station began to intermittently fail on 6/6/24. After troubleshooting the system, the transmitter was reset which caused all transmissions to cease on 6/11/24. Data was still being recorded and stored; it just wasn't being reported to the RTA. On 6/17/24, after a conversation with Jeff Adams from Campbell Scientific, a hard factory default reset was performed on both the transmitter and the data logger. This remedied the issues and telemetry capabilities were restored.

During one of these troubleshooting sessions, the time on the data logger was updated and resulted in losing the data for 6/13/24 13:30. This was the only data lost.

Q3:

Tropical Storm Debby impacted coastal Georgia, including the reserve, from August 5 – 7, 2024. This system brought heavy rain with limited high winds. The majority of the impact was felt during these three days, but some effects were felt before and after this time period.

The barometric pressure sensor was replaced on 8/15/24 between 9:00 – 9:15 eastern standard time. BP data related to this switch have been flagged as <-3> [SMT].

The precipitation gauge was replaced on 9/5/24 between 12:00 – 12:45 eastern standard time. Total precipitation data from 9/5/24 13:00 have been flagged <1> [SMT]. I am confident the bucket did not tip while the switch was happening, and a light rain picked up between 12:45 and 13:00, but flagging out of abundance of caution. Likewise, Cumulative Precipitation from 9/5/24 13:00 – 9/6/24 00:00 has also been flagged as <1> [SMT].

The wind sensor was replaced on 9/20/24 between 8:00 – 10:00 eastern standard time. To complete this swap, the entire meteorological tower had to be lowered, potentially affecting data. All wind data from 9/20/24 8:00 – 10:00 are flagged as <-3> [SMT]. PAR data from the same time period are flagged as <1> [SMT]. Other parameters did not seem to be affected and no further flagging was done.

Hurricane Helene passed to the west of the reserve from September 26 – 27, 2024. This system brought high winds and limited rainfall.

Q4:

On 11/20/2024, the MET station enclosure that houses all station hardware was replaced. During this replacement, the datalogger and transmitter were also replaced. A new datalogger program was made for the new logger to accommodate the updated transmitter. This replacement occurred between 9:30 – 11:30. Once the new hardware and program were replaced, telemetry output was jumbled and a slight modification to the program was needed to resolve the issue. After the modification, telemetry returned to normal operation. Data collection was not affected by this issue.

The temperature/RH sensor was replaced on 12/6/2024 between 11:00 – 11:15. The temperature and relative humidity records at 11:15 12/6/24 are rejected due to this switch.