**North Carolina** (NOC) **NERR Meteorological Metadata**
**January 2023 – December 2023**
**Latest Update:** 05/15/2024

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 CR1000 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. Byron Toothman and Heather Wells are responsible for station maintenance and data management.

### 3) Research objectives –

The principal objectives are to establish long-term monitoring of the weather in the vicinity of Masonboro Island, to obtain better data on storms and to be able to correlate the weather, water quality, chlorophyll and nutrient data. In addition, the weather data collected will be used in support of other ongoing projects within the Reserve and nearby area.

**4) Research methods –**

Campbell Scientific data telemetry equipment was installed at the NOC station on 06/15/1997 and transmits data to the NOAA GOES satellite, NESDIS ID #3B02028E. The transmissions are scheduled hourly at [insert transmission time] 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.

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.)

Recommended calibration frequency for the MET station sensors:
- Temperature/Humidity- yearly recalibration
- Precipitation 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
- CR1000/CR1000X - every 5 years

**5) Site location and character –**

The components of North Carolina's National Estuarine Research Reserve (from north to south) are: Currituck Banks, Rachel Carson, Masonboro Island, and Zeke's Island. They are located along the southeast Atlantic coast of the United States. Currently, only data from Masonboro Island and Zeke's Island components are transferred to the CDMO.

The meteorological site is located on Masonboro Island, 2.09 km from the NOC NERR lab, and approximately 76.2 meters from the Research Creek water quality deployment site. The weather station is located on an active dredge spoil island adjacent to Research Creek east of the Intracoastal Waterway. It is directly across the Intracoastal Waterway from Whiskey Creek, at 34° 9' 19.80 N, 77° 51' 3.24 W. The station sits at an elevation of approximately 4.88 m above sea level, slightly offset from the highest point of the spoil, which has a maximum elevation of approximately 5.8 m. The site has scrub surrounding the periphery, and grassy cover in the central areas. The weather station consists of a 3-meter aluminum tower that holds the Temp/RH sensors, BP sensor, wind sensor (wind speed and direction), and PAR sensors. The rain gauge is located on a separate platform 7.62 m east Southeast of the tower and is mounted atop a 1.5m wood post. The sensors were wired to the CR1000 (Campbell datalogger) according to the protocol in the Meteorological Monitoring SOP. There are no surrounding objects that obstruct or shade the weather station.

| **Tower and sensor heights** | **Height (*meters*)** | **Notes** |
|---|---|---|
| Tower | 3.0 | Base elevation ~4.9 m above Sea Level |

| | | |
|---|---|---|
| Temperature/Relative Humidity | 2.39 | |
| Barometric Pressure | 1.8 | |
| Wind | 3.68 | |
| PAR | 3.66 | |
| Precipitation gauge | 1.79 | 7.6 m SE of tower |

SWMP Station Timeline:

| Station Code | Station Name | SWMP Status | Location | Active Dates | Reason Decommissioned | Notes |
|---|---|---|---|---|---|---|
| NOCRCMET | Research Creek | P | 34° 9' 19.80 N, 77° 51' 3.24 W | 01/01/2001 - | NA | NA |

**6) Data collection period –**

[Instructions/Remove: Note when data collection began initially for your reserve or sample site(s). Specify the exact start and end date and time of data collection for each monitoring site for the year. At a minimum, this should include the January 1st start time and December 31st end time and any breaks in data collection; however, **including the date and time for the first and last readings for each raw file is recommended (see example of table below).**]

| **File start date and time** | **File end date and time** |
|---|---|
| **7/6/2022 1:00** | **1/18/2023 16:00** |
| **1/18/2023 16:15** | **4/27/2023 11:45** |
| **4/27/2023 12:00** | **7/21/2023 11:15** |
| **7/21/2023 11:45** | **10/19/2023 12:30** |
| **10/19/2023 12:45** | **12/21/2023 14:15** |
| **12/21/2023 14:30** | |

**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 2023.

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 –**

[Instructions/Remove: Describe briefly other research (data collection) that correlates or enhances the data collected at your weather station. You may provide links to the other products or programs. At a minimum, mention the SWMP WQ and NUT datasets as below.]

As part of the SWMP long-term monitoring program, NOC 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. . The principal objective of the water quality monitoring is to record long-term water quality data in order to observe and document any physical and chemical changes or trends in water quality over time. The objective of the pigment and nutrient monitoring study is to ascertain the annual and tidal fluctuations in nutrient and chlorophyll a levels surrounding the four water quality sites. Additional projects are ongoing and continually changing. Check with the Research Coordinator or other contact person for an updated list of research (see section I.1.).

## II. Physical Structure Descriptors

**9) Sensor specifications –**

Parameter: Temperature
Units: Celsius
Sensor type: Pt1000 Class A
Model #: EE181 Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ±0.2 °C @ 23°C
Serial Number: 17101600007613
Date of Calibration:03/22/2017
Installed:03/22/2018

Parameter: Relative Humidity
Units: Percent
Sensor type: HC101
Model #: EE181 Temperature and Relative Humidity Probe
Range: 0-100% non-condensing
Accuracy: –15 to 40 °C: ≤90% RH ± (1.3 + 0.003 • RH reading) % RH
–15 to 40 °C: >90% RH ± 2.3% RH
–25 to 60 °C: ± (1.4 + 0.01 • RH reading) % RH
–40 to 60 °C: ± (1.5 + 0.015 • RH reading) % RH
Temperature dependence of RH measurement: typically 0.03% RH/°C
Serial Number: 17101600007613
Date of Calibration:03/22/2017
Installed:03/22/2018

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: 00200775980
Date of Calibration:01/27/2016
Installed:11/20/2017

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:  +/- 0.8% RH with standard configuration settings
Temperature dependence of RH measurement +/- 3% (-40 to 60C)
Serial Number: 00200775980
Date of Calibration:01/27/2016
Installed:11/20/2017

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-105
Operating Range:  Pressure: 600 to 1060 mb; Temperature:  -40°C to +60°C;
Humidity:  non-condensing
Accuracy: ± 0.5 mb @ 20°C; +/- 2 mb @ 0°C to 40°C; +/- 4 mb @ -20°C to 45°C; +/- 6 mb @ -40°C to 60°C
Stability: ± 0.1 mb per year
Serial Number: F1640093
Date of Calibration: 03/29/2017
Installed:04/19/2017
Serial Number: v4730001
Date of Calibration: 9/19/18
Installed:11/27/2018

Parameter: Wind Speed and Wind direction
Units: meters per second (m/s); degrees
Sensor type: Gill Windsonic Ultrasonic Wind Sensor Option:4
Model #: 1405-PK-100
Range: 0-60m/s; 0 to 359° (no dead band)
Accuracy: ±2% @ 12m/s
Resolution: 0.01m/s (0.02 knots)
Serial Number: 0153215400013 Gill 1405-PK-100
Date of calibration: 09/29/2015, installed new on 02/29/2016
Date of Sensor Use: 02/29/2016 – current as of 05/1/2018

Parameter: Photosynthetically Active Radiation (PAR)
Units:  mmoles 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+/-0.06% per °C
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 70°C; Humidity 0 to 100%
Cosine Response: 45° zenith angle: +/- 2%; 75° zenith angle: +/- 5%
Sensitivity: 0.2mV per μmol s-1 m-2
**Multiplier: 0.025**
Serial Number: SQ-110_18785
Date of Calibration: 03/ /2017
Installed: 04/19/2017
Serial Number: SQ-110_18787
Date of Calibration: 09/19/2018
Installed: 11/27/2018

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: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Date of Calibration: 10/23/2017
Date of Previous Calibration: 03/22/2017
Dates of Sensor Use: 10/03/2009 – 11/27/2018
Date of Calibration: 09/20/2018
Date of Previous Calibration: n/a
Dates of Sensor Use: 11/27/2018

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.
**Date CR1000 Installed:** 07/22/2015 11/27/2018, s/n:005200
**Date CR1000 Calibrated:** 05/26/2015
**CR1000 Firmware Version (s):** OS 28(installed during calibration)

**Date CR1000 Installed:** 11/27/2018 - s/n: 33409
**Date CR1000 Calibrated:** 05/26/2015
**CR1000 Firmware Version (s):** OS 28(installed during calibration)

**CR1000 Program Version(s):** NOCRCMET_CR1000_v6.27_020916.CR1
NOCRCMET_CR1000_v6.27_072123.CR1

**GOES Transmitter:**
Model Number: TX321
Serial Number: 1640
Date Installed: 03/22/2018

**10) Coded variable definitions -**
Sampling station: Sampling site code: Station code:

| | | |
|---|---|---|
| Research Creek | RC | nocrcmet |

**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.

[Remove if not applicable – this applies only to the LI-COR sensor] Small negative PAR values are within range of the LI-COR sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the LI-COR sensor is +/- 2.214 mmoles/m2 over a 15 minute interval. These values are automatically flagged and coded as <1> (CAF).

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>.

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.**

General

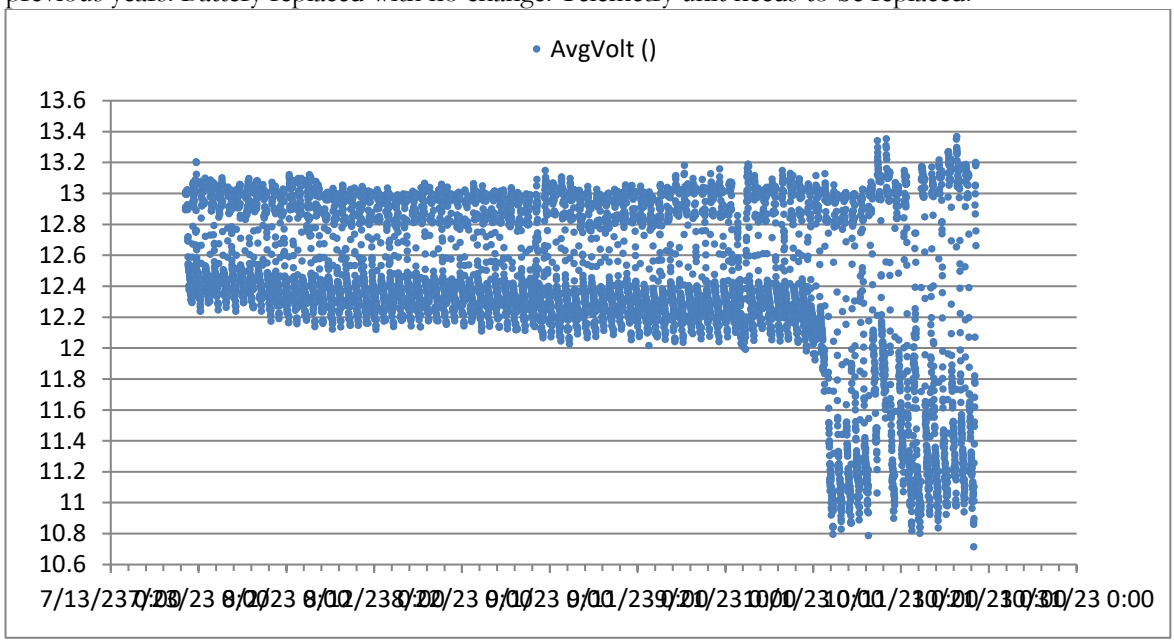
Connectivity with the MET station continued through parts of 2023 though continuity of data collection was maintained. Telemetered data was downloaded for quarterly QAQC procedures. Data missing from the following dates.

Missing data - Data dropped due to suspected power failure, insufficient power, or telemetry issue. Some missing BP data is incorrectly calculated as -282.6 and is an artifact of the BP multiplier correction formula (see BP section below). Some other parameters appear to be affected by this power cycling as well. These were identified and flagged with <-3> [SSM] (CSM)

Program reload

Updated BP multiplier and reloaded program. 07/21/2023 11:30 data missing while station powered down for to station maintenance. Following 15 min data (07/21/2023 11:45) rejected due to maintenance <-3> [GPR].

Telemetry
Telemetry interrupted approximately 10/3/2022. Cause unknown. Battery voltage signal changed abruptly at that time – see graph below. Voltage prior to interruption appears to be ~0.2V lower than previous years. Battery replaced with no change. Telemetry unit needs to be replaced.




BP correction
BP
12/18/2020 12:45 previous BP sensor (PTB101B) was replaced with a newly calibrated CS106 sensor, <-3>[SMT](CSM). The multiplier in the CR1000 program was not updated resulting in lower than expected BP values. BP data from 12/18/2020 13:00 through 07/21/2023 11:15. Corrected data are congruent when checked against nearby weather stations and should be considered accurate. The following steps were taken to correct the data.

(incorrect value - 600)/0.184
(0.24 * value from above) + 500

All corrected BP data are flagged and coded as <5> [SIC] (CSM) and it should be noted that those corrected values are considered suspect.
BP multiplier corrected and program uploaded 07/21/2023 11:45. Data look correct when checked with multiple surrounding stations including NOAA KILM airport station.