North Carolina (NOC) **NERR Meteorological Metadata**
January 2020 – December 2020
Latest Update: 03/01/2022

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

Brandon Puckett, Research Coordinator
101 Pivers Island Road
Beaufort, NC. 28516
Phone: 252-838-0851
Fax: 252-838-0890
Email: brandon.puckett@ncdenr.gov

Byron R Toothman, Research Associate
5600 Marvin K. Moss Lane
Wilmington, NC 28409
Phone: (910) 962-2334
Fax: (910) 962-2410
Email: toothmanb@uncw.edu

Heather Wells, Research Associate
5600 Marvin K. Moss Lane
Wilmington, NC 28409
Phone: (910) 962-2335
Fax: (910) 962-2410
Email: wellsh@uncw.edu

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 NOCRCMET station on 06/15/1997 and transmits data to the NOAA GOES satellite, NESDIS ID #3B02028E The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary

QAQC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at http://cdmo.baruch.sc.edu

Data are collected in Eastern Standard Time (EST) for the entire year.

The 15-minute data are collected in the following formats for the **CR1000**:
Averages from 5-second data:
Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), 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/m^2), and Cumulative Precipitation (mm) (Cumulative precipitation is no longer available via export from the CDMO. Please contact the reserve or the CDMO for more information or to obtain these data.)

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-every 5 years (required beginning 2014, one year initial grace period)

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 wind sensor (wind speed and direction) at a height of 3.68 m and the PAR sensor at a height of 3.66 m. The temperature and relative humidity sensor is mounted on the tower at 2.39 m and the barometric pressure sensor, which is inside of the datalogger housing, is mounted at a height of 1.75 m. The rain gauge is located on a separate platform 7.62 m east south east of the tower and is mounted at a height of 1.79 m. 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.

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 –

Collection of meteorological data began on March 15, 1997. Instruments were deployed prior to this date; however, data were for initial testing and verification of functions, and have since been discarded. The data collection period for 2018 began on January 1 at 00:00 and will end December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/17/2019 12:00	2/18/2020 15:00
2/18/2020 15:15	4/22/2020 15:30
4/22/2020 15:45	7/22/2020 12:15
7/22/2020 12:30	9/24/2020 18:15
9/24/2020 18:30	12/18/2020 12:15
12/18/2020 12:30	12/30/2020 16:15
12/30/2020 16:30	4/19/2021 13:15

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 process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: http://www.nerrsdata.org/; *accessed* 12 October 2020.

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 –

Meteorological data will be used to augment other research components of the System Wide Monitoring Program (SWMP) that currently include water quality, chlorophyll and nutrient monitoring. 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 chlorophyll 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.).

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.

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: 183716000172EC
Date of Calibration: 09/18/2018
Installed: (NEW) 01/08/2019 – 12/18/2020

Serial Number: 17101600007613
Date of Calibration:06/15/2020
Installed: – 12/18/2020 – current as of 12/31/2021

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
Note: This sensor caps relative humidity values at 100%, measured values >100% are altered to 100%
Serial Number: 183716000172EC
Date of Calibration: 09/18/2018
Installed: (NEW) 01/08/2019– 12/18/2020

Serial Number: 17101600007613
Date of Calibration:06/15/2020
Installed: – 12/18/2020 - current as of 12/31/2021

Parameter: Barometric Pressure
Model # PTB101B
Operating Range: Pressure - 600-1060 mb
Temperature: -40-+60C

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: v4730001
Date of Calibration: 9/19/18
Installed:11/27/2018– 12/18/2020

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: PTB110
Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +140°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
Serial Number: S1230221
Date of Calibration: 03/18/2020
Installed: 12/18/2020 – current as of 12/31/2021

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: 15400013 Gill 1405-PK-100
Date of calibration: 09/29/2015, installed new on 02/29/2016
Date of Sensor Use: 02/29/2016 – 12/31/2019

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_18787
Date of Calibration: 09/19/2018
Installed: 11/27/2018 – 12/18/2020

Serial Number: SQ-110_29536
Date of Calibration: 06/01/2020
Installed: 12/18/2020 – current as of 12/31/2020

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 Previous Calibration: 11/27/2018, 12/18/2020
Dates of Sensor Use: 11/27/2018 – current as of 12/31/2020

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.

Date CR1000 Installed: 11/27/2018 – current as of 12/31/2020 - s/n: 33409
Date CR1000 Calibrated: 09/18/2018
CR1000 Firmware Version (s): OS 28 (installed during calibration)
CR1000 Program Version(s): nocrcmet_CR1000_6.27_020916

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, 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 +/-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.**

Hurricane Isaias

Hurricane Isaias made landfall near Ocean Isle beach, NC at 11:10pm EST approximately 46 km ESE of East Cribbings (EC) in Zeke's Basin and approximately 60 km SE of Research Creek (RC) in Masonboro Sound. Affected data from 08/03/2020 17:45 - 08/04/2020 01:45, from when BP began to fall below surrounding values to when it returned, were flagged <0> [GSM] (CWE). Minimum barometric pressure fell to 997 mb, maximum recorded wind speed 33.6 m/s (75.2 mph), and precipitation accumulated to 50 mm. Data for Max WindSpeed on 08/03/2020 22:30 – 23:15 were initially flagged <-5> during the automatic QA/QC process which normally indicate that a reading is outside the range of the sensor. In this case the flagging indicated that wind readings were high enough that the data should be checked to ensure the sensor was functioning correctly. These data were flagged as <0> [GSM] (CWE).
Notably, East Cribbings and Research Creek water quality stations were lost during the storm. Water quality instrumentation at East Cribbings was lost while instrumentation at Research Creek was recovered.

General

The downloaded Date and TimeStamp were advanced by 4 years for unknown reasons. This was corrected manually and uploaded for primary QAQC. Corrected data were flagged in the F_Record column {CSM}.

Air Temperature/Relative Humidity/BP/PAR

Air Temperature and relative humidity, barometric pressure, and PAR sensor were replaced on 12/18/2020. Data for those parameters are rejected at 12:45 for sensor maintenance, <-3>[SMT] (CSM).

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 the end of the year required correction after download. Corrected data were 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.

Precipitation

Total and cumulative precipitation are considered out of calibration from 11/27/2020 00:15 – 12/18/2020 13:00. Those data are considered suspect, <1>[SOC](CSM).

Sensor calibration check at 12/18/2020 13:15. Registered 1.8mm. Affected data were flagged and coded <-3> [SMT] (CSM).

Wind

09/29/2020 04:15 Max Wind record includes NAN and regular Wind Speed record is elevated and does not reflect adjacent records. Entire record for Wind data has been rejected <-3> [SSM] (CSM). Reasons unknown.