

North Carolina (NOC) NERR Meteorological Metadata
Months and year the documentation covers
Latest Update: February 23, 2022

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

Brandon Puckett, Research Coordinator (current as of 2014)
101 Pivers Island Road
Beaufort, NC. 28516
Phone: 252-838-0851
Fax: 252-838-0890
Email: brandon.puckett@ncdenr.gov

Dr. John Fear, Research Coordinator (through January 2014)
101 Pivers Island Rd.
Beaufort, NC 28516
Phone: (252) 838-0884
Fax: (252) 838-0890
Email: john.fear@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 (IBM compatible). Files are exported from or 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>

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)

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 station, 2.5km from the Loosin Creek water quality station, 23.5km from Zeke's Basin water quality station, and 25.3km from East Cribbings water quality stations. 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° 9.328'N, 77° 51.054'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. Due to surrounding maritime forest, the wind sensor may observe the wind speed to be slightly lower than in surrounding areas depending on wind direction. The temperature may also be slightly different from nearby stations due to differences in temperature on the mainland and waters surrounding the spoil island.

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 2012 began on January 1 at 00:00 ends December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/14/2011 12:30	01/23/2012 09:45
01/23/2012 10:00	02/08/2012 15:00
02/08/2012 15:15	02/23/2012 11:30
02/23/2012 11:45	03/28/2012 13:00
03/28/2012 13:15	04/26/2012 10:30
04/26/2012 10:45	05/08/2012 12:00
05/08/2012 12:15	06/13/2012 13:30
06/13/2012 13:45	07/19/2012 13:00
07/19/2012 13:15	08/22/2012 12:45
08/22/2012 13:00	09/26/2012 12:30
09/26/2012 12:45	10/22/2012 12:45
09/26/2012 12:45	11/20/2012 12:15
11/20/2012 12:30	12/20/2012 12:30
12/20/2012 12:45	01/17/2013 12:00

7) Distribution

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from this NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. 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.

NERR weather 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 <http://cdmo.baruch.sc.edu/>. Data are available in comma separated 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.).

II. Physical Structure Descriptors

9) Sensor specifications

Parameter: Temperature

Units: Celsius

Sensor type: Platinum resistance temperature detector (PRT)

Model #: HMP45C Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: ± 0.2 °C @ 20°C

Serial Number: F1640093

Date of Calibration: 04/24/10

Dates of Sensor Use: 02/28/11 – 06/13/12

Serial Number: E453052

Date of Calibration: 05/09/12

Dates of Sensor Use: 06/13/12–05/24/2013

Parameter: Relative Humidity

Units: Percent

Sensor type: Vaisala HUMICAP© 180 capacitive relative humidity sensor

Model #: HMP45C Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy at 20°C: $\pm 2\%$ RH (0-90%) and $\pm 3\%$ (90-100%)

Temperature dependence of RH measurement: $\pm 0.05\%$ RH/°C

Serial Number: F1640093

Date of Calibration: 04/24/10

Dates of Sensor Use: 02/28/11 – 06/13/12

Serial Number: E453052
Date of Calibration: 05/09/12
Dates of Sensor Use: 06/13/12–05/24/2013

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-106
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: F0150065
Date of Calibration: 01/12/10
Dates of Sensor Use: 02/28/11 – 05/24/2013

Parameter: Wind speed
Parameter: Wind Speed and Wind direction
Units: meters per second (m/s); degrees
Sensor type: Vaisala Ultrasonic Wind Sensor
Model #: 425
Range: 0 to 65 m/s (0 to 144 mph, 0 to 125 knots); 0 to 360°
Accuracy: ± 0.135 m/s (± 0.3 mph, ± 0.26 knots) or 3% of reading, whichever is greater; $\pm 2^\circ$
Serial number: 01532
Date of Calibration: Original, no calibration required
dates of use: 07/15/02 – 02/29/2016

Parameter: Wind direction
Parameter: Wind Speed and Wind direction
Units: meters per second (m/s); degrees
Sensor type: Vaisala Ultrasonic Wind Sensor
Model #: 425
Range: 0 to 65 m/s (0 to 144 mph, 0 to 125 knots); 0 to 360°
Accuracy: ± 0.135 m/s (± 0.3 mph, ± 0.26 knots) or 3% of reading, whichever is greater; $\pm 2^\circ$
Serial number: 01532
Date of Calibration: Original, no calibration required
dates of use: 07/15/02 – 02/29/2016

Parameter: Photosynthetically Active Radiation
Units: mmol m⁻² (total flux)
Sensor type: High stability silicon photovoltaic detector (blue enhanced)
Model #: LI190SB
Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.15% per °C maximum
Stability: $< \pm 2\%$ change over 1 yr
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%
Sensitivity: typically 5 μ A per 1000 μ mol s⁻¹ m⁻²
Date Installed:

Serial	Calibrated	Installed	Removed	Multiplier
Q43059	02/19/10	06/18/10	02/28/11	1.093546327
Q43053	02/19/10	02/28/11	05/24/13	1.127812765

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 Last calibration: 07/19/12, previous calibration 04/20/2011

Serial number: 99-36

Date of Calibration: 07/19/12

dates of use: 2010 – current as of 04/15/13

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.

Serial Number: 5200

Date CR1000 Installed: 06/28/06 (new)

CR1000 Firmware Version (s): V19 uploaded 04/22/2010

CR1000 Program Version(s): NOCMET_6.25_030811

10) Coded variable definitions

Sampling station:	Sampling site code:	Station code:
Research Creek	RC	nocrcmet

11) QAQC flag definitions – This section details the automated primary and secondary QAQC flag definitions. Include the following excerpt.

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
SSN	Not a Number / Unknown Value
SSM	Sensor Malfunction
SSR	Sensor Removed

Comments

CAF	Acceptable Calibration/Accuracy Error of Sensor
CDF	Data Appear to Fit Conditions
CML	Snow melt from previous snowfall event
CRE*	Significant Rain Event
CSM*	See Metadata
CCU	Cause Unknown
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.

Small negative PAR values are within range of the sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the Licor sensor is +/- 2.214 mmoles/m² over a 15 minute interval.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-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.

Air Temperature/Relative Humidity

Air temperature/relative humidity sensor was swapped on 06/13/2012 at between 13:45 and 14:00. Both parameters were rejected for sensor maintenance at 14:00, <-3>[SMT](CSM).

There was a noticeable jump in RH values following the sensor swap on 06/13/2012. When looking at multiple years of data, the sensor installed until 06/13/2012, SN F1640093, appeared to have lower readings than the sensor that replaced it, SN E453052. Differences between those 2 sensors and others was noticeable over multiple deployments over the years. To bring attention to this, all RH data for 2012 was coded with CSM, both before and after the 06/13/2012 sensor swap.

PAR

PAR sensor remains relocated from the MET station truss to an independent wooden post since 09/15/2011 through 05/24/2013 to try and isolate any stray charge that may be affecting the PAR sensor. Post is ~ 12' and located a few feet from the south facing side of the MET station. This DID NOT result in any improvement in data quality and data remained unsatisfactory.

PAR values during 2012 were rejected due to sensor malfunction beginning 01/01/2012 and continuing through the end of the year. While data were rejected, it may still be useful for approximate values for the purposes of trend analysis.

Although PAR data for 2012 were rejected, it is important to note the programming changes made during 2013. The voltage differences between the older program command and the newer one in 2013 may have been the reason for many of the PAR problems during 2012. PAR sensors on the NOC NERR weather station show frequent strings of repeating values. It has since been determined that this was caused by the programming of the CR1000 data logger. Changes were made to the PAR/CR1000 programming on 06/26/2013:
old program command: VoltDiff(PAR,1,mV2500,3,True,0,_60Hz,0.897,0)
new program command: VoltDiff(PAR,1,mV25,3,True,0,_60Hz,0.897,0)

The program was updated and sent to the CR1000 on 06/26/2013. The mV25 setting allows measurements to be taken at a finer, more precise scale than mV2500, and has eliminated repeating values from the data set. **While values before this program change are not as precise as they could have been, they are not erroneous.**

Wind

Anomalous Max wind data values of 447 were occasionally recorded during 2012. When those values were recoded, max wind speed data as well as all other wind parameters were rejected, <-3> [SSM] (CSM).

NAN was reported for wind speed and max wind speed data during several blocks of data between 08/24/2012 19:15 and 08/25/2012 22:00. The cause is unknown and all wind data were rejected for these times. <-3> [SSM] (CSM).

Precipitation

Bucket accidentally tipped during routine maintenance. The affected data were corrected and flagged and coded <5> [SMT] (CSM)

07/19/2012 13:30 2.5mm corrected to 0.0 Precipitation calibration check.

08/22/2012 13:00 corrected by subtracting 0.254 for one accidental rain gauge tip to 8.4mm that was recorded earlier in the day