

**North Carolina (NOC) NERR Meteorological Metadata**  
**January 1<sup>st</sup> –December 31<sup>st</sup>, 2014.**  
**Latest Update:** April 19, 2016

**I. Data Set and Research Descriptors**

**1) Principal investigator(s) and contact persons**

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**2) Entry**

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/m<sup>2</sup>), and Cumulative Precipitation  
(mm)

Recommended calibration frequency for the MET station sensors:

- 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- bi-annual recalibration
- CR1000-every 5 years (required beginning 2014, one year initial grace period)

Data are periodically compared to values recorded by other local weather stations to verify accuracy. Data are also quality checked using Excel. The reports, graphs and queries of meteorological data are reviewed. Anomalous data and errors are further investigated and data are corrected, rejected (if necessary) or left unchanged and noted in the metadata report.

#### 5) Site location and

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° 9.328'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.

#### **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 2014 began on January 1 at 00:15 and ended December 31 at 23:45.

#### **7) Distribution**

This section will address data ownership and data liability with the following excerpt from the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program in the metadata.

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 2012.

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](http://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.).

## **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:  $\pm 0.2$  °C @ 20°C

Serial Number: F1640093

Date of Calibration: 04/02/13

Dates of Sensor Use: 05/24/2013 – 07/30/2013

Serial Number: Y1040006

Date of Calibration: 06/14/14

Dates of Sensor Use: 07/30/2014 – current as of 12/31/2014

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: 04/02/13

Dates of Sensor Use: 05/24/2013 – current as of 12/31/2014

Serial Number: Y1040006

Date of Calibration: 06/14/14

Dates of Sensor Use: 07/30/2014 – current as of 12/31/2014

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:  $\pm 0.5$  mb @ 20°C;  $\pm 2$  mb @ 0°C to 40°C;  $\pm 4$  mb @ -20°C to 45°C;  $\pm 6$  mb @ -40°C to 60°C

Stability:  $\pm 0.1$  mb per year

Serial Number: S2230007

Date of Calibration: 04/10/2013  
Dates of Sensor Use: 05/24/2013 – current as of 12/31/2014

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:  $\pm 0.135$  m/s ( $\pm 0.3$  mph,  $\pm 0.26$  knots) or 3% of reading, whichever is greater;  $\pm 2^\circ$   
Serial Number: 01532  
Date of calibration: N/A (no calibration required) installed new on 07/15/02  
Date of Sensor Use: 07/15/2002 – current as of 12/31/2014

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:  $\pm 0.135$  m/s ( $\pm 0.3$  mph,  $\pm 0.26$  knots) or 3% of reading, whichever is greater;  $\pm 2^\circ$   
Serial Number: 01532  
Date of calibration: N/A (no recalibration required) installed new on 07/15/02  
Date of Sensor Use: 07/15/2002 – current as of 12/31/2014

Parameter: Photosynthetically Active Radiation  
Units: mmol m<sup>-2</sup> (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  $\mu$ A per 1000  $\mu$ mol s<sup>-1</sup> m<sup>-2</sup>  
Ex. Serial Number: Q43059  
Multiplier: 1.1626609  
Date of Calibration: 04/2/2013  
Dates of Sensor Use: 05/24/2013 – current as of 12/31/2014

Parameter: Precipitation (unheated)  
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;  $\pm 0, -3\%$  from 1 to 2 in./hr;  $\pm 0, -5\%$  from 2 to 3 in./hr  
Serial Number: 99-36  
Date of Calibration: 07/30/2014  
Date of Previous Calibration: 07/23/2013  
Dates of Sensor Use: 10/03/2009 – current as of 12/31/2014

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:** 06/28/06

**Date CR1000 Calibrated:** 06/28/06

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

**CR1000 Program Version(s):**

Nocrcmet\_V6.62\_062413.cr1

#### 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

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.

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 mmol/m<sup>2</sup> 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 1<sup>st</sup> and December 31<sup>st</sup> 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.**

## **PAR**

### **Nighttime PAR**

Elevated Night-time PAR values continue through the end of 2014. Affected data seems to correlate with periods of high Relative Humidity.

Night time (dark) limitations were defined from the end of astronomical twilight in the evening to the beginning of astronomical twilight in the morning.

Astronomical twilight is defined as the time when the center of the sun is between 12° and 18° below the horizon, [www.sunrisesunset.com](http://www.sunrisesunset.com) was used to determine sunrise and sunset times. Data were flagged and coded as follows:

<-3> [SSM] (CSM) Elevated nighttime values that were >10.0 that were not the result of low light at sunrise/sunset.

<1> (CSM) Elevated nighttime values that were >0.0 but may have reflected ambient environmental conditions such as scattered or reflected urban light sources.

### **Negative PAR**

<1> (CAF) Negative values >-2.2 that appeared to be accurate and within the acceptable sensor error.

## **Wind**

Anomalous Max wind data values 447 were rejected as well as all associated wind parameter values for the dates and times listed below.

01/28/2014 17:15 - 01/29/2014 16:30

02/11/2014 14:30 - 02/12/2014 16:45

04/06/2014 08:45

05/06/2014 06:45

05/18/2014 01:00

05/25/2014 19:45, 05/25/2014 20:00

06/15/2014 20:15

06/23/2014 18:45

07/03/2014 10:00

07/06/2014 17:00

07/09/2014 05:30

07/18/2014 08:30

07/23/2014 05:15

08/08/2014 06:45

08/24/2014 08:00

09/21/2014 14:15

## **Temperature/Relative Humidity**

Relative Humidity values between 101 and 103 are within acceptable range of calibration and flagged <1> (CAF). Values >103 were rejected and flagged <-3> [SQR] (CSM)

Air temperature and humidity data on 7/30/2014 13:15 are rejected due to maintenance to swap sensors.

**Precipitation**

Total Precipitation 7/30/2014 12:45 - 13:00 and through the end of the day for cumulative precipitation are flagged and coded as rejected due to maintenance for rain gauge calibration (-3 SMT CSM).

12/10/2014 12:30 precipitation bucket tipped during routine maintenance. Data rejected <-3> [SMT] (CSM) at 12:30 for total precipitation and from 12:30 through the end of the day for cumulative precipitation.