

North Carolina (NOC) NERR Meteorological Metadata
January 1st –December 31st, 2016.
Latest Update: February 12, 2018

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>.

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/m²), 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- every 2 years 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 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 2016 began on January 1 at 00:00 and ended December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/03/2015 13:45	02/29/2016 12:00
02/29/2016 13:15	04/13/2016 14:15
04/13/2016 14:30	04/28/2016 07:45
04/28/2016 08:00	06/22/2016 10:30
06/22/2016 10:45	08/09/2016 11:45
08/09/2016 12:00	10/18/2016 11:00
10/18/2016 11:15	11/17/2016 11:45
11/17/2016 12:00	12/15/2016 10:45
12/15/2016 11:00	01/17/2016 14:15

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 2016.

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.).

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: 05/16/2015

Dates of Sensor Use: 07/22/2015 – 02/29/2016

Serial Number: 23568M3

Date of Calibration: 01/18/16

Dates of Sensor Use: 02/29/2016 - current as of 12/31/2016

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: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Serial Number: F1640093

Date of Calibration: 05/16/2015

Dates of Sensor Use: 07/22/2015 – 02/29/2016

Serial Number: 23568M3

Date of Calibration: 01/18/16

Dates of Sensor Use: 02/29/2016 - current as of 12/31/2016

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: V4730001

Date of Calibration: 05/19/2015

Dates of Sensor Use: 07/22/2015 – current as of 12/31/2016

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; ±2°

Serial Number: 01532

Date of calibration: N/A (no calibration required) installed new on 07/15/02

Date of Sensor Use: 07/15/2002 – 02/29/2016

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 05/09/2017

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: <±2% change over 1 yr

Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%

Sensitivity: typically 5 µA per 1000 µmoles s⁻¹ m⁻²

Ex. Serial Number: Q43059

Multiplier: 1.1626609

Date of Calibration: 04/2/2013

Dates of Sensor Use: 05/24/2013 – 02/29/2016 Replaced by Apogee sensor

Parameter: Photosynthetically Active Radiation

Units: mmol m⁻² (total flux)

Sensor type: APOGEE Quantum Sensor

Model #: sq-100/200

Light spectrum waveband: 400 to 700 nm

Temperature dependence: 0.06 (±0.06%) per °C maximum

Stability: <±2% change over 1 yr

Operating Temperature: -40°C to 70°C; Humidity: 0 to 100%

Sensitivity: typically 0.2mV per 1000 µmoles s⁻¹ m⁻²

Multiplier: 0.025 (does not change for this sensor)

Ex. Serial Number: 18787

Date of Calibration: 06/01/2015

Dates of Sensor Use: 02/29/2016 – current as of 12/31/2016

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: +/- 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: 99-36

Date of Calibration: 11/17/16

Date of Previous Calibration: 07/22/15

Dates of Sensor Use: 10/03/2009 – current as of 05/09/17

The CR1000 has 4 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 – 02/13/2015,s/n:005200

Date CR1000 Calibrated: Factory calibration

Date CR1000 Installed: 02/13/2015 - 7/22/2015 SN#: 33409

Date CR1000 Calibrated: 06/02/2010

CR1000 Firmware Version (s): V19 uploaded at time of delivery 2013

Date CR1000 Installed: 07/22/2015 - current as of 12/31/2017,s/n:005200

Date CR1000 Calibrated: 05/26/2015

CR1000 Firmware Version (s): OS 28(installed during calibration)

CR1000 Program Version(s): Nocrmet_V6.62_12081515.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 (installed 01/01/2016 - 02/29/2016) 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 Power Down/Reprogram

02/29/2016 12:15 - 02/29/2016 13:00 Power down for station maintenance. PAR, RH/Temp and Wind sensor replaced. Wind sensor upgraded with Gill ultrasonic sensor. LiCor PAR sensor upgraded to APOGEE PAR sensor. Data during this time flagged <-2> [GMT] (CSM).

Following 15 min record rejected due to power down and program upload:
02/29/2016 13:15. Data are flagged as <-3>[GPR](CSM).

PAR

Nighttime PAR

Elevated Night-time PAR values collected with the LiCor sensor continue through February 29, 2016. 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. Data were flagged and coded as follows:

<-3> (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 but <10.0 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 signal noise of the LiCor PAR sensor.

Following PAR upgrade to APOGEE sensor on 02/29/2016 13:15 overall PAR values increased by an estimated 100mM·m⁻², or ~8%.

Small negative PAR values collected with the Apogee PAR sensor (installed 02/29/2016 - 12/31/2016) are flagged and coded as <1> (CSM).

Wind

Wind data malfunction begins 09/20/2015 04:45. All data flagged <-3> [SSM] (CSM) through 02/29/2016 12:00 when the sensor was replaced with a Gill Windsonic sensor.

Anomalous Max wind data values NAN were rejected as well as all associated discrete wind values. In addition to discrete occurrences this block of data were flagged this way: <-3> [SSM] (CSM)

03/02/2016 09:15
03/02/2016 09:30
03/03/2016 23:30
06/07/2016 08:30
06/07/2016 08:45
06/07/2016 09:00
07/06/2016 19:00
07/08/2016 05:30
07/09/2016 09:30
08/14/2016 23:15
10/18/2016 16:15
10/19/2016 15:15
10/20/2016 14:00
10/27/2016 11:15
10/27/2016 11:30

11/19/2016 11:00

11/25/2016 10:45

Temperature/Relative Humidity/Barometric Pressure

Relative Humidity values between 101 and 103 are within acceptable range of calibration and flagged <1> (CAF), unless otherwise coded as CSM (see below). Values >103 were rejected.

Following 7/22/15 sensor calibration swap, RH began recording anomalously high values >104 as well as reporting NAN. Affected data are rejected (<-3>[SSM](CSM) and remainder of data with this sensor is flagged suspect (<1> (CSM)). Affected data stands out from surrounding data but also seems to correspond to extremely high humidity at surrounding weather stations and unaffected data correspond to conditions reported by other surrounding stations as well. Affected RH data were rejected or flagged as suspect through 02/29/2016 12:00

Precipitation

Precipitation gauge was discovered to be partially blocked during station maintenance. Bucket was cleaned and in good working order. Data extending to the prior maintenance on 10/18/16 11:00 though the calibration on 11/17/2016 11:00 were flagged <1 > [SSM] (CSM)

Precipitation gauge was recalibrated on 11/17/16 11:15-11:30. Affected TotPrcp and CumPrcp data were rejected <-3> [GMT] (CSM). Cumulative precipitation values were rejected through 11/18/2016 00:00.

Significant Weather Event(data coded only as CWE)

Hurricane Matthew approached Coastal NC on 10/08/2016. Minimum BP was recorded on 10/08/2016 16:30 and 16:45 at 986mb, maximum wind speed recorded 10/08/2016 12:45 (12:40 MaxWSpdT) at 21.2 m/s.