

North Carolina (NOC) NERR Meteorological Metadata
January 1st –December 31st, 2015
Latest Update: February 1st, 2017

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/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

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 2015 began on January 1 at 00:15 and ended December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/10/2014 12:30	01/06/2015 10:30
01/06/2015 10:45	02/13/2015 15:15
04/02/2015 14:00	05/06/2015 10:30
05/06/2015 10:45	07/08/2015 14:00
07/08/2015 14:15	07/22/2015 12:30
07/22/2015 12:45	09/16/2015 10:30
09/16/2015 10:45	11/18/2015 11:45
11/18/2015 12:00	12/3/2015 13:30
12/3/2015 13:45	02/29/2016 12:00

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 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. 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: $\pm 0.2^\circ\text{C}$ @ 20°C

Serial Number: Y1040006

Date of Calibration: 06/14/14

Dates of Sensor Use: 07/30/2014- 07/22/2015

Serial Number: F1640093

Date of Calibration: 05/16/2015

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

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: Y1040006

Date of Calibration: 06/14/14

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

Serial Number: F1640093

Date of Calibration: 05/16/2015

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

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: S2230007

Date of Calibration: 04/10/2013

Dates of Sensor Use: 05/24/2013 – 07/22/2015

Serial Number: *V4730001*

Date of Calibration: 05/19/2015

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

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

Date of Sensor Use: 07/15/2002 – current as of 12/31/2015

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: N/A (no recalibration required) installed new on 07/15/02

Date of Sensor Use: 07/15/2002 – current as of 12/31/2015

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

Ex. Serial Number: Q43059

Multiplier: 1.1626609

Date of Calibration: 04/2/2013

Dates of Sensor Use: 05/24/2013 – current as of 12/31/2015

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: 07/22/2015

Date of Previous Calibration: 07/30/2014

Dates of Sensor Use: 10/03/2009 – current as of 12/31/2015

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, SN:005200

Date CR1000 Calibrated: Factory calibration

Date CR1000 Installed: 02/13/2015 - 07/22/2015, 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 12/31/2015, SN:005200

Date CR1000 Calibrated: 05/26/2015

CR1000 Firmware Version (s): OS 28

CR1000 Program Version(s): Nocrcmet_6.62_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
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 mmol/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. **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

02/13/2015 15:30 - 02/14/2015 05:15 – Station powered down and CR1000 (SN 005200) was replaced with unit within acceptable calibration period (SN 33409, calibrated within <5yrs). Data were not timestamped correctly until 02/14/2015 05:30. Only the correctly timestamped data was uploaded through the CDMO website for primary QAQC. The data file has been saved intact. Data from original .dat file matches surrounding data very well suggesting that it is accurate. Data flagged <-2> [GIM] (CSM).

07/22/15 12:30 - 07/23/2015 13:00 The CR1000 installed on 2/13/2015 (SN 33409) was replaced with a recently calibrated CR1000 (SN 005200). Data are missing from 12:45-13:15 due to the logger swap and are rejected at 13:30 since those values are not a full 15 minutes of 5-second data. During secondary QAQC it was discovered that two records exist for 07/22/2015 12:30. Data collected from the CR1000 (SN 33409) that was removed was used for the 12:30 timestamp; this was the last reading from that logger. Additionally, data were missing from 07/23/15 12:15 – 13:00. When the recently calibrated CR1000 was installed there appears to have been a timestamp shift. Data from primary QC file was corrected by shifting it forward by an hour to accommodate for this. The corrected timestamps coincide with sunrise/sunset in PAR and replace a gap in missing data (07/23/2015 12:15 - 13:00) that occurred due to the shift. Data from 7/22/2015 13:45 - 7/23/2015 13:00 are flagged as corrected, <5> CSM. Although available from the Reserve but not in the dataset since max and min air temperature do not go through QAQC, the max and min ATemp times were corrected. Maximum wind speed times from 7/22/2015 13:45 - 7/23/2015 13:00 were also corrected. Note that even though the data are not flagged as suspect, corrected data are inherently considered suspect.

PAR

Nighttime PAR

Elevated Night-time PAR values continue through the end of 2015. 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. <http://www.sunrisesunset.com/> was used to determine times for sunrise and sunset. 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 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.

<-3> [SNV] (CSM) Negative values <-2.2 are beyond the acceptable sensor error and were rejected

Wind

Anomalous Max wind data values 447 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)

02/24/2015 12:30 - 02/25/2015 10:00, 10:45-11:00

3/31/2015 17:15

4/16/2015 09:15

4/26/2015 15:15

5/14/2015 07:30

5/26/2015 11:15, 11:30

7/10/2015 08:00

7/13/2015 12:45, 16:45, 17:00

7/14/2015 10:45, 11:00, 14:15, 15:00, 15:45

7/15/2015 06:45

7/17/2015 05:30, 08:45, 12:30, 13:30, 14:00, 17:15

7/18/2015 05:30 - 06:00, 07:30

7/30/2015 12:00

8/21/2015 20:45

8/25/2015 09:15

Max wind speed was rejected on 7/17/2015 at 13:15 due to an anomalous high reading. All associated discrete wind values were also rejected.

Wind data malfunction begins 09/20/2015 04:45. All data flagged <-3> [SSM] (CSM) through the end of 2015. Sensor in need of replacement.

Temperature/Relative Humidity/Barometric Pressure

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) until the sensor began malfunctioning 7/22/2015 (see below)

Air temperature and relative humidity were rejected on 9/8/2015 at 12:15. Maximum and minimum air temperature readings recorded at the same time were around 10° different than adjacent readings.

The Air Temp, RH, and BP sensors were all swapped with more recently calibrated sensors on 7/22/2015 during maintenance to switch the CR1000.

Following 7/22/2015 swap to a more recently calibrated sensor, RH began recording anomalously high values >104 as well as reporting NAN. Affected data are rejected and remainder of data with this sensor is flagged suspect beginning 7/22/2015 13:45. 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. Data were flagged as suspect (<1> or <5>) or rejected through the end of 2015