

North Carolina (NOR) NERR Meteorological Metadata
January 1st –December 31st, 2013.
Latest Update: February 24, 2022

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 year inspection (depending on the sensor)
- Barometric Pressure- every 2 year recalibration
- PAR- every 2 year 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 2008 began on January 1 at 00:00 and ended December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/20/2012 12:45	01/17/2013 12:00
01/17/2013 12:15	02/21/2013 12:15
02/21/2013 12:30	04/11/2013 10:15
04/11/2013 10:30	05/24/2013 10:45
05/24/2013 12:00	06/26/2013 11:00
06/26/2013 11:30	07/23/2013 09:15
06/26/2013 11:30	09/24/2013 13:00
07/23/2013 09:30	10/24/2013 12:30
10/24/2013 12:45	11/20/2013 11:15
11/20/2013 11:30	12/11/2013 15:15
12/11/2013 15:30	01/23/2013 11:45

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: 04/02/13

Dates of Sensor Use: 05/24/2013 – 07/30/2014

Serial Number: E4530101

Date of Calibration: 05/09/2012

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: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Serial Number: F1640093
Date of Calibration: 04/02/13
Dates of Sensor Use: 05/24/2013 – 07/30/2014

Serial Number: E4530101
Date of Calibration: 05/09/2012
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-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: F0150065
Date of Calibration: 01/12/2010
Dates of Sensor Use: 02/28/2011 – 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; ±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 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; ±2°
Serial Number: 01532
Date of calibration: N/A (no recalibration required) installed new on 07/15/02
Date of Sensor Use: 07/15/2002 – 02/29/2016

Parameter: Photosynthetically Active Radiation
Units: mmols 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

Ex. Serial Number: Q43053
Multiplier: 1.127817365
Date of Calibration: 02/19/10
Dates of Sensor Use: 02/28/11 – 05/24/2013

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
Serial Number: 99-36
Date of Calibration: 07/23/2013
Date of Previous Calibration: 07/19/2012
Dates of Sensor Use: 10/03/2009– current as of 12/31/2013

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

Date CR1000 Calibrated: New when installed

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

CR1000 Program Version(s):

Nocrcmet_V6.62_062413.cr1

Nocrcmet_V6.25_052313.cr1

Nocrcmet_V6.25_030811.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
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 – Use this section for further documentation of the research data set. You must include information on any data that were marked with a CSM “See Metadata” comment code. You may include the NERRQAQC macro metadata sheets or any other information regarding significant weather events, maintenance activities, etc that may have affected the weather station and data collected. Include the following excerpts:

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.

General Power Down/Reprogram/Battery Voltage

NAN was recorded for batter volt values from 04/11/2013 10:45 – 18:15. Battery volts are not included in the data but are used for troubleshooting and QAQC. Parameters (AT, RH, BP) that also recorded NAN during this time are rejected, <-3>[SSN](CSM). Wind and precipitation data are coded as CSM since data appear to be accurate. PAR values are already rejected due to sensor malfunction.

NAN was recorded for battery volts on 04/12/2013 12:45. AT, RH, and BP all recorded NAN values at 12:45 through 13:00 for AT and BP and through 13:15 for RH. As with above, those data were rejected when NAN was recorded. All other parameters appear to be accurate and were coded with CSM at 12:45 and 13:00. PAR values are already rejected due to sensor malfunction.

04/16/2013 15:30 and 04/23/2013 15:00, 16:00 – 17:15 battery volts increased to >18volts. Anything over 16.0 volts is considered too high and may indicate a problem with the collection of the battery volt data. It is unknown as to whether a problem with the air temperature/relative humidity sensor caused an error that lead to the high battery voltage or if the battery problems caused sensor issues. AT, RH, and BP were rejected for NAN readings, while wind and precipitation data are coded as CSM since data appear to be accurate, even though battery voltage was >18.0. PAR values are already rejected due to sensor malfunction. Although battery volts did not exceed 16.0 at 15:00 on 04/23/2013, data not rejected were coded with CSM as this was when erroneous data (NANs) were first recorded before the battery spike and could indicate that the 15-minute battery average included higher values. PAR values are already rejected due to sensor malfunction.

Battery volts were not high on 04/17/2013 17:15, 04/26/2013 17:30, 04/26/2013 16:15, 04/30/2013 14:30, 15:00, 15:15, 16:00, 05/23/2013 16:15 - 16:30 but NANs were recorded for AT, RH, and BP. While the other parameters appear to not have been affected, they are coded with CSM to let users know that either the battery or a sensor problem was affecting data collection.

5/5/2013 16:15 – 17:30 NANs were recorded for AT, RH, BP, and PAR. Battery volts were less than 16.0, but had increased to >14.0. This could indicate that the 15-minute battery average included higher values. Those data with NAN reading were rejected. Wind and precipitation data are coded with CSM as they do not appear to be affected.

05/24/2013 11:00 - 05/24/2013 11:45 General Power down for sensor replacement and reprogram. Air temperature, relative humidity, barometric pressure, and PAR sensors were all replaced. Data not collected. Data following the power down and program upload were rejected for 05/24/2013 12:00.

06/26/2013 11:15 -11:30 All data are missing/rejected due to program upload to update PAR programming. See below for more specifics.

PAR

Continuing from 2009, PAR sensor malfunction led to rejected data from 01/01/2013 00: – 05/24/2013 10:45. Data flagged <-3> [SSM][CSM].

PAR sensor returned to the MET station truss following a temporary move to an independent wooden post since 09/15/2011. This was an attempt to 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 sensor returned to original location on MET station on 05-24-13 10:55.

05/24/2013 12:15 - 06/26/2013 11:00 Following the installation of a recently calibrated sensor on 5/23/13, values better reflected expected PAR data, but were

still flagged as suspect, <1>[SSM](CSM) with negative values <-2.2> rejected as <-3>[SSM](CSM). Elevated night values continued to be common as well as repeated values at regular PAR intervals (example = 184.1). The Campbell program was updated (NOCRCMET-V6.62_062413.CR1) on 06/26/13 11:30. Changes made specific to PAR data were decreasing PAR mV from 2500 to 25mV. This appears to have reduced repeating values but elevated night values continue to occur. Following the programming change, all PAR data are coded as suspect, <0> (CSM) until the end of the year, unless otherwise flagged and coded for nighttime or negative values. Negative values <-2.2 were rejected, <-3>[SSM](CSM).

Elevated nighttime PAR

Elevated Night-time PAR values continue through the end of 2013. 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> [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 >2.2 but may have reflected ambient environmental conditions such as scattered or reflected urban light sources.

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

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

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).

Temperature/Relative Humidity/Barometric Pressure

Recurring and often simultaneous values of NAN were reported for Temperature, Barometric Pressure, and Relative humidity. There were also many repeated and contiguous values of -40°C recorded for Temperature. Data for MinTemp were often similarly low at the same times. This pattern did not continue following the installation of newly calibrated equipment on 05/24/2013. Data rejected and flagged <-3> [SSM] (CSM) or [SSN](CSM), using the air temperature, MinTemp, and NANs as a guide for rejecting affected data. Max and Min Temperature and RH(temperature dependent) data were also affected. Note that MaxTemp and MinTemp data are not available in the data set but are used by the reserve during QAQC. Several other very low values were recorded under similar circumstances and were rejected and flagged and coded similarly. All affected data stood out as obvious and confidence is high that flagged data are accurate and reflect conditions.

BP data were rejected when NANs were recorded. It is unknown whether the NAN BP values are related to the battery voltage problems mentioned above and/or to the NAN issues with the AT/RH sensor.

This occurrence stopped following the installation of newly calibrated equipment on 05/24/2013.

In addition to the above flagging and coding, RH data were also rejected from 04/14/2013 08:00 – 05/24/2013 10:45, due to a malfunctioning sensor. RH values suddenly dropped from 100 to 90 and kept dropping and overall remained low until the sensor was swapped on 05/24/2013.

Precipitation

The rain gauge was calibrated on 07/23/2013 at 09:30. Data were corrected at 09:30 for total precipitation and through the end of the day for cumulative precipitation by subtracting 1.8 from the total. No actual precipitation was recorded for the day.