

North Carolina (NOC) National Estuarine Research Reserve
Research Creek Meteorological Metadata
January 1 – Dec 31, 2010
Latest Update September 9, 2015

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact

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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. All data and QAQC is performed by Byron Toothman and Heather Wells.

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 Research Creek station on 06/15/97 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) 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- annual recalibration
- Rain Gauge- annual recalibration
- Wind Speed/Direction- annual or every two years inspection (depending on the sensor)
- Barometric Pressure- every two years recalibration
- PAR- every two years recalibration
- CR1000-every 5 years (required beginning 2014, one year initial grace period)

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° 9.328'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 Li-COR 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 2010 began on January 1 at 00:00 and ended December 31 at 23:45.

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:

National Estuarine Research Reserve System (NERRS). 2012. System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: 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: unknown

Date of Last Calibration: 5/26/2009

Dates Installed: 8/25/2009-11/30/2009

Serial Number: unknown (on loan from Campbell Scientific)

Date of Last Calibration: 5/26/2009

Dates Installed: 11/30/2009 - 1/27/2010

Serial Number: unknown

Date of Last calibration: 10/06/2009

Dates Installed: 1/28/2010-2/28/2011

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:

Date of Last Calibration: 5/26/2009

Dates Installed: 8/25/2009-11/30/2009

Serial Number: unknown (on loan from Campbell Scientific)

Date of Last Calibration: 5/26/2009

Dates Installed: 11/30/2009 - 1/27/2010

Serial Number:

Date of Last calibration: 10/06/2009

Dates Installed: 1/28/2010-2/28/2011

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: unknown
 Date of Last calibration: 04/13/2006
 Dates Installed: 06/05/2008 - 02/28/2011

Parameter: Wind speed
 Units: meter per second (m/s)
 Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene
 Model #: R.M. Young 05103 Wind Monitor
 Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)
 Accuracy: ± 0.3 m/s
 Date of last calibration: N/A (no calibration required) installed new on 07/15/02

Parameter: Wind direction
 Units: degrees
 Sensor type: balanced vane, 38 cm turning radius
 Model #: R.M. Young 05103 Wind Monitor
 Range: 360° mechanical, 355° electrical (5° open)
 Accuracy: ± 3 degrees
 Date of last calibration: N/A (no calibration required) installed new on 07/15/02

Parameter: Photosynthetically Active Radiation (PAR)
 LI-COR Quantum Sensor
 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: $\leq \pm 2\%$ 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

Serial Number	Calibrated	Installed	Multiplier
Q99265	8/22/2007	11/30/09 - 3/4/10	1.25616778
Q22957	02/10/10	03/04/10 - 6/18/10	1.73546031
Q43059	02/19/10	06/18/10 - 2/28/11	1.093546327

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: $\pm 1.0\%$ up to 1 in./hr; $\pm 0.3\%$ from 1 to 2 in./hr; $\pm 0.5\%$ from 2 to 3 in./hr
 Date of Last calibration: 10/03/09

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

10) Coded variable definitions - List the sampling station, sampling site code, and station code used in the data.

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 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
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 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. **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

MET station powered down temporarily for maintenance on several occasions. Following power up, the subsequent 15 data block was rejected. Power down dates are as follows:

01/28/2010 12:30 - 01/28/2010 13:15

03/04/2010 11:15 - 03/04/2010 11:45, 12:00 data were rejected due to program upload.

06/18/2010 12:30 - 06/18/2010 12:45, 13:00 data were rejected due to program upload.

Data missing 04/22/2010 12:00 - 05/03/2010 11:15 due to CR1000 malfunction during firmware upgrade. Data collection restored following second successful upgrade attempt on 05/03/2011. 15 min data at 11:30, following a program upload was rejected.

Record Precipitation

The remnants of Tropical Storm Nicole and another low pressure system dropped excessive rainfall in the Wilmington area at the end of September, 2010. Data from 9/27/2010 01:30-10/01/2010 00:00 were code as {CWE} in the F_Record column. Record 2 and 3 day rainfall occurred along the East Coast between Monday 9/27/10 and Friday 10/1/10 breaking records previously set in the area by Hurricane Floyd. Over 10 inches of rain was reported in the Wilmington area on September 27, 2010. Approximately 2 inches fell on September 28, and an additional 7 inches on September 29, 2010. Precipitation data are coded as CRE from 9/27/2010 01:30 through 9/30/2010 17:15 for total precipitation and through 10/1/2010 00:00 for cumulative precipitation.

ATemp/RH

1/1/2010 00:00 - 1/28/2010 12:15 A loaner ATemp/RH sensor from Campbell Scientific was installed. The loaner sensor was in place until 1/28/2010. The data collected with the loaner sensor are coded as CSM.

Wind

Throughout 2010 Max wind data values of 447 were rejected as well as all other wind parameters (wind speed, wind direction, and standard deviation wind direction). These data are flagged and coded as <-3> SSM CSM.

Precip

11/29/2010 16:00 During station maintenance the rain gauge bucket was accidentally tipped. TotPrp read 0.3 and data was corrected to 0.0 and flagged <5> [SMT] (CSM). All affected Cumulative Precipitation was also corrected and flagged accordingly. 11/29/2010 16:00 - 11/30/2010 00:00. There was no actual or potential for precipitation at this time.

PAR

PAR sensor data continued to be problematic since malfunctions began to occur in 2009. These malfunctions include elevated baseline data, elevated nighttime data, negative nighttime data, and repeating values. Troubleshooting of PAR sensor was ongoing through 2010. A loaner CDMO CR1000 was briefly installed on 1/28/2010 from 12:30 - 13:15 to see if the NOC CR1000 was the cause of the problems, however, the loaner CR1000 did not affect the PAR data. The PAR sensor was swapped on 3/4/2010 and 6/18/2010, but the issues were never

completely resolved. On 03/04/10 – CR1000 program was altered to include the PAR multiplier directly into the measurement code. Measurements began to fall within expected values. However, nighttime values were still elevated slightly (<10) with frequent occurrence of negative values and accompanied by an unstable baseline. Data are not likely to be accurate during this time period, because of these issues, all PAR data were rejected 1/1/2010 00:00 - 06/18/2010 12:15. While rejected for questionable precision, data may still be useful approximate values for the purposes trend analysis.

PAR sensors on the NOC NERR weather station show frequent strings of repeating values. It has been determined that this was caused by the programming of the CR1000 data logger.

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. After the sensor swap on 6/18/2010, all valid PAR values have been flagged <0> (CSM) to draw attention to this issue. Elevated nighttime PAR data occurred during 2010. Values >0 between sunset and sunrise were flagged and coded as either suspect <1> CSM or as rejected <-3> SSM CSM. Nighttime data <10 were flagged and coded as <1> CSM while elevated nighttime data >10 were flagged as rejected <-3> SSM CSM. <http://www.sunrisesunset.com/> was used to determine sunrise and sunset times. It is believed that elevated nighttime readings are caused by moisture intrusion into the sensor.