North Carolina (NOC) National Estuarine Research Reserve
Research Creek Meteorological Metadata Report
1st and 2nd Quarter January 2008 – July 7th, 2008
3rd Quarter July 7th, 2008 – October 3rd, 2008
4th Quarter October 3rd, 2008 –December 31st, 2008
Latest Update: August 30, 2012

I. Data Set and Research Descriptors

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2. Entry verification

Data are uploaded from the CR1000 data logger to a Personal Computer and/or Compact Flash memory card (IBM compatible). Files are exported from 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 Version 2.01242009. The macro inserts station codes, creates metadata worksheets for flagged data, 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. Anomalous data are investigated and noted below in Section 13 Other Remarks/Notes. For more information on QAQC flags and QAQC

codes, see Sections 11 and 12. The most common reported errors/anomalies in 2008 are slightly negative night time PAR values and relative humidity values over 100%. All flags are double checked with other data that could support such "anomalous" weather changes and were noted in the sections that follow. 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 06-15-1997 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), Wind Direction Standard Deviation (degrees) (NOC NERR began collecting as a standard parameter on 9/30/2008) , Battery Voltage (volts)

Maximum, Minimum, and their times from 5-second data (these data are not available in the dataset, but are available from NOC NERR)**:**

Air Temperature (°C)

Maximum and times from 5-second data:

Wind Speed, (m/s) (NOC NERR began collecting as a standard parameter on 5/6/2008)

Totals:

Precipitation (mm), PAR (millimoles/m^2), and Cumulative Precipitation (mm) (NOC NERR began collecting as a standard parameter on 5/6/2008)

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.

The weather station and sensors are inspected monthly for cleaning and/or repair. Sensors are replaced and/or calibrated according to the manufacturer's guidelines (annually or biannually).

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.

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.

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 and calibration dates

Parameter: Precipitation
Units: millimeters (mm)
Sensor Type: Ecoharmony tipping bucket rain gauge
Model # TB4
Range: 0 to 600 mm/hr
Accuracy: 0.01 inches per bucket tip; +/- 3% for intensities from 25-600 mm/hr
Date of last calibration: 06/05/08

Parameter: Temperature
Units: Celsius
Sensor Type: Platinum resistance temperature detector (PRT)
Model #: HMP45C
Range: -40°C to 60°C
Accuracy: +/- 0.2°C @ 20°C
Date of last calibration: 04/19/06 (installed on 06/28/06)

Parameter: Relative Humidity
Units: Percent
Sensor Type: Vaisala HUMICAP© 180 capacitive relative humidity sensor
Model # HMP45C
Range: 0 to 100% non-condensing
Accuracy: 20°C +/- 2% RH (0 - 90% RH), +/- 3% RH (90 - 100% RH)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Date of last calibration: 07/26/2007 (installed on 06/05/08)

Parameter: LI-COR Quantum Sensor
Units: mmoles m-2 (total flux)
Sensor type: High stability silicon photovoltaic detector (blue enhanced)
Model #: LI190SZ
Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.15% per °C maximum
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%
Range: 1% up to 10,000 µmoles s-1m-2, 400-700 nm
Accuracy: 5 µA per 1000 µmoles s-1m-2, with a stability of <± 2% change per year
Date of last calibration:

Calibrated	Installed	Multiplier
08/22/07	06/05/08	1.25616778
06/02/09	08/05/09	1.27356087
11/30/09	08/22/07	1.25616778

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

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barometric Pressure

Model #: PTB101B
Range: 600 to 1060 mb
Accuracy: +/- 0.45 mb
Date of last calibration: 04/13/06 (installed on 06/05/08)

Storage Module
Model#: SM192
Storage capacity: 192,896 bytes
Operating range: Temperature: -35ºC to +65ºC
Processor: Hitachi 6303
Baud rates: 300, 1200, 9600, 76800
Memory type: user selectable for either ring style (default) or fill and drop.
Power requirements: 5 +/-0.4 VDC @ 100mA

Storage Module
Model#: SM4M
Storage capacity: 2 million low-resolution data values
Program storage: stores up to 8 programs with a total capacity of 128 KB
Processor: Hitachi H8S
Operating System: 64 KB, flash memory based, user downloadable
Operating range: Temperature: -35ºC to +65ºC
Baud rates: 9600, 76800
Memory type: user selectable for either ring style (default) or fill and drop.
Power requirements: 5 +/-0.3 VDC @ 100mA

The CR1000 has two MB 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) is 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: 6/28/2006

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 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.

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

SIC	Incorrect Calibration Constant, Multiplier or Offset
SNV	Negative Value
SSN	Not a Number / Unknown Value
SOC	Out of Calibration
SSM	Sensor Malfunction
SSR	Sensor Removed

Comments

CAF Acceptable Calibration/Accuracy Error of Sensor
CDF Data Appear to Fit Conditions
CRE Significant Rain Event
CSM See Metadata
CVT Possible Vandalism/Tampering

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%.

Cumulative precipitation data are recorded from 00:00 to 23:59 with the daily total recorded at the midnight mark (00:00). The midnight CumPrcp value is actually the total from the previous day.

All Reserves were required to align their wind direction sensors to True North by April, 1 2008. NOC NERR aligned the wind sensor to True North on 09/27/2007.

All Data for 2008 was downloaded directly to a portable laptop computer and then uploaded to the CDMO website for 1º QAQC.

MET 2008 maintenance was performed at the following times:

Date	Time	Operation
2/20/2008	11:50-12:00	download
3/12/2008	10:05-10:10	download
4/24/2008	14:55-15:05	download
5/6/2008	1023-10:30	download
	10:35	installed new program
6/5/2008	8:45-8:55	download
		Powered Down, Swapped Licor, BP, RH
	9:00	sensors
	9:35-9:45	recalibrated rain guage
	9:30	repowered
7/9/2008	10:35-10:57	download
8/7/2008	13:45-13:55	download

9/3/2008	12:46-12:56	download
10/3/2008	11:51-11:59	download
11/20/2008	15:16-15:28	download
12/18/2008	13:17-13:28	download
1/27/2009	10:45	download

Data missing due to power down or program installations:

05/06/2008 10:30	New program installed
06/05/2008 09:00	Power down
06/05/2008 09:15	Power down

Data from 01/01/08 at 00:00 to 05/06/08 at 10:30 for Cumulative Precip (CumPrcp) and Maximum Wind (MaxWSpd) and 01/01/08 at 00:00 to 09/30/08 23:45 for Standard Deviation of Wind Direction (SDWDir) were flagged with the open <-1> flag. The first part of the year we weren't ingesting the extra parameters so the data wasn't going through the CDMO's primary QAQC process.

06/05/2008 09:45 Total precipitation and 06/05/2008 09:45-06/06/2008 00:00 cumulative precipitation corrected to 0.0. Reading due to rain gauge calibration.

Wind speed flagged as rejected. It was an inexplicably high reading that coincided with a sensor error for Max Wind speed for the following dates and times. Values for Maximum Wind speed were periodically recorded as 447. These data along with wind speed data were rejected and coded as SSM.

1/24/2008 15:45
02/18/2008 14:30
03/18/2008 19:30, 19:45
04/04/2008 07:15
04/06/2008 08:30
04/21/2008 16:30
04/28/2008 15:30
05/04/2008 16:00
05/05/2008 14:00
05/06/2008 09:00, 09:15, 13:00
05/07/2008 10:30
05/08/2008 15:30
05/24/2008 07:00, 07:45
05/26/2008 18:00
06/06/2008 17:15
06/08/2008 06:45
06/09/2008 05:15, 18:00
06/13/2008 06:15, 16:45
06/16/2008 16:00, 17:15
06/18/2008 17:00
06/19/2008 08:00

06/21/2008 05:45, 06:00
06/24/2008 13:00
06/25/2008 07:45, 11:00
07/21/2008 16:45
07/26/2008 14:30
07/29/2008 19:00
08/15/2008 17:15
08/26/2008 15:00
09/04/2008 12:15
09/06/2008 00:30, 00:45, 01:30
09/11/2008 09:00
10/14/2008 08:45
11/05/2008 12:30

Throughout 2008 both elevated nighttime and negative PAR values were recorded. The reason for the elevated readings is unknown. Several Reserves are looking into the possibility of moisture intrusion into PAR sensors. Due to its location, the NOC MET station may be measuring light from scattered or reflected urban light sources. 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:
<0> (CSM) Data that have passed initial QAQC checks. These data may also include slightly elevated PAR values that are 2.2 or lower.
<-3> [SSM] (CCU) Elevated nighttime values that were >10.0 that were not the result of low light at sunrise/sunset.
<1> (CDF) 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> [SNV] (CSM) Negative values <-2.2 are beyond the acceptable sensor error and were rejected.