**Chesapeake Bay Maryland** (CBM) **NERR Meteorological Metadata**

**January 2012 – December 2012**

**Latest Update:** April 11, 2013

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO ([cdmosupport@belle.baruch.sc.edu](mailto:cdmosupport@belle.baruch.sc.edu)) or Reserve with any additional questions.

**I. Data Set and Research Descriptors**

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**2) Entry verification**

The meteorological information is sampled every 5 seconds from each instrument on the weather station and stored on a Campbell Scientific CR1000 data logger. 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. Processing, data verification, and data upload to the CDMO server was performed by Lauren Cunningham.

**3) Research objectives**

The principal objectives are to record meteorological information for the Chesapeake Bay National Estuarine Research Reserve in Maryland in support of the National Estuarine Research Reserve’s (NERR) System Wide Monitoring Program (SWMP). This information is available for the following: 1) to track and record atmospheric and meteorological conditions useful to help understand and explain additional data collected concurrently, 2) to create a database capable of detecting long-term changes in weather patterns, and 3) to record and identify the impact of storms, hurricanes, heavy rain and other episodic weather events capable of influencing other environmental conditions such as water quality (as monitored by the SWMP effort) and to collect ancillary data in support of other research efforts.

**4) Research methods**

Campbell Scientific data telemetry equipment was installed at the Chesapeake Bay Maryland NERR Jug Bay station August 2000 and transmits data to the NOAA GOES satellite, NESDIS ID #3B0071EA. 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](http://cdmo.baruch.sc.edu/).

The Campbell Scientific weather station samples every 5 seconds continuously throughout the year. Data are used by the CR1000 to produce 15 minutes averages, maximums, and minimums. Data are manually downloaded on site, or is telemetered via cellular technology to a desktop PC at the MD DNR Annapolis Field Office. Typically, data are transferred or uploaded once monthly throughout the year. All collected data are quality checked after the monthly downloads using EQWin and EQWinFormat macro. The reports, graphs and queries of meteorological data are reviewed and any errors or anomalous data are further investigated and the data are corrected, deleted (if necessary), or commented on and left unchanged.

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)

A minimum of monthly maintenance is conducted on the sensors, probes, and weather station in accordance with NERR guidelines. At this time, sensors on the weather station are inspected for damage, debris, and or/fouling and cleaned as needed. Monthly maintenance log sheets are also completed and sensors are checked with a handheld Kestrel 4000 or a local National Weather Station to ensure comparative readings. Additional checks are often done bi-weekly specifically to check the rain gauge for fouling. The rain gauge frequently tends to collect debris and is, therefore, checked as often as possible, with suggested checks prior to onset of storm events. Simultaneous rain data are also recorded by the Jug Bay Wetlands Sanctuary daily, providing supplemental rain data. Old sensors are sent back to Campbell Scientific for calibration and are rotated every year or two years to maintain current calibration requirements.

**5) Site location and character**

The Chesapeake Bay National Estuarine Research Reserve in Maryland consists of three components; Otter Point Creek on the Bush River along the upper western shore of the Chesapeake Bay, Jug Bay along the Patuxent River in the middle Bay, and Monie Bay on the lower eastern shore of the Chesapeake Bay. The weather station is located at the Jug Bay Component of the Reserve, specifically at the Jug Bay Wetlands Sanctuary. The station is situated on the north end of the Jug Bay marsh, along a tidal creek that feeds the Patuxent River. The weather station is situated at 38 deg 46’ 50.6” N and 76 deg 42’29.1” W. The station is housed in a small bird blind situated at the end of a boardwalk in the Jug Bay marsh. The boardwalk extends about 50m from an elevated old railroad track out into the marsh. The CR1000 and BP sensor are in a weatherproof box situated on the inside of the building, while the other probes are fixed to the roof or side of the building so as not to be impacted by the structure. The probes are approximately 5m above mean water and are not shaded. The wind speed and direction sensor and PAR sensors are mounted directly to the roof of the blind. The temperature/relative humidity sensor is mounted directly below those sensors on the side of the building. The tipping rain gauge is mounted on the boardwalk railing, a few meters from the other sensors.

Sensor heights from the marsh surface (meters):

Temperature/humidity: 3.9

PAR: 5.2

Wind speed/direction: 5.4

Rain bucket: 3.9

BP: 3.4

Wind speed may be slightly altered at the site due to proximity of the historic railroad bridge that splits the marsh. The old railroad bridge is on an elevated berm that sits about 2-2.5m above mean water. The berm runs east to west and the boardwalk that houses the weather station runs perpendicular to the berm in the north/south direction. From 1995-2002, the weather station was also the site of a YSI datalogger that recorded water quality at the site. Due to problems with the shallow nature of the site, the water quality component was moved in 2003, approximately 500m westward, from the tidal creek to the mainstem of the Patuxent River.

**6) Data collection period**

Meteorological data have been collected at the Chesapeake Bay Maryland NERR Jug Bay site since August 2000. The current weather station has been operational since this time. Data was collected at CBMJB during 2012 from 01/01/2012 at 00:00:00 through 12/31/2012 at 23:45:00.

Start and end date and times of 2012 raw data files submitted to the CDMO:

CBMJBMET010112.csv : 01/01/2012 00:00:00 – 01/31/2012 23:45:00

CBMJBMET020112.csv : 02/01/2012 00:00:00 – 02/28/2012 23:45:00

CBMJBMET030112.csv : 03/01/2012 00:00:00 – 03/31/2012 23:45:00

CBMJBMET040112.csv : 04/01/2012 00:00:00 – 04/30/2012 23:45:00

CBMJBMET050112.csv : 05/01/2012 00:00:00 – 05/31/2012 23:45:00

CBMJBMET060112.csv : 06/01/2012 00:00:00 – 06/30/2012 23:45:00

CBMJBMET070112.csv : 07/01/2012 00:00:00 – 07/31/2012 23:45:00

CBMJBMET080112.csv : 08/01/2012 00:00:00 – 08/31/2012 23:45:00

CBMJBMET090112.csv : 09/01/2012 00:00:00 – 09/30/2012 23:45:00

CBMJBMET100112.csv : 10/01/2012 00:00:00 – 10/31/2012 23:45:00

CBMJBMET110112.csv : 11/01/2012 00:00:00 – 11/30/2012 23:45:00

CBMJBMET120112.csv : 12/01/2012 00:00:00 – 12/31/2012 23:45:00

**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/](http://cfcdmo.baruch.sc.edu/). Data are available in comma separated format.

**8) Associated researchers and projects**

Meteorological data are most commonly used in support of the System Wide Monitoring Program (SWMP) and to help explain the relationships between water quality, nutrients, and meteorological conditions. Three of the four Chesapeake Bay Maryland SWMP water quality sites are located at the Jug Bay component of the Reserve and, therefore, the collection of meteorological data provides additional information helpful for analyzing and detecting trends in water quality and nutrient data that are collected by the Reserve.

Additional research and data that is available at the Jug Bay component of the Reserve is sediment erosion data and water quality data collected by Jug Bay Wetlands Sanctuary staff. Various sediment erosion tables (SET) are installed and monitored at the site annually to track changes in sedimentation levels. can be obtained through the Research Coordinator.

A second weather station was installed at the Otter Point Creek component of the Reserve, as well as a vented tide gauge in 2004. Both the Jug Bay and Otter Point Creek meteorological stations have been telemetered since 2005.

**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

Date of Last calibration: 03/15/2011

Date Installed: 11/15/2011

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: +/- 2% RH (0-90%) and +/- 3% (90-100%)

Temperature dependence of RH measurement: +/- 0.05% RH/°C

Date of Last calibration: 03/15/2011

Date Installed: 11/15/2011

Parameter: Barometric Sensor

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

Date of Last calibration: 03/28/2011

Date Installed: 11/15/2011

Parameter: Wind speed

Units: meter per second (m/s)

Sensor type: 12 cm diameter cup wheel assembly, three 40 mm diameter hemispherical cups

Model #: R.M. Young 03001-L Wind Monitor

Range: 0-50 m/s (112 mph); gust survival 60 m/s (134 mph)

Accuracy: +/- 0.5 m/s

Date of last calibration: 03/21/2011

Date Installed: 11/15/2011

Parameter: Wind direction

Units: degrees

Sensor type: balanced vane, 16 cm turning radius

Model #: R.M. Young 03001-L Wind Monitor

Range: 360° mechanical, 355° electrical (5° open)

Accuracy: +/- 5 degrees

Date of last calibration: 03/21/2011

Date Installed: 11/15/2011

Parameter: LI-COR Quantum Sensor

Units: mmoles 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

Multiplier: 1.380

Date of last calibration: 03/25/2011

Date Installed: 11/15/2011

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

Date of Last calibration:

Sensor installed 10/31/2006 to 05/16/2012: 05/05/2005

Sensor installed 05/16/2012 to present: 02/02/2012

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: 10/31/2006

**10) Coded variable definitions**

Sampling station: Sampling site code: Station code:

Jug Bay JB cbmjbmet

**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

SQR Data rejected due to QAQC checks

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

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%

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 total and cumulative precipitation data from 01/01/2012 – 05/16/2012 are marked as suspect as the sensor was out of calibration for more than one year after the calibration due date in relation to its initial install date of 10/31/2006.

Total precipitation data for the following dates and times were corrected in the data. The associated cumulative precipitation data were also corrected but are not listed. Field personnel were performing monthly maintenance on the rain gauge at these times. Personnel had to unclog the funnel as documented in the field logs; therefore, the values generated were erroneous.

02/09/2012 10:15 0.254mm corrected to 0mm

07/17/2012 08:30 0.254mm corrected to 0mm

Field personnel replaced the rain gauge with a newly calibrated gauge on 05/16/2012. False tips were recorded at this time. Total precipitation data for the following date and time as a result of these false tips were corrected in the data. The associated cumulative precipitation data were also corrected but are not listed.

05/16/2012 13:15 30.988mm corrected to 0mm

Research technicians discovered that the rain gauge installed on 05/16/2012 was not recording any precipitation data upon analyzing retrieved monthly data and comparing to local national weather stations. Field personnel attempted to fix and believed to have fixed the rain gauge on 06/05/2012 and recorded false tips. Total precipitation data for the following date and time as a result of these false tips were corrected in the data. The associated cumulative precipitation data were also corrected but are not listed.

06/05/2012 09:30 6.096mm corrected to 0mm

Research technicians discovered that the attempted fix performed on 06/05/2012 on the rain gauge installed on 05/16/2012 was not successful and that the rain gauge was not recording any precipitation data upon analyzing retrieved monthly data and comparing to local national weather stations. Field personnel determined that a quick-connect that was installed between the wiring coming from the telemetry box and the wiring attached to the newly calibrated rain gauge was causing resistance and not allowing low strength tip signals coming from the rain gauge to reach the CR1000. Personnel fixed the wiring problem on 06/22/2012. False tips were recorded during maintenance. Total precipitation data for the following date and times as a result of these false tips were corrected in the data. The associated cumulative precipitation data were also corrected but are not listed.

06/22/2012 06:15 0.508mm corrected to 0mm

06/22/2012 07:00 0.508mm corrected to 0mm

06/22/2012 07:15 25.654mm corrected to 0mm

06/22/2012 07:30 24.13mm corrected to 0mm

All total and cumulative precipitation data between 05/16/2012 at 13:15 when the newly calibrated rain gauge was installed and 06/22/2012 at 07:30 when the wiring issue was resolved are suspect as possible rain events were not recorded.

Field personnel discovered that the metal mesh screen that covers the rain gauge was missing upon inspection on 07/03/2012 at 07:45. The funnel was clogged but no water was present in the funnel. Due to the absence of water in the funnel, it is not believed that the lack of a screen affected the rain gauge and it is believed that all rain events that occurred between the previous visit to the weather station on 06/05/2012 and the visit on 07/03/2012 were captured and correctly recorded, including the Mid-Atlantic derecho that passed through the area between 06/29/2012 and 06/30/21012. All subsequent inspections of the rain gauge, occurring on 07/17/2012 and 08/01/2012, until the screen was replaced on 08/15/2012 at 07:45, showed that the rain gauge was not clogged and was free of debris. Therefore, it is not believed that the lack of the screen affected the readings acquired by the rain gauge within that time period.

The total precipitation data for 07/30/2012 at 07:45 when it was discovered that the screen was missing was marked as passing QAQC checks (Flag <0> CSM).

Hurricane Sandy passed through the area beginning on 10/28/2012, with effects lasting until 10/30/2012. It is believed that, during this hurricane, the metal mesh screen that covers the rain gauge was blown away. It was not discovered until the monthly inspection on 12/13/2012 as it happened after the October monthly visit on 10/16/2012 and technicians were unable to access the rain gauge during the November monthly visit due to slippery conditions. Several rain events were captured between 10/30/2012 (after Hurricane Sandy) and 12/13/2012, and no debris or collected water was present in the rain funnel or tipping buckets at the inspection on 12/13/2012. Therefore, it is not believed that the lack of screen affected the readings acquired by the rain gauge within that time period.

Ancillary MET Data Source:

<http://www.wunderground.com> (Either Queenswood or Rolling Acres stations)