

Chesapeake Bay Maryland (CBM) NERR Meteorological Metadata
January 2012 – December 2012
Latest Update: August 5, 2015

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>.

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 the CDMO Excel macro. The metadata worksheets, graphs and stats worksheet of meteorological data are reviewed and any errors or anomalous data are further investigated and the data are corrected, flagged as rejected (if necessary), flagged as suspect, 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.

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)

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' 50.76" N and 76 deg 42'29.52" 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 – 02/29/2012 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 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 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

Serial Number: Z4020126

Date of Calibration: 03/15/2011

Dates of Sensor Use: 11/15/2011 - current as of 12/31/2012

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: Z4020126

Date of Calibration: 03/15/2011

Dates of Sensor Use: 11/15/2011 -current as of 12/31/2012

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: P5050004

Date of Calibration: 03/28/2011

Dates of Sensor Use: 11/15/2011- current as of 12/31/2012

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
Serial Number: 05001-5RM
Date of Calibration: 03/21/2011
Dates of Sensor Use: 11/15/2011 - current as of 12/31/2012

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
Serial Number: 05001-5RM
Date of Calibration: 03/21/2011
Dates of Sensor Use: 11/15/2011 - current as of 12/31/2012

Parameter: Photosynthetically Active Radiation
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: <±2% change over 1 yr
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%
Sensitivity: typically 5 µA per 1000 µmol s⁻¹ m⁻²
Serial Number: Q22439
Multiplier: 1.380
Date of Calibration: 03/25/2011
Dates of Sensor Use: 11/15/2011 - current as of 12/31/2012

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	cbmjbmnet

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
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.**

Occasional elevated nighttime PAR values were recorded during 2012. While an exact cause of these readings is unknown, it is believed that moisture intrusion into the sensor may be causing these elevated values. Nighttime PAR values over 0 were flagged and coded as <1> CSM. <http://www.sunrisesunset.com/> was used to determine the times for sunrise and sunset.

All total and cumulative precipitation data from 01/01/2012 00:00 – 05/16/2012 12:30 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

05/07/2012 10:00 0.254mm corrected to 0mm

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

10/01/2012 08:45 0.508mm corrected to 0mm

All wind parameters were rejected on 5/07/2012 10:00. The wind sensor was temporarily blocked during maintenance.

PAR data are flagged as suspect on 5/12/2012 at 09:00, 5/21/2012 at 11:00, 5/29/2012 11:30, and 6/09/2012 10:15 as the values were much lower than that the previous and next 15 minute readings.

Field personnel replaced the rain gauge with a newly calibrated gauge on 05/16/2012. False tips were recorded at this time, 12:45 - 13:15. 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 12:45 0.762mm corrected to 0mm

05/16/2012 13:00 3.81mm corrected to 0mm

05/16/2012 13:15 35.56mm 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

The PAR sensor was wiped clean during maintenance on both 6/5/2012 at 09:30 and 7/03/2012 at 07:45, data were rejected for those timestamps.

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 flagged as either suspect as possible rain events were not recorded. Precipitation data were compared to rain data from Andrews Air Force Base, which is located about 12 miles from the Jug Bay sanctuary. On days where no precipitation was recorded at Andrews AFB, Jug Bay data were flagged as suspect for the entire day. On days where precipitation was recorded, Jug Bay data were flagged as rejected for the entire day, from the 00:15 timestamp to the 00:00 (midnight) timestamp.

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 06/22/2012 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. Total and cumulative precipitation data from 07/03/2012 at 07:45, when it was discovered that the screen was missing, through 08/15/2012 at 07:45 were 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. The F_Record column is commented with {CWE} for significant weather event from 10/18/2012 through 10/30/2012 at 19:00. 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 (around 08:30) 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 (around 08:45). Therefore, it is not believed that the lack of screen affected the readings acquired by the rain gauge within that time period. These data were marked as passing QAQC checks (<0> CSM).

Ancillary MET Data Source:

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