

Chesapeake Bay Maryland (CBM) NERR Meteorological Metadata
January 2011 – December 2011
Latest Update: May 27, 2014

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

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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 reports, graphs and queries of meteorological data are reviewed and any errors or anomalous data are further investigated and the data are corrected, rejected (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. All sensors except for the rain gauge were removed and replaced with newly calibrated sensors on November 15, 2011. Old sensors are sent back to Campbell Scientific for calibration and are rotated every year or two years to maintain current calibration requirements.

The recommended calibration frequency for the sensors is:

- Temperature/Humidity- annual recalibration
- Rain Gauge- annual recalibration
- Wind Speed/Direction- bi-annual recalibration
- Barometric Pressure- bi-annual recalibration
- PAR- bi-annual recalibration

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°46' 50.76" N, 76°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 were collected for the entire year of 2011, starting at 00:00:00 hrs on January 1st to 23:45:00 hrs on December 31st.

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

CBMJBMET010111.csv : 01/01/2011 00:00:00 – 01/31/2011 23:45:00

CBMJBMET020111.csv : 02/01/2011 00:00:00 – 02/28/2011 23:45:00

CBMJBMET030111.csv : 03/01/2011 00:00:00 – 03/31/2011 23:45:00

CBMJBMET040111.csv : 04/01/2011 00:00:00 – 04/30/2011 23:45:00

CBMJBMET050111.csv : 05/01/2011 00:00:00 – 05/31/2011 23:45:00

CBMJBMET060111.csv : 06/01/2011 00:00:00 – 06/30/2011 23:45:00

CBMJBMET070111.csv : 07/01/2011 00:00:00 – 07/31/2011 23:45:00

CBMJBMET080111.csv : 08/01/2011 00:00:00 – 08/31/2011 23:45:00

CBMJBMET090111.csv : 09/01/2011 00:00:00 – 09/30/2011 23:45:00

CBMJBMET100111.csv : 10/01/2011 00:00:00 – 10/31/2011 23:45:00

CBMJBMET110111.csv : 11/01/2011 00:00:00 – 11/15/2011 07:15:00

CBMJBMET112911.csv : 11/29/2011 13:45:00 – 11/30/2011 23:45:00

CBMJBMET120111.csv : 12/01/2011 00:00:00 – 12/31/2011 23:45:00

There are missing data from 11/15/2011 07:30:00 until 11/29/2011 13:30:00 and 11/29/2011 14:00:00 due to incorrect wiring during the sensor swap on 11/15/2011.

7) Distribution

NOAA 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. 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: <http://cdmo.baruch.sc.edu/>; accessed 12 October 2012.

NERR water quality 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 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. Dr. Marta Ceroni is one of the lead PI's on the sediment effort, which Chris Swarth is the lead PI for supplemental water quality monitoring efforts. Additional information, to include their contact information, 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 – Include parameter description, units, sensor type, model #, (operating temperature), range of measurement, accuracy, (temperature dependence), (sensitivity), (stability), date of last calibration for each sensor and CR1000 description.

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:

Sensor Y1120038 installed from 01/01/2011 – 11/15/2011: 03/02/2009
Sensor Z4020126 installed from 11/15/2011 – 12/31/2011: 03/15/2011

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: $\pm 2\%$ RH (0-90%) and $\pm 3\%$ (90-100%)
Temperature dependence of RH measurement: $\pm 0.05\%$ RH/°C
Date of Last calibration:
Sensor Y1120038 installed from 01/01/2011 – 11/15/2011: 03/02/2009
Sensor Z4020126 installed from 11/15/2011 – 12/31/2011: 03/15/2011

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:
Sensor Y0820021 installed from 01/01/2011 – 11/15/2011: 03/10/2009
Sensor P5050004 installed from 11/15/2011 – 12/31/2011: 03/28/2011

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:
Sensor installed from 01/01/2011 – 11/15/2011: 03/05/2009
Sensor installed from 11/15/2011 – 12/31/2011: 03/21/2011

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:
Sensor installed from 01/01/2011 – 11/15/2011: 03/05/2009
Sensor installed from 11/15/2011 – 12/31/2011: 03/21/2011

Parameter: LI-COR Quantum Sensor

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

Multiplier:

Sensor Q31552 installed from 01/01/2011 – 11/15/2011: 1.562

Sensor Q22439 installed from 11/15/2011 – 12/31/2011: 1.380

Date of last calibration:

Sensor Q31552 installed from 01/01/2011 – 11/15/2011: 03/03/2009

Sensor Q22439 installed from 11/15/2011 – 12/31/2011: 03/25/2011

Date Installed:

Installations dates of 03/30/2010 (Q31552) and 11/15/2011(Q22439)

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: 05/05/2005

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 - List the sampling station, sampling site code, and station code used in the data.

Sampling station:	Sampling site code:	Station code:
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Jug Bay	JB	cbmjbm ^{et}
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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	<i>Open - reserved for later flag</i>
3	<i>Open - reserved for later flag</i>
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
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

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.

Occasional elevated nighttime PAR data were recorded during 2011. With a few exceptions, the data were below the maximum signal noise for the sensor. Exact reasons for the elevated nighttime PAR readings are unknown; however, it is suspected that moisture in the sensor may be causing these elevated readings, as it was observed that these readings typically occurred during or immediately following a precipitation event.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3%.

Relative Humidity data greater than or equal to 104% were marked as rejected (<-3> SSM CSM). Occasional relative humidity values of 104% were recorded during 2011. These values are believed to be a result of the sensor nearing the end of its deployment. Data 101%-103% are flagged and coded <1> CAF and all other data are coded as <0> CSM. The RH sensor was cleaned on 10/11/2011 at 08:30, data were rejected <-3> GMT CSM). Once the newly calibrated relative humidity sensor was installed on 11/15/2011 no further readings of 104% were recorded.

A sensor swap was done on 11/15/2011 beginning at 07:15, to switch out the old sensors with newly calibrated sensors. Unknown at the time, the BP sensor wiring was reversed, causing a short on the wiring panel resulting in missing data from 11/15/2011 at 07:30 until 11/29/2011 at 13:30, and again on 11/29/2011 at 14:00. Beginning on 11/29/2011 at 13:45 a technician re-wired each sensor in order to try to fix the problem and discovered that the BP sensor had crossed wires. The BP sensor started reading correctly on 11/30/2011 at 10:30. It was also discovered that the wind sensor was reversed, causing a 180 degree shift in wind direction between 11/29/2011 at 14:45 and 11/30/2011 at 10:15. These data were corrected in the 2011 data set by adding 180 onto the direction readings from the raw data.

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.

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.

03/23/2011 09:15 0.254mm corrected to 0mm

05/03/2011 09:00 0.254mm corrected to 0mm

08/25/2011 08:45 0.254mm corrected to 0mm

09/26/2011 09:15 0.254mm corrected to 0mm

12/13/2011 09:30 0.254mm corrected to 0mm

Precipitation data also had to be rejected in relation to the sensor swap performed on 11/15/2011. Total precipitation and associated cumulative precipitation were recorded by the rain sensor while there was still a short on the wiring panel and, therefore, that data had to be rejected. Total precipitation and cumulative precipitation data for the following dates and times were rejected in the data.

11/29/2011 13:45 Cumulative precipitation: 0.254mm

11/29/2011 14:15 Total precipitation: 0.508mm, Cumulative precipitation: 1.016mm

11/29/2011 14:30 Total precipitation: 0.254mm, Cumulative precipitation: 1.27mm

All cumulative precipitation data from 11/29/2011 at 14:45 until 11/30/2011 at 00:00 were rejected, total precipitation values were not.

Significant weather events of note in 2011 (to explain observed data):

01/26/2011 – Large winter storm consisting of snow (“thundersnow”), rain, and sleet

02/19/2011 – High winds that caused wildfires

03/10/2011 – Massive outbreak of tornadoes

04/16-17/2011 – Tornadoes and large amounts of rain (flooding)

07/08/2011 – Flash flooding

08/27-29/2011 – Hurricane Irene – Large amounts of rain, high winds, extremely low barometric pressure

09/05-09/2011 – Tropical Storm Lee – Massive amounts of rain causing historical flooding in the

Chesapeake Bay and its watershed (upwards of 13 inches of rain in some areas).

12/07/2011 – Massive amounts of rain

12/08/2011 – Area experienced the first freeze of the new winter, more than 3 weeks later than the average (unusually warm summer and winter).

Ancillary MET Data Source:

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