Chesapeake Bay Maryland (CBM) NERR Meteorological Metadata
January 2008-December 2008
Latest Update: June 2, 2014

I. Data Set and Research Descriptors

1) Principle investigator(s) and contact persons

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2) Entry Verification

a) Data input procedures:

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 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 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. Pre-processing, data verification, and data upload to the CDMO server was performed by John Zimmerelli.

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 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

The Campbell Scientific weather station samples every 5 seconds continuously throughout the year. Data are used by the CR1000 to produce 15 minute averages, maximums, and minimums. Data are manually downloaded on site, or is telemetered via cellular technology to a desktop PC at the 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.

a) Data collection schedule:

CR1000

i) 15 minute data are averages/totals of 5 second sampling over the period of 15 minutes.

ii) Parameters collected during each interval include:

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), Wind Direction Standard Deviation (degrees)

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

Air Temperature (°C)

Maximum and their times from 5-second:

Wind Speed (m/s)

Totals:

Precipitation (mm), PAR (millimoles/m^2), and Cumulative Precipitation (mm)

b) Error/anomalous data criteria:

Air Temp:
-Sample not greater than 45 C or less than –5 C

Relative Humidity:
-Sample not greater than 100% or less than 0%

Pressure:
-Sample not greater than 1060 mb or less than 900 mb

Wind Speed:
-Wind speed not greater than 30 m/s
-Wind speed not less than 0 m/s

Wind Direction:
- Wind direction not greater than 360 degrees or less than 0 degrees

Rainfall:
- Precipitation not greater than 25 mm in 15 min

Photosynthetically Active Radiation (PAR):
-Sample not greater than 5000 mmol/m^2 or less than 0 mmol/m^2

Campbell Scientific data telemetry equipment is used at this station to transmit to the NOAA GOES satellite, NESDIS ID #3B0071EA. The transmissions are scheduled hourly and contain four (4) datasets reflecting the fifteen min data-sampling interval. The telemetry is "Provisional" data and not the "Authentic" Dataset used for long term monitoring and study. This data can be viewed by going to http://cdmo.baruch.sc.edu.

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 to ensure comparative readings. Additional checks are often done weekly and bi-weekly specifically to check the rain gauge and Li-COR sensors 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 and therefore provides supplemental rain data. Sensors were removed and replaced with new sensors on October 31, 2006. Old sensors will be sent back to Campbell Scientific for calibration and rotated every year 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 (meteres):
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

Weather data has been collected at the Chesapeake Bay Maryland NERR Jug Bay site since August 2000. The current weather station has been operational since this date. Data was collected for the entire year in 2008, starting at 00:00:00 hrs on January 1st to 23:45:00 hrs on December 31st.

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 meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Section 2.2-1 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 text tab-delimited format, Microsoft Excel spreadsheet format and comma-delimited format.

8) Associated researchers and projects

Data are most commonly used in support of the System Wide Monitoring Program (SWMP) and to help explain the relationships between water quality and meteorological conditions. Three of the four 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 data. For more information about the SWMP water quality monitoring and nutrient monitoring efforts, refer to the Chesapeake Bay Maryland Reserve water quality data on the CDMO website http://cdmo.baruch.sc.edu/.

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, while 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 were telemetered in 2005.

II. Physical Structure Descriptors

9) Sensor specifications:

The weather station records temperature, relative humidity, barometric pressure, wind speed, wind direction, light as measured by a LI-COR Quantum Sensor, and precipitation. The following is a list of the above parameters along with a parameter description, units, sensor type, model number, range of measurement, accuracy, and date of the last calibration for each sensor. Similar information for the storage module, CR10x, and CR1000 is also listed below.

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: 4/12/2007

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: 4/12/2007

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 4/12/2007

Parameter: Wind speed
Units: meter per second (m/s)
Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene
Model #: R.M. Young 05103 Wind Monitor
Range: 0-60 m/s (130 mph); gust survival 100 m/s (220 mph)
Accuracy: +/- 2%
Date of last calibration: 4/12/2007

Parameter: Wind direction
Units: degrees
Sensor type: balanced vane, 38 cm turning radius
Model #: R.M. Young 05103 Wind Monitor
Range: 360° mechanical, 355° electrical (5° open)
Accuracy: +/- 5%
Date of last calibration: 4/12/2007

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
Date of last calibration: 4/12/2007
Multiplier: 1.183

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: 5/5/2005

Campbell Scientific CR1000 Wiring Panel has 2MB Flash EEPROM that is used to store the Operating System. Another 128K for Flash is used to store configuration settings. A minimum of 2 MB SRAM is available for program storage, operating system use, and data storage.
Date CR1000 installed: October 31, 2006

10) Coded variable definitions:

Sampling station:	Sampling site code:	Station code:
Jug Bay	JB	cbmjbmet

11) QAQC flag definitions – This section details the automated primary and secondary 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 -2flags 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 Good Data
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 – This section details the secondary QAQC Code definitions used in combination with the QAQC flags above.

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 deployment or YSI datasonde, 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
SOC Out of Calibration
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
CRE Significant Rain Event
CSM See Metadata
CVT Possible Vandalism/Tampering

14) Other remarks/notes:

CDMO corrections 5/27/2014: Flagging and coding for PAR data from 7/26/2007-12/31/2008 was changed to 0 CSM (unless otherwise flagged and coded). The sensor installed during that time period drifted over time resulting in suspect data later in the deployment. See explanation below: There were noticeable changes in PAR values following the swap to a freshly calibrated sensor (assumed to be accurate) on 03/30/2010. Campbell Scientific reported a -14.9% post cal drift (-3.76%/year)for the sensor that was installed from 07/26/2007 to 03/30/2010 (Q22439). Acceptable drift is +/- 2% for this sensor. All PAR data ~1year 3 months prior the sensor swap, from 01/01/2009 to 03/30/2010 are flagged and coded as <5> SSD CSM (<5> instead of <1> because the data were corrected due to an incorrect multiplier). PAR data for the remainder of this deployment (07/26/2007 to 12/31/2008) are flagged and coded <0> CSM or <5> SIC CSM and users should note that drift for that period may have exceeded acceptable limits as well. If users are comfortable assuming that drift was linear (in a real world environment it is unlikely to be entirely linear), these data may be 'corrected' for assumed linear drift at the user's discretion using manufacturer's instructions.

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.

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.

RH data of 0% to 103% are within the range of error for the sensor. Any data that fall in this range are considered valid.

From 5/22/2008 23:15 to 6/12/13:30 data were retrieved from telemetered data, therefore, MaxWSpd times are not available.

Precipitation data for the following dates and times were removed from the data set as erroneous. The data generated was from rain accumulated in the sensor due to a clogged funnel. Field personnel allowed rain in funnel to be recorded to get an estimate of the previous rain storms
6/18/2008 09:30 23.9mm
7/16/2008 09:00 13.2mm

Negative PAR data have been observed during the night; small negative 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. These data have been retained.

Beginning in April and continuing through December, occasional elevated nighttime PAR data were recorded during 2008. With a few exceptions, the data were below the maximum signal noise for the sensor. Data were rejected when they exceeded 2.214 mmols/m^2. Reasons for the elevated readings are unknown; however, it is suspected that moisture in the sensors may be causing these readings.

PAR data were corrected from 1/1/2008 00:00 to 12/31/2008 23:45. An incorrect multiplier was used when the data were first collected. To make corrections, the data were divided by the incorrect multiplier (0.74) and then multiplied by the correct multiplier (1.183).

For the following dates and times data are missing for unknown reasons.

5/13/2008 from 06:45 to 07:30
5/27/2008 from 00:45 to 01:30
5/31/2008 from 06:45 to 07:30
6/7/2008 from 11:45 to 12:30
6/10/2008 from 00:45 to 01:30
6/11/2008 from 11:45 to 12:30
6/11/2008 from 23:45 to 6/12/2008 00:30
6/12/2008 from 05:45 to 06:30

Data at 6/12/2008 13:45 and 14:00 are missing and rejected due to a program reload. From 6/12/14:00 to 17:00 unsuccessful attempts were made to insert the PAR multiplier. The 17:15 PAR reading was rejected even though the multiplier successfully inserted because it cannot be verified that this was a full 15 minute interval of data.

On July 18, 2008 at 8:35 the wind sensor was realigned to True North. All wind parameter data at 8:45 were rejected due to false readings for the 15 minute interval.

Ancillary Met Data Source:
http://www.wunderground.com/history/airport/KNAK/2004/7/1/DailyHistory.html?req_city=NA&req_state=NA&req_statename=NA
Various other local weather stations available through the web.