

**Chesapeake Bay Maryland (CBM) NERR Meteorological Metadata**  
**January 2018 – December 2018**  
**Latest Update:** March 24, 2020

**I. Data Set and Research Descriptors**

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**2) Entry verification –**

Data are uploaded from the CR1000 data logger to a Personal Computer (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 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, minimums, and totals. 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. 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. Data are collected in Eastern Standard Time (EST) for the entire year.

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/m<sup>2</sup>), and Cumulative Precipitation (mm) (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.)

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Precipitation Gauge- yearly recalibration
- Wind Speed/Direction- every 2 years recalibration
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000-every 5 years (required beginning 2014, one year initial grace period)

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° 46.846 N and 76° 42.492 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.

##### SWMP Station Timeline

| Station Code | SWMP Status | Station Name | Location                            | Active Dates            | Reason Decommissioned | Notes |
|--------------|-------------|--------------|-------------------------------------|-------------------------|-----------------------|-------|
| CBMJBMET     | P           | Jug Bay      | 38° 46' 50.76 N,<br>76° 42' 29.52 W | 07/01/2003<br>– present | NA                    | NA    |

## **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. Weather data at the JUG Bay site for 2018 was collected from 01/01/2018 00:00:00 to 12/31/2018 23:45:00.

Start and end date and times of 2018 raw data files submitted to the CDMO:

CBMJBMET120217.csv : 12/01/2017 00:00:00 – 01/24/2018 09:30:00 **\*\*Incorrectly named\*\***  
CBMJBMET012418.csv : 01/24/2018 09:45:00 – 04/26/2018 07:45:00  
CBMJBMET042618.csv : 04/26/2018 08:00:00 – 06/14/2018 07:30:00  
CBMJBMET061418.csv : 06/14/2018 07:45:00 – 07/11/2018 09:30:00  
CBMJBMET071118.csv : 07/11/2018 09:45:00 – 09/06/2018 08:30:00  
CBMJBMET090618.csv : 09/06/2018 08:45:00 – 10/17/2018 08:30:00  
CBMJBMET101718.csv : 10/17/2018 08:45:00 – 12/12/2018 09:00:00  
CBMJBMET121218.csv : 12/12/2018 09:15:00 – 01/30/2019 09:30:00

## **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:

NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program.  
Data accessed from the NOAA NERRS Centralized Data Management Office website:  
<http://www.nerrsdata.org/>; accessed 12 October 2018.

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](http://www.nerrsdata.org). Data are available in comma delimited format.

## **8) Associated researchers and projects –**

As part of the SWMP long-term monitoring program, CBM NERR also monitors 15-minute water quality along with monthly grab samples and diel sampling for nutrient data which may be correlated with this meteorological dataset. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org).

Meteorological data are most commonly used in support of the SWMP and to help explain the relationships between water quality, nutrients, and meteorological conditions. Three of the four CBM 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. These can be obtained through the Research Coordinator.

## 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:  $\pm 0.2$  °C @ 20°C

Serial Number: Z4020126

Date of Calibration: 02/24/2017

Dates of Sensor Use: 03/30/2017 – 10/17/2018

Serial Number: Y1120038

Date of Calibration: 09/17/2018

Dates of Sensor Use: 10/17/2018 – current as of 12/31/2018

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: 02/24/2017

Dates of Sensor Use: 03/30/2017 – 10/17/2018

Serial Number: Y1120038

Date of Calibration: 09/17/2018

Dates of Sensor Use: 10/17/2018 – current as of 12/31/2018

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:  $\pm 0.5$  mb @ 20°C;  $\pm 2$  mb @ 0°C to 40°C;  $\pm 4$  mb @ -20°C to 45°C;  $\pm 6$  mb @ -40°C to 60°C

Stability:  $\pm 0.1$  mb per year

Serial Number: P5050004

Date of Calibration: 05/11/2017

Dates of Sensor Use: 06/08/2017 – current as of 12/31/2018

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 05106 Wind Monitor  
Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)  
Accuracy: +/- 0.3 m/s  
Serial Number: WM146507  
Date of Calibration: 01/20/2016  
Dates of Sensor Use: 11/06/2017 – current as of 12/31/2018

Parameter: Wind direction  
Units: degrees  
Sensor type: balanced vane, 38 cm turning radius  
Model #: R.M. Young 05106 Wind Monitor  
Serial Number: WM146507  
Date of Calibration: 01/20/2016  
Dates of Sensor Use: 11/06/2017 – current as of 12/31/2018

Parameter: Photosynthetically Active Radiation (PAR)  
Units: mmoles m<sup>-2</sup> (total flux)  
Sensor type: anodized aluminum with cast acrylic diffuser  
Model #SQ110 Apogee Quantum Sensor  
Light spectrum waveband: 410 to 655 nm  
Temperature dependence: 0.06+/-0.06% per °C  
Stability: <±2% change over 1 yr  
Operating Temperature: -40°C to 70°C; Humidity 0 to 100%  
Cosine Response: 45° zenith angle: +/- 2%; 75° zenith angle: +/- 5%  
Sensitivity: 0.2mV per µmol s<sup>-1</sup> m<sup>-2</sup>  
Multiplier: 0.025  
Serial Number: SQ-110\_20223  
Date of Calibration: 09/19/2016  
Dates of Sensor Use: 06/08/2017 – current as of 12/31/2018

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  
Serial Number: N/A  
Date of Calibration: 09/14/2016  
Dates of Sensor Use: 09/14/2016 – 09/06/2018  
Date of Calibration: 09/06/2018  
Dates of Sensor Use: 09/06/2018 – current as of 12/31/2018

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  
Date CR1000 Calibrated: unknown

Serial Number: 5080

Date CR1000 Installed: 02/11/2015  
Date CR1000 Calibrated: 02/06/2015  
Dates CR1000 in use: 02/11/2015 - current as of 12/31/2018

CR1000 Firmware Version (s): Std. 22 Installed 11/04/2007  
CR1000 Program Version(s): CBMJBMET\_CR1000\_6.0.2\_110617.CR1

#### 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                                    |
| 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 LI-COR sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the LI-COR sensor is +/- 2.214 mmoles/m<sup>2</sup> over a 15 minute interval. These values are automatically flagged and coded as <1> (CAF).

Small negative PAR values and slightly elevated nighttime PAR values measured with the Apogee PAR sensor are flagged and coded as suspect, <1> CSM.

PAR data on 04/03/2018 at 09:00 are rejected due to a technician cleaning the sensor during a maintenance visit. Not a full 15 minutes of data.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3>.

A newly calibrated temperature/relative humidity sensor (Serial # Y1120038) was installed at the station on 10/17/2018. The old sensor was taken out of the gill shield and left lying on the decking of the blind beginning at 08:35 while the technician installed a new gill shield. Once the new gill shield was installed, the new temperature/relative humidity sensor was installed and inserted into the gill shield at 09:16. All temperature and relative humidity data from 08:45 until 09:30 is rejected.

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 1<sup>st</sup> and December 31<sup>st</sup> 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.**

Total precipitation data for the following dates and times were corrected in the data. The associated cumulative precipitation data for the remainder of the day were also corrected but are not listed. Field personnel were cleaning the rain gauge at these times.

01/03/2018 11:00 12.7 mm corrected to 0 mm  
 03/01/2018 09:15 0.762 mm corrected to 0 mm \*\*  
 04/03/2018 09:00 0.254 mm corrected to 0 mm  
 04/26/2018 08:00 0.254 mm corrected to 0 mm  
 05/31/2018 08:30 0.762 mm corrected to 0 mm  
 06/14/2018 07:45 1.016 mm corrected to 0 mm  
 07/11/2018 09:45 0.508 mm corrected to 0 mm  
 08/14/2018 07:30 1.778 mm corrected to 0 mm  
 10/11/2018 11:00 1.016 mm corrected to 0 mm  
 10/24/2018 08:45 0.508 mm corrected to 0 mm  
 12/12/2018 09:15 5.588 mm corrected to 0 mm

\*\* Water was present in tipping bucket when field personnel made the false tips on 3/1/2018. It is unknown how much of the 0.762 mm recorded was the rain water present in the bucket versus how many false tips were made, therefore, the entirety of the 0.762 mm was corrected to zero instead of adding any rain to the previous rain event. As with all corrected values, corrected values on 03/01/2018 are considered suspect.

Field personnel calibrated the rain gauge on 09/06/2018 from 09:05 to 10:05. Total precipitation data for the following dates and times were corrected to 0 mm in the data. The associated cumulative precipitation data were also corrected to zero for the remainder of the day but are not listed

09/06/2018 09:15 10.668 mm  
 09:30 3.81 mm  
 09:45 8.382 mm  
 10:00 4.826 mm

The following dates and times have no data recorded due to power failures. It is believed the power failures are a result of extended time periods with very little sunshine/extensive cloud cover, many times associated with days consisting of rainfall, combined with low temperatures typical of February in Maryland. The lack of solar radiation to charge the battery with the solar panel throughout the day, combined with the low temperatures that can drain the charge of a battery quicker than normal, led to several occasions of power failures overnight and sometimes during the daylight hours. All data from the proceeding timestamps immediately following the power failures have been rejected as it is unknown whether it is a full 15 minutes of data.

| Station Code | DateTimeStamp                       | F_Record |
|--------------|-------------------------------------|----------|
| cbmjbmnet    | 02/13/2018 01:00                    | {CSM}    |
| cbmjbmnet    | 02/17/2018 04:30 – 02/17/2018 07:00 | {CSM}    |
| cbmjbmnet    | 02/18/2018 03:00                    | {CSM}    |
| cbmjbmnet    | 02/18/2018 03:30 – 02/18/2018 04:15 | {CSM}    |
| cbmjbmnet    | 02/18/2018 04:45 – 02/18/2018 07:00 | {CSM}    |

|          |                                     |       |
|----------|-------------------------------------|-------|
| cbmjbmet | 02/24/2018 04:30                    | {CSM} |
| cbmjbmet | 02/24/2018 20:45 – 02/25/2018 03:30 | {CSM} |
| cbmjbmet | 02/25/2018 04:00 – 02/25/2018 06:30 | {CSM} |
| cbmjbmet | 02/25/2018 07:30                    | {CSM} |
| cbmjbmet | 02/25/2018 08:00 – 02/25/2018 08:15 | {CSM} |
| cbmjbmet | 02/25/2018 09:00                    | {CSM} |
| cbmjbmet | 02/25/2018 09:45 – 02/25/2018 10:00 | {CSM} |
| cbmjbmet | 02/25/2018 10:30 – 02/25/2018 10:45 | {CSM} |
| cbmjbmet | 02/25/2018 11:30 – 02/25/2018 11:45 | {CSM} |
| cbmjbmet | 02/25/2018 12:15                    | {CSM} |
| cbmjbmet | 02/25/2018 12:45 – 02/25/2018 13:15 | {CSM} |
| cbmjbmet | 02/25/2018 15:30                    | {CSM} |
| cbmjbmet | 02/25/2018 16:15 – 02/25/2018 16:45 | {CSM} |
| cbmjbmet | 02/25/2018 20:45                    | {CSM} |
| cbmjbmet | 02/25/2018 21:15                    | {CSM} |
| cbmjbmet | 02/25/2018 21:45 – 02/26/2018 08:30 | {CSM} |
| cbmjbmet | 02/26/2018 09:00                    | {CSM} |
| cbmjbmet | 02/26/2018 09:45                    | {CSM} |
| cbmjbmet | 02/26/2018 10:30 – 02/26/2018 10:45 | {CSM} |
| cbmjbmet | 02/26/2018 16:00 – 02/26/2018 16:45 | {CSM} |
| cbmjbmet | 02/26/2018 17:15 – 02/27/2018 07:00 | {CSM} |

In association with the recorded power failures, there were times on 2/13/18, 2/16 – 2/20/18, and 2/24 – 2/26/18 in which the battery voltage dropped below 9.6V but still collected data. If the battery voltage drops below 9.6V there is most likely a problem with the collection of the battery volt data and there may be some readings missed within a 15 minute period. Due to the possibility of missed readings, all data is rejected at times when battery volts dropped below 9.6. Any associated cumulative precipitation as a result of total precipitation collected at times of low battery voltage are also rejected. All rejected values are flagged as <-3> [GPF] (CSM).

Significant Weather Events of 2018 (record marked in data as {CWE} {CSM} in the F\_Record):

- A rapidly strengthening Nor'Easter brought a strong wind storm that lasted more than 24 hours from 3/2/18 – 3/3/18, with sustained winds of 30-40 mph and gusts up to 70 mph in the local area.
- A late season snow storm brought 6-8 inches of snow to the area on 3/21/18. Snow melt was recorded as precipitation on 3/22/18 as temperatures rose above freezing. All total and cumulative precipitation values on 3/22/18 are coded as <0> (CML).

Significant Rain Events of 2018 (record marked in data as {CRE} {CSM} in the F\_Record):

- Flash flooding occurred in the area on 5/27/18. The flooding was so severe it wiped out part of an historic town, Ellicott City, located approximately 40 miles north of the reserve, with up to 12 inches of rain falling in the span of less than five hours. This was the second time in less than two years that Ellicott City experienced a “once in a thousand-year rain event”. While the CBM reserve did not experience this extreme rainfall, almost one inch of rain fell in the span of 30 minutes at the reserve.
- A string of severe thunderstorms along with steady heavy rains occurred from 7/21/18 through 7/24/18, bringing with them widespread flooding, damaging winds, and small tornadoes touching

down in the area. The CBM reserve received upwards of 8.5 inches of rain in that four day span, which 5.5 inches of that total falling on 7/21/18.

The Baltimore and DC area received over 70 inches of rain 2018, making it the rainiest year in recorded history for the area. July and November 2018 were the wettest calendar months in recorded history. There were 24 days in 2018 in which the area received one inch or more of rain.