**Old Woman Creek (OWC) NERR Meteorological Metadata**

**January – December 2018**

**Latest Update:** 25 November 2019

**I. Data Set and Research Descriptors**

**1) Principal investigator(s) and contact persons –**

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**2) Entry verification –**

Data are uploaded from the CR1000 data logger via a RS-232 cable connected to a laptop (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.

Dr. Kristi Arend is responsible for data management.

**3) Research objectives –**

The objective of this work is to record weather data over a long time period for Old Woman Creek to look at long-term trends and seasonal variability in weather conditions. Weather conditions can be related to long-term trends and seasonal variability in estuary water quality. An added function is to provide the weather data so that researchers can examine the impact of changing weather conditions on the ecology of the estuary. Weather information is critical when studying the estuary, because the estuary is a storm-driven system and the source of water in the estuary is a function of both storm activity in the watershed and on the lake proper.

**4) Research methods –**

Campbell Scientific data telemetry equipment (Sutron Sat-Link2 transmitter) was installed at this station on 07/19/2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B017310. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen-minute data sampling intervals. The time zone for Local Standard Time is Eastern Standard Time. Upon receipt by the CDMO, the data undergo 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 Wind Sentry, temperature and relative humidity sensor, barometric pressure sensor and the LiCor PAR sensor are located on a 10-meter tower following the descriptions outlined in the CDMO Manual V 4.0. The tipping rain gauge is located about 2-3 meters southeast of the tower. The sensors are wired to the CR1000 following the protocol in the CDMO Manual. A new CR1000 data logger was installed on 5 September 2013 (re-calibrated 28 September 2018). New software was installed on 15 January 2014 at 15:30. The new software was altered by Mike Mensinger to include the new bp offset value (522), because Old Woman Creek is 604 feet above sea level.

Data collection information:

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) (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.)

Calibration information:

Once a month, the sensors on the weather station are inspected for damage and cleaned, if necessary.

Calibration frequency is as follows:

- 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)

Data quality checks:

Ongoing checks of data quality include comparing data from nearby weather stations with OWC weather data approximately weekly. Precipitation data are also compared to data collected by a manual and digital gauge on site and a local, privately owned weather station. When the data are downloaded monthly, a handheld Kestrel 4000 is run to provide a general check of the sensors.

**5) Site location and character –**

The Old Woman Creek State Nature Preserve and National Estuarine Research Reserve is located on the southern shore of Lake Erie east of the City of Huron, Ohio. The reserve lies within the Lake Erie Biogeographic Region. Old Woman Creek drains a primarily row-crop agricultural watershed, with corn, soybeans, and winter wheat being the most important crops. The weather station is located within the boundaries of the reserve, due east of the parking lot at the Michael Dewine Center for Coastal Research in a field that is maintained in early succession. This ensures that no tall vegetation will interfere with the weather station. The tower is located within an approximately 5-m square fenced (6 foot chain link fencing) enclosure with a gravel base. The coordinates of the station are 41˚ 22’40” N and 82˚ 30’ 29”W. Wind speed and wind direction sensors are atop a 10 meter tower, while the PAR sensor is located off of the south-west edge of the tower at approximately 3 meters in height. The temperature/ RH sensor is located off the north-east edge of the tower at approximately 2.3 meters in height. The barometric pressure sensor is located within the instrument box on the tower at approximately 2 meters height. The sensor is vented to the outside through a hole in the bottom of the instrument box. The heated tipping rain gauge is located about 2-3 meters southeast of the tower on a platform about 1 meter above the ground. The weather station is located within 1 kilometer of three of the SWMP water quality data logger sites (WM, OL, and DR) and within 5 kilometers of the fourth water quality data logger site (BR). The site is 604 feet above sea level.

SWMP Station Timeline

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| OWCOWMET | P | Old Woman Creek | 41˚ 22’40” N  82˚ 30’ 29”W | 2002- present | NA | NA |

**6) Data collection period –**

Weather data were collected from 18 December (16:15 EST) 2017 through 3 January (13:30 EST) 2019; reported data begin 1 January (00:00 EST) 2018 and end 1 January (13:30 EST) 2019.

|  |  |  |
| --- | --- | --- |
| File Start Date and Time | File End Date and time | Download Date |
| 12/18/2017 16:15 | 01/02/2018 10:30 | 01/02/2018 |
| 01/02/2018 10:45 | 02/01/2018 12:30 | 02/01/2018 |
| 02/01/2018 12:45 | 03/01/2018 08:30 | 03/01/2018 |
| 03/01/2018 08:45 | 04/04/2018 10:15 | 04/03/2018 |
| 04/04/2018 10:30 | 04/10/2018 14:45 | 04/12/2018 |
| 04/12/2018 12:30 | 05/01/2018 12:15 | 05/01/2018 |
| 05/01/2018 12:30 | 05/31/2018 23:45 | 07/17/2018\* |
| 06/01/2018 00:00 | 06/30/2018 23:45 | 07/17/2018\* |
| 07/01/2018 00:00 | 07/31/2018 23:45 | 10/23/2018\* |
| 08/01/2018 00:00 | 08/31/2018 23:45 | 10/23/2018\* |
| 09/01/2018 00:00 | 09/12/2018 16:00 | 10/26/2018\* |
| 09/12/2018 16:15 | 09/30/2018 23:45 | 10/25/2018\* |
| 10/01/2018 00:00 | 10/17/2018 11:00 | 10/17/2018 |
| 10/19/2018 08:15 | 11/02/2018 08:30 | 11/02/2018 |
| 11/02/2018 08:45 | 11/26/2018 09:45 | 11/26/2018 |
| 11/27/2018 0:00 | 12/03/2018 15:00 | 12/03/2018 |
| 12/03/2018 15:15 | 01/03/2019013:30 | 01/03/2019 |

\* May 1 -Sept 30 telemetry data obtained via the CDMO Data Graphing and Download website (see Number 13 below).

**7) Distribution –**

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data.  The OWC Research Coordinator (RC) and the NERRS retain the right to be fully credited for having collected and processed the data.  Following academic courtesy standards, the RC or Manager at 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 and the State of Ohio do not assume liability to the Recipient or third persons, nor will the Federal government or State of Ohio 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, OWC NERR also collects 15-minute water quality data along with monthly grab samples and diel sampling for nutrient data at four stations within the estuary. 15-minute water level data are collected at the DR water quality station and adjacent to the WM water quality station. These data may be correlated with this meteorological dataset. Three of the four current SWMP water quality stations (WM, OL, DR) and one former station (SU) are located within 1 kilometer of this weather station; the fourth current station (BR) is located within 5 kilometers and has a USGS water gauge adjacent to it. The four sites were established to determine the role of the estuary in mitigating storm flow through the system and the impact of Lake Erie on the estuary. These data are available at [www.nerrsdata.org](http://www.nerrsdata.org). Periodic vegetation and habitat data and maps also exist and are available from the reserve.

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

Parameter: PAR (Photosynthetically Active Radiation)

Units: mmoles m-2 (total flux)

Sensor type: High stability silicon photovoltaic detector (blue enhanced)

Model: LiCor Quantum Sensor LI190SB

Light spectrum waveband: 400 to 700 nm

Temperature dependence: 0.15% per ˚C maximum

Stability: <+2% change over 1 year

Operating Temperature: -40° to +65° C; Humidity 0 to 100%

Sensitivity: typically 5 µA per 1000 µmoles s-1 m-2

Serial Number Q49472

Multipliers: 1.1997

Date of Last Calibration: 03/10/2016

Dates of Sensor Use: 09/13/2017 (16:15) – current 12/31/2018

Parameter: Wind speed

Units: meters per second (m/s)

Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene

Model: R.M. Young Model 05103 Wind Monitor

Range: 0-60 m/s (134 mph); gust survival 100 m/s (220 mph)

Accuracy: +/- 0.3 m/s

Serial Number WM75736

Date of last calibration: 05/30/2018 (serviced nose cone installed)

Dates of sensor use: 11/02/2006 – current as of 12/31/2018

Parameter: Wind direction

Units: degrees

Sensor type: balanced vane, 38 cm turning radius

Model: R.M. Young Model 05103 Wind Monitor

Range: 3600 mechanical, 3550 electrical (50 open)

Accuracy: + 5%

Serial Number WM75736

Date of last calibration: 05/30/2018 (serviced nose cone installed)

Dates of sensor use: 11/02/2006 – current as of12/31/2018

Parameter: Temperature

Units: degrees Celsius

Sensor type: PT100 RTD, IEC 751 1/3 Class B, with calibrated signal conditioning

Model: Rotronic HC2-S3 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: +0.1°C at 23°C

Serial Number 60749921

Date of Last Calibration: 08/29/2017

Dates of Sensor Use: 09/13/2017 (16:15) – 10/19/2018 (07:45)

Serial Number 61115231

Date of Last Calibration: 09/26/2018

Dates of Sensor Use: 10/19/2018 (08:15) – current as of 12/31/2018

Parameter: Relative Humidity

Units Percent

Sensor type: ROTRONIC® Hygromer IN-1

Model: Rotronic HC2-S3 Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy at 23˚C: +0.8% RH with standard configuration settings

Temperature dependence of RH measurement +/- 3% (-40 to 60C)

Serial Number 60749921

Date of Last Calibration: 08/29/2017

Dates of Sensor Use: 09/13/2017 (16:15) – 10/19/2018 (07:45)

Serial Number 61115231

Date of Last Calibration: 09/26/2018

Dates of Sensor Use: 10/19/2018 (08:15) – current as of 12/31/2018

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type Vaisala Barocap© silicon capacitive pressure sensor

Model # Vaisala PTB110 Barometer (PTB110 1B0CA)

Temperature Range: -40° to + 60°C

Accuracy: + 0.3 mb at 20°C; + 0.6mb at 0°C to 40°C; + 1mb at –20°C to 45°C; + 1.5mb at –40°C to 60°C

Stability: + 0.1 mb per year

Serial Number J2060017

Date of Last Calibration: 08/29/2017

Dates of Sensor Use: 09/13/2017 (16:15) – current as of 12/31/2018

Parameter: Precipitation (heated rain gauge)

Units: millimeters (mm)

Sensor Tipping Bucket Rain Gauge

Model#: Met One Model 385Heated Rain Gauge

Sensitivity: 0.2mm

Rainfall per tip: 0.01 inch

Operating range: Temperature: -20° to 50°C; Humidity: 0 to 100%

Accuracy: + 0.5% < 0.5 in./hr rate; + 2.0% < 3 in./hr rate

Serial Number A1415 (was misidentified as F5714 since at least 2013)

Date of Last Calibration: 10/25/2018

Dates of Sensor Use: pre 04/01/2007 – current as of 10/26/2018

The Campbell Scientific CR1000 has two MB Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. Four MB SRAM is used for program storage (16K), operating system use, and data storage. Data are downloaded from the CR1000 to a laptop via RS-232 cable using LoggerNet software.

CR1000 Serial Number 58337 (mislabeled as 57851 from 2013 – 2017)

Date installed: 09/05/2013

Date calibrated: 08/22/2013

Date removed: 09/12/2018 14:45

CR1000 Serial Number 72109

Date installed: 09/12/2018 15:45

Date calibrated: 07/23/2018

Date removed: 10/18/2018 15:15

CR1000 Serial Number 58337

Date installed: 10/19/2018 08:30

Date calibrated: 09/28/2018

Date removed: in service as of 12/31/2018

CR1000 Firmware Version (s): OS 26, updated when purchased but went back to OS26 on 11/28/2018.

CR1000 Program Version(s):

12/18/2017 (16:30) – present; owcowmet\_5.5\_091317\_2.CR1

**10) Coded variable definitions -**

Sampling station: Sampling site code: Station code:

Old Woman Creek OW owcowmet

**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 are 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** –

General

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.

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.**

Missing/Rejected/ Suspect data

The CR1000 failed to store and transmit data for unknown reasons. Data are flagged as missing during the following time periods: 04/10/2018 15:00 – 04/12/2018 12:15. Data on 09/09/2018 18:15, 09/12/2018 15:15, and 09/20/201813:00 were rejected due to nonsensical or incongruous values.

Data collected 4/12/2018 at 12:30 were rejected due to program re-load.

The RS-232 port on the CR1000 stopped functioning and would no longer communicate with a laptop in May 2018; May 1 -Sept 30 telemetry data were obtained via the CDMO Data Graphing and Download website. The data were not recovered from the CR1000 during repair. Telemetry data are considered suspect, <1>GIT CSM. Telemetry data were in use from 05/01/2018 12:30 until 09/30/2018 23:45. 10/01/2018 00:00 was the first time stamp using data collected from the CR1000. There are occasional gaps with missing data in the telemetry file possibly due to dropped transmission. Those records are flagged as <-2> GIT CSM. Cumulative precipitation data were not recovered for the entire duration and are flagged as missing, <-2> GIT CSM. Beginning 09/01/2018 at 00:00 through 09/09/2018 23:45 and 09/13/2018 12:30 through 09/30/2018 23:45, max wind speed times were not included in the recovered telemetry data, only the max wind speed value. In addition to all parameters being considered suspect due to the use of telemetry data, all data from 09/06/2018 00:15 – 09/12/2018 13:45 are also considered suspect due to the use of an out of calibration CR1000.

The station was powered down 9/12/2018 at 14:00 to remove the CR1000 for calibration and repair; a loaned CR1000 (from Campbell Scientific) was installed and powered on at 15:25. Although the CR1000 was not powered on, a line of data was recorded for 15:15. Those data are not accurate and appear to be older data stored on the CR1000, they were rejected. The CR1000 date and time synch became offset sometime after installation on 9/12/2018; the CR1000 self-corrected on 9/13/2018 between 11:00-12:00. All data collected from 9/12 15:30 through 9/13 12:15 were rejected as a result. Telemetry data were still used during the time the loaner CR1000 was installed.

Beginning 10/01/2018 00:00 the use of telemetered data was discontinued. Data were collected using a loaner CR1000 (sn72109). Data on 10/01/2018 09:00 – 10:00 are missing due to a power down with 10:15 rejected.

The station stopped recording on 10/17/2018 at 11:15. The reason is unknown, but it occurred immediately after data were downloaded from the loaned CR1000. The station was powered down on 10/18/2018 at 15:00 through 10/19/2018 08:00, the loaned CR1000 was removed and replaced with the repaired and recalibrated CR1000(58337). The program was loaded onto the CR1000 on 10/19/2018 at 08:00 and data recording resumed at 08:15. Data collected at 08:15 were rejected due to not being a full 15 minutes of 5-second data following the program re-load.

The operating system on the recalibrated CR1000 was incompatible with the TX312 GOES radio. As a result, the CR1000 frequently stopped collecting and transmitting data and had to be powered down to resume data collection and transmission. This took over a month to trouble-shoot. An older OS was uploaded to the CR1000 on 11/28/2018 at 16:00 and no problems have occurred since. The CR1000 stopped recording during the following times and dates; data collected during the first 15-minutes after the CR1000 resumed recording were rejected due to power down/malfunction that affects 5-second and associated 15-minute data: 10/26 01:00 – 10/27 17:45; 11/3 12:00 – 11/5 11:30; 11/6 04:00 – 11/7 09:45; 11/8 02:00 – 11/12 11:45; 11/13 04:00 – 11/14 08:45; 11/15 01:00-08:30; 11/16 01:00-11:45; 11/17 04:00-10:30; 11/18 03:00-08:15; 11/19 01:00-08:30; 11/21 09:00-13:00; 11/22 06:00 – 11/26 09:00; 11/26 10:00 - 11/27/2018 00:00; 11/27 01:00-14:15.

A program re-load on 11/27/2018 16:00 – 16:45 resulted in missing data. Data at 17:00 were rejected as a result of the program reload causing missing 5 second data.

Sensor exchange

The wind sensor nose cone was exchanged with a newly serviced nosecone (new bearings) on 05/30/2018 at 07:15. Data are rejected at 07:00 and 07:15 due to power down that affects 5-second data.

The temperature/Rh probe was exchange with a newly calibrated sensor on 10/19/2018 at 08:00 while the station was powered down to replace the CR1000.

Maintenance

Electricity to the heated rain gage was restored on 04/04/2018 (no time recorded) and 12/17/2018 12:30.

The precipitation gauge tipping buckets were stabilized (pins tightened) and base was re-levelled on 10/16 11:00 -16:00 and 10/25/2018 10:00 – 13:45, respectively.

The CR1000 was removed for recalibration and repair (RS-232 port not working) on 09/12/2018 14:00 – 15:00; the CR1000 was recalibrated, fixed, and re-installed on 10/19/2018 08:00.

Precipitation

The electrical line that powers the heated precipitation gauge was not functioning through 04/04/2018 and again from 11/01 through 12/17/2018. Precipitation data associated with snow events during these months are not likely to be accurate. Since snow amounts are not accurate and times of snowfall were not always reflected in the precipitation recorded, all total and cumulative precipitation on the dates listed below were coded as CSM when the values were 0.0. Total precipitation and cumulative values are flagged and coded as suspect due to snowmelt, <1> GSM CML, for the timestamps when precipitation was recorded. Snow occurred on the following dates and were coded as <0>(CSM) unless another coding took precedence: 1/12, 1/15, 1/29, 2/4 - 2/7, 2/9, 3/1, 3/8, 11/9-11/10 (overnight and data are flagged as missing), 11/20 am, 11/26 pm – 11/28 am, (most of data are flagged as missing) 11/29 - 12/01 (light), 12/3 - 12/6 (started as rain, 12/3; light), 12/20-12/21 (rain/snow mix to light snow; overnight). Dates with total and cumulative precipitation readings flagged and coded as suspect for snow melt, <1> [GSM](CML), are: 1/19, 1/31, 2/6, 2/9, 2/14, 3/9, 11/29, 11/30, 12/5, 12/6, 12/22. These dates reflect snowfall and snowmelt; however, users should be aware that snow loss due to sublimation may have occurred. Also, there is overlap in the CSM coding of precipitation for possible snow events and the CR1000 issues related to precipitation data (see below).

Total and cumulative precipitation data were corrected (i.e., changed to zero) for the following dates due to the tipping buckets being tipped during maintenance or calibration. Total precipitation data were corrected at the time listed while cumulative corrections continued until the end of the day. Corrected data are considered suspect.

Maintenance: 01/10/2018 09:00, 09:30, 09:45 and 09:00 – 01/11/2018 00:00 for cumulative; 08/08/2018 07:45 (total precipitation only and coded as GIT; telemetered data, so cumulative precipitation not calculated); 12/17/2018 12:30 – 12:45 for total and 12:30 – 12/18/2018 00:00 for cumulative.

From 10/19 – 11/27, when the CR1000 was experiencing operating system issues, data collection would sometimes stop during a precipitation event. Total and Cumulative precipitation data for those dates were compared to precipitation data collected by CoCoRaHs volunteers as Erie County, OH, sites 11 and 18. If met station data collected after the CR1000 resumed operating correctly appeared correct, they were flagged as <0> CSM for that time period; this occurred on 11/5 11:45 – 11/6 00:00, 11/07 10:00 – 11/08 00:00 (only cumulative coded), 11/15 08:45 - 11/16 00:45, 11/16 12:00 – 11/17 00:00, 11/17 10:45 – 11/18 00:00, 11/18 08:30 – 11/19 00:00, 11/19 08:45 - 11/20 08:00, 11/21 13:15 – 11/22 00:00, 11/26 09:15 – 09:45, and 11/27 00:15 – 00:45, and 11/27 14:30 – 15:45. There is overlap in the CSM coding of precipitation for possible snow events (see above) and the CR1000 issues related to precipitation data.

If met station data collected after the CR1000 resumed operating correctly appeared to have underestimated the amount of precipitation, they were flagged as <-3>[GIM](CSM); this occurred on 10/27 18:00 – 10/28 00:00.

The station was powered down on the following dates and time periods to conduct precipitation gauge calibration: 9/20/18 10:15-12:45; 10/10/18 12:15-13:45; 10/16/18 11:15-15:45. The first set of data collected after the CR1000 resumed recording for each of these were rejected due to power down that affects 5-second and associated 15-miniute data. See below for more calibration information.

Calibration of the rain gauge spanned several days. Calibration was checked while the station was powered down on 09/20/2018 10:15 – 12:45 and 10/01/2018 09:00 – 10:00 (See below). The mean, min, and max differences between the met station precipitation gauge and an onsite manual gauge from April 1 – Oct 9, 2018 were -0.39 mm, -2.79 mm, and 1.44 mm, respectively. Calibration occurred on the following dates: 10/10/2018 12:30 – 13:45 (East tipping bucket only), 10/16/2018 11:15 – 15:45 (East tipping bucket only), 10/17/2018 08:30 – 10:10, and 10/25/2018 10:00 – 13:45. Due to bucket readings being off (See below for pre-calibration measurements, all precipitation data collected between 09/20/2018 10:15 – 10/25/2018 09:45 are flagged as suspect for being out of calibration (unless otherwise flagged or coded; GIT was used instead of SOC due to the use of telemetry data), although they were fairly similar to readings from an onsite manual rain gauge (mean difference=-0.14 mm). Maintenance to level and calibrate the rain gauge occurred on 10/25/2018 10:00 – 13:45; data were rejected.

Pre-calibration readings:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Date | 9/20/2018 | 10:02-13:00 EST | |  | Date | 10/1/2018 | 08:58 – 10:00 EST |
| Technicians | Arend |  |  |  | Technicians | Arend |  |
| *Notes: measure only; no adjustments* | | |  |  | *Notes: measure only; no adjustments* | | |
| West bucket |  | East bucket | East bucket |  | West bucket |  | East bucket |
| 19.2 |  | 17.5 | 20.5 |  | 20.8 |  | 19.6 |
| 18.8 |  | 17.4 | 21.2 |  | 19.7 |  | 18.7 |
| 19.4 |  | 18.3 | 19 |  | 21.5 |  | 19.9 |
| 19 |  | 17.8 | 20.4 |  | 19.6 |  | 18.9 |
| 18.7 |  | 18.7 | 18.7 |  | 20.5 |  | 18.9 |
| 18.1 |  | 19.5 | 20.4 |  | 18.4 |  | 19.8 |
| 19.3 |  | 20.4 | 19.3 |  | 19.6 |  | 20 |
| 18.6 |  | 21.1 | 20.9 |  | 20.4 |  | 16.9 |
| 18.4 |  | 19.6 | 20.1 |  | 19.9 |  | 19.1 |
| 19.3 |  | 21.4 | 19.1 |  | 19.8 |  | 19.4 |
| **18.88** |  | **19.17** | **19.96** |  | **20.02** |  | **19.12** |
|  |  |  |  | *mean* | *19.45* |  | *19.42* |

Post-calibration readings:

|  |  |  |
| --- | --- | --- |
| Date | 10/25/2018 | 10:00-13:26 EST |
| Technicians | Arend |  |
| *Notes: no lid on while calibrating; little to no wind; re-levelled the base before calibration* | | |
| West bucket |  | East bucket |
| 18.7 |  | 17.9 |
| 18 |  | 18.9 |
| 17.8 |  | 18.8 |
| 18.5 |  | 18.3 |
| 18.3 |  | 18.1 |
| 18.6 |  | 18.8 |
| 18.7 |  | 18.8 |
| 18.3 |  | 19.1 |
| 19.4 |  | 17.9 |
| 19.1 |  | 17.7 |
| **18.54** |  | **18.43** |

PAR 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 Licor sensor is +/- 2.214 mmoles/m2 over a 15-minute interval. These values are automatically flagged and coded as <1> (CAF), unless otherwise flagged and coded (see above for suspect data due to the use of telemetered data).

Elevated nighttime PAR data are flagged as <1> CSM if values are > 0.1 and < 2.214 mmoles/m2 and as <-3> CSM if values are >2.214 mmoles/m2, unless otherwise flagged and coded (see above for suspect data due to the use of telemetry data).

Temperature/RH

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF), unless otherwise flagged and coded (see above for suspect data due to the use of telemetered data. Values greater than 103 are rejected <-3>.

Wind data

Birds of various sizes and weights (e.g., bluebird, hawk) will occasionally sit on the wind sensor to look for prey. These data are not flagged or coded.