

Weeks Bay National Estuarine Research Reserve (WKB NERR) Meteorological Metadata

Months and year the documentation covers: 01/2023 to 12/2023

Latest Update: 09/09/2025

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 CR1000X data logger to a personal computer with a Windows 7 or newer operating system. 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. Scott Phipps is responsible for data management.

3) Research objectives –

The principle objective is to record long-term meteorological data for Weeks Bay in order to 1) observe any environmental changes or trends over time, 2) use as a reference for research projects at the reserve, and 3) give meteorological context to our fifteen minute SWMP water quality data.

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the Weeks Bay Safe Harbor met station (wkbSHmet) on 07/31/2006 and transmits data to the NOAA GOES satellite, NESDIS ID **3B01A578**. The transmissions are scheduled hourly at 0:00:30 after the hour 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 15-minute data are collected in the following formats for the **CR1000X**:

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.)

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Precipitation 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/CR1000X-every 5 years

5) Site location and character –

The Weeks Bay National Estuarine Research Reserve is located near the Gulf coast, southeast of the city of Fairhope, Alabama. Weeks Bay (30°23' N, 87°50' W) is a small, shallow, microtidal sub-estuary, located on the eastern shore of Mobile Bay in the northern Gulf of Mexico. The bay is nearly diamond shaped, and its longitudinal axis (3.4 km long) runs nearly north-south from the head, where the Fish River flows in, to the mouth, where water is exchanged with Mobile Bay. Its widest point (3.1 km) is located near the center of the estuary, where the Magnolia River discharges into eastern side of Weeks Bay. Average depth is 1.4 m, although there are two areas where depths are significantly greater. The first is in the mouth of the bay, where the average depth is 6 m; the second is about 100 m upstream of the mouth of the Fish River, where the average depth is 3.5 m. Tides are principally diurnal, and have a mean range of 0.4 m. The Fish River drainage basin encompasses 14300 hectares and contributes approximately 73% to the total incoming freshwater flow with the Magnolia River supplying the rest. Mean combined discharge is 9 cubic meters per second; although freshets up to 4 times larger occur throughout the year. These characteristics result in a freshwater residence time of 13 days under average discharge conditions, with a range from 0.5 to 100 days. Salinity in Weeks Bay varies substantially both temporally and spatially. During periods of high flow in the river, salinity in the bay may be fresh from the head to the mouth, except in the deeper holes of the estuary that are not as easily flushed. However, during periods of low flow in the river, wind velocity and tidal stage are strong factors influencing salinity structure. Salinity greater than 25 ppt is infrequently observed in Weeks Bay and is usually restricted to the southern portion of the estuary near the mouth.

CDMO Edits – station measurements updated September 2025. Previous versions of the metadata were not updated and measurements listed were from the original weather station site.

The weather station is located on a reserved owned property, near a restored marsh, about 700 meters from the west bank of Fish River (30°25'14.5"N 87°49'46.6"W) north of highway 98, on a property known to locals as "Safe Harbor". The wind sentry, temperature/RH sensor, and PAR sensor are mounted at the heights listed in the Station Measurements table below. The barometric pressure sensor, height listed below, is located in the datalogger mounting box. Tipping bucket rain gauge is located 6.5m south southwest from the tower.

Station measurements

Tower and sensor heights	Height (<i>meters</i>)	Notes
Tower	6.1	Measurements were taken from the ground for the tower and all sensors
Temperature/Relative Humidity	2.0	
Barometric Pressure	1.7	In the enclosure mounted to the tower
Wind	5.3	
PAR	3.0	
Precipitation gauge	0.6	6.5m SSW from tower

SWMP Station Timeline

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
SH	P	Safe Harbor	30°25'14.5"N 87°49'46.6"W	01/02/2008 - Present	NA	NA
WB		Weeks Bay	30° 24.89' N 87° 49.56' W	01/01/2001 - 12/31/2007	Construction of buildings on site	

6) Data collection period –

Weather data has been collected since January 1, 2001 at Weeks Bay and since January 2, 2008 at the SH site. These metadata are applicable only to data collected from January 1, 2023 through December 31, 2023, 2023.

File start date and time	File end date and time
10/14/2022 09:15	01/23/2023 09:15
01/23/2023 09:30	03/21/2023 07:45
03/21/2023 08:00	04/21/2023 09:00
04/21/2023 09:15	05/16/2023 07:45
05/16/2023 08:00	07/21/2023 12:15
07/21/2023 12:30	08/29/2023 12:15
08/29/2023 21:30	10/25/2023 08:00
10/25/2023 08:15	12/21/2023 13:00
12/21/2023 13:15	01/23/2024 09:45

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 processed 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 2023.

NERR meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects –

As part of the SWMP long-term monitoring program, WKB NERR also collects 15-minute water quality data and monthly grab and diel samples for nutrient/pigment data which may be correlated with this meteorological dataset. These data are available at www.nerrsdata.org.

II. Physical Structure Descriptors

9) Sensor specifications –

Parameter: Temperature

Units: Celsius

Sensor type: Pt1000 Class A

Model #: EE181 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: $\pm 0.2^\circ\text{C}$ @ 23°C

SN. 20061600050157 new 2020, installed 07/21/2020 – 01/23/2023

SN. 2218160022732B 05/12/2022 (new), installed 1/23/2023 – current as of 12/31/2023

Parameter: Relative Humidity

Units: Percent

Sensor type: HC101

Model #: EE181 Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy: -15 to 40 °C: $\leq 90\% \text{ RH} \pm (1.3 + 0.003 \cdot \text{RH reading}) \% \text{ RH}$

-15 to 40 °C: $> 90\% \text{ RH} \pm 2.3\% \text{ RH}$

-25 to 60 °C: $\pm (1.4 + 0.01 \cdot \text{RH reading}) \% \text{ RH}$

-40 to 60 °C: $\pm (1.5 + 0.015 \cdot \text{RH reading}) \% \text{ RH}$

Temperature dependence of RH measurement: typically $0.03\% \text{ RH}/^\circ\text{C}$

Note: This sensor caps relative humidity values at 100%, measured values $> 100\%$ are altered to 100%

SN. 20061600050157 new 2020, installed 07/21/2020 – 01/23/2023

SN. 2218160022732B 05/12/2022 (new), installed 1/23/2023 – current as of 12/31/2023

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor

Model #: PTB-110 (CS-106)

Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +60°C;

Humidity: non-condensing

Accuracy: ± 0.3 mb at +20°C, ± 0.6 mb at 0°C to 40°C, ± 1 mb at -20°C to +45°C, ± 1.5 mb at -40°C to +60°C

Stability: ± 0.1 mb per year

SN. P4610095, November 2019, in service 07/21/2020 – 01/23/2023

SN. U1430487, New 2022, installed 1/23/2023 – current as of 12/31/2023

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 05108 Wind Monitor

Range: 0 - 100 m/s (224 mph)

Accuracy: ± 0.3 m/s

SN. WM00170033, new 2020, in service 07/21/2020 – current as of 12/31/2023

Parameter: Wind direction

Units: degrees

Sensor type: balanced vane, 38 cm turning radius

Range: 360° mechanical, 355° electrical

Accuracy: ± 3 degrees

SN. WM00170033, new 2020, in service 07/21/2020 – current as of 12/31/2023

Parameter: Photosynthetically Active Radiation (PAR)

Units: mmol m⁻² (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 $\pm$ 0.06% per °C

Stability: $\leq \pm 2\%$ change over 1 yr

Operating Temperature: -40°C to 70°C; Humidity 0 to 100%

Cosine Response: 45° zenith angle: $\pm 2\%$; 75° zenith angle: $\pm 5\%$

Sensitivity: 0.2mV per $\mu\text{mol s}^{-1} \text{m}^{-2}$

Multiplier: 0.025 (this does not change)

SN. 18786, calibrated 04/2021, in service 04/14/2021 – 01/23/2023

SN. 3903, New 2022, in service 01/23/2023 – current as of 12/31/2023

Parameter: Precipitation (specify if heated rain gauge)

Units: millimeters (mm)

Sensor type: Tipping Bucket Rain Gauge

Model #: TR-525

Rainfall per tip: 0.01 inch

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

Accuracy: $\pm 1.0\%$ up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr

SN. 79557-319, new 2020, in service 07/21/2020, Calibrated 01/12/2023

CR1000X:

The CR1000X has a total onboard memory of 128 MB of flash and 4MB of battery backed SRAM. There is 8 MB of flash memory reserved for loading the operating system and 1MB of flash reserved for configuration settings. SRAM is used for the CRBasic program operating memory, communication

memory, and data storage, with 72 MB of flash for extended data storage. Additional data storage expansion is available with a removable microSD flash memory card of up to 16 GB.

Serial Number: 13926

Date CR1000/CR1000X Installed: 07/21/2020 – current as of 12/31/2023

Date CR1000/CR1000X Calibrated: 2019 (new)

CR1000/CR1000X Firmware Version (s): CR1000X.Std.03.02 (date of update unknown)

CR1000/CR1000X Program Version(s): WKBSHMET_CR1000X_6.0.1_100720.CR1X

GOES transmitter:

Model number: TX321-G

Serial number: 2364

Date installed: 07/21/2020

10) Coded variable definitions -

Sampling station:	Sampling site code:	Station code:
Safe Harbor	SH	wkbSHmet

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/CR1000X, 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.

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>.

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.

The following sensors were considered out of calibration for part of 2023. Data collected with these sensors are suspect:

Temperature/relative humidity 01/01/2023 00:00 – 01/23/2023 09:15

Wind 07/21/2023 00:15 – 12/31/2023 23:45

Precipitation 01/01/2023 00:00 – 01/12/2023 13:45

The tipping bucket rain gauge was disconnected from the station while being calibrated on 01/12/2023 from 14:00 – 14:30. No precipitation occurred during the calibration, and the only tips recorded in the dataset were at 14:30. Total precipitation at 14:30 and cumulative precipitation from 14:30 until the end of the day at 01/13/2023 00:00 were corrected from 1.0 to 0.0.

01/23/2023 09:30 – 09:45 all parameters except total and cumulative precipitation were rejected due to the tower being lowered for sensor maintenance to swap the air temperature/relative humidity, barometric pressure, and PAR sensors.

06/19/2023 11:30 for total precipitation and through the end of the day for cumulative precipitation, data are considered suspect because rainfall exceeded the upper limit of the sensor range for the 15 minute total.