

Reserve Name WKB NERR Meteorological Metadata
Months and year the documentation covers – 01/2020 through 12/2020
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 CR1000/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. These data are also converted to graphic representation and posted on the Internet at <http://cast-net.disl.org/monitoringdata/nep/index.htm> hourly with the cooperation of the Mobile Bay NEP and the Dauphin Island Sea Lab. For more information on QAQC flags and QAQC codes, see Sections 11 and 12.

Scott Phipps is responsible for all 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 Safe Harbor (WKB SH) station on 07/31/06 and transmits data to the NOAA GOES satellite, NESDIS ID 3B01A578. 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>.

Data are collected for the entire year in Central Standard Time (CST).

The Campbell Scientific CR1000X datalogger uses 5-second data downloaded from the weather station sensors to calculate 15-minute data. The CR1000X stores only 15 minute data. Parameters measured are air temperature, relative humidity, barometric pressure, rainfall, wind speed and wind direction. Precipitation (mm), PAR (millimoles/m²), and Cumulative Precipitation (mm) are collected as 15 minute totals (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.) Periodically, sensors on the weather station are inspected for damage or debris. If any are found, it is repaired and/or cleaned. Sensors are removed and calibrated on an annual or every 2 year basis. The barometric pressure sensor was last calibrated 07/21/2020. A new PAR sensor, anemometer, temperature/relative humidity sensor and tipping bucket rain gauge were installed on 07/21/2020.

The 15-minute data are collected in the following formats for the **CR1000/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- every 2 years
- 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	shading

6) Data collection period

Weather data has been collected from January 1, 2001 at Weeks Bay and beginning January 2, 2008 at the SH site. These metadata are applicable only to data collected from January 1, 2020 through December 31, 2020.

File name	first	last	Notes
wkbSHmet122319	12/23/2019 @ 10:15	01/22/2020 @ 09:15	
wkbSHmet012220	01/22/2020 @ 09:30	02/12/2020 @ 18:45	
wkbSHmet021220	02/12/2020 @ 19:00	03/20/2020 @ 08:30	
wkbSHmet032020	03/20/2020 @ 08:45	04/02/2020 @ 11:30	

wkbSHmet040220	04/02/2020 @ 11:45	04/24/2020 @ 10:00	
wkbSHmet042420	04/24/2020 @ 00:00	05/16/2020 @ 13:30	
wkbSHmet051620	05/16/2020 @ 13:45	06/10/2020 @ 7:15	
wkbSHmet061020	06/10/2020 @ 7:30	07/21/2020 @ 9:15	
wkbSHmet072120	07/21/2020 @ 9:30	11/02/2020 @ 10:15	
wkbSHmet110220	11/02/2020 @ 09:30	01/08/2021 @ 11:00	

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 2020.

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

The Geological Survey of Alabama, in cooperation with the United States Geological Survey, maintains two rain gauges within the Weeks Bay watershed. One is located at the highway 98 Magnolia River overpass; the other is located at the highway 104 Fish River bridge. A new gauging station has been installed at the 32 bridge over the Fish River and data will soon be available.

Weeks Bay National Water Level Observation Network (WB NWLON) tide station data (Station 8732828) can be accessed at: <https://tidesandcurrents.noaa.gov/waterlevels.html?id=8732828>

As part of the SWMP long-term monitoring program, WKB 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 <https://cdmo.baruch.sc.edu/>

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

Serial number, 18471600025123 dates of calibration purchased new 03/03/2019 but calibration certificate says it was calibrated 03/12/2018. Put into service new on 05/02/2019.

Serial number 20061600050157 was put into service new on 07/21/2020 and is currently installed as of 12/31/2020.

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% RH/°C

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

Serial number, 18471600025123 dates of calibration purchased new 03/03/2019 but calibration certificate says it was calibrated 03/12/2018. Put into service new on 05/02/2019.

Serial number 20061600050157 was put into service new on 07/21/2020 and currently installed as of 12/31/2020.

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor

Model #: PTB110 (CS 106)

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

Humidity: non-condensing

Accuracy: $\pm 0.3 \text{ mb}$ at +20°C, $\pm 0.6 \text{ mb}$ at 0°C to 40°C, $\pm 1 \text{ mb}$ at -20°C to +45°C, $\pm 1.5 \text{ mb}$ at -40°C to +60°C

Stability: $\pm 0.1 \text{ mb}$ per year

SN. M0310163

Date of last calibration: 05/05/2017

Date of Sensor Use: 07/06/2017 – 07/21/2020

SN. P4610095 calibrated: November 2019 in service 07/21/2020 and currently installed as of 12/31/2020.

Parameters: Wind Speed and Wind Direction

Units: Wind speed - meter per second (m/s); Wind direction – compass degrees

Sensor type: RM Young Wind Monitor (marine version)

Model # 5106m

Range: 0 - 100 m/s; 360° mechanical
Accuracy: ± 0.3 m/s (± 0.6 mph) or 1% of reading
SN WM0071877 (cable SN 154738)
Date of last calibration/re-furbishment: 05/05/17
Dates of Sensor Use: 07/06/2017 – 07/21/2020

Sensor type: RM Young Wind Monitor (marine version)
Model # 05108-8m
Range: 0 - 100 m/s; 360° mechanical
Accuracy: ± 0.3 m/s (± 0.6 mph) or 1% of reading
SN WM0070033
Put in service new on 07/21/2020 and currently installed as of 12/31/2020.

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: $< \pm 2\%$ 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

SN. 21234; Date of last calibration: New May 2017
Dates of Sensor Use: 07/06/2017 – 07/21/2020
SN. 29466; Date of last calibration: New March 2020, put in service 07/21/2020 and currently installed as of 12/31/2020.

Parameter: Precipitation
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: $\pm 1.0\%$ up to 1 in./hr; $\pm 0, -3\%$ from 1 to 2 in./hr; $\pm 0, -5\%$ from 2 to 3 in./hr
Date of Last calibration: 05/02/2019
Model #: TR525
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; $\pm 0, -3\%$ from 1 to 2 in./hr; $\pm 0, -5\%$ from 2 to 3 in./hr
Date of Last calibration: new in March 2020 (SN 79557-319), in service 07/21/2020

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.

Note: this datalogger was manufactured in 2006, first installed at wkbSHmet in 2007. In continuous service until 04/2017 when it was removed for calibration and replacement of motherboard battery.

SN: 5578

Date CR1000 Installed: 07/06/2017 – 07/21/2020

Date CR1000 Calibrated: 05/05/2017

CR1000 Firmware Version (s): OS rev 31.03 installed May of 2017.

CR1000 Program Version(s): wkbWBmet_v5.5_070617.cri

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.

SN: 13926

Date CR1000/CR1000X Installed: 03/11/2020, officially in use 07/21/2020 – current as of 12/31/2020

Date CR1000/CR1000X Calibrated: new December 2019

CR1000X Firmware Version (s): CR1000X.Std.03.02(install date unknown)

CR1000X Program Version(s): wkbSHmet_CR1000X_6.0.1_100720.CR1X

10) Coded variable definitions

Sampling station:	Sampling site code:	Station code:
Weeks Bay	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
CVI*	Possible vandalism/tampering
CWE*	Significant weather event

13) Other remarks/notes

Data are missing due to equipment or associated specific sensors not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for “not a number” and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

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.**

Beginning in 2019 data from PAR sensor (SN 21234) were considered suspect, <1> (CSM), due to lower than expected readings. This continued into 2020. In addition, PAR values from 07/06/2020 00:15 – 07/21/2020 09:15 are suspect due to an out of calibration sensor. There was a noticeable jump in values when the CR1000X with PAR SN 29466 began collecting data on 07/21/2020 09:30. PAR data from that date and time until 09/02/2020 18:15 are not considered suspect but are coded with CSM to make users aware that even though the data appear to be accurate, there were issues with the cable and moisture intrusion and we do not know when that began. From 09/01/2020 18:30 until end of year, the PAR sensor (SN 29466) began recording elevated nighttime and negative numbers occasionally. Values <0.0 and elevated nighttime values >10.0 were rejected, <-3> [SSM](CSM) while all other PAR values are considered suspect. Upon returning both sensors to Apogee for troubleshooting it was found that the sensors were working correctly and in calibration except that there was a problem with water infiltration into the cable connection and when this water shorted out the sensor, it caused a negative reading.

Tropical Storm Christobal passed to the west of Weeks Bay with the outer wind bands reaching the SH met station early in the morning of 6/6/2020 and the effects of this wind field were gone by 6/9/2020. Peak winds reached 9.5m/s (21.25mph). We received 164.4mm (6.47 inches) of rainfall during this period, {CWE} {CSM}.

The SH weather station CR1000 logger was replaced by a CR1000X on 07/21/2020 at 09:30, {CSM}. There was no disruption in data collection when the CR1000X became the logger in use as both loggers were set up to run at the same time to determine if they were collecting the same data. The CR1000X was installed earlier in the year (03/11/2020) with a full set of new or re-calibrated sensors for the comparison. When the CR1000 was shut down on 7/21/2020 at 9:15, the CR1000X became the official SH met station along with the sensors that were installed for the comparison.

On 16 September, 2020 at 15:45 CST **Hurricane Sally** officially made landfall near Gulf Shores, AL. This site is a few miles south east of Weeks Bay. This was a strong category 2 hurricane that was slow moving with heavy rainfall and high sustained winds for 22 hours. The Weeks Bay weather station (wkbSHmet) recorded 17.62 inches of rain during this event. The watershed sustained quite a bit of damage resulting in the loss of the FR and MR water quality deployment sites, {CWE} {CSM}.

On 28 October, 2020 **Hurricane Zeta** came ashore near Houma, LA and tracked to the north of the Weeks Bay Reserve. Winds reached tropical storm strength and we received 41 mm rain. These winds cause more damage than was predicted due to the previous damage caused by hurricane Sally, {CWE} {CSM}.