Rookery Bay (RKB) **NERR Meteorological Metadata**
January – September 2025
Latest Update: October 9th, 2025

Note: This is a provisional metadata document; it has not been authenticated as of its download date. Contents of this document are subject to change throughout the QAQC process and it should not be considered a final record of data documentation until that process is complete. Contact the CDMO (cdmosupport@baruch.sc.edu) or reserve with any additional questions.

I. Data Set and Research Descriptors

1)Principal investigator(s) and contact persons –

a) Principal Investigator:

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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. The data were saved as monthly raw data files (.dat) onto a separate hard drive and backed up onto the Rookery Bay NERR server. 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.

Jenna Flickinger, Environmental Specialist I, was responsible for sensor calibration, monthly downloads, data management, and reporting.

3) Research objectives –

As part of the National Estuarine Research Reserve's (NERR) System-Wide Monitoring Program (SWMP), the principal objective was to record long-term meteorological data at Rookery Bay NERR to observe any environmental changes or trends over time. Secondary objectives included using the meteorological data to help document periodic biological and environmental events such as: fish kills, red tides, wildfires, prescribed burns, and hurricanes/tropical storms. It also supported other research conducted at the Reserve including providing valuable ancillary data for the reserve's water quality monitoring programs.

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the rkbuhmet station on 05/13/2006 and transmits data to the NOAA GOES satellite, NESDIS ID #3B01D3E8. The transmissions are scheduled hourly at one minute 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.

All data are collected in Eastern Standard Time (EST) for the entire year.

After inspection of the weather station, the data was uploaded from the CR1000X to a laptop. Field readings were recorded prior to data downloading from the nearest NOAA weather station, located at the Naples Municipal Airport (KAPF), approximately 11 miles away**.** Once the data was downloaded, live parameters were recorded from the CR1000X to compare to the data recorded from the Naples Municipal Airport to look for any obvious anomalies. The data was then converted to a .csv file using Microsoft Excel. After submitting the files to CDMO for automated primary QAQC as described in Section 2, the flagged data and graphs were reviewed within one week of the data download. Data were further flagged and coded based on the field notes and review of the graphs. There were no other analyses done on the meteorological data. If erroneous data were found the sensor(s) underwent troubleshooting to determine if there was a problem that warranted removal and repair.

The 15-minute data are collected in the following formats for the CR1000X:

Averages from 5-second data:

Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts)

Maximum and Minimum 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^2), 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
- CR1000X - every 5 years

5) Site location and character –

The RKBNERR spans approximately 110,000 acres (445.2 km2) of public lands on Florida's Gulf coast south of Naples. Approximately 5 percent (6,000 acres) are uplands and 95 percent (104,000 acres) are submerged lands. Within the submerged lands, 68,000 acres are open water, and 36,000 acres are mangroves. The Reserve covers approximately 40 percent of the Collier County coastline, from Gordon Pass in Naples southward to the northwestern boundary of Everglades National Park. Major habitats of the Reserve include extensive pristine subtropical mangrove-forested wetlands, undeveloped barrier islands, and some of the last remaining intact tropical hardwood hammocks and coastal scrub habitats in southwest Florida. The coastal ecosystem within the Reserve has national and international significance as the western edge of the Everglades ecosystem, yet it is located adjacent to one of the fastest developing coastal areas in the United States. DEP has designated all tidally connected waters within the boundaries of the Reserve as Class II and Outstanding Florida Waters (OFW).

Located in the Tropical Monsoon climatic group of Köppen–Geiger climate classification (1961), i.e., the area below a west-east line extending from Ft. Myers to Melbourne, and where the mean temperature does not fall below 17.7°C (64°F) in the coolest month of the year. Due to the influence of the warm-water Florida Current, the seasonal effects from the Gulf of Mexico Loop Current and its geographical position at 26° N latitude, the average annual temperature in the Rookery Bay area is about 24°C (75°F). Winter temperatures range from -1°C (ca. 30°F) to about 26°C (75°F), with cooler days and nights (10-15°C) in the months of January and February. Warming trends in April and May are frequently modified by blustery winds from the southwest off the Gulf of Mexico, and by late season cold fronts with northerly breezes. Summer high temperatures approach 35°C (95°F) or higher on occasion (Thomas 1974).

Rookery Bay and the vicinity have an annual rainfall of 50-55 inches (127-140 cm) per year (Thomas 1974). The heaviest average monthly rainfall, 8-9 inches per month, occurs from June through September. The lowest average rainfall, 1-2 inches per month, occurs from November through March. Approximately 66% of the total yearly rainfall occurs between the months of June and October. Southwest Florida lies in the seasonal tropical weather belt that channels hurricanes toward or along the coast. Historically, the area has been fortunate in that few severe hurricanes have come ashore.

An 18.2-meter tower housing the weather station are located approximately 0.08 km to the northwest of the environmental learning center building on a cleared area with a limestone dirt lot at about 1.8 m above sea level (latitude: 26° 03'00.24' N/ longitude: 81° 42'06.18' W). The weather station is approximately 2.5 miles upstream from the water quality site located in lower Henderson Creek. There is minimal natural vegetation below the tower and weather station. The weather station is approximately 9.1 meters – 60.6 meters away from the about 9-18 m high tree line surrounding it. The CR1000X enclosure box housing the GOES transmitter, battery, and the barometric pressure sensor were mounted approximately 1.2 m above the ground on a 2.7 m pole that was set in concrete next to the tower. The PAR and temperature/relative humidity sensors were mounted on a cross bar about 1.85 meters above the ground on the east and west sides of the pole respectively. The rain gauge was mounted 2.7 meters above the ground at the top of the pole. The WS425 ultrasonic wind sensor was mounted on the north side of the tower at about 18.2 meters above the ground (approximately 20 meters above sea level) and positioned for true north. Sensors were wired according to NERR SWMP Campbell Scientific CR1000/CR1000X Meteorological Monitoring Station SOP.

Station measurements:

Tower and sensor heights	Height (*meters*)	Notes
Tower	18.2	
Temperature/Relative Humidity	1.85	distance from the ground
Barometric Pressure	0.238	height in the enclosure
Wind	18.2	distance from the ground
PAR	1.85	distance from the ground
Precipitation gauge	2.7	distance from the ground

SWMP station timeline:

Station Code	SWMP Status	Station Name	Location	Active Dates	Reason Decommissioned	Notes
RKBUHMET	P	Upper Henderson Creek	26° 3' 0.24 N, 81° 42' 6.18 W	01/07/2004 – Current	NA	NA
RKBHCMET	P	Henderson Creek	26° 1' 29.64 N, 81° 43' 53.76 W	09/01/2001 – 12/01/2003	Insufficient Site Characteristics	Too close to buildings and tower too low

6) Data collection period –

Rookery Bay Reserve began collecting weather data at the Henderson Creek site intermittently from 1996-2001. In 2001 data was collected on a more regular basis. The weather station was moved to the Upper Henderson Creek site in 2004 and collected data from January 7, 2004 13:15 - June 12, 2009 08:30. Due to construction happening adjacent to the weather station, it had to be relocated 0.08 km northwest. Data began collecting from the adjusted Upper Henderson Creek site on October 28, 2009 at 12:10. The data collection for the third quarter began on July 23rd, 2025 at 13:30 and continued through September 30th, 2025 at 07:30.

File Start Date and Time	File End Date and Time
12/13/2024 09:30	**01/27/2025 09:00**
01/27/2025 09:15	**02/27/2025 12:15**
02/27/2025 12:30	**03/31/2025 11:30**
03/31/2025 11:45	**05/01/2025 13:00**
05/01/2025 13:15	**05/22/2025 11:00**
06/12/2025 13:45	**06/19/2025 12:15**
06/19/2025 12:30	**07/23/2025 13:15**
07/23/2025 13:30	**08/20/2025 08:45**
08/20/2025 09:00	**09/30/2025 07:30**

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 2024.

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, RKBNERR also collects 15-minute water quality data at five locations within the RKBNERR boundary. These data parameters include temperature, salinity, conductivity, pH, turbidity, dissolved oxygen, and depth. The principal objective of this study is to record long-term water quality data within Rookery Bay NERR to observe any physical changes or trends in water quality over time. The five sites were selected to represent various degrees of watershed hydrologic alteration. The Henderson Creek water quality monitoring station is located approximately 2.5 miles downstream from this weather station on upper Henderson Creek. Additionally, Rookery Bay participates in the SWMP long-term nutrient monitoring with monthly grab and diel samples for nutrient/pigment data. Parameters measured include soluble reactive phosphorus (filtered), ammonium (filtered), nitrite (filtered), nitrite + nitrate (filtered), and chlorophyll a. This data is available at www.nerrsdata.org.

Both water quality and nutrient data generated by RKBNERR have been used by the USACOE, USFWS, SFWMD and Florida DEP to analyze restoration targets established for the PSRP, which is a portion of the CERP.

In 2021, Florida DEP started using water quality and nutrient data to create an internal departmental data analysis dashboard to analyze the duration of hypoxia, trends and comparisons relating to dissolved oxygen (DO) and other analytes available for the continuous monitoring stations, change and patterns at those stations, including how the stations may relate to external factors. Florida DEP is also using SWMP data for the Statewide Ecosystem Assessment of Coastal and Aquatic Resources (SEACAR) project. The project will provide status and trends reporting through web-based access to data and assessments and a tiered reporting format for a variety of audiences.

Other significant water quality research and monitoring initiatives within the RKBNERR include regular monitoring by Florida Department of Environmental Protection's Division of Environmental Assessment and Restoration (https://floridadep.gov/DEAR) water quality assessment program, oyster reef/benthic crab survey (1999 – 2008), long-term fisheries survey (July 1998 - June 2013 and October

2015 - present), shark demographics survey (May 2000 - present) and shorebird mortality MST water quality study (July 2021 – present). The fisheries data are obtained through monthly trawls in the bays corresponding with the SWMP water quality sites to document the population dynamics in a variety of fish species, as well as commercially important invertebrates such as stone crabs, blue crabs, and pink shrimp. Shark demographic data are also collected monthly from the reference bays downstream of the PSRP through long-line and gillnet 'tag, measure and release' surveys. Benthic crabs were collected from oyster reefs using Hester-Dendy collection substrates at the four SWMP water quality stations. In July 2022, the journal *Estuaries and Coasts* published the NOAA paper, Too Much Freshwater, Not Enough, or Just Right? Long-Term Trawl Monitoring Demonstrates the Impact of Canals that Altered Freshwater Flow to Three Bays in SW Florida. Kendall, M.S., Williams, B.L., O'Donnell, P.M. et al. Estuaries and Coasts (2022). https://doi.org/10.1007/s12237-022-01107-4

The water quality and nutrient data are also used by visiting investigators/ researchers to support the research conducted within the Reserve.

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: ±0.2 °C @ 23°C
Serial number: 1949160000655A7
Dates of calibration: 09/10/2024
Dates of use: current as of 09/30/2024

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: ≤90% RH ± (1.3 + 0.003 • RH reading) % RH
–15 to 40 °C: >90% RH ± 2.3% RH
–25 to 60 °C: ± (1.4 + 0.01 • RH reading) % RH
–40 to 60 °C: ± (1.5 + 0.015 • RH reading) % 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: 1949160000655A7
Date of Calibration: 09/10/2024
Dates of Sensor Use: current as of 09/30/2024

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-106 (PTB110)
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
Serial Number: H1230003
Date of Calibration: 08/23/2023
Dates of Sensor Use: current as of 09/29/2023

Parameter: Wind speed
Units: meter per second (m/s)
Sensor type: Gill Windsonic 4-L
Model #: Windsonic 4-L
Range: 0-60 m/s or up to 134 mph
Accuracy: ± 2% of the reading @ 12m/s
Operating Temperature: -35 to 70°C

Serial Number: 19060044
Date of Calibration: 02/05/2019
Dates of Sensor Use: current as of 11/07/2019

Parameter: Wind direction
Units: degrees
Sensor type: Gill Windsonic 4-L
Model #: Windsonic 4-L
Range: 0° – 359°
Accuracy: ± 3°
Operating Temperature: -35 to 70°C

Serial Number: 19060044
Date of Calibration: 02/05/2019
Dates of Sensor Use: current as of 11/07/2019

Parameter: Photosynthetically Active Radiation (PAR)
Units: mmoles m-2 (total flux)
Sensor type: Quantum Sensor; high stability silicon photodiode (blue enhanced) in anodized aluminum case with acrylic diffuser
Model: CS310 (SQ-500)
Light spectrum waveband: 389 to 692 nm
Temperature dependence: –0.11 ± 0.04%/°C
Stability: < ±2% change over a 1-year period
Operating temperature: –40 to 70 °C
Cosine Response: ±5% at 75° zenith angle
Sensitivity: 0.01 mV per µmol/m2/s
Multiplier: 0.5 (this does not change)
Serial Number: SS_3541
Date of Calibration: 12/14/2021
Date of Sensor in Use: current as of 09/29/2023

Parameter: Precipitation
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TR525
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: 21099-498
Dates of calibration: 12/6/2024
Dates of use: current as of 12/6/2024

Datalogger:

CR1000X:
The CR1000X has a total onboard memory of 128 MB of flash and 4MB of battery backed SRAM. There are 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: 12960
Date CR1000X installed: 05/21/2020
Date CR1000X calibrated: 06/04/2025

CR1000X firmware version (s):
CR1000X_OS_07.02: 12/06/2024 – 06/04/2025
CR1000X_OS_8.2.1: Current as of 06/04/2025

CR1000X program version(s):
RKBUHMET_CR1000x_6.0.6_121224.CR1x: current as of 12/13/2024

GOES transmitter:
Model number: TX325
Serial number: 300003090
Date installed: 12/06/2024

10) Coded variable definitions -

Sampling station:	**Sampling site code:**	**Station code:**
Upper Henderson Creek	UH	rkbuhmet

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.**

Slightly negative nighttime PAR values that were recorded are considered suspect, <1> (CSM).

The CR1000X was removed from the tower on 05/22/2025 at 11:16, sent to Campbell Scientific for calibration and re-installed on 06/12/2025 at 13:48. Values for all parameters from 05/22/2025 11:15 through 06/12/2025 13:30 were flagged as <-2> [SSR]. The datalogger recorded NAN and out of range readings at 13:45 for all parameters when it was re-installed. Therefore, all readings on 06/12/2025 at 13:45 were flagged as <-3> [SMT]. No values were recorded for all parameters from 06/12/2025 14:00 through 06/12/2025 14:45 therefore values for all parameters are flagged as <-2> [SMT].

On 07/14/2025 an animal tampered with the wiring for the ATemp/RH sensor. This caused the sensor to record NAN values. All values for ATemp/RH were flagged as <-3> [SSM] from 07/14/2025 23:45 through 08/08/2025 14:15. The wire for the PAR sensor was also tampered with. The sensor began recording values of NAN on 07/15/2025 04:45. All values for PAR from 07/15/2025 04:45 through 08/08/2025 15:15 were flagged as <-3> [SSM].

On 09/05/2025 an animal tampered with the wiring for the Wind sensor. This caused the sensor to record NAN values. All wind parameter values were flagged as <-3>[SSM] from 09/05/2025 05:45 through 09/30/2025 07:30.

The BP sensor was installed on 9/29/2023 and was due to be swapped before 9/29/2025. BP data from 9/29/2025 0:00 through 9/30/2025 07:30 were flagged as <1> [SOC] for being out of calibration.

The PAR sensor was installed on 9/29/2023 and was due to be swapped before 9/29/2025. PAR data from 9/29/2025 0:00 through 9/30/2025 07:30 were flagged as <1> [SOC] for being out of calibration.

The ATemp/RH sensor was installed on 9/30/2025 and was due to be swapped before 9/30/2025. ATemp and RH data from 9/30/2025 0:00 through 9/30/2025 07:30 were flagged as <1> [SOC] for being out of calibration.

Acknowledgement: The data included with this document were collected by the staff of the Florida Department of Environmental Protection at the Rookery Bay National Estuarine Research Reserve with funding through NOAA's Estuarine Research Division. Any products derived from this data should

clearly acknowledge this source (please use the attached logos). This recognition is important for ensuring that this long-term monitoring program continues to receive the necessary political and financial support.