**Reserve Name** (HUD) **NERR Meteorological Metadata**

**Q1, January 1st –December31st, 2021**

**Latest Update:** May 11, 2021

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@belle.baruch.sc.edu](mailto:cdmosupport@belle.baruch.sc.edu)) or Reserve with any additional questions.

**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 (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.

The Research Assistant is responsible for data verification.

**3) Research objectives –**

The objective of this study is to monitor the meteorological conditions at the Tivoli Bays component site of the Hudson River National Estuarine Research Reserve. Measurements of air temperature, relative humidity, barometric pressure, precipitation, photosynthetically active radiation, and wind speed and direction are taken throughout the year at the Tivoli Bays Field Station. A water quality-monitoring program has been ongoing since 1991 at this component site, and the meteorological data will help provide ancillary data. This will help us to better understand the relationships between the atmospheric conditions and aquatic environments at this site.

In 2018, a “secondary SWMP” meteorological monitoring station was incorporated into the reserve. This station will provide a secondary source of the above mentioned protocol and parameters in the vicinity around the Norrie Point Environmental Center which is home to HRNERR offices. This station will provide supplemental data in conjunction with a newly established water quality station at the same location. The station has been operational since 2008 and historical data is available upon request.

**4) Research methods –**

Campbell Scientific data telemetry equipment was installed at the Field Station (FS) station on 11/14/2005 and transmits data to the NOAA GOES satellite, NESDIS ID #3B00B4F4. Identical telemetry equipment is installed at the Norrie Point (NP) monitoring station which transmits data to the NOAA GOES satellite, NESDIS ID # 3B01301A 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](http://cdmo.baruch.sc.edu/).

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)

Recommended calibration frequency for the MET station sensors:

- 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)

**5) Site location and character –**

The Hudson River National Estuarine Research Reserve (HUDNERR) is a multi-component site totaling approximately 5,000 acres. Each component of the reserve is referenced by River Mile (RM) of the Hudson River in New York State proceeding north from the southern tip of Manhattan (RM 0). The reserve includes the following four component sites: Piermont Marsh, Rockland County (RM 24)(41o02'30"N 73o54'15"W), Iona Island, Rockland County (RM 45)(41o18'15"N 73o58'45"W), Tivoli Bays, Dutchess County (RM 98)(42o02'15"N 73o55'10"W), and Stockport Flats, Columbia County (RM 124)(42o02'30"N 73o46'00"W). The Reserve sites are managed at the Norrie Point Environmental Center, the headquarters for the Reserve, in Staatsburg NY, Dutchess County (41°49'53"N, 73°56'32"W). The four component sites include open water, tidal wetland, and adjacent upland buffer habitats and are representative of the diverse plant and animal communities that occupy the salinity gradient within the Hudson River Estuary. Development within the watersheds of the four component sites ranges from predominantly urban/suburban to forested/agricultural.

The weather station (FS) is located at the Tivoli Bays component site in Annandale, NY (42°01'05.46"N 73°55'01.13"W). A 30 foot, aluminum tower is used to elevate some of the weather monitoring equipment. The tower is on the deck of an office building, on the west side, 9 feet (2.7m) off the ground. The wind anemometer, wind speed, and light sensors are located at the top of the tower, 39 feet (11.9m) off the ground. The datalogger and the barometric pressure sensor are enclosed within a fiberglass case attached to the tower, 12 feet (3.7m) off the ground. A heated rain gauge is next to the tower, attached to the building, 16 feet (4.9m) off the ground. The temperature/humidity sensor is next to the tower, attached to the deck handrail, 12 feet (3.7m) off the ground. GOES telemetry equipment includes a larger solar panel and battery, a larger enclosure to house the battery, a Campbell TX-312 transmitter, associated GPS for time synchronization and a Yagi antenna.

Although trees surround the area, the tree line begins approximately 60 feet (18.3m) from the tower in most directions. In past years the trees were at similar heights to the tower, but the sensors were not shaded at the location. However in recent years the surrounding forest canopy height has increased possibly leading to a decline in the accuracy of wind data during leaf-in months (typically May to October). The tower is approximately 1.2 miles (1.9km) southeast of the Tivoli South Bay water quality monitoring station, 2.3 miles (3.7km) southeast of the Tivoli North Bay water quality monitoring station, and 0.2 miles (0.3km) northwest of the Saw Kill Creek water quality monitoring station.

The NP weather station is located at the Norrie Point Environmental Center, the HRNERR headquarters in Staatsburg, NY ( 41°49'53"N, 73°56'32"W). A 30 foot, aluminum tower is used to elevate all of the weather monitoring equipment. The tower is anchored to the concrete patio, south of the HRNERR offices. It is situated directly adjacent (2 meters) to the Hudson River. The wind anemometer and wind speed sensors are located at the top of the tower, 30 feet off the ground. The datalogger and the barometric pressure sensor are enclosed within a fiberglass case attached to the tower, 6 feet off the ground. A heated rain gauge is attached to the tower, 8 feet off the ground. The temperature/humidity sensor is attached to the tower, 10 feet off the ground. A light sensor is attached to an arm protruding from the tower 12 feet off the ground. GOES telemetry equipment includes a larger solar panel and battery, a larger enclosure to house the battery, a Campbell TX-312 transmitter, associated GPS for time synchronization and a Yagi antenna. The station is surrounded by the Hudson River in all directions but Northeast. The tower is located approximately 60 feet from the building, which should minimize any impact from the structure.

SWMP Station Timeline

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station Code | SWMP Status | Station Name | Location | Active Dates | Reason Decommissioned | Notes |
| FS | P | Field Station | (42°01'05.46"N 73°55'01.13"W) | July 1999-present | NA | NA |
| NP | S | Norrie Point | (41°49'53"N  73°56'32"W) | Secondary SWMP January 1, 2018 - Present |  | Non-SWMP May 7, 2008-December 31 2017 |

**6) Data collection period –**

Weather data have been collected at the Field Station at Tivoli Bays since July 1999. Weather data provided in this document were collected between 01/01/2019 at 00:00 through 03/18/18 at 14:15.

Data Retrieval intervals were as follows:

**FS**

|  |  |
| --- | --- |
| 01/01/2021 @ 00:15 | 01/22/21 @ 10:45 |
| 01/22/21 @ 11:00 | 04/01/21 @ 11:15 |
| 4/01/21 @ 11:15 | 7/15/21 @ 11:15 |
| 07/15/21 @ 11:15 | 09/29/21 @ 13:15 |
| 09/29/21 @ 13:15 | 11/8/21 @ 11:45 |
| 11/8/21 @ 11:45 | 11/18/21 @ 12:45 |
| 11/18/21 @ 12:45 | 12/31/21 @ 23:45 |

**NP**

|  |  |
| --- | --- |
| 01/01/2021 @ 00:15 | 1/19/21 10:15 |
| 1/19/21 @ 10:15 | 3/5/21 @ 17:00 |
| 3/5/2021 @ 17:00 | 3/10/2021 @ 13:30 |
| 3/10/2021 @ 15:45 | 3/11/2021 @ 10:45 |
| 3/17/2021 @ 13:30 | 4/26/2021 @ 11:45 |
| 4/26/2021 @ 11:45 | 6/11/2021 @ 10:30 |
| 6/11/2021 @ 10:30 | 7/9/2021 @ 10:30 |
| 7/9/2021 @ 10:30 | 8/6/21 @ 12:45 |
| 8/6/2021 @ 12:45 | 8/10/21 @ 14:15 |
| 8/10/21 @ 14:15 | 9/15/21 @ 12:30 |
| 9/15/21 @ 12:30 | 10/19/21 @ 10:15 |
| 10/19/21 @ 10:15 | 12/2/21 @ 12:30 |
| 12/2/21 @ 12:30 | 12/31/21 @ 23:45 |

**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 process the data.  Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used.  The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement.  The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons.  The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:

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

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

**8) Associated researchers and projects –**

[

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

**II. Physical Structure Descriptors**

**9) Sensor specifications –**

Parameter: Temperature

Units: Celsius

Sensor type: Campbell Scientific 1000 Ω Platinum Resistance Thermometer

Model #:  EE-181-L Temperature and Relative Humidity Probe

Operating Temperature:  -40°C to +60°C

Range: -40°C to +60°C

Accuracy: ± 0.2 °C @ 23°C

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | 1645160D0139CC | 04/02/19 | 10/29/19-11/18/21 |
| FS | 170516000140F8 | 11/9/20 | 11/18/21 - Current |
| NP | 170516000153DE | 12/3/19 | 10/6/20 – Current |

Parameter: Relative Humidity

Units: Percent

Sensor type: Campell Scientific Capacitance RH Sensor

Model #: EE-181-L Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy at 23°C:  > +/- (1.3 + 0.003 \* RH reading) % (0 to 90% RH)  
 > +/- 2.3% RH (90 to 100% RH)

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | 1645160D0139CC | 04/02/19 | 10/29/19-11/18/21 |
| FS | 170516000140F8 | 11/9/20 | 11/18/21 - Current |
| NP | 170516000153DE | 12/3/19 | 10/06/20 – Current |

Parameter: Barometric Pressure

Units: millibars (mb)

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor

Model #: CS-106

Operating Range: Pressure: 600 to 1060 mb; Temperature: -40°C to +60°C;

Humidity: non-condensing

Accuracy: ± 0.5 mb @ 20°C; +/- 2 mb @ 0°C to 40°C; +/- 4 mb @ -20°C to 45°C; +/- 6 mb @ -40°C to 60°C

Stability: ± 0.1 mb per year

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | L1430917 | 4/1/2019 | 10/29/19 – 11/18/21 |
| FS | L1440691 | 11/9/2020 | 11/18/21 - Current |
| NP | N1230355 | 12/3/2019 | 10/06/20- Current |

Parameter: Wind speed

Units: meter per second (m/s)

Sensor type:

Model #: R.M. Young 05103-45 Wind Monitor

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

Accuracy: +/- 0.3 m/s or 1%

Parameter: Wind direction

Units: degrees

Sensor type: balanced vane, 57 cm turning radius

Range: 360°

Accuracy: +/- 3°

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | WM125766 | 4/3/19 | 10/29/19 – 11/18/21 |
| FS | WM140711 | 11/9/20 | 11/18/21 - Current |
| NP | WM125404 | 12/6/2019 | 10/06/20 - Current |

Parameter: Photosynthetically Active Radiation

Units: mmoles m-2 (total flux)

Sensor type: High stability silicon photovoltaic detector

Model #: Apogee SQ-110

Light spectrum waveband: 360 to 1120 nm

Temperature Response: < 1% at 5° to 40°C

Stability: <±2% change over 1 yr

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

Sensitivity: Sensitivity: 5 W m-2 mV-1 (0.2 mV W-1 m-2)

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | 17009 | 4/2019 | 10/29/19 – 11/18/21 |
| FS | 17012 | 11/1/20 | 11/18/21 - Current |
| NP | 17011 | 12/3/19 | 10/06/20 - Current |

Parameter: Precipitation (heated rain gauge)

Units: millimeters (mm)

Sensor type: Tipping Bucket Rain Gauge

Model #: RM52202-L

Rainfall per tip: 0.01 mm

Operating range: -20°C to +50°C (heated); Humidity: 0 to 100%

Accuracy: 2% up to 25 mm/hr, 3% up to 50 mm/hr

\*Both Stations were replaced in 2021 on the dates reflected below with the following sensor

Sensor type: Tipping bucket with magnetic reed switch

Model #: RainVue20

Rainfall per tip: 0.01 in

Operating range: 1°C to +70°C; Humidity: 0 to 100%

Accuracy: 1% (0-500 mm/h intensity of rainfall)

|  |  |  |  |
| --- | --- | --- | --- |
| **Station** | **Serial Number** | **Date of Last Cal** | **Dates of Sensor Use** |
| FS | TB27014-7 | 10/06/20 (In field) | 10/17/2017 – 11/18/21 |
| FS | \*212610 |  | 11/18/21 – Current |
| NP | TB11432 | 10/06/20 (In field) | 9/13/16-8/6/21 |
| NP | \*203321 |  | 08/06/21 - Current |

Transmitter

Model #: TX312

On-board memory: Non-volatile flash for setup parameters. 16 Kbytes for data.

Data Transmission Rates: 100, 300 and 1200 BPS

Transmit Power: 5.6 Watts for 100 and 300 bps, 11.2 watts for 1200 bps

Frequency range: 401.701 MHz – 402.09850 MHz

Channel bandwidth: 100/300 BPS 1.5 KHz; 1200 BPS 3 KHz

Time Keeping: Initial setting accuracy: ± 100 microseconds synchronized to GPS; Drift ± 10 milliseconds/day over operating temperature range; GPS scheduled updates are 1 at power up and once per day thereafter. Once every 28 hours required for continual operation.

Operating range: -40° to +60°C; Storage -50° to +70°C; 0-99% RH, non-condensing

Power requirements: 10.8 to 16 VDC, 5 mA during GPS fix and 2.6 Amps during transmission

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.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Station** | **Type** | **Front Serial Number** |  | **Rear Serial Number** | **Date of Cal** | **Dates of Sensor Use** |
| FS | CR1000x | 8215 |  |  | 01/17/2019 | 10/29/19-Current |
| NP | Cr1000 | 3047 |  | 003020 |  | 2/9/15 – 3/17/21 |
| NP | Cr1000x | 23320 |  |  | 12/16/2020 | 3/17/21 - Current |

**CR1000x Firmware Version (s):**

|  |  |  |
| --- | --- | --- |
| **Station** | **OS** | **Dates of Use** |
| FS | 5.0 | 03/17/21-Current |
| NP | 5.0 | 3/17/21 - Current |

**CR1000 Program Version(s):**

|  |  |  |
| --- | --- | --- |
| **Station** | **Program Name** | **Dates Used** |
| NP | HUDNPMET\_6.0.3\_092117 | 09/21/17 – 3/17/21\* |

\*Denotes end of Cr1000 use and switch to new CR1000x

**CR1000x Program Version(s):**

|  |  |  |
| --- | --- | --- |
| **Station** | **Program Name** | **Dates Used** |
| FS | HUDFSMET\_CR1000x\_6.1.1\_102919 | 10/29/19-Current |
| NP | HUDNPMET\_CR1000x\_6.0.0\_031721 | 3/17/21-Current |

**10) Coded variable definitions -**

Sampling station: Sampling site code: Station code:

Field Station FS hudfsmet

Norrie Point NP hudnpmet

**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.

Small negative PAR values are within range of the LI-COR sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the LI-COR sensor is +/- 2.214 mmoles/m2 over a 15 minute interval. These values are automatically flagged and coded as <1> (CAF).

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.**

**Data Flagged CRE or CWE**

**FS**

**2/15 @ 9:15 – 2/16 @ 00:00**

**3/28 @ 9:30 – 3/29 @ 00:00**

**5/3 @ 15:30 – 5/5 @ 00:00**

**7/17 @ 16:30 – 7/18 @ 00:00**

**NP**

**3/26 @ 02:15 – 3/27 @ 00:00**

**3/28 @ 9:15 – 3/29 @ 00:00**

**5/28 @ 15:00 – 5/30 @ 00:00**

**7/12 @ 12:30 – 7/13 @ 00:00**

**8/22 @ 12:45 – 8/24 @ 00:00**

**9/1 @ 7:15 – 9/2 @ 00:00**

**9/23 @ 17:30 – 9/25 @ 00:00**

**10/3 @ 22:30 – 10/5 @ 00:00**

**10/24 @ 21:00 – 10/27 @ 00:00**