

Hudson River (HUD) NERR Meteorological Metadata
January 01, 2016 – December 31, 2016
Latest Update: March 29, 2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

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2) Entry verification –

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from or 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.

Persons responsible for data verification are the Research Assistant and the Research Coordinator

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.

4) Research methods –

Campbell Scientific data telemetry equipment was installed at the Field Station on 11/14/2005 and transmits data to the NOAA GOES satellite, NESDIS ID #3B00B4F4. 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 in Eastern Standard Time (EST) for the entire year.

Data are backed-up to a PC file appended hourly via serial connection to the CR1000. The data are downloaded and pre-processed as described in Section 2.

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)(41°02'30"N 73°54'15"W), Iona Island, Rockland County (RM 45)(41°18'15"N 73°58'45"W), Tivoli Bays, Dutchess County (RM 98)(42°02'15"N 73°55'10"W), and Stockport Flats, Columbia County (RM 124)(42°02'30"N 73°46'00"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°01'05.52"N 73°55'01.20"W). A 30 foot (9.14m), 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 (1.9 km) 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.

SWMP Station Timeline:

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
HUDFSMT	Field Station	P	42° 1' 5.52 N, 73° 55' 1.20 W	01/01/2001 -	NA	NA

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 01/01/2016 @ 00:00 - 12/31/2016 23:45.

Data Retrieval intervals were as follows:

12/30/15 @ 13:00 – 01/27/16 @ 11:15
 01/27/16 @ 11:30 – 02/23/16 @ 13:45
 02/23/16 @ 14:00 – 04/28/16 @ 10:30
 04/28/16 @ 10:45 – 05/26/16 @ 10:30
 05/26/16 @ 10:45 – 06/22/16 @ 12:45
 06/22/16 @ 13:00 – 07/25/16 @ 13:00
 07/25/16 @ 13:15 – 08/02/16 @ 12:45
 08/02/16 @ 13:00 – 08/31/16 @ 08:45
 09/01/16 @ 14:45 – 10/26/16 @ 10:15
 10/26/16 @ 10:30 – 12/01/16 @ 13:15
 12/01/16 @ 13:30 – 12/21/16 @ 13:30
 12/21/16 @ 13:45 – 12/23/16 @ 14:00
 12/23/16 @ 14:15 – 01/12/17 @ 14:00

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 2016.

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 –

Associated researchers working at the Tivoli Bays component site include scientists from the Cary Institute of Ecosystem Studies in Millbrook, NY and Bard College, Annandale-on-Hudson, NY

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.

II. Physical Structure Descriptors

9) Sensor specifications –

Parameter: Temperature

Units: Celsius

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

Model #: HC2-S3 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy: ± 0.1 °C @ 23°C

Cable:

Serial Number: 61102825

Dates of Cable Use: 8/10/2015-12/23/2016

Serial Number: 20072771

Dates of Cable Use: 12/23/2016 – current as of 12/31/2016

Probe:

Serial Number: 61102825

Date of Last Calibration: 04/12/2013

Dates of Sensor Use: 10/02/2013 – 08/10/2015

Serial Number: 61366599
Date of Last Calibration: 08/28/14
Dates of Sensor Use: 08/10/2015 – 10/26/2016

Serial Number: 20045059
Date of Last Calibration: 09/09/2015
Dates of Sensor Use: 10/26/2016 – current as of 12/31/2016

Parameter: Relative Humidity
Units: Percent
Sensor type: ROTRONIC® Hygromer IN-1
Model #: HC2-S3 Temperature and Relative Humidity Probe
Range: 0-100% non-condensing
Accuracy at 23°C: +/- 0.8% RH with standard configuration settings
Temperature dependence of RH measurement +/- 3% (-40 to 60°C)

Serial Number: 61102825
Date of Last Calibration: 04/12/2013
Dates of Sensor Use: 10/02/2013 – 08/10/2015

Serial Number: 61366599
Date of Last Calibration: 08/28/14
Dates of Sensor Use: 08/10/2015 – 10/26/2016

Serial Number: 20045059
Date of Last Calibration: 09/09/2015
Dates of Sensor Use: 10/26/2016 – current as of 12/31/2016

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-105
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

Serial Number: W5040014
Date of Last Calibration: 09/12/2013
Dates of Sensor Use: 10/02/2013 – 08/10/2015

Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-106
Operating Range: Pressure: 500 to 1100 mb; Temperature: -40°C to +60°C;
Humidity: non-condensing
Accuracy: ± 0.3 mb @ 20°C; +/- 0.6 mb @ 0°C to 40°C; +/- 1.0 mb @ -20°C to 45°C;
+/- 1.5 mb @ -40°C to 60°C
Stability: ± 0.1 mb per year

Serial Number: L1440691
Date of Last Calibration: 04/07/2015
Dates of Sensor Use: 08/10/2015 - current as of 12/31/2016

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°

Serial Number: WN125766
Date of Last Calibration: 04/23/2013
Dates of Sensor Use: 10/02/2013 – 09/11/2015

Serial Number: WM140711
Date of Last Calibration: 05/29/2015
Dates of Sensor Use: 09/11/2015 – Current as of 12/31/2016

Parameter: Photosynthetically Active Radiation
Units: mmol m⁻² (total flux)
Sensor type: High stability silicon photovoltaic detector (blue enhanced)
Model #: LI190SB
Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.15% per °C maximum
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%
Sensitivity: typically 5 µA per 1000 µmol s⁻¹ m⁻²

Serial Number: Q30333
Multiplier Value: 1.35
Date of Last Calibration: 09/06/2013
Dates of Sensor Use: 10/02/2013 – 08/10/2015

Parameter: Photosynthetically Active Radiation
Units: mmol 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)

Serial Number: SQ-110_17012
Multiplier: 0.025 (this does not change)

Date of Last Calibration: Nov 2014
Date of Sensor Use: 08/10/2015 - current as of 12/31/2016

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

Date of Calibration: 10/07/2014
Dates of Sensor Use: 10/07/2014 – 08/10/2015

Date of Calibration: 08/10/2015
Dates of Sensor Use: 08/10/2015 – Current as of 12/31/2016

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.

CR1000 Data Logger
Serial Number 5083
Date of Calibration: 06/05/2006
Date of Installation: 01/18/2007

CR1000 Data Logger
Serial Number J8743
Date of Calibration: 03/2013
Date of Installation: 10/02/2013 - current as of 12/31/2016

CR1000 Firmware Version (s):

OS 24 Installed on 03/19/2012
OS 26 Installed on 10/03/2013

OS 29 Installed on 02/23/2016

CR1000 Program Version(s):

HUFSMET_6.0.1_081315

Dates Used: 08/13/2015 - Current as of 12/31/2016

10) Coded variable definitions -

Sampling station:	Sampling site code:	Station code:
Field Station	FS	hufsmet

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, 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 sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the Licor sensor is +/- 2.214 mmol/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 Coded CRE (Significant Rain Events)

Anything >20mm over 24 hours was considered a significant rain event.

01/10/16 @ 05:45 – 01/10/16 @ 17:00 total precipitation, 01/11/16 00:00 cumulative
02/23/16 @ 14:00 – 02/25/16 @ 15:45 total precipitation, 02/26/16 00:00 cumulative
06/05/16 @ 01:00 – 06/05/16 @19:00 total precipitation, 06/06/16 00:00 cumulative
07/08/16 @ 16:45 – 07/10/16 @00:00 total and cumulative precipitation
08/10/16 @ 07:00 – 08/10/16 @09:45 total precipitation, 08/11/16 00:00 cumulative
10/27/16 @ 07:45 – 10/27/16 @ 23:00 total precipitation, 10/28/16 00:00 cumulative
11/15/16 @ 08:45 – 11/15/16 @ 23:15 total precipitation, 11/16/16 00:00 cumulative
11/29/16 @ 08:00 – 11/29/16 @ 22:15 total precipitation, 11/30/16 00:00 cumulative
11/30/16 @ 05:45 – 12/01/16 @ 04:30 total precipitation, 12/01/16 00:00 cumulative
12/17/16 @ 05:00 – 12/18/16 @ 12:00 total precipitation, 12/19/16 00:00 cumulative

All Data flagged <-2> GMT CSM and <-3> GPD CSM

08/31/16 @ 09:00 - 09/01/16@ 14:30 Data flagged <-2> GMT CSM are missing due to power being turned off to the station and the tower being disassembled in order for the decking under the tower to be replaced during site maintenance. The tower was reassembled in its original location and orientation after the decking project was completed. All data at 09/01/16 14:45 were rejected due to not being a full 15 minutes of 5-second data.

Data from the period 12/01/2016 @13:30 - 12/01/2016 @14:00 are rejected or missing due to powering down the station to field calibrate the precipitation rain gauge.

Air temperature and relative humidity data flagged<-3> SSM CSM

Data flagged <-3> SSM CSM are rejected due to the failure of the Temp/RH probe cable/handle from the period 12/21/16 @ 13:45 – 12/23/16 @ 14:15