

Hudson River (HUD) NERR Meteorological Metadata  
January 2008 - December 2008  
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## I. Data Set & Research Descriptors

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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 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 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 Coordinator is responsible for data management and data entry 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.

### 4. Research methods:

For routine maintenance, sensors are investigated at least once a month to ensure there is no damage or blockage to the sensors. According to Campbell Scientific, sensors are to be calibrated,

depending on the sensor, yearly or every two 2 years for proper data collection. After that time, the sensors are removed from the tower, and shipped to their respective manufacturers for proper and professional calibration. In order to avoid missing data, a second set of sensors is calibrated and available to be installed on the tower to continue data collection

For data collection, the CR1000 datalogger is programmed to collect data in the following formats:

i) 15-minute data are averages of 5-second readings for Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees) and Battery Voltage (Volts).

ii) 15-minute data are totals of 15-minute readings for Total Precipitation (mm), Total Photosynthetically Active Radiation (PAR) (mmoles/m<sup>2</sup>) and Cumulative Precipitation (mm) (began collecting as a standard parameter on 5/5/2008).

The highest or lowest 5-second readings within the 15-minute data are recorded as follows: Maximum Air Temperature (°C), Maximum Air Temperature Time (hh:mm), Minimum Air Temperature (°C), Minimum Air Temperature Time (hh:mm) (maximum and minimum air temperatures and times are not included in the dataset, but are available from the HUD Reserve), Standard Deviation Wind Direction (Deg) (began collecting as a standard parameter in 2008 , Maximum Wind Speed (m/s), Maximum Wind Speed Time (hh:mm) (began collecting as a standard parameter in 2008 ).

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. QA/QC flags are applied on the following anomalous data criteria:

Air Temperature:

-Sample not greater than 45 C or less than -40 C

Relative Humidity:

-Sample not greater than 100% or less than 0%

Pressure:

-Pressure greater than 1060 mb or less than 900 mb

Wind Speed:

-Wind speed greater than 30 m/s

Wind Direction:

-Wind direction not greater than 360 degrees or less than 0 degrees

Rainfall:

-Precipitation not greater than 25 cm in 15 min

Photosynthetically Active Radiation (PAR)

-Sample not greater than 5000 mmol/m<sup>2</sup> or less than 0 mmol/m<sup>2</sup>

Time:

-15-minute interval recorded

Campbell Scientific data telemetry equipment was installed at the field station on 11/14/2005 at 16:30 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>.

## 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°01'05.46"N 73°55'01.13"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 (11.9) feet 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 from the tower in most directions. The trees are at similar heights to the tower, but the sensors are not shaded at that location. The tower is approximately 1.2 miles Southeast of the Tivoli South Bay water quality monitoring station, 2.3 miles Southeast of the Tivoli North Bay water quality monitoring station, and 0.2 miles Northwest of the Saw Kill Creek water quality monitoring station.

## 6. Data collection period:

Weather data have been collected at the Field Station at Tivoli Bays since July 1999. Weather data were collected for the entire year in 2008 from January 1 at 00:00 to December 31 at 23:45.

## 7. Distribution:

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program, NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance/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.

NERR weather data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Section 1 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 <http://cdmo.baruch.sc.edu/>. Data are available in comma separated format.

#### 8. Associated researchers and projects:

The Hudson River NERR water quality-monitoring program examines the physical and chemical constituents of the tributary waters and the tidal waters of the freshwater tidal marshes at the Tivoli Bays component site. Measurements include seston, dissolved oxygen, alkalinity, pH, temperature, salinity, conductivity, and concentrations of nitrate, phosphate, sulfate, and chloride. These data are used to identify long-term trends and to determine the relationship between meteorological conditions and the aquatic environments at this site.

Associated researchers working at the Tivoli Bays component site include scientists from the Cary Institute of Ecosystem Studies in Millbrook, NY, Yale School of Forestry and Environmental Studies in New Haven, CT, Bard College, Annandale-on-Hudson, NY, Simon's Rock College, Great Barrington, MA, Cornell University Center for the Environment, Cornell Institute for Resource Systems, Cornell Department of Natural Resources, Ithaca, NY, State University of New York College of Environmental Science and Forestry, Syracuse, NY and Rensselaer Polytechnic Institute in Troy, NY.

## II. Physical Structure Descriptors

#### 9. Sensor specifications, operating range, accuracy, date of last calibration:

Parameter: Temperature

Units: Celsius

Sensor type: Platinum resistance temperature detector (PRT)

Model #: HMP45C Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -40°C to +60°C

Accuracy:  $\pm 0.2$  °C @ 20°C  
Date of Last calibration: August 25, 2008

Parameter: Relative Humidity  
Units: Percent  
Sensor type: Vaisala HUMICAP® 180 capacitive relative humidity sensor  
Model #: HMP45C Temperature and Relative Humidity Probe  
Range: 0-100% non-condensing  
Accuracy at 20°C:  $\pm 2\%$  RH (0-90%) and  $\pm 3\%$  (90-100%)  
Temperature dependence of RH measurement:  $\pm 0.05\%$  RH/°C  
Date of Last calibration: August 25, 2008

Parameter: Barometric Sensor  
Units: millibars (mb)  
Sensor type: CS-105 Vaisala Barocap © silicon capacitive pressure sensor  
Model #: PTB101B  
Operating Range: Pressure: 600 to 1060 mb; Temperature: -40°C to +60°C;  
Humidity: non-condensing  
Accuracy:  $\pm 0.5$  mb @ 20°C;  $\pm 2$  mb @ 0°C to 40°C;  $\pm 4$  mb @ -20°C to 45°C;  $\pm 6$  mb @ -40°C to 60°C  
Stability:  $\pm 0.1$  mb per year  
Date of Last calibration: May 9, 2007

Parameter: Wind speed  
Units: meter per second (m/s)  
Sensor type: 18 cm diameter 4-blade helicoids propeller molded of polypropylene  
Model #: R.M. Young 05103 Wind Monitor  
Range: 0-60 m/s (130 mph); gust survival 100 m/s (220 mph)  
Accuracy:  $\pm 2\%$   
Date of last calibration: December 5, 2008

Parameter: Wind direction  
Units: degrees  
Sensor type: balanced vane, 38 cm turning radius  
Model #: R.M. Young 05103 Wind Monitor  
Range: 360° mechanical, 355° electrical (5° open)  
Accuracy:  $\pm 5\%$   
Date of last calibration: December 5, 2008

Parameter: LI-COR Quantum Sensor  
Units: mmol m<sup>-2</sup> (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:  $\leq \pm 2\%$  change over 1 yr  
Operating Temperature: -40°C to 65°C; Humidity: 0 to 100%  
Sensitivity: typically 5  $\mu$ A per 1000  $\mu$ moles s<sup>-1</sup> m<sup>-2</sup>  
Multiplier: 1.72 as of 1/10/2008  
Date of last calibration: May 9, 2007

Parameter: Precipitation (heated rain gauge)

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: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr  
Date of Last calibration: September 16, 2008

#### 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:  $\pm 100$  microseconds synchronized to GPS; Drift  $\pm 10$  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  
Date CR1000 Installed: January 18, 2007

#### 10. Coded variable indicator and variable code definitions:

|                              |                     |               |
|------------------------------|---------------------|---------------|
| Sampling Station:            | Sampling Site Code: | Station Code: |
| Field Station at Tivoli Bays | FS                  | hudfsmet      |

#### 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.

### 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

|     |                                                      |
|-----|------------------------------------------------------|
| SIC | Incorrect Calibration Constant, Multiplier or Offset |
| SNV | Negative Value                                       |
| SOC | Out of Calibration                                   |
| SSN | Not a Number / Unknown Value                         |
| SSM | Sensor Malfunction                                   |
| SSR | Sensor Removed                                       |

### Comments

|     |                                                 |
|-----|-------------------------------------------------|
| CAF | Acceptable Calibration/Accuracy Error of Sensor |
| CDF | Data Appear to Fit Conditions                   |
| CRE | Significant Rain Event                          |
| CSM | See Metadata                                    |
| CVT | Possible Vandalism / Tampering                  |

## 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 mmoles/m<sup>2</sup> over a 15 minute interval.

Relative Humidity (RH) values periodically are slightly greater than 100% throughout the year. The observed values, of +1 to 3%, are within the error range of the sensor and have been retained. The values can be attributed to a super-saturation event.

Cumulative precipitation data are recorded from 00:00 to 23:59 with the daily total recorded at the midnight mark (00:00). The midnight CumPrecp value is actually the total from the previous day.

All Reserves were required to align their wind direction sensors to True North by April, 1 2008. HUD NERR aligned the wind sensor to True North on 1/10/2008.

CSM – data coded “See Metadata”

1/1/08 00:00 – 1/10/08 10:15

The wind sentry was rewired & realigned on 1/10/08 between 10:10 and 10:20. Thus wind speed data only valid from 1/10/08 10:45. Old program (LoggerNet) installed (v4 from June 07) at 09:25 on 1/10/08. All parameters were rejected at 9:30 on 1/10/08 because of the program upload.

1/10/08 09:30 – 1/11/08 10:15

Total PAR data rejected for above period due to incorrect calibration - A PAR multiplier (1.72) was added on 1/11/08 @ 10:18. Data valid from 1/11/08 10:45.

5/5/08 10:30

The system was powered down in order to install a new program (v5.5 041608), causing a missed data point. PAR multiplier added (1.72). Data valid from 11:00.

7/29/2008 16:15 -19:00 and 8/6/2008 10:15 - 8/22/2008 13:30

BP data rejected due to abnormally low values, assumed to be caused by a sensor malfunction

8/25/08 13:30

The system was powered down at 13:15 in order to replace Temperature and Relative Humidity sensors with newly calibrated ones, causing a missed data point. System powered up at 13:40. Data are valid from 14:00.

9/16/08 12:15 – 12:45

The system was powered down at 12:10 in order to calibrate the Tipping Bucket Rain Gauge, causing missed data points. The system was powered up again at 12:55. Data are valid from 13:15.

9/16/08 17:30-19:15

All wind data were rejected. The anemometer and wind direction appeared to be stuck. From 9/16/08 16:15-17:15 and 9/16/08 19:30-9/17/08 7:15, wind speed and max wind speed were flagged as suspect due to the possibility of the anemometer being stuck.

12/5/08 9:30 – 10:15

Wind data invalid due to sensor swap. The wind sentry (model 03002) was swapped for a newly calibrated wind sentry (model 03001 – the correct model). System was not powered down but all wind data are invalid for the period listed above.

If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.