

Wells (WEL) National Estuarine Research Reserve
Provisional Meteorological Metadata
January-December 2014
Latest Update: July 18, 2017

I. Data Set & Research Descriptors

1) Principal investigator & contact persons:

Contact Persons:

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2) Entry verification:

a) Data Input Procedures:

The meteorological information is sampled every 5 seconds from each instrument on the weather station and stored on a Campbell Scientific CR1000 data logger. The CR1000 has two MB Flash EEPROM that is used to store the Operating System and another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM (4 MB optional) is available for program storage (16K), operating system use, and data storage.

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. Jeremy Miller is responsible for all aspects of data management.

3) Research Objectives:

The principal objective is to record long-term meteorological data for Wells, in order to supplement SWMP water quality YSI data and research data, and to observe any environmental changes or trends over time.

4) Research Methods:

The CR1000 datalogger samples every 5 seconds continuously and 15 minute averages are produced and recorded as 15 minute data. This data is stored within the CR1000 until it is manually downloaded through LoggerNet and uploaded to the CDMO for initial QA\QC procedures.

Campbell Scientific data telemetry equipment was installed at the Laudholm Farm Weather station on 07/11/06 and transmits data to the NOAA GOES satellite, NESDIS ID #3b024184. 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>.

Sensors on the weather station are inspected monthly for damage or debris. Sensors are removed and replaced with recently calibrated sensors approximately every two years, with the exception of the rain gauge and Temp/Humidity probe, which is calibrated approximately every year. Also, once a month on download day, we use regional NWS data, to run a comparative set of observations as a general check on the Campbell station sensors and hardware.

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)

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), and Battery Voltage (volts)

Maximum, Minimum, and their times from 5-second data:

Maximum and Minimum Air Temperature (°C) and their times (these data are available from the Reserve)

Maximum Wind Speed (m/s) and time

Wind Direction Standard Deviation (degrees) from 5-second data

Totals:

Precipitation (mm), PAR (millimoles/m²), and Cumulative Precipitation (mm)

5) Site location and character:

The Wells National Estuarine Research Reserve (and Laudholm Farm Meteorological station) is located in York County, within the Town of Wells, on the coast of southern Maine and faces the Atlantic Ocean at an elevation of 18.62 meters above sea level. The Wells NERR is approximately 31 km (20 miles) south of Portland, Maine and 110 km (70 miles) north of Boston, Massachusetts. The Reserve encompasses 1,690 acres along the Gulf of Maine coastline of tidally flushed wetlands, riparian and transitional upland fields and forests within the Little River Estuary and the larger Webhannet River Estuary. Both estuaries arise in the sandy glacial outwash plain about eight miles inland. Both rivers empty into Wells Bay, a sandy basin stretching for approximately ten miles along the Atlantic coast. Bordering each river's inlet are double spit barrier beaches attached to the mainland. The backbarrier system is approximately 5 sq. km and is composed of large intertidal marshes (predominantly *S. patens* and *S. alterniflora*), intertidal sand and mud flats, and tidal channels. The watershed for the Webhannet River estuary covers an area of 35 sq. km and has a total of 6 streams, brooks or creeks, which enter the estuary. These tributaries flow across sand and gravel deposits near the headwaters and the impermeable sandy mud of the Presumpscot Formation in the lower reaches. The Webhannet River is connected to the ocean via Wells Inlet, which has a spring tidal prism of 28,200,000 cub. m (Ward 1993). The force and volume of tidal action affect the salinity level of both rivers. In the Wells region, the annual mean wave height is almost 20 inches. The estuarine system is dominated by semi-diurnal tides having a range of 8.5 to 9.8 feet. The volume of freshwater influx into both estuaries is moderate to low (on the order of 0.5 cubic meters/second), especially in the summer, because of the rivers' relatively small drainage areas and the presence of deep glacial deposits. The relatively low flows from these two rivers taken in with the 20 inch per year average runoff of the area surrounding the estuaries combine to form a freshwater flow that is dwarfed by tidal flushing. Twelve-foot tides dwarf the freshwater flow into the Webhannet estuary, which has a drainage area of 14.1 square miles. The Webhannet estuary, fed by both Blacksmith and Depot Brooks, is adjacent to the harbor and greatly developed land. It offers a valuable opportunity for comparison with the relatively pristine Little River estuary. The land use of the Webhannet estuary include a total of 15% for wetland, fresh water, and tidal marsh; a total of 63.7 % for woodland; and a total of 18.6% for developed land (compared to a total of 5.7% development in the Little River estuary) (WNERR RMA 1996; Holden 1997).

The following information regarding annual weather patterns in the area was supplied by Maine State Climatologist Professor Gregory A. Zielinski extracted from "Monthly Station Normals of Temperature, Precipitation, Heating and Cooling Degree Days 1971-2000", Climatology of the United States No. 81, National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, NC. and "Daily Normals of Temperature, Precipitation, and Heating and Cooling Degree Days, 1971-2000", Climatology of the United States No. 84: "Average monthly temperatures range from 21.6F in January to 66.7F in July with daily highs averaging just below freezing in January and lows around 11F. Daily highs in July average around 76F and daily lows around 57F. The sea breeze often keeps daily highs lower during the summer than areas inland. Annual average temperature is 44.6F. Annual precipitation is 47.07 inches, including the water equivalent of snowfall, with monthly averages ranging from 3.01 inches in July to 4.77 inches in October. August receives just 3.02 inches on average. Annual snowfall is around 66 inches." According to Zielinski, "cool ocean temperatures keep down the number of afternoon showers and especially thunderstorms resulting in low summer precipitation amounts."

The weather station is located (43 deg 20' 14.52" N, and 70 deg 32' 58.03" W) on a 32' (9.75m) telephone pole surrounded by mowed grass. The temperature and humidity probes are located on the north side of the pole at a height of 10' (3.0m). The PAR sensor is located on the South side of the pole at a height of approx. 15' (4.6m). The Barometric pressure sensor is located within the Campbell Scientific enclosure at a height of approx. 5' (1.5m) and vented to the outside by a small length of aquarium tubing. The wind sensor is located atop the pole at approximately 33 feet (10.1m) above the ground. To the NW of the pole is the Coastal Ecology Center, a 20' (6.1m) high, 111' (33.8m) long building, at a distance of 37' (11.3m), running NE/SW. Further to the NW (153' (46.6m) from the pole) is the library, in a 25' (7.6m) high wing of the barn. The barn itself is 223' (68.0m) from the station and runs NE/SW. It is 38' (11.6m) high and is the largest obstruction in the area. The rain gauge is located 9' (2.7m) southeast of the weather station pole and is situated on a post with the top of the funnel is 10' (3.0m) from the ground.

There are two SWMP water quality sampling sites in the Webhannet River estuary. These are located at the Webhannet River Head of Tide, at the Webhannet Inlet, at Skinner Mill on the Merriland River. The tidal range at each of these sites is 2.6-2.9 meters. The Inlet site is approximately 2.25km from our weather station and the Head of Tide site is approx. 5.37km from our weather station.

6) Data collection period: Weather data has been collected at the Wells NERR since December 1996. Data was collected for the entire year in 2014 from 1/1/2014 00:00 to 12/31/2014 23:45, with the exception of occasional gaps in the data which are due to weather station maintenance and program upload.

7) Distribution:

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program:

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 2012.

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:

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2014
(Please visit our website: www.wellsreserve.org/research.htm for further information on the Wells NERR research program):

The Research Program at the Wells NERR conducts and supports research, monitoring, workshops, and research/resource management planning of relevance at local, regional and national levels. The overall aim of our work is to produce science-based information needed to sustain or restore Gulf of Maine coastal habitats and resources, especially those found in salt marsh estuaries and watersheds. During 2014, many different studies involving scores of scientists, students, staff and volunteers focused on several related themes: 1) the quality of water resources in salt marsh estuaries and watersheds 2) land conservation strategies to protect coastal watersheds 3) factors controlling salt marsh accretion, erosion and plant community vigor 4) the impacts of invasive species on native habitat and species, 5) restoration of salt marsh habitat degraded through human actions, and 6) the restoration of anadromous fish passage in a number of streams and rivers in southern Maine.

Estuarine Water Resource Quality

Water quality is monitored continuously at four long term monitoring stations with automated instruments as part of a NERRS system wide monitoring program. Monthly nutrient sampling also occurs at these sites (see NERRS SWMP Nutrient metadata). We have worked with the Maine Department of Environmental protection to collect nutrient and water quality data in several Maine estuaries using SWMP protocols. Our water quality work has contributed to the designation of several Priority Watersheds in coastal Southern Maine by the Maine Department of Environmental Protection.

Seacoast Watershed Information Manager (Project S.W.I.M.)

The Seacoast Watershed Information Manager (Project S.W.I.M.) will be an online resource to help local planners and the public evaluate, conserve, and restore coastal watershed resources along the Maine and New Hampshire seacoast by developing a website that describes the region and its resources, provides access to GIS data and other relevant information, and includes a decision-support tool that examines the impact of growth and development on water resources. It will include:

- A Narrative that informs local resource planners and the public by describing development impacts, water resources, and land use.
- Socioeconomic Analysis focused on water resource use as it relates to human activities.
- Land Use Change Assessments focusing on shoreland and permeability.
- A Data Clearinghouse providing users access to key data needed for local and regional-scale resource management.
- A GIS-based Decision Support Tool to help communities manage and protect water resources by considering how water supply, water quality and land use change are affected by land use planning decisions.

The Project focuses on the coastal watersheds from the Cocheco and Salmon Falls River in New Hampshire to the Kennebunk River in Maine. These 15 watersheds include 38 municipalities and cover 1,800 square miles. The Wells National Estuarine Research Reserve is the lead partner with support from NOAA's Coastal Services Center Landscape Characterization and Restoration Program and the Great Bay National Estuarine Research Reserve.

Salt Marsh Habitats and Communities

Factors that control the dynamics and vigor of salt marsh plant communities and marsh peat formation consequently determine the ability of a salt marsh to persist in the face of sea level rise. Through a combination of experimental manipulations and long term monitoring, a number of multi-year studies are currently producing data to answer questions concerning the sustainability of salt marsh habitats in this region. These studies are looking at nutrient-plant relations, plant community responses to physical and hydrologic disturbance, and the relative contribution of short-term natural events (e.g. storms) and human activities (dredging, tidal restriction) on patterns of sediment accretion and erosion. The Reserve's marshes and beaches are already among the best studied sites in the U.S. with regard to long term accretion and erosion (over thousands of years).

HABITAT VALUE FOR FISH, SHELLFISH AND BIRDS

The Reserve combines long-term monitoring with periodic surveys and short-term experiments to identify species and measure trends and changes in populations of fish, crustaceans, clams and birds. We have 10 years of data on upland and shore birds with which to assess the status of resident and migratory avian populations, and several years of wading bird data that we use as a gross level indicator of salt marsh health, which appears to be stable. Our periodic larval, juvenile and adult fish surveys have produced the best available data for fish utilization of salt marsh estuaries in the Gulf of Maine. Since 1994 we have been conducting surveys and field experiments to look at the survival and growth of hatchery seed, juvenile and adult softshell clam with regard to habitat characteristics and predation by the invasive green crab. Benthic invertebrates have been sampled from a number of marshes from Wells to Casco Bay in hopes of gaining a better understanding of invertebrate assemblage and their value to higher trophic levels.

Salt Marsh Degradation and Restoration

Salt marsh ecosystems in the Gulf of Maine have sustained themselves in the face of sea-level rise and other natural disturbances for nearly five thousand years. Since colonial times large areas of salt marsh (up to half of the total area) have been lost through diking, draining and filling. Today, the remaining marshland is fairly well protected from outright destruction, but during the past 100 years, and especially since the 1950's, salt marshes have been divided into fragments by roads, causeways, culverts and tide gates. Most of these fragments have severely restricted tidal flow, leading to chronic habitat degradation and greatly reduced access for fish and other marine species. Since 1991, the Wells Reserve has been studying the impact of these restrictions on salt marsh functions and values, and the response of salt marshes to tidal restoration. We have been working to promote an awareness of the damage being done and the benefits of salt marsh restoration throughout the Gulf of Maine.

Outside Researchers: Theresa Theodose, Ph.D., University of Southern Maine
Project Title: Relationships between soil nutrient availability and species composition of a high salt marsh in southern Maine.

David Burdick, Ph.D. and Roelof Boumans, Ph.D. University of New Hampshire, University of Maryland
Project Title: Sediment dynamics in salt marshes: functional assessment of accretionary biofilters

Peter Rand, M.D., Chuck Lubelczyk, Robert Smith, M.D. Maine Medical Center
Project Title: Ecological determinants of the spread of the tick vector of Lyme disease and other pathogens.

June Ficker. Maine Audubon Society. Project Title: Monitoring avian productivity and survivorship. 30+ years of bird tagging and migration studies.

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 #: HC2-S3
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C
Serial Number: 0061115998
Date of Last Calibration: 08/13/2013
Dates in use: 12/20/2013 through 12/19/2014

Parameter: Temperature
Units: Celsius
Sensor type: Platinum resistance temperature detector (PRT)
Model #: HC2-S3
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C
Serial Number: 0061290211
Date of Last Calibration: 02/24/2014
Dates in use: 12/19/2014 current as of 12/31/2014

Parameter: Relative Humidity
Units: Percent
Sensor type: Rotronics HC2-S humidity sensor
Model #: HC2-S3
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
Serial Number: 0061115998

Date of Last Calibration: 08/13/2013
Dates in use: 12/20/2013 through 12/19/2014

Parameter: Relative Humidity
Units: Percent
Sensor type: Rotronics HC2-S humidity sensor
Model #: HC2-S3
Range: 0-100% non-condensing
Accuracy at 20°C: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Serial Number: 0061290211
Date of Last Calibration: 02/24/2014
Dates in use: 12/19/2014 current as of 12/31/2014

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: P4910021
Date of Last calibration: 7/2/2012
Dates in Use: 09/18/2012 through 11/05/2014

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: V4920039
Date of Last calibration: 10/16/2014
Dates in Use: 11/05/2014 current as of 12/31/2014

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 (134 mph); gust survival 100 m/s (220 mph)
Accuracy: +/- 0.3 m/s
Serial Number: WM82868
Date of last calibration: 7/10/12
Dates in Use: 10/02/2012 through 11/05/2014

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 (134 mph); gust survival 100 m/s (220 mph)
Accuracy: +/- 0.3 m/s
Serial Number: WM73891
Date of last calibration: 10/16/14
Dates in Use: 11/05/2014 current as of 12/31/2014

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: +/- 3 degrees
Serial Number: WM82868
Date of last calibration: 7/10/12
Dates in Use: 10/02/2012 through 11/05/2014

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: +/- 3 degrees
Serial Number: WM73891
Date of last calibration: 10/16/14
Dates in Use: 11/05/2014 current as of 12/31/2014

Parameter: Photosynthetically Active Radiation (PAR)
LI-COR Quantum Sensor
Units: mmoles 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 µmoles s⁻¹ m⁻²
Serial Number: Q22444
Multiplier: 1.62 for entire year
Date of last calibration: 6/18/2012
Dates in use: 9/18/2012 through 11/20/2014

Parameter: Photosynthetically Active (PAR)
Apogee SQ-110 Quantum Sensor
Units: umoles/s/m²
Sensor type: High stability silicon photovoltaic detector (blue enhanced)
Model #: SQ-110
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 µmoles s⁻¹ m⁻²
Serial Number: 16741
Multiplier: Not needed for sensor model

Date of last calibration: 09/01/14
Dates in use: 11/20/2014 current as of 12/31/2014

Parameter: Precipitation
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TE525
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Dates of calibration: 7/18/2013, 8/5/2014

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: 07/12/06.

CR1000 Firmware Version (s): *Last firmware upgrade was performed on May26th, 2010 to version 19.*

CR1000 Program Version(s): wellfmet_6.1_122013 was used from 1/1/2014-11/20/2014. wellfmet_7.0_112014 was uploaded to the station on 11/20/2014 and was in place for the remained of the year.

10) Coded variable code definitions:

Sampling Station: Laudholm Farm
Sampling site code: LF
Station code: wellfmet

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 mmoles/m2 over a 15 minute interval.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-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.**

During 2017 the CDMO discovered an incorrect line in the CR1000 programming. If RHumidity>100 And RHumidity<108 Then RHumidity=100. A decision was made by the DMC during 2006 to discontinue correcting >100 RH values to 100. This change was never made in our program and has remained in each updated version until it was removed during 2017. By correcting all values >100 during data collection we may have missed erroneous values that could have indicated a problem with the RH sensor. CSM coding was added to all RH data from 2007 until the programming change in 2017.

*Rapid changes in Relative Humidity and Temperature are quite common at the Wells NERR due to our close proximity to the coast and shifts in wind from the ocean to the land (and vise versa). These shifts in wind direction can dramatically affect both the temperature of the air as well as the amount of moisture there in, causing air temperatures and Relative Humidity to rise and fall sharply.

***Elevated Nighttime PAR:** There are many occurrences of slightly elevated nighttime PAR readings occurring in this dataset. The exact cause of this anomaly is not known although moisture entering the sensor is a likely culprit. Light pollution is not an issue at this station. Any nighttime PAR data (after sunset/before sunrise) greater than 0 have been flagged as suspect (<1> CSM) due to the readings being within the sensors specs.

*Drops in battery voltage (below 9.6 volts) resulted in missing data during January. Data were missing 01/01/2014 03:30 - 08:30, 01/02/2014 15:00, 15:45 - 01/03/2014 11:15, and 01/03/2014 20:45 - 01/04/2014 08:45. Battery failure occurs when the voltage drops below 9.6 volts causing the CR1000 to shut down. Data were rejected on 01/01/2014 03:15 when the battery dropped to 9.2 volts and at 08:45 since the first reading after the power failure was more than likely not a full 15 minutes of data. Data were also rejected at 01/02/2014 15:15 and 15:30, 01/03/2014 11:30, 01/03/2014 20:30, and 01/04/2014 at 09:00 for the same reasons.

* There was a MAJOR rain event on the Night of 8/13 from around 15:00-22:00. Severe and heavy downpours occurred for almost an hour straight. 15 Min precip data from 8/13/2014 19:45 was auto flagged as -5 by the CDMO but changed to a 1

CSM by the author of this document as we believe this to be accurate data as the downpour during this period was extremely heavy. Cumulative precipitation values were also flagged as suspect beginning at 19:45 through the end of the day.

*BP data on 11/5/2014 13:45 were rejected due to a sensor swap at 13:40.

*All wind data were rejected 11/5/2014 12:45 - 13:45. The sensor was removed and swapped with a more freshly calibrated sensor.

***NEW PAR SENSOR:** A new PAR sensor (Apogee) was installed as of 11/20 at 11:00 and the issue of nighttime elevated PAR seems to be resolved with the upgrade to the new sensor. PAR data were rejected due to the maintenance from 10:00 - 10:45. PAR Data from 11/20 at 11:45 were also rejected as the sensor had just been installed and the readings were likely affected by the technician shading or blocking the optic during that period.

*All data were rejected on 11/20/2014 11:00 due to a program reload following the PAR sensor switch.

* Relative Humidity and Temp data from 12/19 at 12:00 were rejected as this was the 1st reading from a newly installed probe and therefore a full 15 minutes of sampling was not accomplished for this data point making the data erroneous.

Significant rain and weather events:

Significant Rain Events: The following rain events were deemed significant and are flagged as {CRE} in the dataset.

2/14 00:00 - 11:45
2/21 02:45 - 18:30
3/29 19:45 - 3/30 11:30
4/7 22:15 - 4/8 07:30
4/30 19:45 - 5/1 10:15
6/13 10:45 - 18:45
6/26 01:30 - 03:30
7/2 17:15 - 19:30
7/28 8:30 - 11:15
8/13 06:15 - 22:00
8/31 19:45 - 22:45
10/16 16:00 - 21:30
10/21 14:00 - 10/23 21:15
12/9 10:45 - 23:00

Hurricane Arthur July 3-4th 2014

A major Nor' Easter passed by Maine from October 21-23rd.