

Wells (WEL) National Estuarine Research Reserve Meteorological Metadata
January-December 2008
Latest Update: July 18th, 2017

I. Data Set & Research Descriptors

1) Principal investigator & 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 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. All data management is handled by Jeremy Miller, the author of this document.

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 and totals 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.

From January 1, 2008 - December 31, 2008 the Campbell Scientific weather station (operated by the CR1000 datalogger) collected data every 15 minutes in the following format:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), and Battery Voltage (volts) based on averages from 5-second data.

Maximum Air Temperature (°C), Minimum Air Temperature (°C), and their times from 5-second data. (these are not included in the data, but are available from the WEL NERR).

Maximum Wind Speed (m/s) and its time from 5-second data (began collecting as a standard parameter at WEL on 6/19/2008).

Wind Direction Standard Deviation (degrees) from 5-second data (began collecting as a standard parameter at WEL on 11/18/2008).

Precipitation (mm), Cumulative Precipitation (mm) (began collecting as a standard parameter at WEL on 6/19/2008), and Photosynthetic Active Radiation (PAR; millimoles/m²) based on totals of 5-second data.

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, 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.

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' 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'. The PAR sensor is located on the South side of the pole at a height of approx. 15'. The Barometric pressure sensor is located within the Campbell Scientific enclosure at a height of approx. 5' and vented to the outside by a small length of aquarium tubing. The wind sensor is located atop the pole at approximately 33

feet above the ground. To the NW of the pole is the Coastal Ecology Center, a 20' high, 111' long building, at a distance of 37', running NE/SW. Further to the NW (153' from the pole) is the library, in a 25' high wing of the barn. The barn itself is 223' from the station and runs NE/SW. It is 38' high and is the largest obstruction in the area. The rain gauge is located 9' southeast of the weather station pole and is situated on a post with the top of the funnel is 10' 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 and near the . The tidal range at each of these sites is 2.6-2.9 meters.

6) Data collection period:

Weather data has been collected at the Wells NERR since December 1996. Data was collected for the entire year in 2008 from 1/1/2008 00:00 to 12/31/2008 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/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. As of 7/11/2006, data is also available from the CDMO webpage in Near Real Time thanks to the installation of a Campbell Scientific Telemetry station.

8) Associated researchers and projects:

WELLS NATIONAL ESTUARINE RESEARCH RESERVE RESEARCH AT THE RESERVE for 2008 (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 2004-2005 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 value of salt marsh as habitat for fish, shellfish and birds, 5) restoration of salt marsh habitat degraded through human actions, and 6) understanding the ecology and functions of salt marsh habitat.

Estuarine Water Resource Quality

Water quality is monitored continuously at several stations with automated instruments as part of a NERRS systemwide monitoring program, as well as bimonthly at 15-20 stations through our WET volunteer monitoring program. The WET program also monitors two important biological parameters: fecal coliform bacterial contamination (an indicator of human health risk) and phytoplankton productivity (an indicator of estuarine health). These data have 1) allowed us to identify several bacterial "hot spots" that we will be working to eliminate, 2) are used to identify and open areas safe for shellfishing, and 3) have uncovered a relation between tides and low dissolved oxygen (a stressful condition for marine life) that needs further study. 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.

Research Program Update: In addition to the Reserve-sponsored projects outlined above, numerous visiting investigators will be involved in on-site research. Topics include: the effects of land use, sea level, and climate on estuarine productivity; the relationship between soil nutrients and plant community patterns; the influence of soil salinity on plant community interactions; the effect of tidal restriction on marsh peat accretion; the comparative ecology of fringe marshes and back barrier marshes; habitat use by upland birds, and the ecology of lyme disease.

"Ecological Functions of Fringing Salt Marshes Susceptible to Oil Spills in Casco Bay, Maine". We examined the ecological function of 9 different fringing marsh systems in Casco Bay that ranged from undisturbed to disturbed. Physical parameters measured included sedimentation rates, total suspended solids, and tidal range. Biological parameters included primary production, macroinvertebrate community composition and secondary production (4cm sediment cores), and resident and transient nekton community composition (fyke net). The project is still under way.

"BENTHIC HABITAT CORRELATES OF JUVENILE FISH DISTRIBUTION IN THE BIGELOW BIGHT AND ADJACENT ESTUARIES: LINKAGES BETWEEN FISH, HABITATS, SUBSTRATE AND HUMAN ACTIVITY". This recent project was a collaboration between the Wells N.E.R.R. and several members of the local fishing community. Through the use of beam trawls, gill nets, fish traps, van veen ponar, and a sediment profile imager (SPI camera), we are attempting to correlate benthic habitat type to juvenile groundfish and invertebrate assemblages in estuarine, near shore, and offshore habitat. Stations were also established near dredge spoil dump sites as well as sewage outflow to determine the impacts of human activity on the coast to benthic habitat.

"Controlled Closure Retrofit and Bi- directional Controlled Tide Gates: Low Cost Retrofits for Existing Standard Tide Gates and Restricted Tidal Marsh Culverts": Although salt marshes are now protected, man-made structures such as roads, bridges, undersized culverts, and earthen dikes remain as barriers that reduce tidal exchange and degrade habitat. In Maine alone there are at least 350 marshes whose functionality is compromised due to insufficient flow of tidal water. The Wells NERR and NOAA have partnered in a project aimed to install newly designed and affordable gate and culvert systems into restricted tidal marshes. The systems must be able to achieve ecological restoration in the marsh without compromising the functionality of the engineering infrastructure. Two systems have been developed and are ready for installation and testing; 1. Controlled Closure Retrofit Tide Gate System and 2. Bi-directional Controllable Tide Gate. To see the second system in action, visit the Drakes Island culvert on Drakes Island Road, South on RT1 out of Laudholm Farm Rd when leaving the reserve.

The Wells NERR Research Department also worked on the following project: In partnership with the York Rivers Association and the Town of York, the Wells Reserve conducted a survey of the York River watershed. In this survey, volunteers looked for sources of pollution within a 250-foot buffer of the river and its tributaries (erosion, trash and debris and runoff from roads and lawns could have a negative impact on water quality). Most pollutants entering water bodies come from such undefined sources. Therefore, this type of survey is the best way to begin to address the problems of pollution in a water body. The idea of the project was to work with the community and landowners to help them understand the problems that come from these types of pollution and learn activities they might be able to do on their own land that would help prevent this pollution from entering the water. The results of the survey will become part of a Watershed Management Plan to improve and restore the water quality of the York River.

The Wells NERR Research Dept. is involved with the following CICEET* Projects:

Project Title: Estuarine Responses to Dredging: Analysis of Sedimentary and Morphological Change in Back Barrier Marsh to Aid Local Management and Develop a Regional Management Tool Principal Investigator (s): Michele Dionne, Wells NERR,

Management Issue: Coastal management tool for assessing the impacts of dredging in estuaries. Project Summary: An adequate supply of sediment is essential for maintaining salt marshes. Human activities, such as channel dredging and tidal restriction due to road construction, can alter water flows in estuaries and result in dramatic changes in salt marsh sediment supply, affecting the speed of salt marsh erosion. The objective of this project is to determine the impact of dredging and tidal restriction on salt marshes in the Wells NERR. A digital coastal management guide will be created on CD ROM, providing coastal managers with useful conceptual models for predicting the impacts of dredging and other activities that affect water flow and sediment deposition in salt marshes.

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.

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.

9) Sensor specifications, operating range, accuracy, date of last Calibration:

Parameter: Wind speed and direction
Units: meter per second (m/s)- degrees of a 360 circle
Sensor type: RM Young 5103 wind speed and direction
Model #: 05103-5

Operating Temperature: -50° to +50°C assuming non-riming conditions
Range: 0 to 50 m/s
Accuracy: +/-0.5 m/s
Threshold: 0.5 m/s
Date of last calibration: 04-01-2008

Parameter: Temperature
Units: degrees Celsius
Sensor type: 1000 ohm PRT, part of CSI Temperature and Relative Humidity Probe
Model #: HMP45C
Operating Temperature: -40 to +60°C
Range: -39.2° to +60°C
Accuracy: +/- 0.2 °C @ 20°C
Date of Last calibration: 04-20-2008

Parameter: Relative Humidity
Units: percent
Sensor type: CSI Temperature and Relative Humidity Probe
Model #: HMP45C
Operating Temperature: -40 to +60°C
Range: 0.8-100% non-condensing
Accuracy: +/-2% RH (0-90%) and +/-3%(90-100%)
Temperature Dependence: +/-0.05% RH/°C
Stability: Better than 1% RH per year
Date of Last calibration: 04-20-2008

Parameter: Barometric Pressure
Units: millibar
Sensor type: CSI Barometric Sensor
Model#: CSI 105 (also known as Vaisala PTB101B)
Operating Range: Pressure: 600-1060 mb
Temperature: -40 to +60C
Humidity: non-condensing
Total Accuracy:
+/-0.5 mb @ +20 degrees C
+/-1.5 mb @ 0° to 40 degrees C
+/-2.0 mb @ -20 degrees to +45 degrees C
+/-3.0 mb @ -40 degrees to +60 degrees C
Stability: +/- 0.1 mb per year
Date of Last calibration: 04-20-2008

Parameter: Precipitation
Units: mm
Sensor type: Electrically Heated Tipping Bucket Rain/Snow Gauge
Model #: 385/385M (also known as Met One 385)
Range: 0.1mm to unlimited
Resolution: 0.1 mm
Accuracy: +/-0.5%<0.5" (1.27 cm)/hr rate
 +/-2.0%<3.0" (7.62 cm)/hr rate
Operational Temperatures: -20° to 50°C; 0 to 100% RH
Date of Last calibration: 05-07-2008

The CR1000 has two MB 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) is 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. This station was installed on 07/11-12/06.

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	<i>Open - reserved for later flag</i>
3	<i>Open - reserved for later flag</i>
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 Campbell scientific 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/m2 over a 15 minute interval.

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3%.

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

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.

All Reserves were required to align their wind sensors to True North by April 1, 2008. WEL NERR's sensor was aligned to true north on 4/1/08 at 13:15.

On April 1, 2008 from 13:15 - 13:45 data are missing because of the station being powered down to swap wind sensors and to align the wind direction to True North. Data at 14:00 were not a full 15 minutes worth of data and were therefore rejected.

Following a sensor swap of all sensors, except for the wind sensor, on 4/23/2008 at 13:15, Version 5 of the CR1000 program was uploaded. Because the data recorded at 14:00 was not a full 15 minutes work of data, they were rejected.

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 vice 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.

Occasional elevated and repeating nighttime PAR values were flagged as suspect. Moisture seeping into the sensor may be the reason for these suspect PAR values; however, the exact cause has not been determined.

The following weather events were considered significant:

- *Heavy rains during July 18-31. Heaviest on 18th, 24th, 27th, and 31st

- *Heavy rains on Sept 6th due to remnants of Hurricane Hannah. 6+ inches of rain in one day!

- * Sept 26th through Oct 2nd saw many periods of heavy rain and wind due to tropical storms and hurricanes hitting the northeast. 1st hurricane warning for coast of Maine in 17 years! BP data from this period was originally marked 2 and 3 but changed to zeros and a CSM comment added to alert the user that the "extreme" data was from a hurricane.

- * Heavy winds and rain on the 25th of Nov. 30-40mph along Maine coast according to NWS

There is missing rain data from 6/22 at 0:00 to 6/24 at 13:30 due to a malfunction with our tipping bucket. The data from 6/24 at 13:45 to 14:00 was rejected due to manual tipping of the bucket to repair the gauge. Adjustments were made to the Cum Precip data to reflect the rejected data removed from the data set due to the above issue.