Narragansett Bay (NAR) National Estuarine Research Reserve Meteorological Metadata

January – June 2001

Latest Update: **February 10, 2023**

I. Data Set & Research Descriptors

1) Principal investigator(s) & contact persons:

Contact Persons:

Dr. Christopher Deacutis, Research Coordinator, deacutis@etal.uri.edu

Patricia Richard, Monitoring Technician, tap5@mindspring.com

Address:

55 South Reserve Drive

Prudence Island, RI 02872

Phone: (401) 683-6780

2) Entry verification:

a) Data Input Procedures

The 15-minute, 1-hour average, and 24-hour meteorological data were

downloaded from each instrument on the weather station to a Campbell

Scientific CR21X data logger. A data logger program (Pi6oct2k) similar

to the CDMO Data Logger Program (nerr30.csi) was loaded into the CR21X and

controls the sensors and data collection schedule (see 2b of the Entry

Verification section for the data collection schedule). The CR21X then

interfaced with the PC208W software supplied by Campbell Scientific.

This software was located on a laptop computer at the reserve to which

the data was downloaded via a telephone modem. The data was saved at regular

intervals to a data file (mmddyy.dat) onto the computer's hard

drive and backed up to a desktop computer, also located at the reserve.

Each time a download was executed, the CDMO Weather Data Management

Program (WDMP) was used to convert the files to an Access database. This

program was developed in Visual Basic to interface with the NERR

Meteorological Data Collection Schedule (see 2b of the Entry Verification

section for the data collection schedule). The WDMP automatically inputs and

converts the raw data file into an Access database. There are three main

steps the WDMP performs:

First, it converts the comma delimited monthly raw data file into an

Access database. Secondly, it checks the data against a predetermined set of

error criteria (see Appendix G for the CDMO Meteorological Data

Collection Error/Anomalous Data Criteria). Finally, it produces error and

summary reports. Any anomalous data are noted below in the Anomalous Data

Section. Any data corrections that were performed are noted in the Data

Correction Section below.

Common errors noted in the monthly error reports were wind speeds below

the 0.5 m/s criteria, temperature change of greater than 3 C in a 15-minute

period, and relative humidity difference of greater than 25% in 15

minutes. No anomalous data was corrected for 2001 data. Both raw data files

and Access databases were saved to Zip Disks for backup. Patricia Richard

compiled the 2001 weather data.

b) Data Collection Schedule

i) Data is collected in the following formats:

1) 15 minute data are instantaneous readings except for PAR and precipitation

data that are totalized from 5 second samples sorted by date and time.

(Arrays 150 and 151)

2) Hourly averages (Arrays 101 and 102) are calculated from 5 second

samples sorted by date and time except for PAR and precipitation data that

are hourly totals calculated from 15 minute totals (Arrays 105 and 106).

3) Daily average (arrays 241 and 242), maximum with time, and minimum

with time (arrays 243 and 244) are calculated from 5 second samples sorted

by date and time except for PAR and precipitation data which are 24 hour

totals calculated from hourly totals (arrays 245 and 246).

ii) 15 minute sample point parameters: Date, Time, Air Temperature (°C), Relative

Humidity (%), LiCor (PAR), Barometric Pressure (mb), Wind Speed (m/s), Wind

Direction (Array 150); Rainfall (mm) (Array 151)

iii) Hourly average parameters: Date, Time, Air Temperature (°C), Relative Humidity

(%), Barometric Pressure (mb) (Array 101); Wind Speed (m/s), Wind Direction, Wind

Speed Maximum (Array 102)

iv) Hourly total parameters: LiCor (PAR) (Array 105); Rainfall (mm) (Array 106)

v) Daily Average parameters: Date, Time, Air Temperature (°C), Relative Humidity

(%), Barometric Pressure (mb) (Array 241); Wind Speed (m/s), Wind Direction,

Wind Direction Standard Deviation (using Yamartino's Algorithm) (Array 242)

vi) Daily Total parameter: LiCor (PAR) (Array 245); Rainfall (mm) (Array 246)

vii) Daily Maximum parameters: Date, Time, Air Temperature (°C), Time, Relative

Humidity (%), Time, LiCor (PAR), Time, Barometric Pressure (mb), Time, Wind

Speed (m/s), Time, Battery Voltage, Time (Array 243)

viii) Daily Minimum parameters: Date, Time, Air Temperature (°C), Time, Relative

Humidity (%), Time, LiCor (PAR), Time, Barometric Pressure (mb), Time, Wind

Speed (m/s), Time, Battery Voltage, Time (Array 244)

c) Error/Anomalous Data Criteria

Air Temp:

- 15 min sample greater than max for the day

- 15 min sample less than the min for the day

- 15 min sample greater than 3.0 °C from the previous 15 minutes

- Max and Min values not recorded for the day

- 1-hour average greater than 10% above the greatest 15 min sample recorded in the hour

Relative Humidity:

- Changed by more than 25% from the previous 15 minutes

- Max and Min values not recorded for the day

- 1-hour average greater than 10% above the greatest 15 min sample recorded in the hour

Rainfall:

- Precipitation greater than 5 mm in 15 minutes

- No precipitation for the month

Wind Speed:

- Wind speed greater than 30 m/s

- Wind speed less than 0.5 m/s

Wind Direction:

- Wind direction greater than 360 degrees

- Wind direction less than 0 degrees

Pressure:

- Pressure greater than 1040 mb or less than 980 mb

- Pressure changes greater than 5 mb per hour

- Max and Min values not recorded for the day

- 1-hour average greater than 10% above the greatest 15 min sample recorded in the hour

Time:

- 15-minute interval not recorded

For all data:

- Duplicate interval data

3) Research objectives:

The principal objective is to record long-term meteorological data for

Narragansett Bay in order to observe any environmental changes or trends over

time. These data are also used in support of both water quality and

biological sampling data.

4) Research methods:

The Campbell Scientific weather station samples every 10 seconds to produce

both hourly and daily averages of those measurements of air temperature,

relative humidity, barometric pressure, rainfall, wind speed and wind

direction. An instantaneous sample is taken every 15 minutes and that data

is stored in array 150. A sampling interval was chosen to ensure that the

CR21X data logger would not run out of memory and overwrite data.

5) Site location and character:

The NBNERR consists of 2350 acres of diverse estuarine and terrestrial

habitats ranging from open estuarine water to salt marshes to forested

uplands. The land holdings include 60% of Prudence Island, most of nearby

Patience Island and all of Hope Island off the west shore of Prudence. The

Reserve is located close to the geographic center of Narragansett Bay in

Rhode Island. The bay has a drainage basin of 1,800 square miles.

The weather station is located on Prudence Island, east of Potter's Cove

at 41° 38.335’N, 71° 20.362’W. The Wind Sentry and the Temperature and Humidity

sensor are located on an aluminum tower approximately 10m in height. The Licor

sensor is located on a shorter (3m) aluminum tower. The tipping Bucket Rain gauge

is located to the NW, away from the tower and the platform. The barometer is

located within the housing of the CR21X.

Descriptions of the specific sampling station follows:

The Potter's Cove weather station is in a grassland area bordering the cove.

This location is approximately 100 yards from a water quality monitoring

station maintained by the NBNERR since 1995. The water quality in the

cove is considered to be an adversely affected by boaters' wastes and storm

runoff from urban areas. Locating the weather station near this site might

help to determine whether meteorological factors further influence water

quality within the cove.

6) Data collection period:

Weather data has been collected at the Potter's Cove 1992. The current

weather station has been operational since October 2000. Data has been

collected from January through June 2001.

Weather data were collected from January to June of 2001. An apparent

lightning strike on June 17 destroyed the CR21X data logger which remained

inoperable until the installation of a new CR10X data logger on

February 6, 2002.

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 homepage

http://cdmo.baruch.sc.edu. Data are available in text format

and Access data tables.

8) Associated researchers and projects:

The NERR Water Quality Monitoring Project has a station located nearby at

Potter's Cove. The principal objective of this study is to record long-term

water quality data for Narragansett Bay in order to observe any physical

changes or trends in water quality over time. Four sites were selected; one

to represent an impacted site, two in open water (at both the surface and

near-bottom), and one located in a salt marsh tidal creek. The Potter's Cove

site is located on Prudence Islands' northeastern shore and is impacted by

boat traffic and storm runoff from mainland urban and residential areas.

Measurements are taken every 30 minutes over a roughly two week collecting

periods at all water quality monitoring locations throughout the year.

A Physical Oceanographic Real-Time System (PORTS) meteorological station is

housed in the NERRS weather station at Potter's Cove and independently

records wind speed, wind direction, atmospheric pressure, and air

temperature. This is one of six PORTS meteorological stations in

Narragansett Bay. The purpose of PORTS is to support safe and cost efficient

navigation. Data is available real-time and the system is managed for

quality control.

Volunteers from the Prudence Conservancy have maintained a drum-recorder rain

gauge located at the Potter's Cove weather station since 1992. The

volunteers clean the rain gauge periodically, as well as replace the

recording pens and paper as necessary. The data are managed by the NBNERR.

II. Physical Structure Descriptors

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

Eppley Black and White Pyranometer

Model # 8-48

Resistance: 353 O at 23°C

Temperature Compensation Range: -20 to +40°C

Sensitivity: 10.35 X 10-6 volts/watts meter-2

7.22 millivolts/cal cm-2 min-1

Date of last calibration: unknown

LiCor Quantum Sensor

Model # LI190SB

Stability: <±2% change over 1 yr

Operating Temperature: -40 to 65°C

Sensitivity: typically 5 µA per 1000µmoles s-1 m-2

Light spectrum wavelength: 400 to 700 nm

Date of last calibration: unknown

Wind Sentry

Model # 03001

Range: 0-50 m/s; 360° mechanical

Date of last calibration: unknown

Temperature & Relative Humidity

Model #: HMP35C

Temperature Measurement Range: -35° to +55°C

Thermistor Interchangeability Error:

Typically < ±0.2°C over 0° to +60°C, ±0.4°C @ -35°C

Polynomial Linearization Error: < ±0.5°C over -35° to +50°C

Relative Humidity Measurement Range: 0 to 100% non-condensing

Accuracy at 20°C

±2% RH (0 to 90% Relative Humidity)

±3% RH (90 to 100% Relative Humidity)

Date of Last calibration: unknown

Barometric Sensor

Model # CS-105

Operating Range: Pressure: 600-1060 mb

Temperature: -40 to +60C

Humidity: non-condensing

Accuracy: ±0.5 to 6.0 mb (+20-60C)

Stability: ± 0.1 mb per year

Date of Last calibration: unknown

Tipping Bucket Rain Gauge

Model #: TE 525

Range: 0.1 mm

Accuracy: 1.0% at <2"/hr

Date of Last calibration: unknown

10) Coded variable indicator and variable code definitions:

Site definitions: PC = Potter's Cove

11) Data anomalies/Data corrections:

**Arrays:**

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at [www.nerrsdata.org/get/landing.cfm](http://www.nerrsdata.org/get/landing.cfm) throughout the fall of 2022.

January 2001:

This error message is due to a break in the data set for this time period.

Array Day Date Time Error Message

150 29 29 515 Pressure difference from 29 ( 29) 515 ( 1026.3) to

31 ( 31) 600 ( 1001.2) is greater than 5 mb

February 2001:

These data appear to be correct.

Array Day Date Time Error Message

150 12 43 745 Pressure is greater than 1040 or less than 980 on 12 ( 43) 745 ( 1040.4)

150 12 43 800 Pressure is greater than 1040 or less than 980 on 12 ( 43) 800 ( 1040.6)

150 12 43 815 Pressure is greater than 1040 or less than 980 on 12 ( 43) 815 ( 1040.9)

150 12 43 830 Pressure is greater than 1040 or less than 980 on 12 ( 43) 830 ( 1041)

150 12 43 845 Pressure is greater than 1040 or less than 980 on 12 ( 43) 845 ( 1040.7)

150 12 43 900 Pressure is greater than 1040 or less than 980 on 12 ( 43) 900 ( 1040.7)

150 12 43 915 Pressure is greater than 1040 or less than 980 on 12 ( 43) 915 ( 1040.9)

150 12 43 930 Pressure is greater than 1040 or less than 980 on 12 ( 43) 930 ( 1041)

150 12 43 945 Pressure is greater than 1040 or less than 980 on 12 ( 43) 945 ( 1040.8)

150 12 43 1000 Pressure is greater than 1040 or less than 980 on 12 ( 43) 1000 (1040.7)

150 12 43 1015 Pressure is greater than 1040 or less than 980 on 12 ( 43) 1015 (1040.6)

150 12 43 1030 Pressure is greater than 1040 or less than 980 on 12 ( 43) 1030 (1040.7)

150 12 43 1045 Pressure is greater than 1040 or less than 980 on 12 ( 43) 1045 (1040.7)

150 12 43 1100 Pressure is greater than 1040 or less than 980 on 12 ( 43) 1100 (1040.3)

March 2001:

NONE

April 2001:

These data appear to be correct:

Array Day Date Time Error Message

150 22 112 2100 Air temp difference from 22 ( 112) 2100 ( 18.125) to 22 ( 112) 2115 (22.318) is greater than 3.0 degrees C

150 13 103 1745 Rel hum difference from 13 ( 103) 1745 ( 89.822) to 13 ( 103) 1800 (63.057) is greater than 25%

150 22 112 2100 Rel hum difference from 22 ( 112) 2100 ( 92.744) to 22 ( 112) 2115 (56.001) is greater than 25%

May 2001:

The following data is suspect due to the offset being output when there

was no wind recorded. This datum was converted to 0:

Array Day Date Time Error Message

150 5 125 1000 Wind direction is greater than 360 or less than 0 on 5 ( 125) 1000

(-.29445)

June 2001:

NONE

12) Missing data:

**Arrays:**

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at [www.nerrsdata.org/get/landing.cfm](http://www.nerrsdata.org/get/landing.cfm) throughout the fall of 2022.

January 2001:

All data are missing due to a file overwrite.

Array Day Date Time Error Message

150 29 29 530 Missing 150 Array data (15 minute data) from 29 ( 29) 530 to 31 ( 31) 545

101 29 29 600 Missing 101 Array data (Hourly Averages) from 29 ( 29) 600 to 31 ( 31) 500

102 29 29 600 Missing 102 Array data (Hourly Average Wind Parameters) from 29 (29) 600 to 31 ( 31) 500

241 29 29 2400 Missing 241 data (Daily Averages) from 29 ( 29) 2400 to 30 ( 30) 2400

242 29 29 2400 Missing 242 data (Daily Average Wind Parameters) from 29 ( 29) 2400 to 30 ( 30) 2400

243 29 29 2400 Missing 243 data (Daily Max/Time Values) from 29 ( 29) 2400 to 30 (30) 2400

244 29 29 2400 Missing 244 data (Daily Min/Time Values) from 29 (

29) 2400 to 30 ( 30) 2400

February 2001:

NONE

March 2001:

NONE

April 2001:

These errors are the result of a communications error which resulted in

overwritten data. All hourly and daily array data are missing through day 30

(120) at 2400.

Array Day Date Time Error Message

150 26 116 530 Missing 150 Array data (15 minute data) from 26 ( 116) 530 to 30 (120) 2400

101 26 116 600 Missing 101 Array data (Hourly Averages) from 26 ( 116) 600 to 30 (120) 2400

102 26 116 600 Missing 102 Array data (Hourly Average Wind Parameters) from 26 (116) 600 to 30 ( 120) 2400

241 26 116 2400 Missing 241 data (Daily Averages) from 26 ( 116) 2400 to 30 ( 120) 2400

242 26 116 2400 Missing 242 data (Daily Average Wind Parameters) from 26 ( 116) 2400 to 30 ( 120) 2400

243 26 116 2400 Missing 243 data (Daily Max/Time Values) from 26 ( 116) 2400 to 30 (120) 2400

244 26 116 2400 Missing 244 data (Daily Min/Time Values) from 26 ( 116) 2400 to 30 (120) 2400

May 2001:

These errors are the result of a file overwrite.

Array Day Date Time Error Message

150 1 121 30 Missing 150 Array data (15 minute data) from 1 ( 121) 15 to 1 ( 121) 730

101 1 121 100 Missing 101 Array data (Hourly Averages) from 1 ( 121) 100 to 1 ( 121) 700

102 1 121 100 Missing 102 Array data (Hourly Average Wind Parameters) from 1 (121) 100 to 1 ( 121) 700

These errors are the result of communications error which resulted in

overwritten data. Hourly and daily array data are missing through day 31

(151) at 2400.

Array Day Date Time Error Message

150 28 148 1545 Missing 150 Array data (15 minute data) from 28 ( 148) 1545 to 31 (151) 2400

101 28 148 1600 Missing 101 Array data (Hourly Averages) from 28 ( 148) 1600 to 31 (151) 2400

102 28 148 1600 Missing 102 Array data (Hourly Average Wind Parameters) from 28 (148) 1600 to 31 ( 151) 2400

241 28 148 2400 Missing 241 data (Daily Averages) from 28 ( 148) 2400 to 31 ( 151) 2400

242 28 148 2400 Missing 242 data (Daily Average Wind Parameters) from 28 ( 148) 2400 to 31 ( 151) 2400

243 28 148 2400 Missing 243 data (Daily Max/Time Values) from 28 ( 148) 2400 to 31 (151) 2400

244 28 148 2400 Missing 244 data (Daily Min/Time Values) from 28 ( 148) 2400 to 31 (151) 2400

June 2001:

These data are missing due to an apparent lightning strike that damaged the

data logger on June 17 (168) at 645. Hourly and daily array data are missing through

day 30 (181) at 2400.

Array Day Date Time Error Message

150 17 168 645 Missing 150 Array data (15 minute data) from 17 ( 168) 645 to 30 (181) 2400

101 17 168 700 Missing 101 Array data (Hourly Averages) from 17 ( 168) 700 to 30 (181) 2400

102 17 168 700 Missing 102 Array data (Hourly Average Wind Parameters) from 17

( 168) 700 to 30 ( 181) 2400

241 17 168 2400 Missing 241 data (Daily Averages) from 17 ( 168) 2400 to 30 ( 181) 2400

242 17 168 2400 Missing 242 data (Daily Average Wind Parameters) from 17 ( 168) 2400 to 30 ( 181) 2400

243 17 168 2400 Missing 243 data (Daily Max/Time Values) from 17 ( 168) 2400 to 30

( 181) 2400

244 17 168 2400 Missing 244 data (Daily Min/Time Values) from 17 ( 168) 2400 to 30

( 181) 2400

13) Other remarks:

**Arrays:**

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at [www.nerrsdata.org/get/landing.cfm](http://www.nerrsdata.org/get/landing.cfm) throughout the fall of 2022.

**Precipitation:**

During the initial years of NERRS SWMP weather data collection the CR10X programming was inconsistent in how precipitation values were recorded. For most reserves, zeros were not recorded when rainfall had not occurred between 2001-2003, instead no rainfall was represented by a blank cell. The CDMO verified which datasets were impacted by this issue for the 2001-2006 datasets and inserted zeros when the metadata indicated that no precipitation occurred and data were not missing for other reasons. In some cases, zero values for precipitation data were evaluated and removed where the metadata confirmed that no rainfall should have been in the dataset. The pre-2007 data did not go through a thorough QAQC process again at that time (in addition to previous QAQC); however, if discrepancies were noticed between what was documented in the metadata and what was in the dataset, additional updates may have been made. The updated datasets were uploaded to the database and made available through the various data applications at [www.nerrsdata.org/get/landing.cfm](http://www.nerrsdata.org/get/landing.cfm) throughout early 2023.

Weather data were collected from January to June of 2001. An apparent

lightning strike on June 17 destroyed the CR21X data logger which remained

inoperable until the installation of a new CR10X data logger on

February 6, 2002.

The 2001 data were recompiled and the metadata document revised in May 2003

to correct problems relating to an earlier version of the Weather Data

Management Program.

Rain Events:

Please note that monthly rain totals are not available during months were data

were missing.

January

Date RainAmount (mm)

1 .020

5 .070

6 .180

8 .080

9 .140

15 .420

19 .600

20 .030

22 .220

23 .030

February

Date RainAmount (mm)

3 .010

5 .670

6 .310

9 .050

10 .010

13 .020

15 .010

16 .220

17 .010

23 .120

25 .810

"Monthly Total" 2.2

March

Date RainAmount (mm)

2 .010

5 .580

6 .730

7 .050

8 .010

9 .150

10 .010

13 1.280

14 .010

17 .020

18 .060

21 .970

22 1.250

23 .050

24 .010

27 .120

29 .030

30 2.950

"Monthly Total" 8.3

April

Date RainAmount (mm)

6 .300

8 .840

9 .150

12 .350

13 .010

17 .140

18 .120

22 .010

May

Date RainAmount (mm)

5 .020

15 .060

22 .680

23 .630

24 2.090

25 .100

26 .160

27 .110

28 .070

June

Date RainAmount (mm)

2 1.080

3 .020

11 2.090

12 .020