Delaware (DEL) NERR Meteorological Metadata
January 01, 2016 – December 31, 2016
Latest Update: January 17, 2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons –

Contact Persons:
Kari StLaurent, Ph.D., Research Coordinator, kari.StLaurent@state.de.us
Michael G. Mensinger, Environmental Scientist, mike.mensinger@state.de.us

Address:
Delaware National Estuarine Research Reserve
818 Kitts Hummock Road
Dover, DE 19901

Phone: 302-739-6377
Fax: 302-739-3446

2) Entry verification –

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Loggernet software, installed on the DNERR computer, is utilized to automatically upload data (every 15 minutes) via a short haul modem to this computer located at St. Jones Center for Estuarine Studies. The data are saved as a raw data file (SJ_RAW.dat) onto a separate hard drive and backed up onto Delaware Coastal Programs' (DCP) server. 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 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. Michael G. Mensinger conducts all data collection, data management, and QA/QC activities.

All errors were double checked with other data that could support such "anomalous" weather changes. Wind speeds below the 0.5 m/s are common between 1900 and 0600 hours.

3) Research objectives –

The principal objective is to record long-term meteorological data for the St. Jones component of the Delaware National Estuarine Research Reserve in order to observe any environmental changes or trends over time. The data are also used for specific research studies relating to atmospheric deposition of nutrients and pesticides, and nutrient runoff influences from encroaching

urbanization on estuarine systems. The meteorological data also serves a supporting role for the SWMP water quality and nutrient data sets since meteorological conditions directly impact these projects.

4) Research methods –

The Campbell Scientific weather station sampled every 5 seconds to produce both 15 minute averages of the measurements of air temperature, relative humidity, barometric pressure, wind speed and wind direction and 15 minute totals of precipitation and photosynthetically active radiation. Data are collected in Eastern Standard Time (EST) for the entire year. The CR1000, installed on 09/18/06, contains 2 Mbytes of memory. The data is sent every 15 minutes to a computer for real-time display and storage. If the short haul modem link failed and data could not be automatically sent from the datalogger to the computer, the data would be downloaded from the CR1000 to a laptop computer following procedures in the CDMO Operations Manual. On a monthly basis, sensors on the weather station are inspected for damage or debris. If any is found, it is repaired and/or cleaned. Sensors are removed and sent back to Campbell Scientific for calibration at the following intervals:

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 (Delaware recalibrates yearly)
- 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**:

i) Averages from 5-second data:
Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts)
ii) Maximum and Minimum Air Temperature (°C) and their times from 5-second data (these data are available from the Reserve)
iii) Maximum Wind Speed (m/s) and time from 5-second data
iv) Wind Direction Standard Deviation (degrees)
v) Totals:
Precipitation (mm), PAR (millimoles/m^2), and Cumulative Precipitation (mm)

Campbell Scientific data telemetry equipment was installed at the St. Jones station on 11/16/05 and transmits data to the NOAA GOES satellite, NESDIS ID #3B00F7FE. 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 Delaware National Estuarine Research Reserve is comprised of two component sites, the St. Jones River and Blackbird Creek components. Both components are located along the Delaware

Bay Coast. The St. Jones River Component is located in central Kent County Delaware, east of the State capitol city, Dover. The Blackbird Creek component is located in the unincorporated area of Southern New Castle County. The meteorological station site, is located in the St. Jones DNERR component. It is located in a tidal marsh area with a wooded fringe area 100 m to the north, 75 m to east, 75 m to the west and 1+ km to south. The wooded area is of an approximate average height of 16 m.

Position: Latitude 39 degree 05' 20.05" N
Longitude 75 degree 26' 12.78" W

The unit is mounted on a 3-meter tower adjacent to the boardwalk that crosses the marsh. The elevations above the marsh surface are as follows; Barometric pressure - 2.2 m, temperature and relative humidity - 2.9 m , wind and PAR - 4.5 m, highest point on tower (lightning rod) - 4.9 m. The rain gauge is 2.4 m above the surface and 3 m south of the tower. The adjacent boardwalk is 1.1 m above the surface with a railing height of 1.0 m. A vegetative cover of spartina surrounds the area with an average height of 1 m. The tower and rain gauge are both 1 m east of the boardwalk. The weatherstation is located approximately 2 km from the water quality datasonde at Scotton Landing, approximately 4km from the water quality station at Lebanon Landing, and approximately 10km away from the water quality monitoring station at Division Street.

SWMP Station Timeline:

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
DELSJMET	Saint Jones River	P	39° 5' 20.05 N, 75° 26' 12.78 W	01/01/2001 -	NA	NA

6) Data collection period –

The meteorological monitoring program was started in October 1997 at the DNERR and has been continuous through the present. The data collection format has followed NERRS protocol since standardized meteorological program development in November of 1998.The 2016 data set runs from January 1, 2016 (00:00 EST) through December 31, 2016 (23:45 EST). There were no lines of missing data during 2016.

Monthly data were downloaded from the station on the following dates:

01/04/2016
02/04/2016
03/07/2016
04/04/2016
05/02/2016
06/01/2016
07/01/2016
08/01/2016
09/01/2016
10/14/2016
11/03/2016
12/05/2016
01/06/2017

7) Distribution –

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: http://www.nerrsdata.org/; *accessed* 12 October 2016.

NERR meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects –

As part of the SWMP long-term monitoring program, DEL NERR also monitors 15-minute water quality along with monthly grab samples and diel sampling for nutrient data which may be correlated with this meteorological dataset. These data are available at www.nerrsdata.org.

II. Physical Structure Descriptors

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: 8/15/2000 (installed new 12/20/2000)
12/19/2002: Replaced with unit (s/n Q22182, recalib 11/14/2002)
12/21/2004: Replaced with unit (s/n Q99240, recalib 09/17/2004)
01/11/2007: Replaced with unit (s/n Q22182, recalib 05/03/2005)
01/07/2008: Replaced with unit (s/n Q99240, recalib 11/14/2007) (multiplier = 1.29)
12/30/2008: Replaced with unit (s/n Q22182, recalib 10/31/2008) (multiplier = 1.51)

11/30/2009: Replaced with unit (s/n Q99240, recalib 05/22/2009) (multiplier = 1.35)
04/04/2011: Replaced with unit (s/n Q30325, recalib 01/20/2011) (multiplier = 1.591951)
04/12/2012: Replaced with unit (s/n Q22182, recalib 03/14/2012) (multiplier = 1.616825)
05/08/2013: Replaced with unit (s/n,Q30325 recalib 07/23/2012) (multiplier = 1.642489)

05/01/2014: Replaced with unit ((s/n Q22182 recalib 04/10/2014 (multiplier = 1.652324)
Discontinued use of this sensor model on 06/05/2015

PAR Multipliers:
1.29 (Used 01/07/2008 to 12/30/2008)
1.51 (Used 12/30/2008 to 11/30/2009)
1.35 (Used 11/30/2009 to 04/11/2011)
1.591951 (Used 04/11/2011 to 04/12/2012)
1.616825 (Used 04/12/2012 to 05/08/2013)
1.642489 (Used 05/08/2013 to 05/01/2014)
1.652324 (Used 05/01/2014 to 06/05/2015)

Apogee Quantum Sensor
Model # SQ-110
Stability: <2% per year
Operating Temperature: -40 to 70 C
Sensitivity: 0.2 mVper umol m^{-2} s^{-1}
Light spectrum wavelength: 410 nm to 655 nm
Initiated Use of this Sensor Model: 06/05/2015
Date of Last Calibration:
06/05/2015: (s/n 17010 installed new, initial calib 11/2014)
06/01/2016: (s/n 20562 installed new, initial calib 04/2016)

PAR Multiplier: 0.025 (multiplier never changes with this model: Used 06/05/2015 to current)

Wind Monitor
Model # 05103
Range: 0-60 m/s; 360° mechanical
Date of last calibration:
04/05/1999 (installed new 12/20/2000)
12/19/2002: Replaced with unit (s/n WM49558)
12/21/2004: Replaced with unit (s/n 35269, recalib 09/01/2004)
01/11/2007: Replaced with unit (s/n 49546, recalib 12/01/2006)
01/07/2008: Replaced with unit (s/n 35269, recalib 09/14/2007)
03/10/2010: Replaced with unit (s/n 49558, recalib 02/19/2010)
08/20/2012: Replaced with unit (s/n 49546, recalib 07/30/2012)
05/01/2014: Replaced with unit (s/n 49558, recalib 04/04/2014)
06/22/2016: Replaced with unit (s/n 49546, recalib 05/19/2016)

Temperature and Relative Humidity
Model #: HC2-S3 (05/08/2013 - current)
Operating Temperature: -40-+60°C
Temperature Measurement Range: -40-+60°C
Temperature Accuracy: ± 0.1 °C @ 23°C
Relative Humidity Measurement Range: 0-100% non-condensing
RH Accuracy: +/-0.8% @ 23°C

05/08/2013: Replaced with unit (s/n 0061045311, brand new sensor)
05/01/2014: Replaced with unit (s/n 0061218130, brand new sensor)
06/05/2015: Replaced with unit (s/n 0020017749, brand new sensor)
06/22/2016: Replaced with unit (s/n 61218130, recalib, 05/18/2016)

Barometric Pressure (Discontinued Use of CS-105 on 11/04/2013)
Model # CS-106 (PTB110)
Operating Range: Pressure - 500-1100 mb
Temperature: -40-+60C
Humidity: non-condensing
Accuracy: ±0.3 to 1.5 mb (+20-60C)
Stability: ± 0.1 mb per year
Date of Last calibration:
11/04/2013: (s/n J4060004 installed new, initial calib 10/07/2013)
05/01/2014: (s/n J513002 installed new, initial calib 12/18/2013)
06/22/2016 (s/n J4060004, recal 05/24/2016)

Tipping Bucket Rain Gauge
Model #: TE 525
Range: 0.1 mm
Accuracy: 1.0% at <2"/hr
Date of Last calibration: field calibrated 12/20/2000, 12/19/2001, 12/19/2002, 12/22/2003, 12/22/2004, 12/16/2005, 12/29/2006, 01/07/2008, 12/30/2008, 10/05/2009, 09/23/2010, 09/19/2011, 09/20/2012, 09/20/2013, 09/11/2014, 09/08/2015, 09/06/2016

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.

CR1000 S/N: 4976 (installed on September 18, 2006)
Last Calibrated: 01/30/2015 (reinstalled 02/04/2015)

CR1000 Firmware Version: OS27.05 (installation date unavailable)

CR1000 Program Versions: delsjmet_5.5_040411 (April 4, 2011 – April 12, 2012)
delsjmet_5.5_041212 (April 12, 2012 – May 07, 2013)
delsjmet_5.5_050713 (May 07, 2013 – May 08, 2013)
delsjmet_5.5_050813 (May 08, 2013 – November 04, 2013)
delsjmet_5.5_110413 (November 04, 2013 – December 11, 2013)
delsjmet_5.5_121113 (December 11, 2013- May 01, 2014)
delsjmet_5.5_050114 (May 01, 2014- June 05, 2015)
delsjmet_5.5_060515 (June 05, 2015 – June 25, 2015)
delsjmet_5.5_062515 (June 25, 2015 – present)

10) Coded variable definitions -
[Instructions/Remove: List the sampling station, sampling site code, and station code used in the data.]

Sampling station:	Sampling site code:	Station code:
St. Jones	SJ	delsjmet

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. These values are automatically flagged and coded as <1> (CAF).

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/- 3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3>.

Data recorded for all parameters (with the exception of cumulative precipitation) at the midnight timestamp (00:00) are the 15 minute averages and totals for the 23:45-23:59 time period of the previous day. Cumulative precipitation data at the midnight timestamp (00:00) are the sum of raw (unrounded) precipitation data from 00:00 to 23:59 of the previous day. Summing each individual 15-minute total precipitation value from the same period will result in small differences from cumulative precipitation due to rounding. It is especially important to note how data at the midnight timestamp are recorded when using January 1st and December 31st data. **Note: Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.**

"See Metadata Comment" (CSM Code) Explanations:

1) The precipitation gauge did not actively collect rainfall data during the month of January due to insect interference to the tipping bucket mechanism. Rainfall data of 0.0 mm from 01/10/2016, 01/15/216, and 01/16/2016 have been rejected as a result. Rainfall totals for those days, as reported by the Dover Airforce Base meteorological

station, are: 01/10/2016 (0.30”), 01/15/2016 (0.69”), and 01/16/2016 (0.20”). A major nor’easter storm impacted Delaware from January 22-24, 2016. Precipitation related to this storm was in the form of snow. The TE-525 precipitation gauge is not capable of recording snowfall, so rainfall data from those three days have not been marked as anomalous nor rejected. Instead, those data are coded as {CWE} in the F_Record column.

2) PAR data were rejected on 6/1/2016 08:15 - 08:30 due to a sensor swap.

3) A negative minimum temperature value of -39.4199 at 2121 EST on 6/2/2016 was included in the 15 minute average resulting in a rejection of the 15 minute air temperature and relative humidity reading at 21:30.

4) A negative minimum temperature value of -39.5223 at 0824 EST on 06/15/2016 was included in the 15 minute average resulting in a rejection of the 15 minute air temperature and relative humidity reading at 08:30.

5) The following sensors were swapped on 6/22/2016: air temperature/relative humidity (data rejected at 13:00), barometric pressure (data rejected at 13:00, and wind (all parameters rejected 13:00 - 13:15).

6) A partial precipitation gauge clog was identified on 09/28/2016 resulting in the rejection of 15 minute precipitation readings from 03:00 – 12:45 EST and cumulative precipitation readings from 09/28/2016 (03:00 EST) to 09/29/2016 (00:00 EST). The cumulative daily recorded total of 83.3 mm, despite its rejection, is likely fairly accurate since heavy and high rainfalls were experienced that day.