

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

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2) Entry verification

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from 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. Patrick Hagan is responsible for all data management.

3) Research objectives

The principal objectives are to record meteorological information for the Sapelo Island NERR's site that can be used 1) as a reference for meteorological data for research projects on the reserve, 2) to give meteorological context for our quarter hourly SWMP water quality data, and other long term environmental monitoring projects at the Reserve, 3) to observe and characterize important events such as storms, heat and cold waves, droughts, and heavy rainfalls, and 4) to detect trends and characterize climate variability over the long-term

4) Research methods

Campbell Scientific data telemetry equipment was installed at the Marsh Landing station on 02/15/2007 and transmits data to the NOAA GOES satellite, NESDIS ID #3B036592. 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>.

Data are reported in Eastern Standard Time(EST) for the year.

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), Battery Voltage (volts)
Maximum and Minimum Air Temperature (°C) and their times from 5-second
data (these data are available from the Reserve)
Maximum Wind Speed (m/s) and time from 5-second data
Wind Direction Standard Deviation (degrees)

Totals:

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

Sensors are visually inspected on a monthly basis and are removed and recalibrated by the manufacturer on the following schedule:

- Temperature/Humidity- yearly recalibration
- Precipitation 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)

5) Site location and character

The site is located at 31° 25' 4.08 N, 81° 17' 43.26 W, about 15 feet (4.6m) above sea level. All sensors are mounted on a 10m-aluminum tower located in the northern corner of the Marsh Landing parking lot on the southwest corner of the island. The parking lot surface is approximately a meter above the surrounding marsh. The heights of the sensors on the tower are as follows:

Temperature and relative humidity	2m
Barometric pressure	1m
PAR	3m
Precipitation gauge	6m
Wind sensor	10m

It is bordered with salt marsh to the north and south with transition into pine forest occurring 1/2 mi to the east. On the immediate west lie the Duplin River and the ferry dock, which is also the location of our lower Duplin and marsh Landing Water Quality sampling sites(about 202ft from the MET station) . The station is well exposed to all winds and weather with little blockage and no shading. This region is subject to multiple severe weather phenomena partially due to the proximity to the ocean. These phenomena include

severe summer thunderstorms, which can cause drastic, localized drops in pressure, temperature, and heavy rains; powerful fall and winter frontal systems carrying prolonged strong winds (usually NNE), drastic and sudden drops in temperature and pressure, and long, steady rains; and finally the late summer and early fall hurricanes. It must be noted that due to the remote location and proximity to the ocean our weather patterns can vary greatly from those on the mainland, particularly temperatures which tend to moderate due to our being surrounded by water. The nearest sites for comparison is the Grays Reef NOAA weather Buoy located about 20nm east of Sapelo Island and Glynco airport located approx. 30 mi to the SSE.

SWMP Station Timeline:

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
SAPMLMET	Marsh Landing	P	31° 25' 4.08 N, 81° 17' 43.26 W	09/01/2002 -	NA	NA

6) Data collection period

January 1 @ 00:00 to December 31 @ 23:45 2017

Data from 10/26 @14:30 to 10/31 @ 07:45 are missing due to station malfunctions.

Raw File Start Date and Time	Raw File End Date and Time
12/02/2016 10:15	01/27/2017 14:00
01/27/2017 14:15	04/25/2017 13:00
04/25/2017 13:15	08/01/2017 13:15
08/01/2017 13:30	09/22/2017 10:30
09/22/2017 10:45	12/13/2017 12:45
12/13/2017 13:00	01/24/2018 13:00

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.

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 2017.

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

In 1953, the University of Georgia Marine Institute (UGAMI) was formed and the island became a working laboratory for many. The research continues today with SAP NERR and UGAMI creating a unique partnership with much of the current research being done facilitated by SAP NERR and UGAMI together. Given UGAMI's long history on Sapelo, a bibliographic list of over 800 articles of current and previous research can be found on the UGAMI website: <http://www.uga.edu/ugami>

As part of the SWMP long-term monitoring program, SAP 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.

9) Sensor specifications Parameter

Parameter: Temperature

Units: Celsius

Sensor type: Platinum resistance temperature detector (PRT)

Model #: HC2S3 Temperature and Relative Humidity Probe

Operating Temperature: -40°C to +60°C

Range: -50°C to +100°C

Accuracy: $\pm 0.1^\circ\text{C}$ with standard configuration settings

Date of Last calibration: 10/01/2015

Dates of Sensor Use: 02/02/2016 - 05/08/2018

SN 61115039

Date of Last calibration: 11/25/2015

Dates of Sensor Use: 05/08/2018 - current as of 05/09/2018

SN 0020072700

Parameter: Relative Humidity

Units: Percent

Sensor type: HC2S3 Temperature and Relative Humidity Probe

Range: 0-100% non-condensing

Accuracy at 23°C: $\pm 0.8\%$ RH

Temperature dependence of RH measurement: $\pm 3\%$ (-40 to 60°C)

Date of Last calibration: 10/01/2015

Dates of Sensor Use: 02/02/2016 - 05/08/2018

SN 61115039

Date of Last calibration: 05/08/2015
Dates of Sensor Use: 05/08/2018 - current as of 05/09/2018
SN 0020072700

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
Date of Last calibration: 10/14/2015
Dates of Sensor Use: 02/02/2016 - 05/08/2018
SN: J0560059

Date of Last calibration: 12/20/2016
Dates of Sensor Use: 05/08/2018 - current as of 05/09/2018
SN: M4930097

Parameter: wind speed
Units: Meters/second (m/s)
Sensor type: 12cm dia cup wheel assembly, 40 mm dia hemispherical cups
Model #: R.M. Young 0300-L Wind Sentry
Range: 0-50m/s (112mph) gust survival; 60m/s (134mph)
Accuracy: $\pm 2\%$
Last service: 10/06/2015
Dates of Sensor Use: 02/02/2016 - 10/03/2017
SN: unknown

Last service: New in 2016
Dates of Sensor Use: 10/03/2017 - current as of 05/09/2018
SN: unknown

Parameter: wind direction
Units: degrees
Sensor type: balanced vane 16cm turning radius
Model #: R.M. Young 0300-L Wind Sentry
Range: 360deg
Accuracy: $\pm 5\%$
Last service: 10/06/2015
Dates of Sensor Use: 02/02/2016 - 10/03/2017
SN: unknown

Last service: New in 2016
Dates of Sensor Use: 10/03/2017 - current as of 05/09/2018
SN: unknown

Parameter: Photosynthetically Active Radiation (PAR)
Units: mmol m⁻² (total flux)
LI-COR Quantum Sensor
Units: mmol 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 µmol s⁻¹ m⁻²
Multiplier: 1.22
Date of last calibration: 10/07/2015
Dates of Sensor Use: 02/02/2016 - 05/08/2018
SN: Q49457

Apogee Quantum Sensor
Sensor type: anodized aluminum with cast acrylic diffuser
Model #SQ110 Apogee Quantum Sensor
Light spectrum waveband: 410 to 655 nm
Temperature dependence: 0.06+/-0.06% per °C
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 70°C; Humidity 0 to 100%
Cosine Response: 45° zenith angle: +/- 2%; 75° zenith angle: +/- 5%
Sensitivity: 0.2mV per µmol s⁻¹ m⁻²
Multiplier: 0.025
Last cal: 03/10/2017
Serial # SQ-110_22481
Dates of Sensor Use: 05/08/2018 -current as of 05/09/2018

Parameter: Precipitation (specify if heated rain gauge)
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TE525
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Date of Last calibration: 03/01/2017, previous calibrations: 02/02/2016, 10/08/2014
SN:50994-412

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.
SN 5203 installed from 6/26/2006 - 04/24/2015
Date CR1000 calibrated: 07/14/2014
Date CR1000 Installed: 5/5/2015 - current as of 12/31/2017
SN: 66489

CR1000 Firmware Version (s): unknown

Currently running CR1000 program Version: SAPMLMET_V6.0_020216.CR1

10) Coded variable definitions

Sampling station:	Sampling site code:	Station code:
Marsh Landing	ML	sapmlmet

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 LI-COR sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the LI-COR sensor is +/- 2.214 mmol/m² over a 15 minute interval. These values are automatically flagged and coded as <1> (CAF).

There were noticeable changes in PAR values following the swap to a freshly calibrated sensor (assumed to be accurate) on 05/08/2018. The sensor (Q49457) was retired after removal and was not post calibrated to check for drift. Since drift numbers are not known all PAR data 1 year prior the sensor swap, from 05/08/2017 to 05/08/2018 are flagged and coded as <1> SSD CSM. PAR data for the remainder of this deployment (02/02/2016 - 05/07/2017) are flagged and coded <0> CSM (or 1 CSM for other reasons the data are considered suspect; see below for elevated nighttime flagging and coding) and users should note that drift for that period may have exceeded acceptable limits as well. If users are comfortable assuming that drift was linear (in a real world environment it is unlikely to be

entirely linear), these data may be 'corrected' for assumed linear drift at the user's discretion using manufacturer's instructions.

Elevated nighttime PAR values occurred throughout the year, it is suspected this is caused by water intrusion into the probe both from rain and dew. All PAR data are considered suspect, <1> CSM unless otherwise flagged and coded as suspect or rejected (see above for drift information).

All wind parameters were rejected due to sensor malfunction (<-3>)[SSM](CSM), 9/14/2017 18:30 - 10/03/2017 09:45 . Prior to this failure wind values sporadically dropped to 0. All wind parameters from the beginning of the year until consistent drops to 0 occurred are coded with CSM and users should be aware that the bearings may have begun to fail earlier than when the data are flagged as suspect. Although there were time periods when all wind parameter values were recorded as 0, the data were not flagged as suspect because calm conditions at the site are normal. Wind data from 01/10/2017 19:30 until the failure on 9/14/2017 are considered suspect as drops to 0 became more frequent. The sensor was replaced on 10/03/2017. All parameters were rejected, <-3> [SMT](CSM), 10/03/2017 10:00 - 11:15 during maintenance to replace the sensor.

The maximum effects from hurricane Irma were felt from 9/10/2017 @ 22:00 to 9/11/2017 @ 20:45. It is believed these data are accurate and are flagged and coded as <0> [GSM](CWE). The suspect coding for wind parameters continued during this time frame; however, the coding was edited to reflect the weather event, <1> GSM CWE. PAR data flagging and coding for drift, <1> SSD CSM, was not changed.

The tipping bucket funnel was found to be clogged on 8/10/2017, the clog was cleared at 15:30 and the remaining volume was logged. Total Precipitation data from 8/8 @ 16:30 - 8/10 15:30 and cumulative until 8/11 00:00 have been flagged as suspect as it is believed to have been affected by the clog.

10/03/2017 10:00 - 11:15 all parameters were rejected due to maintenance to replace the wind sensor, <-3> SMT CSM. Cumulative precipitation values were rejected through the end of the day.

10/25/2017 Data at 14:30 are missing due to a power failure possible caused by a bad connection at the fuse. Data were rejected at 14:45 since they were more than likely not a full 15 minutes of 5-second data.

10/26/2017 10:15 - 10/31/2017 07:45 Data are missing due to a power failure that was more than likely caused by the bad connection at the fuse (mentioned above). All data were rejected at 10/31/2017 08:00 for maintenance to repair the connection.

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.**