Waquoit Bay National Estuarine Research Reserve Meteorological Metadata
January 2005-December 2005
Lastest Update **October 19, 2023**

I. Data Set & Research Descriptors

1) Principal Investigator(s) & contact persons

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2) Entry Verification

System I.

In late October 2003 a CR10X program was installed. The old program (ner30.csi) was revised (NERR_4.CSI) to standardize the program for all sites. The revision was necessary to meet new data reporting requirements of CDMO to eliminate instantaneous data sample reporting, add cumulative daily rainfall and additional sensors.

The meteorological information is sampled every 5 seconds from each instrument on the weather station and stored on a Campbell Scientific CR10X datalogger. Data are output to a file in three arrays: array 15 stores 15 minutes average , max and min data; array 60 stores hourly average, max and min data; and array 144 stores daily (24 hr) average, max and min data. The CDMO Data Logger (NERR_4.CSI) was loaded into the CR10X and controls the sensors. The CR10X then interfaces with the PC208W software supplied by Campbell Scientific.

In general, at the end of every month, in the first few days of the new month, the data are uploaded from the CR10X data logger and / or storage module to a personal computer (IBM compatible) and saved as a deployment or "monthly" raw data file (DATA000.dat) onto a separate hard drive and backed up onto the Waquoit Bay NERR server . The server data is itself backed-up everyday offsite by a server located at the Massachusetts Dept. of Conservation and Recreation headquarters in Boston, MA. Files are exported from the PC208W or LoggerNet in a comma-delimited format (.dat) and opened in Microsoft Excel for pre-processing with the EQWin format macro (EQWinFormat.xls) that was developed by the CDMO to reformat the header columns, insert station codes, insert a date column (mm/dd/yyyy), correct the time column format and reformat the data to the appropriate number of decimal places. The pre-processed file is then ready to be copied into the EQWin weather.equi file where data can be QA / QC checked and archived in a database. In practice at Waquoit Bay NERR, we also scan the raw data in both the earlier formats as well, just after uploading to look for significant time gaps and other gross anomalies, and similarly in the Excel format. EQWin queries, reports and graphs are used to look for outliers and other significant anomalies. Any anomalous or missing data are investigated and then noted below in the Anomalous / Suspect Data and Missing Data sections. Any Data corrections or substitutions (from real-time database or other source) are noted and any deleted data sections are noted in the Deleted Data sections.

The most common reported errors/anomalies noted in the monthly error reports in 2005 were:

1) Total PAR Licor data values with negative readings that ranged from -0.10 to -0.20.
2) Relative Humidity percentages data values above 100%. Range from 101% to 103%

In all cases in 2005, these two most commonly reported anomalies were found to be valid data and retained. All reported errors/anomalies are double checked, and where data truly appear anomalous, they are compared with other regional meteorological data for verification.

Chris Weidman, Research Coordinator and MaryKay Fox, Assistant Research Coordinator, error checked and compiled the meteorological data for 2005.

System II.

In March 2004, our meteorological station was linked to a Marisys TR system box, which allowed near real-time access to our meteorological data over the internet. All the real-time meteorological data since March 9, 2004 are archived at a CDMO server and available on the web (Note this is currently a separate database from data acquired through System I methods. The web address is still provisional and only accessible by authorized NERRs staff. The parameters available in this format are the following:

Air Temperature (C)
- 15 minute average (over previous 15 minute period)
- Maximum (1 min average in previous 15 minute period)
- Minimum (1 min average in previous 15 minute period)
- Time Maximum
- Time Minimum

Relative Humidity (%)
- 15 minute average (over previous 15 minute period)
- Maximum (1 min average in previous 15 minute period)
- Minimum (1 min average in previous 15 minute period)
- Time Maximum
- Time Minimum

Barometric Pressure (mb)
- 15 minute average (over previous 15 minute period)
- Maximum (1 min average in previous 15 minute period)
- Minimum (1 min average in previous 15 minute period)
- Time Maximum
- Time Minimum

Wind Speed
- 15 minute average (over previous 15 minute period)
- Maximum (1 min average in previous 15 minute period)
- Minimum (1 min average in previous 15 minute period)
- Time Maximum
- Time Minimum

Wind Direction
- 15 minute average (over previous 15 minute period)
- Standard Deviation (over previous 15 minute period)

Total Precipitation (mm)
- previous 15 minute total

Total Photosynthetically Available Radiation (PAR)
- previous 15 minute total (millimoles/ m2)

Note that some of the Marisys system flags data fall outside the preset filter ranges. As this system has been in pilot mode throughout 2005, the flagged data are simply appended with a "BAD" at the end of a given sample value. Almost all of these flags are not indicative of "bad" data but simply the result of an inappropriately set filter threshold setting. These filter settings were finally improved, though not entirely corrected, in early December 2004. Data from this database can be obtained by contacting Chris Weidman at Chris.Weidman@state.ma.us.

System III.

On February 10th, 2005, a new EPLAB© Black and White Pyranometer was installed. It was mounted on the same structure as the PAR instrument approximately within one meters distance apart. This

pyranometer is an Eppley 10-and 50-junction 180^{O} pyrheliometer originally introduced by Kimball and Hobbs in 1923. The detector is a differential thermopile with the hot-junction receivers blackened and the cold-junction receivers whitened. The element is of radial wirewound-plated construction with the black segments coated with 3M black and the white segments with Barium Sulfate. Built in temperature compensation with thermistor circuitry is incorporated to free th instrument from the effects of ambient temperature. A precision ground optical glass hemisphere of Schott glass WG295 uniformly transmits energy from 285 to 2,800 millimicrons. This hemispherical envelope seals the instrument from the weather, but is readily removable for instrument repair. The cast aluminum case carries a circular spirit level and adjustable leveling screws. Also supplied is a desiccator, which can be inspected readily. The Pyranometer was calibrated and installed November 15th, 2005

3) Research objectives

The principal objectives are to record meteorological information for the Waquoit Bay NERR's site that can be used 1) as a vital reference of atmospheric data for various research projects at the reserve -- an integral part of our general NERR mission is to provide a platform for estuarine research, 2) to give meteorological context (atmospheric-forcing) for our half-hourly SWMP water quality data, and other long-term environmental monitoring programs at the Reserve (including nutrients and shoreline change), 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

The Campbell Scientific weather station samples every 5 seconds continuously throughout the year. These data are used by the CR10X to produce 15 minute, hourly and daily averages of those measurements of air temperature, relative humidity, barometric pressure, wind speed, and wind direction. Precipitation and PAR are recorded as totals for each interval. As mentioned above, we generally upload data from the CR10X / storage module about once a month. CR10X raw data are currently stored on 2 data storage modules capable in combination of storing about 4 or more months of data. The CR10X is also cabled directly to a desktop PC where the instantaneous 5 sec data are displayed (in a PC208W window) and can be viewed at anytime. All collected data is quality checked immediately after the monthly downloads. The error/anomaly reports and all monthly parameter graphs are printed and reviewed. Any error/anomaly messages are further investigated and the data is either corrected/deleted (if necessary) or commented on and left unchanged.

Sensors on the weather station are inspected monthly for damage or debris. The heated rain gauge tends to collect debris and is cleaned out every few days, particularly before and after major storms events. Sensors are removed and calibrated on an annual basis depending on the particular sensor, unless the real-time date stream indicates a malfunction. In October 2005 WQBNERR installed a remote sensing weather station (a "Weather Channel © Weather Statioin") on the west side of the Carriage House and within 50 ft of the NERR weather tower and PAR/SW Radiation sensors. It records Wind Direction(degree), Wind Speed and Gusts (mph), Temperature (^{o}C), Humidity (%), Barometric Pressure (mb), and Precipitation. We utilize this ancillary station for our monthly download day to run a comparative set of local observations as a general check on the Campbell station sensors.

5) Site Location and character

The weather station is located on a 24-acre parcel of Reserve land that includes the Reserve headquarters at 41^{O} 34.895 N, 70^{O} 31.511' W. Wind (speed and direction), temperature and relative humidity sensors are mounted on a 10-m aluminum tower next to the Carriage House, which houses our grounds facilities, classroom and laboratory. The tower is surrounded on three sides by an open parking area; its attached probes stand approximately 2.5 m above the roof peak of the adjacent building and are separated from any trees by at least 30 m. A crushed shell parking area (bleach white in color) is located directly to the south and west of the tower, with the building and its roof peak to the northeast. The tower base is 10.39 m above sea level (NGVD), approximately 100 m north from Waquoit Bay's northern shoreline. The location is most well exposed to winds from the west and south (southeast clockwise to northwest). The LiCor (PAR) sensor and EPLAB Pyranometer are mounted about 10 m away on an extended aluminum arm at a height of 3 m above the ground level and is well exposed at all times to the sun in both winter and summer.

The air pressure sensor is mounted next to the CR10X in the laboratory. The rain gauge is located in an open field away from trees about 55 m northwest of the laboratory and tower at 41^{o} 34.908' N, 70^{o} 31.546' W and 11.2 m above sea level (NGVD).

As for its general setting, the Waquoit Bay National Estuarine Research Reserve (WBNERR) is located in the northeastern United States on the southern coast of Cape Cod, Massachusetts. Climatically, this region is considered temperate maritime, and experiences relatively mild winters and cool summers relative to the rest of New England because of its exposed oceanic location. Typical of the mid-latitudes (41 N), prevailing winds are from the southwest, while storm winds tend to be from the east.
The area is adjacent to one of the world's most active regions for cyclogenesis (extra-tropical cyclone formation) off the East coast of North America. These generally winter season storms are most frequent (almost weekly) from late October until late April and are locally called Nor'easters because of the NE wind direction typical to the area during the period of peak wind speeds. These storms generally develop rapidly as secondary lows off the mid-Atlantic coast (Carolinas to New Jersey) and track northeastward passing Cape Cod either directly overhead, or to the southeast or northwest. These winter season storms are important agents of coastal erosion and shoreline alteration in the region, particularly for easterly facing coasts.

Hurricanes are also important phenomena in the region. Most years, during the period from July to November, the Cape experiences some brush with a passing tropical storm. About once every decade the area experiences a nearby landfall, with winds exceeding hurricane threshold (>33 m/s), usually from the southerly quarter. Hurricanes are particularly important agents of change for the Cape's southern coastal areas, and can have profound effects on local estuaries, including Waquoit Bay. Typically, barrier beach over-wash (with salt marsh burial) and breaching (with new tidal inlet formation) occur during these extreme events.

Average temperature and rainfall conditions for the period 1882-1960 for Provincetown (about 50 km to the northwest) (Ptown) are shown in the table below in comparison with Waquoit Bay (WQB) monthly values for 2002.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Ptown Temp (C)	-0.6	-1.1	1.7	6.7	11.7	17.2	20.6	20.0	17.2	12.2	6.7	1.7	**9.5**
WQB Temp (C)	0.0	3.3	5.7	10.0	13.6	18.2	22.8	22.8	18.6	11.0	6.7	1.1	**11.2**
Ptown Ppt (cm)	9.9	8.7	9.4	9.0	7.5	7.0	6.8	8.1	8.4	8.7	8.1	9.2	**100.8**
WQB Ppt (cm)	12.5	5.6	14.5	10.7	13.4	8.1	1.4	6.5	13.8	8.2	19.9	20.4	**135.0**

Note: The temperatures for Waquoit Bay on the southwest corner of Cape Cod vs. for Provincetown on the northeast corner are likely to be a bit warmer in Spring and Summer and a bit colder in Autumn and Winter. Provincetown is on a very small peninsula a couple of miles wide, surrounded by colder (in Summer) Gulf of Maine waters, while Waquoit Bay is closer to the mainland of New England and is bathed by the warmer shelf waters of southern New England. Also, these averages do not include the period since 1960. The last two decades, in particular, have been known to be among the warmest recorded (last 150 years), though that may be compensated in part by the historically cold periods of mid-1960s and mid-1970s.

Meteorological data from Waquoit Bay NERR can also be compared to that from other nearby meteorological stations. These stations are located at Otis Air Force Base (10 km to the north), Falmouth Water Department-Long Pond (8 km to the west), Woods Hole Oceanographic Institution–Quisset Campus (13 km to the southwest), Hyannis Airport (23 km to the northeast), and Buzzards Bay Texas Tower (41 km to the southwest) – this latter station being a particularly valuable reference site because it is offshore and weatherward (southwest) with at least 15 km of unobstructed open water around it and it also records other useful sea surface parameters (wave height and direction, and ocean temperatures). We frequently compare our observations with data from the NOAA offshore tower at the entrance to Buzzards Bay

(Temperature, Wind, Air Pressure) because its current (within the hour) and archived measurements are available online (website). A comparison of monthly data for 2002 between the Buzzards Bay Tower and Waquoit Bay SWMP data is shown in the table below:

Buzzards Bay Tower and Waquoit Bay *(data)* Monthly Meteorological Statistics for 2002
Note: Water temps in Waquoit Bay are from Menauhant SWMP Station

Month	Wdir	Wspd m/s	Gust m/s	Wave ht	Baro	Air T	Water T
Jan mean	243 *(249)*	9.0 *(2.1)*	10.0	1.3	1013.1 *(1011)*	4.0 *(3.9)*	5.7 *(3.3)*
Jan min	----	1.4 *(0.0)*	1.5	0.3	986.1 *(980)*	-4.5 *(-4.7)*	4.5 *(0.6)*
Jan max	----	21.5 *(16.6)*	24.6	2.9	1031.6 *(1031)*	11.1 *(13.7)*	8.0 *(5.8)*
Feb mean	220 *(237)*	8.6 *(3.1)*	9.5	1.1	1016.0 *(1014)*	3.1 *(3.3)*	4.6 *(3.7)*
Feb min	----	0.6 *(0.0)*	0.7	0.3	995.7 *(992)*	-6.9 *(-9.7)*	3.6 *(1.0)*
Feb max	----	21.0 *(14.4)*	23.6	3.1	1037.6 *(1036)*	11.1 *(13.7)*	6.1 *(6.9)*
Mar mean	179 *(186)*	8.8 *(2.5)*	9.6	1.3	1020.3 *(1018)*	4.5 *(5.7)*	5.1 *(5.8)*
Mar min	----	0.4 *(0.0)*	0.5	0.4	998.0 *(998)*	-6.6 *(-5.5)*	4.4 *(3.2)*
Mar max	----	20.0 *(18.0)*	22.0	3.7	1038.8 *(1038)*	12.7 *(17.9)*	5.9 *(9.8)*
Apr mean	201 *(214)*	7.6 *(2.4)*	8.3	0.9	1018.4 *(1016)*	8.0 *(10.0)*	7.9 *(10.9)*
Apr min	----	0.4 *(0.0)*	0.5	0.2	997.6 *(995)*	-0.9 *(-2.0)*	5.6 *(6.7)*
Apr max	----	21.6 *(17.1)*	25.4	2.3	1039.5 *(1038)*	22.4 *(31.2)*	10.2 *(16.3)*
May mean	200 *(194)*	7.8 *(2.0)*	8.5	0.9	1016.5 *(1015)*	11.4 *(13.6)*	11.1 *(14.2)*
May min	----	0.2 *(0.0)*	0.7	0.3	993.2 *(990)*	5.3 *(2.4)*	9.1 *(10.4)*
May max	----	22.1 *(16.6)*	24.6	2.4	1028.4 *(1027)*	19.6 *(24.9)*	14.5 *(20.3)*
Jun mean	175 *(216)*	6.9 *(1.6)*	7.5	0.8	1016.0 *(1015)*	16.2 *(18.2)*	15.3 *(19.1)*
Jun min	----	0.0 *(0.0)*	0.0	0.4	998.2 *(996)*	9.7 *(5.9)*	13.6 *(14.9)*
Jun max	----	18.6 *(10.7)*	20.3	1.8	1033.6 *(1033)*	26.2 *(31.3)*	18.5 *(24.3)*
Jul mean	207 *(218)*	6.6 *(1.4)*	7.0	0.7	1014.8 *(1014)*	20.6 *(22.8)*	18.7 *(23.4)*
Jul min	----	0.0 *(0.0)*	0.0	0.4	1005.3 *(1004)*	15.7 *(11.2)*	16.0 *(21.5)*
Jul max	----	15.9 *(11.8)*	17.1	1.6	1024.8 *(1024)*	29.4 *(34.2)*	21.5 *(26.5)*
Aug mean	178 *(207)*	6.4 *(1.4)*	6.8	0.6	1017.5 *(1017)*	21.2 *(22.8)*	20.0 *(24.3)*
Aug min	----	0.1 *(0.0)*	0.3	0.3	1005.4 *(1006)*	15.6 *(11.7)*	18.1 *(20.6)*
Aug max	----	14.2 *(11.4)*	14.9	1.4	1034.4 *(1035)*	25.9 *(33.5)*	22.9 *(28.1)*
Sep mean	180 *(192)*	7.1 *(1.7)*	7.7	0.8	1017.7 *(1017)*	18.8 *(18.6)*	19.0 *(21.0)*
Sep min	----	0.2 *(0.0)*	0.5	0.3	988.3 *(992)*	12.6 *(7.8)*	17.7 *(19.0)*
Sep max	----	21.2 *(15.7)*	24.5	2.9	1033.1 *(1033)*	23.9 *(27.9)*	20.6 *(23.4)*
Oct mean	177 *(206)*	8.5 *(1.9)*	9.5	0.9	1019.0 *(1018)*	12.5 *(11.0)*	16.4 *(15.2)*
Oct min	----	0.7 *(0.0)*	1.1	0.2	995.1 *(995)*	2.8 *(-1.4)*	13.2 *(9.6)*
Oct max	----	19.9 *(13.2)*	23.0	3.3	1030.3 *(1029)*	22.0 *(24.9)*	19.2 *(21.3)*
Nov mean	204 *(241)*	10.1 *(2.5)*	11.2	1.3	1013.0 *(1012)*	8.0 *(6.7)*	11.3 *(9.0)*
Nov min	----	0.1 *(0.0)*	0.5	0.3	987.2 *(983)*	-5.0 *(-7.3)*	8.5 *(3.9)*
Nov max	----	20.6 *(15.8)*	23.0	3.2	1028.4 *(1028)*	17.2 *(21.1)*	13.3 *(14.2)*
Dec mean	246 *(254)*	9.6 *(2.8)*	10.7	1.2	1014.2 *(1013)*	2.6 *(1.1)*	6.3 *(3.3)*
Dec min	----	0.0 *(0.0)*	0.0	0.3	974.3 *(975)*	-8.0 *(-9.5)*	4.4 *(1.2)*
Dec max	----	21.4 *(17.2)*	24.6	3.1	1036.4 *(1035)*	12.7 *(13.0)*	9.6 *(6.7)*
Ann mean	201 *(218)*	8.1 *(2.1)*	8.9	1.0	1016.4 *(1015.0)*	10.9 *(11.5)*	11.8 *(12.8)*

Ann min	----	0.0 *(0.0)*	0.0	0.2	974.3 *(975)*	-8.0 *(-9.7)*	3.6 *(0.6)*
Ann max	----	22.1 *(18.0)*	25.4	3.7	1039.5 *(1038)*	29.4 *(34.2)*	22.9 *(28.1)*

Meteorological differences between the offshore Buzzards Bay Tower and our Waquoit Bay station are to be expected both because of a separation of about 40 km and because of the site geographies (offshore vs. coastal land). Wind direction values generally are higher for Waquoit Bay versus Buzzards Bay Tower, meaning a more westward and northward component at the Waquoit Bay site. This is an expected result of winds encountering greater friction over land than over water causing the wind to turn more to the right over land. Average wind speeds are notably lower at Waquoit Bay by about a factor of four. Somewhat lower wind speeds are expected again because of the greater surface friction and topography encountered at land versus offshore stations, but a factor of four appears to us to be unusually large. We have verified our Wind Monitor wind speeds using a hand-held Kestrel, but our wind speeds are also lower by a factor of 2-3 compared with other nearby land stations (Otis Air Base and Hyannis Airport). The Buzzards Bay station is noted for its very high (often the highest) wind speeds recorded for even nearby offshore sites, so the fact that it has some "outlier" characteristics relative to other regional stations is to be noted. As for local topographic effects at Waquoit Bay, the site (as noted above) is about 100 m from a 6 m bluff and the surrounding area is forested with tree canopies topping out at about 10 m., so the wind sensors no doubt experience a fairly turbulent (gusty) wind stream. In contrast maximum wind speeds at Waquoit are not so different (80%)from Buzzards Bay Tower values strongly indicating that the Waquoit wind sensor is calibrated correctly and that the winds at Waquoit show more variability. Air pressure values between stations track closely with Waquoit showing only a slightly lower average of about 1 mb. Air Temperatures also track closely, with the expected land/ocean contrasts of Waquoit's land site showing more extreme hot and cold values, and with colder averages in the winter and warmer averages in the summer. Water temperatures also show a similar though more subdued set of contrasts between stations.

Other stations which are also used for reference are 1) the Woods Hole Oceanographic Institution in Woods Hole (Temperature, Air Pressure, Solar Radiation),2) DataGarrison Weather Observation Reporting Station in East Falmouth 3) Falmouth DPW (rainfall), 4) Otis Air Force Base (wind), and 5) Hyannis Airport (Temperature, Wind, Rainfall, Air Pressure, Relative Humidity). A comparison of daily data from WBNERR and Buzzards Bay Tower and Falmouth DPW is shown below for the Month of December 2001.

Waquoit Bay(WQB) vs Buzzards Bay Tower(BUZ) and Falmouth DPW(FAL): December 2001
Note: ppt is only measured once a day at Falmouth DPW.

DAY	WQB Temp	BUZ Temp	WQB Baro	BUZ Baro	WQB WSpd	BUZ WSpd	WQB WDir	BUZ WDir	WQB PPT	FAL PPT
1	15.4	14.8	1014.1	1015.7	2.8	10.3	244	200	0.762	0.000
2	9.3	11.5	1021.4	1019.8	1.3	7.0	319	296	0	0.000
3	7.8	8.8	1024.0	1025.7	1.6	5.6	267	268	0.254	0.000
4	11.1	10.6	1024.4	1024.9	1.0	8.0	251	245	0	0.508
5	13.6	12.1	1022.9	1025.7	1.0	6.0	211	216	0	0.000
6	15.0	13.5	1014.2	1020.0	2.4	8.9	239	224	0	1.016
7	11.3	12.5	1012.9	1013.2	1.1	7.0	288	257	1.27	0.000
8	4.7	8.3	1019.3	1019.0	1.1	7.0	10	214	2.54	13.208
9	2.7	3.9	1016.2	1016.3	2.2	9.2	356	74	15.24	0.508
10	4.9	3.4	1027.3	1026.7	1.5	6.1	245	265	0.254	0.000
11	8.3	8.9	1025.2	1026.5	1.1	6.2	21	138	3.302	0.000
12	7.6	7.4	1030.0	1029.9	1.5	9.3	43	31	0	0.508
13	10.7	8.3	1015.6	1024.6	1.4	5.6	151	83	4.064	2.540
14	11.7	10.9	1010.6	1013.6	1.5	7.4	251	239	4.826	0.000
15	6.2	9.6	1014.1	1009.4	3.4	8.4	331	200	0.508	0.762
16	0.6	2.1	1026.4	1026.4	2.0	10.1	329	333	0	0.000
17	3.3	3.6	1014.6	1025.2	1.3	4.1	43	98	6.604	19.812
18	6.8	8.9	990.9	997.5	3.3	8.8	314	218	28.702	10.668
19	6.2	5.7	1006.9	1002.6	2.5	13.2	290	284	0	0.000
20	7.3	8.7	1002.1	1006.8	3.2	5.6	322	213	0	0.000
21	2.9	4.6	1008.2	1005.1	4.2	13.4	314	289	0	0.000

22	0.3	0.9	1021.7	1019.7	2.7	11.9	325	324	0	0.000
23	2.6	1.9	1019.2	1024.1	0.9	5.2	258	314	0	0.000
24	9.2	9.2	1004.7	1011.6	1.8	7.1	189	168	19.304	10.160
25	2.1	4.5	1012.2	1009.2	1.3	8.8	302	276	0	5.080
26	1.3	2.8	1006.9	1014.0	0.6	3.9	9	160	2.54	6.350
27	-0.4	0.3	1000.0	1002.1	2.9	8.4	296	230	0.254	0.000
28	1.7	0.2	1002.8	1004.7	2.3	11.5	275	264	1.27	0.000
29	2.2	3.0	1004.0	1004.3	2.7	12.1	286	256	0	0.000
30	-0.1	0.7	1007.2	1007.5	3.4	10.2	284	278	0	0.000
31	-1.1	-1.1	1011.6	1011.6	3.0	11.6	287	270	0	0.000
Mean	5.97	6.47	1013.9	1015.6	2.0	8.32	237.1	223.4	91.694	72.078
SD	0.85	0.80	1.66	1.63	0.16	0.47	18.7	13.5		

6) Data collection period

Weather data has been collected at the Waquoit Bay NERR Carriage House since December 2001. The current weather station has been operational since this date. Data were collected continuously for the entire year in 2005, except for a 2 day period in mid-June when sensors were being calibrated.

Data were downloaded from the logger with the following dates and file numbers:

2005 Summary of Data files					
EQWIN Data File	WBNERR Excel File	**Start Date**	**Start time**	**End Date**	**End time**
wqbchmet 010105 to 020405	DATA 059b	1/1/2005	0:00	1/6/2005	11:15
wqbchmet 010105 to 020405	DATA 060	1/6/2005	11:30	2/4/2005	10:00
wqbchmet 020405 to 060205	DATA061	2/4/2005	10:15	3/7/2005	11:45
wqbchmet 020405 to 060205	DATA062	3/7/2005	12:00	4/19/2005	15:30
wqbchmet 020405 to 060205	DATA063	4/19/2005	15:45	5/9/2005	10:15
wqbchmet 020405 to 060205	DATA064	5/9/2005	10:30	6/2/2005	7:30
wqbchmet 060205 to 080805	DATA065	6/2/2005	7:45	6/17/2005	11:30
wqbchmet 060205 to 080805	DATA066	6/17/2005	11:45	6/17/2005	11:45
wqbchmet 060205 to 080805	DATA067	6/17/2005	12:00	6/22/2005	9:15
wqbchmet 060205 to 080805	DATA068	6/22/2005	9:30	6/22/2005	9:30
wqbchmet 060205 to 080805	DATA069	6/22/2005	9:45	7/5/2005	7:45
wqbchmet 060205 to 080805	DATA070	7/5/2005	8:00	8/8/2005	13:00
wqbchmet 080805 to 120605	DATA071	8/8/2005	13:15	9/20/2005	11:45
wqbchmet 080805 to 120605	DATA072	9/20/2005	12:00	9/26/2005	13:30
wqbchmet 080805 to 120605	DATA073	9/26/2005	13:45	11/1/2005	15:00
wqbchmet 080805 to 120605	DATA074	11/1/2005	15:15	11/16/2005	15:00
wqbchmet 080805 to 120605	DATA075	11/16/2005	15:15	12/6/2005	17:30
wqbchmet 120605 to 123105	DATA076a	12/6/2005	17:45	12/31/2005	23:59

As noted above data were also collected continuously in near real-time since 03/09/2004 and archived on a server now at CDMO.

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 homepage) and online at the CDMO home page **http://cdmo.baruch.sc.edu**. Data are available in Excel, text and EQwin formats.

8) Associated researchers and projects

Not applicable at this time.

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

LiCor Quantum Sensor
Model #: LI-190SZ S/N Q12415
Stability: <±2% change over a 1 year period
Operating Temperature: -40 to +65 °C
Sensitivity: typically 5μA per 1000 μmoles $s^{-1}m^{-2}$
Light spectrum wavelength: 400 to 700 nm
Date of last calibration: 7/22/2004

EPLAB Pyranometer
Model #: 8-48 SW/N 9698
Stability: >1% over 5 years (0.2 % per year)
Operating Temperatures: ± 1.5 percent constancy from -20 to + 40 °C
Sensitivity: 11 microvolts/watt $meter^{-2}$ approximately
Impedance: 350 ohms approximately
Response Time: 5 seconds (1/e signal)
Linearity: ± 1 percent from 0 to 1400 watts $meter^{-2}$
Calibrated and Installed November 16th, 2005 at 15:15

Wind Monitor
Model #05103
Range: 0-60 m/s (130 mph), threshold: 0.5 m/s (1.1 kts)
(Note: from observation we note that the monitor seems to have a lower threshold than 0.5 m/s with the wind propeller spinning and values down to 0.1 m/s being measured).
Direction Range: 360°; Threshold Sensitivity: 0.5 m/s (1.1 kts) at 10° displacement
Calibration not required. Bearings replaced 6/15/2005

Temperature and Relative Humidity
Model #: HMP35C
Operating Temperature: -20 to +60°C
Temperature Measurement Range: -35 to +50°C
Temperature Accuracy: 0.5°C
Relative Humidity Measurement Range: 0 to 100%

RH Accuracy: ±2% RH, 0 to 90% or ±3% RH, 90-100%
Uncertainty of calibration: 0.3% RH
Date of last calibration: 6/15/2005

Barometric Sensor
Model #: PTP101B
Operating Range: 600-1060 hPa
Temperature: -40 to +60°C
Humidity: non-condensing
Accuracy: ±0.5 hPa
Stability: NA
Date of last calibration: 6/17/2005

Heated Tipping Bucket Rain Gauge
Model #: TR-525
Range: 0.1 mm
Accuracy: 1.0% at <10 mm/hour
Direct calibration was carried out in 11/22/2005 through 12/01/2005.

Storage Module
Model # SM4M
Storage capacity: 2 million low-resolution data values
Program storage: stores up to 8 program with a total capacity of 128 KB
Processor: Hitachi H8S
Operating system: 64 KB, flash memory based, user downloadable
Operating range: Temp: -35 to +65 degree C
Baud rates: 9600, 76800
Power requirements: 5 +/- 0.3 VDC @ 100 mA

Campbell Scientific CR10X datalogger and wiring panel has 128K flash memory (EEPROM), in which it stores the operating system and the actual weather program used to make the station operational. Additionally, there are 128K of SRAM, which it uses to run the program and store its measurements for final data storage.

10) Coded variable indicator and variable code definitions

Site definitions: CH=Carriage House
Station Code= wqbchmet

11) Anomalous 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 throughout the fall of 2022.

COMMENT 1: 15 min sample rainfall amount differences of over 5mm in 15 minutes can occur during storms and indicate intense ppt bursts during thunderstorms or frontal passages.

COMMENT 2: Small negative PAR values sometimes occur at night. These small values are within the range of the sensors. The maximum signal noise error for the LIcor sensor is +/- 2.214 mmoles/m2 over a 15 minute interval. These data have been retained..

COMMENT 3: Relative Humidity data greater than 100% have been observed; these data are within the range of the sensor accuracy of +/- 3%. These data have been retained.

COMMENT 4: Sensors calibration occurred this year from 07/15/2005 14:45 until the morning of 07/17/2005 with everything back in operation by 11:30. Different sensors were out of operation at various times during this time while others continued in operation. The calibration event resulted in several categories of corrupted or incorrect data (anomalous -99999, missing data, and deleted data. (See note below in other remarks)

January 2005

a) Some January PAR data show values slightly negative values. See Comment 2.
b) Some January RH data show values slightly above 100%. See Comment 3.

February 2005

a) Some February PAR data show values slightly negative values. See Comment 2.
b) Some February RH data show values slightly above 100%. See Comment 3.

March 2005

a) Some March PAR data show values slightly negative values. See Comment 2.
b) Some March RH data show values slightly above 100%. See Comment 3.
c) PPT outliers below were supported as valid using nearby PPT records from the East Falmouth Weather Observer station, which both indicate a period of heavy rainfall. See Comment 1. These data were retained: 03/28/2005 21:15

April 2005

a) Some April PAR data show values slightly negative values. See Comment 2.
b) Some April RH data show values slightly above 100%. See Comment 3.
c) PPT outliers below were supported as valid using nearby PPT records from the East Falmouth Weather Observer station, which both indicate a period of heavy rainfall. See Comment 1. These data were retained: 04/30/2005 23:45

May 2005

a) Some May PAR data show values slightly negative values. See Comment 2.
b) Some May RH data show values slightly above 100%. See Comment 3.

June 2005

a) Some June PAR data show values slightly negative values. See Comment 2.
b) Some June RH data show values slightly above 100%. See Comment 3.
c) Annual sensor calibration was carried out from 06/15/2005 14:45 to 06/17/2005 11:45. No meaningful Temperature and Relative Humidity data were recorded during this period of time, and so these data were deleted. After calibration, in readjusting the calibration constants in the weather data management program, a small error was made in the constant for barometric pressure causing the barometric pressure to read 4 mb too high. This error affected the data from 06/17/2005 12:00 to 06/22/2005 09:30, after which it was corrected. These slightly offset barometric pressure data were retained, but should be corrected if used for quantitative analysis.
d) As part of calibration, -99999 values were recorded for total PAR on 06/17/2005 11:15.
e) As part of calibration, -99999 values were recorded for Average Volts on 06/17/2005 11:15.

July 2005

a) Some July PAR data show values slightly negative values. See Comment 2.
b) PPT outliers below were supported as valid using nearby PPT records from the East Falmouth Weather Observer station, which both indicate a period of heavy rainfall. See Comment 1. These data were retained: 07/08/2005 20:00

August 2005

a) Some PAR data this month show values slightly negative values. See Comment 2.

September 2005

a) Some PAR data this month show values slightly negative values. See Comment 2.
b) PPT outliers below were supported as valid using nearby PPT records from the East Falmouth Weather Observer station, which both indicate a period of heavy rainfall. See Comment 1. These data were retained: 09/15/2005 17:30-18:00; 09/27/2005 01:30

October 2005

a) Some PAR data this month show values slightly negative values. See Comment 2.
b) PPT outliers below were supported as valid using nearby PPT records from the East Falmouth Weather Observer station, which both indicate a period of heavy rainfall. See Comment 1. These data were retained: 10/09/2005 03:00; 10/15/2005 5:15-5:30, 13:15

November 2005

a) Some PAR data this month show values slightly negative values. See Comment 2.

December 2005

a) Some PAR data this month show values slightly negative values. See Comment 2.

12) Deleted 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 throughout the fall of 2022.

January 2005

No deleted data this month.

February 2005

No deleted data this month.

March 2005

No deleted data this month.

April 2005

No deleted data this month.

May 2005

No deleted data this month.

June 2005

a) Annual sensor calibration was carried out from 06/15/2005 14:45 to 06/17/2005 11:15. No meaningful Temperature and Relative Humidity data were recorded during this period of time, and so these data (mean, Min, Max and associated times) were deleted. Therefore, the Temperature and Relative Humidity values for 06/17/2005 12:00 (60 min) and 24:00 (1440 min) were deleted.
b) After calibration, in readjusting the calibration constants in the weather data management program, an error was made in the constant for wind speed causing the wind speed to be

recorded about an order of magnitude too high. This error affected the wind speed data from 06/17/2005 12:00 to 06/22/2005 09:30, after which it was corrected. These wind speed data (mean, max, min and associated times) were deleted. Therefore, the Wind Speed values (mean, max, min and associated times) for 06/22/2005 10:00 (60 min) and 24:00 (1440 min) were deleted.

c) As part of barometric pressure calibration -99999 mean BP and min BP values were recorded for the period 06/17/2005 11:00 and 11:15 (15 min readings) and 11:00 (60 min readings). Therefore, all Barometric pressure (Mean, Min, Max and associated times) readings were deleted for the period 06/17/2005 11:00-11:15 (15 min), 11:00 and 12:00 (60 min), and 24:00 (1440 min).

d) As part of calibration, -99999 values were recorded for total PAR on 06/17/2005 11:15, therefore, Total PAR values for 06/17/2005 12:00 (60 min) and 24:00 (1440 min) were deleted.

e) As part of calibration, -99999 values were recorded for Average Volts on 06/17/2005 11:15, therefore, Average Volt values for 06/17/2005 12:00 (60 min) and 24:00 (1440 min) were deleted.

July 2005

No deleted data this month.

August 2005

No deleted data this month.

September 2005

No deleted data this month.

October 2005

a) Owing some kind of undetermined mechanical or electrical malfunction, two ppt spikes were recorded on 10/25/2005 12:45-13:00. Therefore these data (15 min) and associated 60 min (13:00) and 1440 min (24:00) were deleted.

November 2005

a) Owing to a likely mechanically obstruction (suspected heated wire fouling tipping bucket), ppt readings were about two times higher than the nearby east Falmouth weather reporting station from early November to late November, before being noted and the instrumentation repaired. PPT Data were therefore deleted for the following periods:

11/06/2005 00:15 to 11/10/2005 24:00
11/16/2005 00:15 to 11/17/2005 24:00
11/21/2005 00:15 to 11/22/2005 24:00

December 2005

No deleted data this month.

13) 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 throughout the fall of 2022.

January 2005
No missing data this month.

February 2005
No missing data this month.

March 2005
No missing data this month.

April 2005
No missing data this month.

May 2005
No missing data this month.

June 2005
No missing data this month.

July 2005
No missing data this month.

August 2005
No missing data this month.

September 2005
No missing data this month.

October 2005
No missing data this month.

November 2005
No missing data this month.

December 2005
No missing data this month.

14) Other Comments & Data

On 10/19/2023 this dataset was updated to include embedded QAQC flags for anomalous/suspect data. System-wide monitoring data beginning in 2007 were processed to allow for QAQC flags and codes to be embedded in the data files rather than detailed in the metadata alone (as in the anomalous/suspect, deleted, and missing data sections above). Prior to 2007, rejected data were deleted from the dataset so they are unavailable to be used at all, but suspect data were only noted in the metadata document. Suspect data flags <1> were embedded retroactively in order to allow suspect data to be easily identified and filtered from the dataset if desired for analysis and reporting purposes. No other flags or codes were embedded in the dataset and users should still refer to the detailed explanations above for more information.

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 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 throughout early 2023.

In June 2009, in order to repopulate data tables, the Centralized Data Management Office removed all -99999 from SWMP weather data files and replaced them with -99.

a) Pyranometer data.

WBNERR has been collecting Total Solar Radiation data since November 16th , 2005 at 3:15pm on an experimental basis. See section 9: Sensor specifications, operating range, accuracy, date of last calibration for detailed information on the Pyranometer instrumentation. Contact Waquoit Bay NERR Research Coordinator for questions on the Pyranometer data.

b) Local National Weather Service Reporting Station.

Since December 2002, in the SW corner of the Reserve, at the outlet of Eel River and located at the Menauhant Yacht Club, a National Weather Service Reporting Station in East Falmouth has been recording local 24 hour weather conditions (DataGarrison https://datagarrison.com/). Dr. Doc Taylor records daily observations at 0700 and 1900 for the following weather parameters: Temperature (°F; minimum and maximum), Precipitation (inches; rain and melted snow, snow fall, initial and endpoint times of events), Sky Conditions and Wind Direction (mph; gusts). WBNERR compares its weather data with this station, Hyannis Airport (http://www.wunderground.com/cgi-bin/findweather/getForecast?query=02601#History), and WHOI Climate Reports (http://cis.whoi.edu/science/PO/climate/index.cfm). A complete monthly data set from the East Falmouth Reporting Station is available by contacting WBNERR Research Coordinator.

d) Correspondence on Calibration of RH/AT anemometer with WBNERR Consultant Dr. Richard Payne:

From: "Richard Payne" <rpayne@whoi.edu>
Sent: Tuesday, April 04, 2006 3:47 PM
To: Fox, MaryKay (DCR)
Subject: Re: Met system recal

Hi MaryKay,

There are two sets of bearings in the anemometer. One set is for the propeller and I replace those every year even though they are still in good shape. The others are on the vertical axis and would only affect the speeds if they got corroded and did not turn freely. You can tell by looking up at the anemometer to see if it is swinging a little with the wind turbulence. According to my log, I calibrated RH and AT and replaced the propeller shaft bearings in the anemometer.

Took the tower down on 15 June and removed the Vaisala RH/AT sensor. Replaced the sensors and the anemometer propeller shaft bearings on 17

June and put new constants in the program on the PC, version 4.03. On 22 June I found that the program version in the PC was an old one, not 4.03, which did not correspond to the sensor setup we had (I never did figure out how it got in there) and replaced it with the correct one, version 4.04. Email from Chris on 23 June says everything is ok. I did not replace the vertical shaft bearings last year. They are a lot more work and we have found on the [NOAA] buoys that they do not need replacing nearly as often.

c) Precipitation Totals

January 2005

01/04/2005	7.6
01/05/2005	16.3
01/06/2005	2.3
01/07/2005	15.7
01/09/2005	20.6
01/11/2005	0.5
01/12/2005	3.3
01/13/2005	14.5
01/14/2005	0.3
01/15/2005	12.4

01/17/2005	4.6
01/18/2005	3.3
01/20/2005	2.3
01/21/2005	1.5
01/23/2005	11.2
01/24/2005	19.3
01/25/2005	0.8
01/26/2005	0.5
01/27/2005	5.8
01/28/2005	2.5

Monthly Total 145.3

February 2005

02/04/2005	4.6
02/05/2005	0.8
02/11/2005	23.1
02/12/2005	0.8
02/15/2005	1.5
02/16/2005	8.9
02/17/2005	3.0
02/22/2005	11.4
02/23/2005	0.8
02/24/2005	0.5
02/25/2005	2.0
02/26/2005	7.6

Monthly Total ***65.0***

March 2005

03/01/2005	13.5
03/02/2005	18.0
03/03/2005	0.3
03/09/2005	43.2
03/10/2005	0.3
03/12/2005	4.8
03/13/2005	31.2
03/14/2005	0.3
03/22/2005	1.5
03/24/2005	8.6
03/25/2005	13.2
03/29/2005	54.6
03/30/2005	4.3

Monthly Total ***193.8***

April 2005

04/02/2005	0.3
04/03/2005	25.7
04/04/2005	10.7
04/05/2005	0.3
04/09/2005	24.6
04/21/2005	0.8
04/22/2005	0.3
04/23/2005	0.3
04/24/2005	5.3
04/25/2005	9.7
04/26/2005	2.0
04/28/2005	15.2
04/29/2005	2.8

Monthly Total ***97.8***

May 2005

05/01/2005	30.0
05/02/2005	16.5
05/07/2005	5.6
05/08/2005	31.0
05/09/2005	6.6
05/10/2005	3.8
05/16/2005	1.3
05/17/2005	8.6
05/20/2005	0.3
05/22/2005	7.6
05/24/2005	9.7

05/25/2005	26.4
05/26/2005	22.9
05/27/2005	9.4
05/28/2005	6.4
05/29/2005	0.3
05/30/2005	5.6
Monthly Total	***191.8***

June 2005

06/11/2005	0.3
06/15/2005	0.5
06/16/2005	0.5
06/17/2005	0.3
06/21/2005	0.3
06/22/2005	1.6
06/23/2005	1.5
06/29/2005	13.0
06/30/2005	0.8
Monthly Total	***17.0***

July 2005

07/01/2005	3.3
07/02/2005	11.9
07/03/2005	2.8
07/05/2005	0.3
07/06/2005	2.5
07/07/2005	0.3
07/08/2005	37.8
07/09/2005	0.3
07/19/2005	0.5
07/22/2005	0.8
Monthly Total	***60.5***

August 2005

08/02/2005	0.3
08/10/2005	0.3
08/15/2005	1.8
08/24/2005	3.3
08/25/2005	0.3
08/28/2005	0.3
08/30/2005	20.3
08/31/2005	3.1

Monthly Total 26.7

September 2005

09/01/2005	1.0
09/05/2005	0.3
09/07/2005	0.3
09/10/2005	0.3
09/15/2005	38.6
09/16/2005	34.0
09/17/2005	7.4
09/20/2005	0.3
09/23/2005	1.0
9/26/2005	2.8
9/27/2005	16.3
9/29/2005	3.0

Monthly Total 105.2

October 2005*

10/4/2005	0.3
10/6/2005	0.3
10/8/2005	4.1
10/9/2005	39.1
10/10/2005	6.4
10/11/2005	4.3
10/12/2005	6.9
10/13/2005	4.8
10/14/2005	27.7
10/15/2005	60.7
10/18/2005	1.0
10/22/2005	8.9
10/23/2005	3.3
10/24/2005	1.5
10/26/2005	0.3
10/29/2005	14.7
10/30/2005	1.0

* The October daily ppt values have been corrected. See Deleted Section of Metadata

Monthly Total 185.3

November 2005*

11/1/2005	0.4
11/6/2005	1.3
11/7/2005	0.3
11/9/2005	9.4
11/10/2005	30.1
11/16/2005	0.8
11/17/2005	14.0

11/21/2005	8.0
11/22/2005	46.4
11/23/2005	0.2
11/24/2005	3.7
11/28/2005	0.2
11/30/2005	11.7

* The November daily ppt values have been corrected. See Deleted Section of Metadata

Monthly Total 125.9

December 2005

12/1/2005	0.3
12/4/2005	4.3
12/5/2005	0.5
12/06/2005	4.6
12/09/2005	18.3
12/16/2005	25.7
12/25/2005	4.3
12/26/2005	4.8
12/29/2005	4.1
12/30/2005	1.3
12/31/2005	3.3

Monthly Total 71.5