National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway
Miami, FL 33149-1097

October 31, 2012

Final Cruise Report

U.S. Dept. of State Cruise No: F2011-095.

Ship Names: M/V Island Clan (trips 1,3), and R/V Hildebrand (trips 2,4,5).

Dates: April 4, 2012; May 31, 2012; July 9, 2012; July 17, 2012; July 24, 2012.

Chief Scientists: Molly Baringer and Christopher Meinen

Foreign Participants: None

Operating Institution: NOAA/AOML

Cruise Report by: Rigoberto Garcia, Christopher Meinen, Molly Baringer.

Project Title: Western Boundary Time Series.

Clearance Countries: Bahamas

Port Calls: West Palm Beach, FL to West Palm Beach, FL.

Description of the Scientific Program:

Voltages induced on a submarine cable by the Florida Current have been shown to be proportional to the total current transport. In order to calibrate the cable measurements, direct transport observations are needed at a few times during each year. A dropsonde is an instrument consisting of an expendable weight and a glass tube or sphere containing electronic sensors, including a Global Positioning System (GPS) receiver. The instruments determine vertically-averaged horizontal velocity by sinking to the ocean bottom, dropping the weight, and then rising to the ocean surface, with the GPS providing an accurate location for the start and end of the profile. Using the dropsonde technique, horizontal velocity is estimated at nine stations across the Straits. AOML has obtained these vertically-averaged velocities across the Strait of Florida on several cruises during this year, and horizontal-integration of the velocity values has yielded calibration values for submarine cable transport measurements. Cable voltages have been monitored and daily total transport values obtained since 1982.

Beginning in 1995 the cable calibration effort was augmented in support of the Volunteer Observing Ship Program (VOS) that deploys expendable bathythermographs (XBTs) in the interior Atlantic. The goal of this VOS/XBT program is to study the upper ocean thermal structure of the subtropical North Atlantic using volunteer observing merchant ships. Repeat XBT sections, approximately every 3 months, have been conducted since October 1984 with the intent of determining and monitoring the seasonal-to-interannual variability of the upper ocean heat content. The ship-track, which roughly follows along 30°N, is designated as AX7 and it is ideal for monitoring heat flux variability in the Atlantic because it lies near the center of the subtropical gyre, which has been shown to be the latitude of the maximum heat flux in the ocean. The upper ocean thermal structure obtained using the expendable temperature probes (XBTs) is being used to correlate the subtropical gyre intensity with atmospheric forcing as well as for determining the heat transport.

Essential to the goal of monitoring the meridional heat transport is a measure of the heat content and transport within the Florida Straits. Therefore, on each of the cable calibration cruises completed as part of this project, the dropsonde measurements are augmented by XBT casts at all nine of the nominal station locations to measure the vertical temperature profile.

Data Observations and Samples Collected:

This report refers to the last 7 cruises performed in the Florida Current. On a typical cruise a single AOML participant drives to Palm Beach the evening prior to the departure. The boat departs Palm Beach at about 0600, conducts a total of seven hours of work at the nine stations plus five hours of steaming time, and returns to Palm Beach at roughly 1700. The AOML participant then returns to Miami that same day. Expendable Bathythermographs (XBTs) are launched at each station to obtain temperature profiles of the water column beneath the ship. The XBTs are numbered as the station numbers, whose positions are given in Table 1. Plots of the XBT temperature sections are shown in the Appendix.

The GPS/dropsonde used in all 9 stations is a glass tube housing a Garmin GPS 18x PC receiver/logger (or equivalent), RDF beacon, pinger, and batteries. A second Magellan 5000 Pro GPS receiver (or equivalent) is used to determine the ship positions on all cruises. In addition to vertically integrated velocities, after surfacing the GPS/dropsonde is allowed to drift for five minutes to obtain a surface velocity estimate. During these cruises a new generation of dropsonde floats is also being tested using a sphere instead of a tube. Some of these new dropsondes will be equipped with self contained conductivity, pressure and temperature sensors.

The station locations are listed in Table 1 and a typical cruise trackline is shown in Figure 1. Table 2 lists the dropsonde deployment and surface time positions, and the computed vertically integrated velocities for each cruise. Surface positions are determined using the dropsonde GPS record. The midpoint time for all profiles is used as the time for the cruise. Table 3 lists the observed meridional surface velocities for each station.

Problems/issues observed during cruises:

Problems with the dropsonde used on July 17, 2012 were observed during the processing of the data. These electronics issues resulted in the failure of the velocity estimates at five of the stations. During the cruise of July 24, 2012 a glasstube dropsonde instrument was lost on station number 1. That instrument was later found on the shore in Ormond Beach, Florida.

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Schedule of Delivery of Data and Reports: All data are contained herein. No further report is planned.

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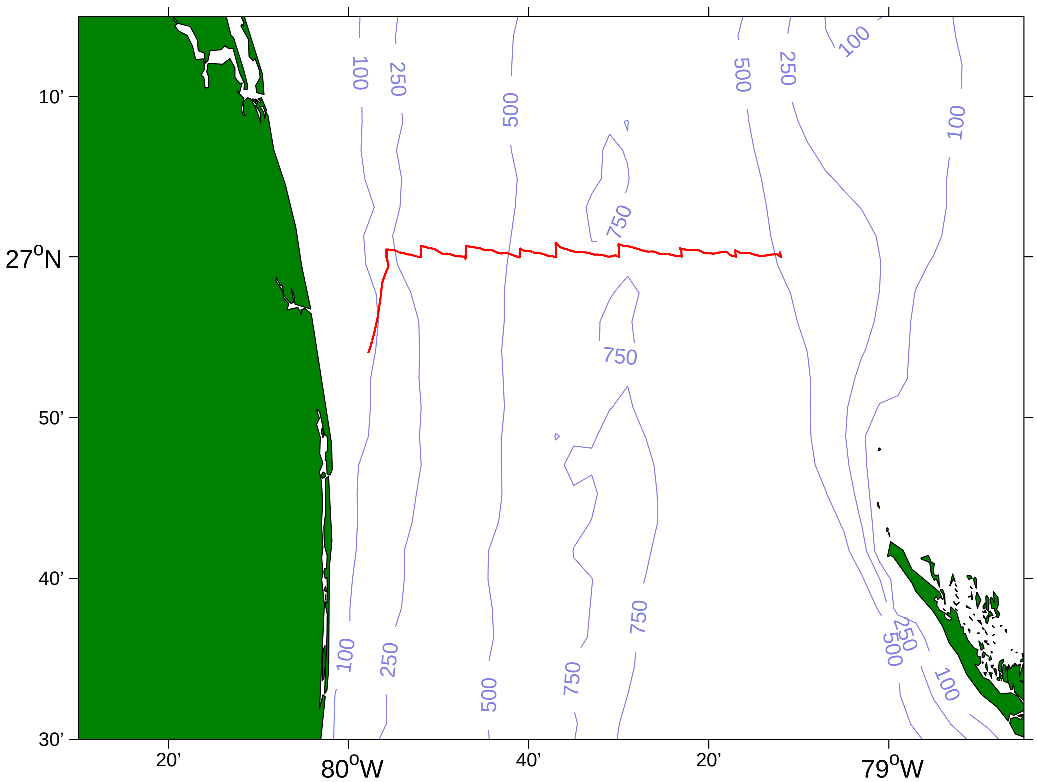


Figure 1: Typical cruise track

Station	Latitude	Longitude	Depth
0	27 00.00 N	79 55.80 W	139 M
1	27 00.00 N	79 52.00 W	261 M
2	27 00.00 N	79 47.00 W	389 M
3	27 00.00 N	79 41.00 W	540 M
4	27 00.00 N	79 37.00 W	661 M
5	27 00.00 N	79 30.00 W	783 M
6	27 00.00 N	79 23.00 W	708 M
7	27 00.00 N	79 17.00 W	624 M
8	27 00.00 N	79 12.00 W	485 M

Table 1: Station Locations.

Sta	Deployed			Surfaced			Mean Velocities	
	Time (GMT)	Lon	Lat	Time (GMT)	Lon	Lat	U cm/s	V cm/s
April 4, 2012								
0	19:21:25	-79.9308	27.0011	19:29:25	-79.9302	27.0060	10.81	110.11
1	18:54: 4	-79.8668	27.0011	19: 7:24	-79.8662	27.0083	6.54	97.71
2	18:15:24	-79.7824	26.9998	18:37:33	-79.7812	27.0123	7.91	103.42
3	17:26: 8	-79.6841	27.0018	17:55:36	-79.6831	27.0159	5.65	88.06
4	16:37:21	-79.6160	27.0008	17:12:22	-79.6146	27.0164	6.27	81.45
5	15:33:18	-79.4996	27.0006	16:14:18	-79.4976	27.0171	7.61	73.42
6	14:33:10	-79.3833	26.9999	15:11:56	-79.3824	27.0130	3.27	61.52
7	13:42:36	-79.2834	27.0000	14:13:53	-79.2837	27.0072	-2.21	42.38
8	12:59:31	-79.1991	26.9995	13:23:46	-79.2001	27.0034	-7.27	30.18
May 31, 2012								
0	22:43:46	-79.9298	27.0002	22:52:37	-79.9293	27.0009	9.27	11.35
1	22: 5: 8	-79.8668	27.0005	22:19:13	-79.8662	27.0044	7.19	48.99
2	21:24:23	-79.7835	27.0005	21:45: 7	-79.7831	27.0123	3.28	103.99
3	20:28: 1	-79.6833	27.0006	20:56:40	-79.6833	27.0171	-0.82	106.16
4	19:36:24	-79.6169	27.0006	20: 9:57	-79.6166	27.0186	2.16	98.52
5	18:28:28	-79.4998	27.0004	19: 8:22	-79.5001	27.0181	-1.25	81.81
6	17:22:49	-79.3833	27.0005	17:59: 0	-79.3838	27.0149	-1.93	72.97
7	16:23:17	-79.2833	27.0001	16:54:53	-79.2852	27.0132	-9.93	75.82
8	15:25:31	-79.1998	27.0002	15:50:29	-79.2029	27.0098	-19.93	71.21
July 9, 2012								
0	19:19:22	-79.9311	27.0011	19:27:11	-79.9310	27.0044	3.26	75.13
1	18:51:22	-79.8678	27.0009	19: 4:47	-79.8674	27.0084	4.97	98.50
2	18: 9:46	-79.7845	27.0002	18:32:43	-79.7840	27.0146	4.20	112.21
3	17:19:50	-79.6834	27.0005	17:52:46	-79.6833	27.0211	2.42	122.57
4	16:27:36	-79.6173	27.0003	17: 5:14	-79.6165	27.0208	3.21	100.21
5	15:24: 1	-79.5002	27.0002	16: 4: 5	-79.4997	27.0174	1.50	78.96
6	14:24:35	-79.3834	27.0002	15: 0:30	-79.3830	27.0141	2.53	70.85
7	13:28:10	-79.2843	27.0003	14: 2:35	-79.2847	27.0106	-1.82	54.95
8	12:46:38	-79.1990	26.9998	13:11: 3	-79.2004	27.0050	-9.69	39.49
July 17, 2012								
0	0:25:41	-79.9300	27.0009	0:34: 1	-79.9299	27.0051	1.43	92.98
1	23:31:11	-79.8681	27.0011	23:44:41	-79.8678	27.0087	3.73	102.75
2	99:99: 0	-79.7833	27.0000	99:99: 0	-79.7833	27.0000	-999.00	-999.00
3	21:12:25	-79.6535	27.0131	22: 3:53	-79.6801	27.0275	-999.00	-999.00
4	20: 3:49	-79.5867	27.0066	20:54:20	-79.6145	27.0270	-999.00	-999.00
5	18:46: 5	-79.4700	27.0043	19:40:29	-79.4993	27.0228	-999.00	-999.00
6	99:99: 0	-79.3833	27.0000	99:99: 0	-79.3833	27.0000	-999.00	-999.00
7	16:43: 3	-79.2839	27.0003	17:17: 8	-79.2849	27.0109	-5.48	58.20
8	15:51:29	-79.2000	27.0002	16:15:24	-79.2002	27.0063	-1.71	47.04

Table 2: Dropsonde Data: Values of -999 indicate instrument failure.

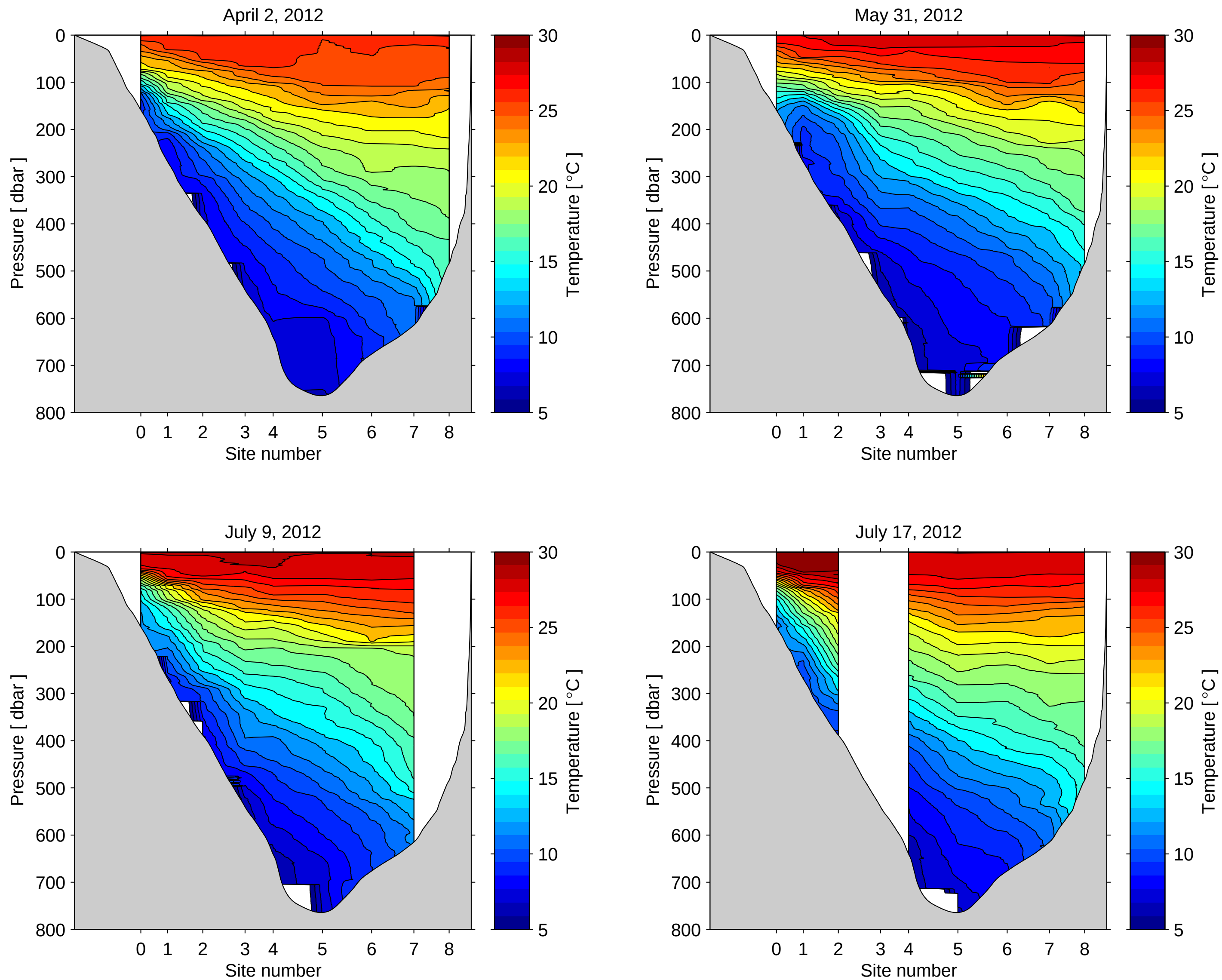
Sta	Deployed			Surfaced			Mean Velocities	
	Time (GMT)	Lon	Lat	Time (GMT)	Lon	Lat	U cm/s	V cm/s
July 24, 2012								
0	23:48:23	-79.9304	27.0014	23:56:28	-79.9306	27.0046	-4.77	71.57
1	99:99: 0	-79.8667	27.0000	99:99: 0	-79.8667	27.0000	-999.00	-999.00
2	99:99: 0	-79.7833	27.0000	99:99: 0	-79.7833	27.0000	-999.00	-999.00
3	20:44:41	-79.6835	27.0006	21:12:44	-79.6836	27.0142	-0.16	88.16
4	19:49:45	-79.6169	27.0007	20:23: 0	-79.6171	27.0153	-0.12	81.09
5	18:42: 7	-79.5000	27.0005	19:20: 9	-79.5007	27.0134	-3.38	62.14
6	17:34:26	-79.3835	27.0004	18:10: 6	-79.3844	27.0102	-4.10	50.16
7	16:36: 7	-79.2834	27.0004	17: 7:57	-79.2844	27.0081	-6.11	43.74
8	15:46: 1	-79.2003	27.0001	16:12:39	-79.2017	27.0052	-8.77	36.23

Table 2: Continued.

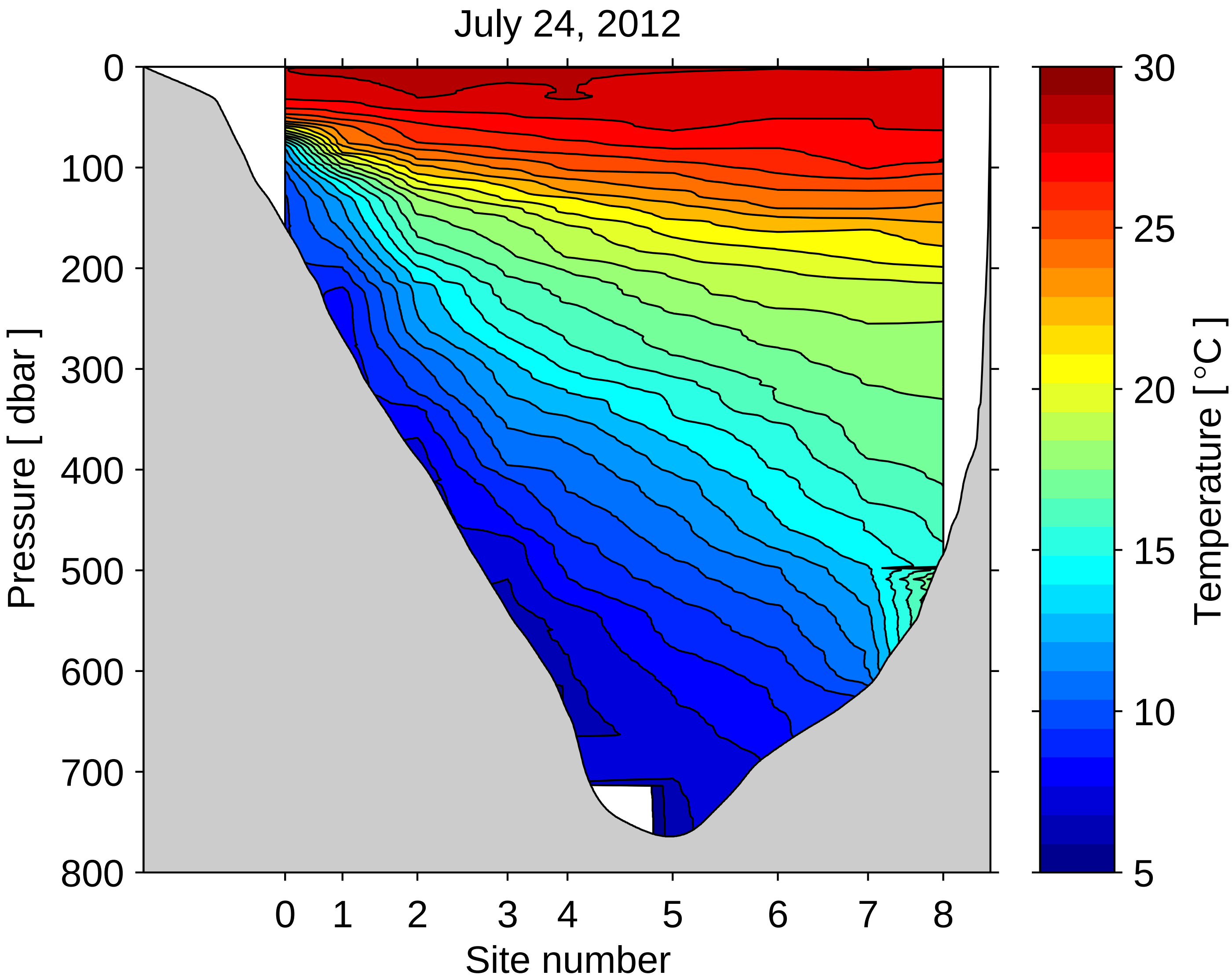
Date	Station #								
	0	1	2	3	4	5	6	7	8
April 2, 2012	210.55	191.63	175.04	149.51	143.13	146.53	113.58	57.67	19.69
May 31, 2012	80.65	147.11	207.01	160.60	164.77	130.12	140.88	107.05	70.76
July 9, 2012	225.82	438.51	406.84	-417.82	133.67	104.19	123.51	59.13	40.35
July 17, 2012	202.74	207.30	-999.00	-999.00	-999.00	-999.00	-999.00	1.10	23.77
July 24, 2012	164.06	-999.00	-999.00	188.08	114.95	147.47	105.92	110.67	7.28

Table 3: Meridional Surface Velocities in cm/s. Values of -999 indicate instrument failure.

APPENDIX



April 2, 2012
May 31, 2012
July 9, 2012
July 17, 2012
Pressure [dbar]
Site number
Temperature [°C]
0
100
200
300
400
500
600
700
800
0 1 2 3 4 5 6 7 8
5
10
15
20
25
30



July 24, 2012
Pressure [dbar]
0
100
200
300
400
500
600
700
800
0 1 2 3 4 5 6 7 8
Site number
Temperature [°C]
30
25
20
15
10
5