National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
4301 Rickenbacker Causeway
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Final Cruise Report

U.S. Dept. of State Cruise No: F2015-070.

Ship Names: R/V Ooids (trips 1-5).

Dates: April 26, 2016; June 30, 2016; July 15, 2016; August 23, 2016; September 27, 2016.

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 5 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 sphere 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.

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:

Serious electronics issues with both instruments, dropsonde and XBT, occurred during this period. The dropsondes used on April 27, 2016 and on June 30, 2016 were lost during the cruises. Electronics issues during the cruise on September 27, 2016 resulted in the failure of the velocity estimates at several stations. During the cruise of June 2016, no XBT data were collected. Also, during the cruises of April 2016 and August 2016 the XBT system failed to record data in at least one of the stations as shown in the figures in the Appendix.

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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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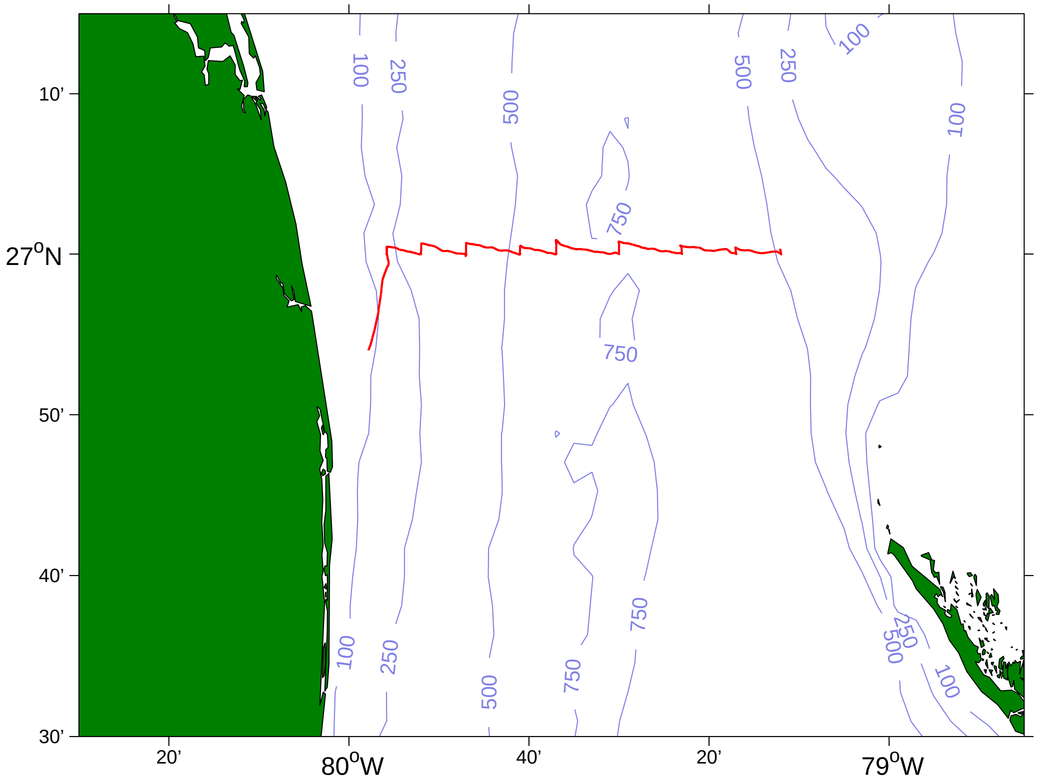


Figure 1: Typical cruise track

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.

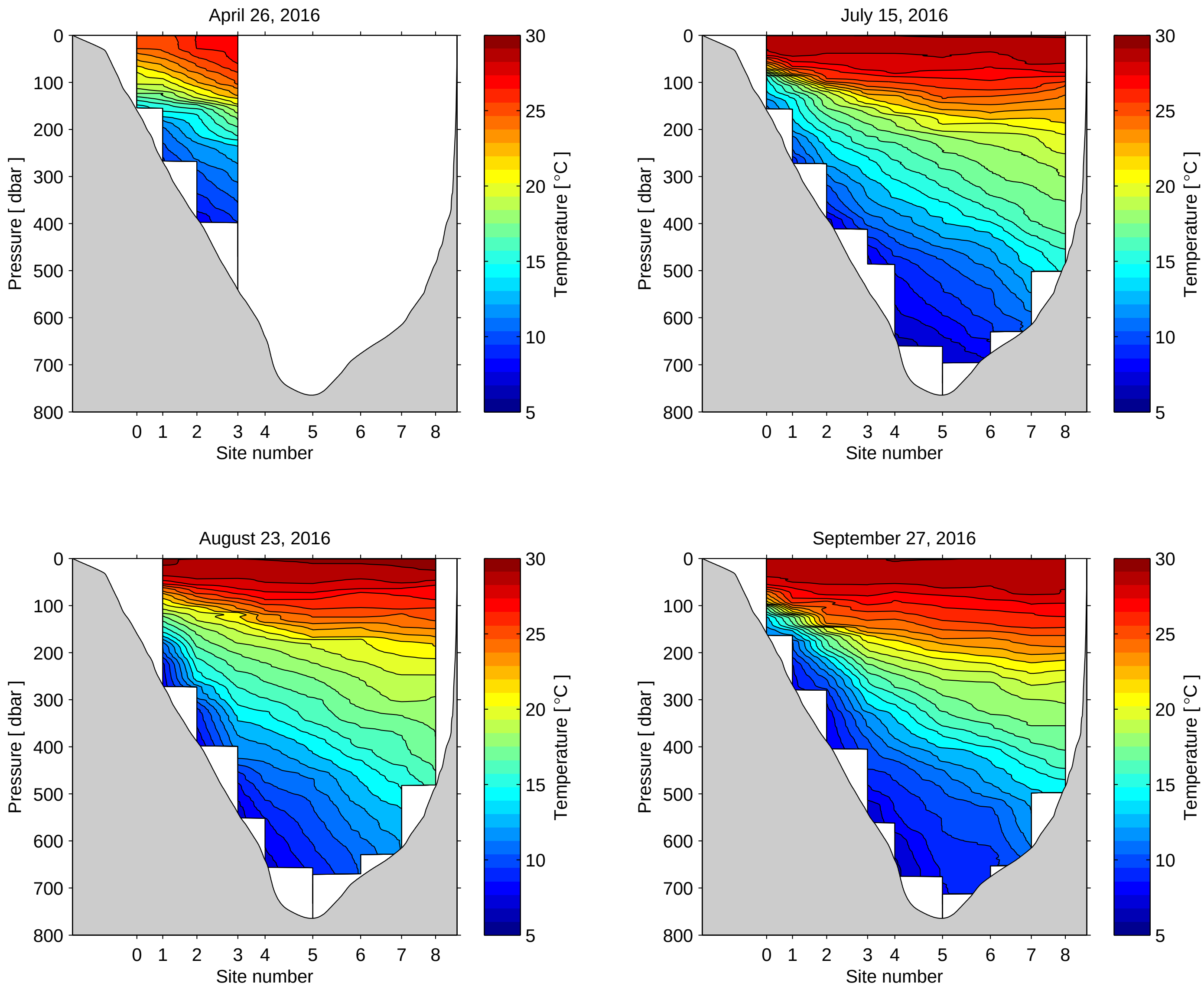
Sta	Deployed			Surfaced			Mean Velocities	
	Time (GMT)	Lon	Lat	Time (GMT)	Lon	Lat	U cm/s	V cm/s
July 15, 2016								
0	8:25:58	-79.9299	27.0057	8:35:14	-79.9298	27.0106	0.81	96.52
1	9:12:36	-79.8668	27.0053	9:29: 1	-79.8661	27.0154	5.55	112.24
2	10: 9:24	-79.7833	27.0006	10:34:36	-79.7830	27.0171	1.75	119.68
3	11:10: 8	-79.6834	27.0003	11:43:52	-79.6828	27.0229	3.00	122.67
4	12:35:56	-79.6168	27.0005	13:17:39	-79.6161	27.0252	2.87	108.94
5	14: 9: 0	-79.4999	27.0017	14:55:25	-79.4996	27.0246	1.89	90.21
6	15:34:26	-79.3834	27.0001	16:17: 6	-79.3836	27.0167	-0.53	71.27
7	17:14:41	-79.2835	27.0004	17:53: 6	-79.2849	27.0112	-5.60	51.32
8	18:11:17	-79.2001	27.0000	18:41:23	-79.2020	27.0060	-10.11	37.69
August 23, 2016								
0	7:40:40	-79.9299	27.0064	7:50:29	-79.9295	27.0129	5.05	121.23
1	8: 8:13	-79.8666	27.0050	8:24:43	-79.8658	27.0163	8.78	126.23
2	8:47:52	-79.7832	27.0075	9:14: 1	-79.7824	27.0242	5.83	117.25
3	9:41:42	-79.6834	27.0005	10:16:57	-79.6817	27.0223	7.37	113.58
4	10:36:29	-79.6168	27.0005	11:19:33	-79.6150	27.0238	7.62	100.41
5	11:43:58	-79.5001	27.0005	12:33:46	-79.4996	27.0204	1.44	73.60
6	15:15: 8	-79.3835	27.0000	15:57: 5	-79.3839	27.0137	-1.14	60.13
7	14:10:28	-79.2837	27.0002	14:50:47	-79.2842	27.0096	-1.89	43.24
8	13:18:34	-79.2001	27.0000	13:50: 7	-79.2019	27.0063	-9.49	37.38

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

Date	Station #								
	0	1	2	3	4	5	6	7	8
July 15, 2016	180.27	188.56	231.83	226.42	184.53	147.42	125.98	80.44	-2.57
August 23, 2016	221.79	213.40	182.32	168.13	100.22	102.91	70.38	49.34	26.96

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

APPENDIX



April 26, 2016
July 15, 2016
August 23, 2016
September 27, 2016
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