National Oceanic and Atmospheric Administration
Atlantic Oceanographic and Meteorological Laboratory
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**Final Cruise Report**

**U.S. Dept. of State Cruise No:** F2019-092.

**Ship Names:** R/V Angler Management 2.0 (trips 1)

**Dates:** January 16. 2020.

**Project Investigators:** Molly Baringer and Denis Volkov

**Chief Scientist (for cruises):** Ryan Smith

**Foreign Participants:** None

**Operating Institution:** NOAA/AOML

**Cruise Report by:** Rigoberto Garcia, Ryan Smith, Molly Baringer, and Denis Volkov.

**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 cruise 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:

During this period, the XBT system failed to record data in several stations during the cruise as shown in the figure in the Appendix.

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

**Acknowledgements:** A sincere thanks to Diego Ugaz for his participation in this cruise and to the crew of the R/V Angler Management 2.0 for their reliable assistance.

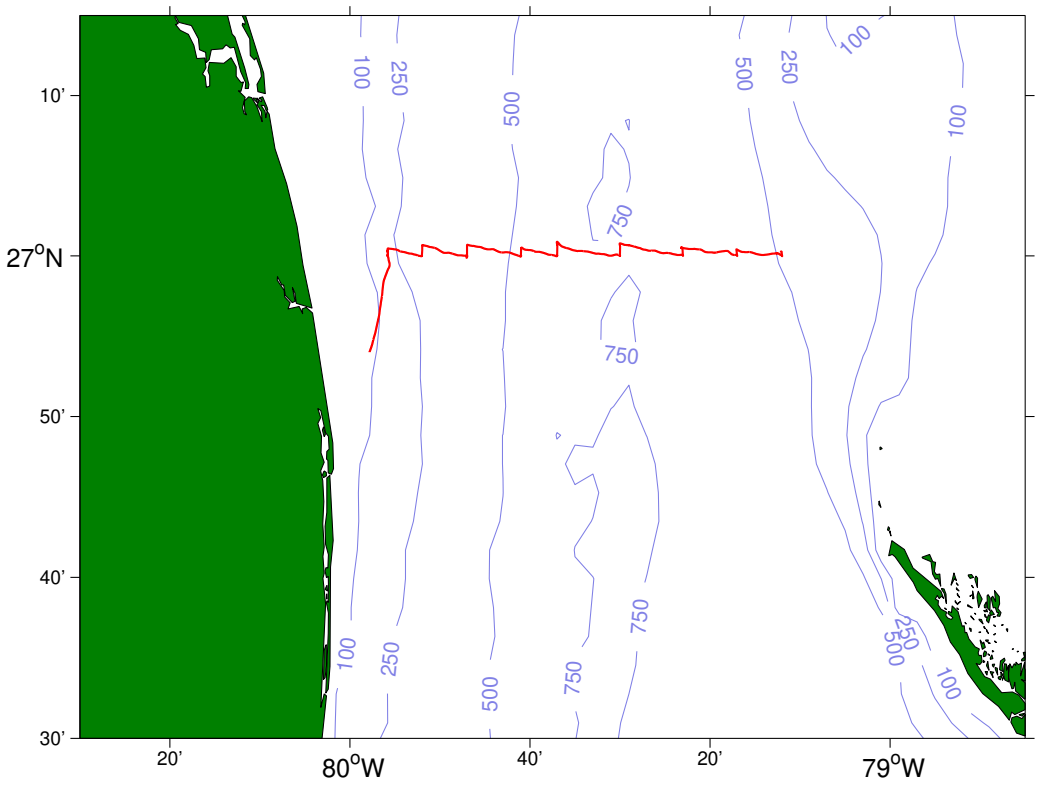


Figure 1: Typical cruise track

| 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 |
| January 16, 2020 | | | | | | | | |
| 0 | 13:13:57 | -79.9301 | 27.0001 | 13:21: 9 | -79.9300 | 27.0042 | 1.07 | 102.89 |
| 1 | 13:40:29 | -79.8667 | 27.0000 | 13:53:17 | -79.8668 | 27.0064 | -0.34 | 91.07 |
| 2 | 14:17:47 | -79.7834 | 27.0000 | 14:37: 5 | -79.7831 | 27.0115 | 1.87 | 108.86 |
| 3 | 15: 5:47 | -79.6833 | 26.9997 | 15:32:42 | -79.6829 | 27.0158 | 3.09 | 111.65 |
| 4 | 15:53:11 | -79.6166 | 26.9999 | 16:25:15 | -79.6160 | 27.0176 | 3.49 | 101.72 |
| 5 | 17:10:33 | -79.5000 | 27.0001 | 17:48: 8 | -79.4999 | 27.0170 | 0.75 | 82.94 |
| 6 | 18:16:55 | -79.3834 | 27.0003 | 18:51: 0 | -79.3840 | 27.0114 | -3.13 | 60.54 |
| 7 | 19:15: 6 | -79.2834 | 26.9999 | 19:45:32 | -79.2846 | 27.0069 | -6.13 | 42.60 |
| 8 | 20: 6:59 | -79.1999 | 26.9999 | 20:31:24 | -79.2009 | 27.0039 | -7.08 | 30.46 |

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

| Date | Station # | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| January 16, 2020 | 217.65 | 212.08 | 210.29 | 26.58 | 124.24 | 108.86 | 77.07 | 49.18 | 13.70 |

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

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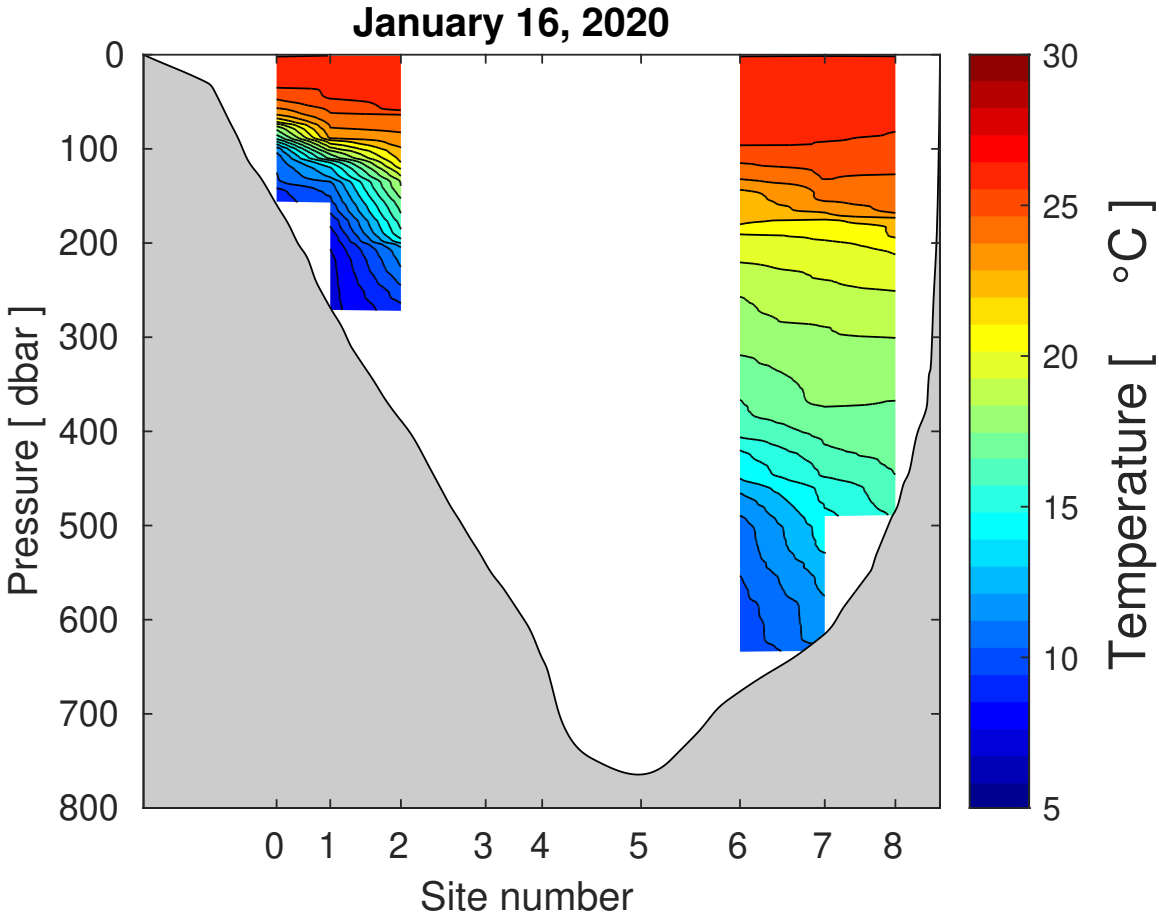
# APPENDIX


January 16, 2020
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