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

January 8, 2016

Final Cruise Report

U.S. Dept. of State Cruise No: F2014-086.

Ship Names: R/V Ooids (trips 1-10).

Dates: October 1, 2014; October 22, 2014; December 19, 2014; March 24, 2015; June 19, 2015; July 22, 2015; August 10, 2015; August 26, 2015; September 11, 2015; October 15, 2015.

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 10 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. Problems with the dropsondes used on March 24, 2015 were observed during the cruise. These electronics issues resulted in the failure of the velocity estimates at all of the stations. During the cruises of June 2015 and July 2015, no XBT data were collected. Also, during the cruises of October 2014, December 2014 and August 2015 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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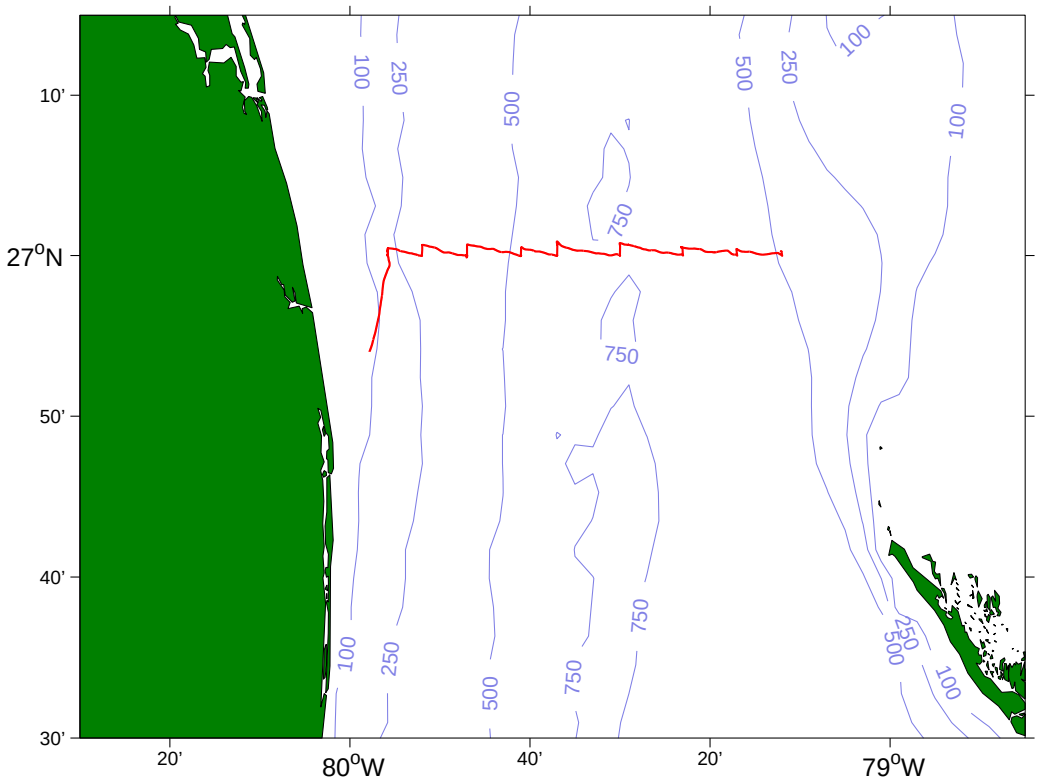


Figure 1: Typical cruise track

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
October 1, 2014								
0	11:47:10	-79.9288	27.0017	11:55: 1	-79.9284	27.0045	6.59	65.44
1	12:10:29	-79.8665	27.0000	12:23:43	-79.8655	27.0067	11.44	92.85
2	12:42:11	-79.7831	27.0004	13: 1:37	-79.7819	27.0129	8.86	117.93
3	13:19: 4	-79.6833	27.0003	13:46:19	-79.6823	27.0171	5.15	112.60
4	14: 3: 8	-79.6164	27.0005	14:36:22	-79.6153	27.0187	4.78	100.92
5	14:59: 2	-79.4994	27.0004	15:37:12	-79.4992	27.0171	0.39	80.27
6	15:59:13	-79.3832	27.0000	16:34:56	-79.3838	27.0115	-3.40	59.50
7	16:54:34	-79.2832	27.0000	17:26:28	-79.2847	27.0078	-8.14	45.73
8	17:44:15	-79.1998	27.0000	18: 9:34	-79.2010	27.0042	-8.88	31.82
October 22, 2014								
0	13:39:19	-79.9300	27.0005	13:47:47	-79.9301	27.0050	-2.15	97.97
1	14: 9:27	-79.8665	27.0007	14:24: 5	-79.8664	27.0083	1.86	94.28
2	14:45:53	-79.7828	27.0017	15: 8:47	-79.7823	27.0149	3.01	105.02
3	15:34:22	-79.6833	27.0003	16: 4:56	-79.6826	27.0186	4.43	109.61
4	16:26:33	-79.6167	27.0003	17: 2:48	-79.6160	27.0216	3.43	108.03
5	17:31:50	-79.5000	27.0001	18:15:17	-79.5007	27.0199	-3.02	83.95
6	18:41:21	-79.3834	27.0004	19:17:34	-79.3847	27.0125	-4.83	61.20
7	19:44: 1	-79.2834	27.0000	20:17:14	-79.2861	27.0110	-13.93	61.10
8	20:36:56	-79.1999	27.0001	21: 3:39	-79.2024	27.0078	-15.73	53.67
December 19, 2014								
0	13:14:31	-79.9298	27.0002	13:22:19	-79.9296	27.0020	4.15	41.10
1	13:40:38	-79.8664	27.0005	13:54: 2	-79.8655	27.0051	10.98	61.80
2	14:18:43	-79.7836	27.0005	14:38:16	-79.7829	27.0088	6.18	76.93
3	15: 1:10	-79.6832	27.0004	15:28:46	-79.6823	27.0157	5.61	102.28
4	15:48: 1	-79.6165	27.0003	16:20:50	-79.6158	27.0185	3.08	101.67
5	16:44: 2	-79.4998	27.0014	17:22:38	-79.4992	27.0174	2.45	76.21
6	17:45:38	-79.3833	27.0003	18:20:21	-79.3828	27.0105	1.90	54.61
7	18:39:21	-79.2833	26.9999	19:11:12	-79.2835	27.0069	-1.08	40.89
8	19:27: 1	-79.2001	26.9999	19:51:46	-79.2007	27.0035	-3.72	27.30
June 19, 2015								
0	20:56: 2	-79.9307	27.0012	21: 3:40	-79.9307	27.0057	1.50	105.87
1	20:26:20	-79.8668	27.0016	20:39:31	-79.8664	27.0100	4.51	116.70
2	19:50:47	-79.7837	27.0019	20: 9:52	-79.7837	27.0137	0.90	113.90
3	18:59:46	-79.6834	27.0009	19:27:10	-79.6835	27.0167	-0.47	105.56
4	18: 1:25	-79.6166	27.0020	18:34:16	-79.6174	27.0183	-5.57	89.97
5	16:54:29	-79.5001	27.0017	17:33:24	-79.5014	27.0190	-5.10	82.05
6	15:58: 5	-79.3836	27.0010	16:31:36	-79.3860	27.0138	-11.68	70.36
7	15: 3:33	-79.2832	27.0007	15:35:16	-79.2864	27.0102	-16.62	55.73
8	14: 5: 1	-79.1998	27.0000	14:28:58	-79.2032	27.0073	-23.49	56.33

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 22, 2015								
0	12:11:23	-79.9299	27.0073	12:19: 7	-79.9299	27.0112	-0.33	92.73
1	12:39:59	-79.8664	27.0005	12:53:24	-79.8662	27.0078	1.10	100.16
2	13:16: 6	-79.7829	27.0010	13:36: 9	-79.7827	27.0124	0.75	103.73
3	13:59: 9	-79.6832	27.0006	14:28:50	-79.6829	27.0185	1.32	110.89
4	14:46: 8	-79.6165	27.0005	15:24: 0	-79.6160	27.0231	2.00	109.63
5	15:47:18	-79.5001	27.0016	16:25:38	-79.4999	27.0190	0.45	85.43
6	16:52:30	-79.3833	27.0002	17:27:14	-79.3839	27.0130	-2.82	67.79
7	17:48:53	-79.2832	27.0001	18:20:33	-79.2840	27.0096	-4.92	55.69
8	18:41:52	-79.1999	27.0001	19: 7: 6	-79.2016	27.0067	-12.05	48.88
August 10, 2015								
0	12:32:58	-79.9298	27.0020	12:40:34	-79.9294	27.0078	7.89	138.80
1	12:57:52	-79.8666	27.0004	13:11:11	-79.8660	27.0088	7.12	115.34
2	13:28:55	-79.7832	27.0004	13:49:17	-79.7824	27.0128	6.24	111.59
3	14:28:41	-79.6835	27.0008	14:55:28	-79.6829	27.0166	2.73	108.11
4	15:14:17	-79.6161	27.0017	15:47:25	-79.6155	27.0194	2.59	96.85
5	16:12: 3	-79.5000	27.0010	16:51:40	-79.4996	27.0191	1.19	83.36
6	17:21:53	-79.3831	27.0003	17:56:21	-79.3827	27.0132	1.24	68.69
7	19:26:53	-79.2831	27.0001	19:57:33	-79.2837	27.0094	-3.12	56.01
8	18:30:14	-79.1996	27.0004	18:55: 3	-79.2009	27.0055	-9.09	38.70
August 26, 2015								
0	12:26:54	-79.9299	27.0007	12:34:28	-79.9297	27.0069	3.29	152.96
1	12:57:11	-79.8661	27.0017	13:10:30	-79.8657	27.0108	3.97	125.03
2	13:39:21	-79.7832	27.0007	13:58:50	-79.7831	27.0135	0.48	120.24
3	14:22:49	-79.6833	27.0006	14:49:59	-79.6832	27.0162	0.57	104.72
4	15:10:41	-79.6167	27.0008	15:43:47	-79.6168	27.0166	-0.91	87.30
5	16:15:33	-79.4995	27.0023	16:53:31	-79.5005	27.0190	-4.62	80.86
6	17:21:31	-79.3827	27.0019	17:55:39	-79.3838	27.0149	-5.82	70.01
7	18:26: 0	-79.2833	27.0001	18:56:42	-79.2848	27.0111	-8.39	66.12
8	19:17: 9	-79.2000	27.0003	19:41:35	-79.2017	27.0057	-11.98	40.18
September 11, 2015								
0	12: 4:18	-79.9294	27.0015	12:11:57	-79.9294	27.0048	0.55	76.28
1	12:31: 4	-79.8663	27.0010	12:44: 6	-79.8663	27.0073	-0.46	88.26
2	13: 7: 6	-79.7831	27.0006	13:26:35	-79.7827	27.0116	3.57	102.72
3	14: 2:54	-79.6832	27.0006	14:31:54	-79.6817	27.0186	7.92	113.46
4	14:54:25	-79.6165	27.0004	15:29: 0	-79.6147	27.0212	8.45	110.49
5	15:54:40	-79.5001	27.0021	16:27:33	-79.4984	27.0200	8.15	100.15
6	16:50:43	-79.3830	27.0007	17:26:22	-79.3829	27.0153	-0.05	74.96
7	17:53:11	-79.2831	27.0004	18:23:25	-79.2840	27.0113	-5.51	66.60
8	19: 4:30	-79.2000	27.0004	19:29:50	-79.2013	27.0070	-8.97	48.28

Table 2: Continued.

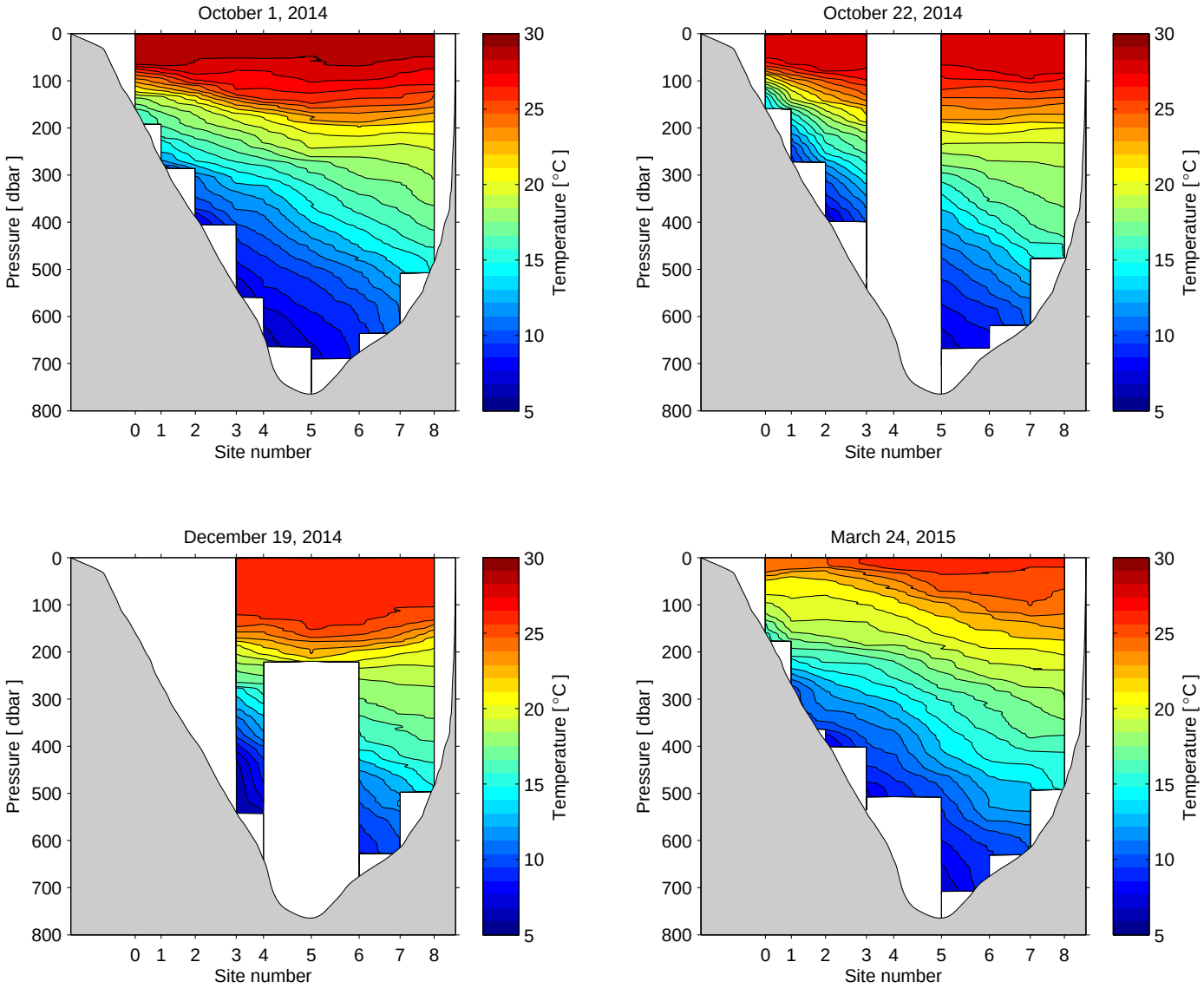
Sta	Deployed			Surfaced			Mean Velocities	
	Time (GMT)	Lon	Lat	Time (GMT)	Lon	Lat	U cm/s	V cm/s
October 15, 2015								
0	12:43:36	-79.9300	27.0006	12:51:32	-79.9298	27.0044	5.08	87.01
1	13:14:36	-79.8667	27.0006	13:27:59	-79.8661	27.0063	6.48	79.37
2	13:52:23	-79.7834	27.0003	14:12:39	-79.7820	27.0096	11.20	84.34
3	14:37:55	-79.6833	27.0003	15: 5:31	-79.6816	27.0159	9.56	103.87
4	15:26:27	-79.6167	27.0008	15:59:31	-79.6148	27.0185	9.21	98.60
5	16:28:49	-79.5000	27.0003	17: 7:31	-79.4985	27.0167	6.57	77.78
6	17:35:58	-79.3833	27.0000	18: 9:45	-79.3825	27.0104	4.22	56.39
7	18:33:25	-79.2833	27.0001	19: 4:38	-79.2834	27.0065	-1.03	38.15
8	19:24:56	-79.2000	26.9999	19:49:17	-79.2004	27.0025	-2.88	19.94

Table 2: Continued.

Date	Station #								
	0	1	2	3	4	5	6	7	8
October 1, 2014	92.40	93.56	140.62	198.34	146.95	125.46	61.23	27.89	-23.78
October 22, 2014	157.32	214.59	186.06	177.14	141.59	114.62	117.27	63.63	14.90
December 19, 2014	71.30	157.71	178.92	169.67	150.38	102.16	41.32	12.16	-33.34
June 19, 2015	170.01	207.26	219.85	194.16	272.11	119.48	109.48	53.01	33.96
July 22, 2015	158.64	180.98	165.95	210.29	174.76	3.79	105.28	55.06	20.94
August 10, 2015	213.88	178.63	186.99	209.69	244.34	153.10	111.16	57.96	32.88
August 26, 2015	46.84	219.85	219.35	209.10	179.48	140.50	125.60	77.45	56.67
September 11, 2015	170.60	171.25	203.12	206.27	180.39	138.52	148.12	96.67	33.35

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

APPENDIX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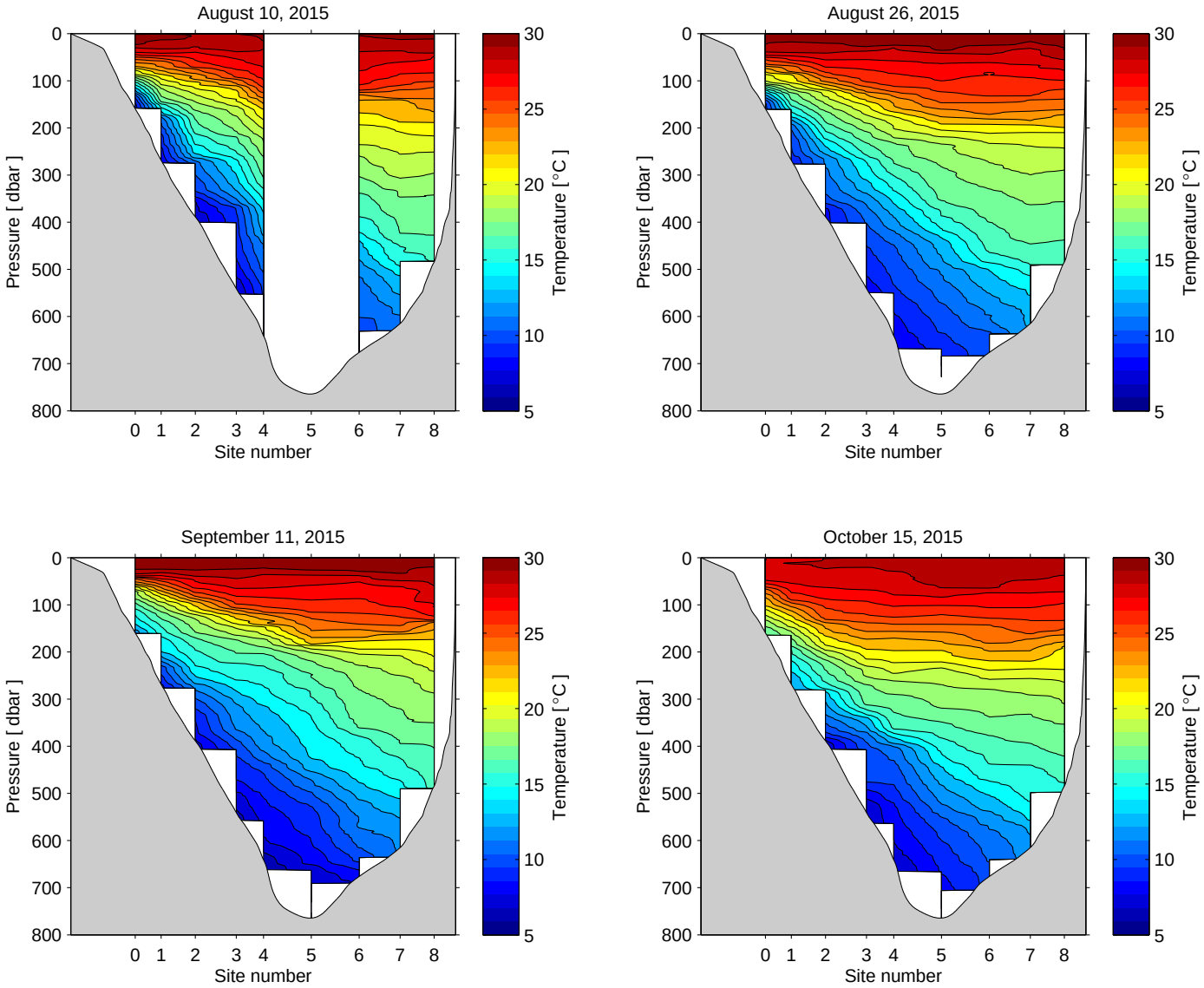
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