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October 19, 2006

Cruise Report

Ship Names: M/V *Playing Hooky* (trips 1-5), M/V *La Vida* (trips 6, 7 and 9), and M/V *Boomerang* (trip 8).

Dates: November 11, 2005; November 17, 2005; February 2, 2006; March 14, 2006; March 27, 2006; June 22, 2006; June 30, 2006; July 20, 2006; September 15, 2006.

Chief Scientists: Molly Baringer and Christopher Meinen

Foreign Participants: None

Operating Institution: NOAA/AOML

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

Project Title: Atlantic Climate Change Program: Volunteer Observing Ship High Resolution XBT line AX7 and Direct Observations in Support of Operational Monitoring in the Straits of Florida.

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 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 using the vessels charted through Sailfish Marina, the dropsonde measurements are augmented by XBT casts at all nine of the nominal station locations to measure the vertical temperature profile. Two crossings are typically attempted during each quarterly AX7 cruise, roughly one week apart, in an attempt to capture an estimate of the mean transport of the Florida Current that is not contaminated by the seven to ten day waves observed in the Straits.

Data Observations and Samples Collected:

This report refers to the last 9 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 Geologger 8 portable GPS receiver/logger, RDF beacon, pinger, and batteries. A second Magellan 5000 Pro GPS receiver is used to determine the ship positions on all cruises. In addition to vertically integrated velocities, after surfacing the GPS/dropsonde was 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 fiscal year the only significant problem was a failure in the XBT system during the June 30, 2006 cruise at one station.

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

Acknowledgements: A very sincere thanks to Andrew Stefanick, Pedro DiNezio, Ulises Rivero and Craig Engler for their participation in these cruises and to the crew of the vessels M/V *Playing Hooky*, M/V *Boomerang*, and M/V *La Vida* for their reliable assistance.

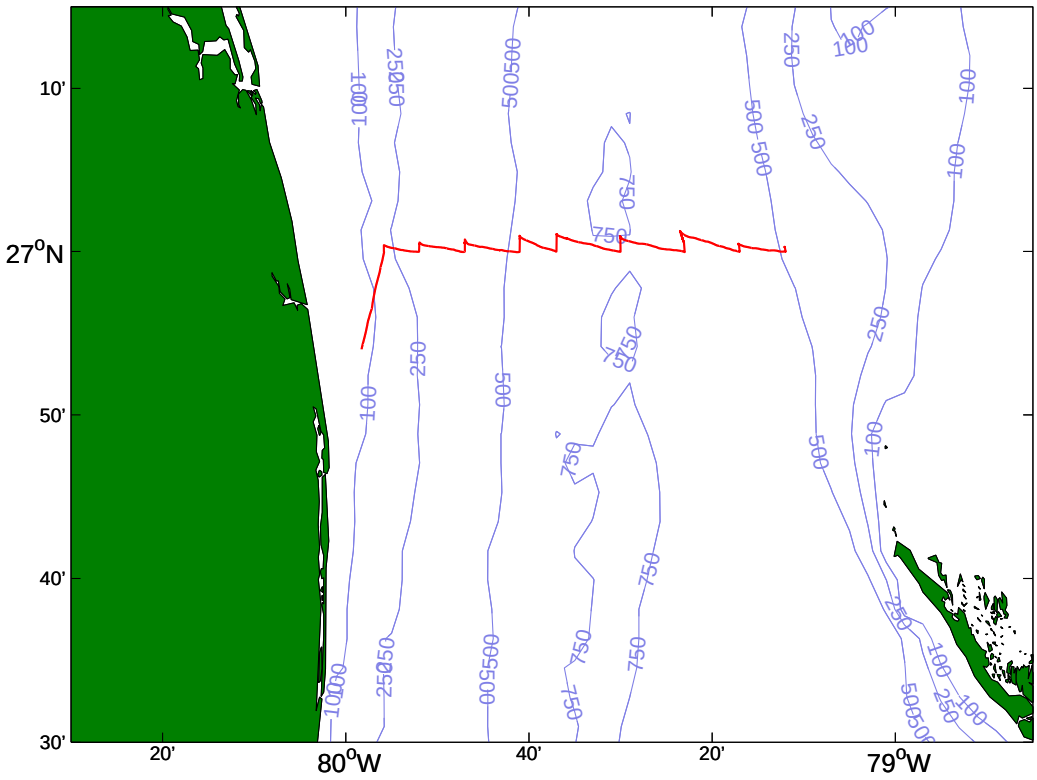


Figure 1: Typical cruise track

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
November 11, 2005								
0	12: 0: 2	-79.9307	27.0002	12: 6:22	-79.9307	27.0032	-0.39	87.46
1	12:22:44	-79.8667	26.9997	12:33:51	-79.8663	27.0058	4.74	100.34
2	12:52:25	-79.7834	26.9999	13: 8:33	-79.7831	27.0085	2.85	97.38
3	13:30:18	-79.6836	26.9996	13:52:27	-79.6834	27.0122	1.55	104.21
4	14:10:10	-79.6166	27.0000	14:36:39	-79.6162	27.0132	2.99	91.91
5	15: 4:13	-79.4999	26.9998	15:35:21	-79.5002	27.0124	-1.22	74.53
6	16: 1:32	-79.3834	26.9994	16:29:45	-79.3846	27.0090	-6.90	63.20
7	17:23:39	-79.2833	27.0000	17:49: 9	-79.2847	27.0072	-9.07	53.07
8	18: 8:52	-79.1999	26.9999	18:28:45	-79.2015	27.0047	-13.30	45.66
November 17, 2005								
0	12: 7:46	-79.9292	27.0006	12:14:20	-79.9293	27.0043	-2.60	103.15
1	12:31:34	-79.8668	27.0004	12:42:39	-79.8662	27.0071	8.50	111.35
2	13: 1:32	-79.7833	26.9998	13:17:45	-79.7829	27.0085	3.72	98.93
3	13:38:29	-79.6834	27.0000	14: 0:57	-79.6829	27.0125	4.46	104.20
4	14:16:31	-79.6169	27.0001	14:43:21	-79.6163	27.0131	3.74	89.39
5	15: 7:51	-79.4999	27.0004	15:39:15	-79.4998	27.0121	1.03	68.40
6	16: 2:55	-79.3834	27.0001	16:31:33	-79.3838	27.0089	-2.18	56.15
7	16:51:59	-79.2834	27.0001	17:17:20	-79.2842	27.0066	-5.05	47.72
8	17:35:11	-79.2002	27.0002	17:54:56	-79.2019	27.0052	-13.54	46.63
February 2, 2006								
0	12:10:37	-79.9304	27.0005	12:16:56	-79.9305	27.0041	-2.44	104.72
1	12:36:34	-79.8666	27.0000	12:47:38	-79.8665	27.0058	0.75	95.37
2	13:11:49	-79.7833	27.0001	13:28: 2	-79.7830	27.0080	2.75	89.19
3	13:54:19	-79.6834	27.0003	14:15:56	-79.6832	27.0104	1.49	84.90
4	14:36:36	-79.6167	27.0003	15: 3: 8	-79.6167	27.0106	0.35	70.97
5	15:33:15	-79.5001	27.0002	16: 4:14	-79.5002	27.0102	-0.52	58.96
6	16:34:29	-79.3832	26.9998	17: 2: 2	-79.3835	27.0075	-1.83	51.25
7	17:27:27	-79.2833	26.9996	17:52:38	-79.2839	27.0046	-4.38	36.35
8	18:15:35	-79.1998	26.9990	18:35: 8	-79.2008	27.0020	-8.51	28.89
March 14, 2006								
0	12: 1:46	-79.9307	27.0004	12: 7:56	-79.9307	27.0035	-0.03	92.24
1	12:25:35	-79.8665	26.9999	12:36:44	-79.8666	27.0057	-1.14	92.28
2	12:57:52	-79.7833	27.0015	13:14: 8	-79.7833	27.0102	-1.00	98.01
3	13:37:35	-79.6835	27.0003	13:58:32	-79.6833	27.0115	1.93	97.37
4	14:16:58	-79.6167	26.9999	14:43:25	-79.6165	27.0132	1.41	92.80
5	15: 8:43	-79.5000	27.0001	15:39: 8	-79.5003	27.0123	-1.56	73.79
6	16: 5:33	-79.3834	27.0005	16:32:56	-79.3840	27.0094	-3.23	59.67
7	16:55: 9	-79.2834	27.0004	17:20:31	-79.2846	27.0083	-8.32	57.48
8	17:40:23	-79.1999	26.9999	17:59: 7	-79.2014	27.0053	-13.83	52.75

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
March 27, 2006								
0	12: 5:43	-79.9304	26.9994	12:11:53	-79.9306	27.0022	-7.22	83.31
1	12:29:51	-79.8664	27.0005	12:40:56	-79.8664	27.0050	-0.40	75.13
2	13: 1:57	-79.7835	27.0006	13:17:32	-79.7840	27.0074	-4.81	79.40
3	13:41:58	-79.6835	27.0003	14: 3:32	-79.6841	27.0091	-4.03	74.61
4	14:22:17	-79.6168	27.0003	14:48: 8	-79.6174	27.0106	-3.41	73.30
5	15:14:57	-79.5002	27.0006	15:45: 8	-79.5007	27.0111	-3.03	64.34
6	16:11:28	-79.3833	26.9998	16:37:26	-79.3837	27.0076	-2.43	55.51
7	17: 1:15	-79.2835	27.0000	17:26:45	-79.2851	27.0076	-11.09	55.69
8	17:46:46	-79.1998	26.9999	18: 5:38	-79.2015	27.0050	-15.52	50.72
June 22, 2006								
0	11:26:53	-79.9299	27.0017	11:33:14	-79.9296	27.0062	6.92	130.75
1	11:52: 4	-79.8662	27.0023	12: 2:44	-79.8658	27.0088	7.03	111.48
2	12:23:42	-79.7832	27.0009	12:39:26	-79.7830	27.0102	1.65	109.08
3	13: 3:29	-79.6836	27.0002	13:24:44	-79.6830	27.0127	5.81	107.93
4	13:41:22	-79.6173	27.0009	14: 7: 2	-79.6166	27.0144	4.79	96.63
5	14:31: 6	-79.4999	27.0005	15: 1:29	-79.5000	27.0129	-0.52	74.28
6	16:12:53	-79.3835	27.0002	16:40:14	-79.3839	27.0109	-2.37	72.40
7	17:13: 7	-79.2833	27.0001	17:37:20	-79.2849	27.0087	-11.73	65.34
8	17:58: 0	-79.2000	27.0001	18:16:49	-79.2014	27.0057	-12.77	55.92
June 30, 2006								
0	11:26:54	-79.9297	27.0009	11:33: 4	-79.9296	27.0044	5.13	103.27
1	11:50:46	-79.8667	27.0004	12: 1:43	-79.8664	27.0058	5.12	90.83
2	12:23: 9	-79.7831	27.0008	12:39:14	-79.7828	27.0094	3.12	96.12
3	13: 5: 4	-79.6825	27.0024	13:26:56	-79.6820	27.0136	3.52	93.36
4	13:44:24	-79.6165	27.0005	14:11:44	-79.6159	27.0134	3.89	86.85
5	14:36:22	-79.5002	27.0003	15: 8:25	-79.5002	27.0120	-0.01	66.79
6	15:33:20	-79.3837	27.0003	16: 1:14	-79.3839	27.0090	-0.95	56.98
7	16:22:28	-79.2833	26.9999	16:47:56	-79.2836	27.0055	-2.17	40.68
8	17: 7:48	-79.1994	27.0001	17:27:19	-79.2001	27.0033	-6.10	30.80
July 20, 2006								
0	11:33:23	-79.9295	27.0061	11:39:40	-79.9292	27.0097	8.22	104.75
1	12: 2:59	-79.8666	27.0007	12:14:26	-79.8664	27.0071	3.76	100.34
2	12:40:31	-79.7827	27.0014	12:56:49	-79.7824	27.0110	3.63	107.46
3	13:26:37	-79.6830	27.0008	13:48:50	-79.6826	27.0134	2.90	103.54
4	14:12:39	-79.6166	27.0008	14:47:50	-79.6157	27.0192	3.90	95.72
5	15:18:29	-79.5000	27.0004	15:48:49	-79.5001	27.0144	-0.51	84.64
6	16:18:34	-79.3837	27.0110	16:46: 2	-79.3831	27.0226	3.55	77.96
7	17:12:26	-79.2833	27.0066	17:36:44	-79.2830	27.0140	2.12	55.99
8	17:59:13	-79.2004	27.0039	18:19: 2	-79.2011	27.0077	-5.99	35.00

Table 2: Continued.

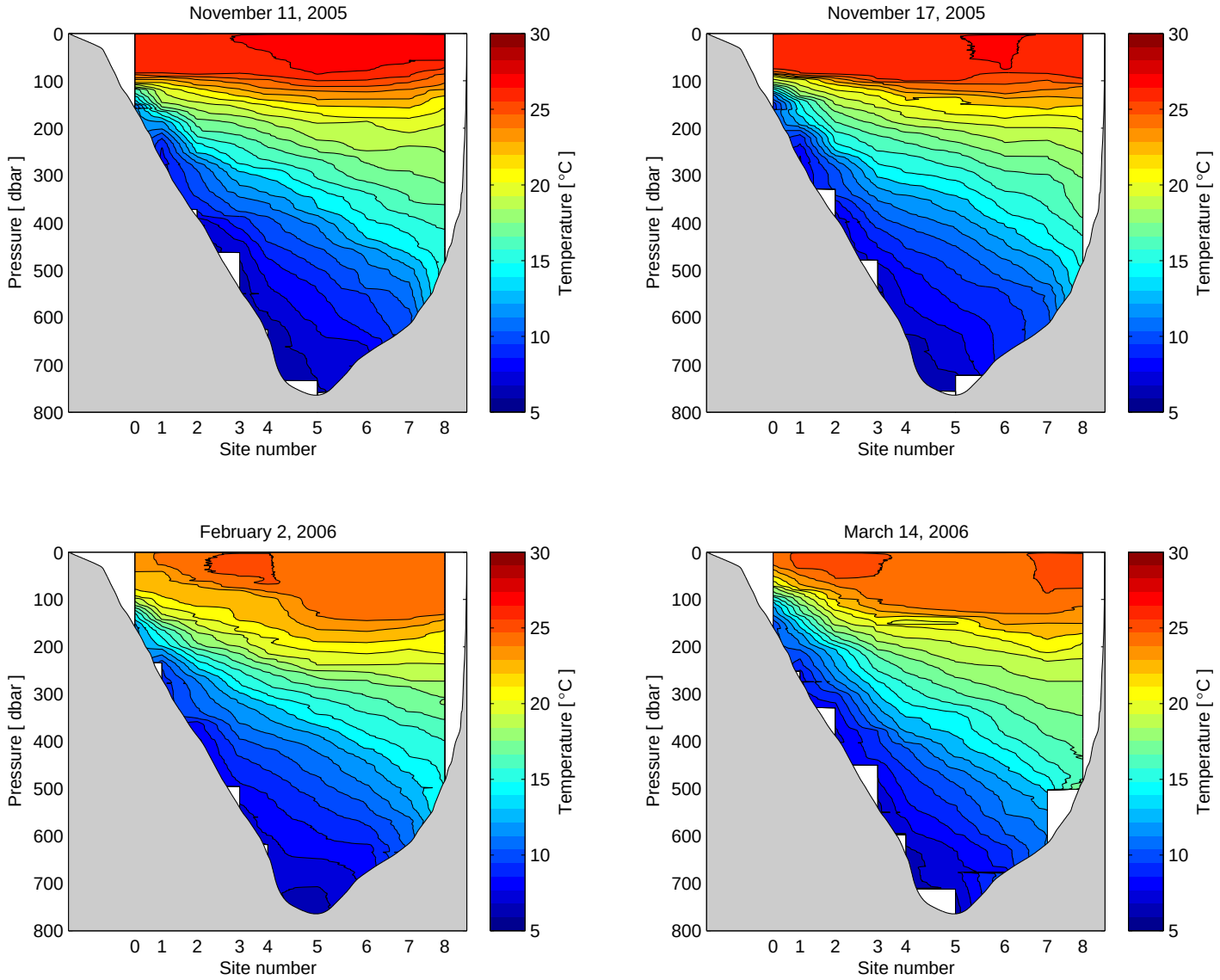
Sta	Deployed			Surfaced			Mean Velocities	
	Time (GMT)	Lon	Lat	Time (GMT)	Lon	Lat	U cm/s	V cm/s
September 15, 2006								
0	11:35:19	-79.9288	27.0028	11:41:34	-79.9285	27.0060	7.81	95.38
1	12: 1:42	-79.8660	27.0018	12:12:44	-79.8659	27.0076	1.45	97.18
2	12:36:35	-79.7827	27.0014	12:52:14	-79.7822	27.0098	5.19	97.61
3	13:19: 8	-79.6833	27.0008	13:41: 2	-79.6828	27.0119	4.26	92.67
4	14: 0:58	-79.6168	27.0003	14:26:13	-79.6162	27.0124	4.27	88.11
5	14:54:39	-79.4998	27.0005	15:25:26	-79.4997	27.0134	0.52	77.25
6	15:54:20	-79.3835	27.0002	16:22:38	-79.3840	27.0110	-2.41	70.56
7	16:49:12	-79.2833	27.0004	17:14:39	-79.2840	27.0083	-4.83	57.34
8	17:36:16	-79.2000	26.9997	17:56: 8	-79.2011	27.0039	-9.37	40.09

Table 2: Continued.

Date	Station #								
	0	1	2	3	4	5	6	7	8
November 11, 2005	111.72	139.69	138.88	136.21	137.31	111.75	57.93	31.60	-8.06
November 17, 2005	134.94	130.78	149.95	27.22	115.30	92.60	76.70	38.64	44.72
February 2, 2006	158.91	201.93	182.81	174.17	142.07	122.45	101.05	61.74	31.43
March 14, 2006	195.36	207.30	188.78	179.23	158.32	122.45	105.21	86.02	63.01
March 27, 2006	98.08	130.83	138.00	125.46	107.73	89.61	74.90	36.91	-12.07
June 22, 2006	187.84	218.75	196.76	184.42	172.98	149.95	81.44	87.09	-4.14
June 30, 2006	160.71	182.49	194.16	167.12	139.20	114.11	75.11	41.22	5.23
July 20, 2006	202.53	234.19	210.29	202.53	190.58	149.95	117.69	66.83	44.13
September 15, 2006	143.98	167.28	191.17	154.13	140.39	104.55	64.52	46.60	20.43

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

APPENDIX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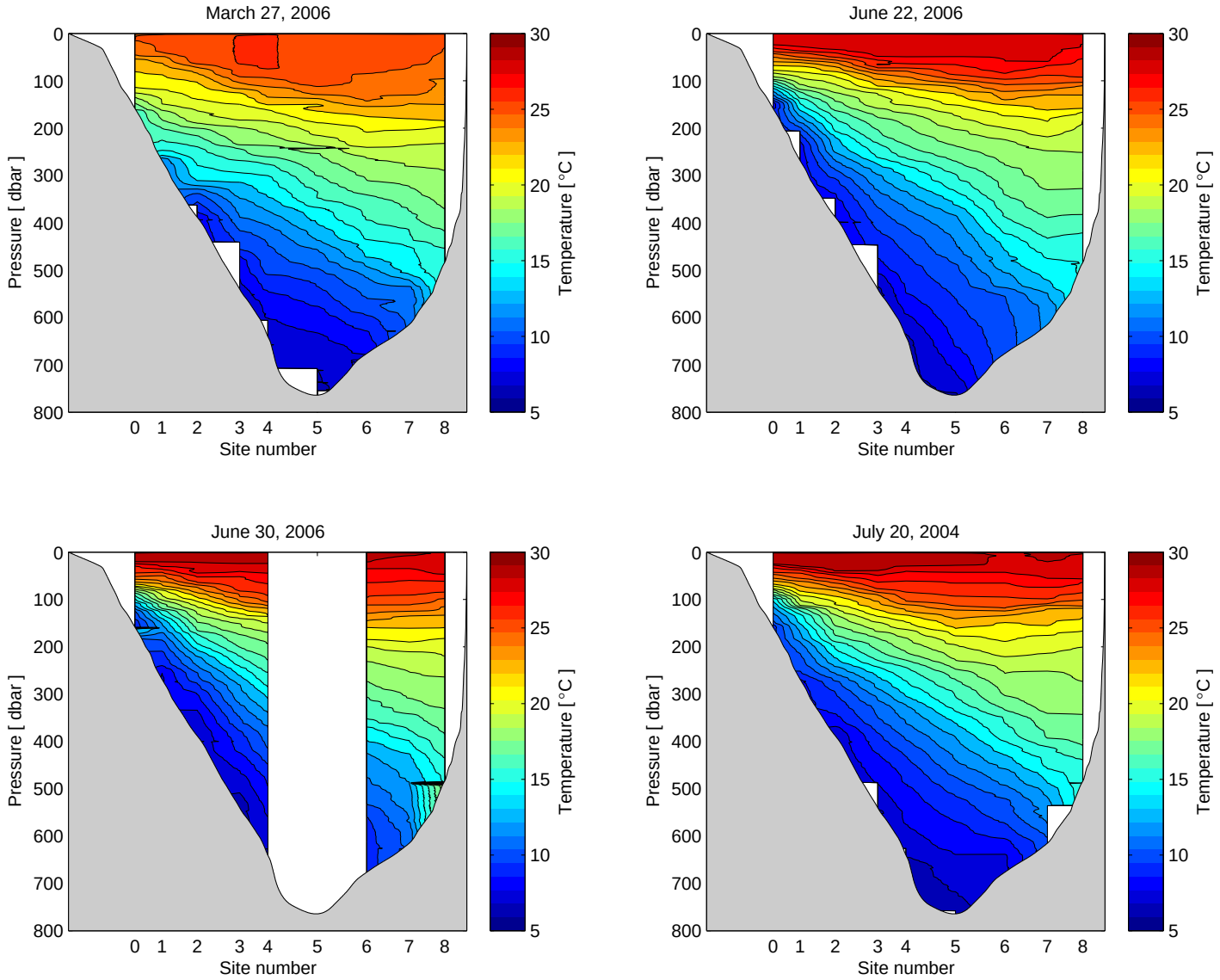
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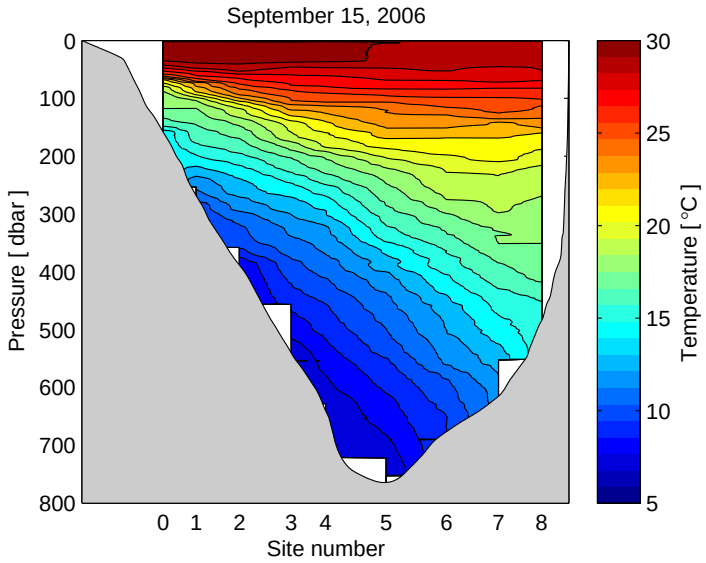
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