Table 1. Locations of moored current stations and first order statistics for period April 1989-April 1994. Annual statistics were not computed for records with fewer than 8 calendar months of data. Units in cm/s and °C.

Instr. Depth (m)	Record Length (days)	Variable	Record Length Mean	Record Length +/-S.D.	Annual Mean	Annual +/-S.E.	%Variance 40hlp	%Variance (3-40)hlp
Amer. Shoal Lat: 24° 32.58'N - Lon: 81° 32.06'W - Water Depth: 13m Rot: 73°								
6	226	u	0.7	1.2			23.4	76.6
6	226	v	-2.5	7.8			61.0	39.0
6	226	T	28.7	1.6			99.2	0.8
Carysfort Lat: 25° 12.25'N - Lon: 80° 12.25'W - Water Depth: 30m Rot: 28°								
7	274	u	-2.0	3.9			36.8	63.2
7	274	v	19.1	18.4			49.9	50.1
7	274	T	26.5	2.1			99.6	0.4
17	527	u	-1.9	2.7	-1.9	0.4	26.8	73.2
17	527	v	19.7	16.7	19.8	2.4	45.5	54.5
17	527	T	26.7	2.3	26.6	.09	99.4	0.6
27	231	u	-0.8	2.7			21.1	78.9
27	231	v	9.6	12.0			40.0	60.0
27	231	T	26.6	2.3	26.3	.08	99.9	0.1
Tennessee Lat: 24° 44.63'N - Lon: 80° 46.79'W - Water Depth: 30m Rot: 61°								
7	310	u	-3.0	8.0	-3.1	1.3	46.3	53.7
7	310	v	7.6	27.3	7.0	4.7	67.0	33.0
7	310	T	27.3	2.2	27.4	0.1	99.4	0.6
17	655	u	1.6	3.8	1.7	0.5	46.4	53.6
17	655	v	2.8	18.7	4.2	2.3	66.1	33.9
17	655	T	27.0	2.3	26.9	0.08	99.2	0.8
27	656	u	1.7	4.0	1.6	0.5	12.7	87.3
27	656	v	1.0	15.0	1.1	1.9	61.0	39.0
27	656	T	26.2	2.2	26.5	0.09	97.6	2.4
Looe Key Lat: 24° 32.53'N - Lon: 81° 24.11'W - Water Depth: 30m Rot: 73°								
7	1274	u	-0.7	3.3	-1.0	0.8	34.0	66.0
7	1274	v	0.4	21.4	0.1	4.9	72.6	27.4
7	1274	T	27.0	2.2	26.9	0.2	99.4	0.6
17	1953	u	-0.2	2.6	-0.2	0.6	37.0	63.0
17	1953	v	0.0	18.3	-0.3	3.6	73.2	26.8
17	1953	T	26.8	2.4	26.7	0.4	95.2	4.8
27	1365	u	2.3	3.6	2.5	0.8	42.5	57.5
27	1365	v	-1.3	11.8	-2.1	2.6	66.3	33.7
27	1365	T	26.8	2.4	26.4	0.2	98.4	1.6

Table 1. Continued.

Instr. Depth (m)	Record Length (days)	Variable	Record Length Mean	Record Length +/-S.D.	Annual Mean	Annual +/-S.E.	%Variance 40hlp	%Variance (3-40)hlp
East Sambo Lat: 24° 28.84'N - Lon: 81° 39.67'W - Water Depth: 30m Rot: 73°								
7	227	u	0.6	2.3			28.1	71.9
7	227	v	-2.0	22.7			86.3	13.7
7	227	T	28.2	1.5			99.1	0.9
17	336	u	0.5	2.1	0.6	0.8	37.6	62.4
17	336	v	-1.9	17.6	-0.5	7.0	81.9	18.1
17	336	T	26.9	2.1	26.9	0.2	99.3	0.7
27	242	u	-0.3	2.0			28.8	71.2
27	242	v	2.8	7.9			66.7	33.3
27	242	T	28.0	2.0			95.5	4.5
Marquesas Lat: 24° 27.11'N - Lon: 82° 11.41'W - Water Depth: 30m Rot: 90°								
7	842	u	-2.2	3.0	-2.0	0.8	15.1	84.9
7	842	v	-4.0	12.8	-5.0	3.4	67.7	32.3
7	842	T	27.0	2.3	26.7	0.2	99.4	0.6
17	600	u	-0.4	3.3	-0.1	0.8	22.3	77.7
17	600	v	-2.6	9.4	-5.0	2.7	62.0	38.0
17	600	T	27.4	1.8	27.1	0.2	97.3	2.7
27	377	u	-0.7	5.1	-0.9	1.5	44.3	55.7
27	377	v	-1.2	6.2	-1.2	2.4	46.5	53.5
27	377	T	25.7	2.3	25.5	0.3	95.7	4.3
Dry Tortugas Lat: 24° 33.60'N - Lon: 82° 54.03'W - Water Depth: 30m Rot: 104°								
7	296	u	1.3	6.8			17.4	82.6
7	296	v	-8.4	8.6			30.8	69.2
7	296	T	28.3	1.9			99.7	0.3
17	451	u	3.7	5.6			18.2	81.8
17	451	v	-4.1	5.1			22.8	77.2
17	451	T	25.8	2.6			99.6	0.4
27	122	u	0.6	1.4			11.7	88.3
27	122	v	-0.5	1.1			13.4	86.6
Looe ADCP Lat: 24° 28.39'N - Lon: 81° 21.61'W - Water Depth: 150m Rot: 73°								
25	938	u	1.2	10.1	2.3	2.4		
25	938	v	46.6	57.4	47.1	13.9		
50	940	u	1.6	10.4	3.0	2.5		
50	940	v	49.4	56.9	49.8	13.6		
100	940	u	2.5	7.1	3.2	1.6		
100	940	v	39.8	35.3	38.8	8.4		
Dry Tort. ADCP Lat: 24° 19.92'N -Lon: 82° 54.18'W -Water Depth: 200m Rot: 104°								
30	373	u	-1.8	9.3	-1.7	3.2		
30	373	v	1.1	41.4	0.5	14.0		
50	373	u	-0.9	7.8	-0.8	2.8		
50	373	v	1.1	37.6	0.6	13.1		
100	373	u	0.6	4.9	0.7	1.8		
100	373	v	1.1	31.5	0.7	11.9		

Table 2. CMAN Station locations and wind statistics for 5-year period, April 1989 to April 1994. Wind units are in m/s. Wind rotations along isobaths are shown.

Station	Record Length (days	Vari-able	Record Mean	Record +/-S.D.	Annual Mean	Annual +/-S.E.
Fowey Rocks						
25° 35.4'N	948	u	-2.4	3.6	-2.2	0.5
80° 06.0'W		v	0.4	3.2	0.3	0.3
Rotation: 0°						
Molasses Reef						
25° 00.6'N	1826	u	-0.8	3.4	-0.8	0.2
80° 22.8'W		v	-2.7	3.7	-2.7	0.3
Rotation: 40°						
Sombrero						
24° 37.6'N	1826	u	-0.7	3.4	-0.7	0.2
81° 06.6'W		v	-2.7	3.4	-2.8	0.3
Rotation: 73°						
Sand Key						
24° 27.4'N	1368	u	-0.03	3.7	0.1	0.3
81° 52.7'W		v	-3.0	3.4	-2.9	0.3
Rotation: 80°						
Dry Tortugas						
24° 38.3'N	699	u	1.9	3.2	2.0	0.2
82° 51.7'W		v	-2.7	3.5	-2.6	0.3
Rotation: 104°						

Table 3. Larval durations of selected species in the Florida Keys.

Species	Larval Duration	Reference
reef building corals	hours - weeks	Szmant (personal com.)
queen conch	2 - 4 weeks	Davis *et al.* (1993)
pink shrimp	3 - 4 weeks	Criales and Lee (1995)
snapper/grouper	1 - 2 months	Leis (1987); Lindeman *et al.* (1999)
spiny lobster	6 - 12 months	Lewis (1951); Sims and Ingle (1966)

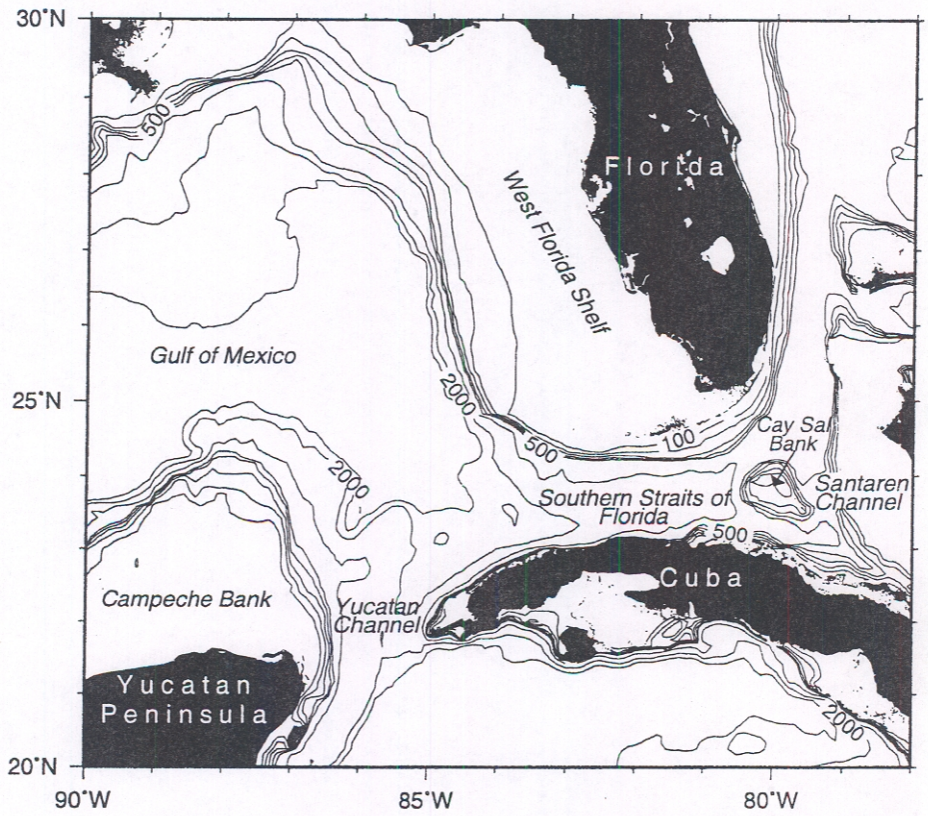


Fig. 1. The bathymetry of the eastern Gulf of Mexico and Straits of Florida.

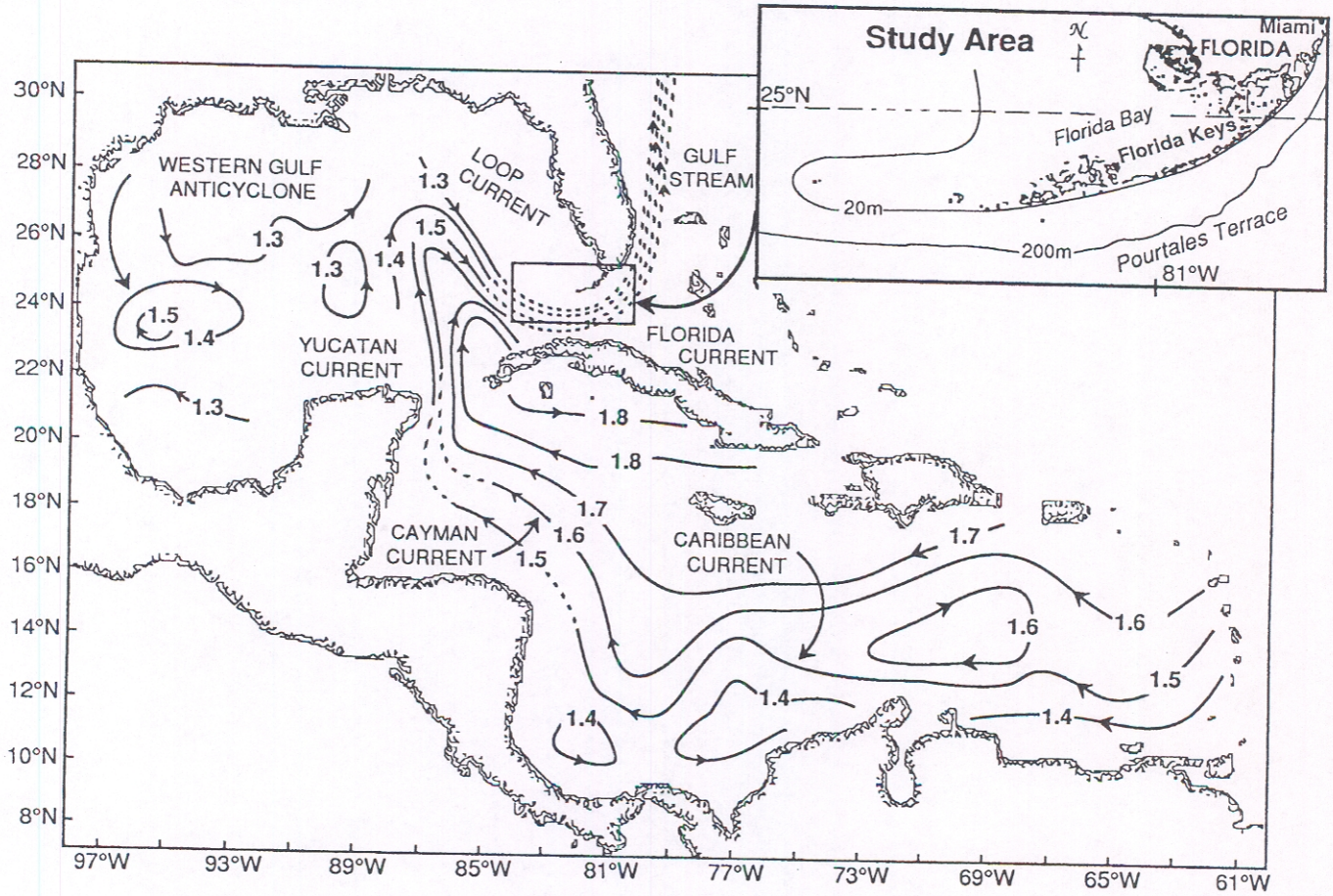


Fig. 2. Location of the study area and major current systems as determined from mean annual dynamical topography (dyne meters) adapted from Molinari [1980, Fig. 2].

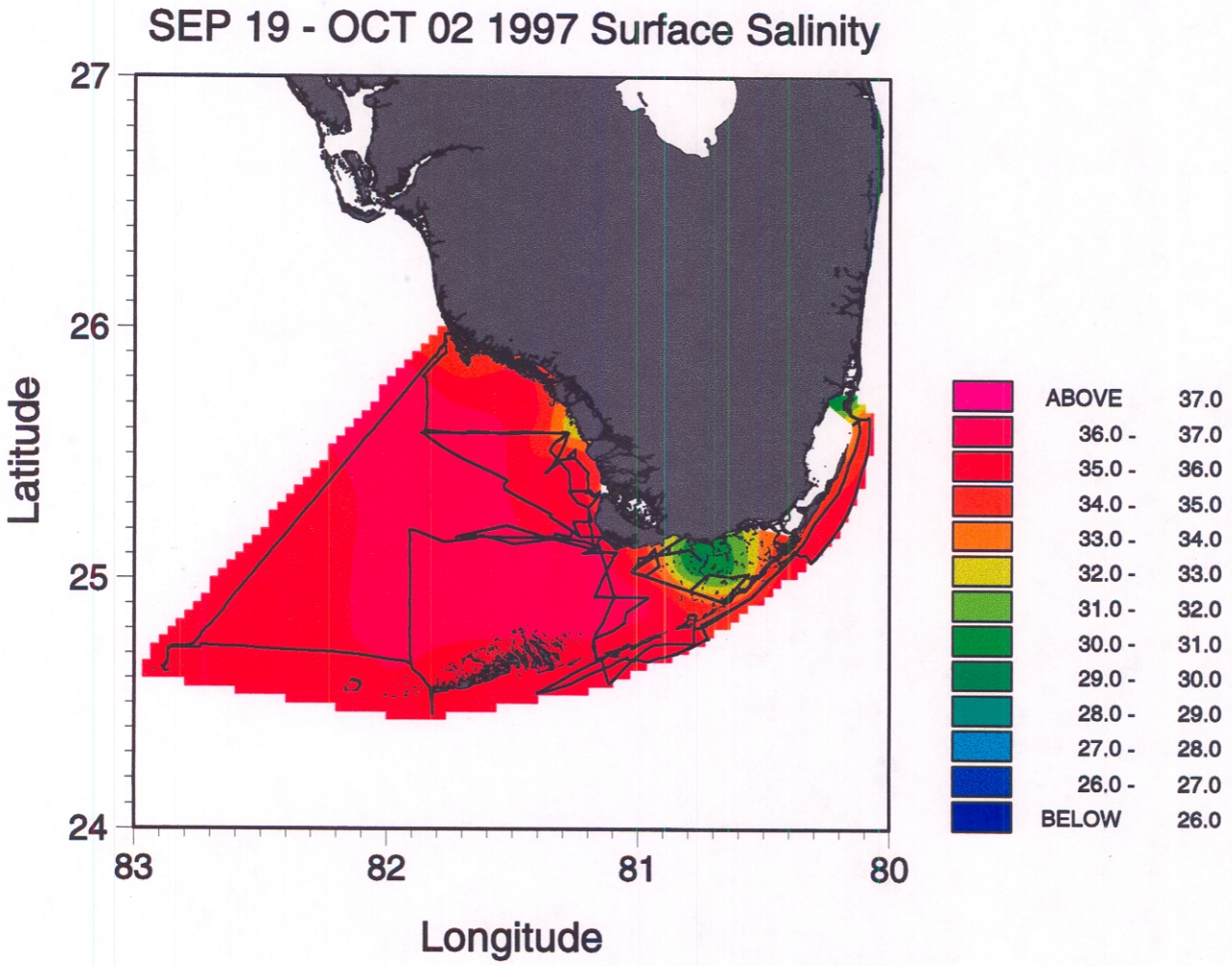


Fig. 3a. Fall multidisciplinary survey of R/V Calanus Sept. 19 - Oct. 2, 1997; surface salinity patterns.

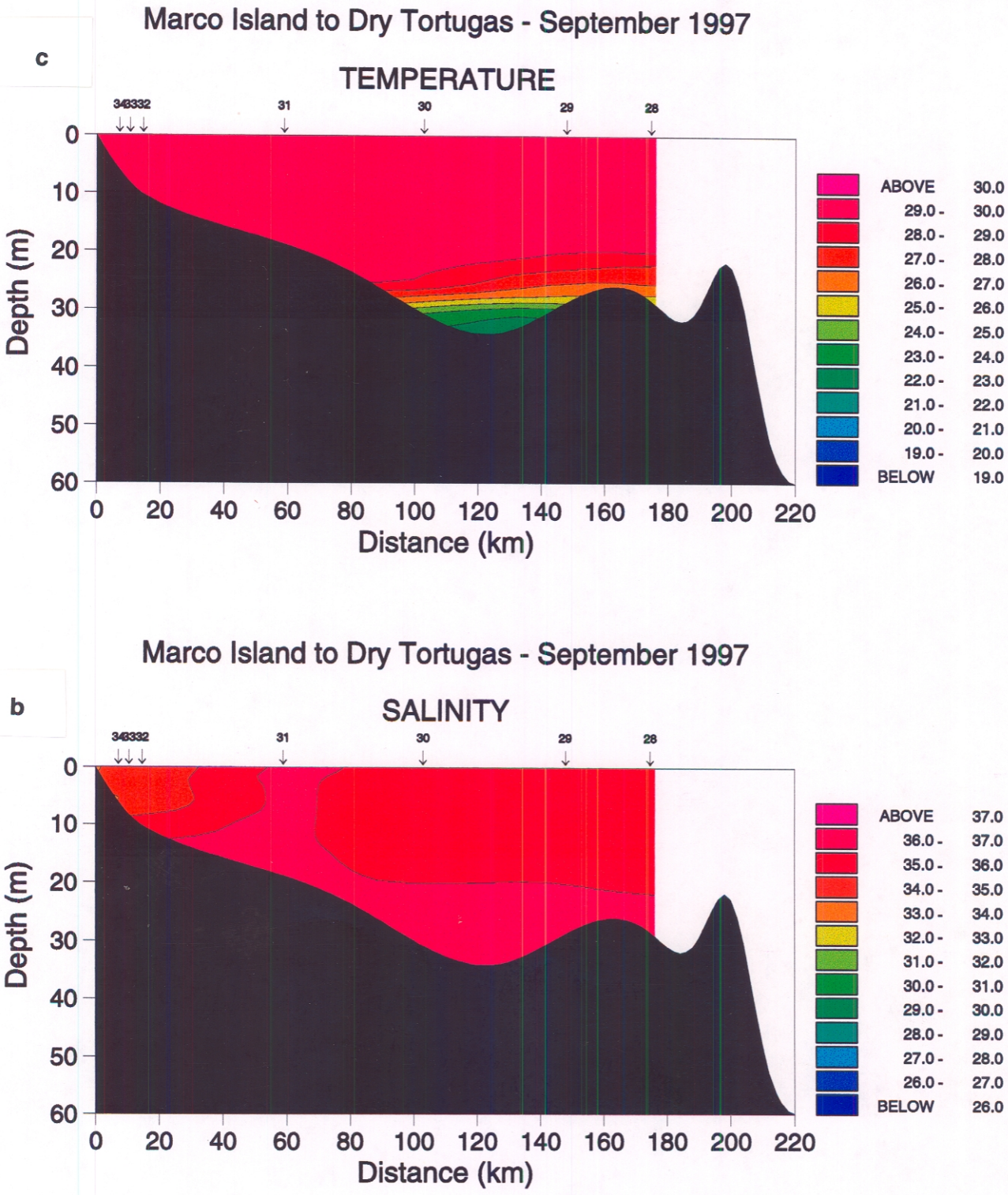


Fig. 3b and c. Fall multidisciplinary survey of R/V Calanus Sept. 19 - Oct. 2, 1997; b) Marco Island to Tortugas salinity section; c) Marco Island to Tortugas temperature section.

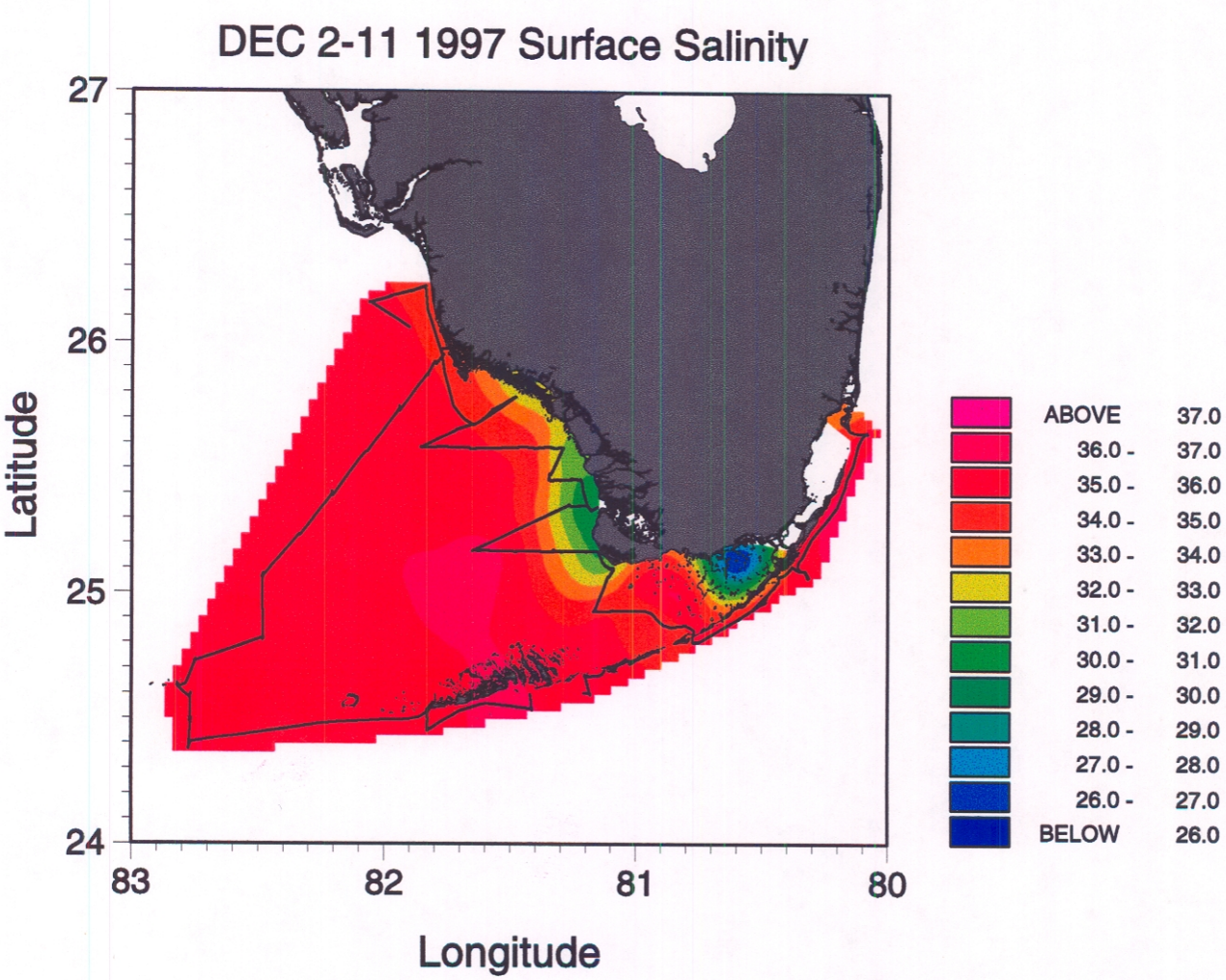
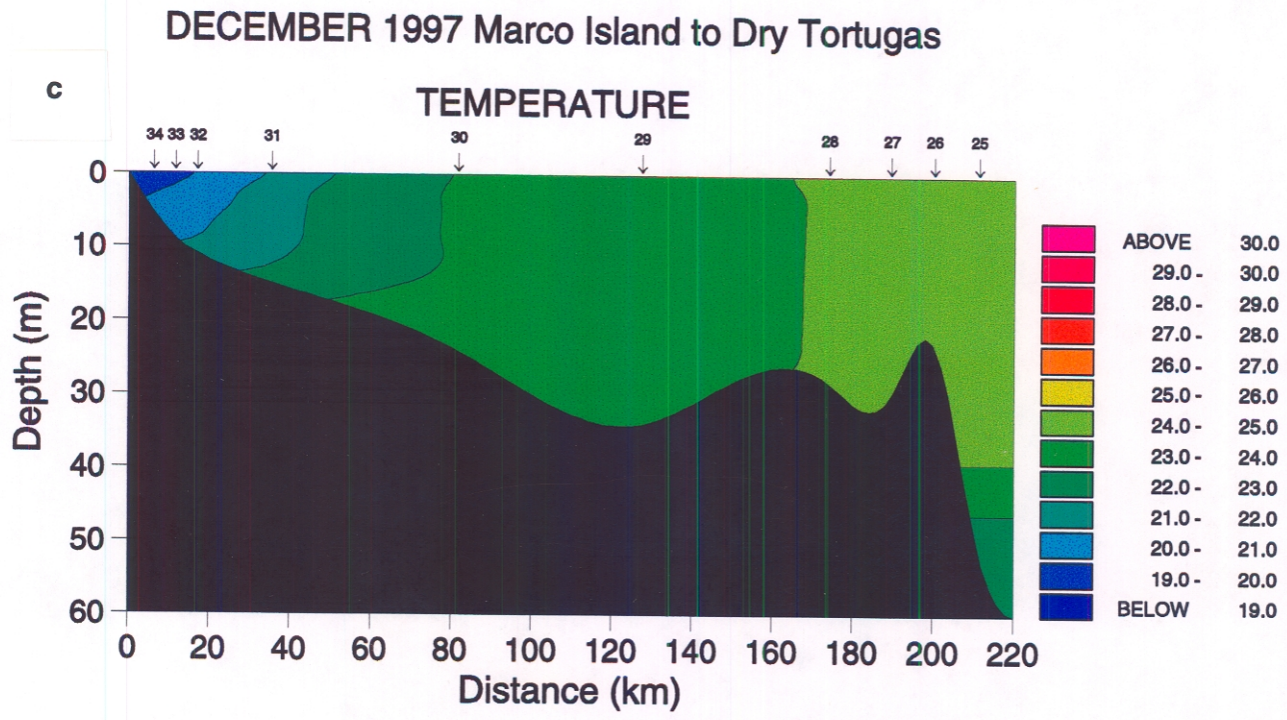


Fig. 4a. Winter multidisciplinary survey of R/V Calanus Dec. 2-11, 1997; surface salinity patterns.



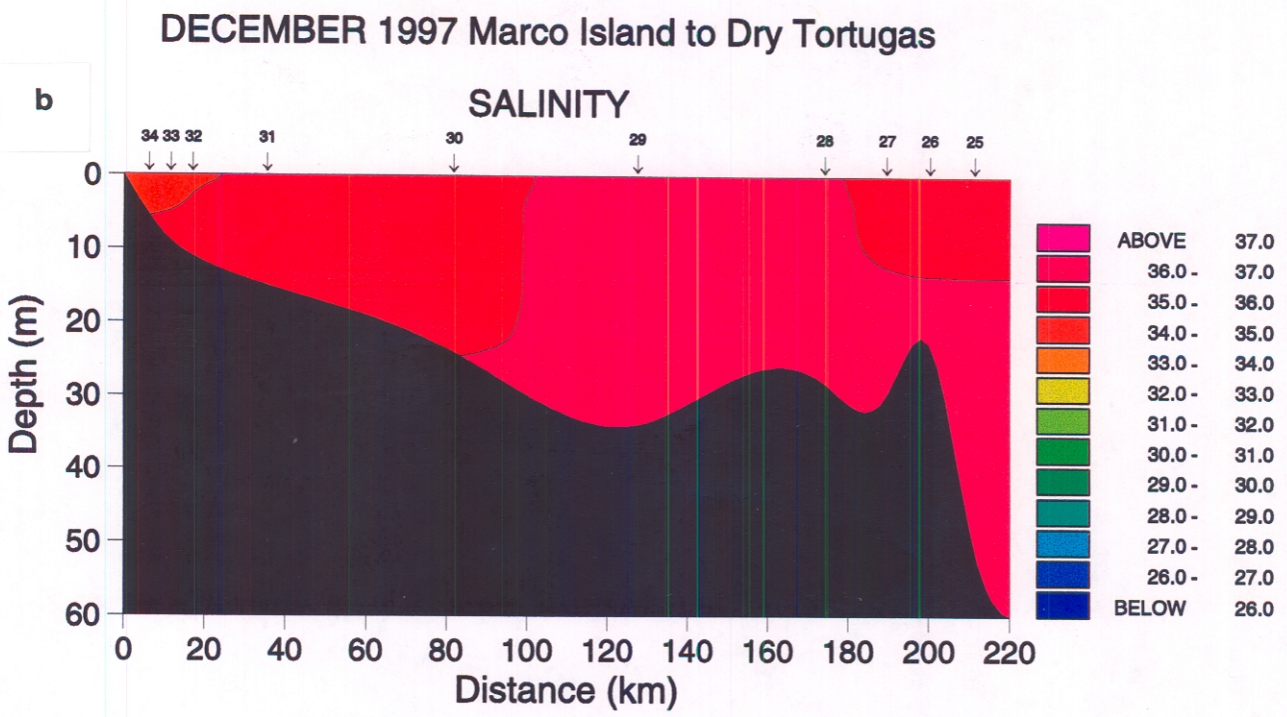


Fig. 4b and c. Winter multidisciplinary survey of R/V Calanus Dec. 2-11, 1997; b) Marco Island to Tortugas salinity section; c) Marco Island to Tortugas temperature section.

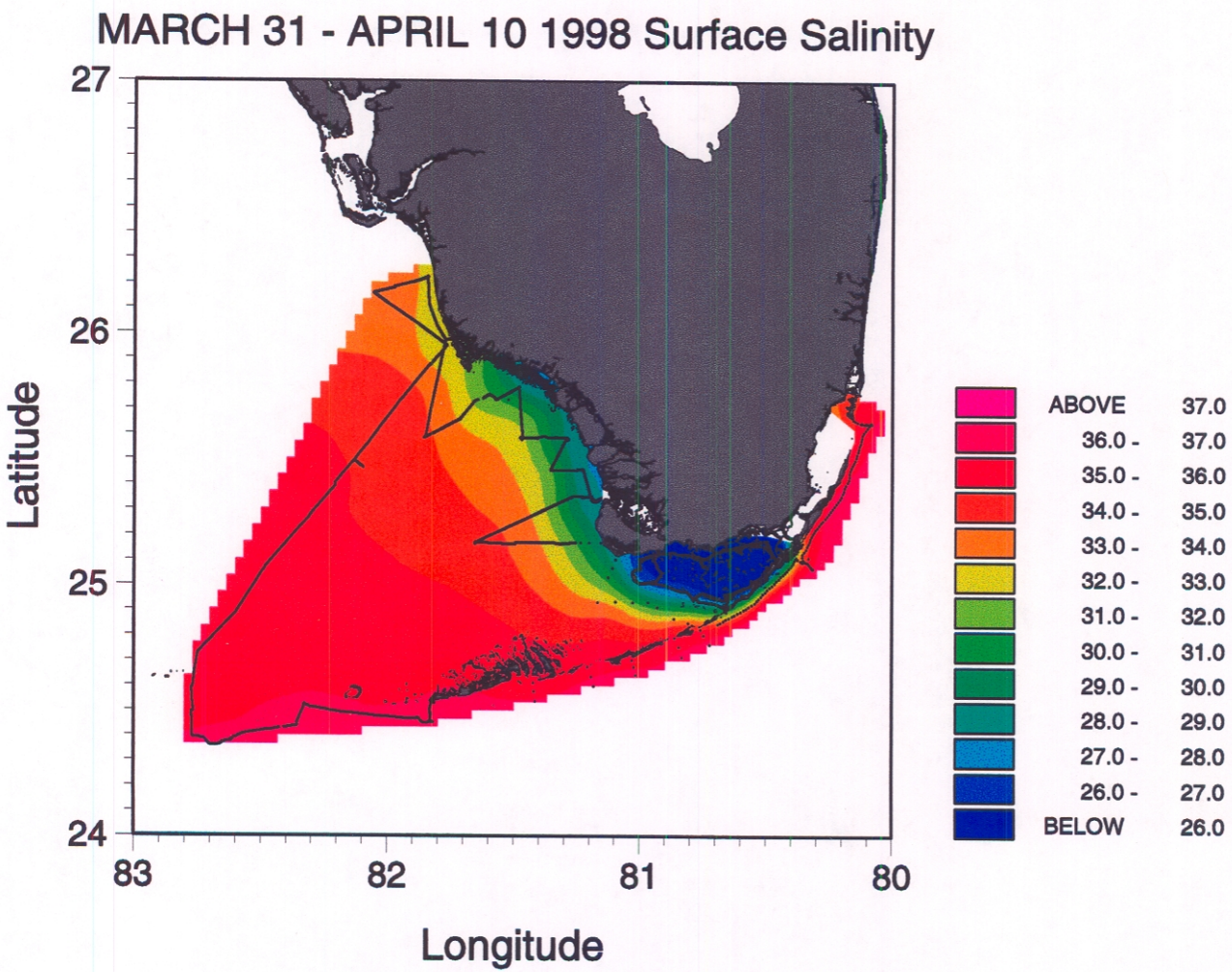
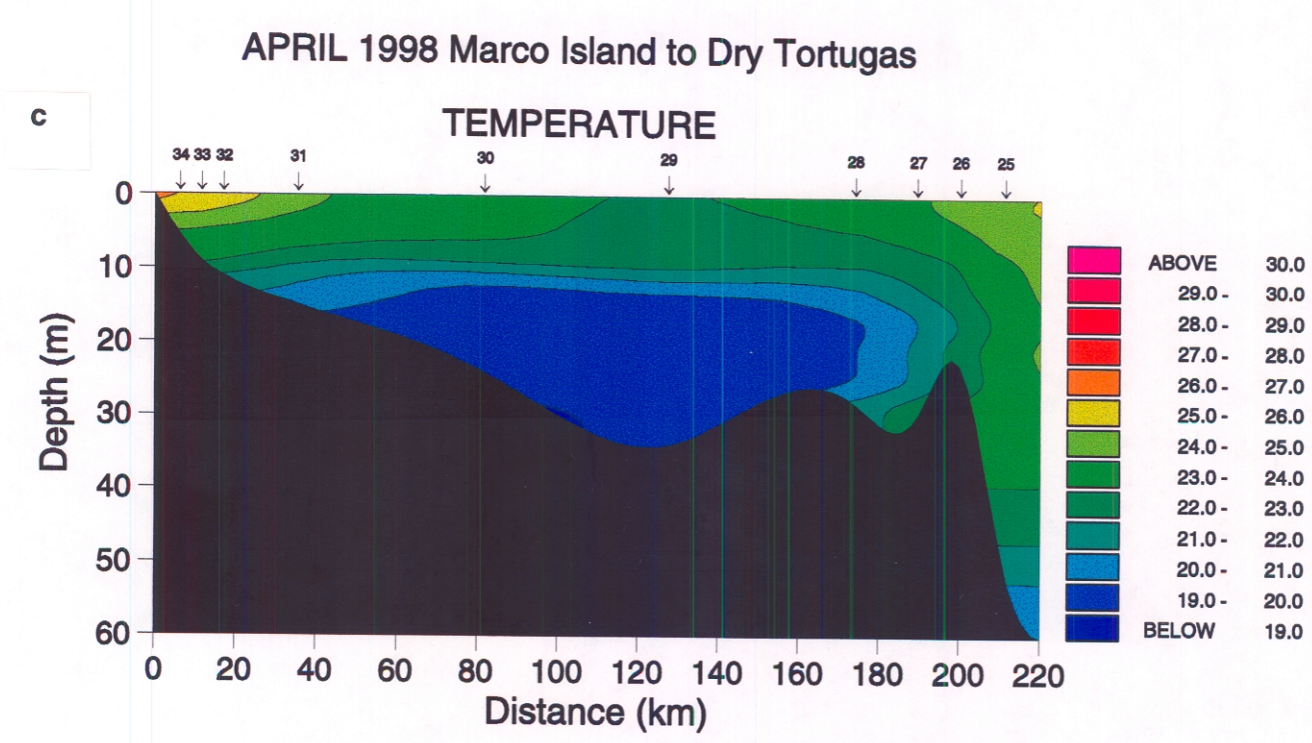


Fig. 5a. Spring multidisciplinary survey of R/V Calanus Apr. 2-9, 1998; surface salinity patterns.



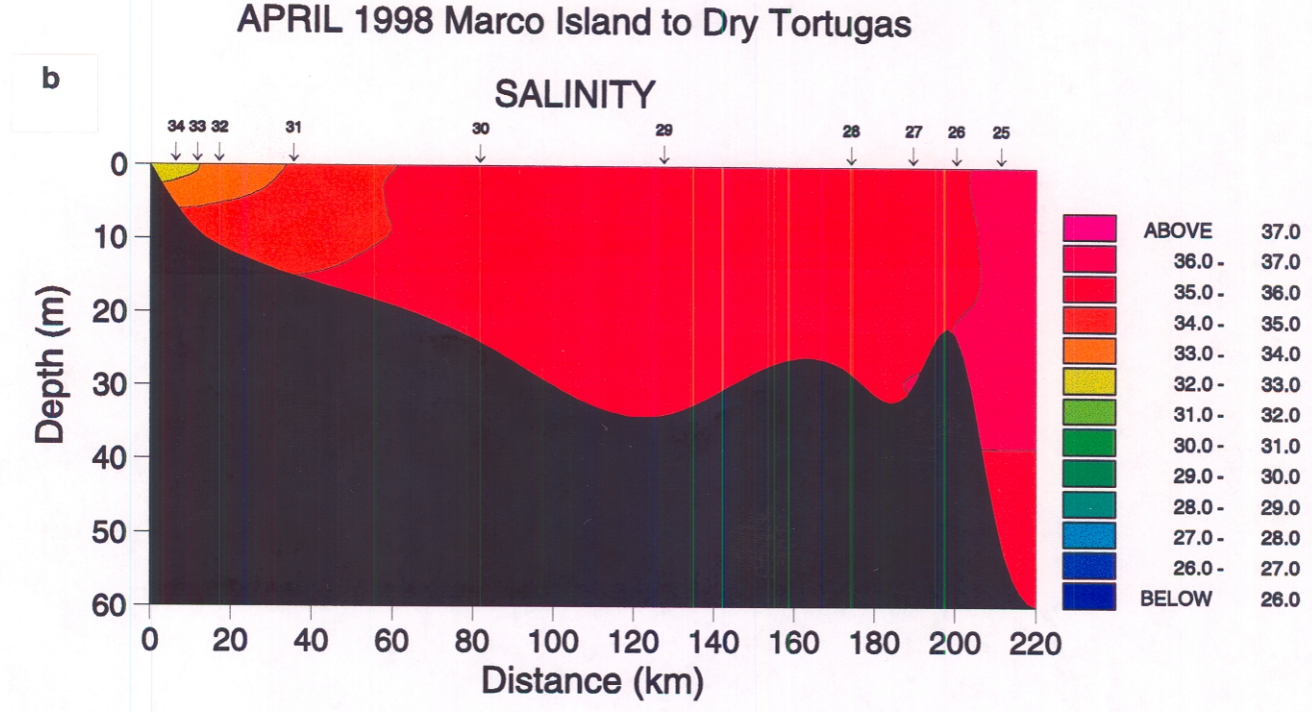


Fig 5b and c. Spring multidisciplinary survey of R/V Calanus Apr. 2-9, 1998; b) Marco Island to Tortugas salinity section; c) Marco Island to Tortugas temperature section.

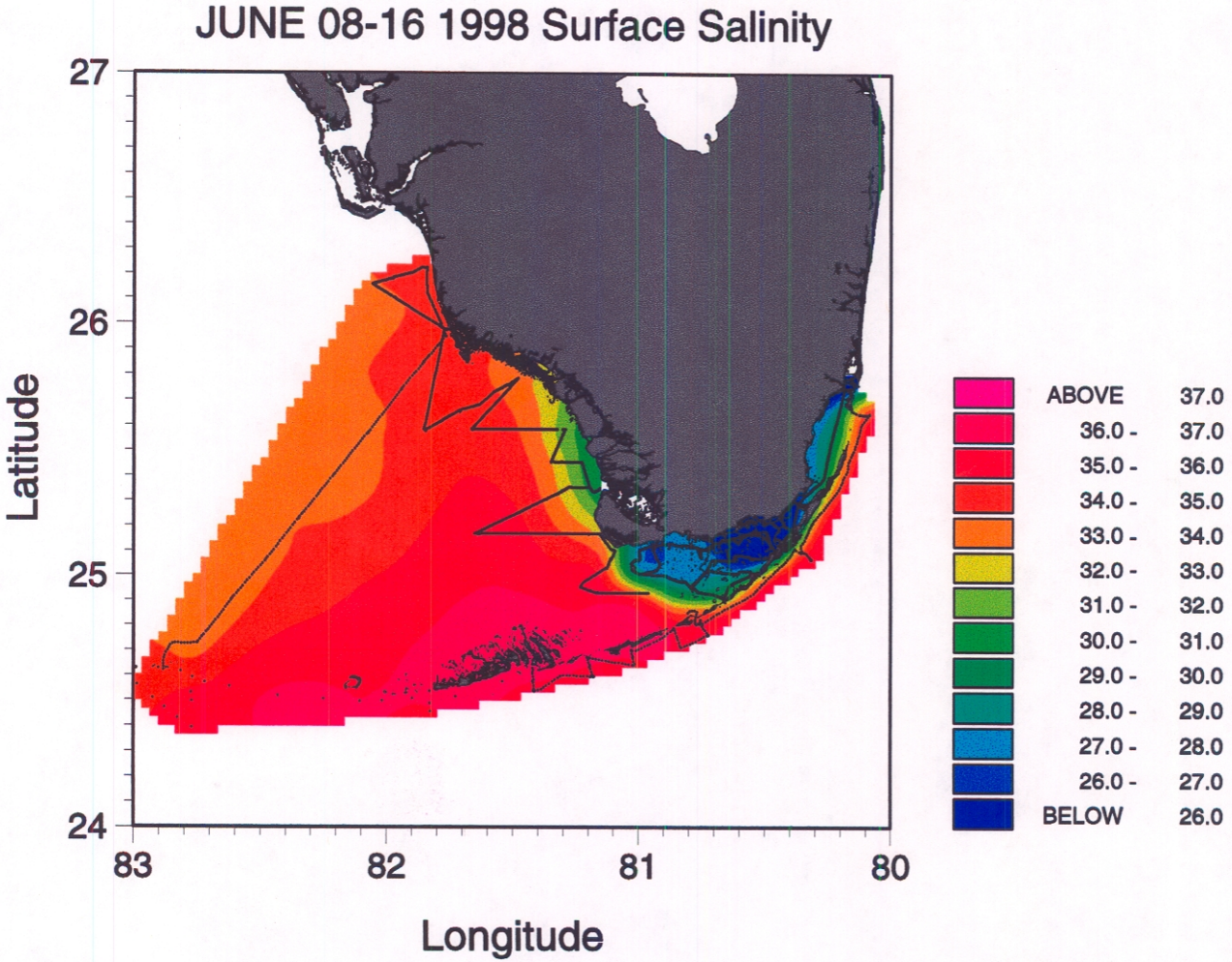
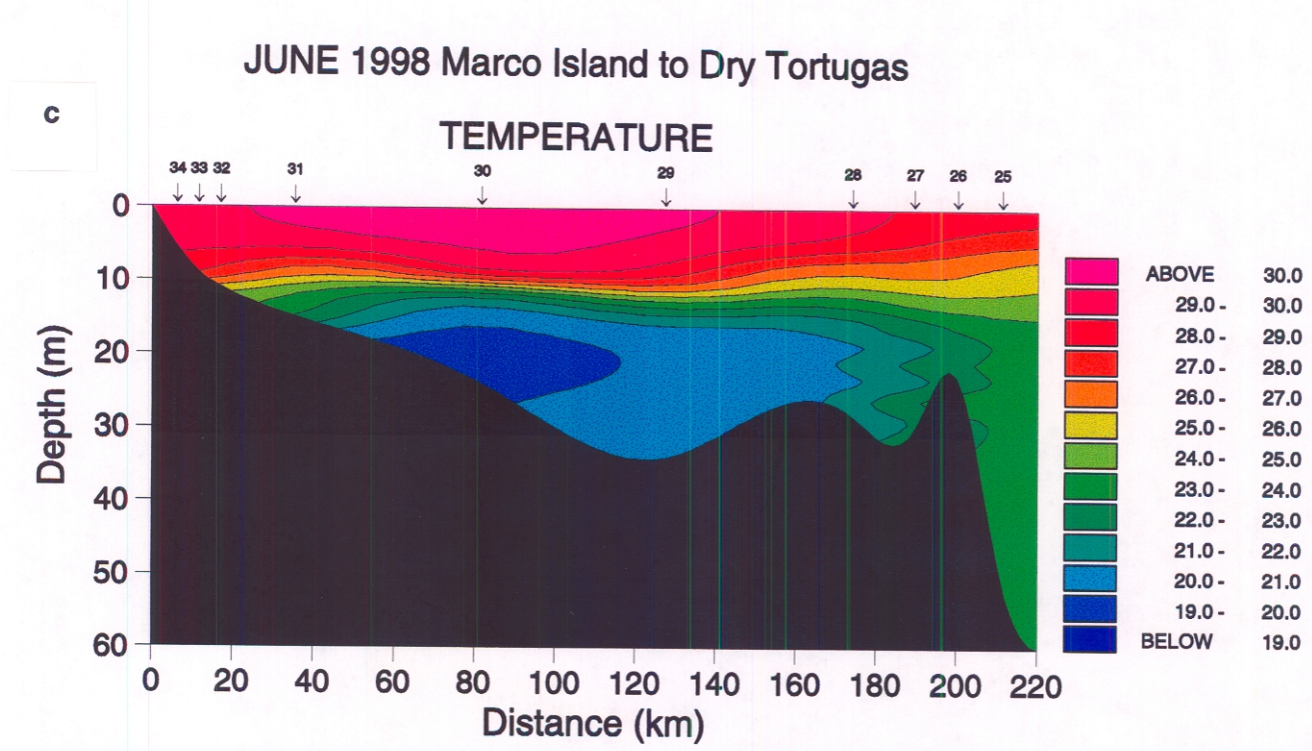


Fig. 6a. Summer multidisciplinary survey of R/V Calanus Jun. 8-16, 1998; surface salinity patterns.



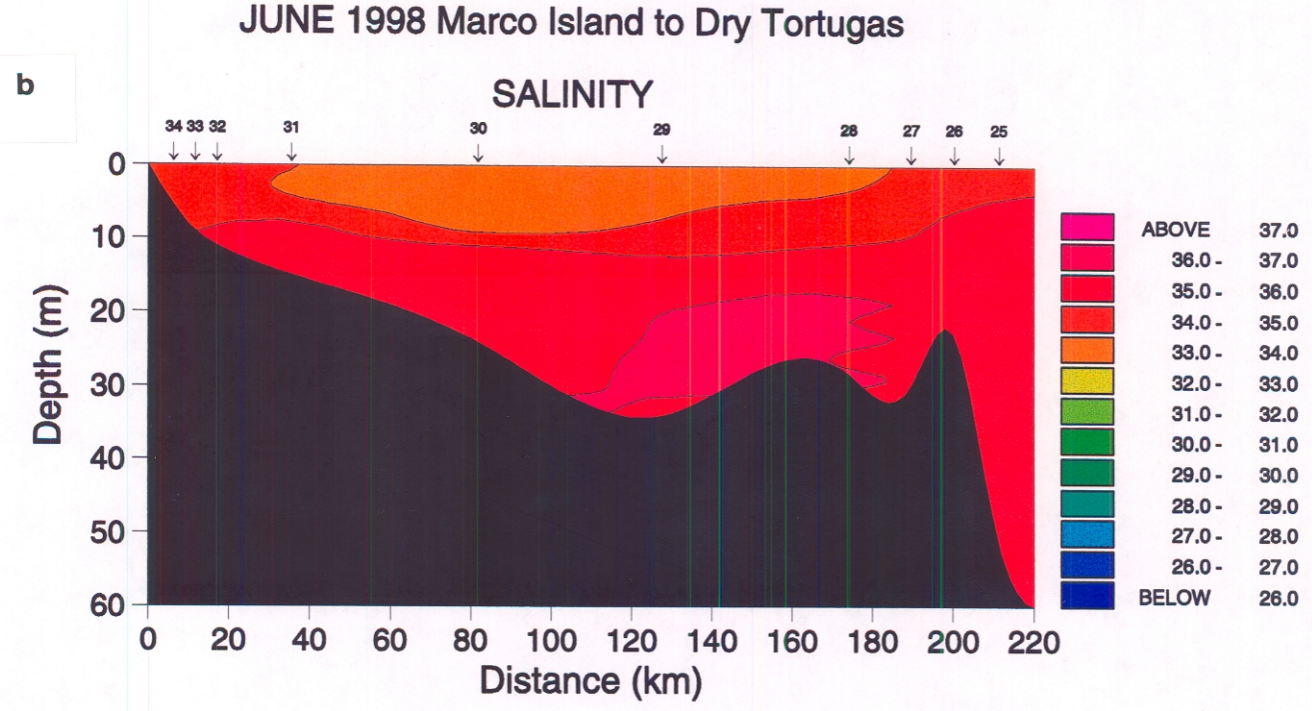


Fig. 6b and c. Summer multidisciplinary survey of R/V Calanus Jun. 8-16, 1998; b) Marco Island to Tortugas salinity section; c) Marco Island to Tortugas temperature section.

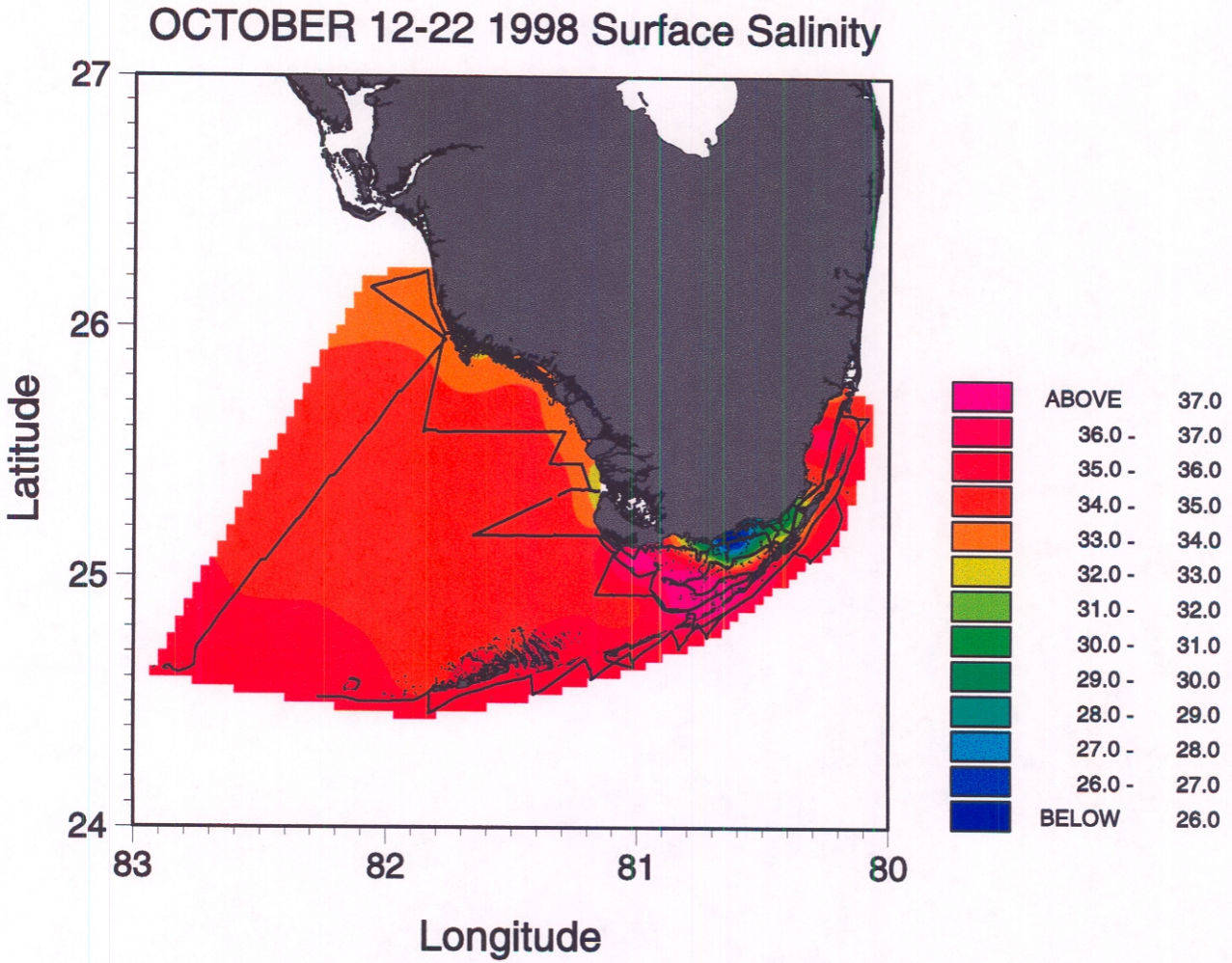
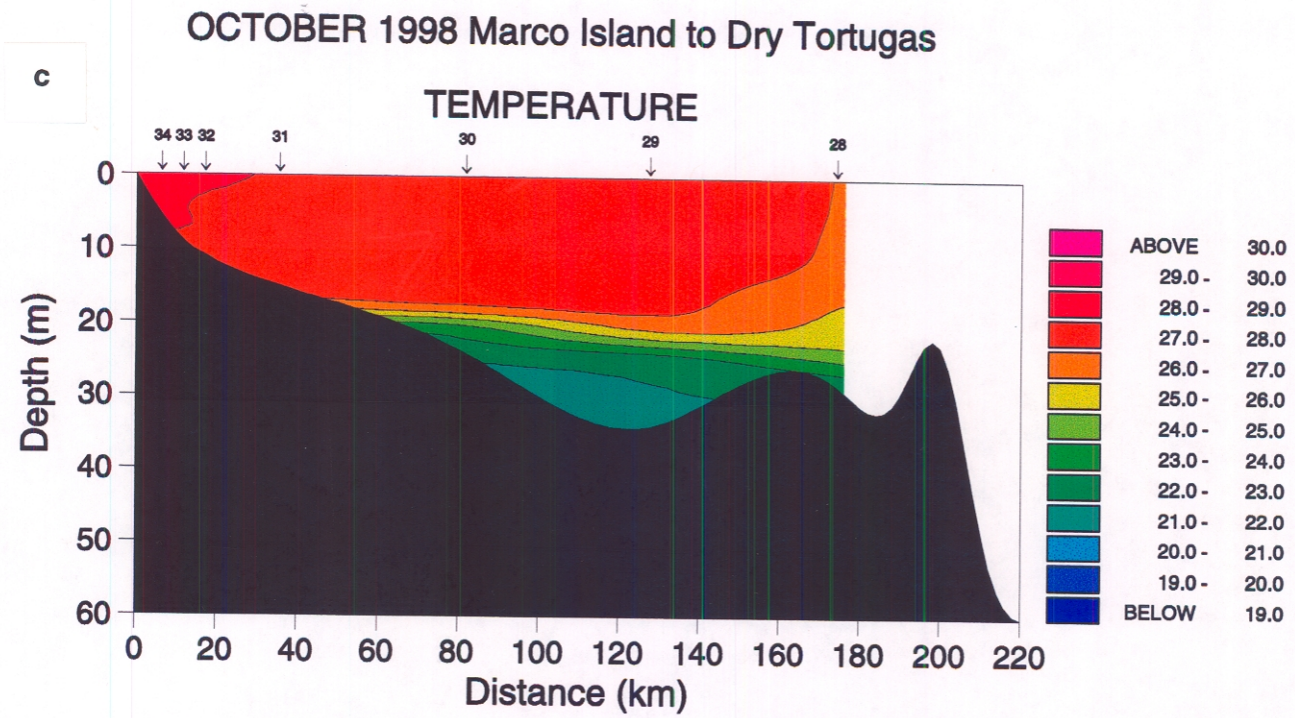


Fig. 7a. Fall multidisciplinary survey of R/V Calanus Oct. 12-22, 1998; surface salinity patterns.



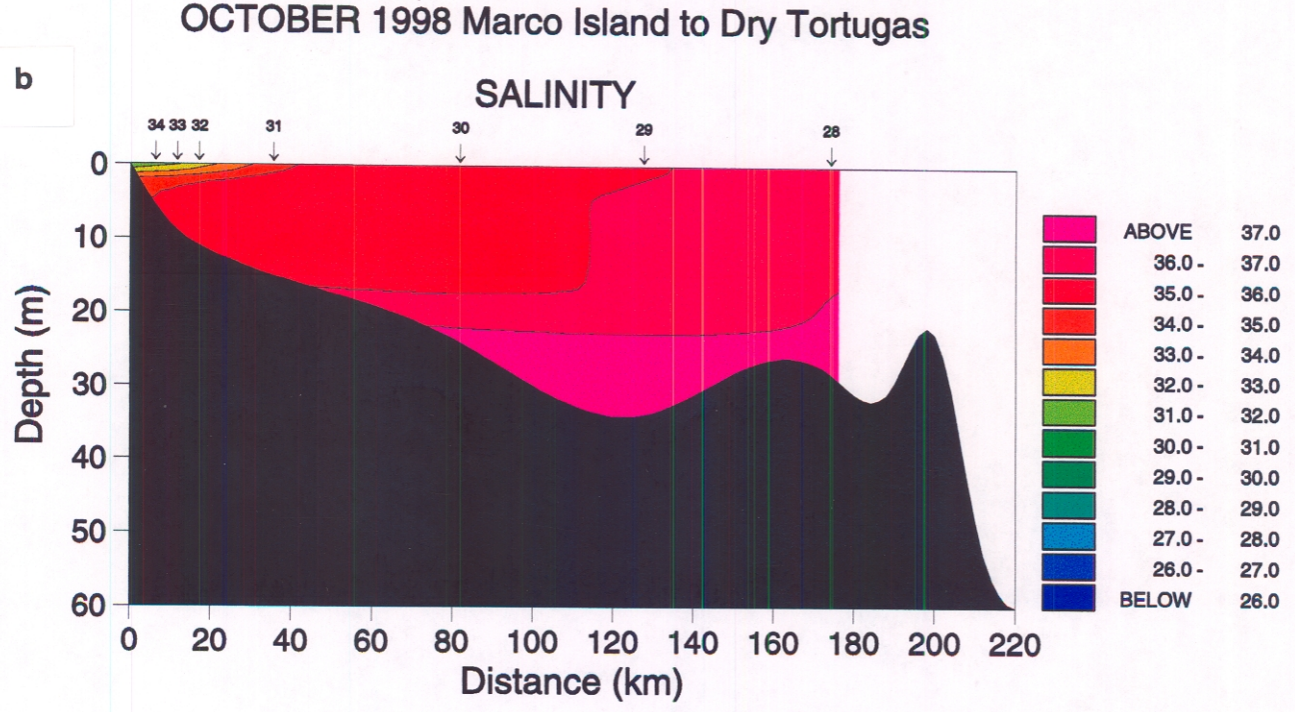


Fig. 7b and c. Fall multidisciplinary survey of R/V Calanus Oct. 12-22, 1998; b) Marco Island to Tortugas salinity section; c) Marco Island to Tortugas temperature section.

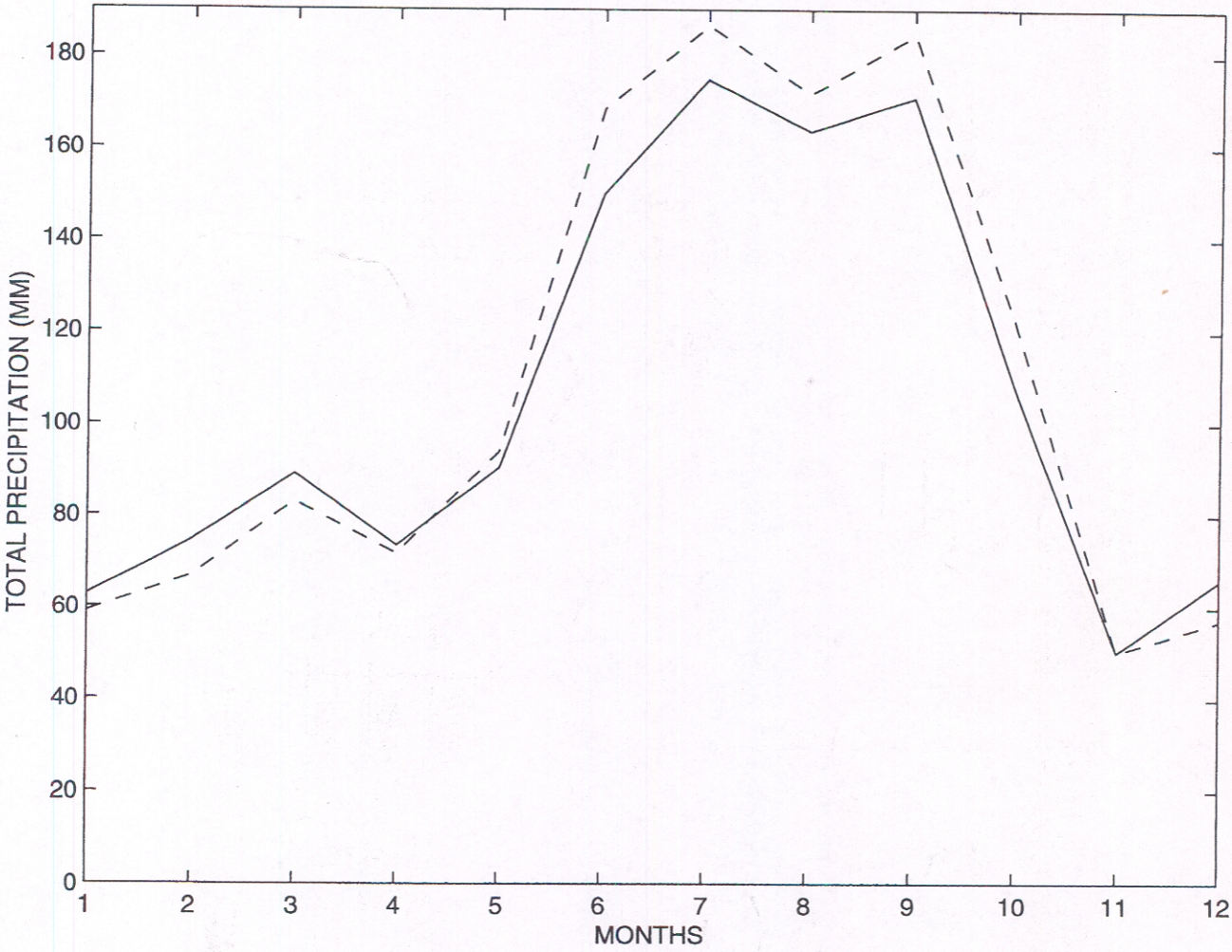


Fig. 7.5. Monthly average precipitation over the entire state (solid) and over south Florida only (dashed) for period 1979 - 1992.

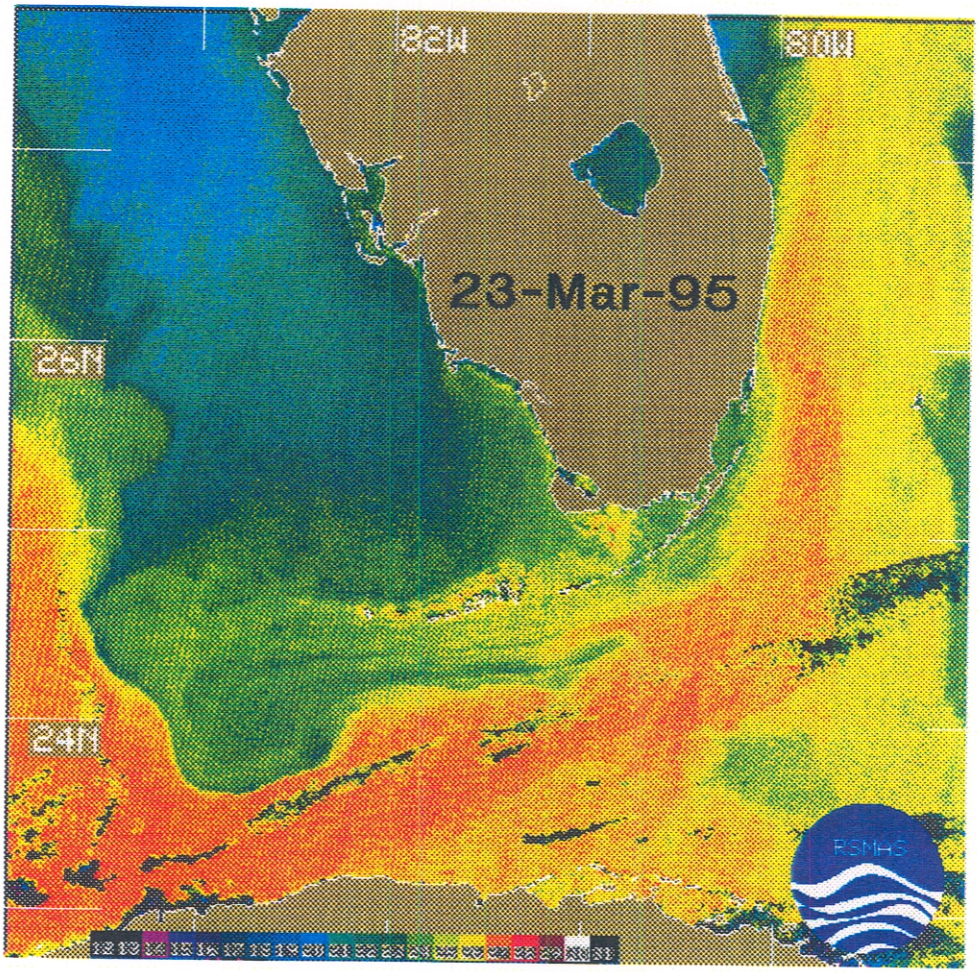


Fig. 8. SST for 23 March, 1995, derived from AVHRR measurements. Cooler temperatures are represented by shades of blue and green while warmer temperatures are represented by shades of oranges and reds, as depicted by the color scale. Clouds in the domain are represented by black patches. A TE is located near 83° W, as evidenced by the cooler (green) surface waters north of the meander in the warmer (orange) Florida Current. Streamers of warm Florida Current water are advected cyclonically into the interior of the eddy.

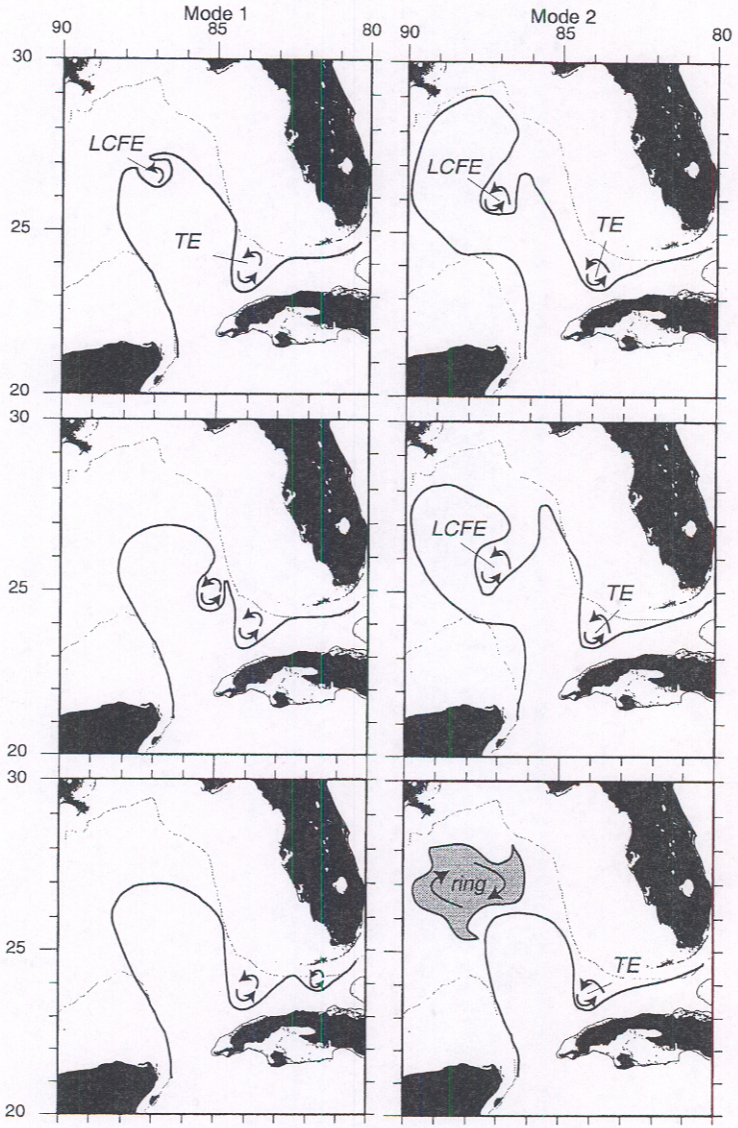


Fig. 9. Cartoons depicting the 2 modes of eddy evolution common in the AVHRR observations. The lines drawn are representative of the position of the LC and Florida Current. The positions of cyclonic LCFEs and Tes and anticyclonic rings are labeled.

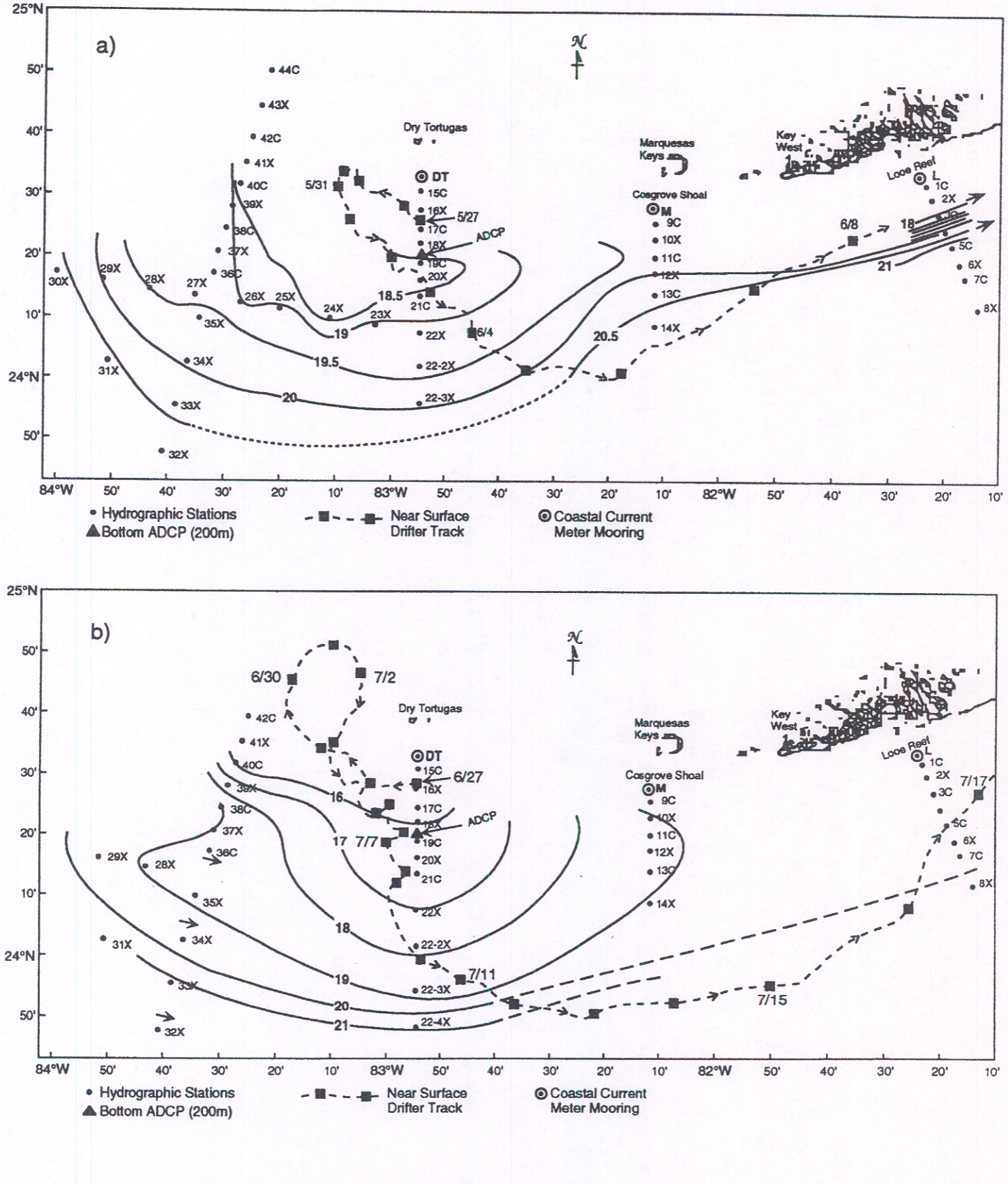


Fig. 10. Temperature at 100 m with Argos satellite tracked, nearsurface drifter trajectory superimposed. a) from May 24 -27, 1991 hydrographic survey; b) from June 25 - 27, 1991 hydrographic survey.

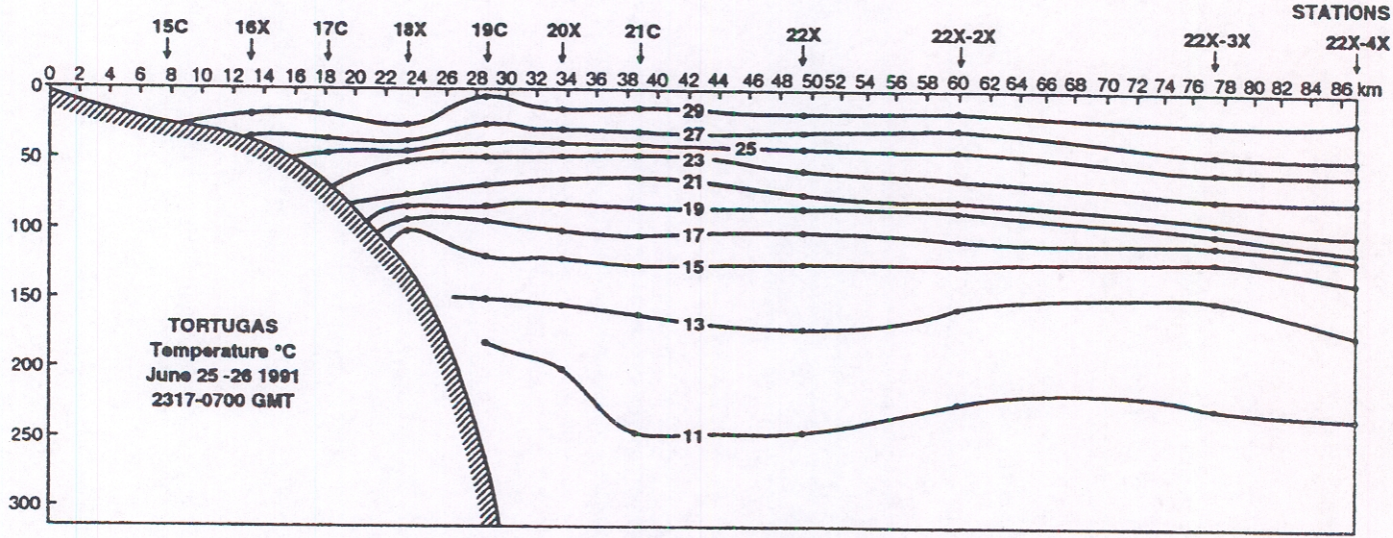


Fig. 11. Temperature section offshore of the Dry Tortugas June 25, 1991.

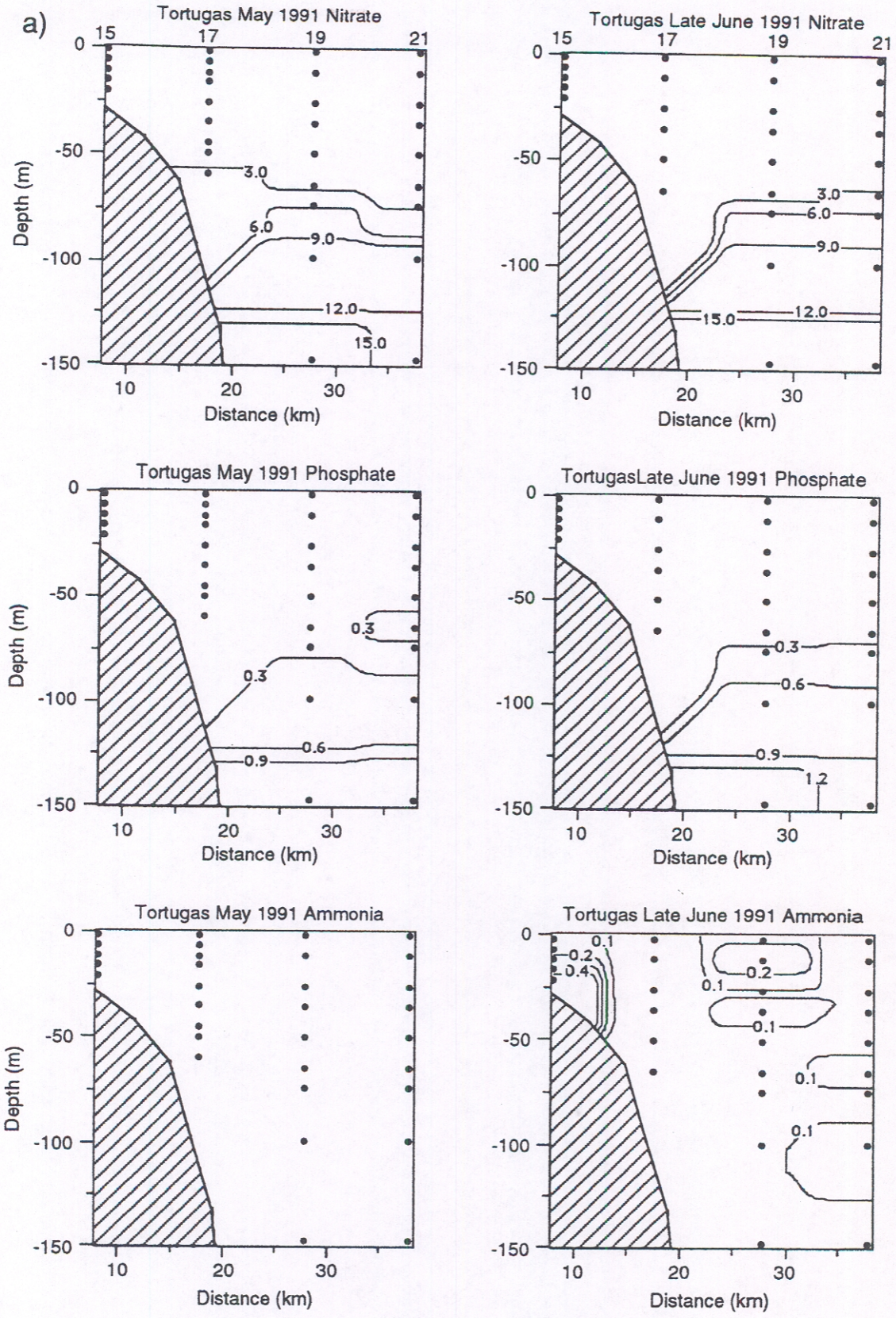


Fig. 12a. Dry Tortugas nutrient (μM) sections in May and late June 1991.

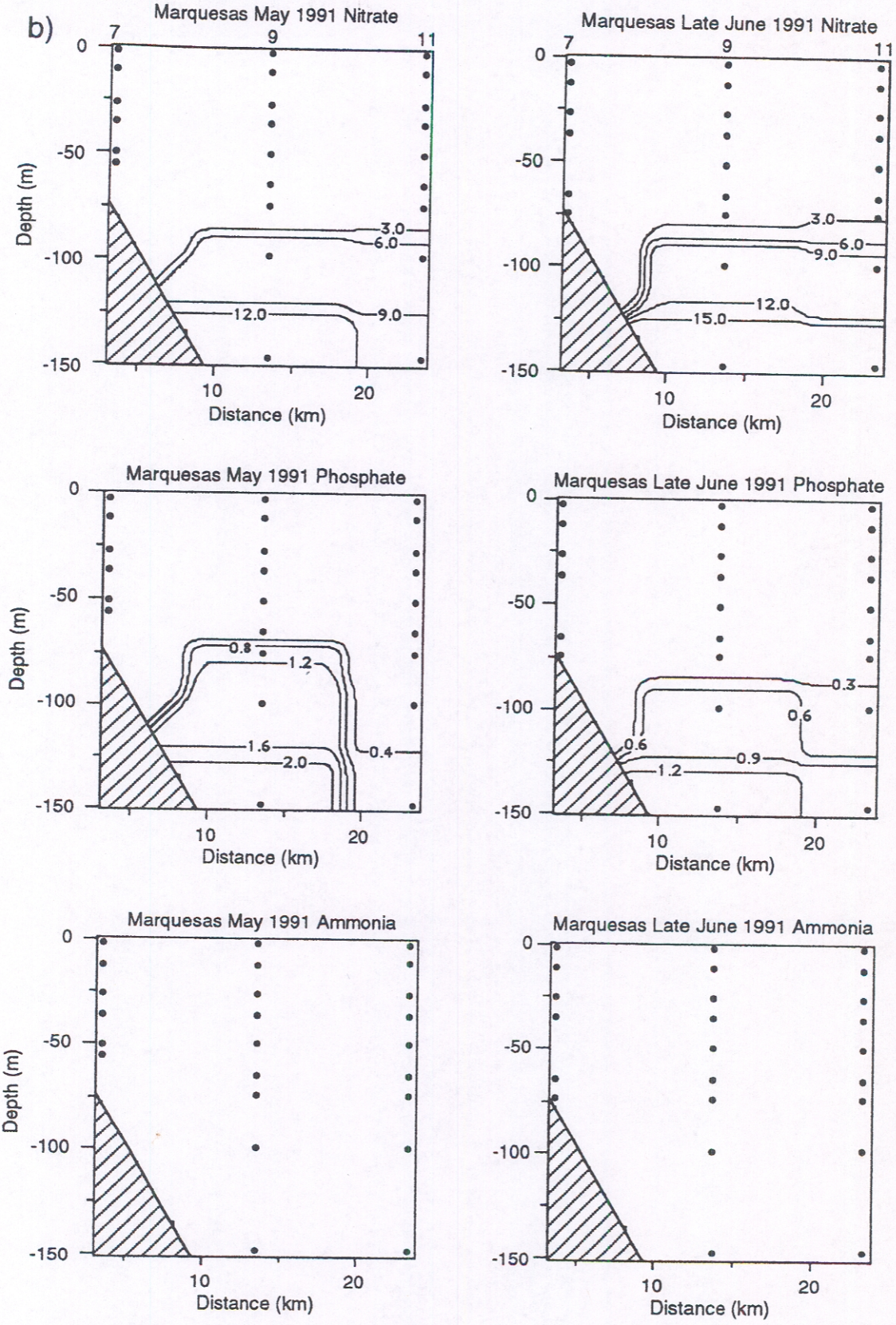


Fig. 12b. Marquesas nutrient (μM) sections in May and late June 1991.

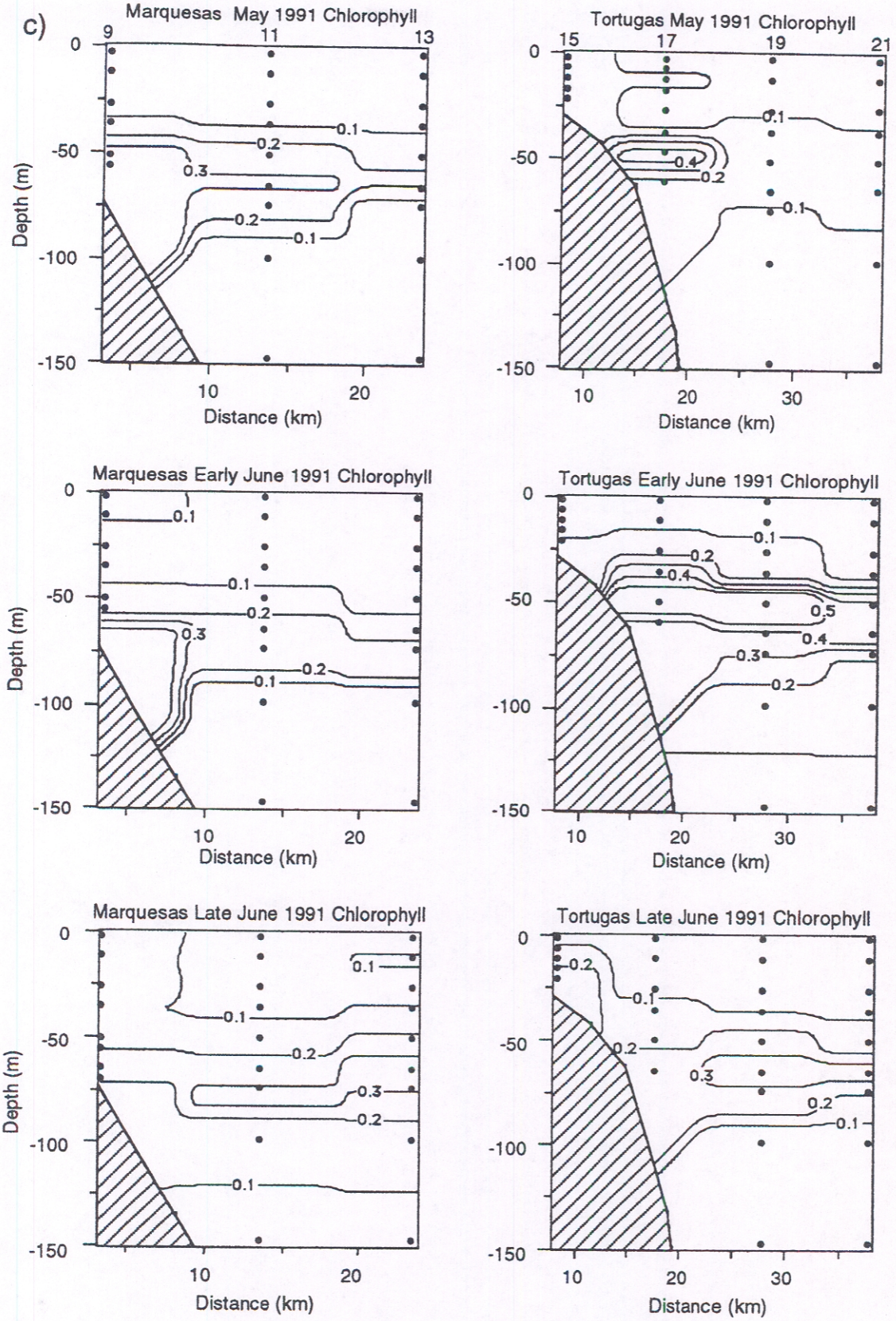


Fig. 12c. Chlorophyll (µg/liter) in sections at the Dry Tortugas and Marquesas sections in May 1991, early June 1991, and late June 1991.

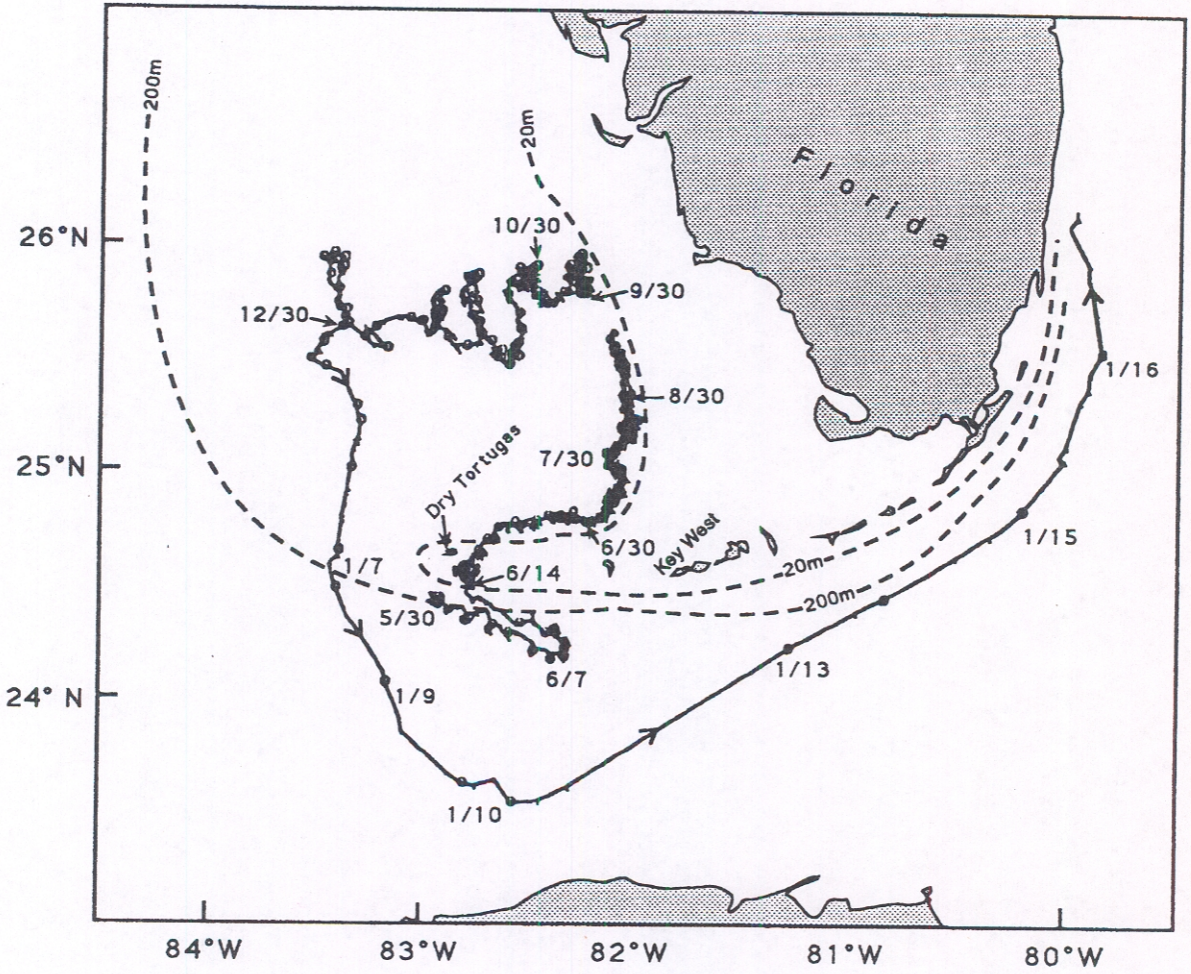


Fig. 13. Nearsurface trajectory of Argos satellite tracked drifter for period May 30, 1991 to Jan. 17, 1992.

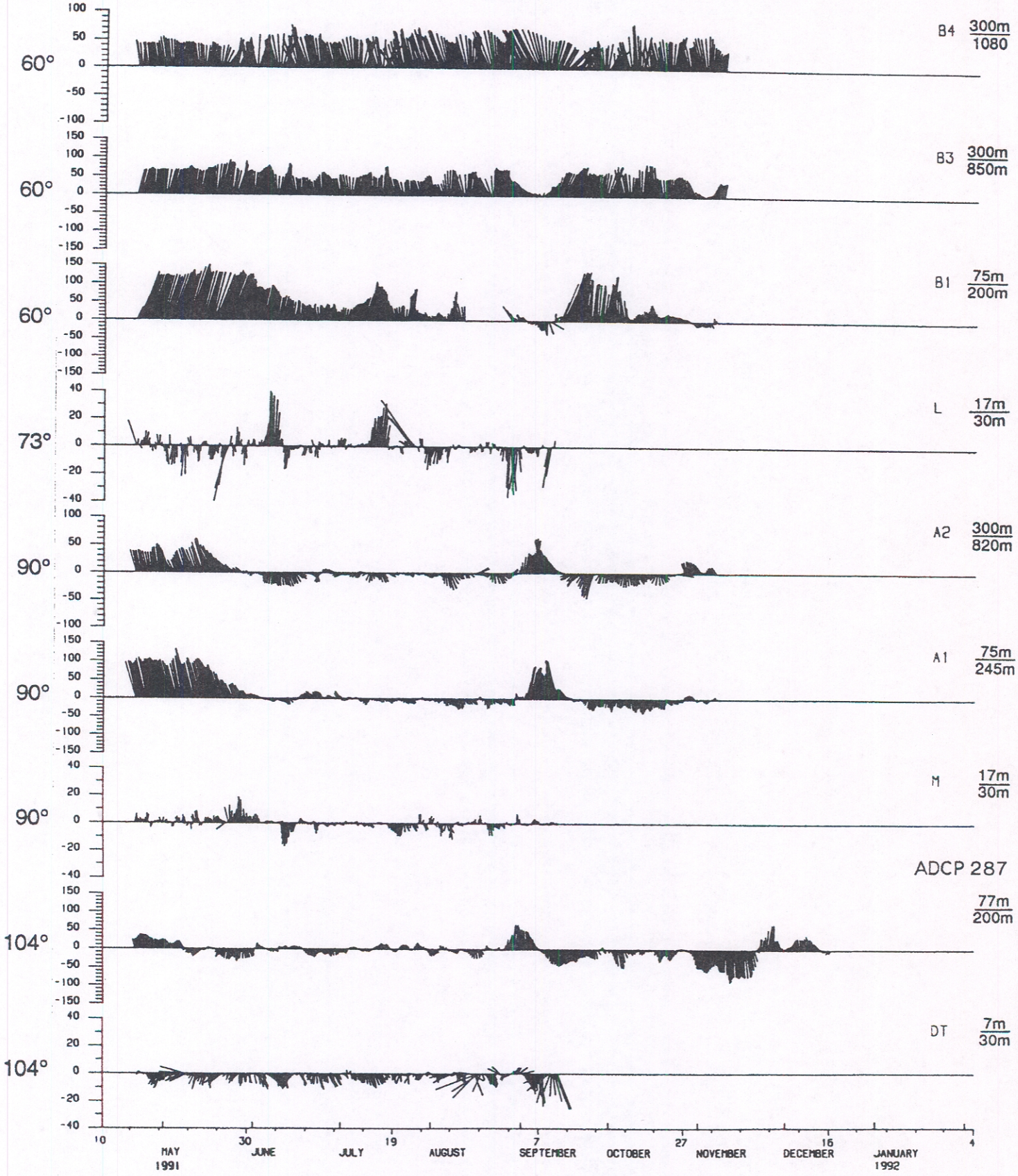


Fig. 14a. Low-frequency current vectors rotated to align with local isobaths for the period May - Dec. 91. Mooring I.D., instrument depth and water depth given to the right, rotation angle given at the left. Current locations are off the Dry Tortugas (DT and ADCP 287), Marquesas (M, A1 and A2), Looe Reef (L, B1, B3 and B4).

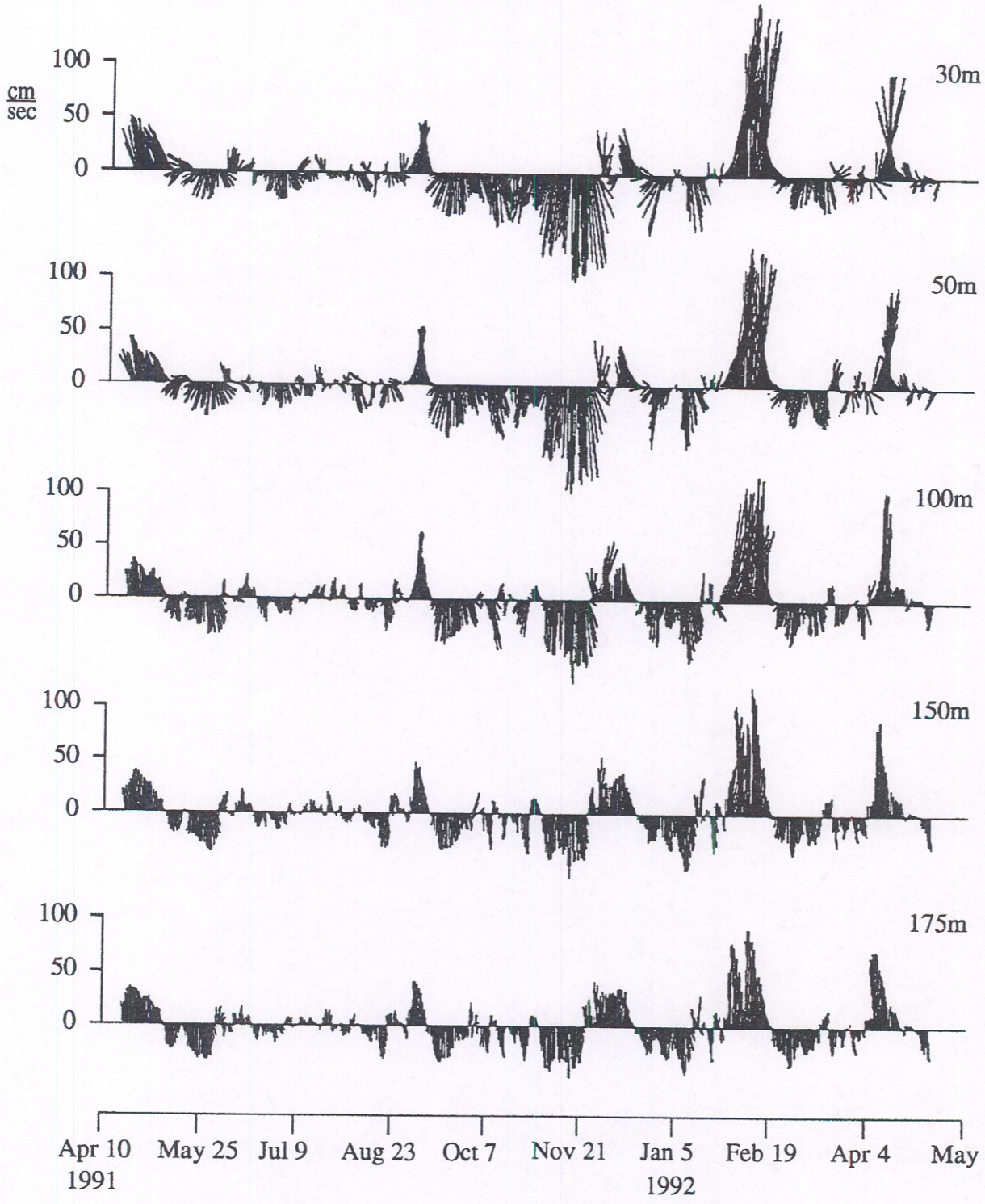


Fig. 14b. Vector time series of low-frequency currents from the ADCP on the 200 m isobath off the Dry Tortugas (DT) for the period April 1991 to May 1992. Vectors have been rotated 104°, water depths are given to the right.

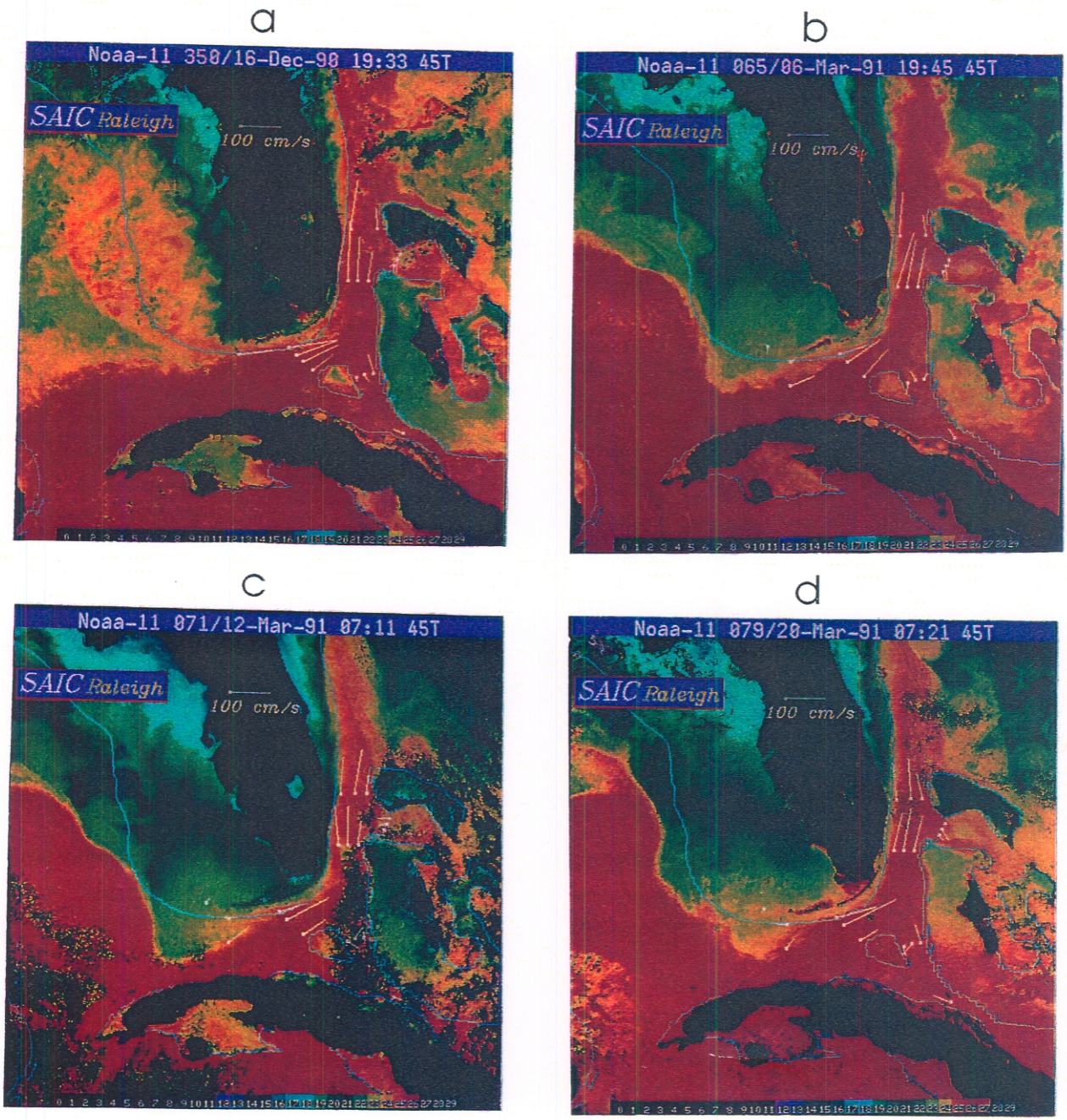


Fig. 15. Surface thermal patterns derived from Satellite AVHRR with upper level low-frequency current vectors superimposed. a) for the period Dec. 16 - 22, 1990, current vectors for 1200 hours Dec. 19; b) March 3 - 9, 1991, current vectors for 1200 hours March 5; c) March 10 - 16, 1991, current vectors for 1200 hours March 12; d) March 17 - 23, 1991, current vectors for 1200 hours March 19.

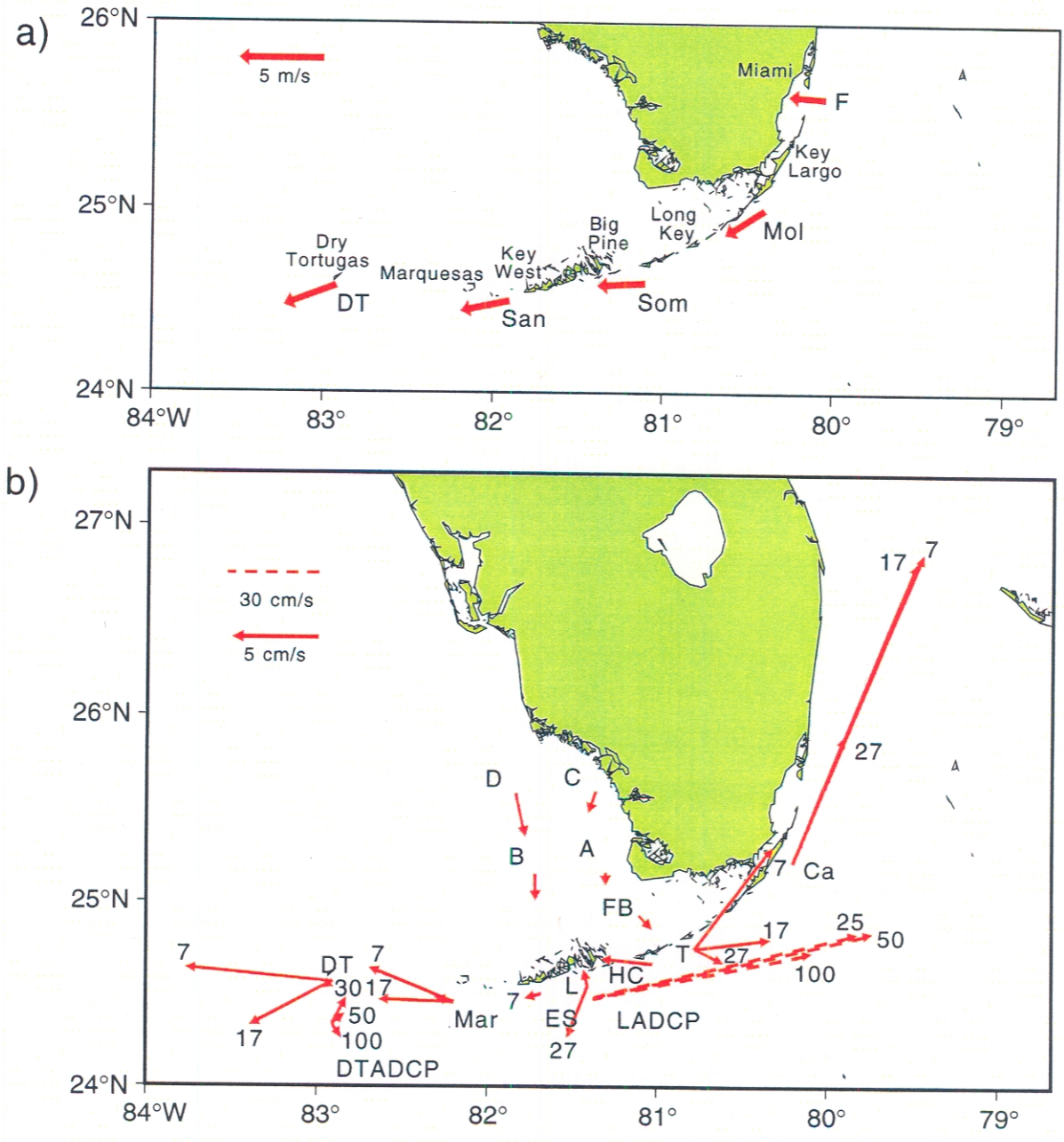


Fig. 16. Mean winds and currents for the period April 1989 to April 1994. Annual means are used except for those stations with fewer than 8 months of data where record lenght means are used (see Table 1). a) Mean wind vectors from CMAN stations at: Dry Tortugas (DT); Sands Key (San); Sombrero Reef (Som); Molasses Reef (Mol); and Fowey Rocks (F). b) Mean current vectors from moored current stations along the 30 m isobath at: Carysfort Reef (C); Tennessee Reef (T); Looe Reef (L); East Sambo (ES); Marquesas (Mar); and Dry Tortugas (DT and from offshore ADCP stations at the Dry Tortugas (DTADCP) and Looe Reef (LADCP). Depths of current records are shown at the end of the arrows.

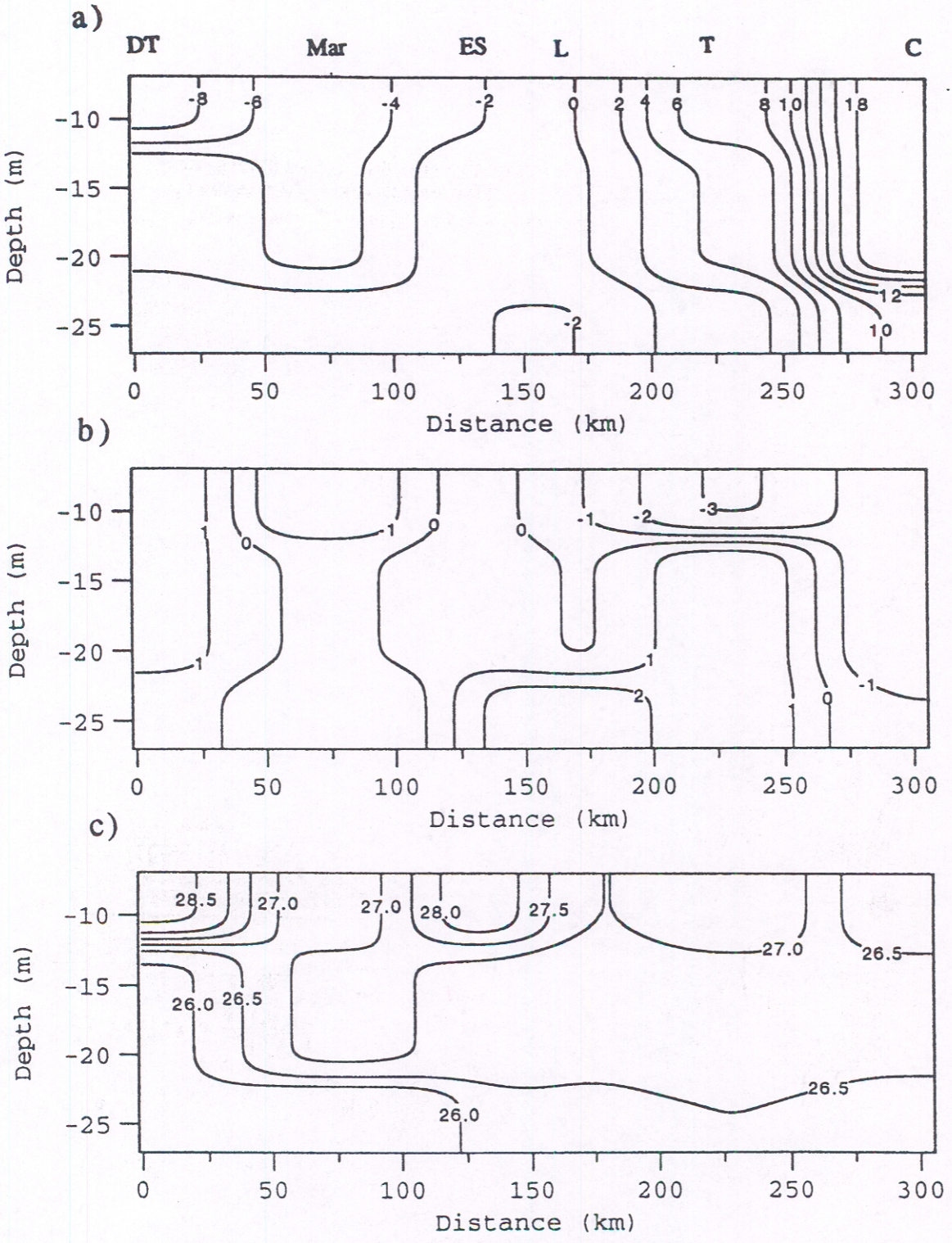


Fig. 17. Alongshore distribution of annual mean: a) alongshore currents (cm/s); b) cross-shore currents (cm/s); c) temperature (C) at the 30m isobath. Position of mooring sites are given at the top using the same identifications as in Fig. 16.

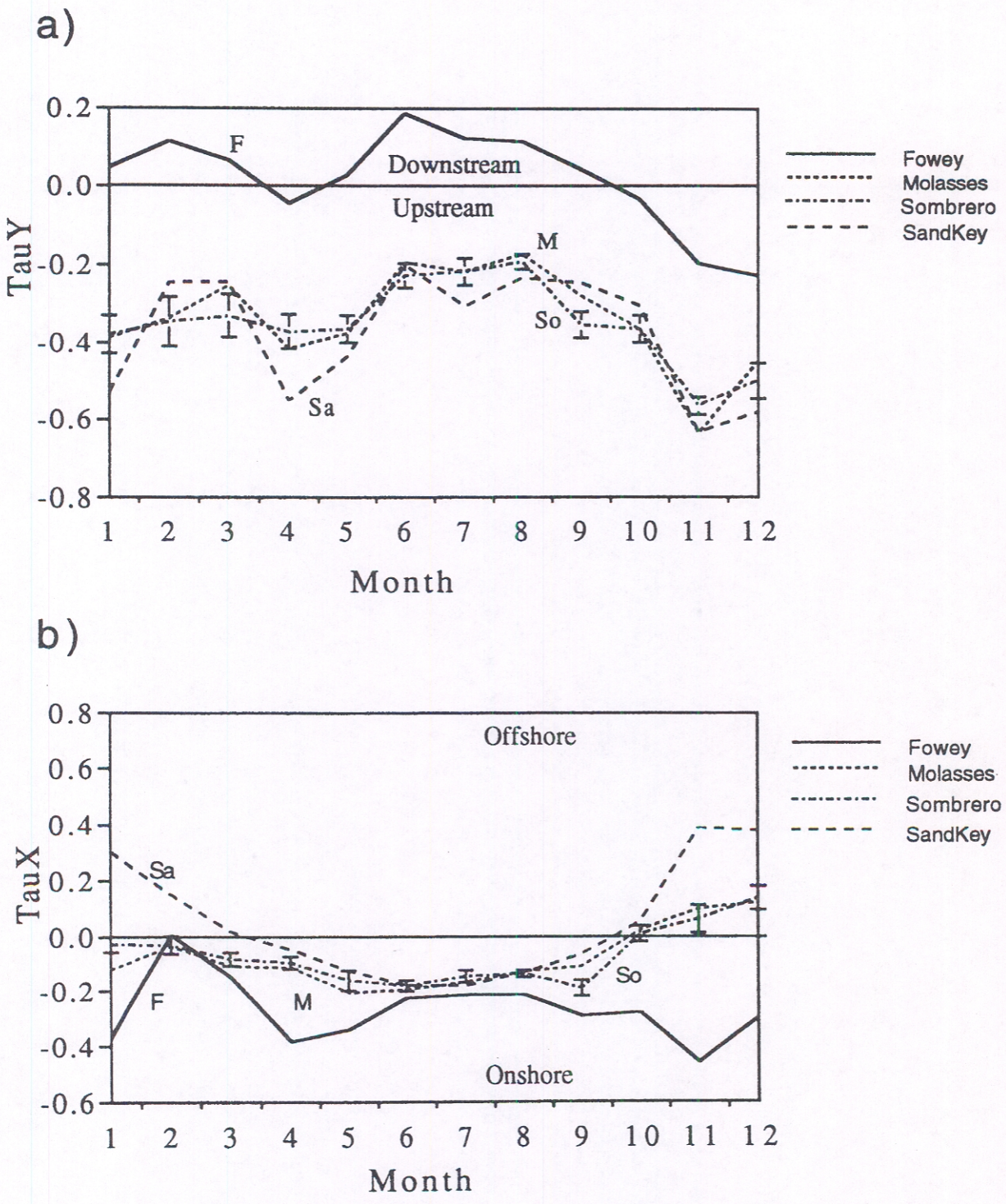


Fig. 18. a) Alongshore and b) cross-shore monthly mean wind stress components from CMAN wind stations, site identifications are the same as in Fig. 16.

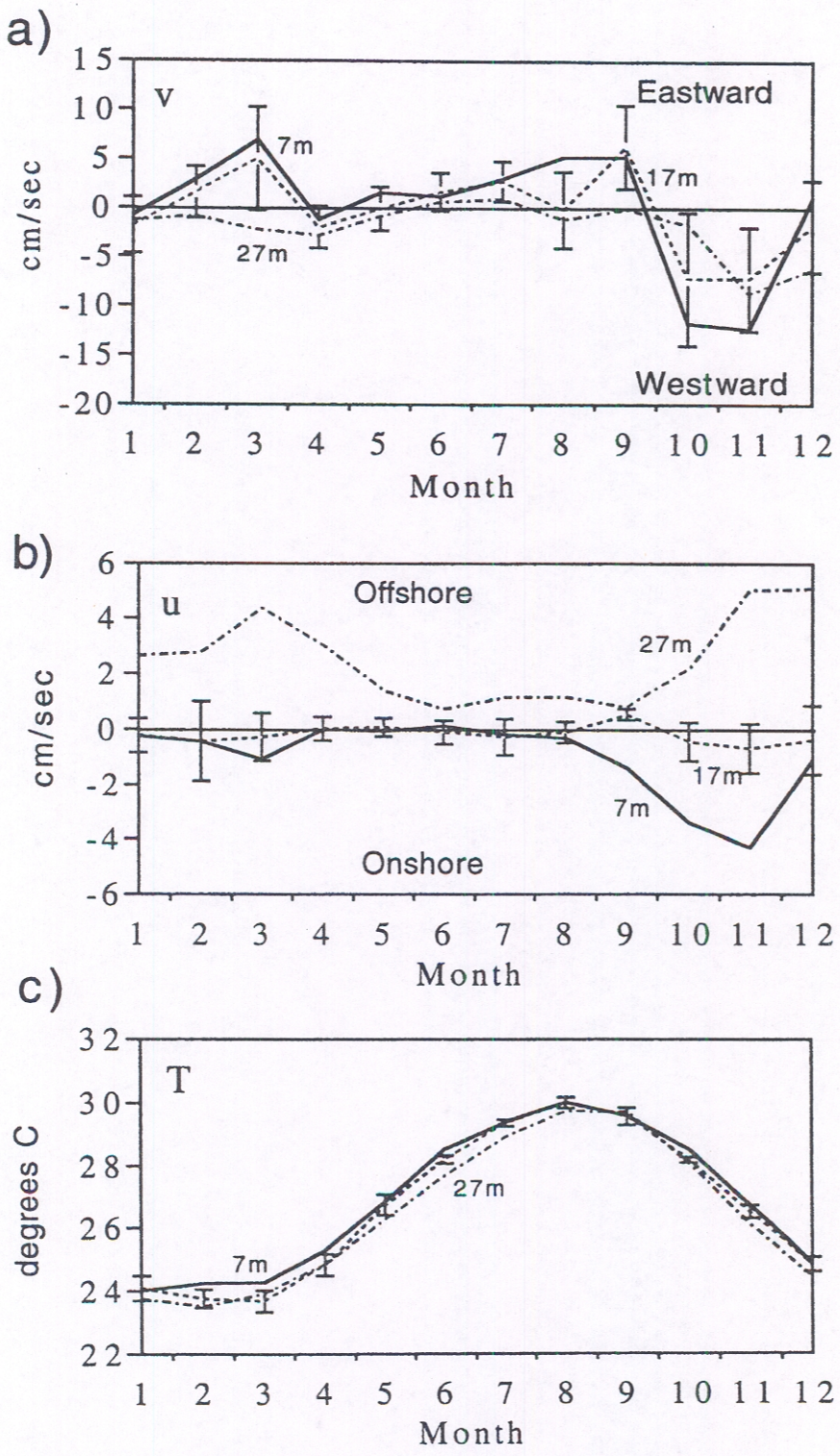


Fig. 19. Monthly mean a) alongshore currents, b) cross-shore currents and c) temperature from the Looe Reef coastal mooring site from April 89 to April 94. Error bars display the standard error of the means.

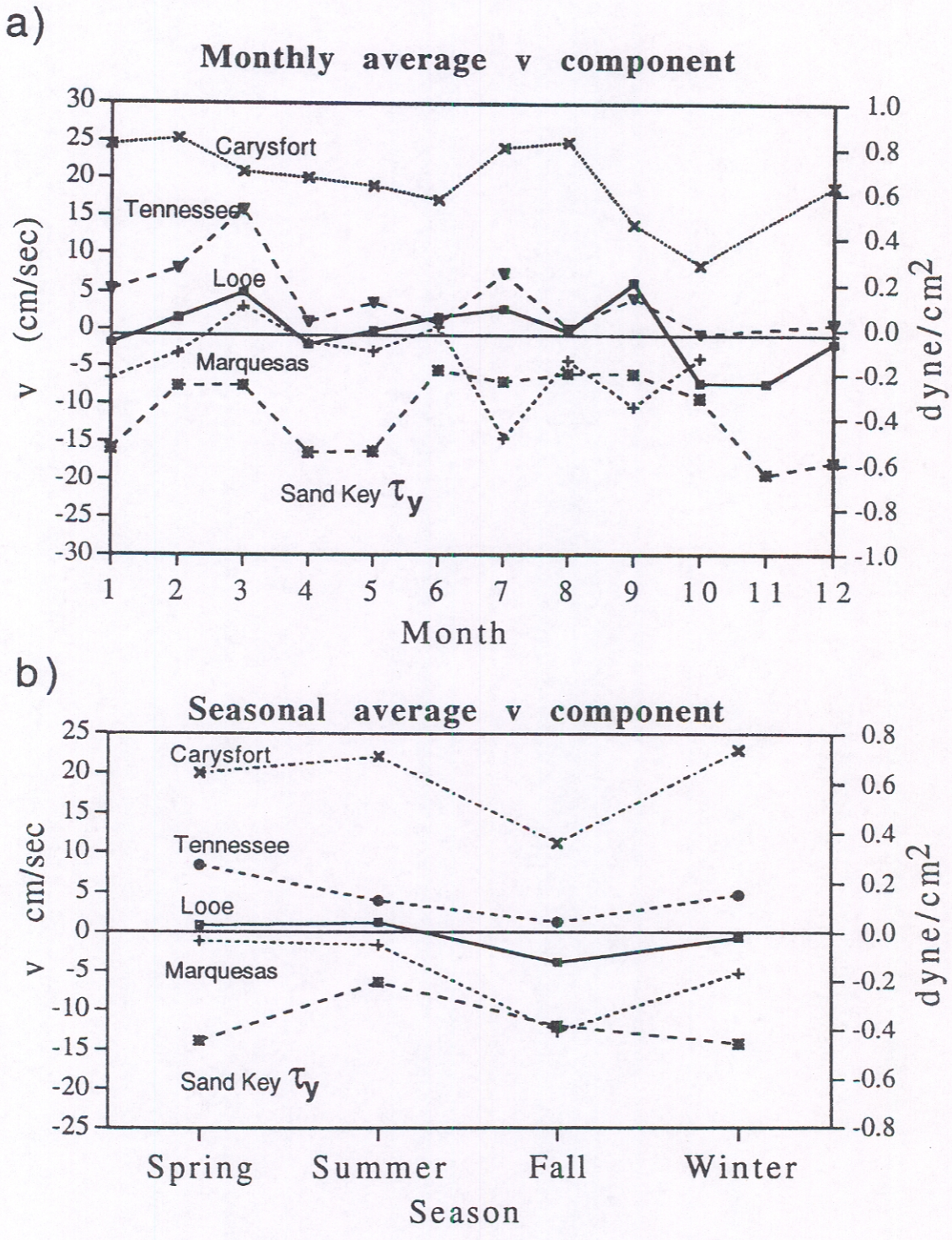


Fig. 20. Monthly a) and seasonal b) averaged alongshore currents from upper level current meters at Keys shelfbreak current meter moorings and Sand Key CMAN alongshore wind stress for 5-year period April 1989 - April 1994.

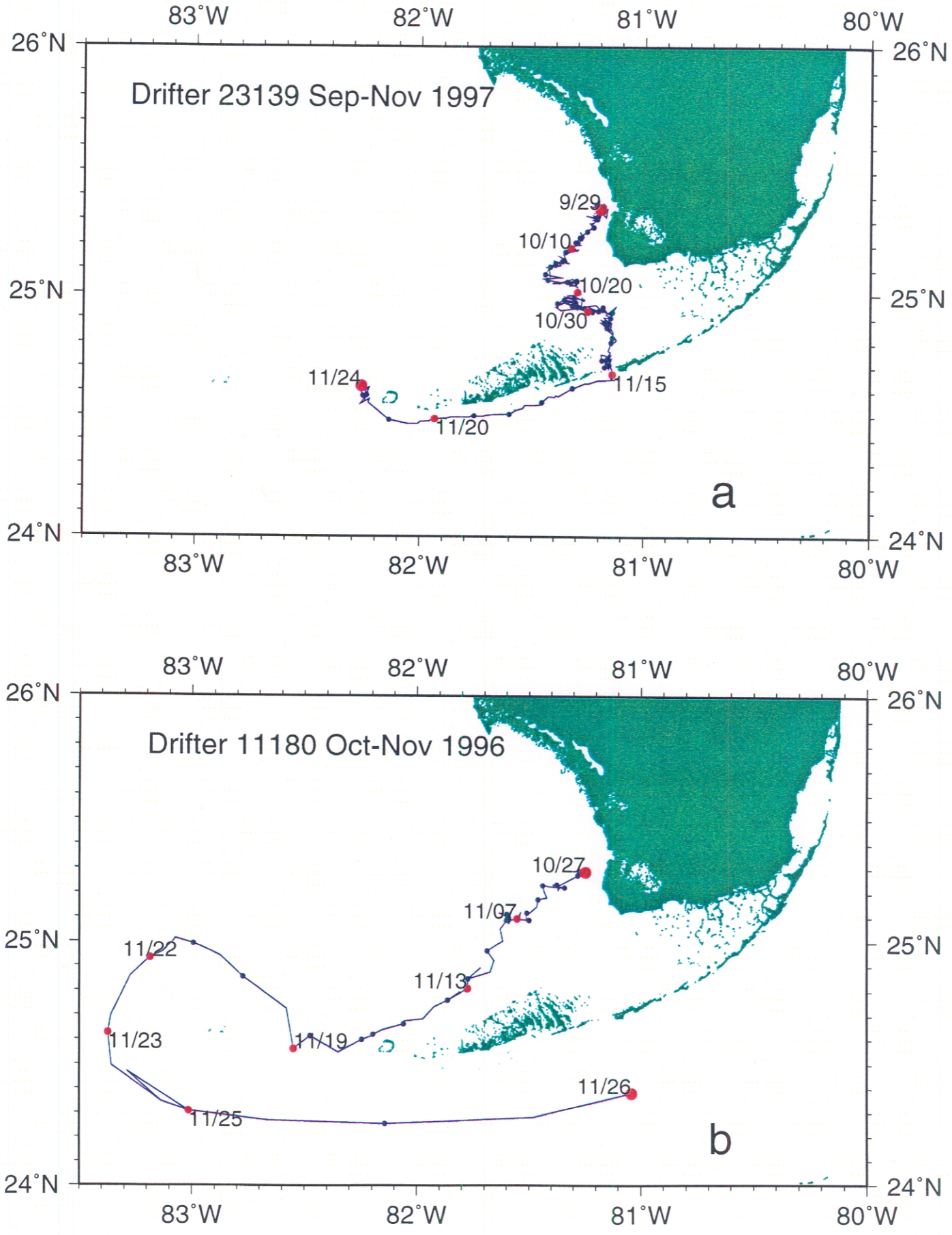


Fig. 21. Surface drifter trajectories **a**) Sept. 29 to Nov. 24, 1997; **b**) Oct. 26 to Dec. 17, 1996

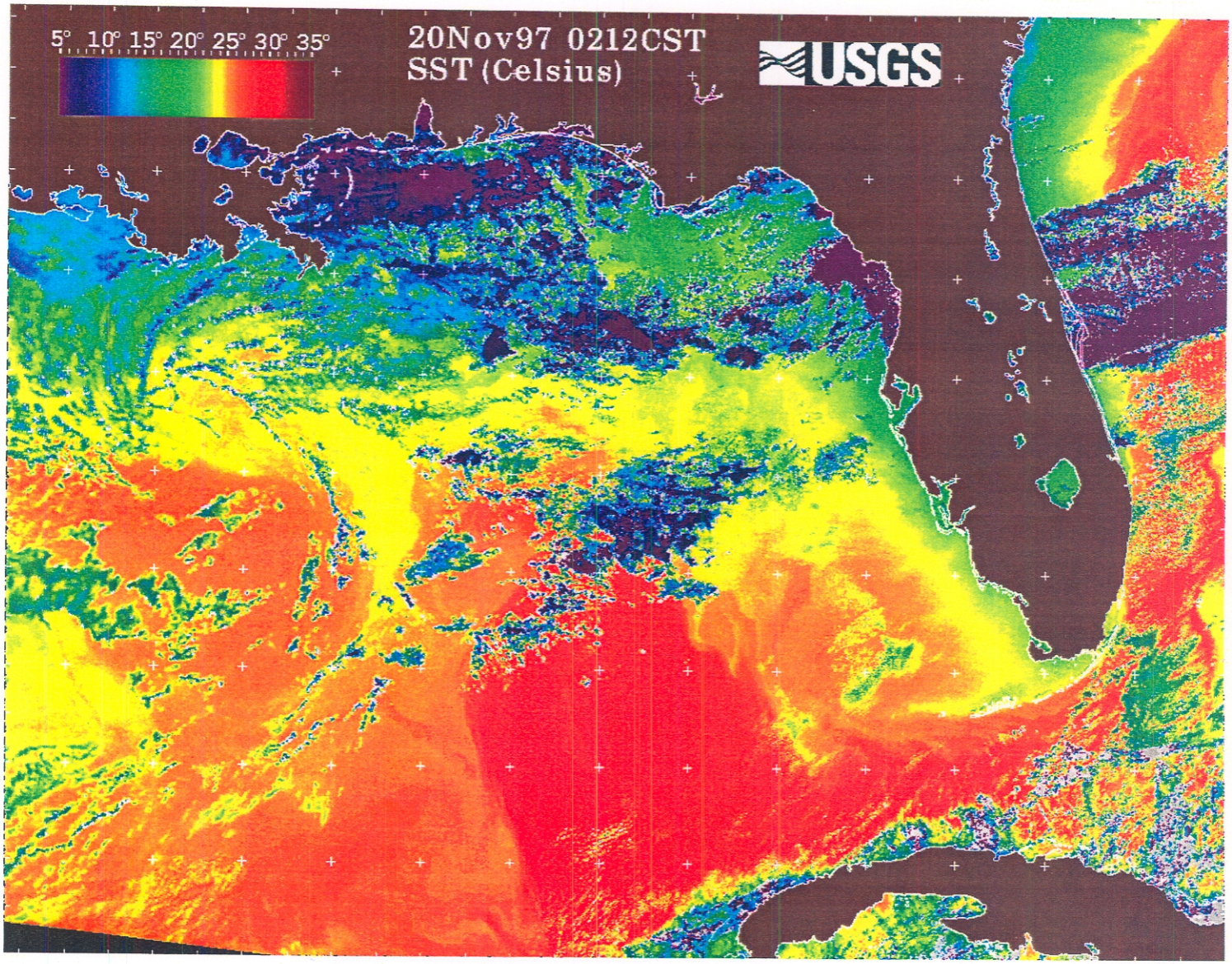


Fig. 22. Surface thermal image from AVHRR Nov. 20, 1997 indicating westward counter current south of the Keys similar to the drifter track shown in Fig. 21a. Thermal image copied from USGS web site.

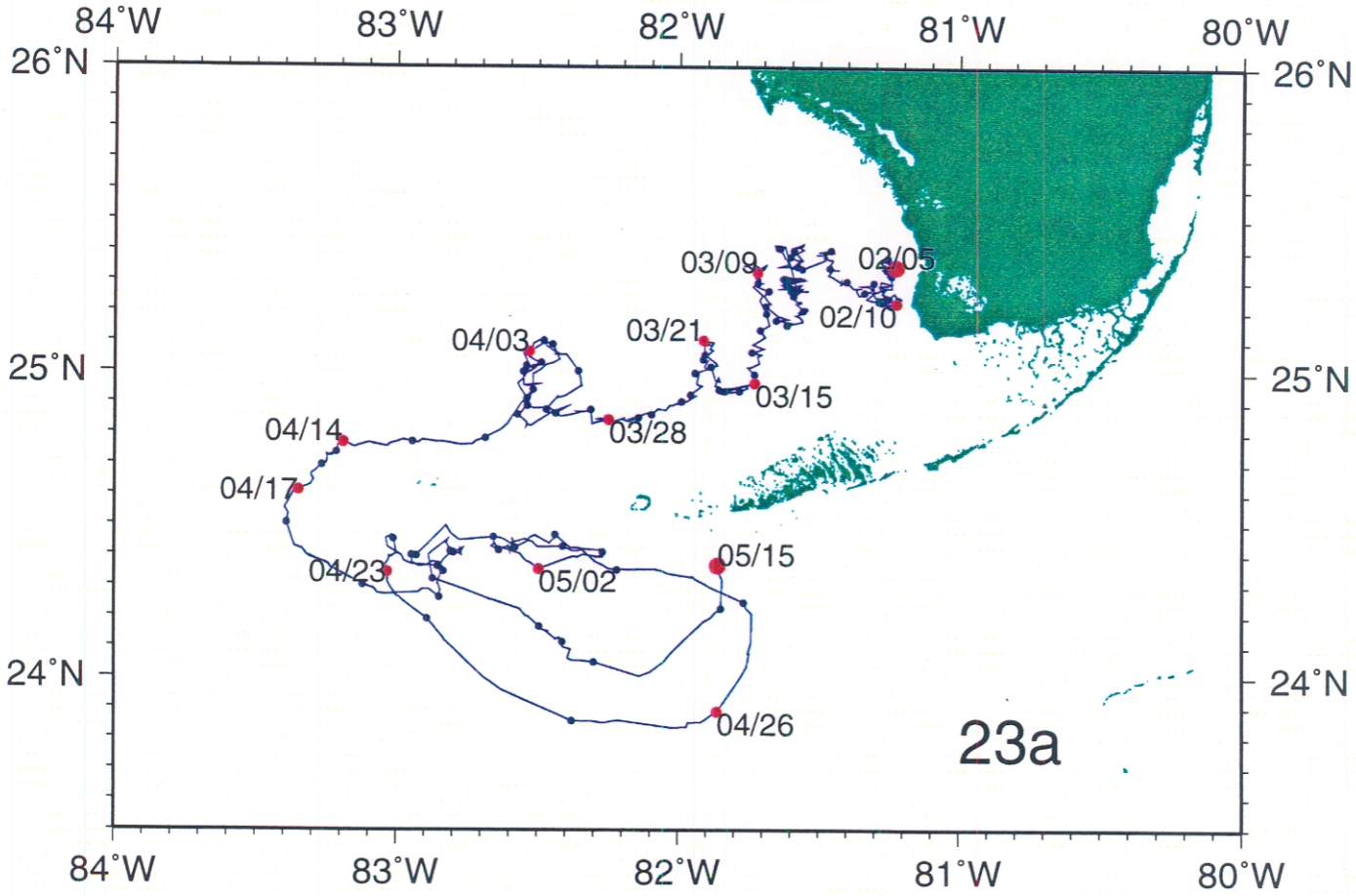


Fig. 23a. Surface drifter trajectory of Feb. 5 to May 15, 1998.

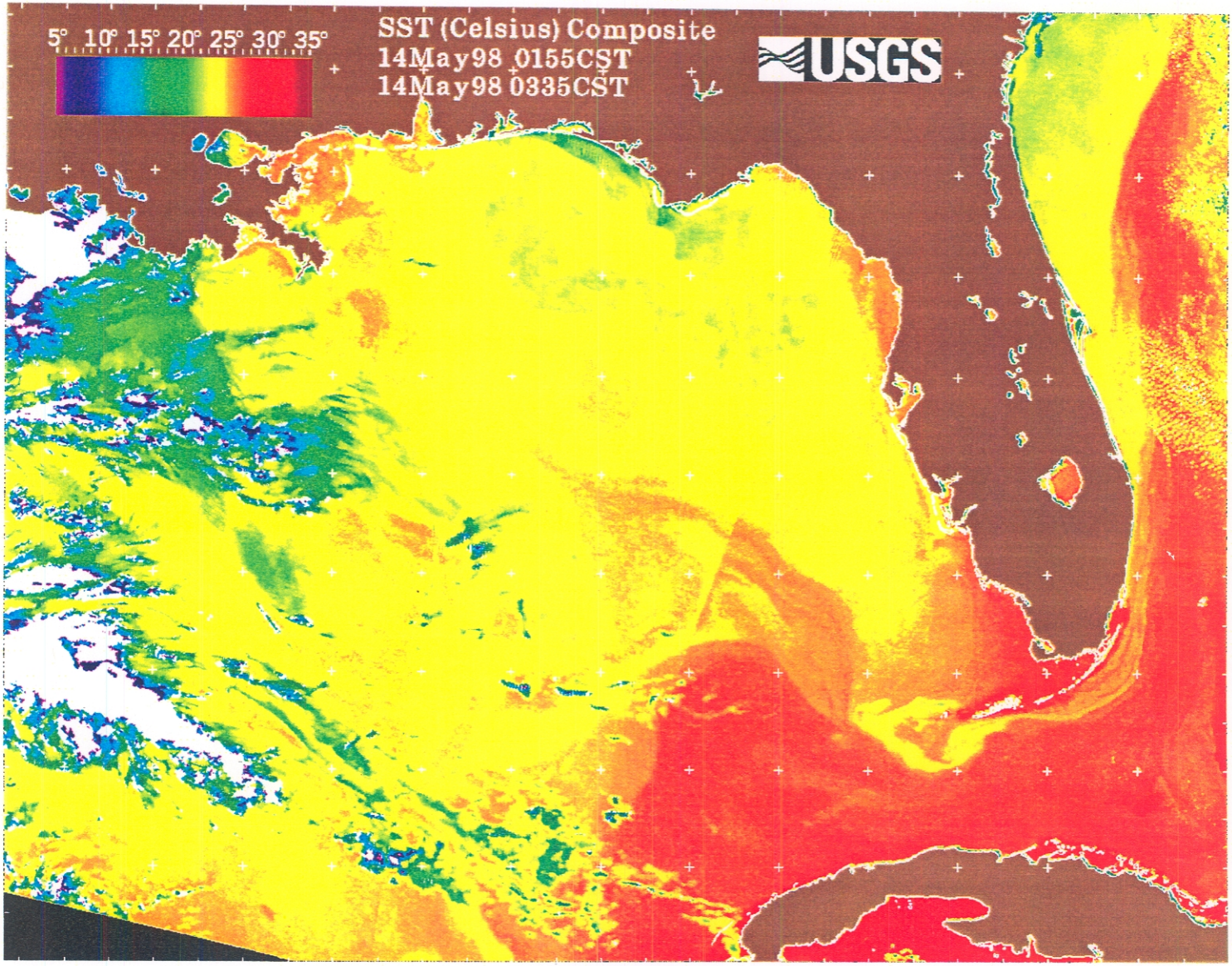


Fig. 23b. Surface thermal image from AVHRR OF 5/14/98 showing cold, cyclonic gyre south of the Keys that causing recirculation pattern of the drifter of Fig. 23a. Thermal image copied from USGS web site.

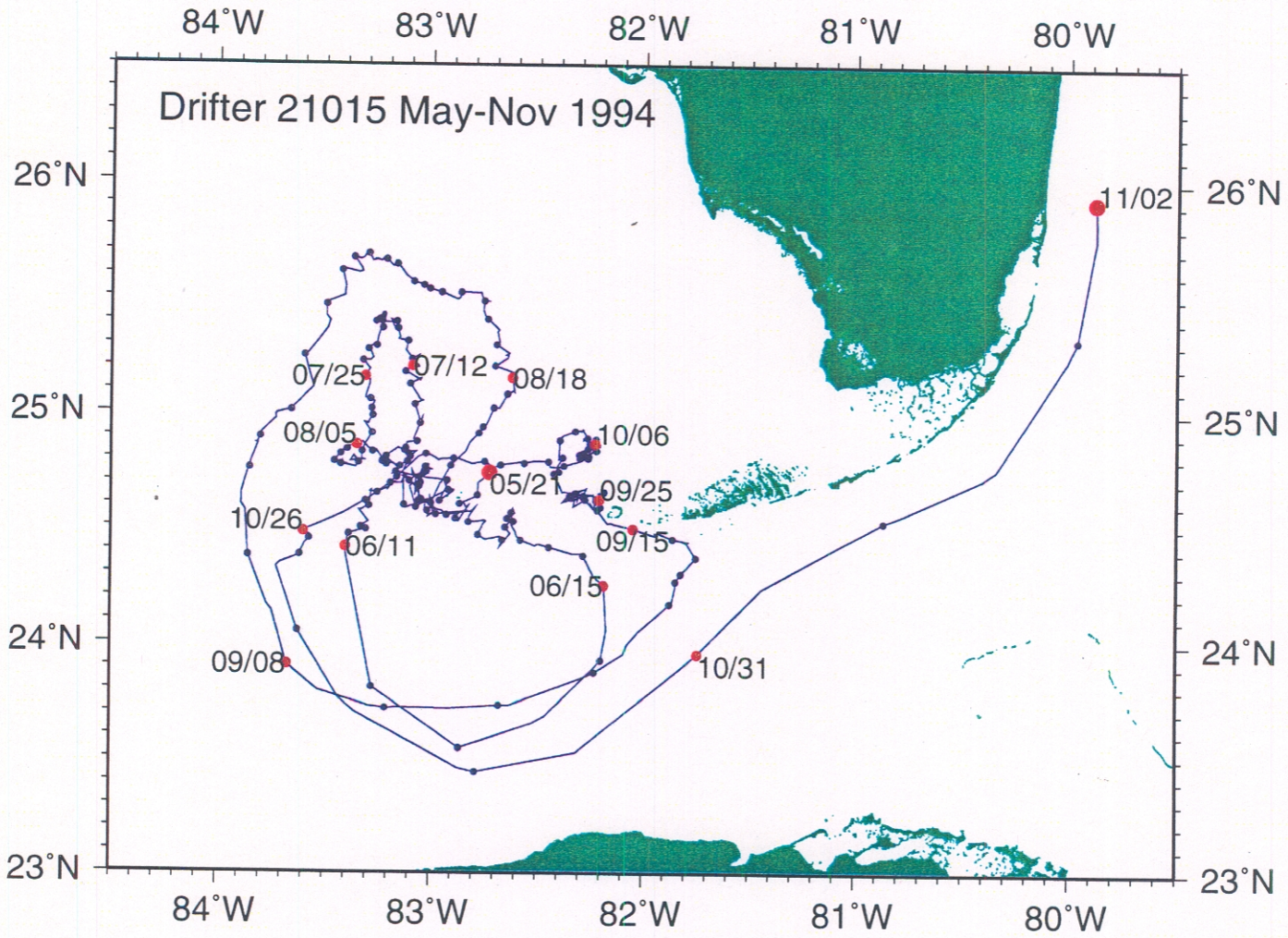


Fig. 24. Surface drifter track of May 21 to Nov. 2, 1994.

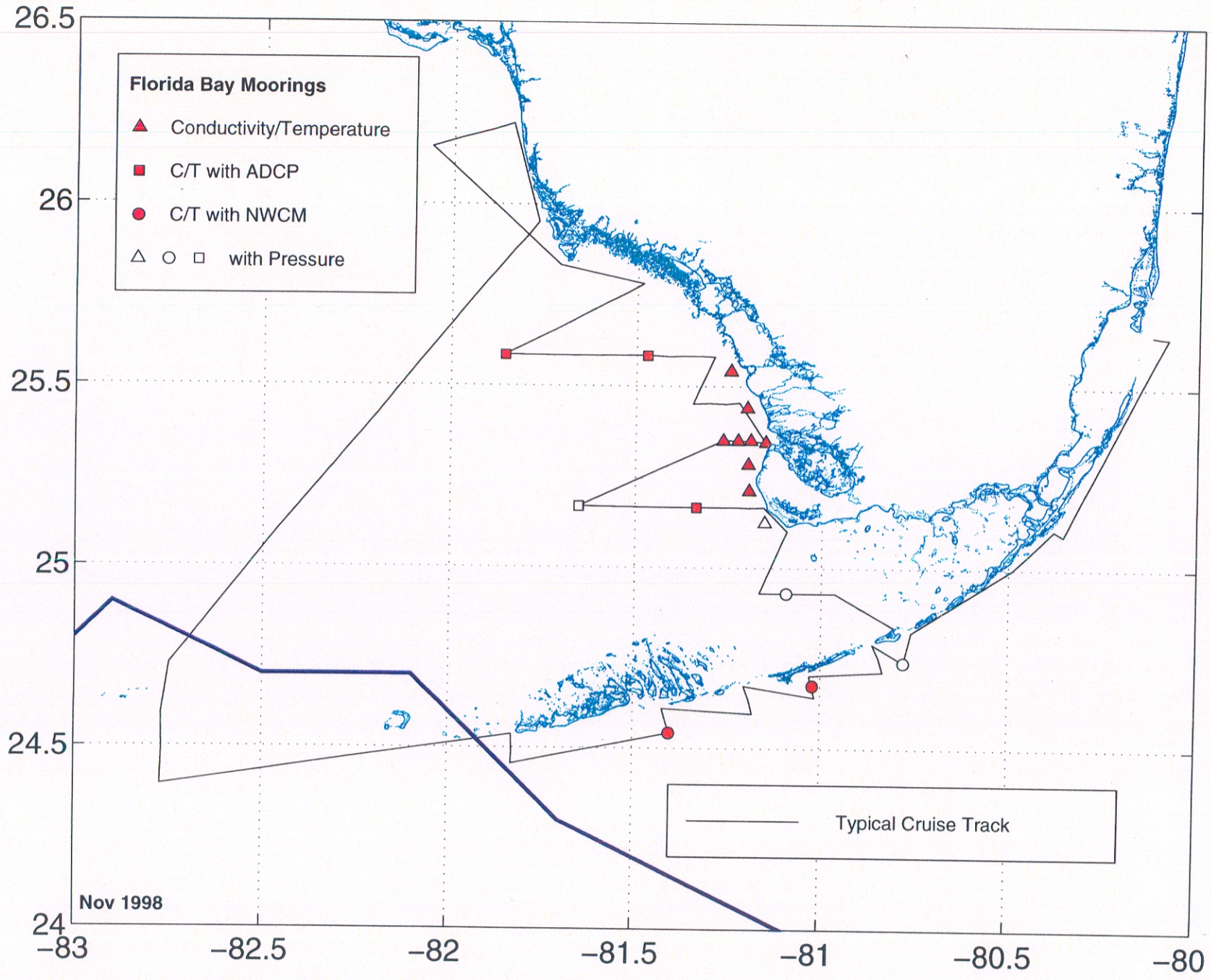


Fig. 25. Ongoing measurements of the Florida Bay Circulation and Exchange Study, part of the NOAA South Florida Ecosystem Restoration, Prediction and Modeling Program. Moored array deployed Sept. 21, 1997 for two year period. Heavy blue line is track of hurricane Georges on Sept. 24 and 25, 1998. RV Calanaus track shown by light black line. Small boat track inside Florida Bay not shown.

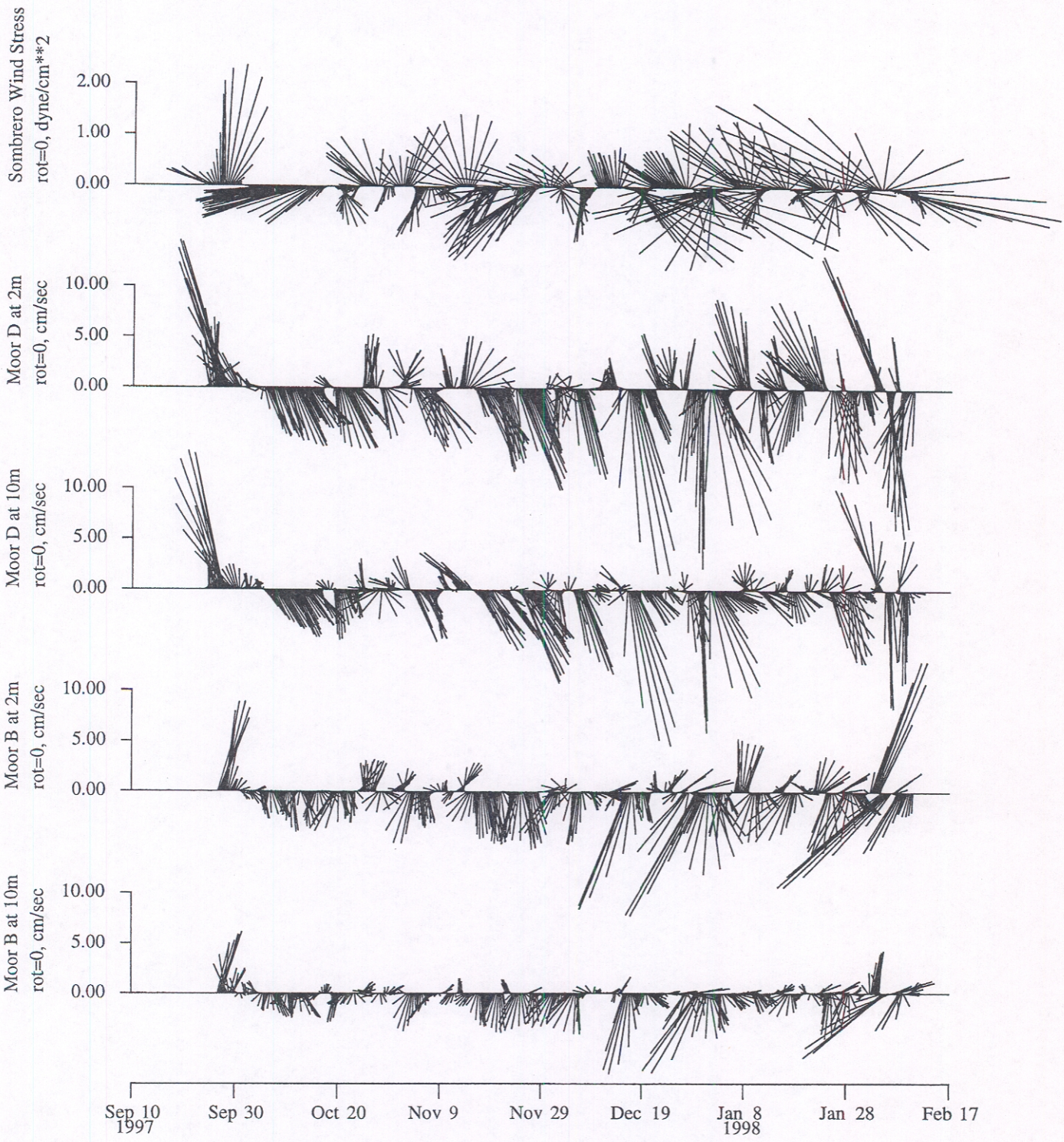


Fig. 26. Vector time series of 40 hour low-pass filtered currents (cm/s) from ADCP's B and D (Fig. 25) and Sombrero CMAN wind stress (dyne/cm2) for a five month period Sept. 1997 to Feb. 1998. Observation depths are given to the left of each time series.

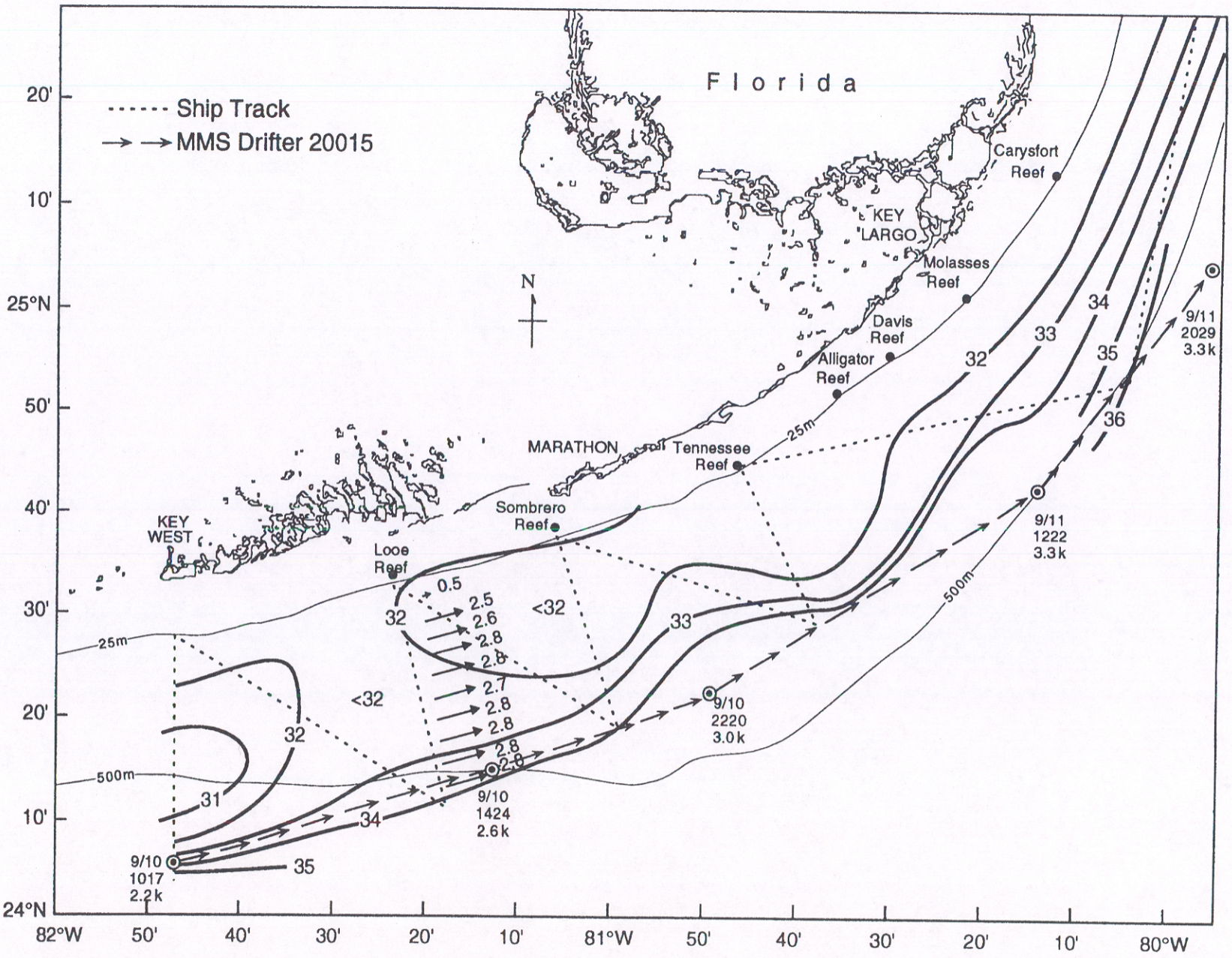


Fig. 27. Surface salinity (psu) from continuous thermosalinograph on the R/V Columbus Iselin for the period Sept. 10-13, 1993. Near surface current vectors from shipboard ADCP are shown on the section south of Looe Reef, and the trajectory of MMS satellite tracked surface drifter #20015 is superimposed. Date, time and current speed are given at drifter locations.

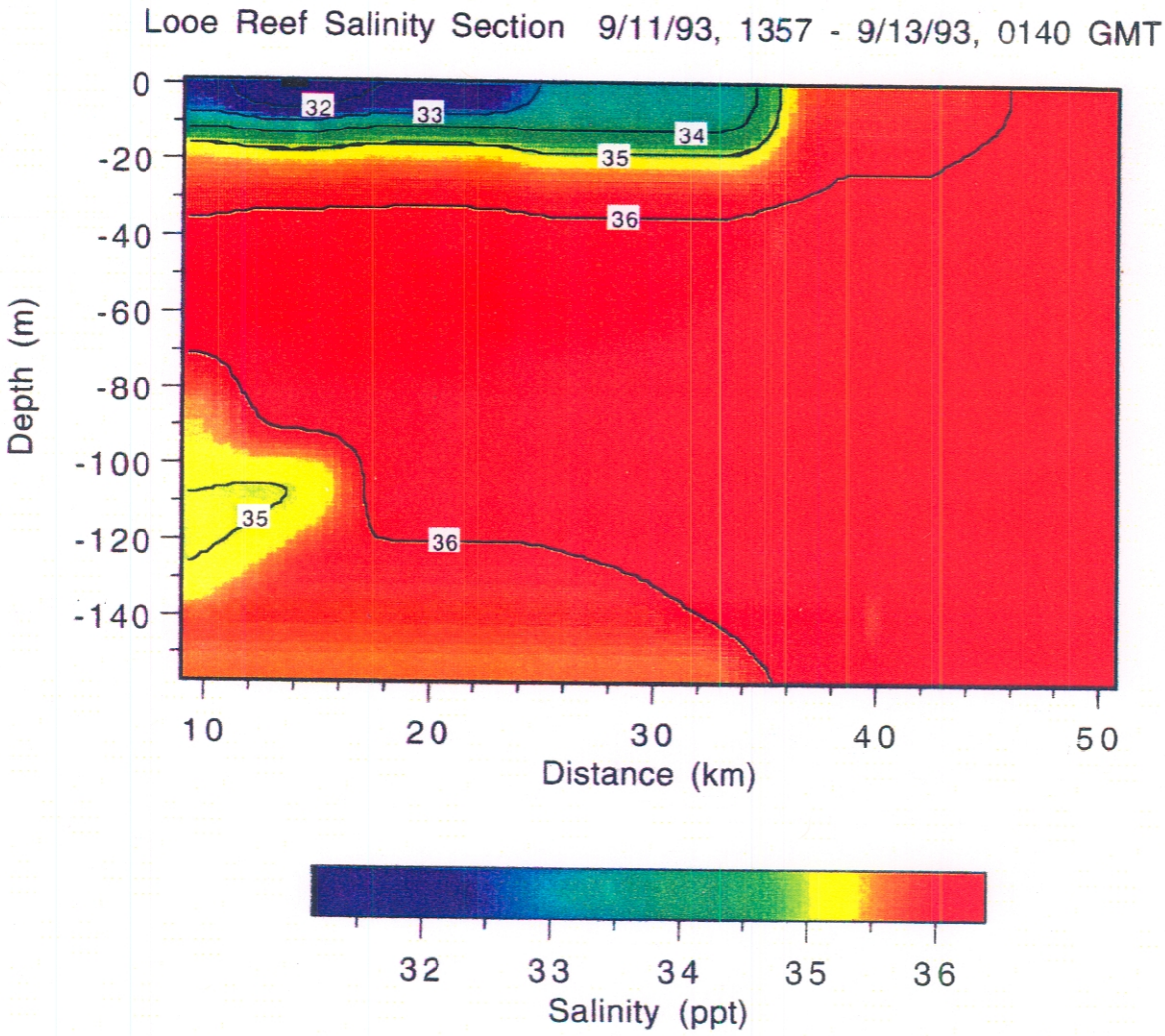


Fig. 28. Salinity section made along transect south of Looe Reef on Sept. 11-13, 1993.

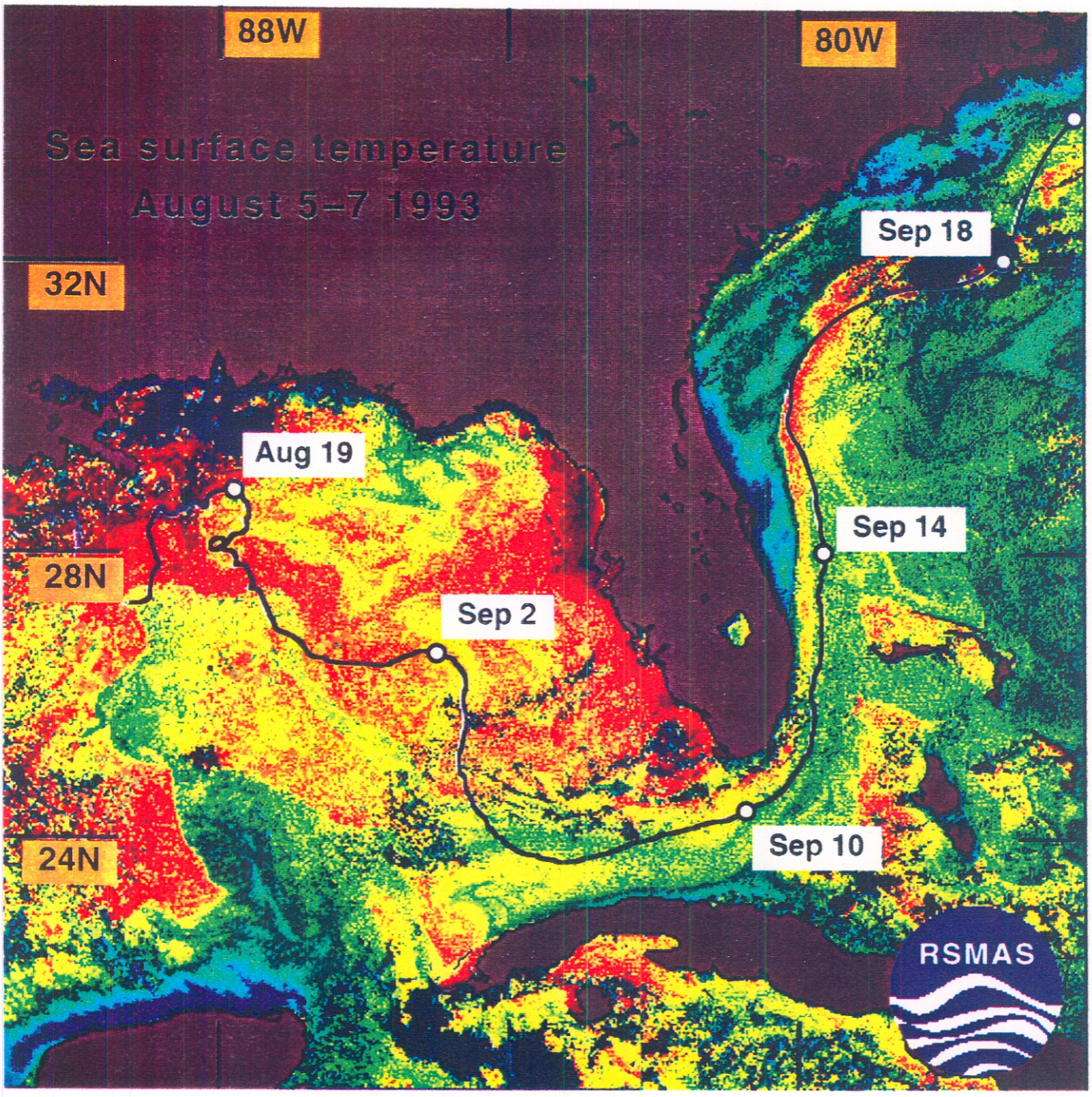


Fig. 29. Sea surface temperature patterns derived from a composite of AVHRR satellite thermal imagery for the period August 5-7, 1993. Red represents relatively warmer temperatures, green cooler and blue still colder. Superimposed on the temperature field is a segment of the trajectory of MMS drifter # 20015, originally deployed on the Texas shelf by Dr. Walter Johnson of MMS and Dr. P. Niiler of Scripps and shown in Fig. 27.

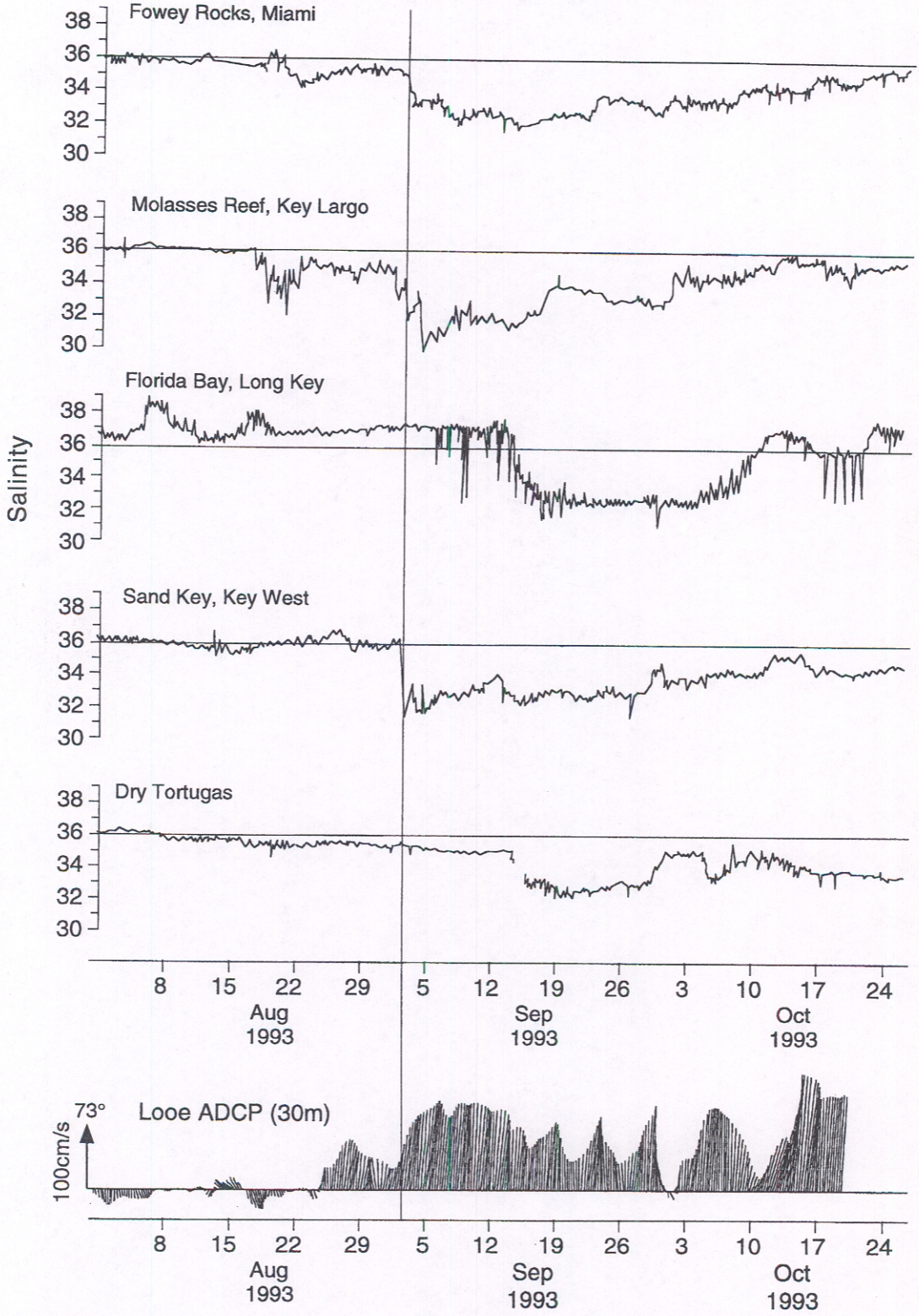


Fig. 30. Salinity (psu) records from offshore C-MAN towers for the period Aug. 1 to Oct. 26, 1993. Salinity records have been verified through CTD casts. Shown in the lower panel is a times series from a bottom mounted ADCP off Looe Reef at a bin level of 30 m for the period Aug. 1 to Oct. 20, 1993. The event line (vertical line) is drawn to identify the onshore meander of the FC front and the simultaneous drop in salinities at Molasses, Fowey Rocks and Sands Key CMAN stations.

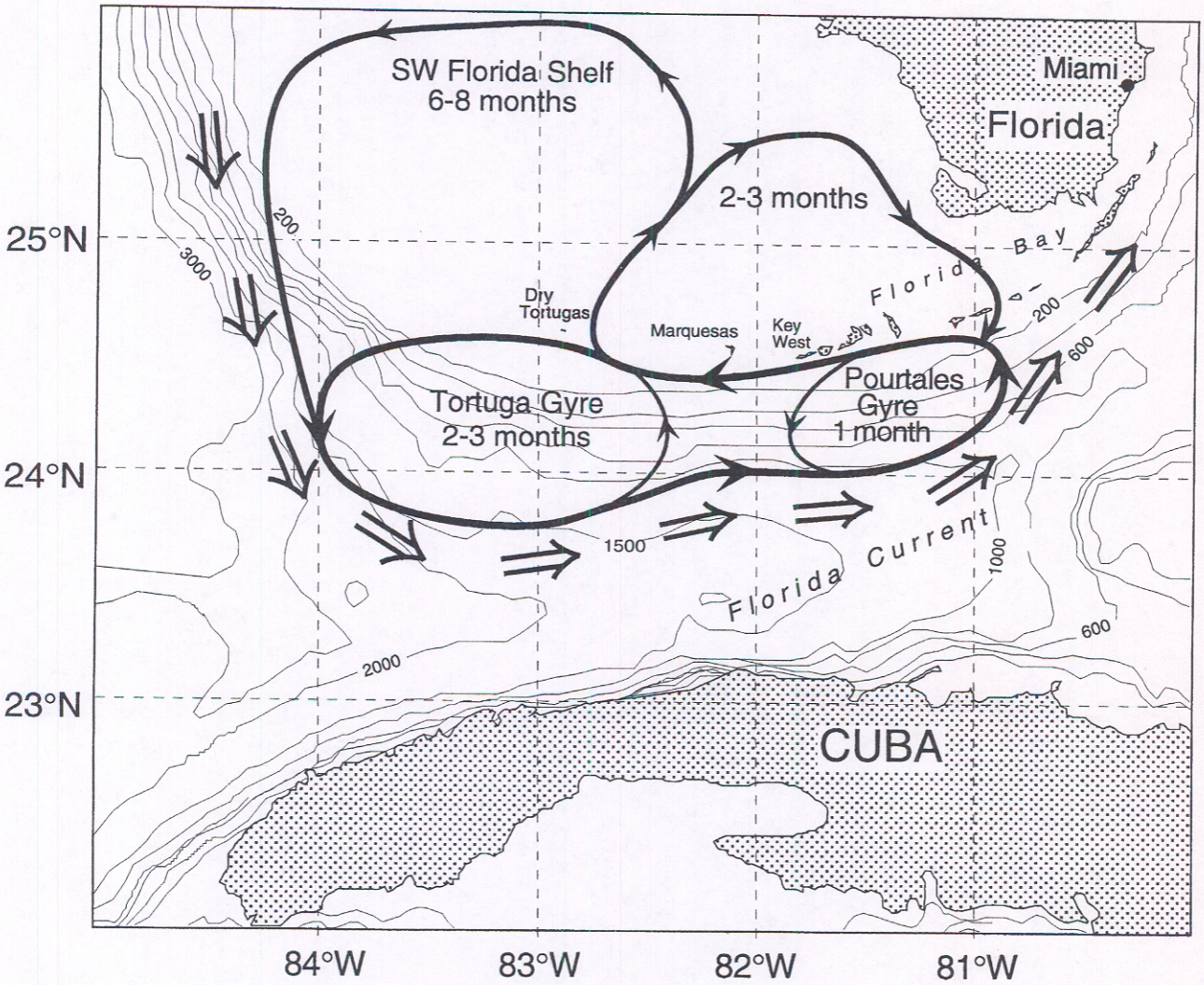


Fig. 31. Schematic of possible recruitment pathways for fish and lobster larvae spawned locally in the Dry Tortugas and Florida Keys.

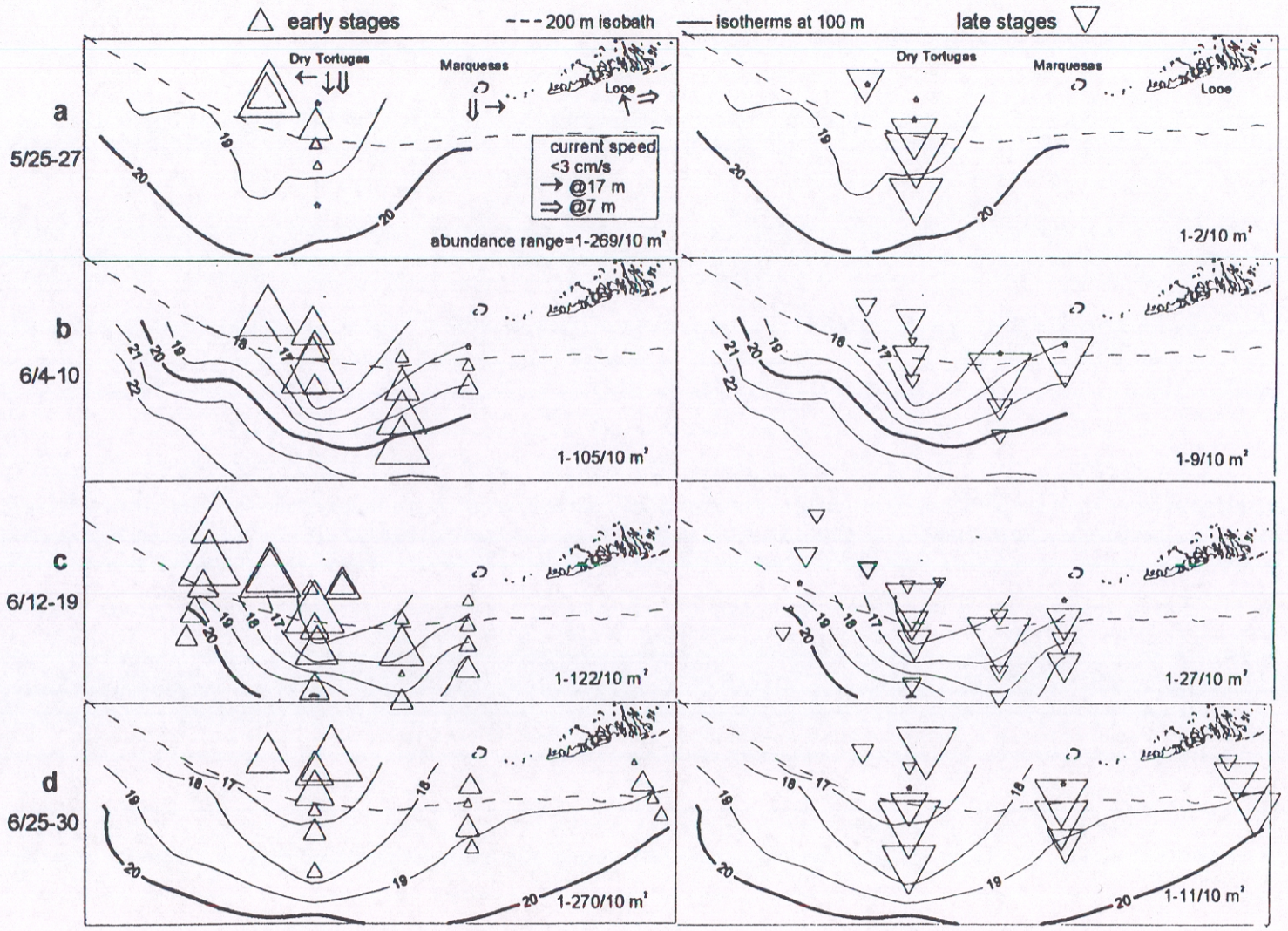


Fig. 32. Distribution of early and late stages of spiny Lobster larvae concentrations in the Dry Tortugas region May - June 1991 (courtesy of Cynthia Yeung from Yeung, 1996).

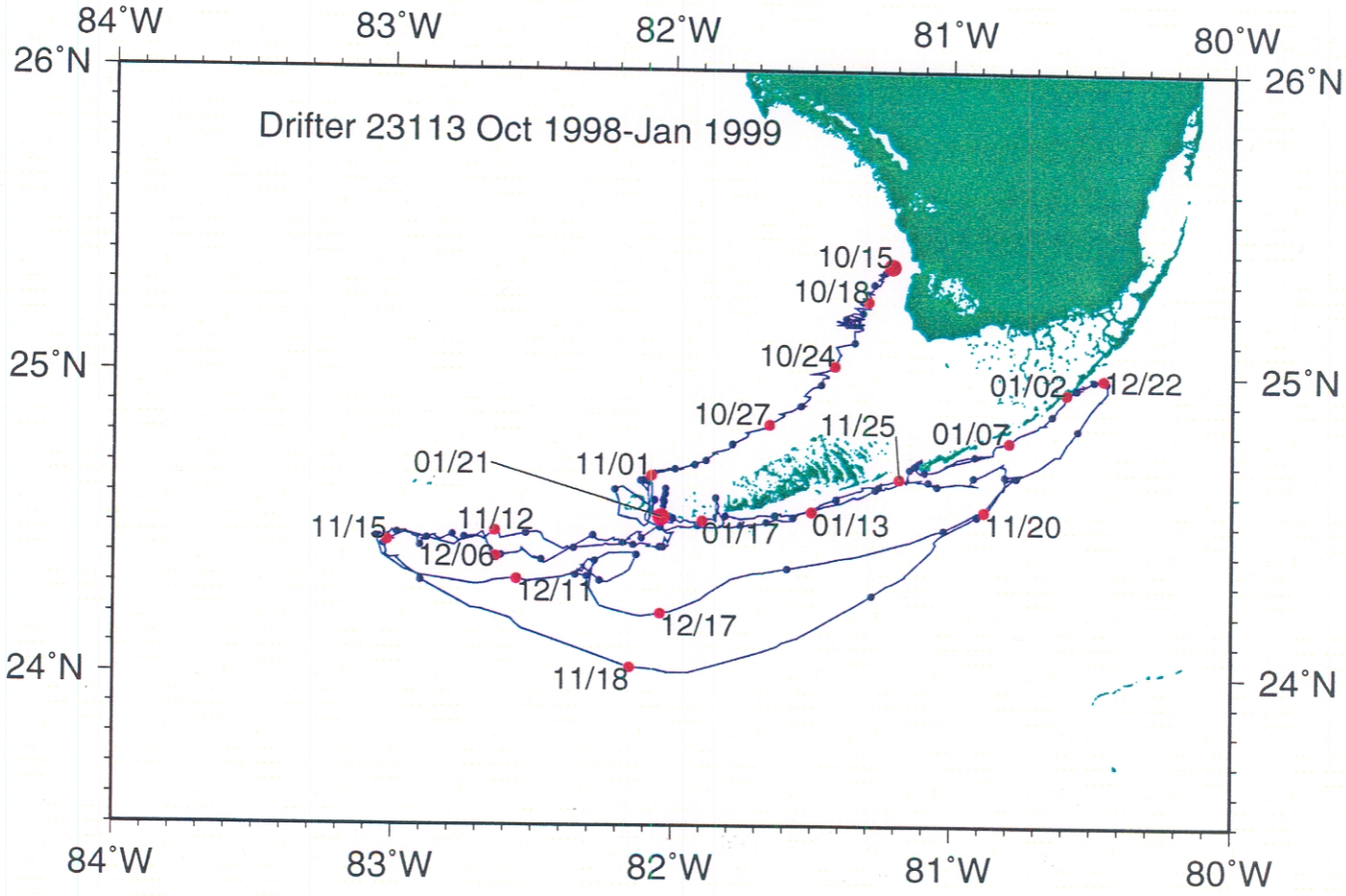


Fig. 33. Surface drifter track of Oct. 15, 1998 to Jan. 21, 1999.

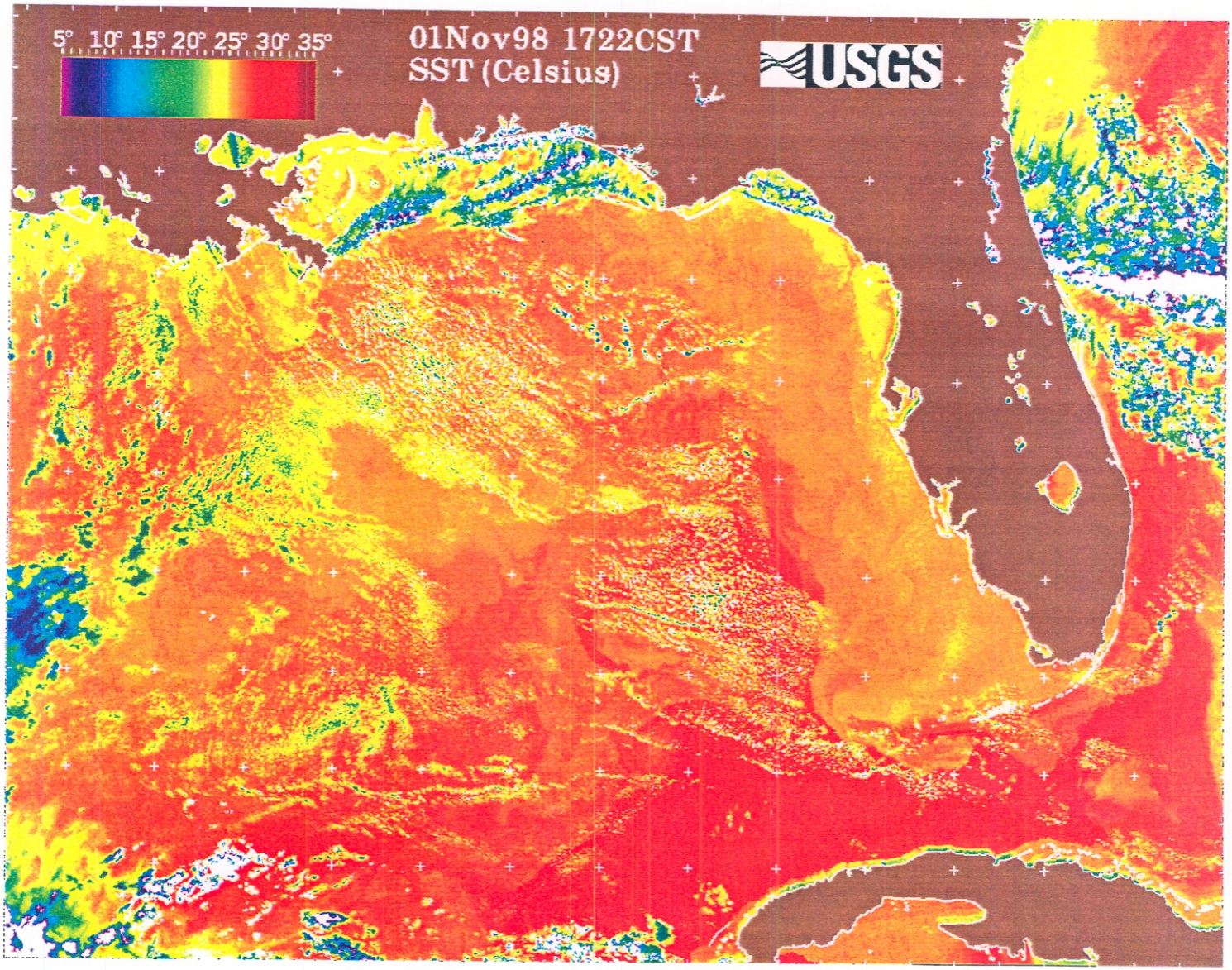


Fig. 34a. Surface thermal image from AVHRR OF 11/1/98 showing three Tortugas eddies located off the Marquesas Keys, Marathon and Key Largo. The eddy off the Marquesas influenced the westward movement of drifter 23113 during this period. Thermal image copied from USGS web site.

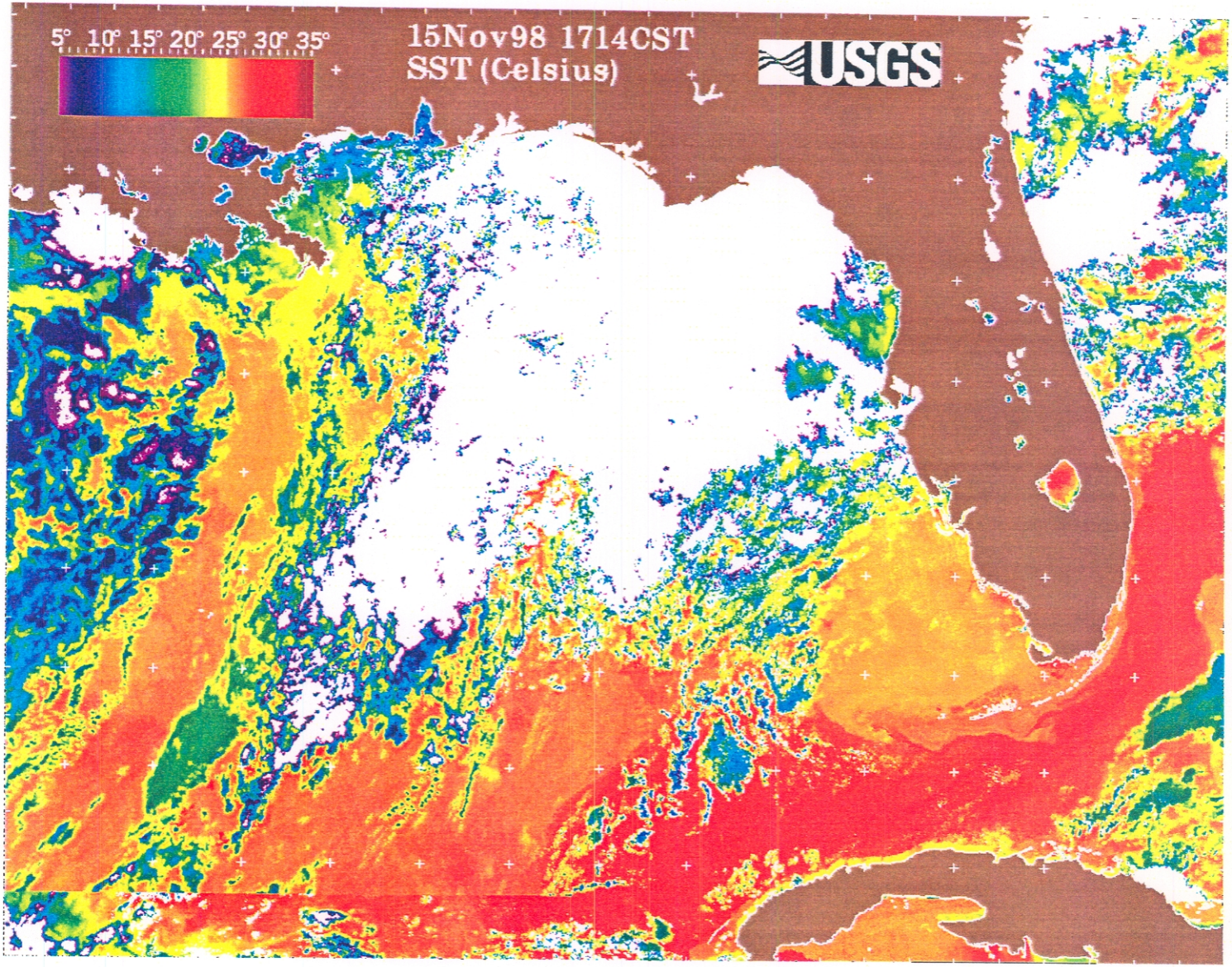


Fig. 34b. Surface thermal image from AVHRR OF 11/15/98. The three eddies shown in Fig. 34a have moved eastward and decreased in size. Recirculation of drifter 23113 into the coastal zone near Long Key appears aided by the smaller sized eddy circulations present at this time. Thermal image copied from USGS web site.

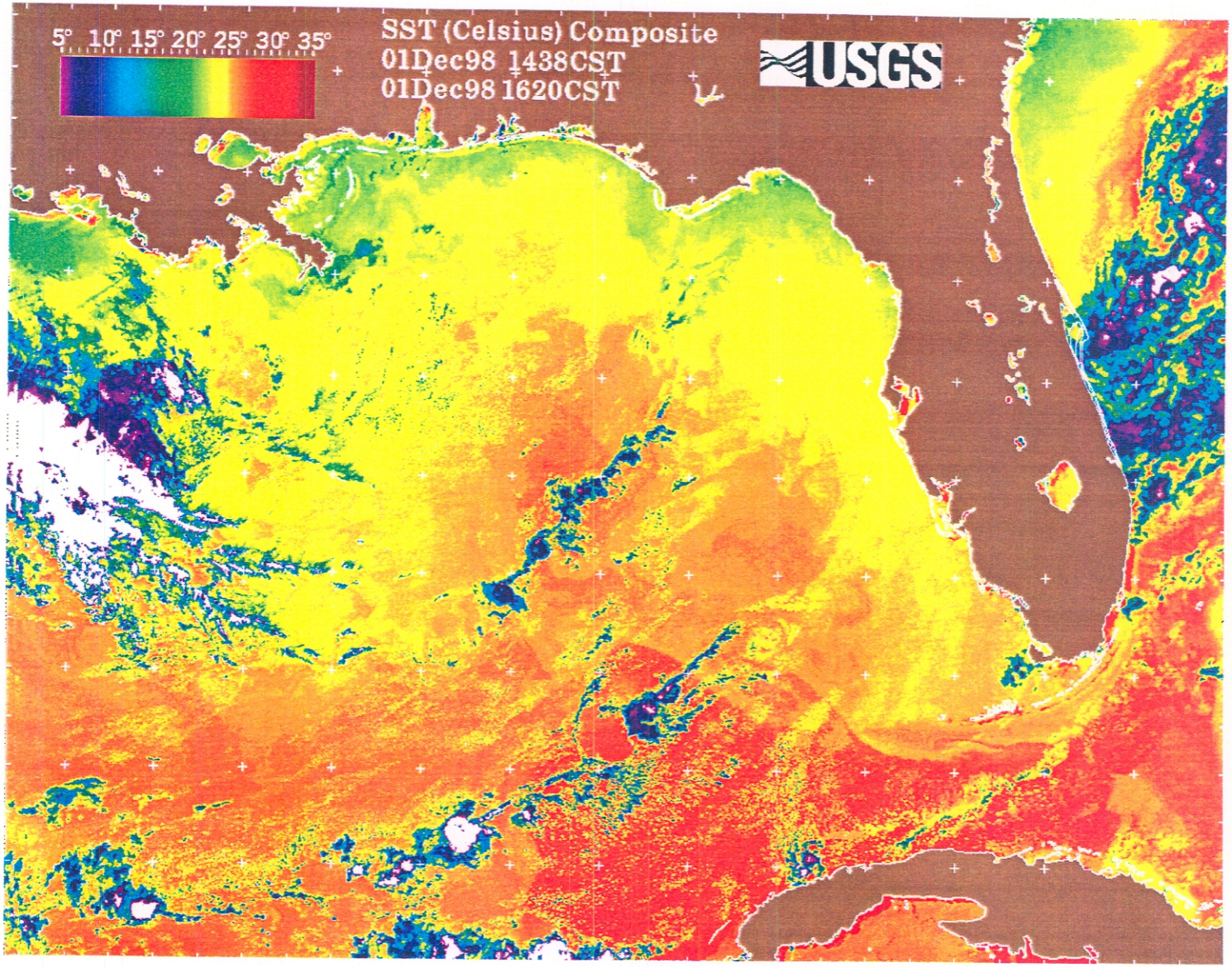


Fig. 34c. Surface thermal image from AVHRR OF 12/1/98 indicating the Tortugas eddies have evolved into a elongated recirculation zone shown by a series of long streamers as the eddies shear apart. Drifter 23113 was returned to the Tortugas on Dec. 7 and 8 by the countercurrent in this recirculation zone. Thermal image copied from USGS web site.

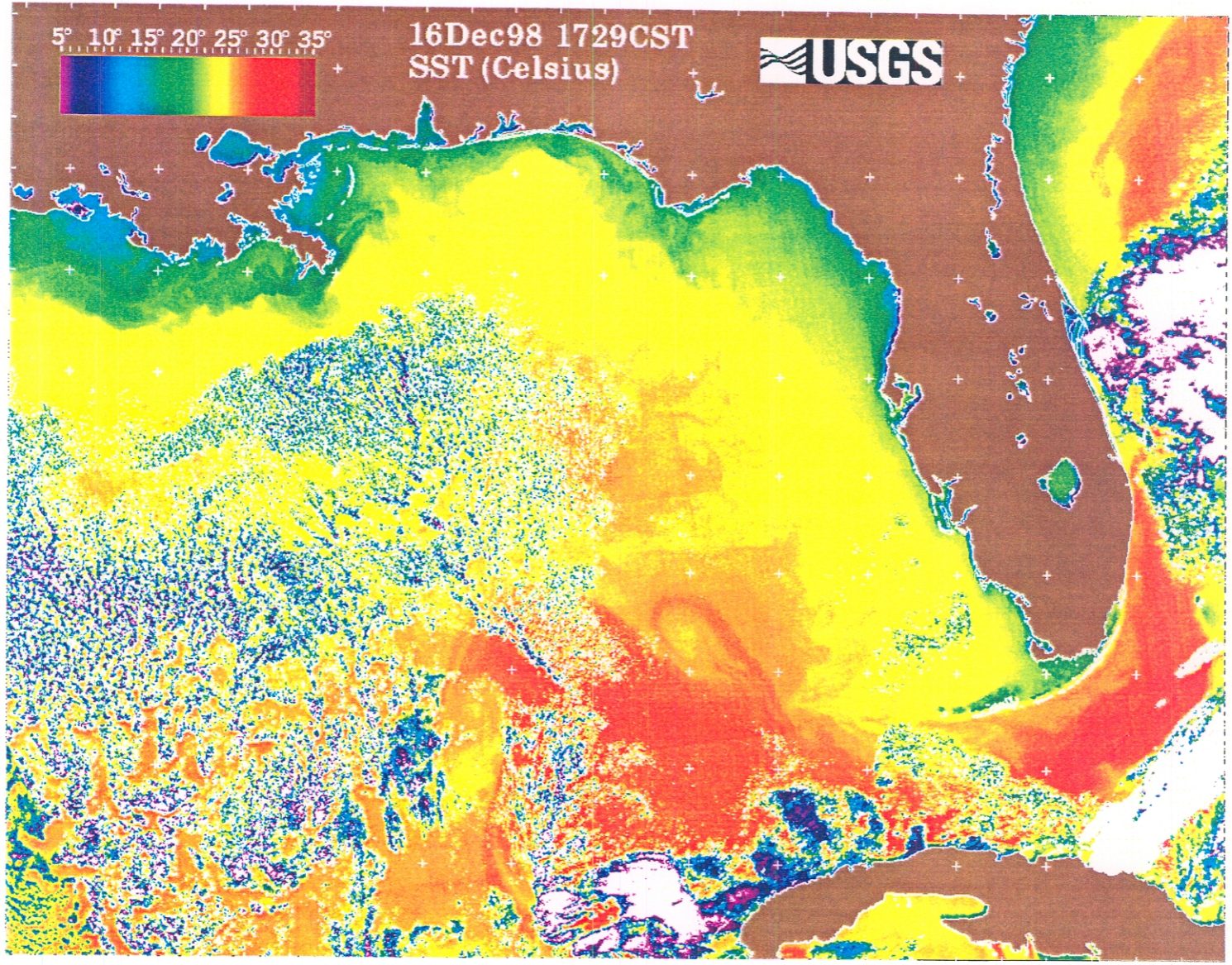


Fig. 34d. Surface thermal image from AVHRR OF 12/16/98 showing continuation of the eddy induced recirculation zone, which has extended to the north to Key Largo and contributed to the recirculation of drifter 23113 into the countercurrent off Key Largo. Thermal image copied from USGS web site.

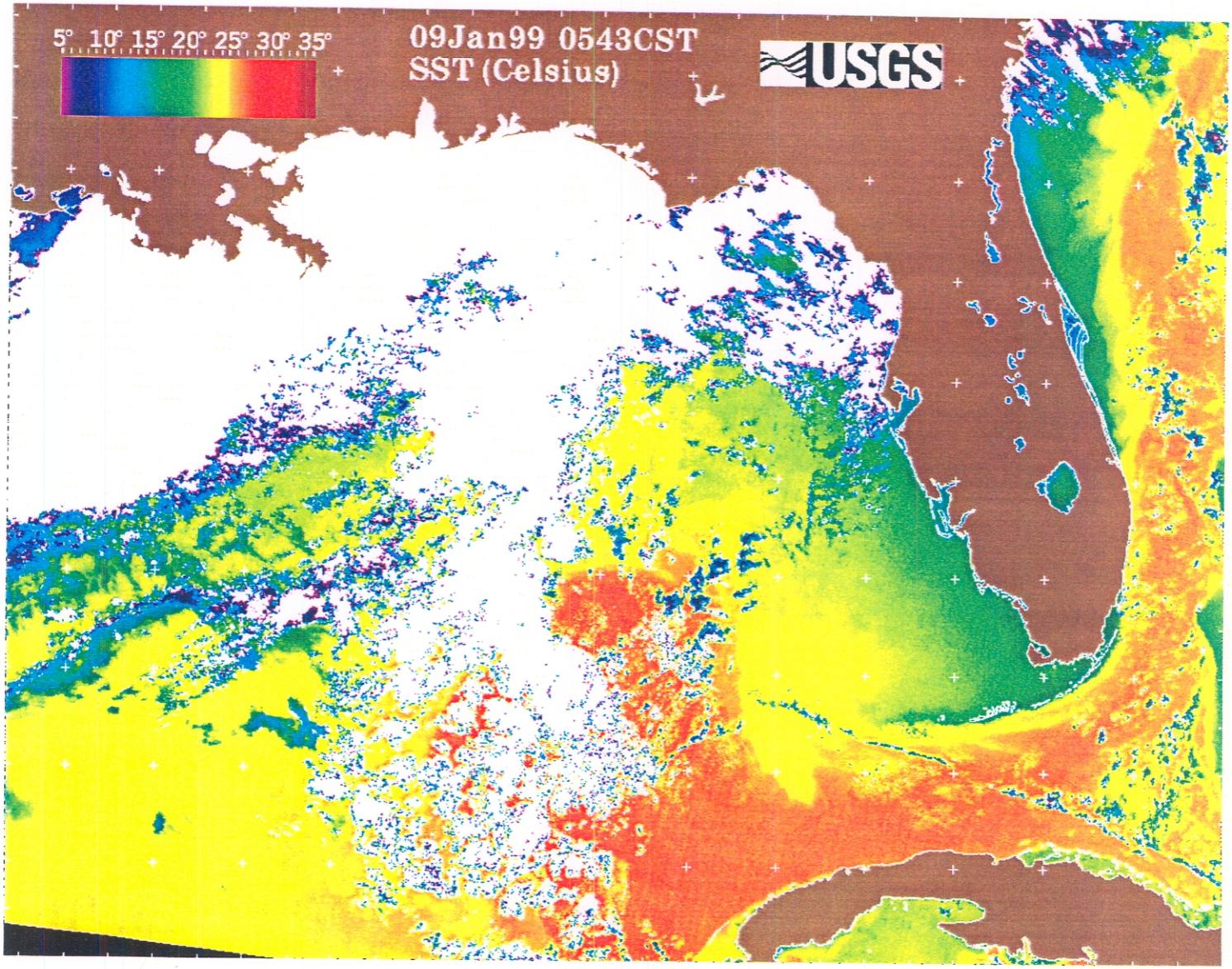


Fig. 34e. Surface thermal image from AVHRR OF 1/9/99 showing continuation of the coastal recirculation zone and the formation of a new Tortugas gyre near 84W. Thermal image copied from USGS web site.

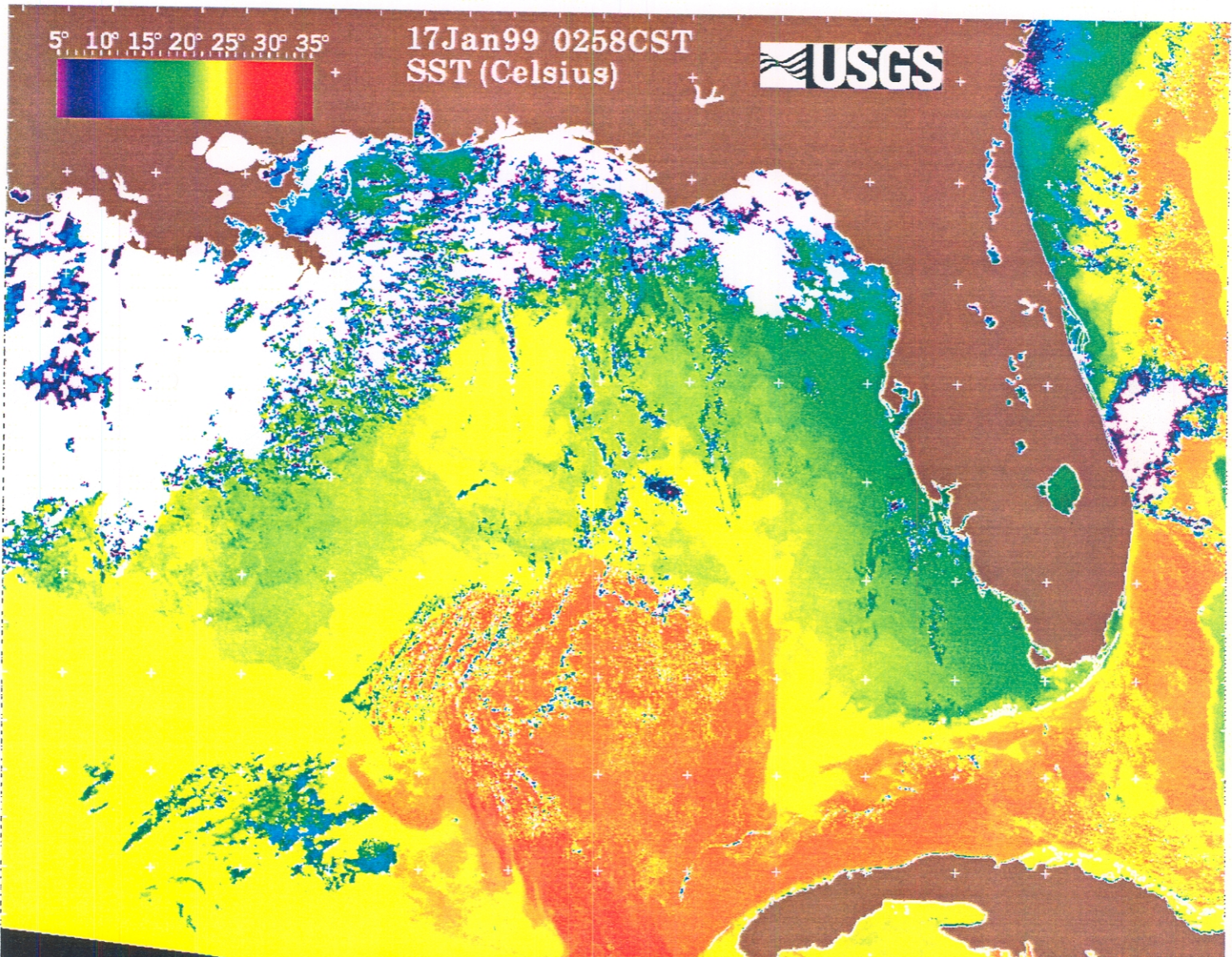


Fig. 34f. Surface thermal image from AVHRR OF 1/17/99 showing enlargement of the Tortugas gyre and two well defined eddies along the Florida Current front between the Tortugas and Marathon. Thermal image copied from USGS web site.