Northeast Fisheries Science Center Reference Document 02-08

Description of the 2001 Oceanographic Conditions on the Northeast Continental Shelf

by

Maureen H. Taylor, Cristina Bascuñán,
and James P. Manning

May 2002

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract

A summary of hydrographic observations for 15 surveys on the northeast continental shelf during 2001 is presented. Distributions of CTD stations, surface and bottom temperature, salinity, and anomalies are portrayed. The average surface and bottom temperatures and salinities have been calculated in five geographic regions over the northeast continental shelf: western Gulf of Maine (GOMW), eastern Gulf of Maine (GOME), Georges Bank (GB), northern Middle Atlantic Bight (MABN) and southern Middle Atlantic Bight (MABS). Time series plots from various shipboard environmental sensors are included if available.

Hydrographic data collected during 2001 were sorted into six 2-month time bins to provide the best spatial coverage used in the averaging method. Review of the computed areal average temperature and salinity data indicate that much of the northeast continental shelf experienced both warmer and fresher conditions during the year relative to the MARMAP reference period. Exceptions to this trend were observed during the spring in the eastern Gulf of Maine which exhibited colder surface temperatures and during the fall in the southern Mid-Atlantic Bight where higher than expected salinities were observed. The latter event is believed to be associated with the shoreward movement of the shelf/slope front in that region.

Introduction

The Northeast Fisheries Science Center (NEFSC) conducts several different surveys off the northeast continental shelf each year. Complete coverage of the shelf (Cape Hatteras to the Gulf of Maine) occurs during the spring and fall bottom trawl surveys and during some of the Ecosystem Monitoring cruises. Station coverage on other cruises throughout the year varies.

Temperature and salinity observations from 15 NEFSC surveys conducted during 2001 are summarized and presented in this report. Cruise operation summaries are presented for all cruises. Distribution plots of surface and bottom temperature, salinity, and anomalies are contoured where sufficient data are available. Areal average temperature and salinity and the corresponding anomalies also are presented for the five different regions on the shelf and for 6 time periods throughout the year. The data are presented chronologically in atlas form. Environmental data from the SCS system (Ship-board Computing System) are presented as time series figures for each leg of a cruise. No attempt has been made here to analyze the data or discuss in detail individual observations from the cruises.

Data and Methods

Temperature and salinity measurements were obtained with a Seabird (SBE) model 19 profiling CTD (Profiler), which measures the pressure, temperature and conductivity of the water twice per second. Two different methods of deployment were used depending upon the type of work conducted at a station (See Taylor and Bascuñán, 2000). Whenever a plankton haul was done, the Profiler was placed above the bongo nets (sensors facing up), and a double oblique tow was made. Upcast data are used as the primary data when the Profiler is deployed with bongo nets. The turbulence generated by the bongo nets during the downcast adversely affects the temperature and conductivity data quality. If no plankton haul was done, the Profiler was deployed vertically (sensors facing down) through the water column and the downcasts are processed as the primary data. Salinity samples are taken from the bottom of a vertical profile cast, generally twice per day, in order to calibrate the conductivity data. These samples are analyzed on shore with a Guildline Autosal Salinometer.

All raw Profiler data were processed using the Seabird manufactured software: DATCNV, FILTER, ALIGNCTD, BINAVG, DERIVE, and ASCIIOUT to produce 1 decibar averaged ASCII files. The data were edited, cleaned, and converted to a standard 80-column ASCII formatted cruise file and were archived in ORACLE tables and in the NEFSC anonymous FTP account (whsun2:/ftp/pub/hydro).

Station distributions and horizontal contour plots of the surface and bottom temperature, salinity, and temperature anomaly were prepared for each survey if coverage was sufficient. In addition, all the hydrographic data were combined and sorted into 2-month time bins. Areal average temperatures and salinities were then calculated for the six time periods and for the five regions of the northeast continental shelf shown in Figure 1a: western and eastern Gulf of Maine (GOMW, GOME), Georges Bank (GB), and the northern and southern Middle Atlantic Bight (MABN, MABS). Station distributions for each time period are shown in Figure 1b. The areal averaging was done using the method described in Holzwarth and Mountain (1990). The areal averages and anomalies were plotted against the calendar day mid-date of all observations within each of the six time periods. Areal averages and anomalies were also calculated by cruise and are listed in Tables 4 and 5 of Appendix C.

Results

The NEFSC cruises for which data are presented in this report are listed in Table 1. A summary of each cruise is listed in Appendix A and includes information on the type of cruise, its objectives, dates, the number of hydrographic stations, type(s) of instruments used, salinity calibration value, and notes pertaining to instrument performance. No salinity correction was applied to the cruise data if the mean salinity offset was less than +/- 0.01 psu.

Table 2 lists the surface and bottom areal average temperatures and temperature anomalies that were calculated for each of the five regions. Table 3 lists the surface and bottom areal average salinity and salinity anomalies for the same five regions. The January Ecosystem Monitoring cruise was cancelled due to an extended repair period for the Albatross IV and this resulted in no hydrographic data collected in the Gulf of Maine during January-February 2001. For most cruises, the areal averages and anomalies could not be calculated for all regions due to limited station coverage. Combining all the hydrographic data from all NEFSC programs and ships provided a better chance of adequate spatial and temporal coverage within the regions of the northeast continental shelf. In some cases however, a simple average (not an areal weighted mean) was determined for the observations in the region; these values are indicated in tables 2 and 3 by an asterisk. The standard deviations are also listed. SDV1 indicates how well the calculated anomaly represents the true regional average anomaly. SDV2 is an indicator of how closely the areal average matches the anomaly at any particular location within that region (see Holzwarth and Mountain, 1990 for explanation of SDV1 and SDV2).

Figures 2 - 3 present the time series of surface and bottom average temperature/salinity and temperature/salinity anomaly for each region. Cruises having less than 10 observations were not included in the time series figures. We were not able to resolve small-scale, localized events because of the regional averaging method used in this report. Station positions and distributions of surface and bottom temperature, salinity, and anomalies for the different cruises are presented in figures 4 - 56. Contour distribution figures were not prepared for some of the cruises because of poor station coverage. In addition, contour levels are not always consistent for a variable within a cruise. Contour distributions have been routinely produced for the scallop survey although the station coverage for this survey does not provide sufficient spatial coverage to allow

one to produce realistic hydrographic distributions. Environmental time series plots from shipboard sensors (SCS data) are included in Appendix B. Further information about this data may be obtained at http://www.wh.whoi.edu/~jmanning/foi/alongtrack.html.

Discussion

The majority of the northeast continental shelf experienced warmer and fresher conditions during the year 2001 compared to the MARMAP reference values. However, the eastern Gulf of Maine experienced colder surface temperatures, but near-normal bottom temperatures, during the spring. During July – August, a relatively greater amount of low salinity Scotian Shelf water was observed in the eastern Gulf of Maine and on Georges Bank (see figure 38). This coincided with colder bottom temperatures in both of these regions. It is possible that the presence of the lower salinity water created a relatively high degree of density stratification which inhibited vertical mixing of the warmer surface waters with the cooler and saltier bottom water. Both regions of the Mid-Atlantic Bight showed a pattern of increasing (positive) temperature anomalies that subsided somewhat in November.

The salinity anomaly time series for both regions of the Gulf of Maine indicate that the fresher conditions persisted during most of the year. The lower salinities in the eastern Gulf of Maine were previously noted during the fall of 2000 (Taylor and Bascuñán 2001). However, the mid-November 2001 areal values are consistent with near-normal salinity conditions in the Gulf of Maine regions. Examination of the salinity data from Georges Bank reveals that the Bank experienced a gradual freshening during much of the year but the salinity increased during the September-October time period. The increase in salinity and the positive salinity anomalies

observed in the southern Mid-Atlantic Bight during the fall may be associated with shoreward movement of the shelf/slope front or the passage of Gulf Stream rings.

The Northeast Regional Climate Center (NRCC, Cornell University) compiles seasonal and yearly summaries of mean air temperature and precipitation using 107 years of compiled historical data. Seasons and years are assigned a rank according to their mean air temperatures (1= coolest, 107 = warmest) and total precipitation (1 = driest, 107= wettest). The northeast region (Maine to Virginia) ranked "97" in average air temperature and "5" in total precipitation. The above average air temperatures are consistent with the warmer sea surface temperatures observed throughout the year and over much of the northeast continental shelf. Further information about the NRCC and its data products may be obtained at:

http://met-www.cit.cornell.edu/climate/nrcc_home.html.

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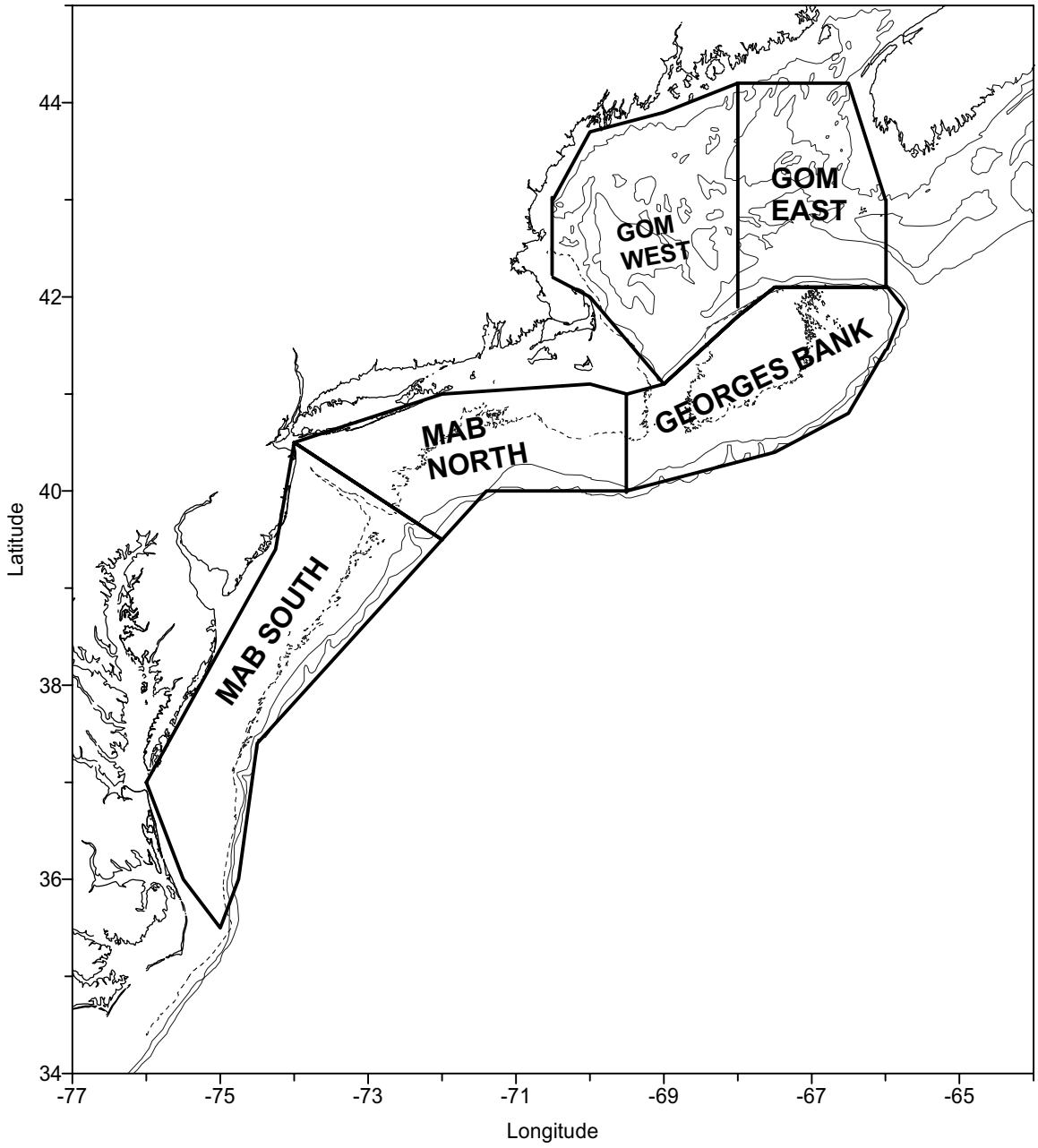


Figure 1a. The regions of the northeast continental shelf covered by the Northeast Fisheries Science Center cruises during 2001.

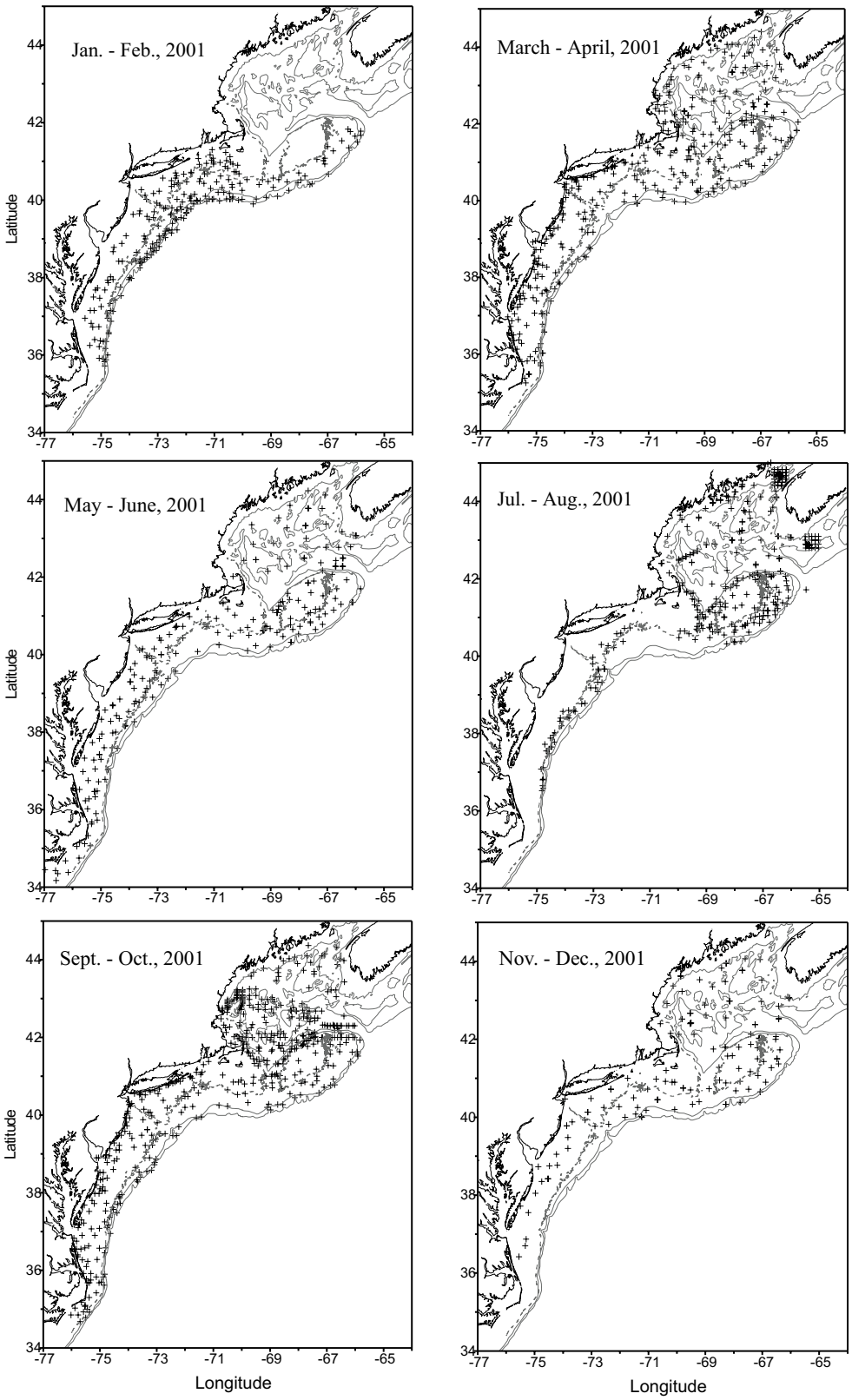


Figure 1b. Distributions of hydrographic stations occupied during 2001.

Table 1. Summary of 2001 Cruises.

Cruise	Program	Dates	Regions[1]
DEL0101	HydroAcoustic Survey	2 – 21 February	MAB
ALB0102	Winter Bottom Trawl	30 Jan – 22 February	MAB, GB
ALB0103	Spring Bottom Trawl	28 February – 30 April	MAB, GB, GOM
DEL0104	Apex Predator Survey	16 April – 24 May	S. MAB
ALB0106	ECOMON Survey Leg1	20 – 25 May	MAB
DEL0105	ECOMON Survey Leg2	29 May – 6 June	MAB, GB, GOM
DEL0106	Benthic Habitat	13 – 21 June	GB, GOM
DEL0107	AWARE Sonar Testing	19 July – 2 August	GOM
ALB0107	Scallop Survey	27 June – 16 August	GB, GOM
ALB0108	Right Whale Survey	24 July – 2 August	GOM
ALB0109	ECOMON Survey	21 – 28 August	GB, GOM
DEL0108	Right Whale Survey	8 – 29 August	GOM
DEL0109	HydroAcoustic Survey	6 Sept – 10 October	GB, GOM
ALB0110	Fall Bottom Trawl	5 Sept – 22 October	GB, GOM, MAB
ALB0111	ECOMON Survey	30 Oct – 16 November	GB, GOM, MAB

[1] Regional Abbreviations:

GOM = Gulf of Maine
MAB = Mid-Atlantic Bight
GB = Georges Bank

Table 2. Areal average surface and bottom temperature and temperature anomalies presented in two month time periods using hydrographic data collected during 2001 in the five regions of the northeast continental shelf.

	SURFACE					BOTTOM				
Region	**#obs**	**Temp**	**Anomaly**	**SDV1**	**SDV2**	**#obs**	**Temp**	**Anomaly**	**SDV1**	**SDV2** (1)
					January - February					
GOMW	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GOME	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GB	30	5.62	0.43	0.32	.53*	21	5.90	0.31	0.29	1.32*
MABN	83	5.47	0.12	0.20	0.99	63	6.74	0.53	0.26	1.33
MABS	85	6.76	-0.13	0.23	1.91	64	7.00	0.08	0.26	1.56
					March - April					
GOMW	53	5.79	0.46	0.19	0.96	50	5.87	0.81	0.14	0.63
GOME	35	3.88	-0.87	0.21	1.04	32	6.71	0.18	0.20	0.85
GB	52	5.21	0.31	0.18	0.68	44	5.56	0.34	0.25	0.83
MABN	54	5.11	0.66	0.29	0.73	50	5.81	0.31	0.33	1.08
MABS	86	6.67	0.65	0.23	1.19	80	6.83	0.94	0.28	1.30
					May - June					
GOMW	14	10.39	-0.10	0.32	2.50	12	6.57	0.67	0.31	.72*
GOME	22	7.94	-0.43	0.30	0.92	14	7.19	0.15	0.33	0.88
GB	53	10.67	1.09	0.18	2.29	49	8.12	0.30	0.22	1.19
MABN	29	12.36	0.53	0.34	2.30	27	7.58	0.41	0.40	1.81
MABS	70	15.37	0.06	0.24	2.01	67	8.71	-0.12	0.29	1.58
					July - August					
GOMW	54	17.69	1.46	0.19	1.63	50	6.69	0.11	0.16	1.48
GOME	46	14.60	0.36	0.20	2.45	42	7.80	-1.05	0.21	2.41
GB	107	17.54	1.91	0.15	1.80	102	10.99	-0.62	0.17	2.07
MABN	13	19.21	1.40	0.43	1.83*	13	9.14	1.45	0.44	1.77*
MABS	39	23.72	0.75	0.29	1.46*	38	8.34	0.77	0.35	2.57*
					September - October					
GOMW	126	14.44	0.81	0.13	1.15	126	7.25	0.18	0.09	1.46
GOME	64	13.38	0.34	0.20	1.40	64	8.62	-0.06	0.18	1.36
GB	91	16.97	1.67	0.17	1.24	83	13.11	0.38	0.21	1.88
MABN	55	20.88	2.75	0.29	1.26	52	14.52	1.32	0.22	2.62*
MABS	102	22.55	1.39	0.21	1.06	93	14.28	-0.28	0.25	3.15
					November - December					
GOMW	29	9.87	-0.08	0.25	0.94	21	7.48	0.11	0.22	1.16
GOME	17	10.01	-0.57	0.32	0.72	14	8.59	0.09	0.35	0.80
GB	35	13.30	0.71	0.23	1.02	28	12.53	0.50	0.28	1.21
MABN	28	15.50	1.25	0.34	0.75	26	13.80	0.59	0.38	1.58
MABS	20	16.34	0.64	0.34	.68*	20	15.96	1.20	0.36	.89*

(1) "Region", the geographic region of the northeast continental shelf: "#obs", the number of observations included in each average: "Temp", the areal average temperature: "Anomaly", the areal average temperature anomaly: "SDV1", the standard deviation associated with the average temperature anomaly : "SDV2", the standard deviation of the individual anomalies from which the the average anomaly was derived.

(*) A true areal average could not be calculated due to poor station coverage. The average values listed were derived from a simple average of the observations within the region.

"ND": no data available

Table 3. Areal average surface and bottom salinity and salinity anomalies presented in two month time periods using the hydrographic data collected during 2001 in the five regions of the northeast continental shelf

	SURFACE					BOTTOM				
Region	**#obs**	**Salt**	**Anomaly**	**SDV1**	**SDV2**	**#obs**	**Salt**	**Anomaly**	**SDV1**	**SDV2** (1)
January - February										
GOMW	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GOME	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GB	30	32.84	-0.15	0.12	.30*	21	33.01	-0.15	0.10	.40*
MABN	83	32.87	-0.26	0.10	0.33	62	33.32	-0.30	0.09	0.43
MABS	85	33.38	-0.38	0.13	0.57	64	33.54	-0.21	0.10	0.49
March - April										
GOMW	53	31.87	-0.57	0.08	0.65	50	33.22	-0.16	0.05	0.29
GOME	32	31.84	-0.63	0.12	0.34	32	33.81	-0.19	0.08	0.46
GB	51	32.73	-0.17	0.07	0.23	44	32.97	-0.20	0.08	0.39
MABN	54	32.58	-0.23	0.14	0.90	50	32.97	-0.46	0.11	0.35
MABS	85	32.75	-0.44	0.13	1.14	80	33.19	-0.32	0.10	0.62
May - June										
GOMW	14	31.75	-0.45	0.14	0.32	12	33.12	-0.21	0.09	.18*
GOME	21	31.84	-0.57	0.14	0.24	13	33.74	-0.15	0.12	0.35
GB	54	32.59	-0.21	0.07	0.57	50	32.86	-0.18	0.07	0.28
MABN	29	32.36	0.00	0.16	0.59	27	32.83	-0.26	0.13	0.28
MABS	70	31.92	-0.17	0.14	0.74	67	32.65	-0.57	0.10	0.52
July - August										
GOMW	45	31.68	-0.37	0.11	0.33	41	33.47	-0.10	0.06	0.22
GOME	44	32.06	-0.28	0.11	0.40	40	33.82	0.08	0.09	0.37
GB	107	32.22	-0.46	0.05	0.34	102	32.65	-0.30	0.06	0.30
MABN	13	31.91	-0.09	0.20	.54*	13	33.22	0.24	0.15	.50*
MABS	38	31.44	-0.57	0.14	.51*	38	33.46	0.03	0.11	.61*
September - October										
GOMW	123	32.19	-0.18	0.05	.22 1	26	33.45	-0.10	0.04	0.30
GOME	63	32.39	-0.19	0.10	0.20	64	34.30	0.04	0.08	0.22
GB	90	32.70	-0.04	0.06	0.39	83	32.79	-0.16	0.08	0.31
MABN	54	32.85	0.20	0.13	0.56	52	32.33	-0.53	0.08	.39*
MABS	100	32.58	0.30	0.12	1.08	93	33.01	-0.13	0.09	0.66
November - December										
GOMW	29	32.67	-0.06	0.11	0.21	21	33.69	0.05	0.09	0.25
GOME	17	32.85	0.18	0.16	0.34	14	34.13	-0.08	0.10	0.40
GB	35	32.62	-0.17	0.09	0.28	28	32.70	-0.27	0.10	0.34
MABN	26	32.98	-0.04	0.17	0.45	26	33.58	-0.12	0.13	0.53
MABS	18	33.06	0.50	0.21	.39*	20	33.24	0.31	0.15	.34*

(1)

"Region", the geographic region of the northeast continental shelf; "#obs", the number of observations included in each average; "Salt", the areal average salinity; "Anomaly", the areal average salinity anomaly; "SDV1", the standard deviation associated with the average salinity anomaly; "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived.

(*)

A true areal average could not be calculated due to poor station coverage. The average values listed were derived from a simple average of the observations within the region.

"ND", No Data Available

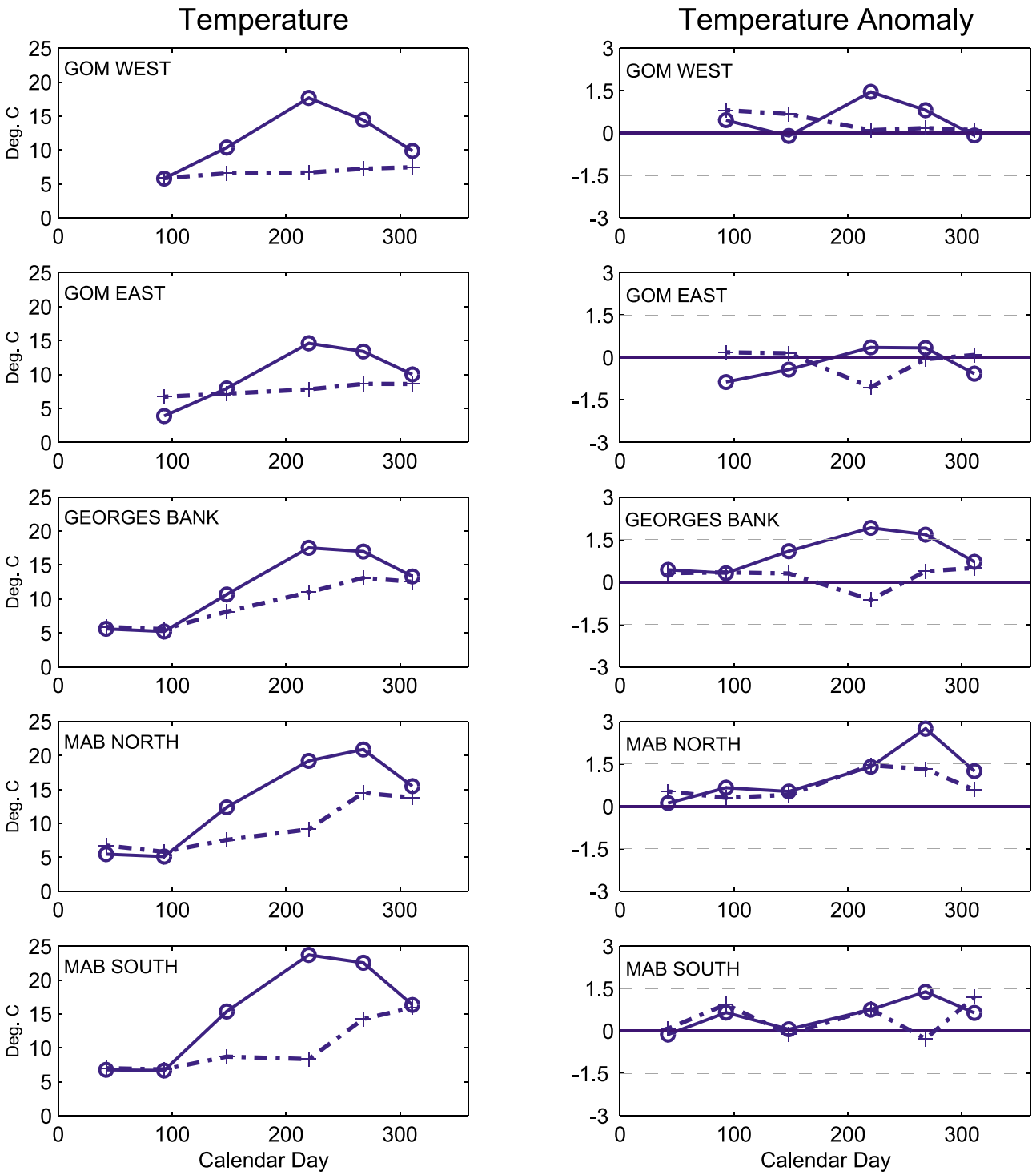


Figure 2. The 2001 areal average surface (-o) and bottom (--+) salinity (left) and anomalies (right) from Table 2.

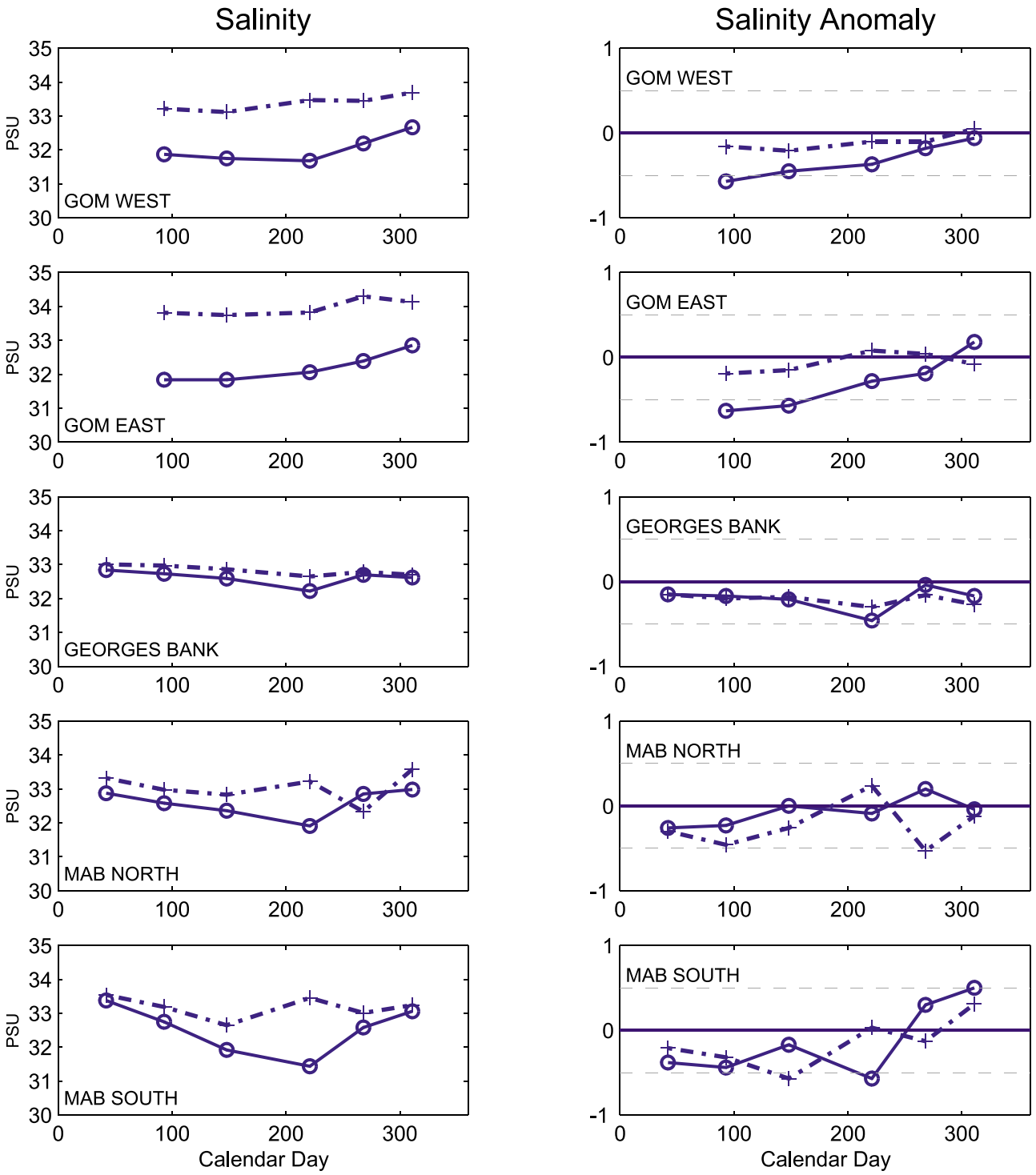


Figure 3. The 2001 areal average surface (-o) and bottom (--+) salinity (left) and anomalies (right) from Table 3.

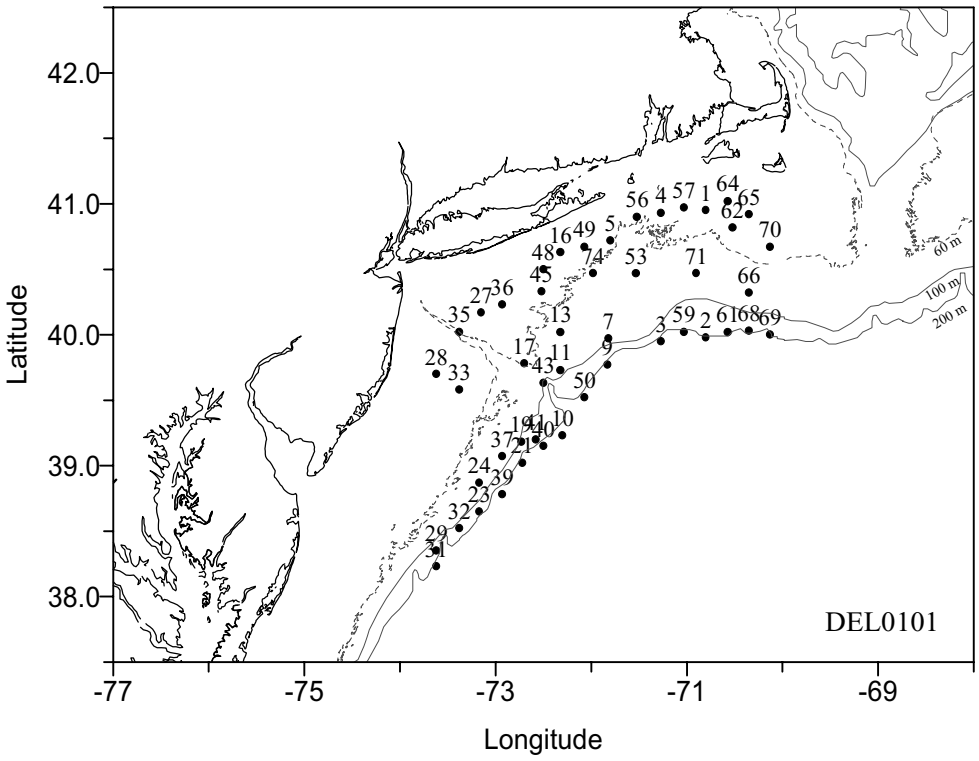


Figure 4. Hydrographic stations occupied during HydroAcoustic Survey DEL-01-01.

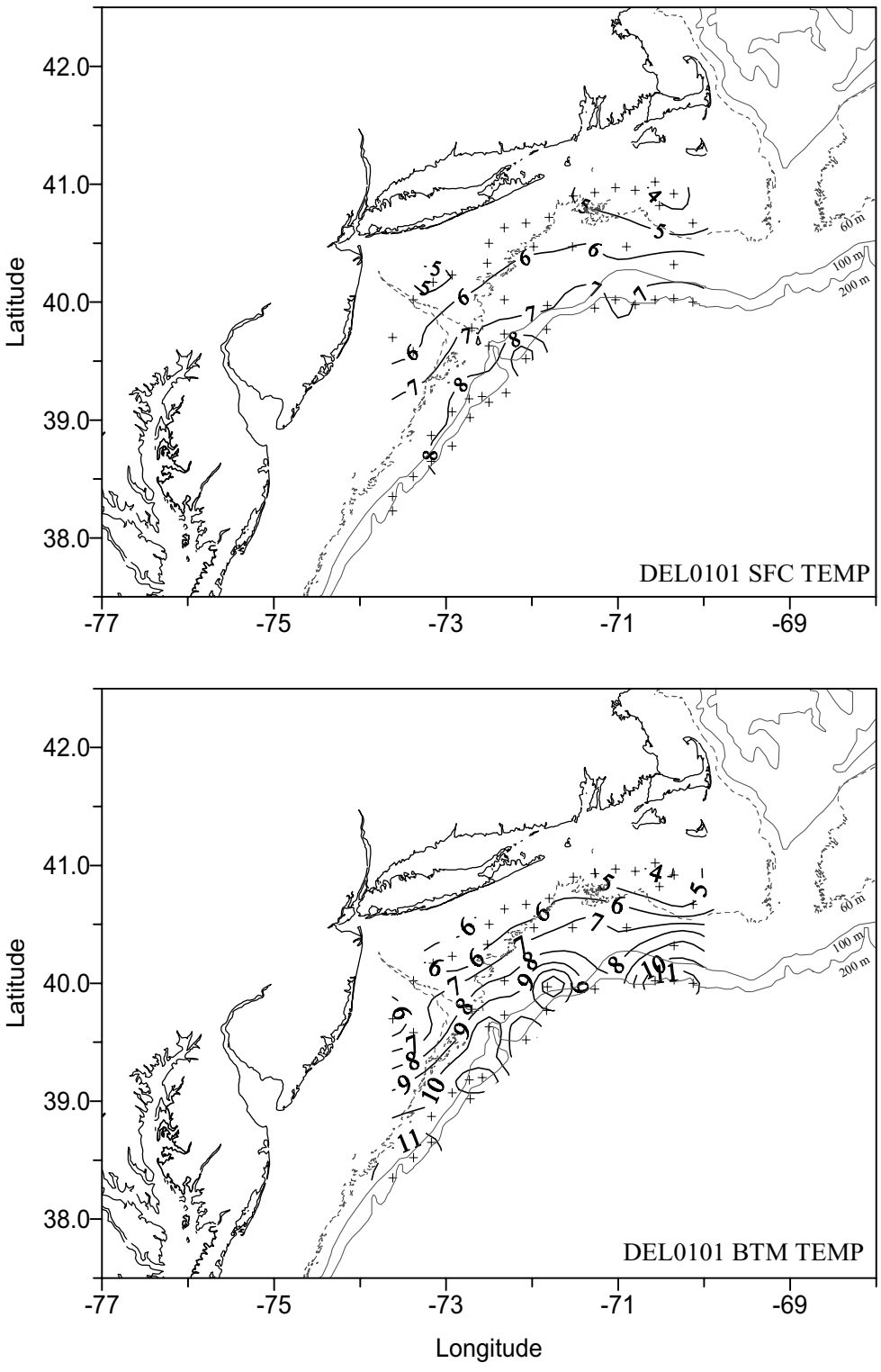


Figure 5. Surface (upper) and bottom (lower) temperature distributions for the HydroAcoustic Survey DEL-01-01.

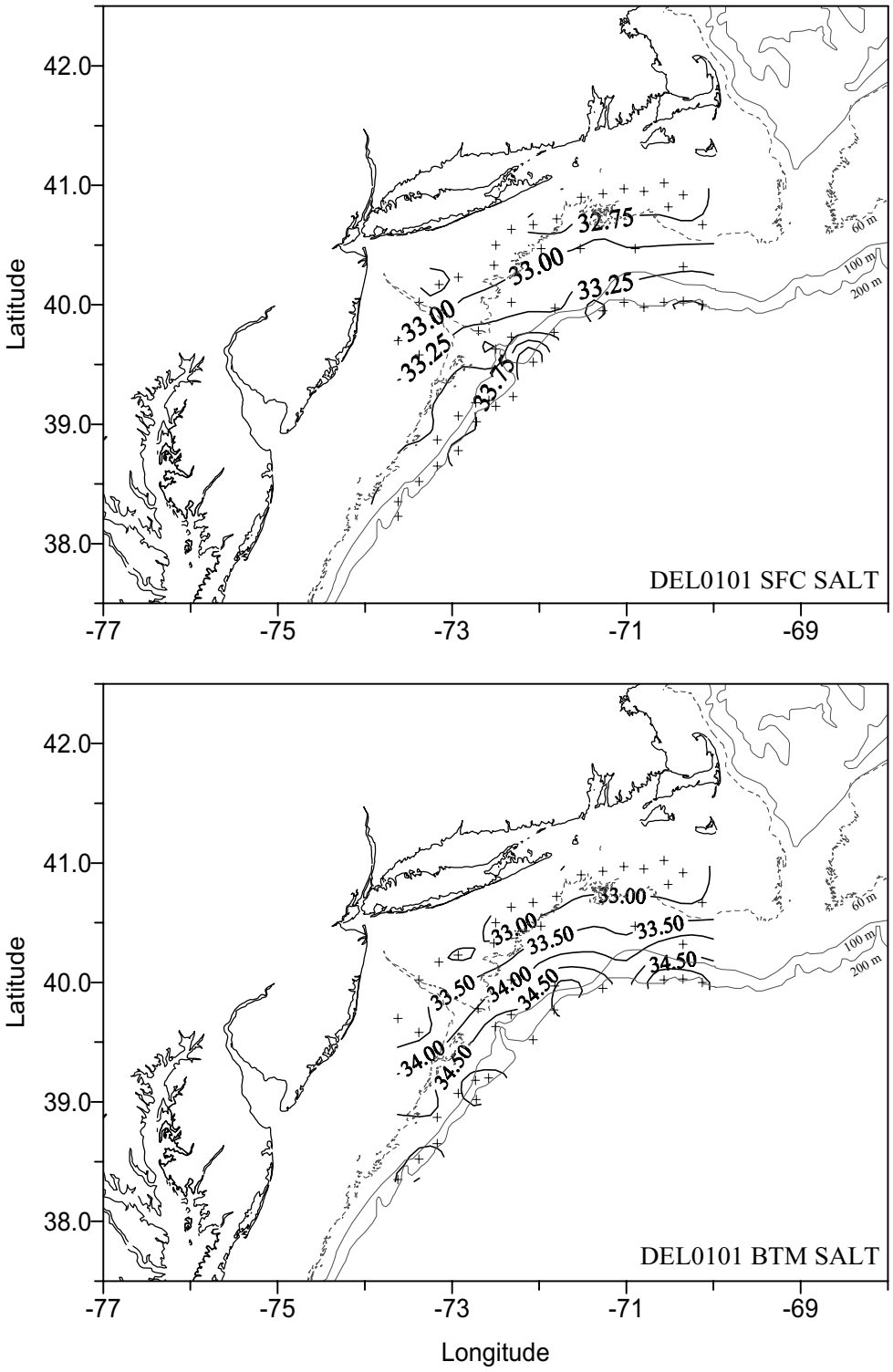


Figure 6. Surface (upper) and bottom (lower) salinity distributions for the HydroAcoustic Survey DEL-01-01.

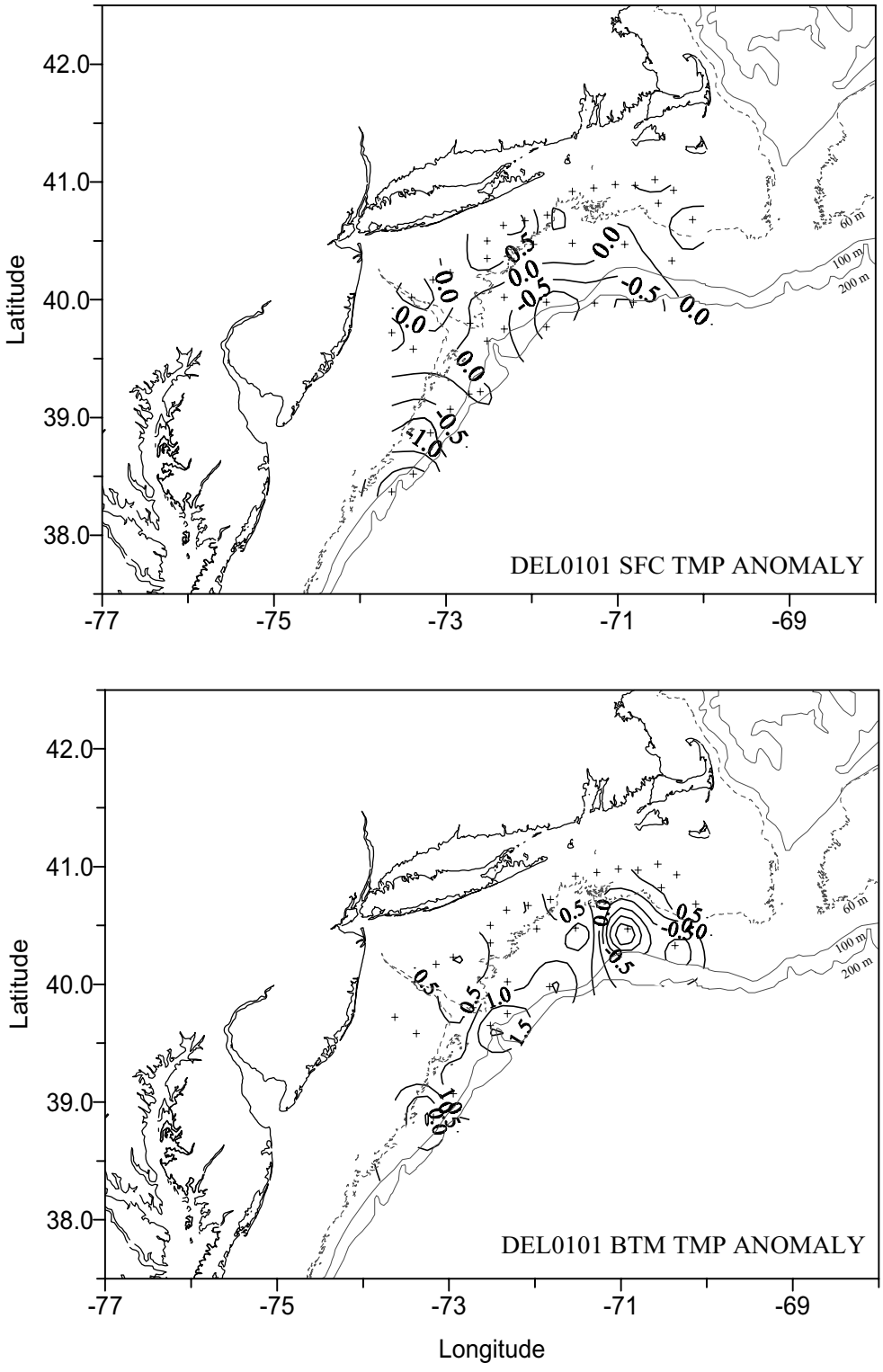


Figure 7. Surface (upper) and bottom (lower) temperature anomaly distributions for the Hydro-Acoustic Survey DEL-01-01.

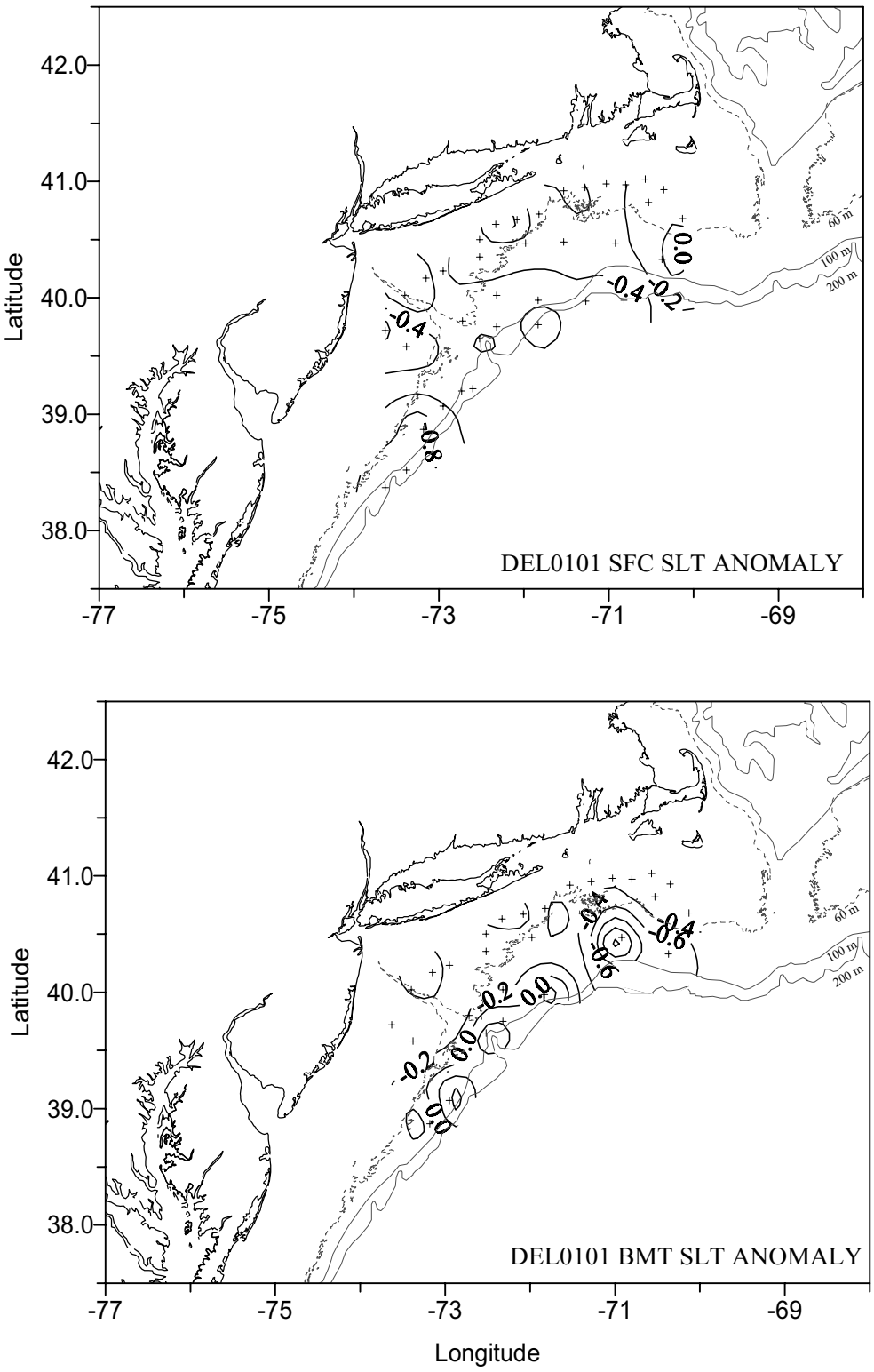


Figure 8. Surface (upper) and bottom (lower) salinity anomaly distributions for the Hydro-Acoustic Survey DEL-01-01.

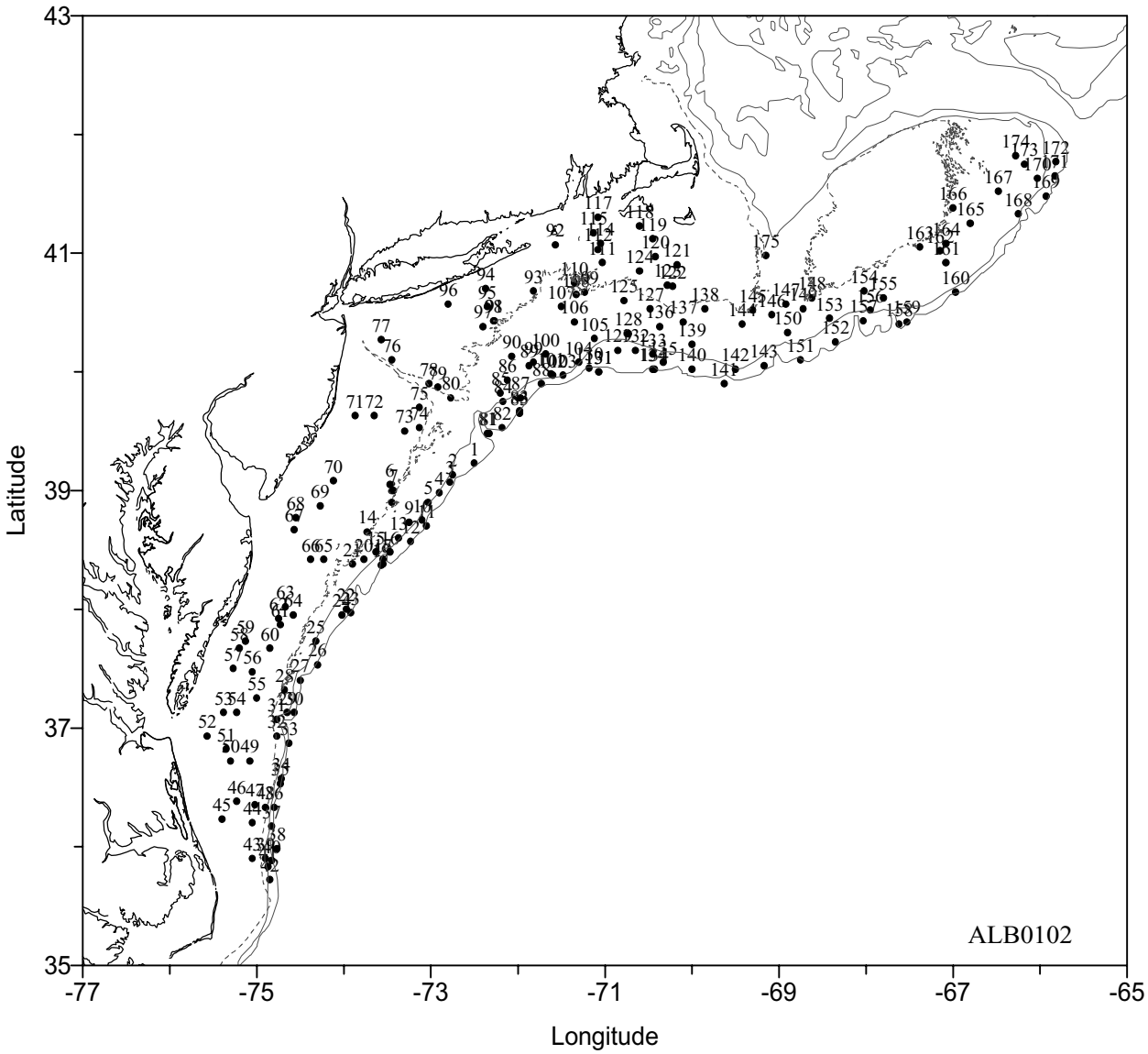


Figure 9. Hydrographic stations occupied during the Winter Bottom Trawl Survey ALB-01-02.

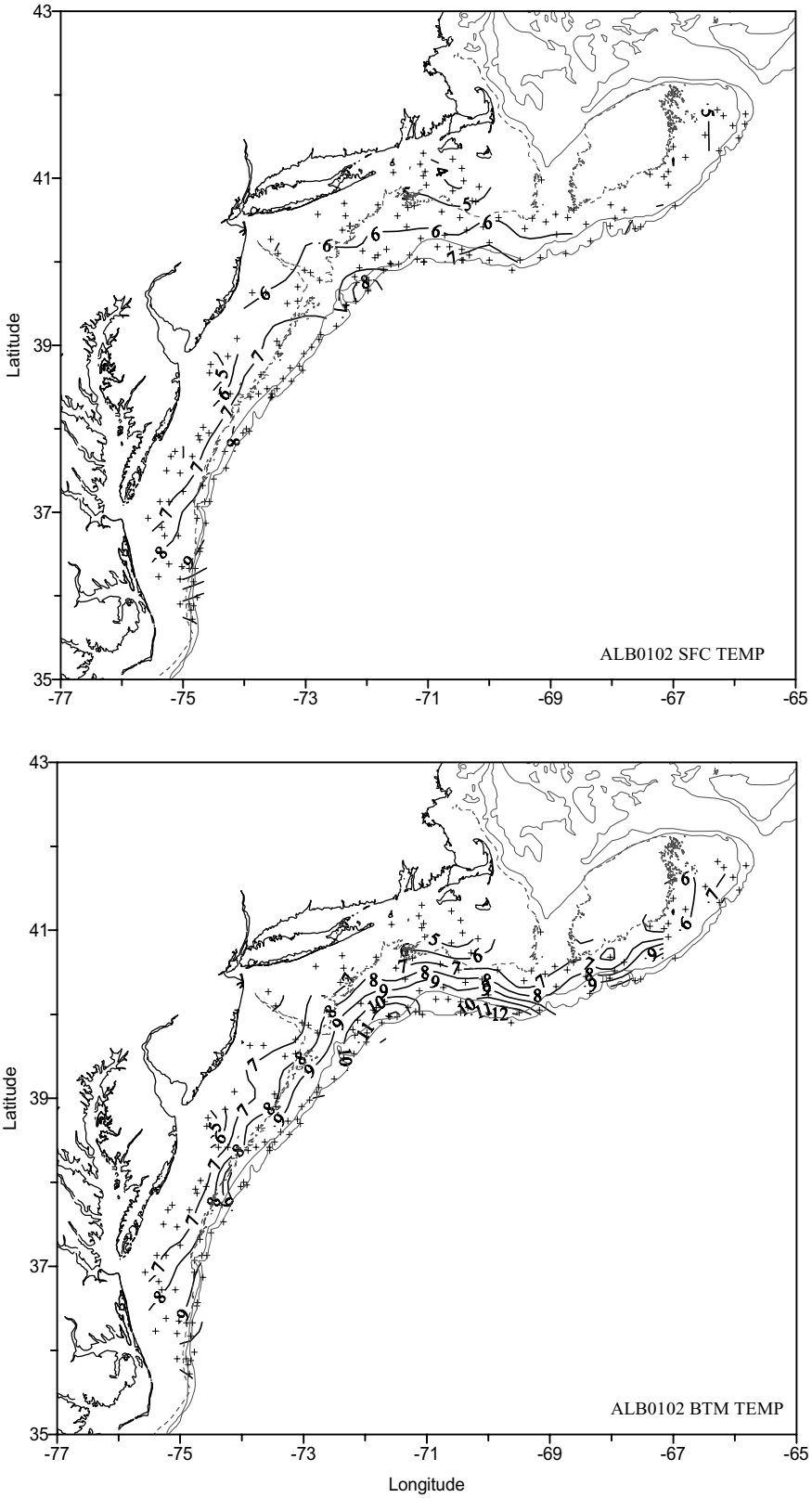


Figure 10. Surface (upper) and bottom (lower) temperature distributions for the Winter Bottom Trawl survey ALB-01-02.

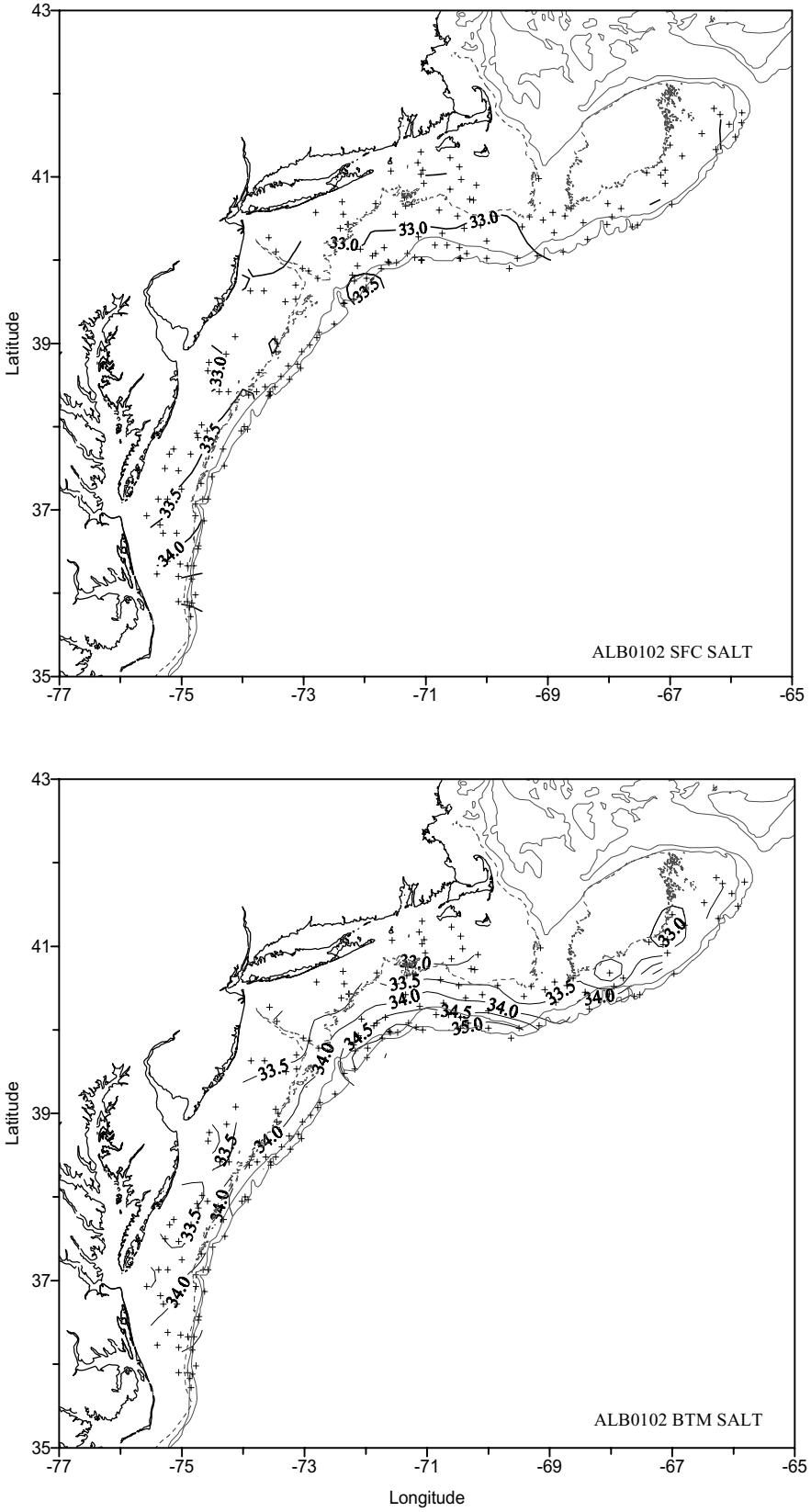


Figure 11. Surface (upper) and bottom (lower) salinity distributions for the Winter Bottom Trawl ALB-01-02.

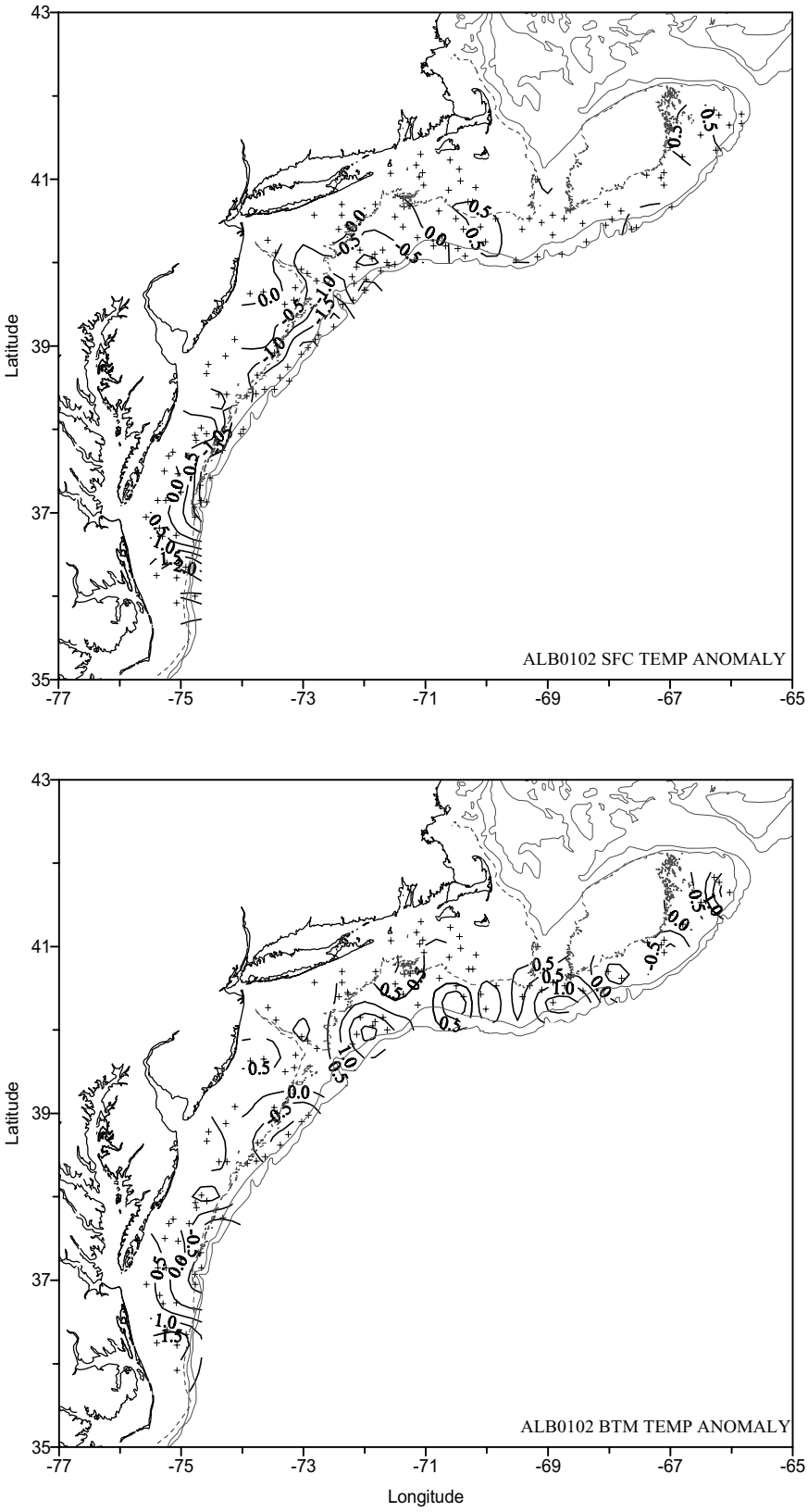


Figure 12. Surface (upper) and bottom (lower) temperature anomaly distributions for the Winter Bottom Trawl Survey ALB-01-02.

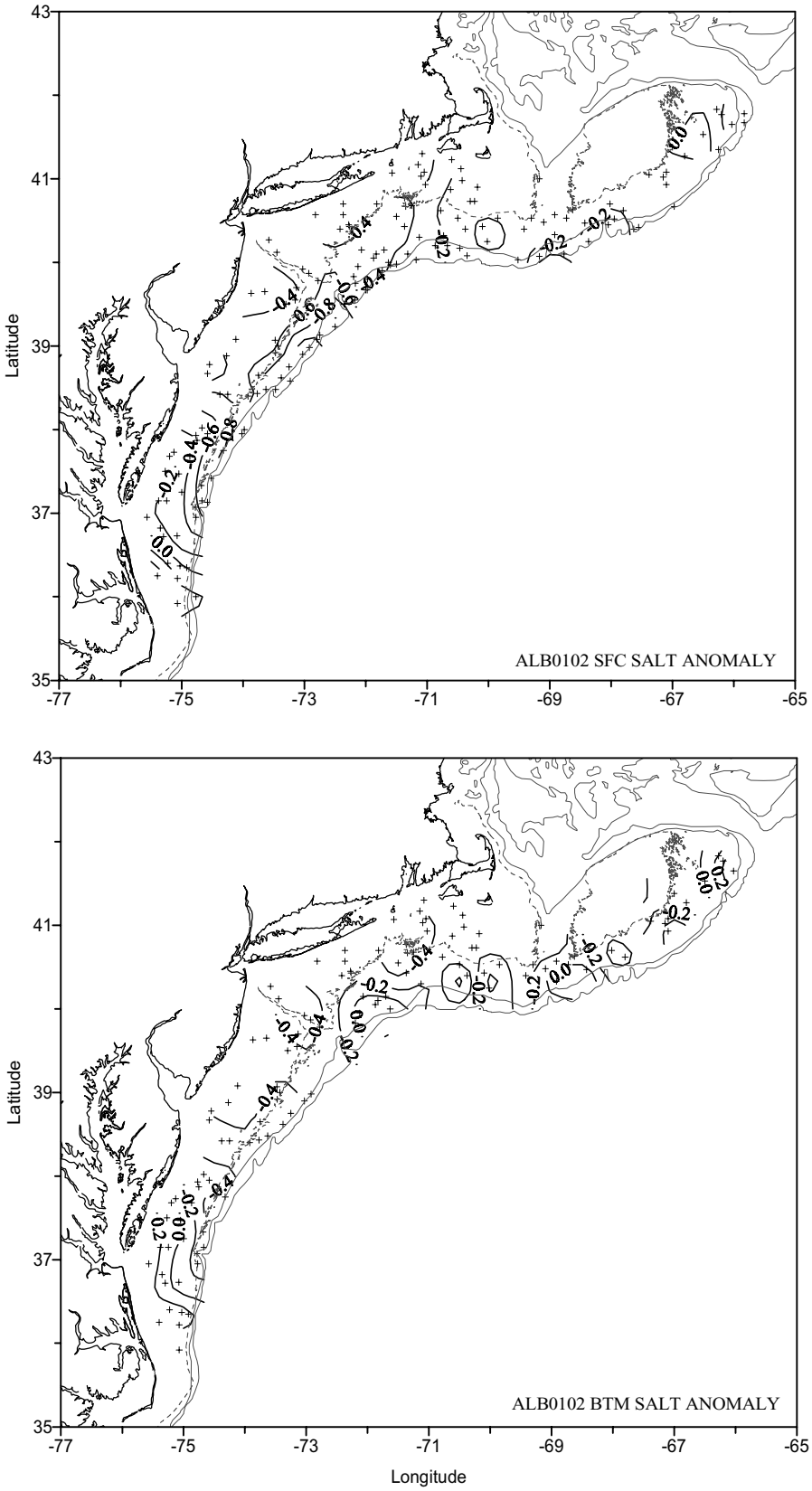


Figure 13. Surface (upper) and bottom (lower) salinity anomaly distributions for the Winter Bottom Trawl Survey ALB-01-02.

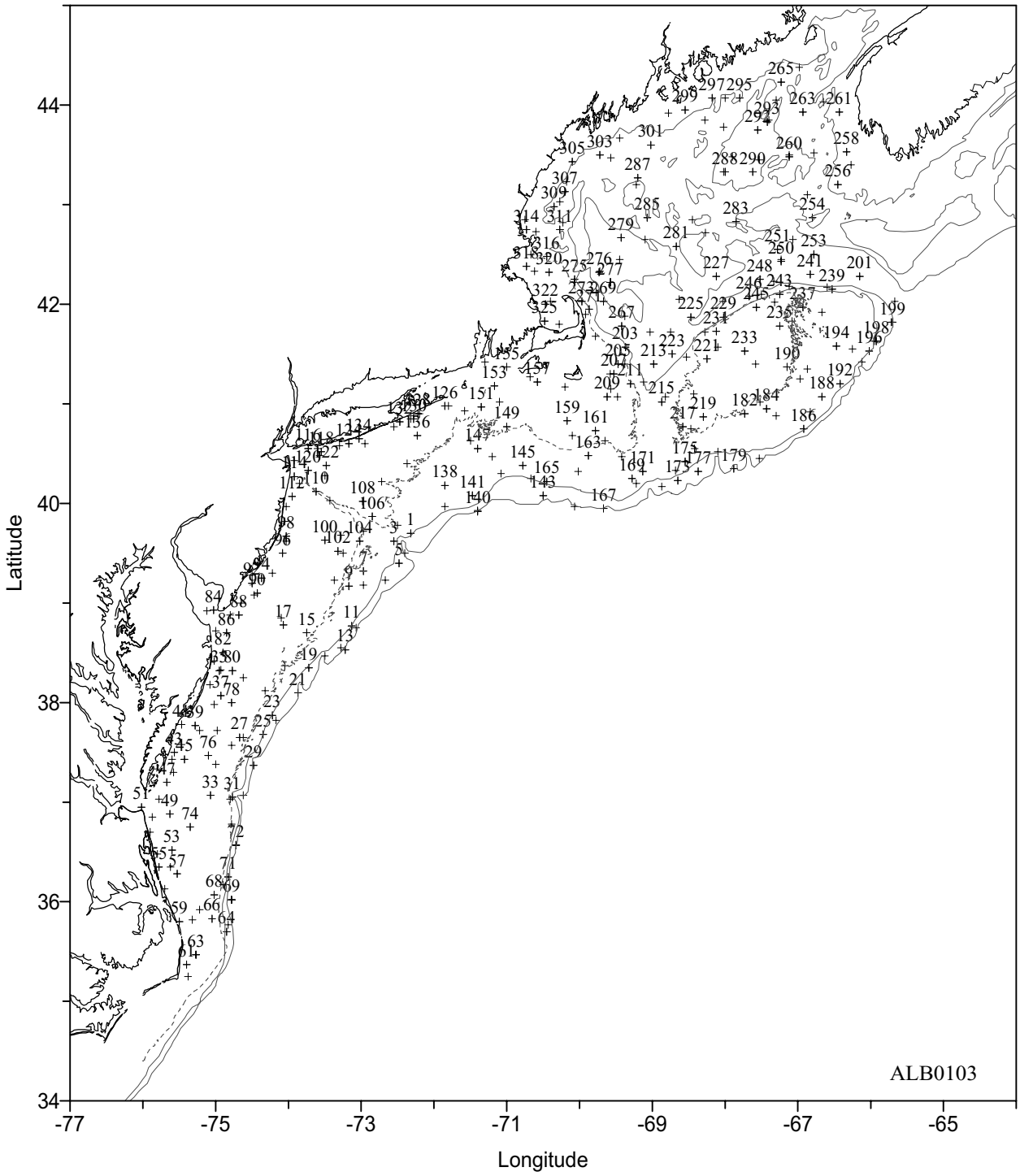


Figure 14. Hydrographic stations occupied during the Spring Bottom Trawl ALB-01-03.

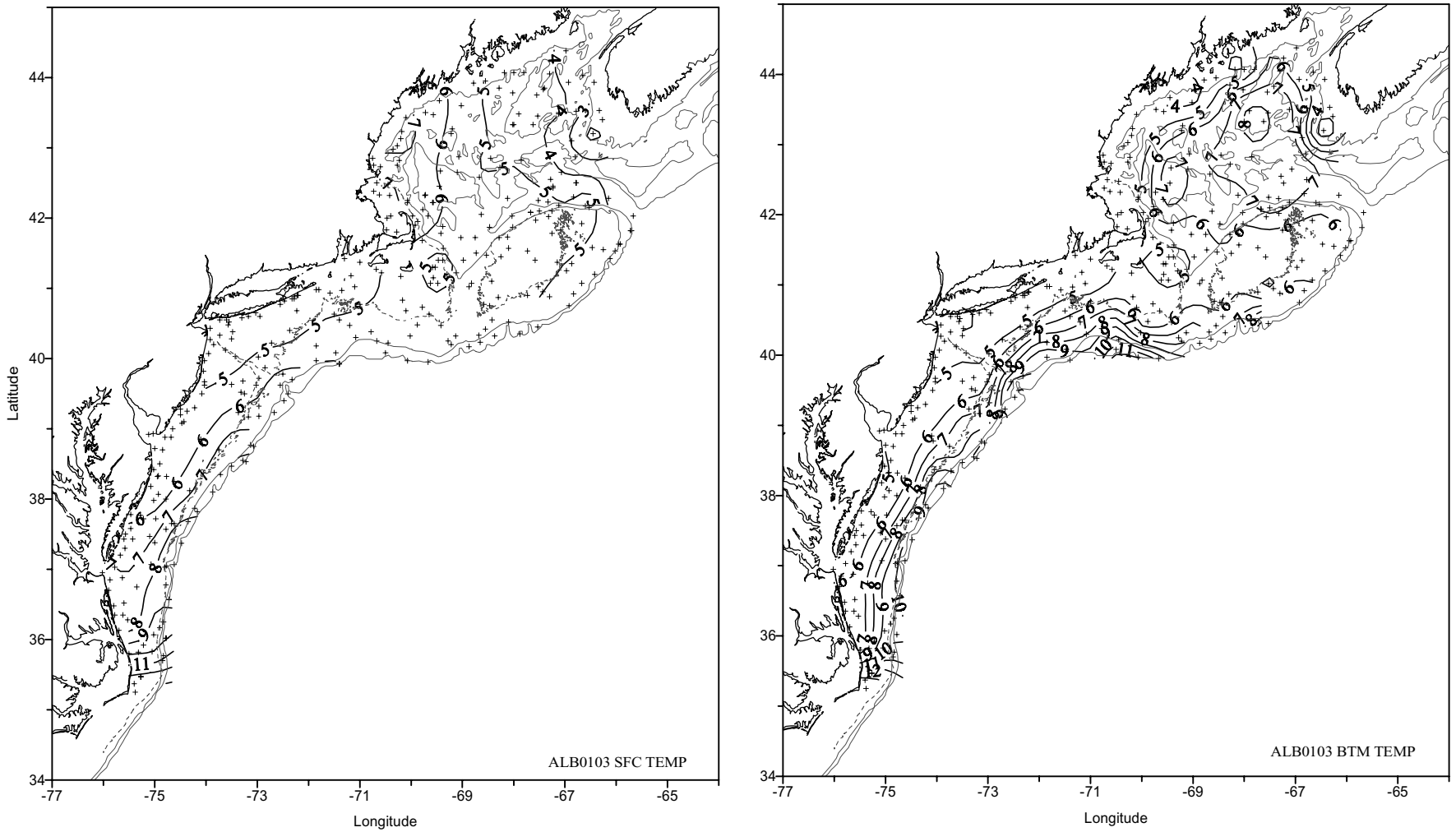


Figure 15. Surface (left) and bottom (right) temperature distributions for the Spring Bottom Trawl ALB-01-03.

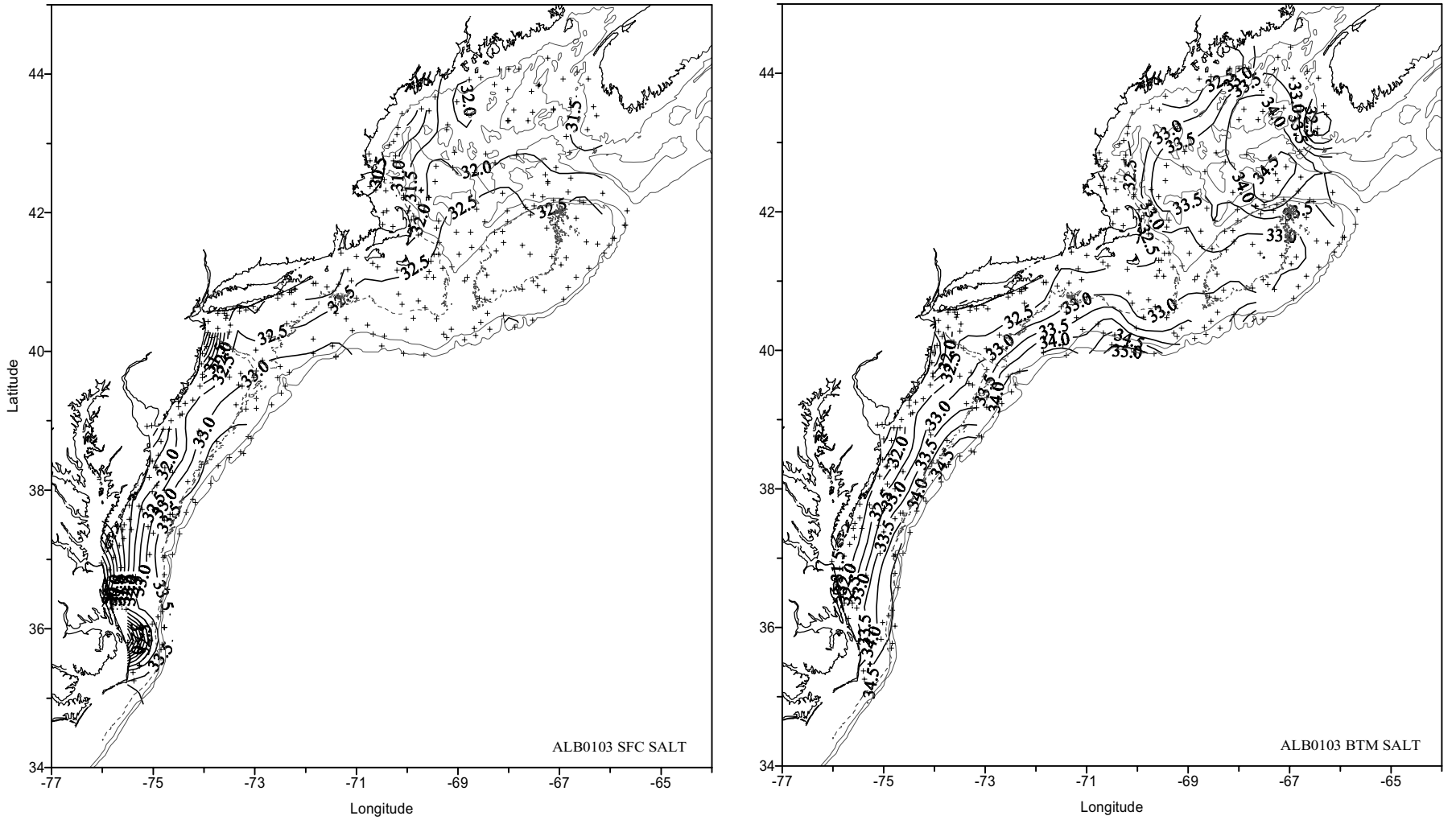


Figure 16. Surface (left) and bottom (right) salinity distributions for the Spring Bottom Trawl ALB-01-03.

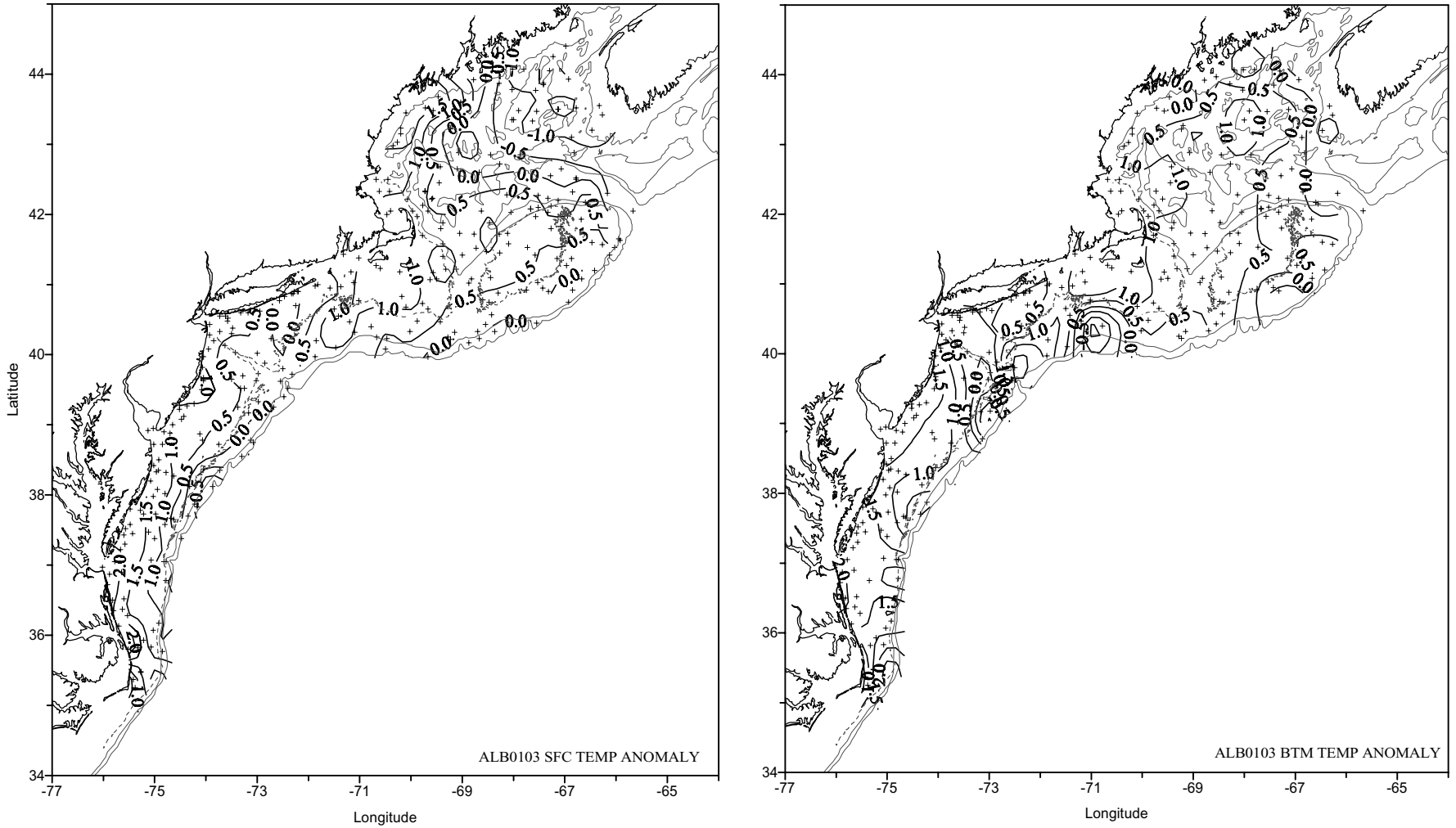


Figure 17. Surface (left) and bottom (right) temperature anomaly distributions for the Spring Bottom Trawl ALB-01-03.

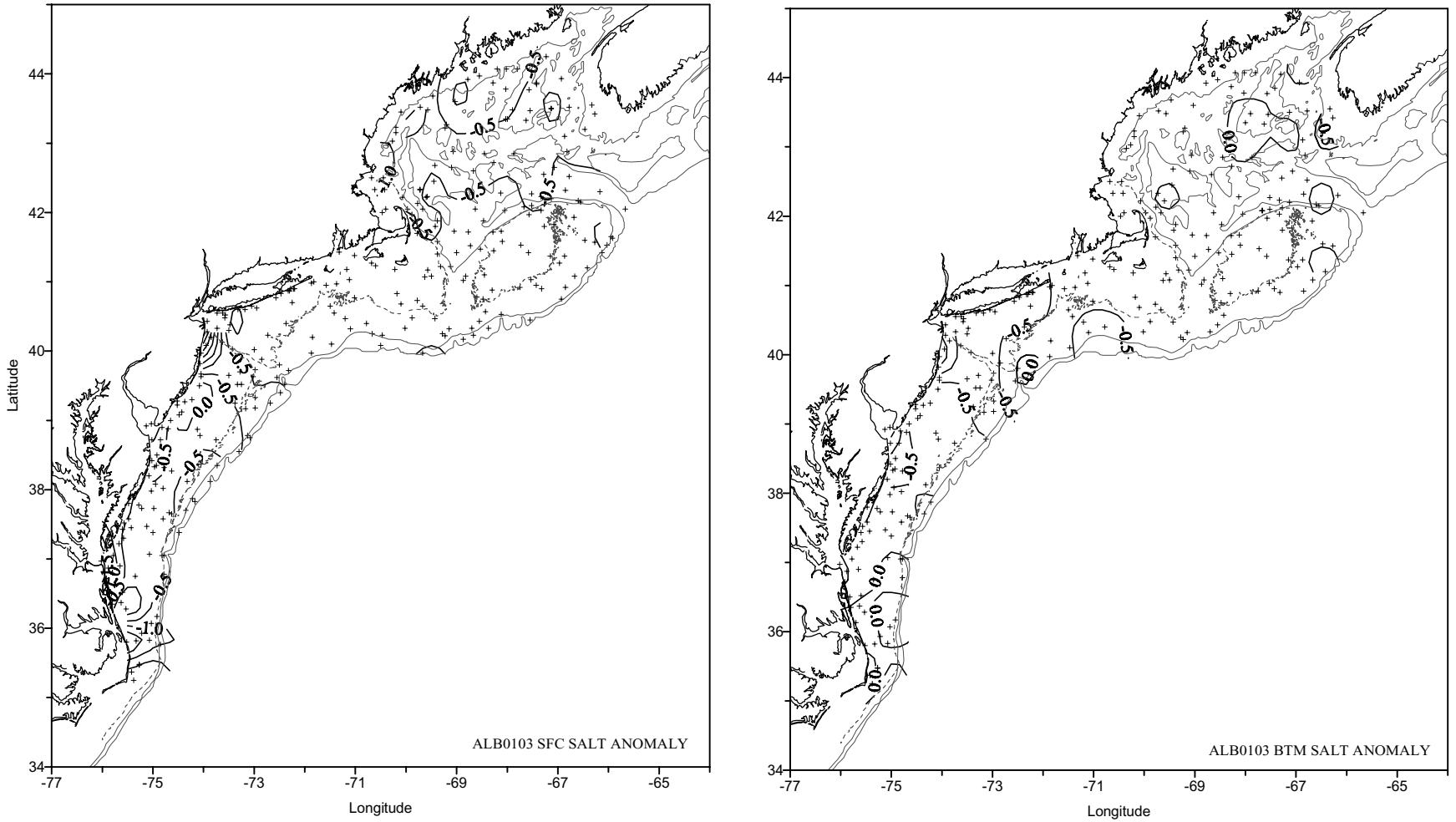


Figure 18. Surface (left) and bottom (right) salinity anomaly distributions for the Spring Bottom Trawl ALB-01-03.

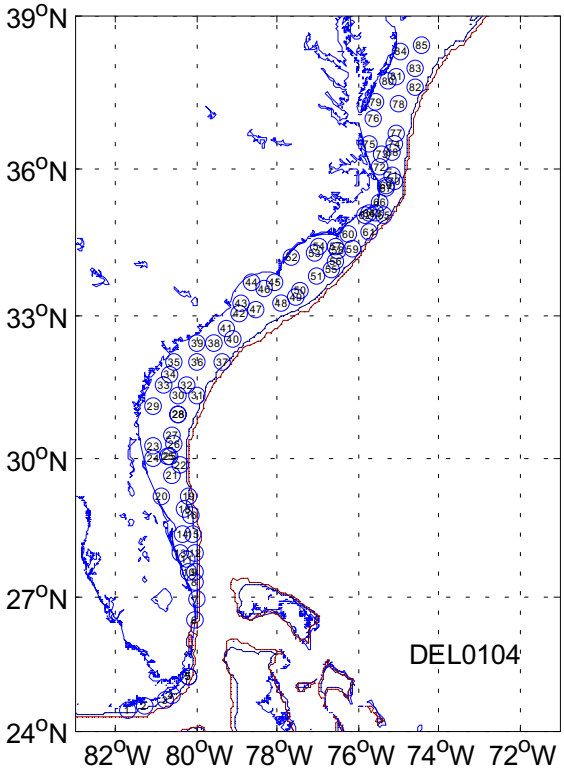


Figure 19. Hydrographic stations occupied during the Apex Predator Survey DEL-01-04.

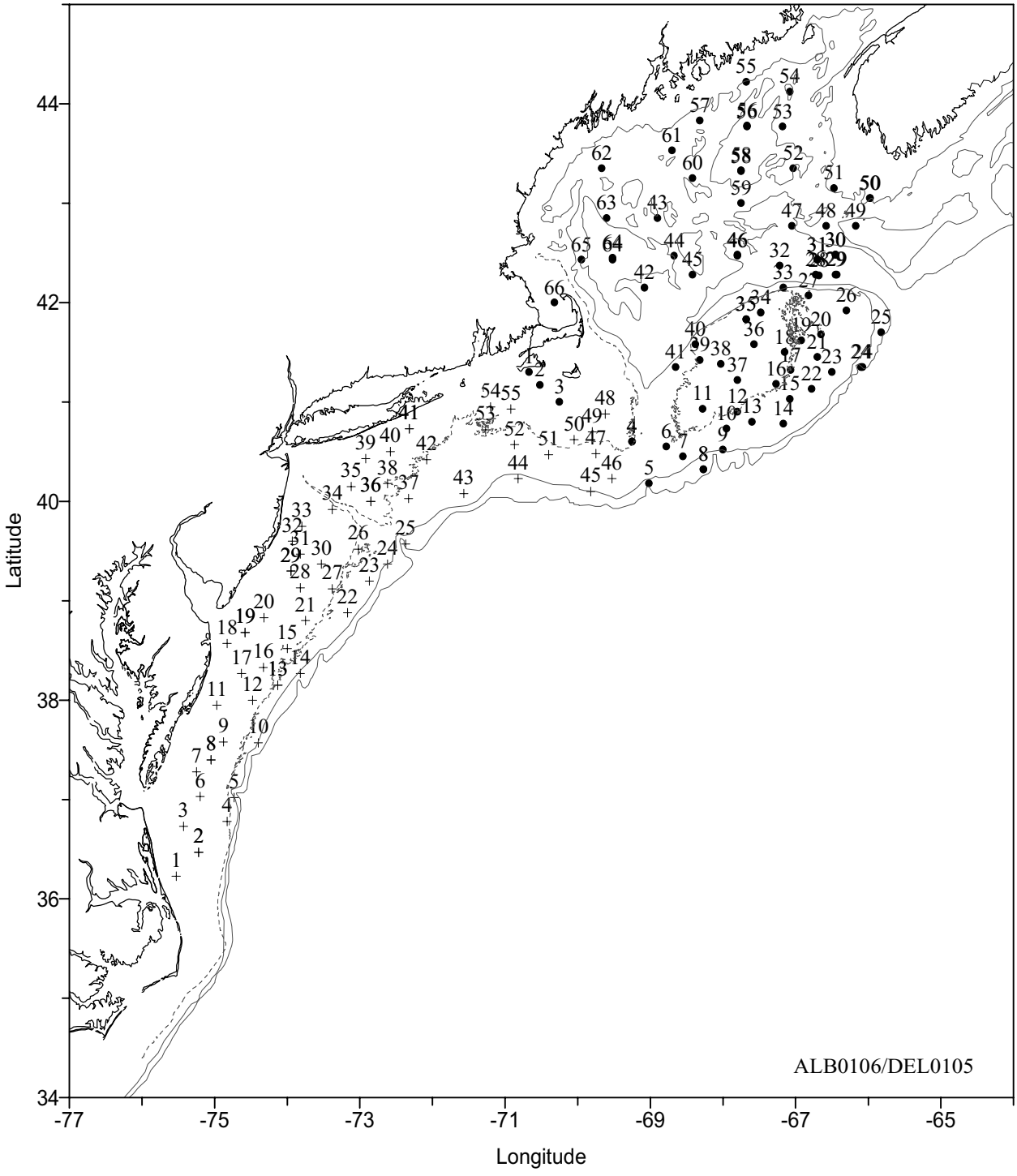


Figure 20. Hydrographic stations occupied during the ECOMON survey ALB-01-06 and DEL-01-05.

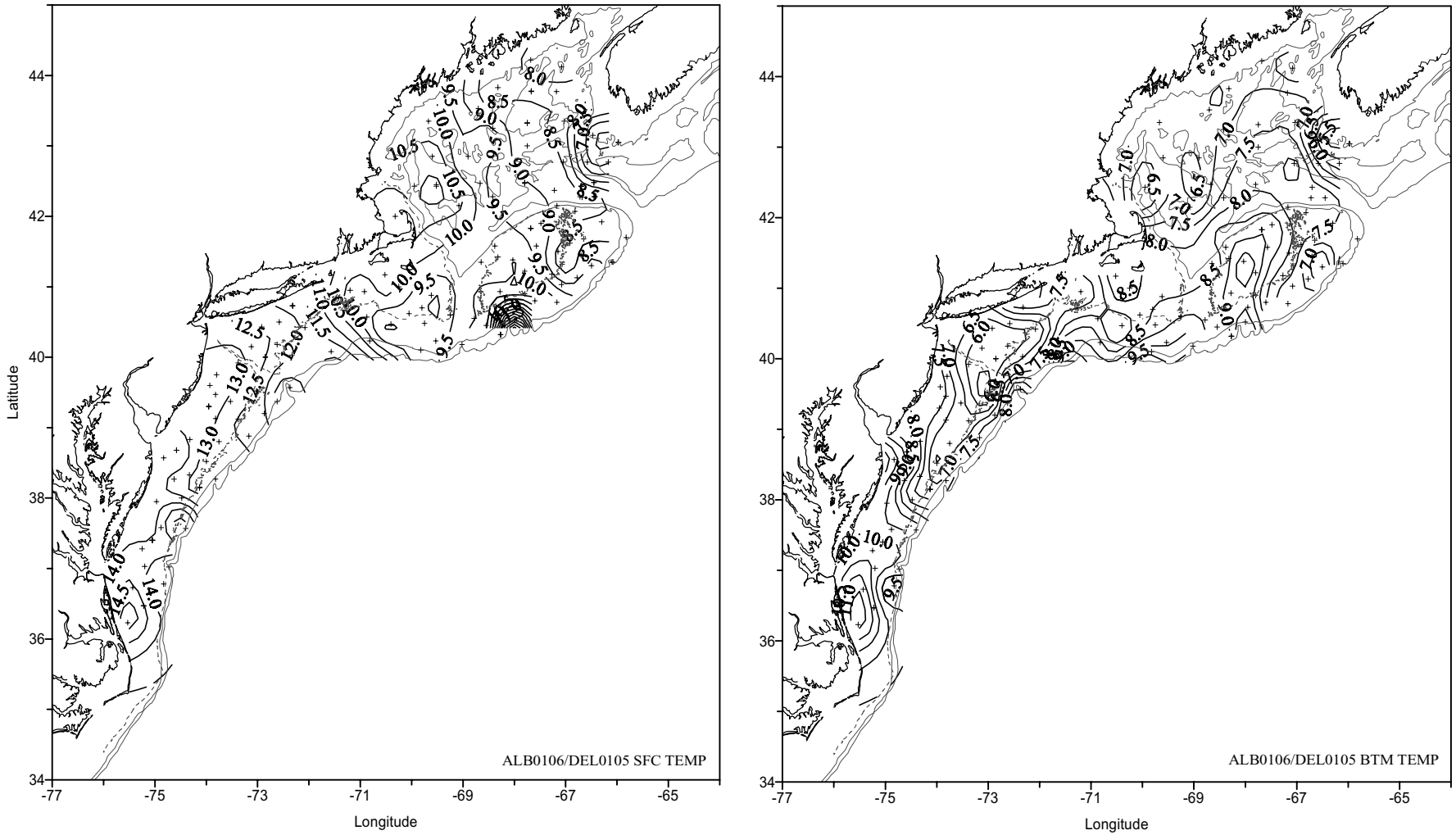


Figure 21. Surface (left) and bottom (right) temperature distributions for the ECOMON Survey ALB-01-06 and DEL-01-05.

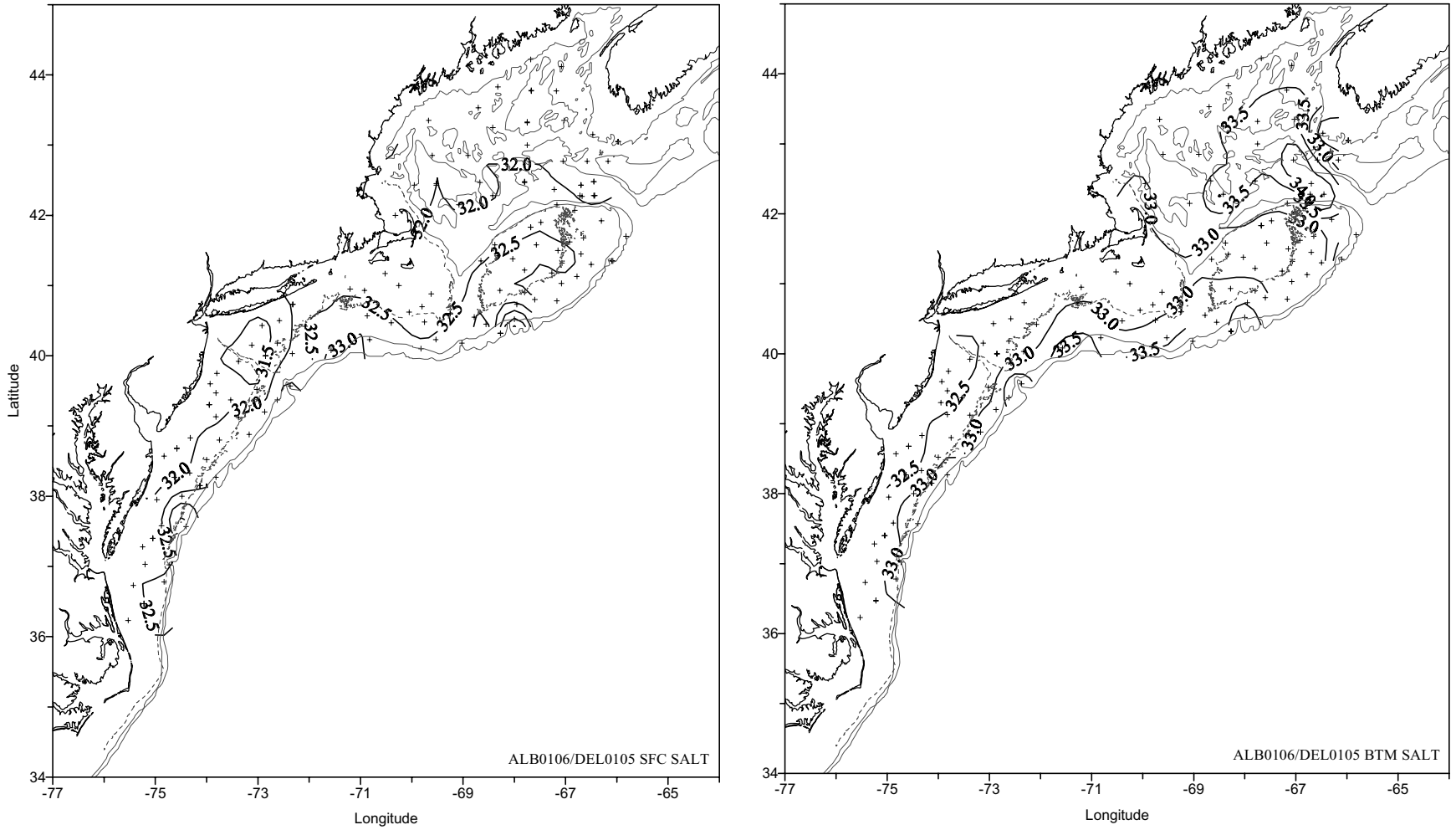


Figure 22. Surface (left) and bottom (right) salinity distributions for the ECOMON Survey ALB-01-06 and DEL-01-05.

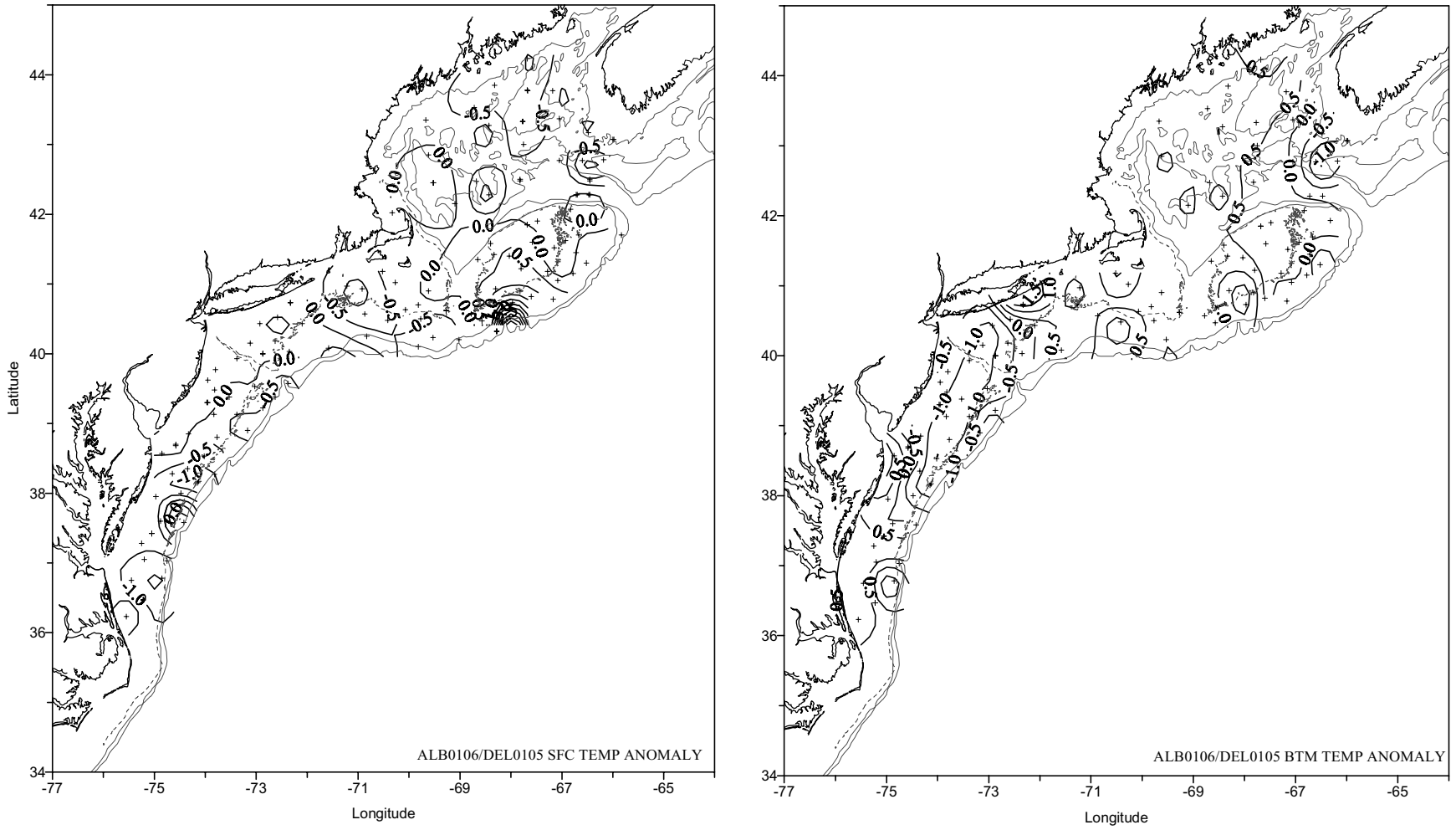


Figure 23. Surface (left) and bottom (right) temperature anomaly distributions for the ECOMON Survey ALB-01-06 and DEL-01-05.

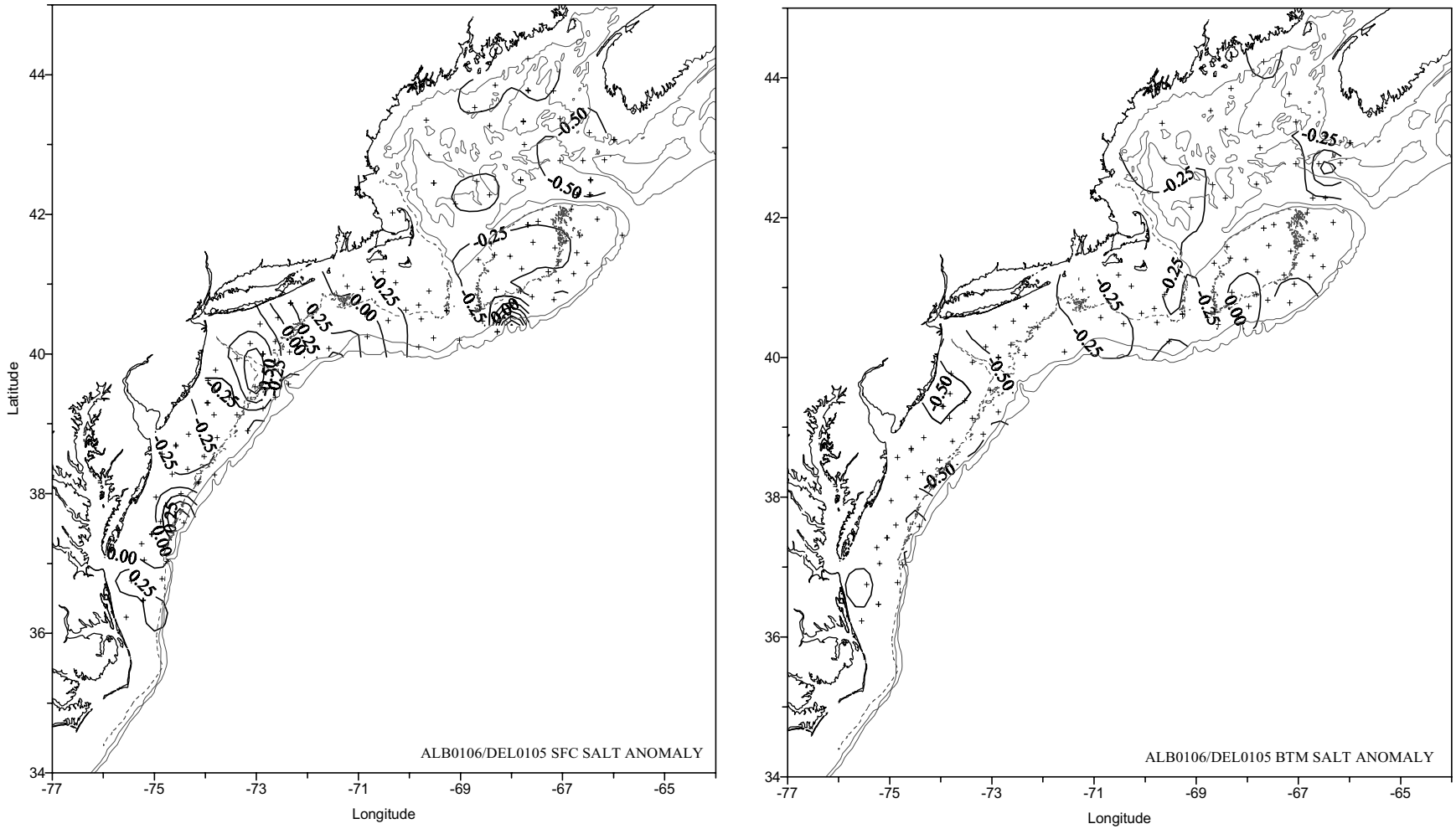


Figure 24. Surface (left) and bottom (right) salinity anomaly distributions for the ECOMON Survey ALB-01-06 and DEL-01-05.

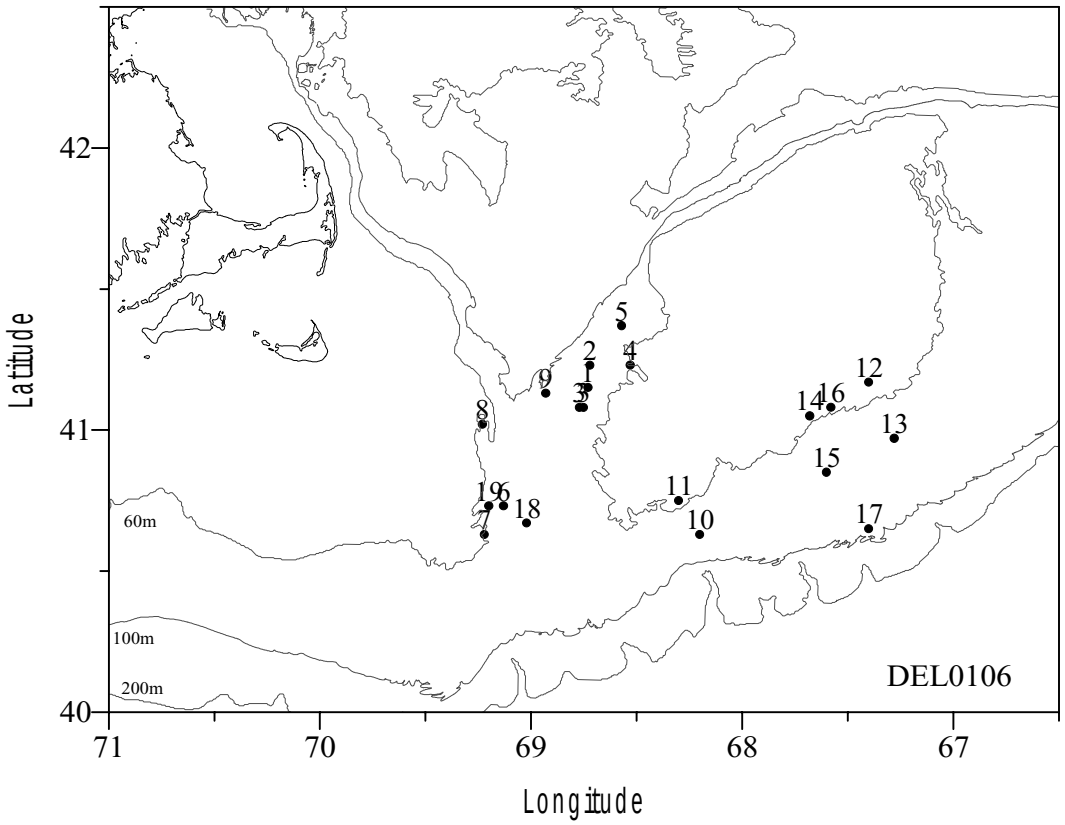


Figure 25. Hydrographic stations occupied during the Benthic Habitat cruise DEL-01-06.

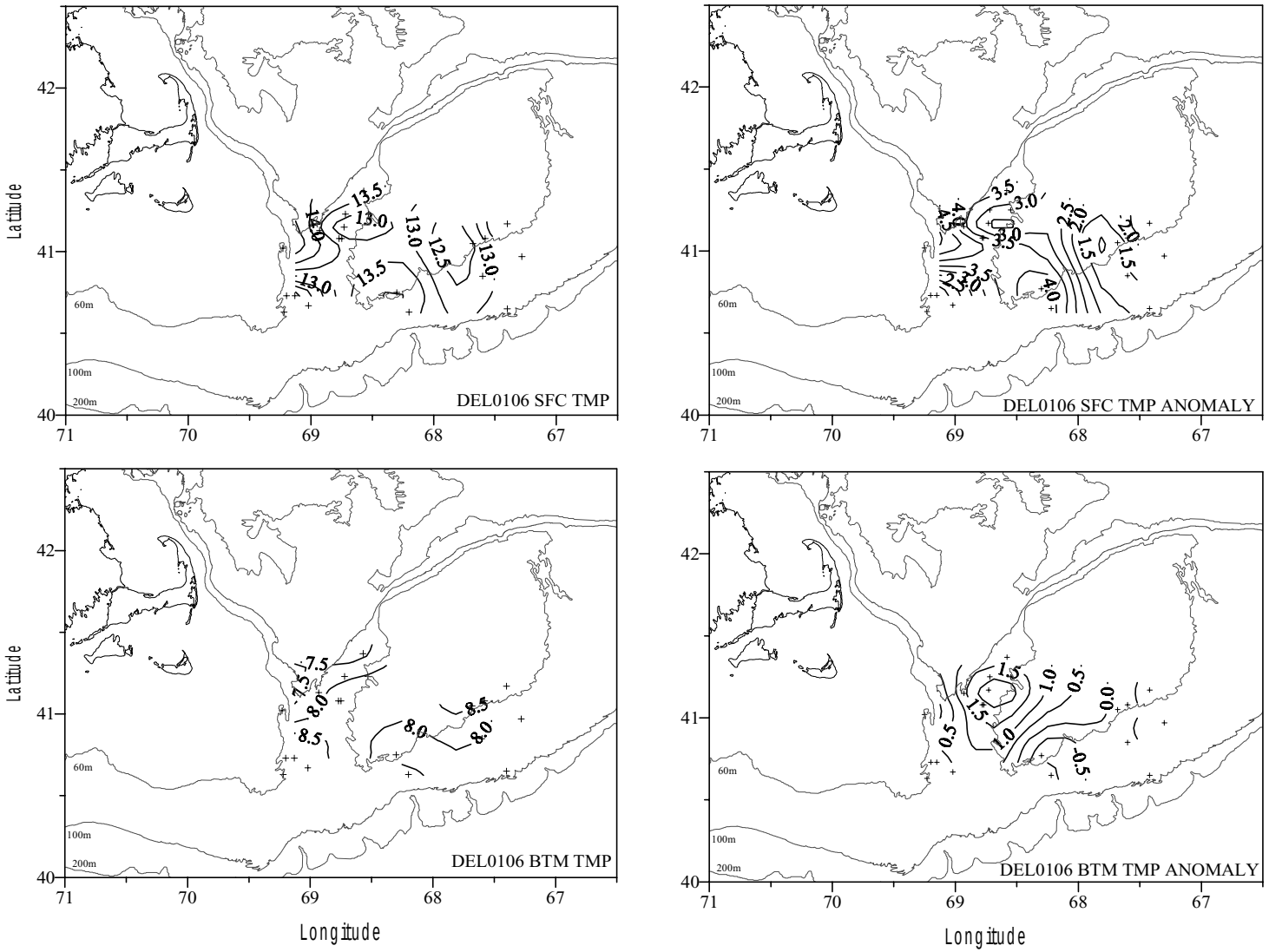


Figure 26. Surface and bottom temperature (left) and surface and bottom temperature anomaly (right) distributions for the Benthic Habitat cruise DEL-01-06.

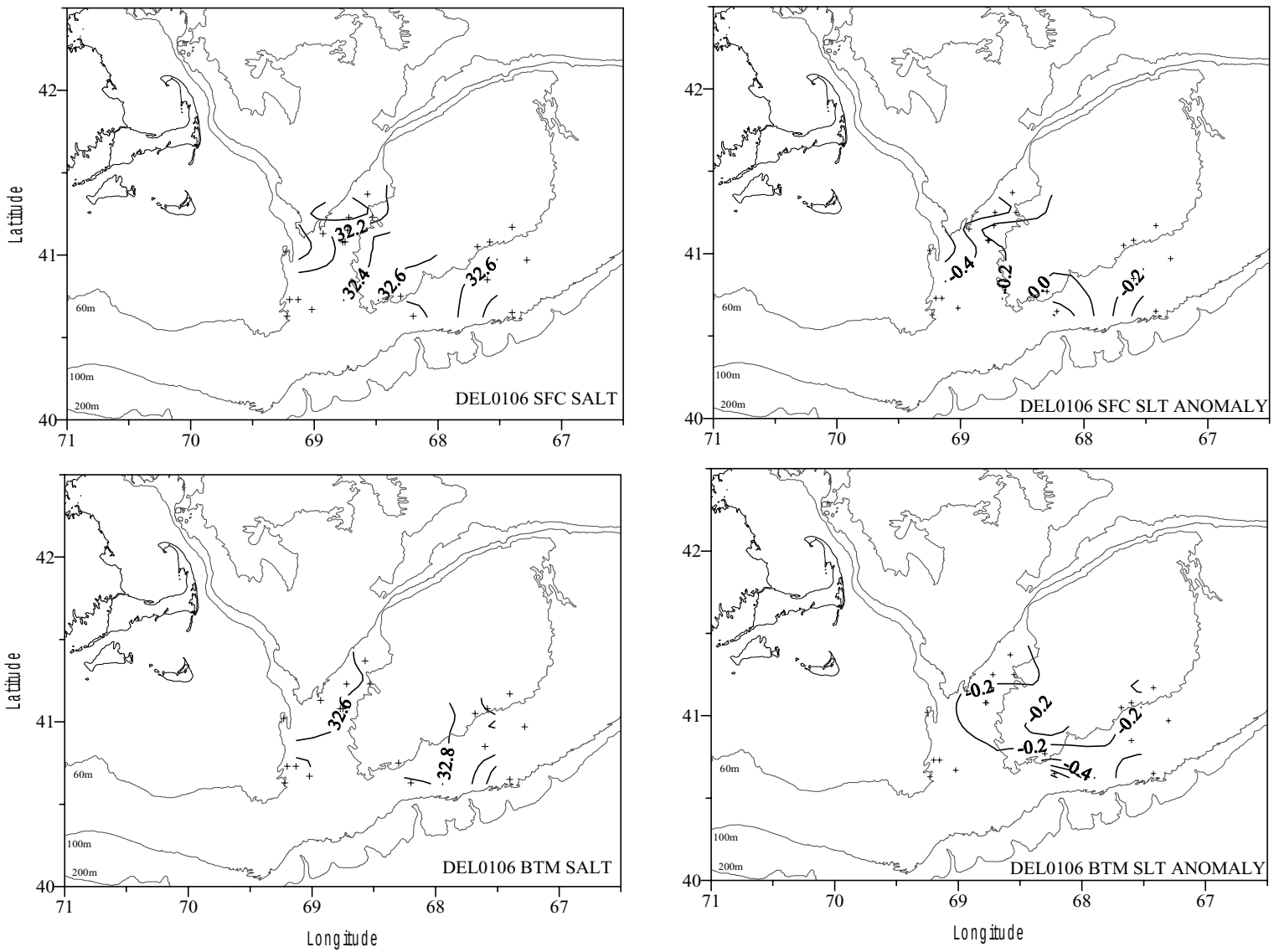


Figure 27. Surface and bottom salinity (left) and surface and bottom salinity anomaly (right) distributions for the Benthic Habitat Cruise DEL-01-06.

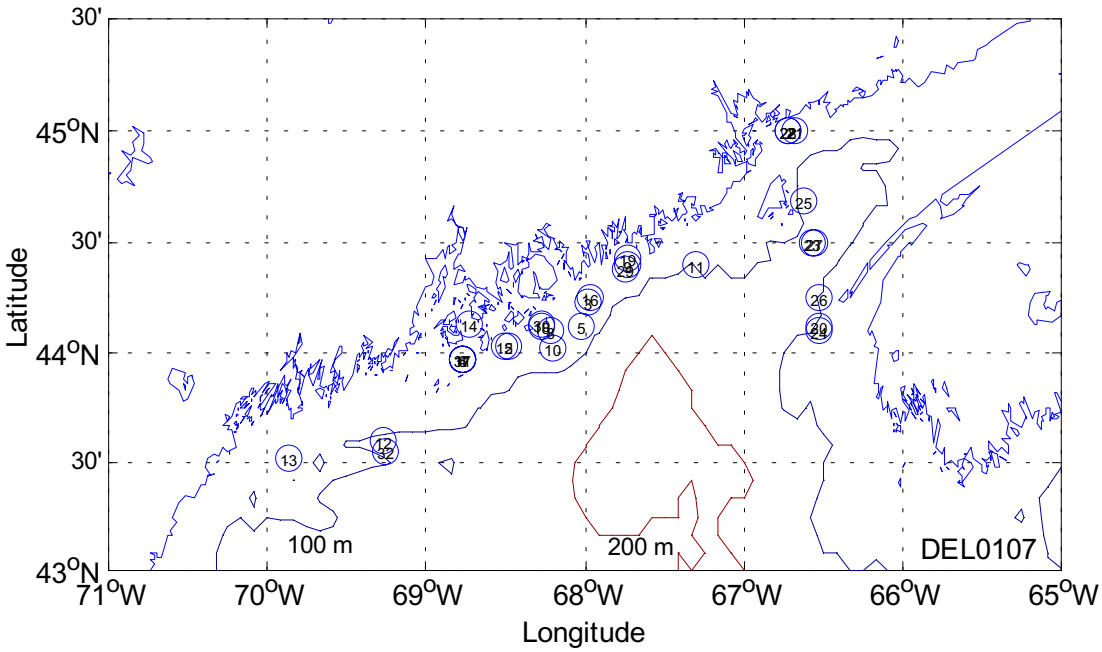


Figure 28. Hydrographic stations occupied during the AWARE Sonar Test cruise DEL-01-07.

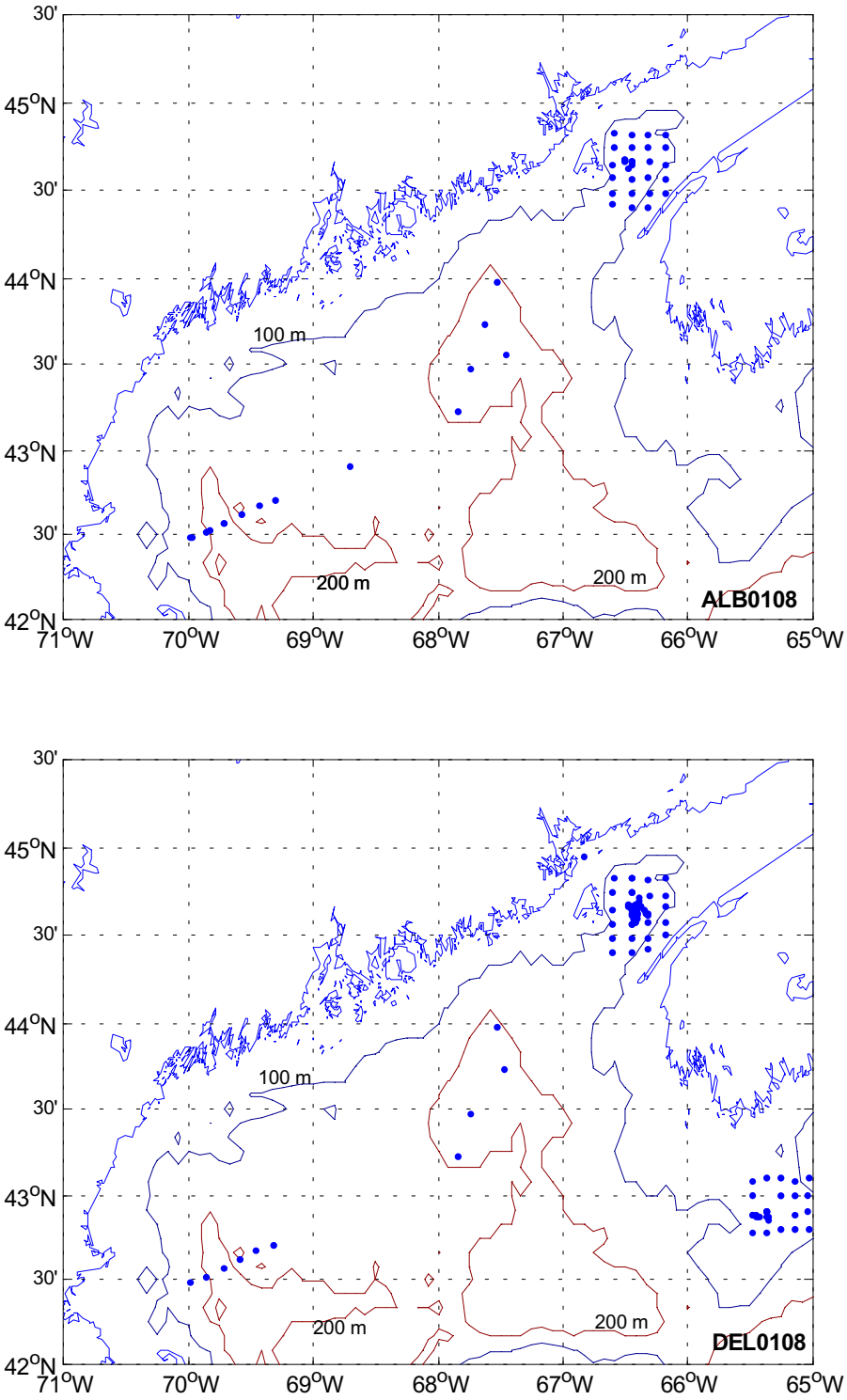


Figure 29. Hydrographic stations occupied during the Right Whale survey ALB-01-08 and DEL-01-08.

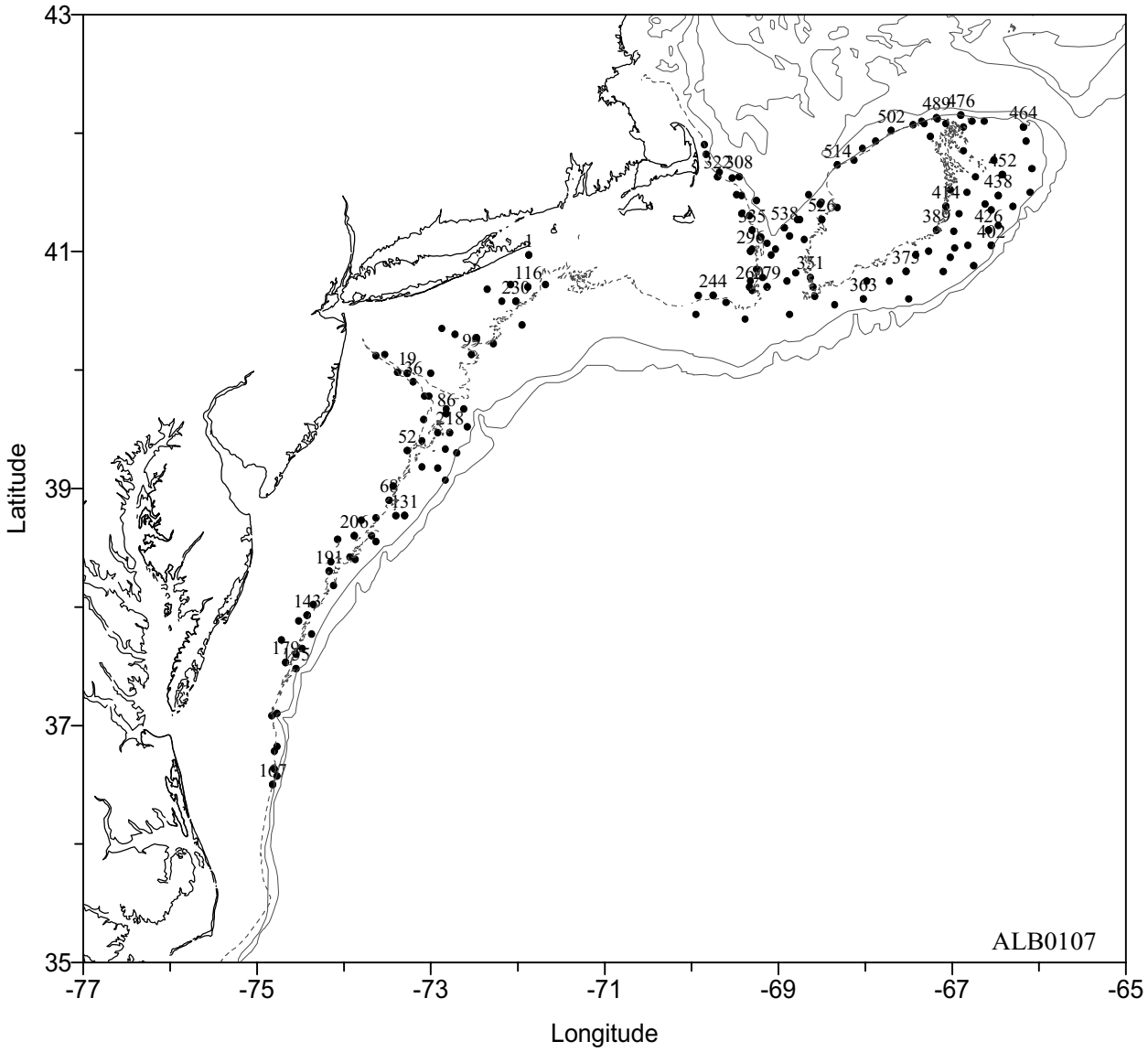


Figure 30. Hydrographic stations occupied during the Scallop Survey ALB-01-07.

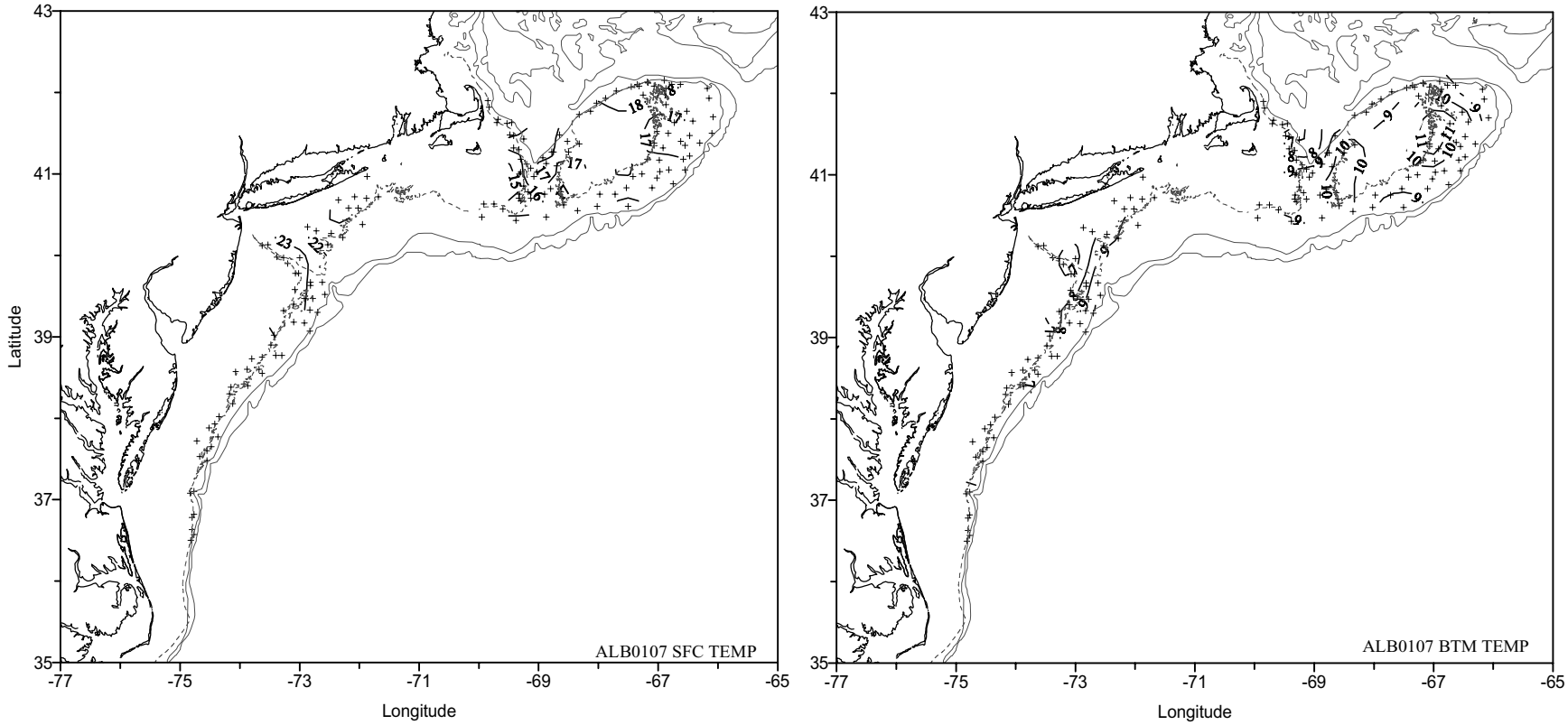


Figure 31. Surface (left) and bottom (right) temperature distributions for the Scallop Survey ALB-01-07.

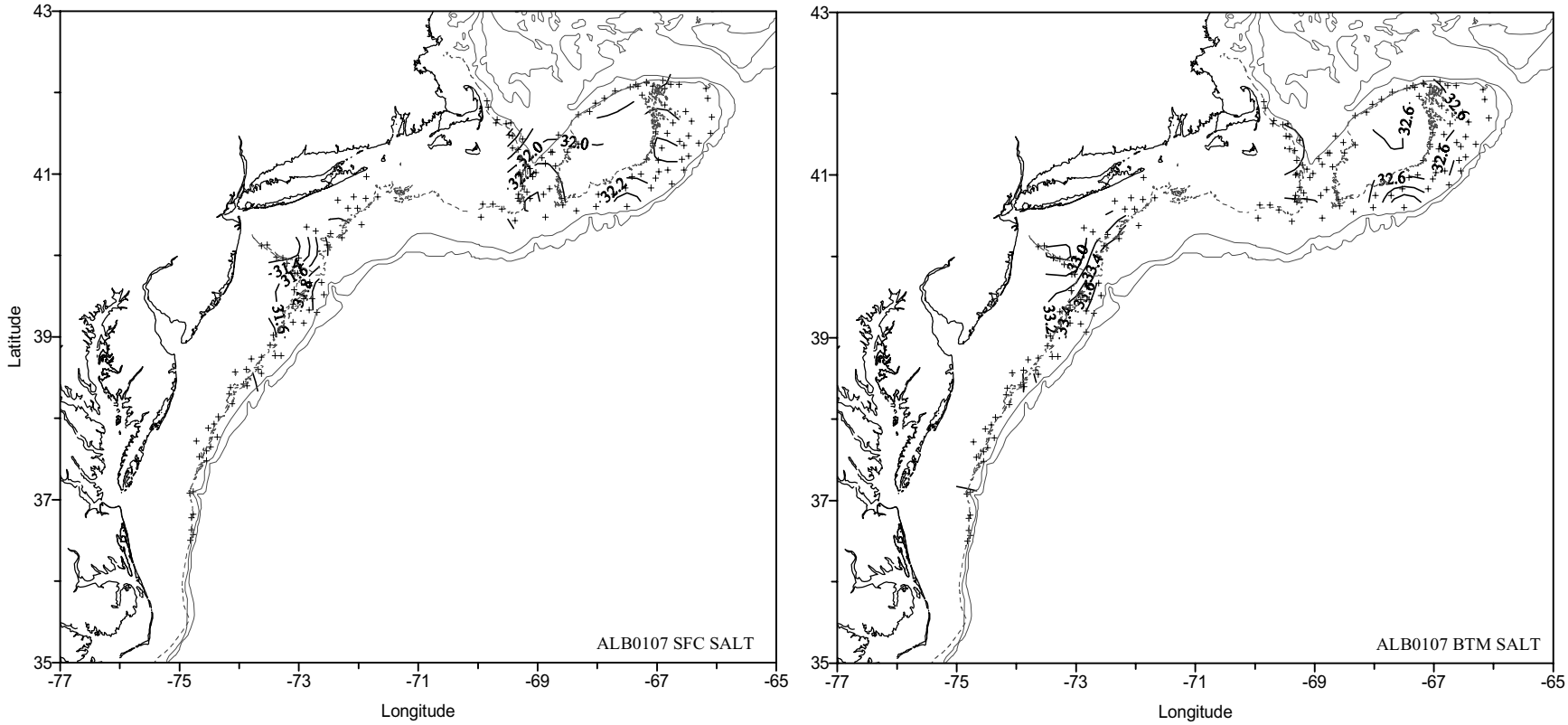


Figure 32. Surface (left) and bottom (right) salinity distributions for the Scallop Survey ALB-01-07.

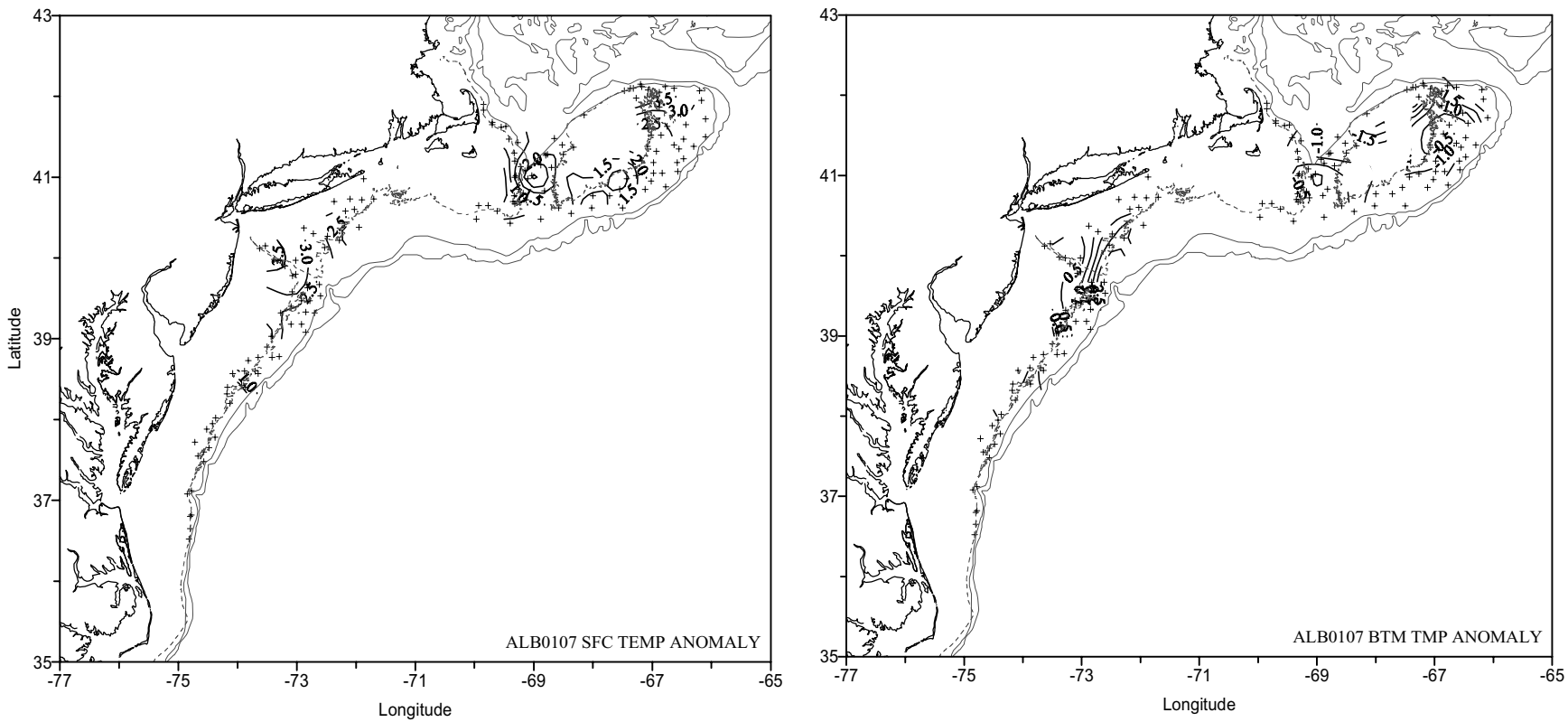


Figure 33. Surface (left) and bottom (right) temperature anomaly distributions for the Scallop Survey ALB-01-07.

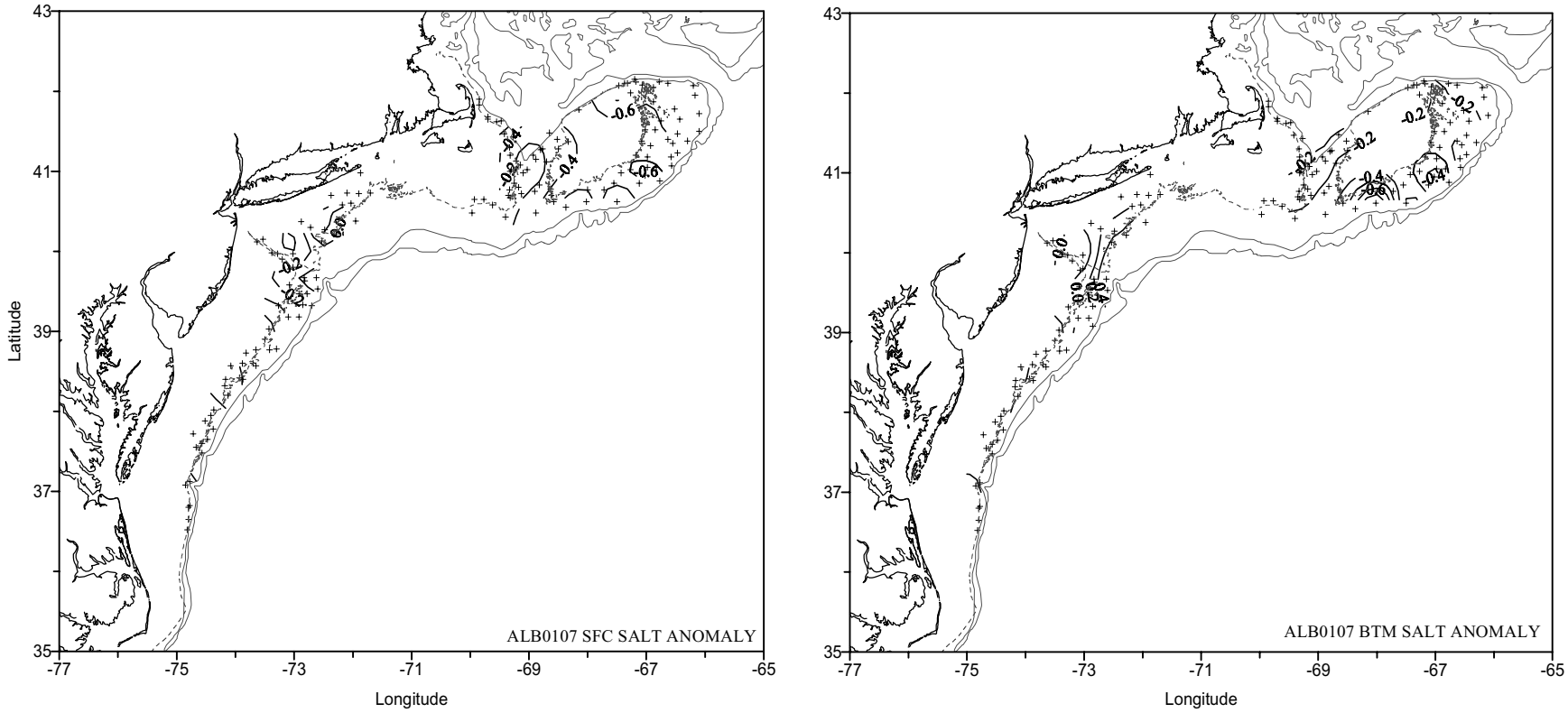


Figure 34. Surface (left) and bottom (right) salinity anomaly distributions for the Scallop Survey ALB-01-07.

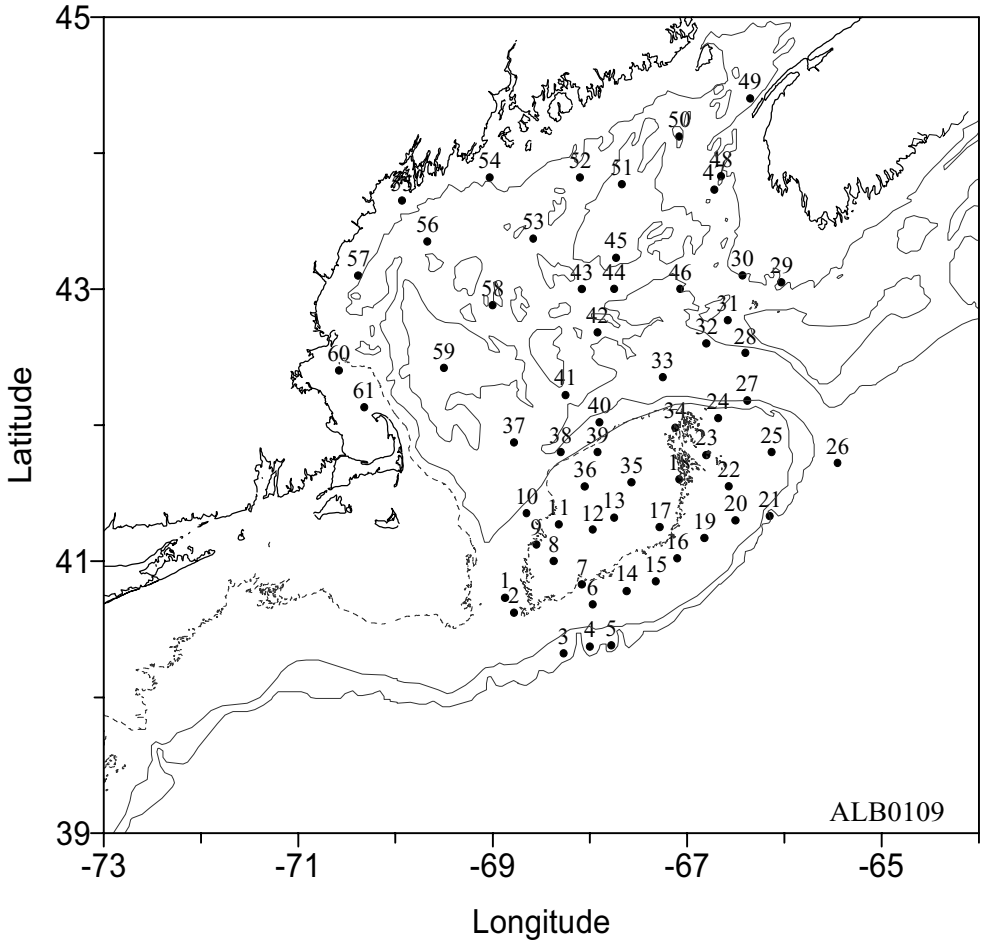


Figure 35. Hydrographic stations occupied during the ECOMON Survey ALB-01-09.

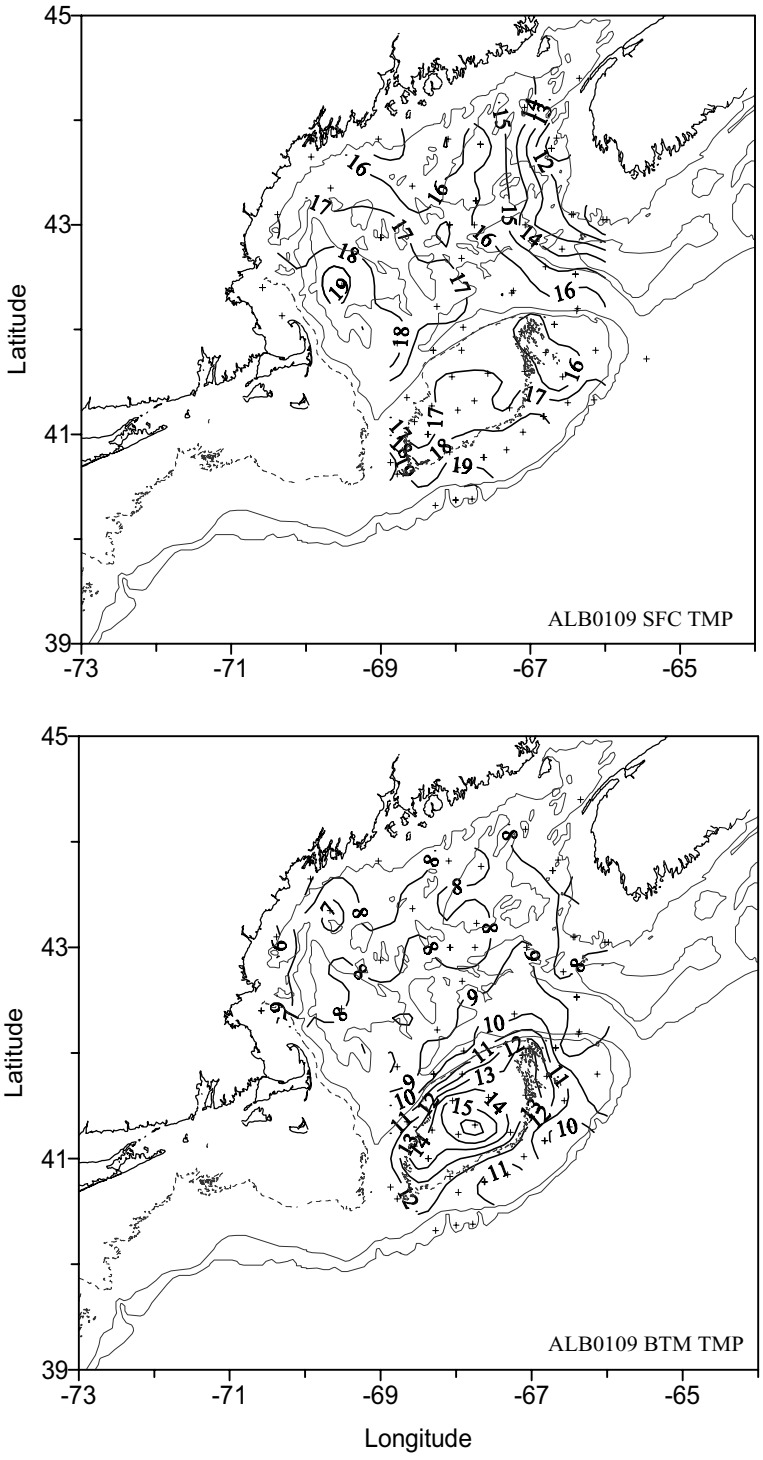


Figure 36. Surface (upper) and bottom (lower) temperature distributions for the ECOMON Survey ALB-01-09.

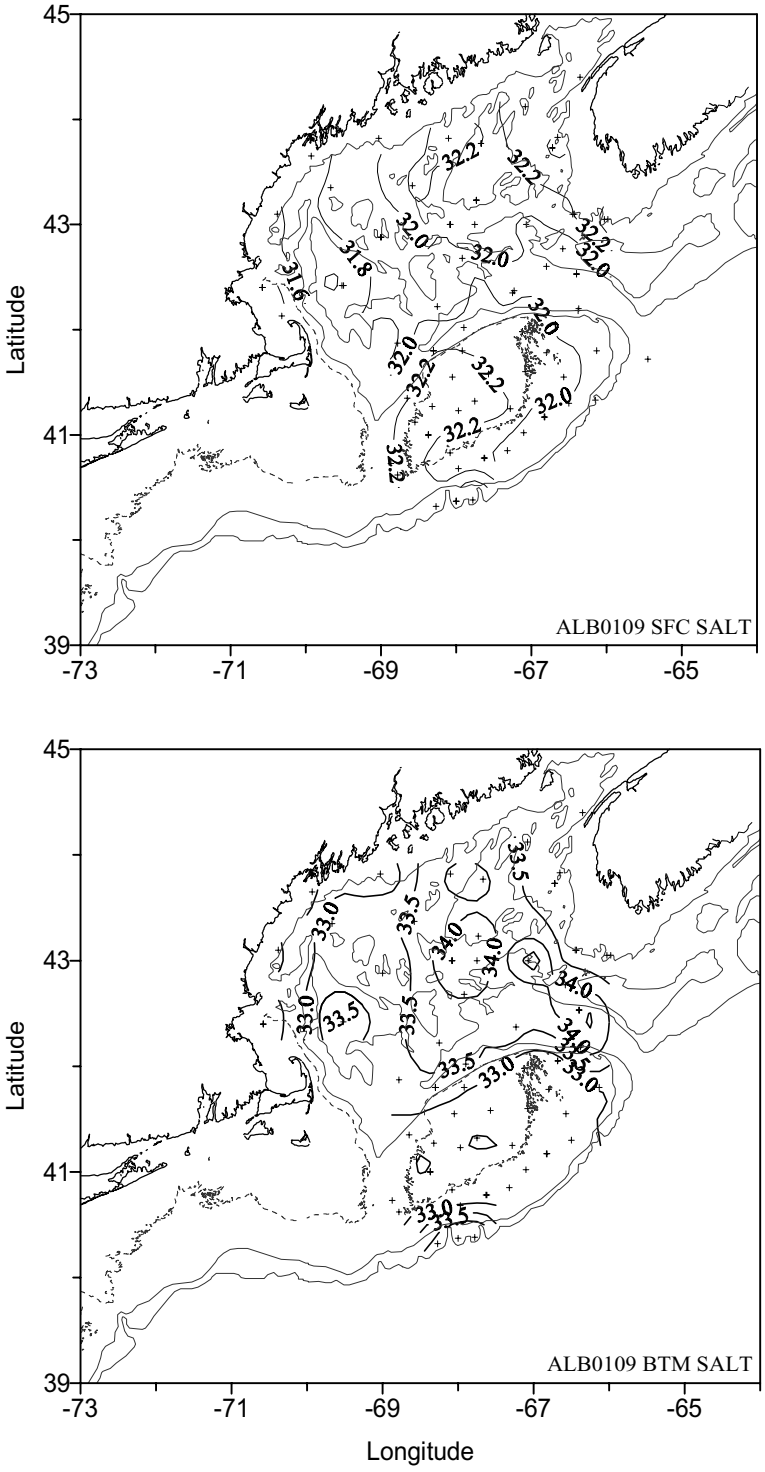


Figure 37. Surface (upper) and bottom (lower) salinity distributions for the ECOMON Survey ALB-01-09.

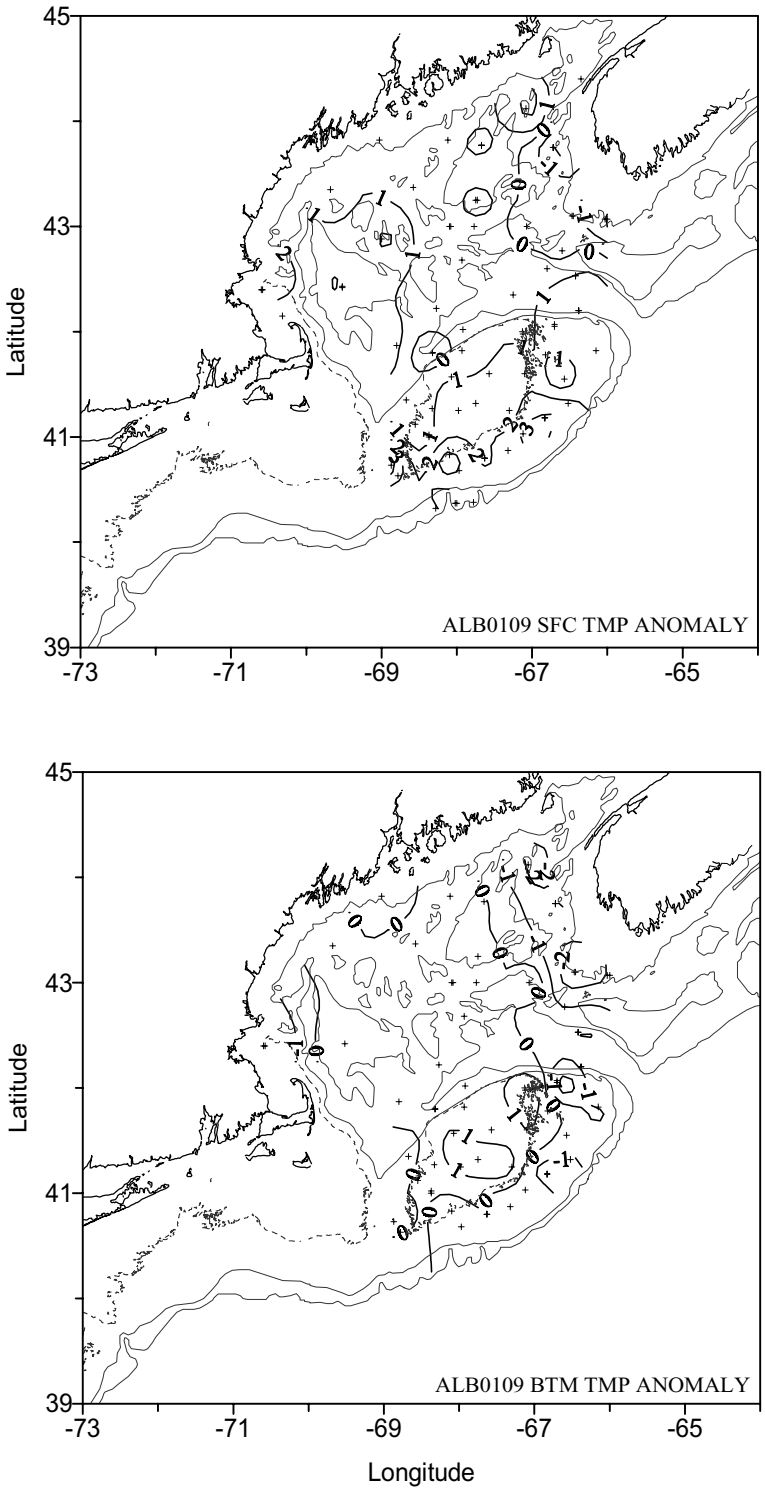


Figure 38. Surface (upper) and bottom (lower) temperature anomaly distributions for the ECOMON survey ALB-01-09.

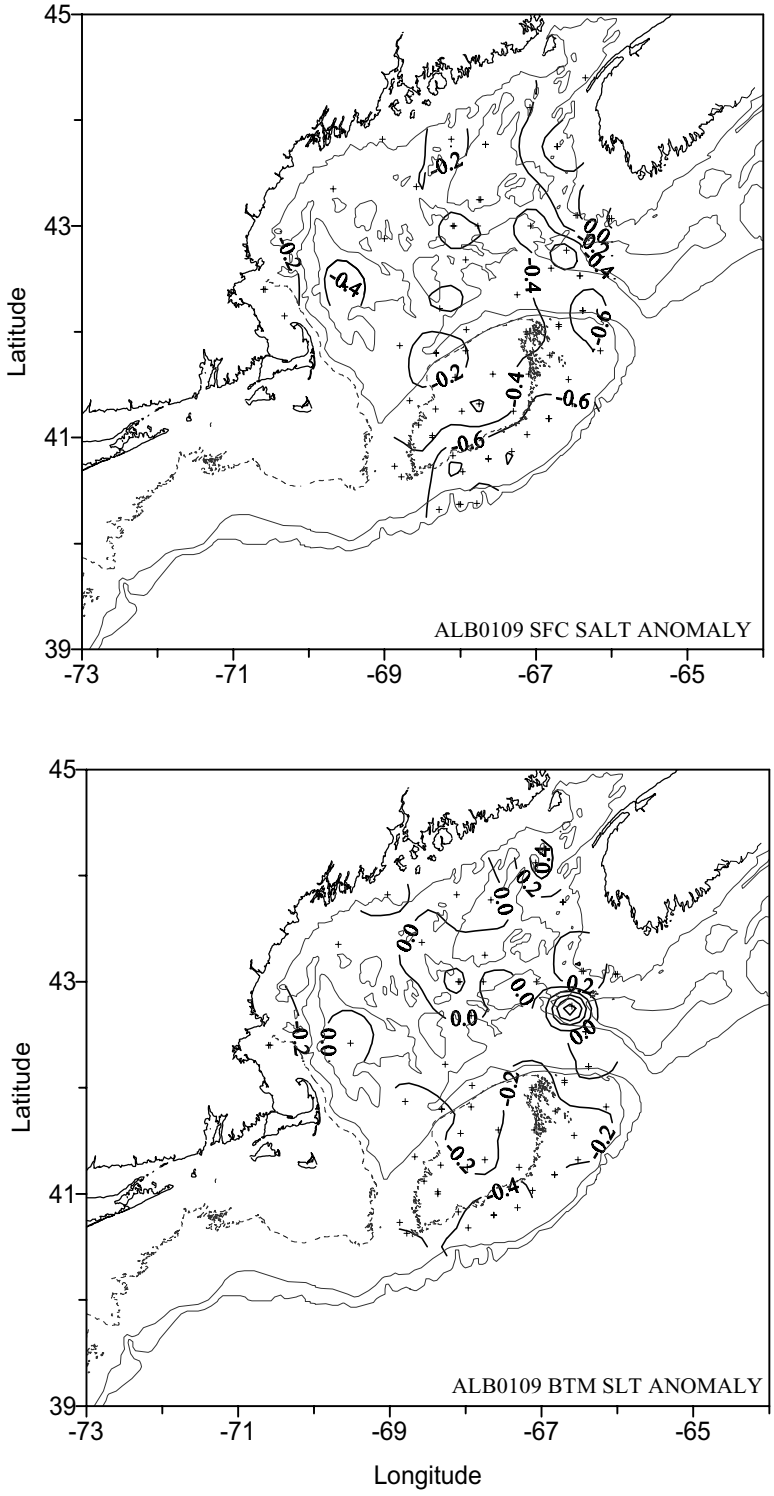


Figure 39. Surface (upper) and bottom (lower) salinity anomaly distributions for the ECOMON Survey ALB-01-09.

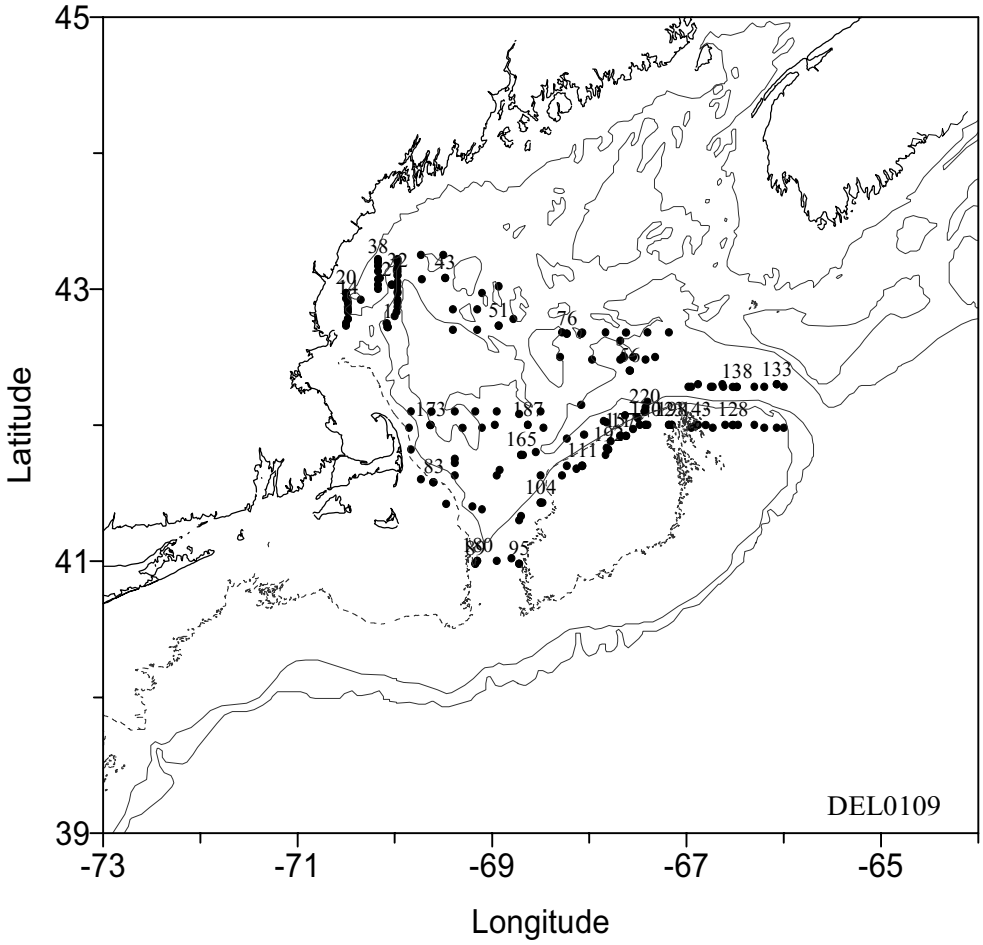


Figure 40. Hydrographic stations occupied during the HydroAcoustic survey DEL-01-09.

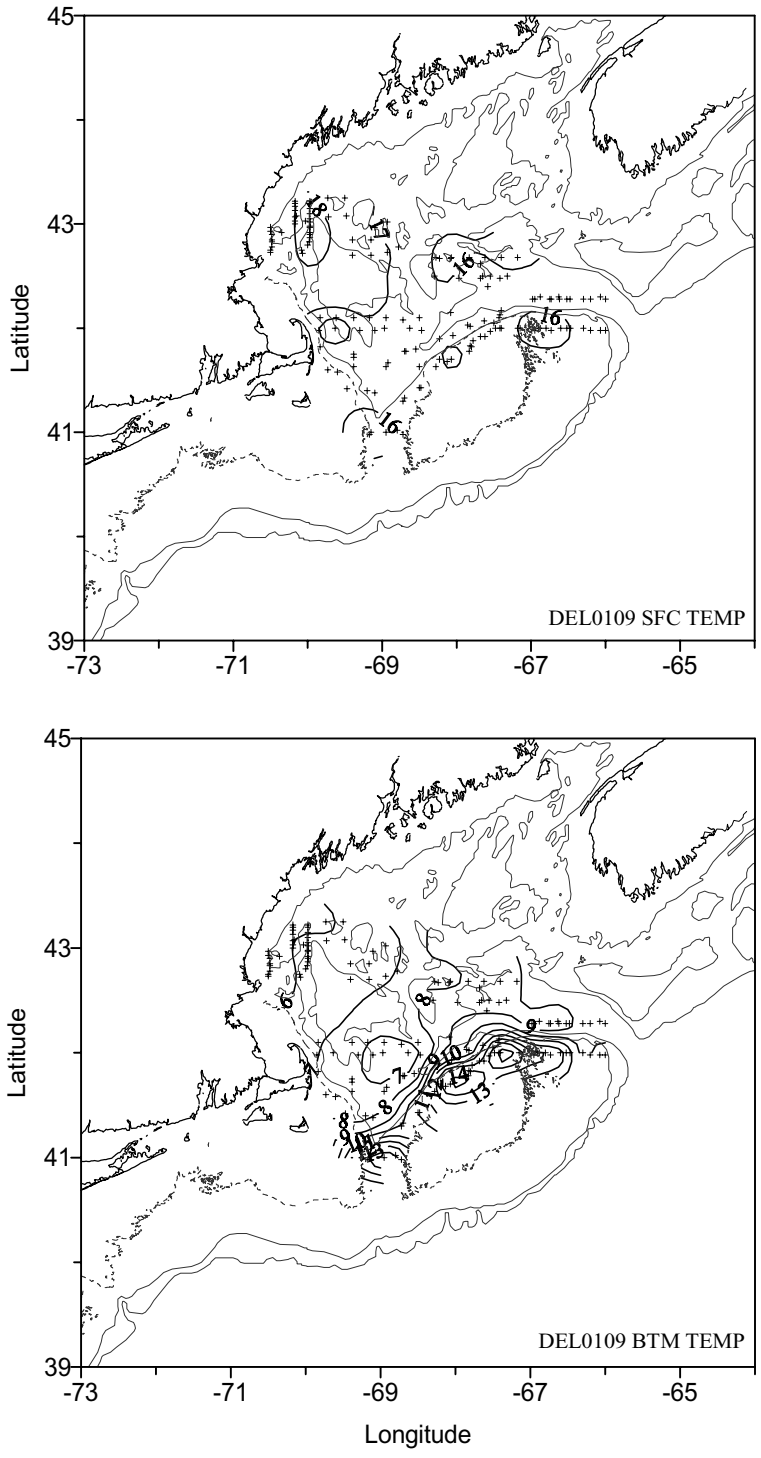


Figure 41. Surface (upper) and bottom (lower) temperature distributions for the HydroAcoustic Survey DEL-01-09.

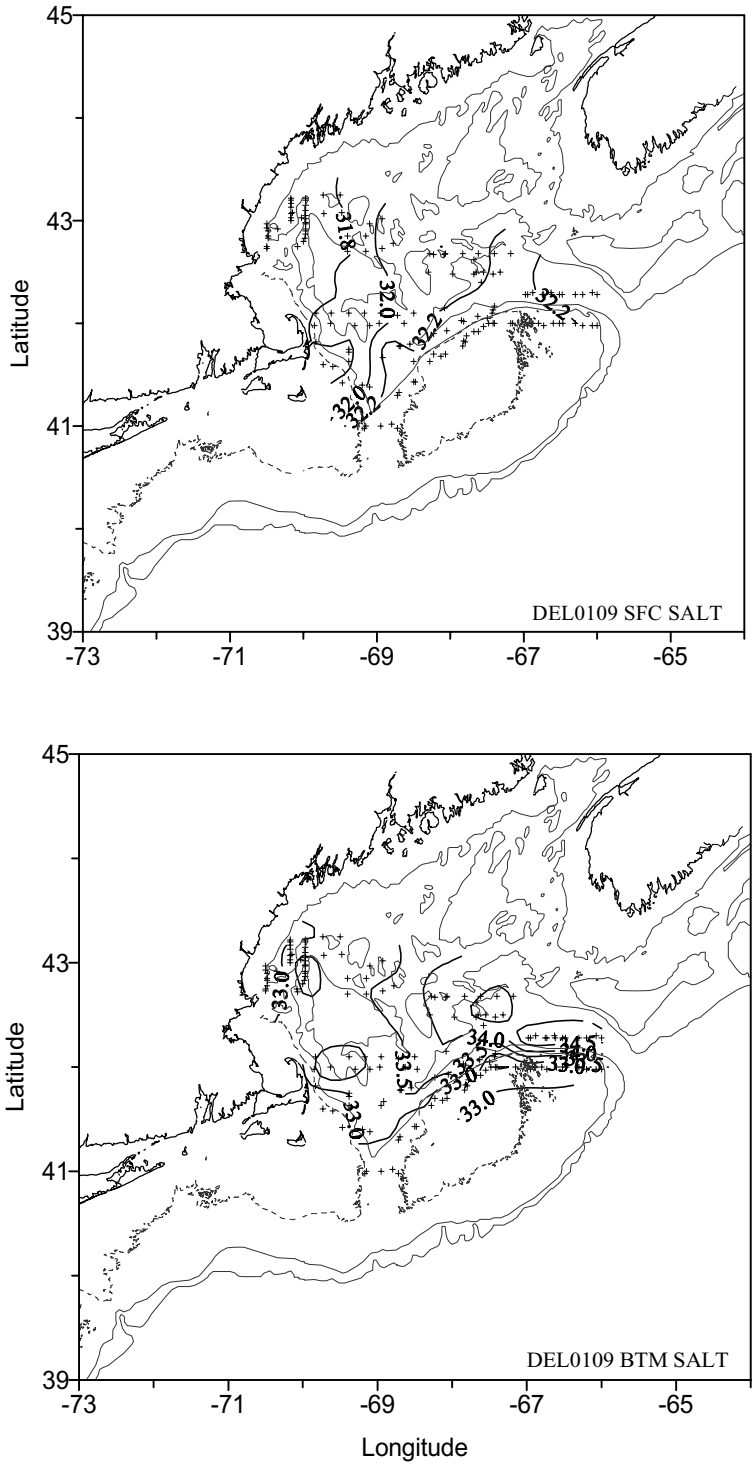


Figure 42. Surface (upper) and bottom (lower) salinity distributions for the HydroAcoustic Survey DEL-01-09.

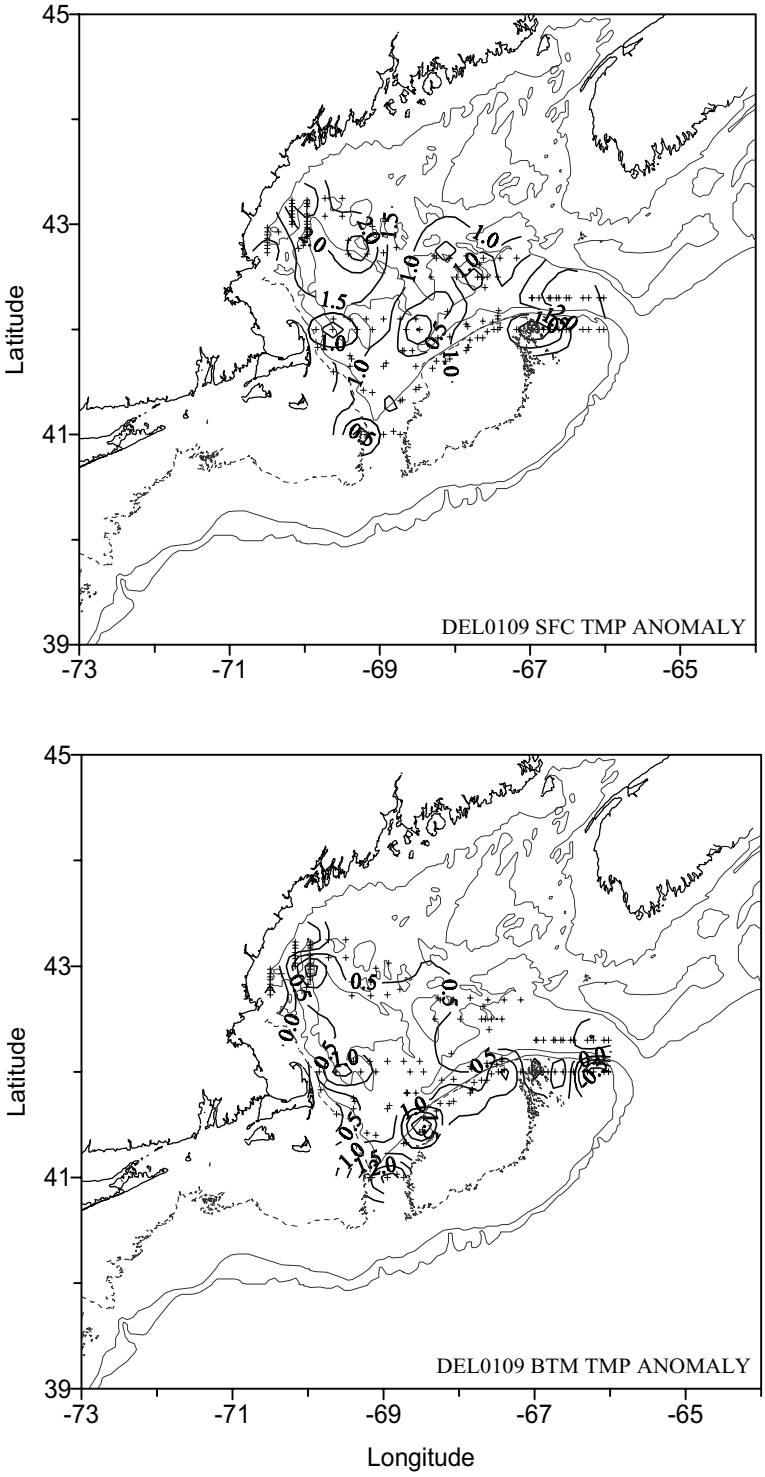


Figure 43. Surface (upper) and bottom (lower) temperature anomaly distributions for the HydroAcoustic survey DEL-01-09.

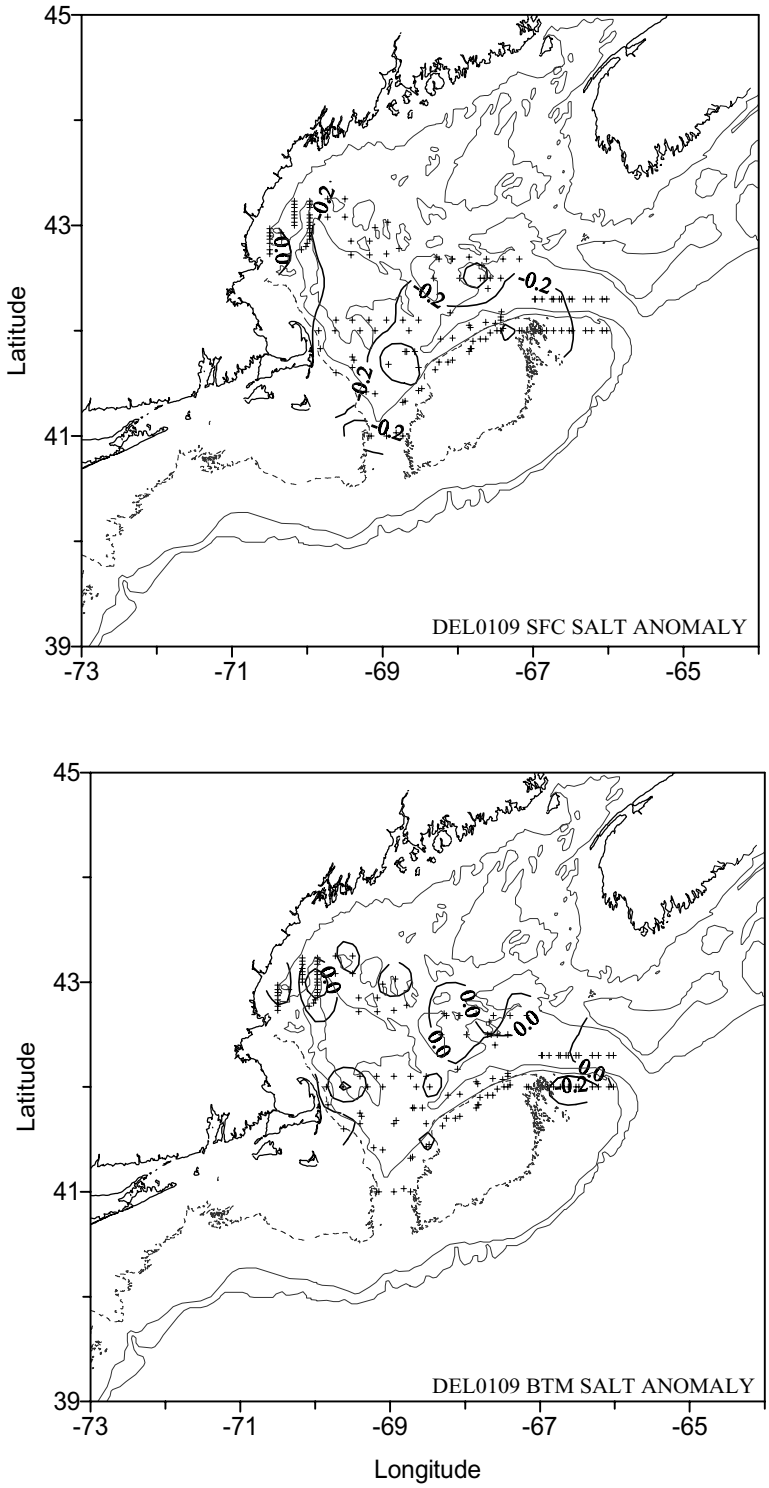


Figure 44. Surface (upper) and bottom (lower) salinity anomaly distributions for the HydroAcoustic survey DEL-01-09.

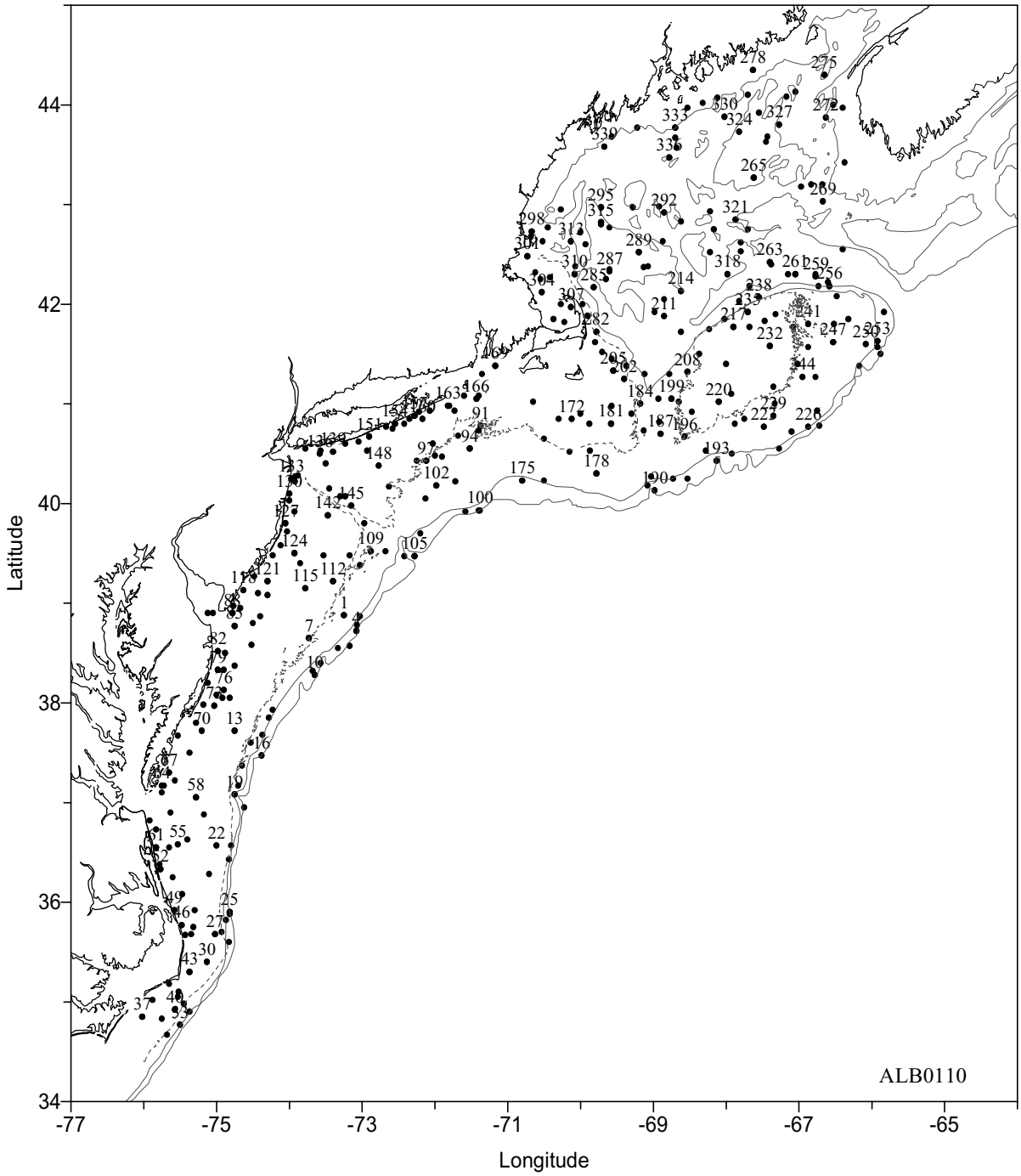


Figure 45. Hydrographic stations occupied during the Fall Bottom Trawl survey ALB-01-10.

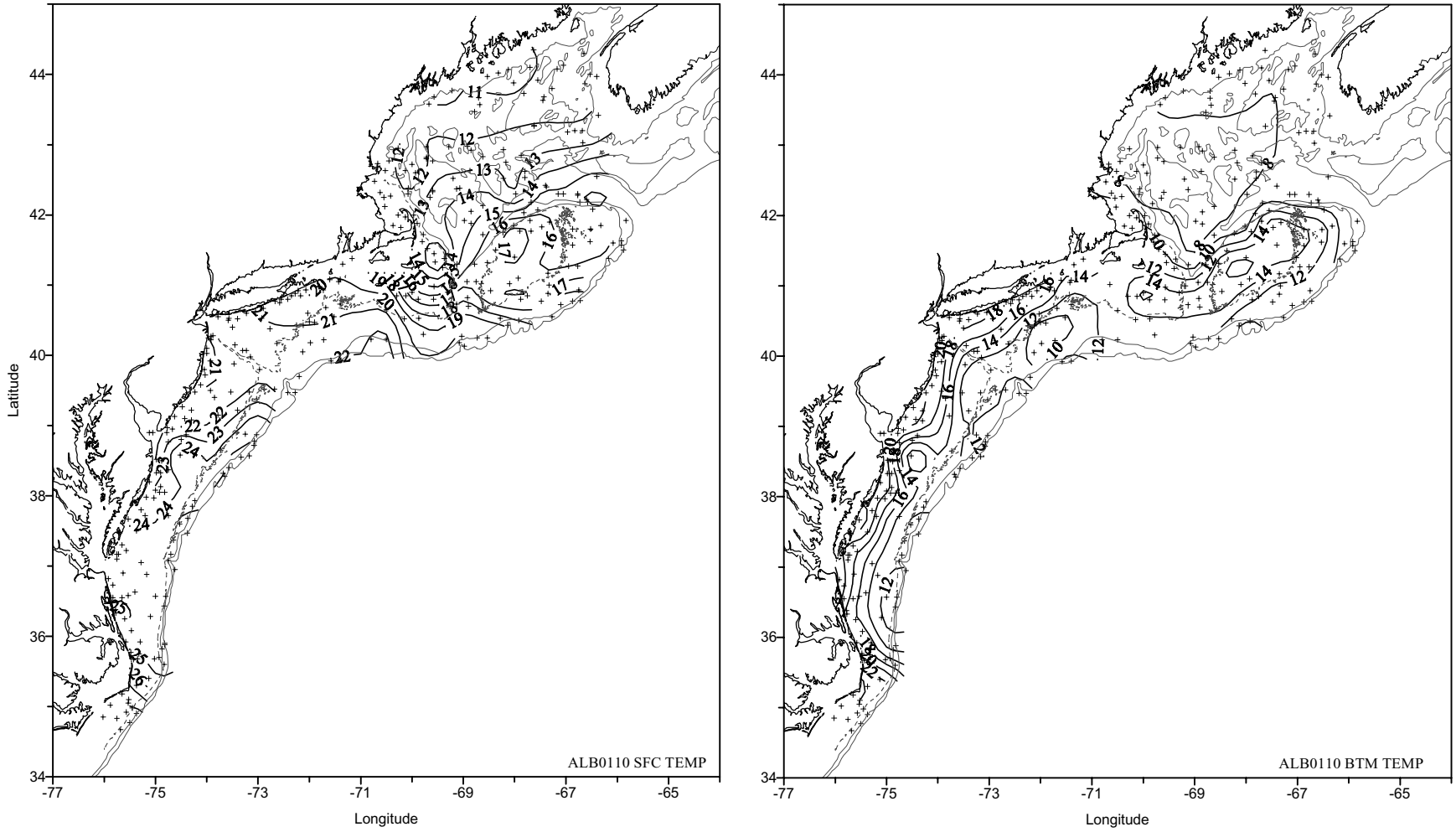


Figure 46. Surface (left) and bottom (right) temperature distributions for the Fall Bottom Trawl survey ALB-01-10.

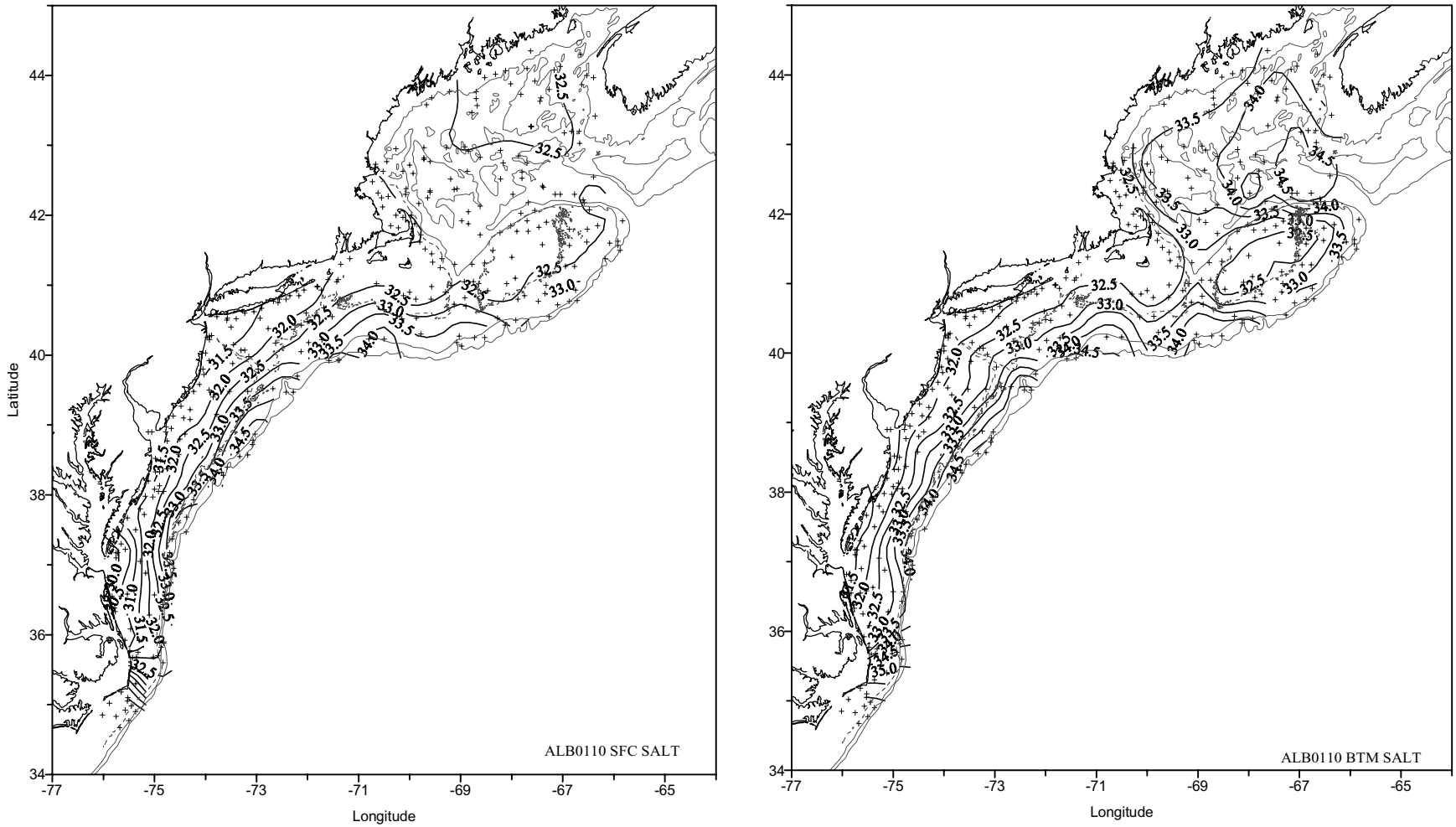


Figure 47. Surface (left) and bottom (right) salinity distributions for the Fall Bottom Trawl survey ALB-01-10.

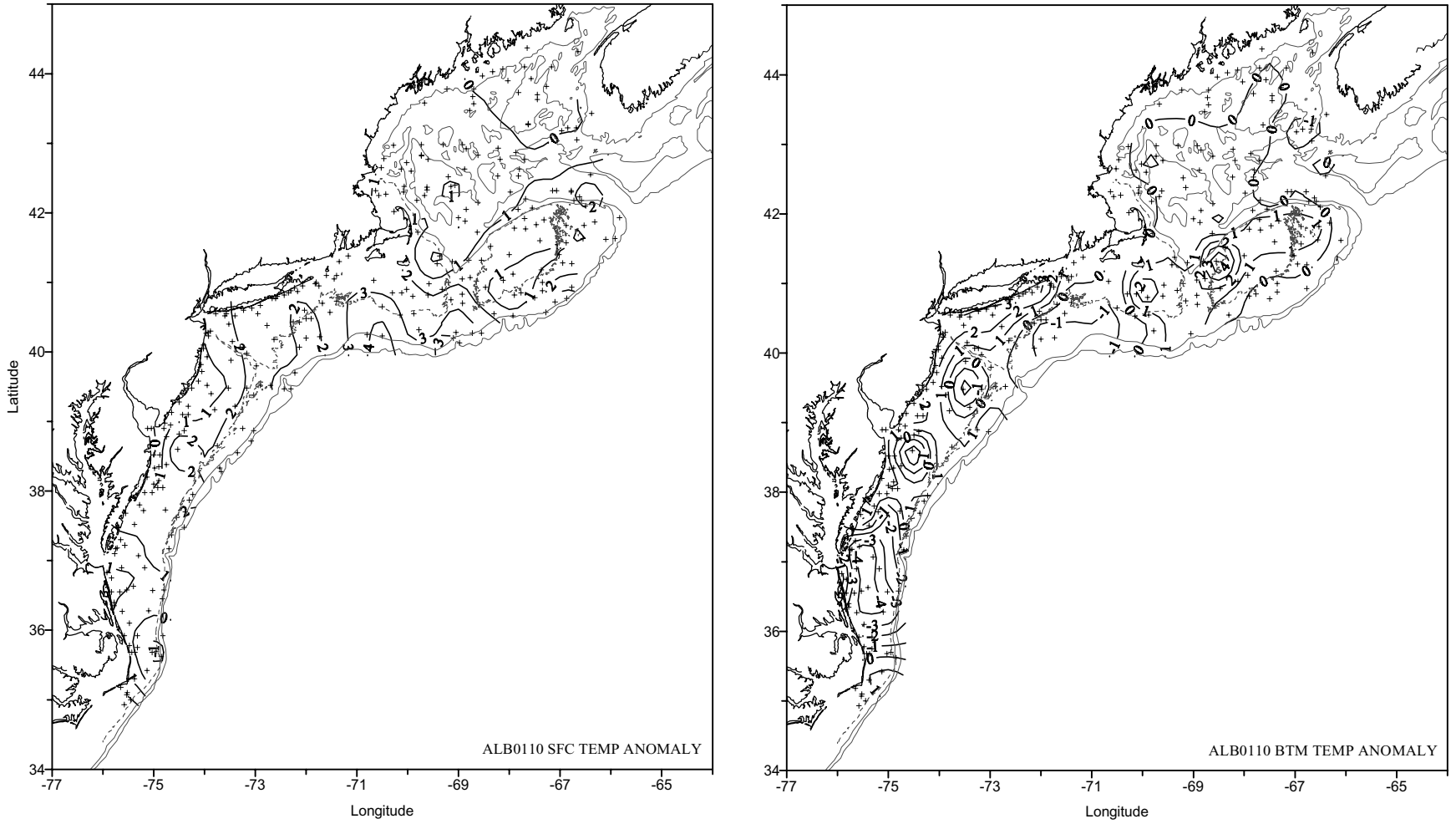


Figure 48. Surface (left) and bottom (right) temperature anomaly distributions for the Fall Bottom Trawl survey ALB-01-10.

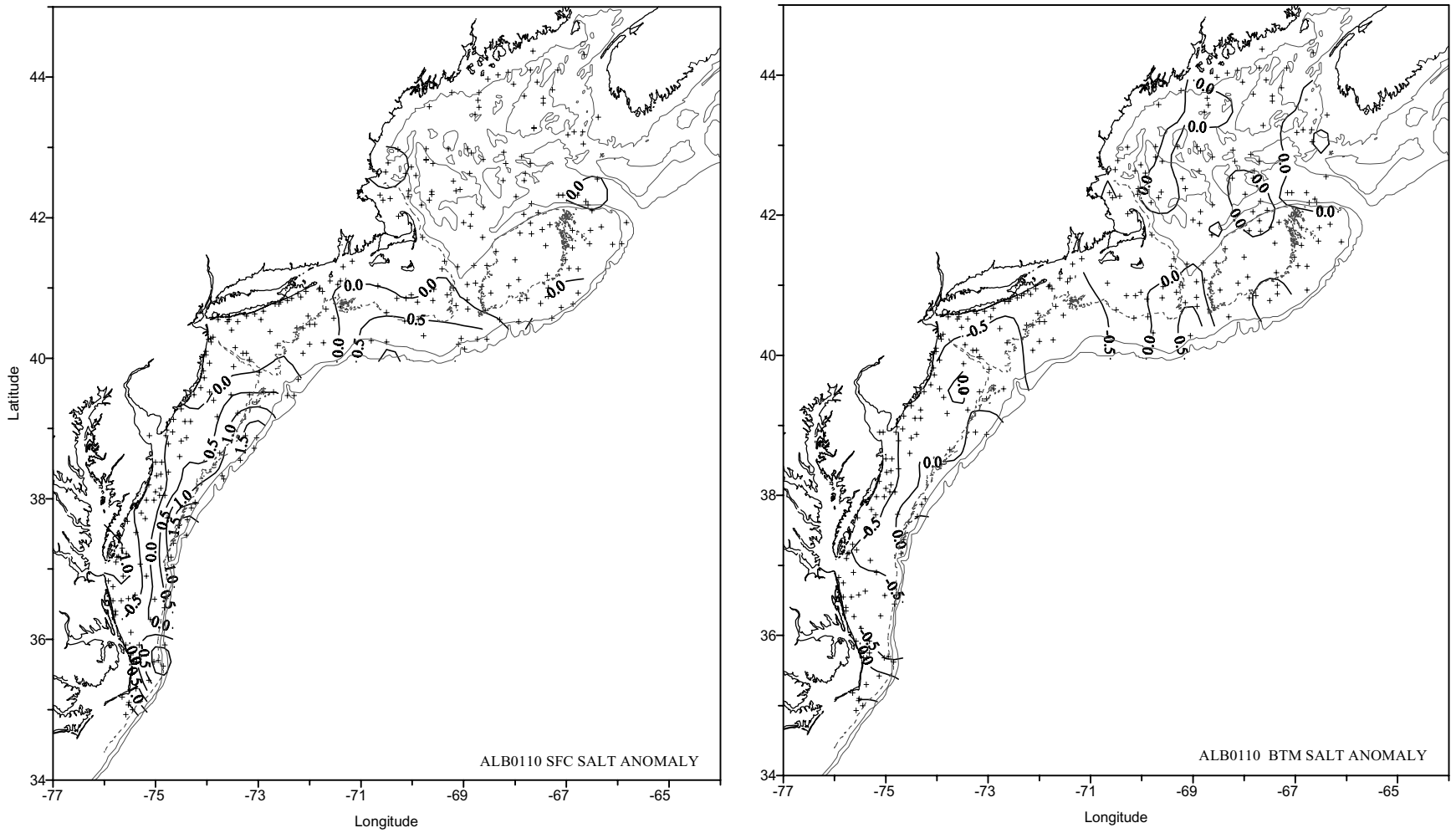


Figure 49. Surface (left) and bottom (right) salinity anomaly distributions for the Fall Bottom Trawl survey ALB-01-10.

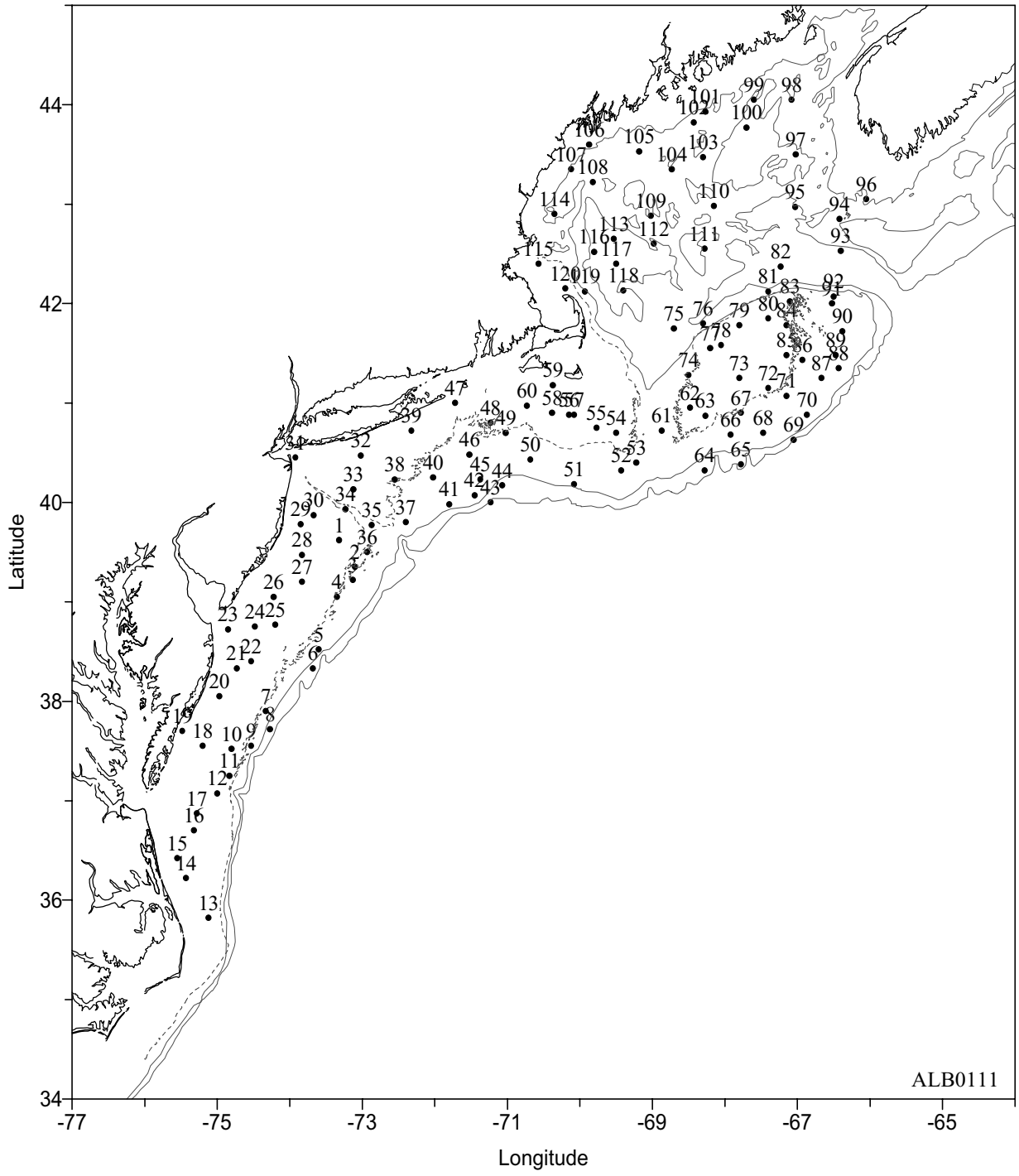


Figure 50. Hydrographic stations occupied during the ECOMON Survey ALB-01-11.

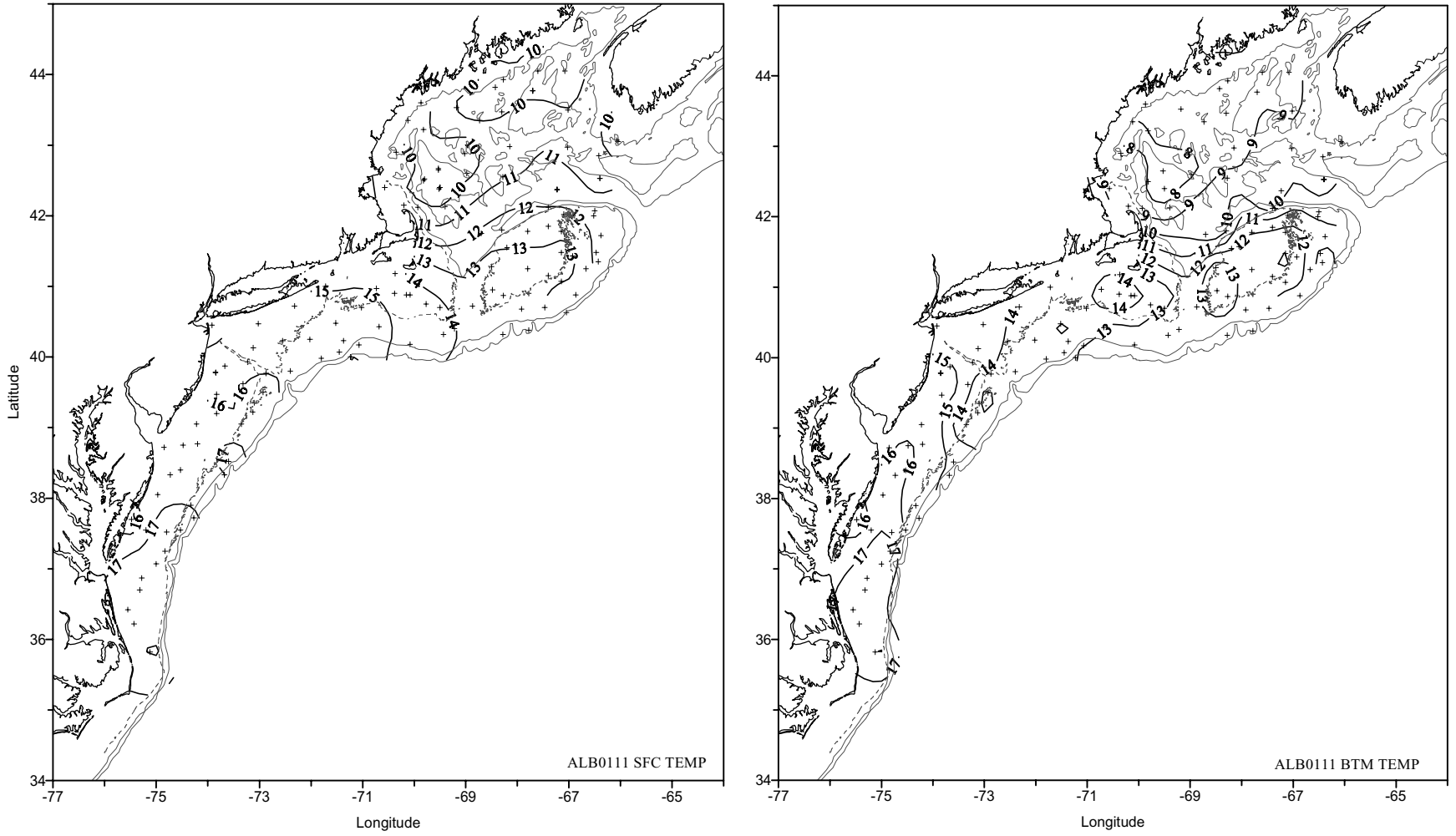


Figure 51. Surface (left) and bottom (right) temperature distributions for the ECOMON Survey ALB-01-11.

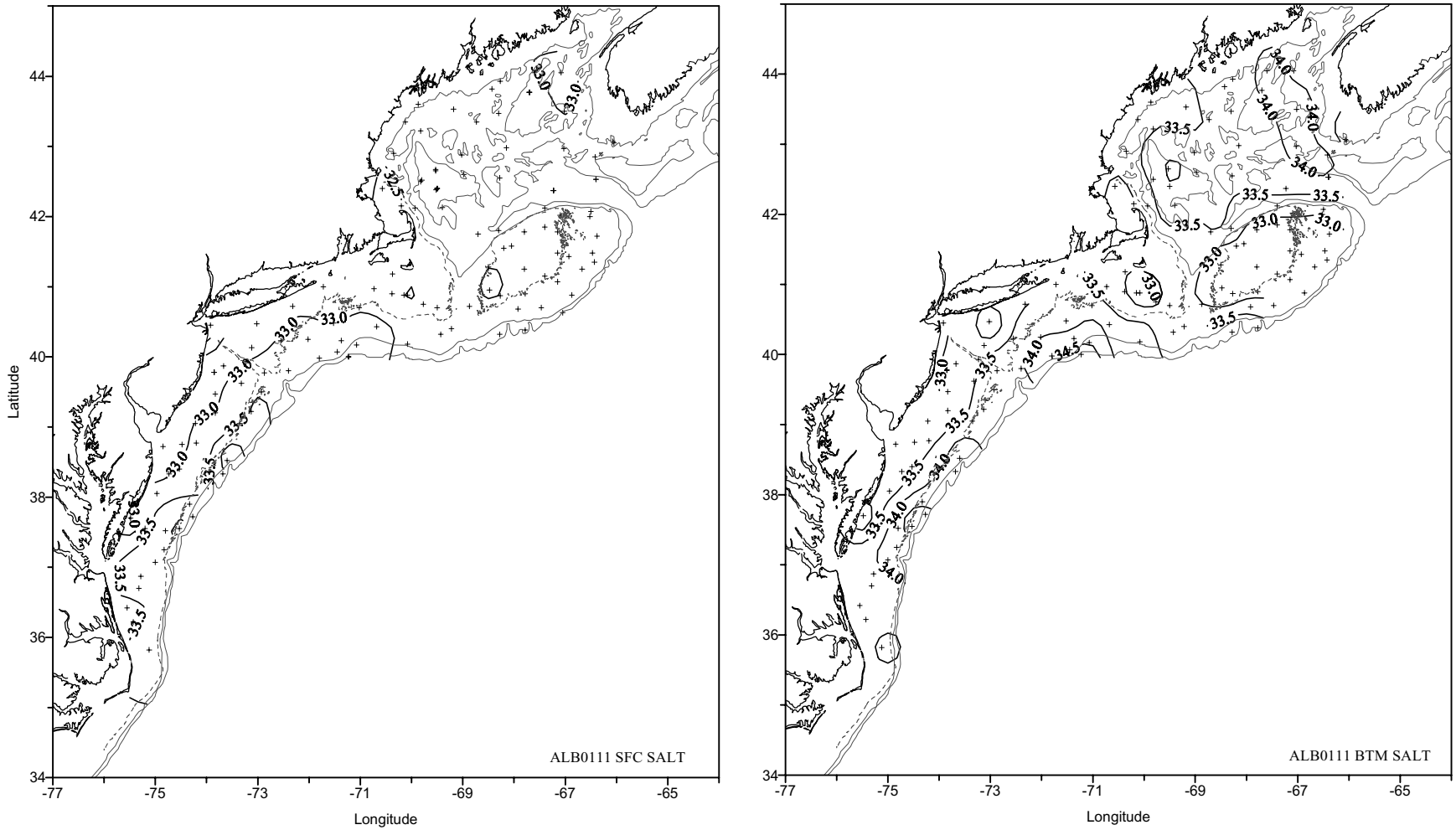


Figure 52. Surface (left) and bottom (right) salinity distributions for the ECOMON Survey ALB-01-11.

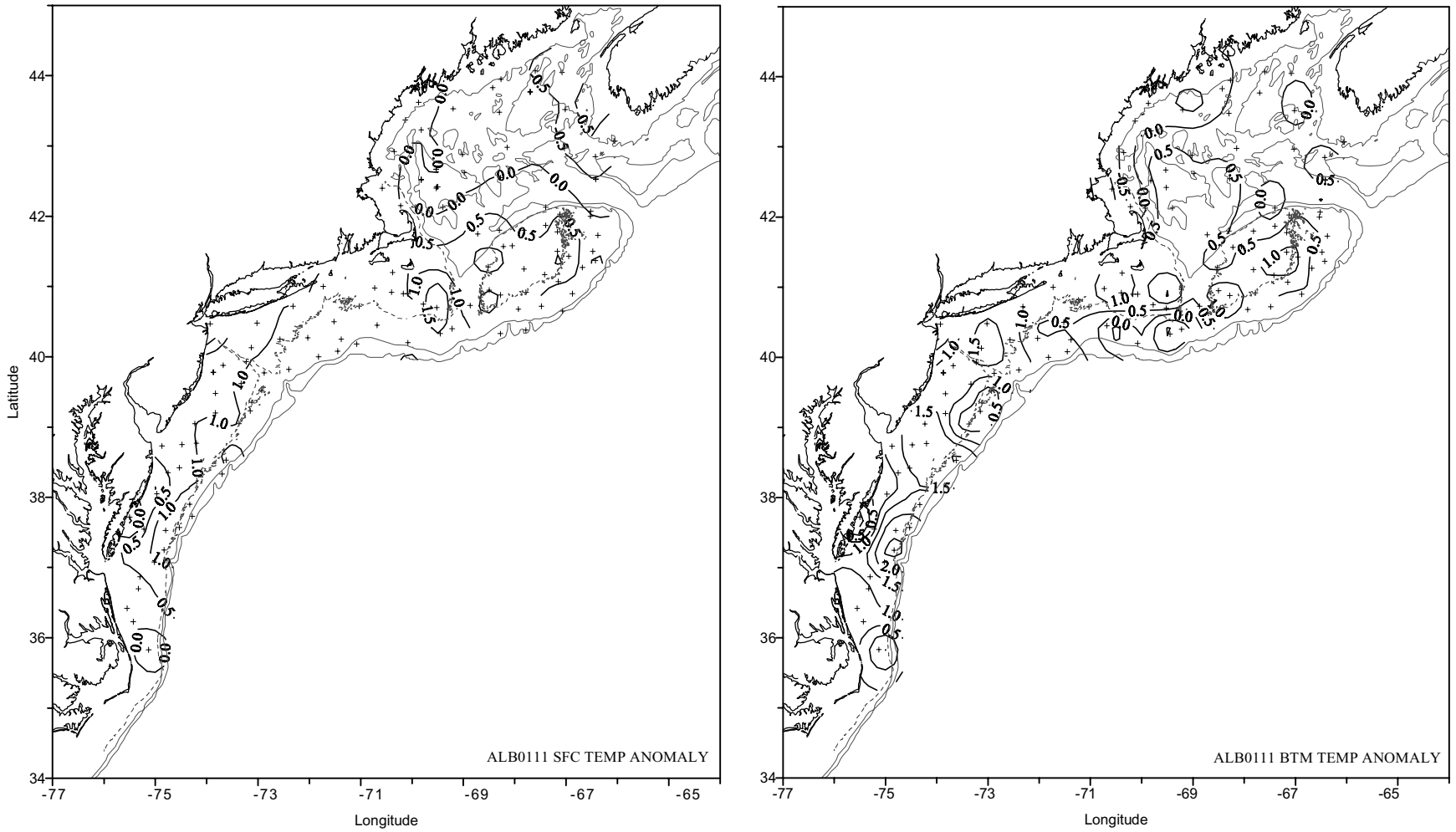


Figure 53. Surface (left) and bottom (right) temperature anomaly distributions for the ECOMON Survey ALB-01-11.

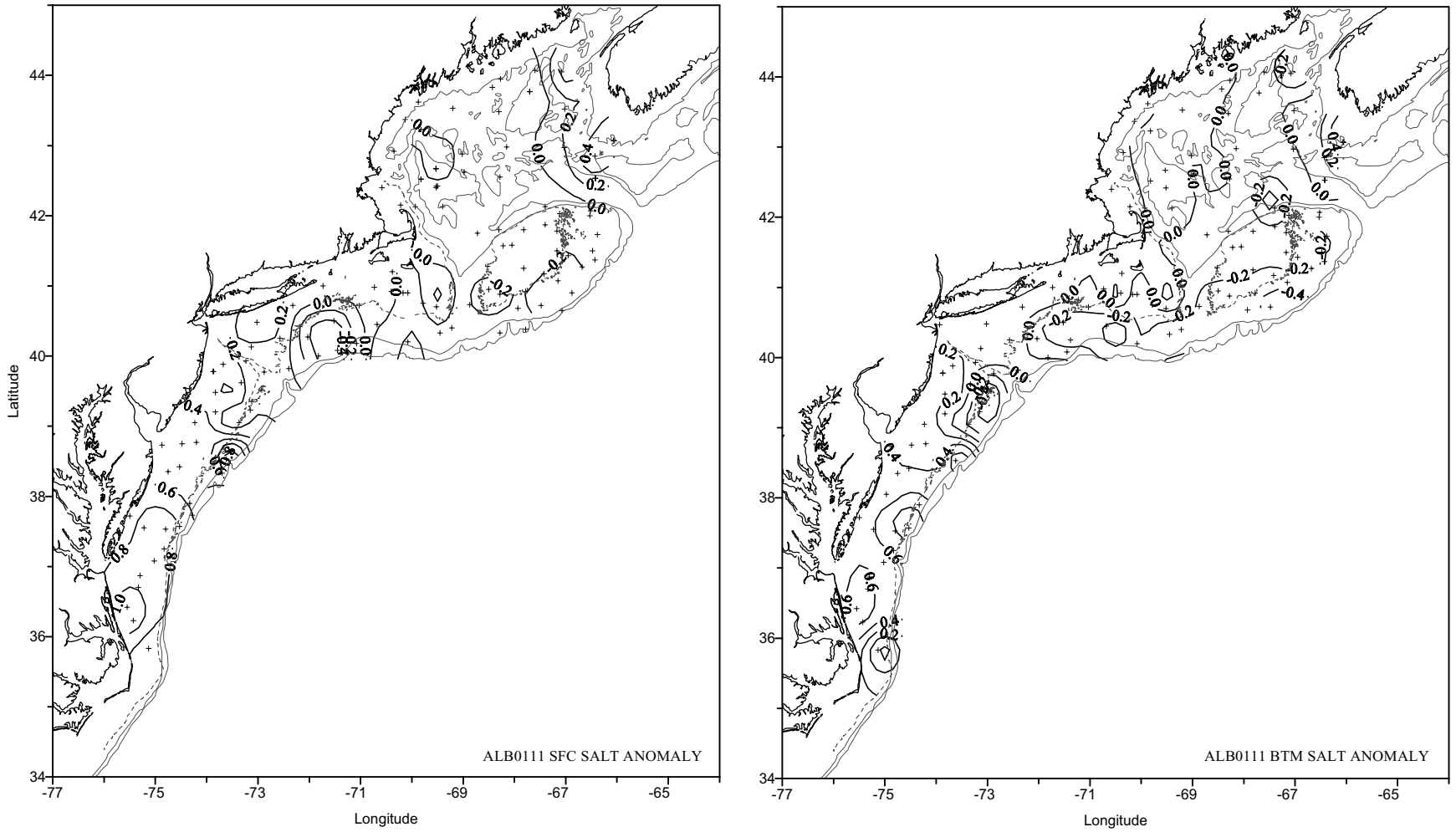


Figure 54. Surface (left) and bottom (right) salinity anomaly distributions for the ECOMON Survey ALB-01-11.

Appendix A. Summary of cruise information and hydrographic work completed.

Hydro-Acoustic Survey

Cruise:	DEL0101
Vessel:	R/V Delaware II
Dates:	2 – 21 February
Sea Days:	20
Instrument(s):	2277
Total # of stations:	74
# of vertical CTD/Profiler casts:	49
# of double oblique Profiler casts:	0
# Salinity samples:	9
Salt correction:	0.00, None Applied

Cruise Objectives: The primary goal is to provide fisheries independent abundance estimates of Atlantic herring in the Georges Bank and Gulf of Maine regions, and to calibrate the EK-500 echo-integrator and test the mid-water trawl performance.

Winter Bottom Trawl Survey

Cruise:	ALB0102
Vessel:	R/V Albatross IV
Dates:	30 January – 22 February
Sea Days:	23
Instrument(s):	1496
Total # of stations:	175
# of vertical CTD/Profiler casts:	104
# of double oblique Profiler casts:	73
# Salinity samples:	34
Salt correction:	+.018

Cruise Objectives: To (1) determine the winter distribution and relative abundance of fish and selected invertebrate species; (2) collect biological samples for studies of age and growth relationships, fecundity, maturity, and food habits; (3) collect hydrographic and meteorological data; (4) collect samples of ichthyoplankton and zooplankton; (5) make data and sample collections for cooperative researchers and programs.

Spring Bottom Trawl Survey

Cruise:	ALB0103
Vessel:	R/V Albatross IV
Dates:	28 February – 30 April
Sea Days:	38
Instrument(s):	1496
Total # of stations:	325
# of vertical CTD/Profiler casts:	235
# of double oblique Profiler casts:	102
# Salinity samples:	43
Salt correction:	+.014

Cruise Objectives: To (1) determine the spring distribution and relative abundance of fish and invertebrate species; (2) collect biological samples for studies of age and growth relationships, fecundity, maturity, and food habits; (3) collect hydrographic and meteorological data; (4) make collections of data and samples for cooperative researchers and programs.

Apex Predator Survey

Cruise:	DEL0104
Vessel:	R/V Delaware II
Dates:	16 April – 24 May
Sea Days:	47
Instrument(s):	2277,0851, 0853
Total # of stations:	85
# of vertical CTD/Profiler casts:	97
# of double oblique Profiler casts:	0
# Salinity samples:	31
Salt correction:	2277 = +.011, 0851= +.006 (not applied)

Cruise Objectives: To 1) investigate the distribution, abundance and species composition of sharks; 2) collect baseline catch per effort (C/E) data; 3) tag sharks for migration studies; 4) inject, with tetracycline, tagged sharks whenever feasible for age validation studies; 5) collect biological samples for age and growth, food habits and reproductive studies; 6) collect morphometric data.

Ecosystem Monitoring Survey

Cruise:	ALB0104 and DEL0105
Vessel:	R/V Albatross IV (leg 1) R/V Delaware II (leg 2)
Dates:	20 – 26 May (leg 1) 29 – 6 June (leg 2)
Sea Days:	16
Instrument(s):	1496, 1447
Total # of stations:	121
# of vertical CTD/Profiler casts:	25
# of double oblique Profiler casts:	130
# Salinity samples:	24
Salt correction:	1496 = +.012

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources.

Benthic Habitat

Cruise:	DEL0106
Vessel:	R/V Delaware II
Dates:	13 –21 June
Sea Days:	9
Instrument(s):	1447
Total # of stations:	19
# of vertical CTD/Profiler casts:	20
# of double oblique Profiler casts:	0
# Salinity samples:	15
Salt correction:	0.00

Cruise Objectives: To monitor the recovery of the benthic habitat in closed areas.

AWARE Sonar Testing

Cruise: DEL0107
Vessel: R/V Delaware II
Dates: 19 July – 2 August
Sea Days: 15
Instrument(s): 0851, 0456
Total # of stations: 32
# of vertical CTD/Profiler casts: 32
# of double oblique Profiler casts: 0
 # Salinity samples: 8
Salt correction: 0851-all salts bad, 0456 – 0.00 None applied

Cruise Objectives: To conduct sea-trials of a new forward looking sonar to be used for whale detection and tracking. Areas will be surveyed that have been recently identified as having either right whales of humpback whales present. Testing will evaluate the sonar's ability to localize animals underwater and track them between surfacings.

Right Whale Survey

Cruise: ALB0108, DEL0108
Vessel: R/V Albatross IV, R/V Delaware II
Dates: 24 July – 29 August
Sea Days: 37
Instrument(s): 1447
Total # of stations: 169
# of vertical CTD/Profiler casts: 169
# of double oblique Profiler casts: 0
 # Salinity samples: 3
Salt correction: N/A

Cruise Objectives: ALB-01-08 – To conduct oceanographic sampling in areas of right whale habitat and to assess the feasibility of methods for several ECOHAB studies . DEL-01-08 - To 1) deploy the VHF-linked time-depth recorders on right whales to examine their diving behavior relative to prey abundance and availability; 2) Conduct systematic, broad-scale oceanographic and marine mammal surveys to characterize right

whale habitat; 3) to collect *Calanus finmarchicus* specimens for studies on natural toxin concentrations and energy content; 4) to support studies being conducted by WHOI on the reaction of right whales to vessel approaches; and 5) photographing and/or opportunistic biopsy sampling of cetaceans for individual identification, as well as genetic, toxicological and stable isotope analyses.

Scallop Survey

Cruise:	ALB0107
Vessel:	R/V Albatross IV
Dates:	27 June – 16 August
Sea Days:	20
Instrument(s):	1495
Total # of stations:	551
# of vertical CTD/Profiler casts:	162
# of double oblique Profiler casts:	0
# Salinity samples:	49
Salt correction:	0.00 None Applied

Cruise Objectives: To 1) determine the distribution and relative abundance of the sea scallop *Placopecten magellanicus* and Iceland scallop *Chlamys islandica*; 2) collect biological samples and data relative to assessment needs; 3) monitor hydrographic and meteorological conditions; and 4) make collections for interested scientists at other institutions and laboratories.

Ecosystem Monitoring Survey

Cruise:	ALB0109
Vessel:	R/V Albatross IV
Dates:	21 – 28 August
Sea Days:	9
Instrument(s):	1495
Total # of stations:	61
# of vertical CTD/Profiler casts:	16
# of double oblique Profiler casts:	66
# Salinity samples:	12
Salt correction:	0.00 None Applied

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources.

HydroAcoustic Survey

Cruise:	DEL0109
Vessel:	R/V Delaware II
Dates:	6 September – 10 October
Sea Days:	35
Instrument(s):	1447, 0360
Total # of stations:	220
# of vertical CTD/Profiler casts:	152
# of double oblique Profiler casts:	0
# Salinity samples:	10
Salt correction:	1147- 0.00 None Applied, 0360 – 0.00 None Applied

Cruise Objectives: The primary goal is to provide fisheries independent abundance estimates of Atlantic herring in the Georges Bank and Gulf of Maine regions, and to calibrate the EK-500 echo-integrator and test the mid-water trawl performance

Fall Bottom Trawl

Cruise:	ALB0110
Vessel:	R/V Albatross IV
Dates:	5 September – 22 October
Sea Days:	42
Instrument(s):	1495
Total # of stations:	339
# of vertical CTD/Profiler casts:	228
# of double oblique Profiler casts:	115
# Salinity samples:	42
Salt correction:	0.00 None Applied

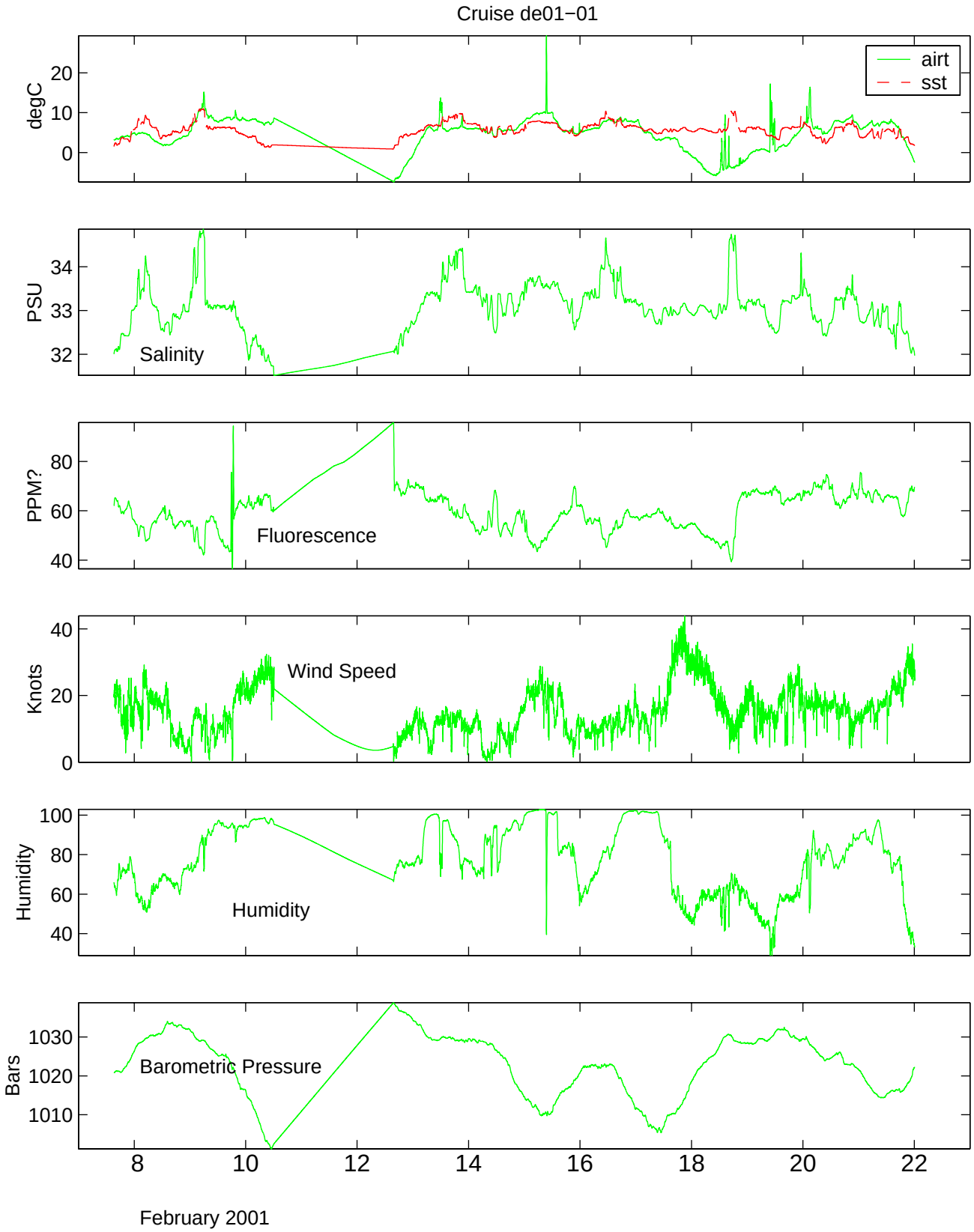
Cruise Objectives: To 1) determine the autumn distribution and relative abundance of fish and invertebrate species; 2) collect biological samples for studies of age and growth relationships, fecundity, maturity and food habits; 3) collect hydrographic and meteorological data; 4) make collections of data and samples for cooperative researchers and programs.

ECOMON Survey

Cruise:	ALB0111
Vessel:	R/V Albatross IV
Dates:	6 September – 10 October
Sea Days:	35
Instrument(s):	1495
Total # of stations:	120
# of vertical CTD/Profiler casts:	19
# of double oblique Profiler casts:	127
# Salinity samples:	20
Salt correction:	-0.016

Cruise Objectives: To assess the impact of changing biological and physical properties of the Northeast Continental Shelf ecosystem which influence the sustainable productivity of the living marine resources

Appendix B. Time series plots of shipboard environmental sensor records.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PPM?
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Fluorescence
Knots
40
20
0
Wind Speed
Humidity
100
80
60
40
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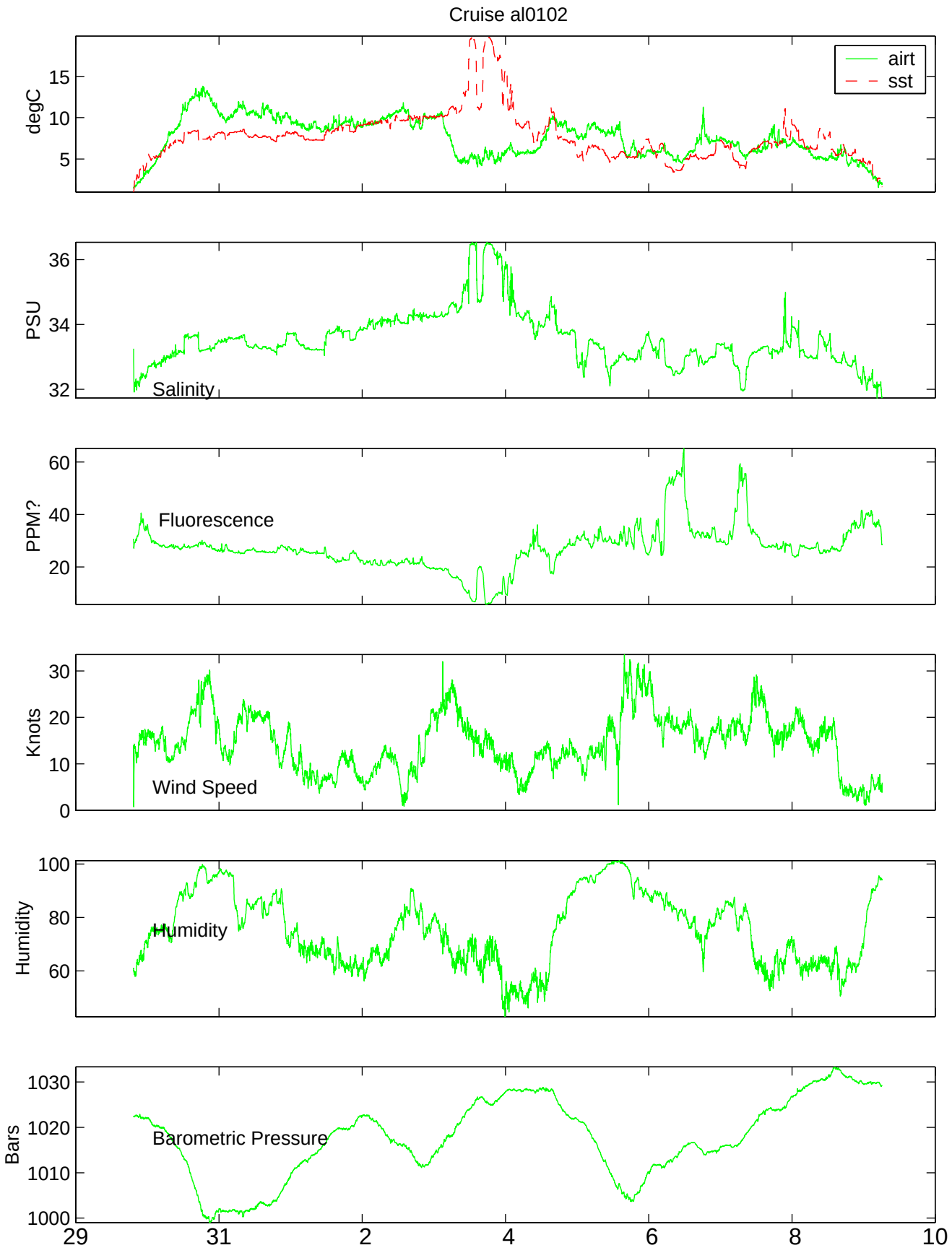
1030
1020
1010
Barometric Pressure
8
10
12
14
16
18
20
22
February 2001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Knots
30
20
10
0
Wind Speed
Humidity
100
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60
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Barometric Pressure
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2
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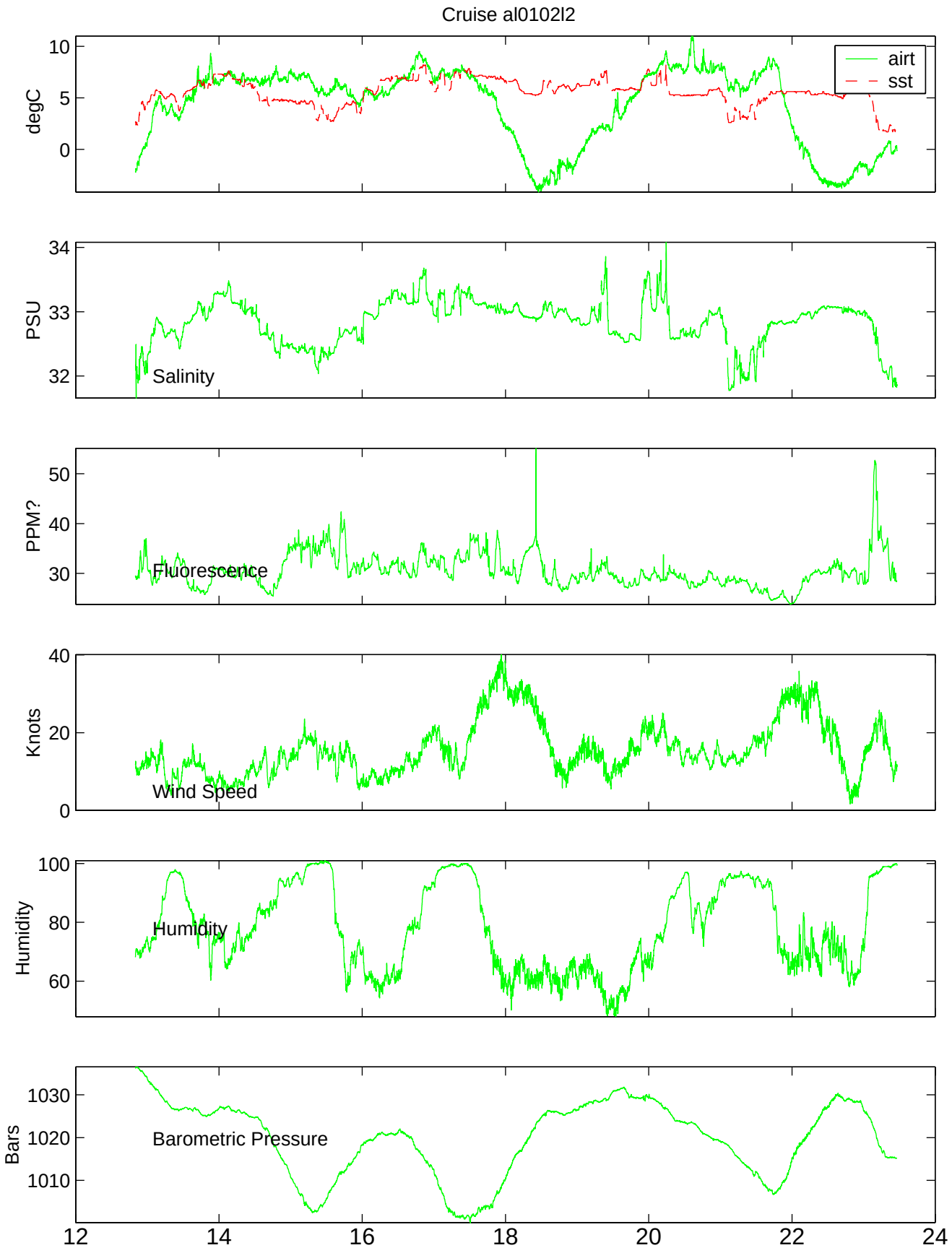
6
8
10
January 2001
February 2001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Fluorescence
Knots
40
20
0
Wind Speed
Humidity
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Humidity
Bars
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1010
Barometric Pressure
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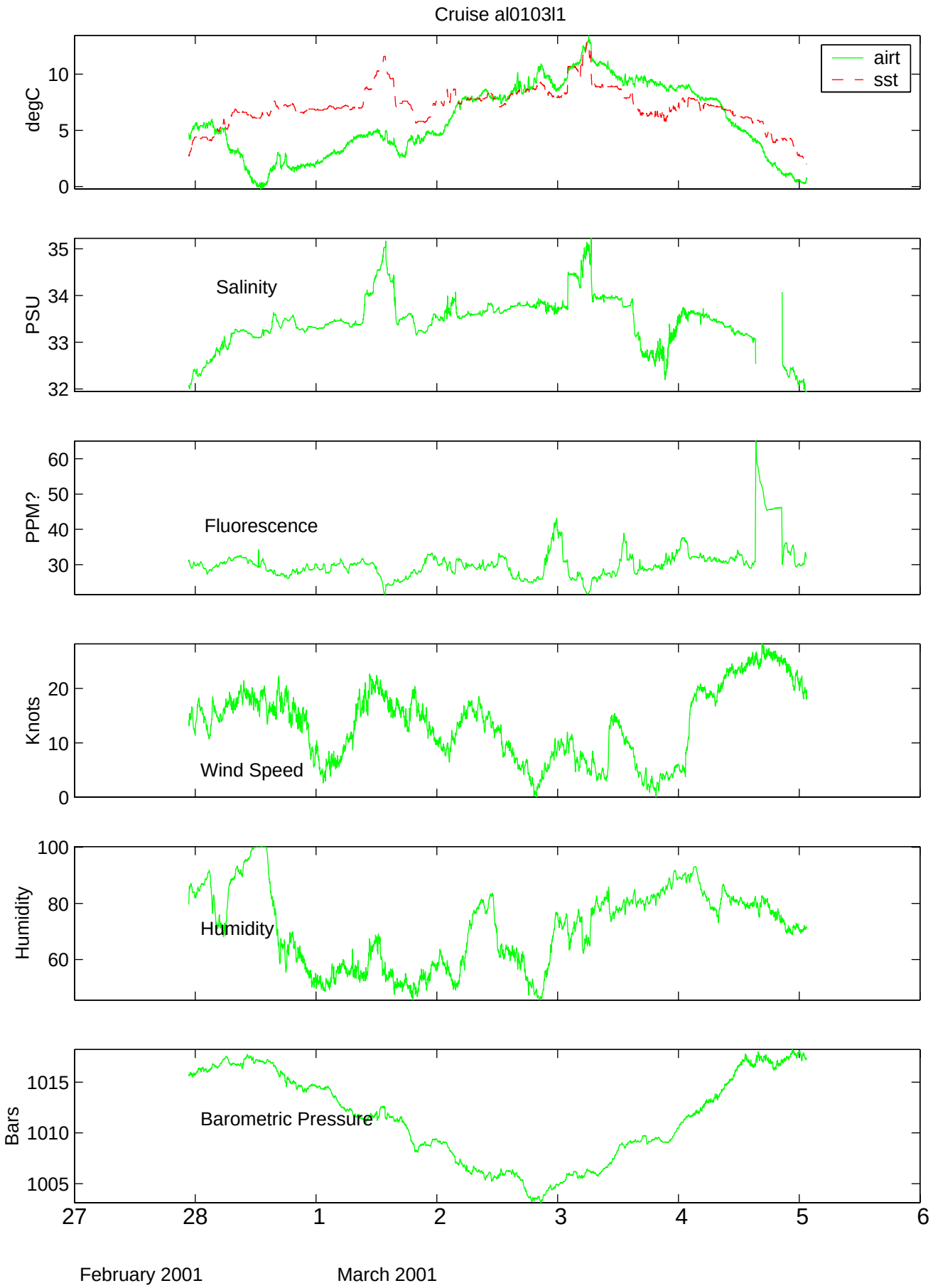
24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PPM?
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50
40
30
Fluorescence
Knots
20
10
0
Wind Speed
Humidity
100
80
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1005
Barometric Pressure
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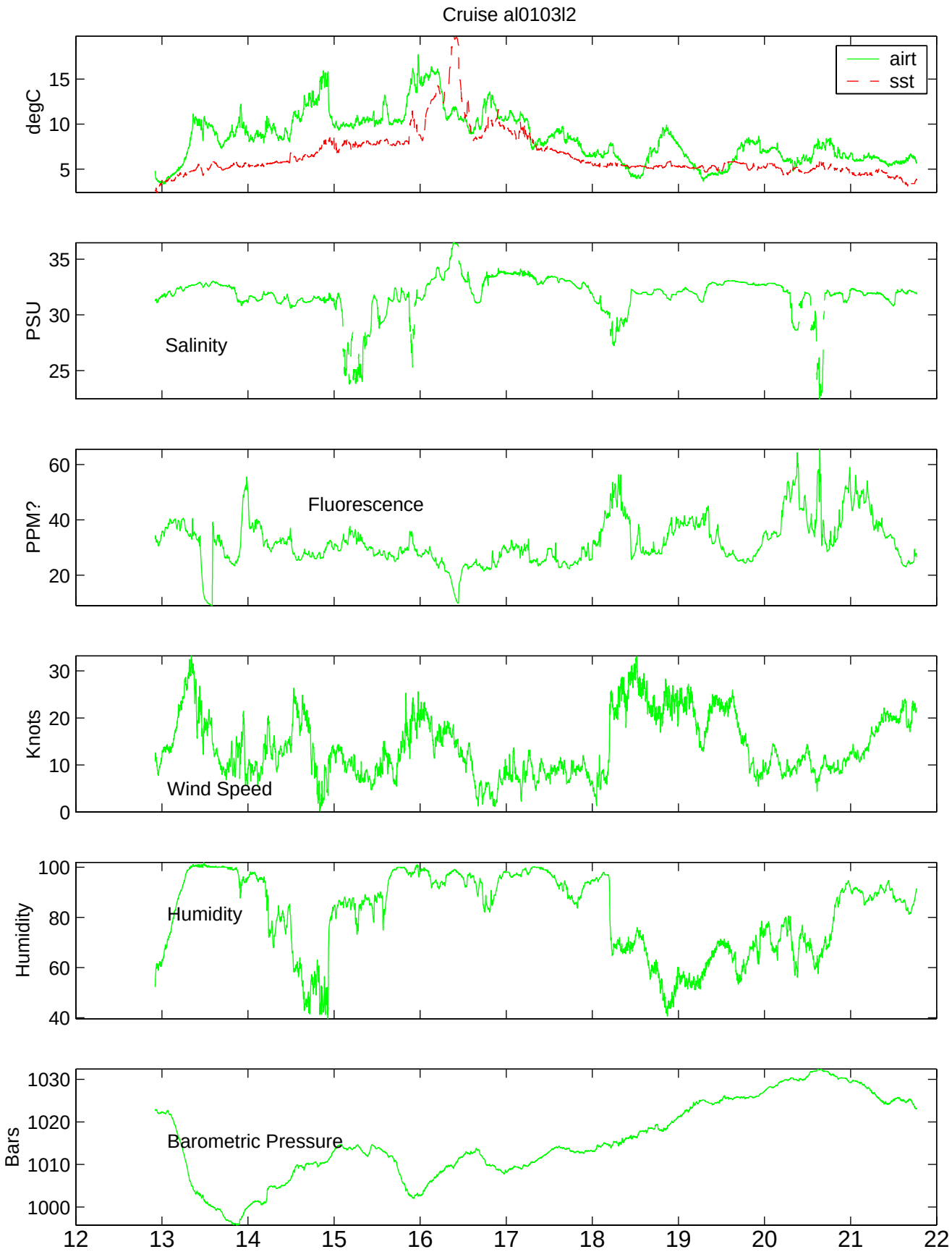
1
2
3
4
5
6
February 2001
March 2001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Fluorescence
Knots
30
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Wind Speed
Humidity
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Humidity
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21
22

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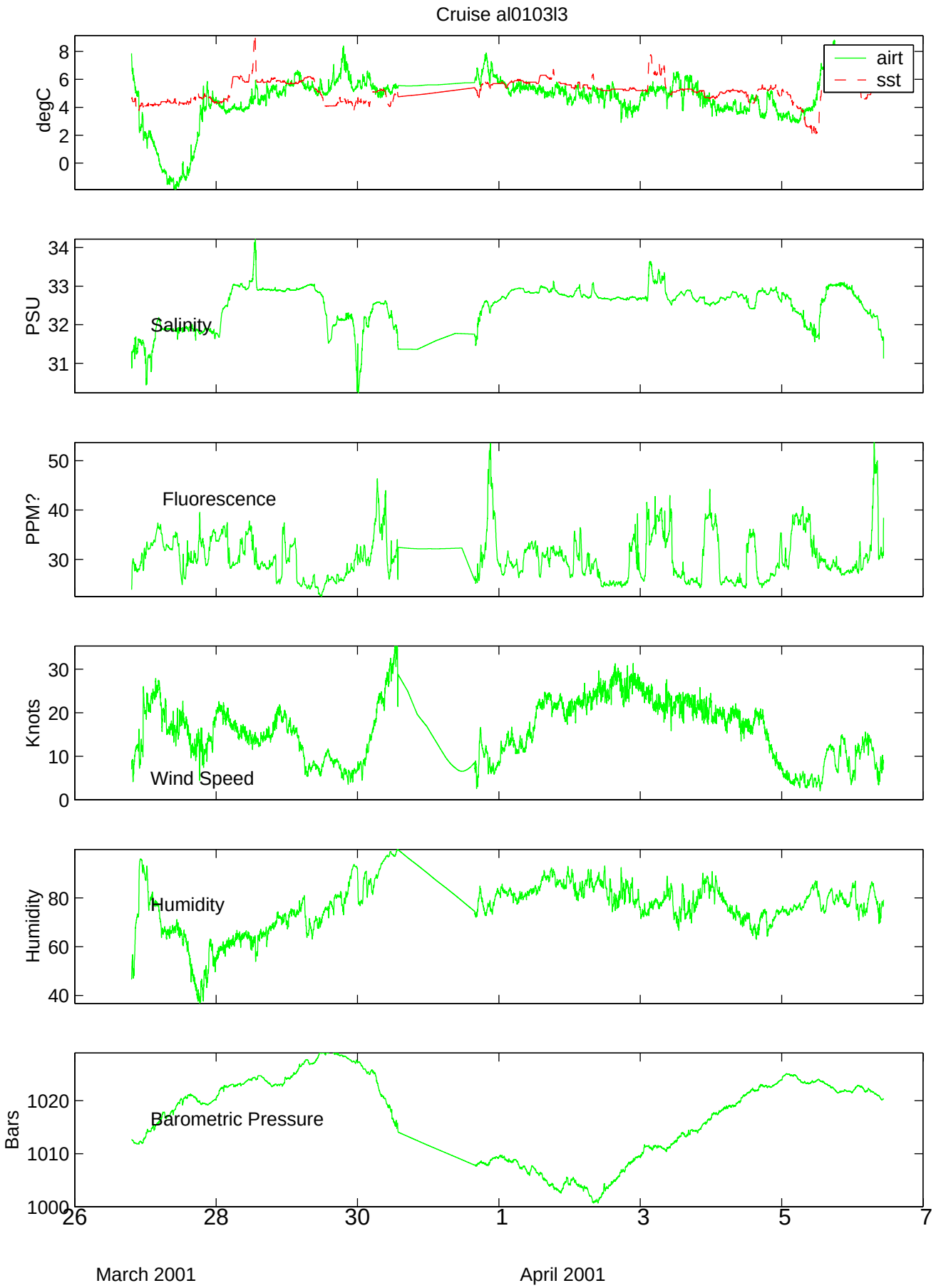
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Humidity
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3
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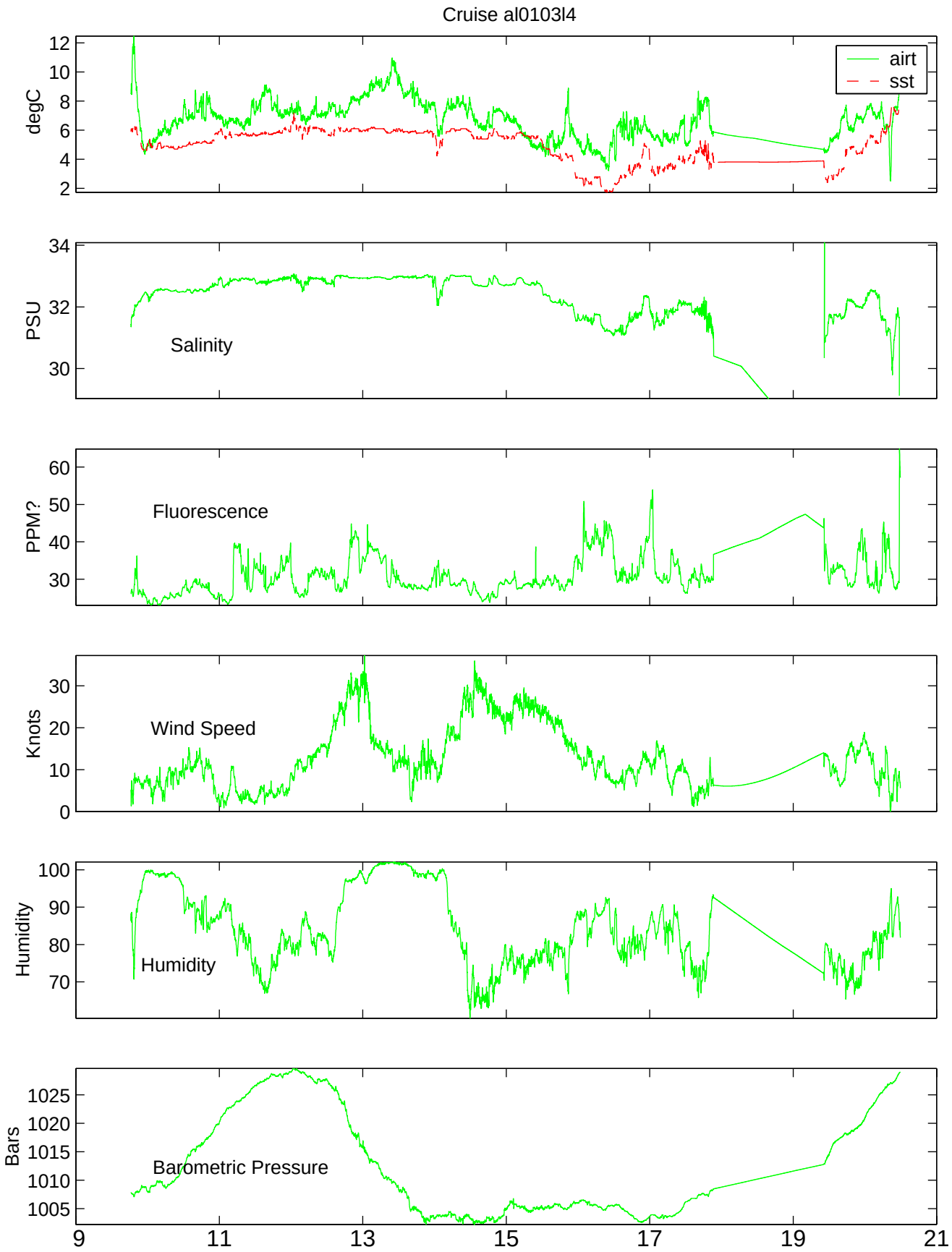
March 2001
April 2001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PPM?
Fluorescence
Knots
Wind Speed
Humidity
Humidity
Bars
Barometric Pressure
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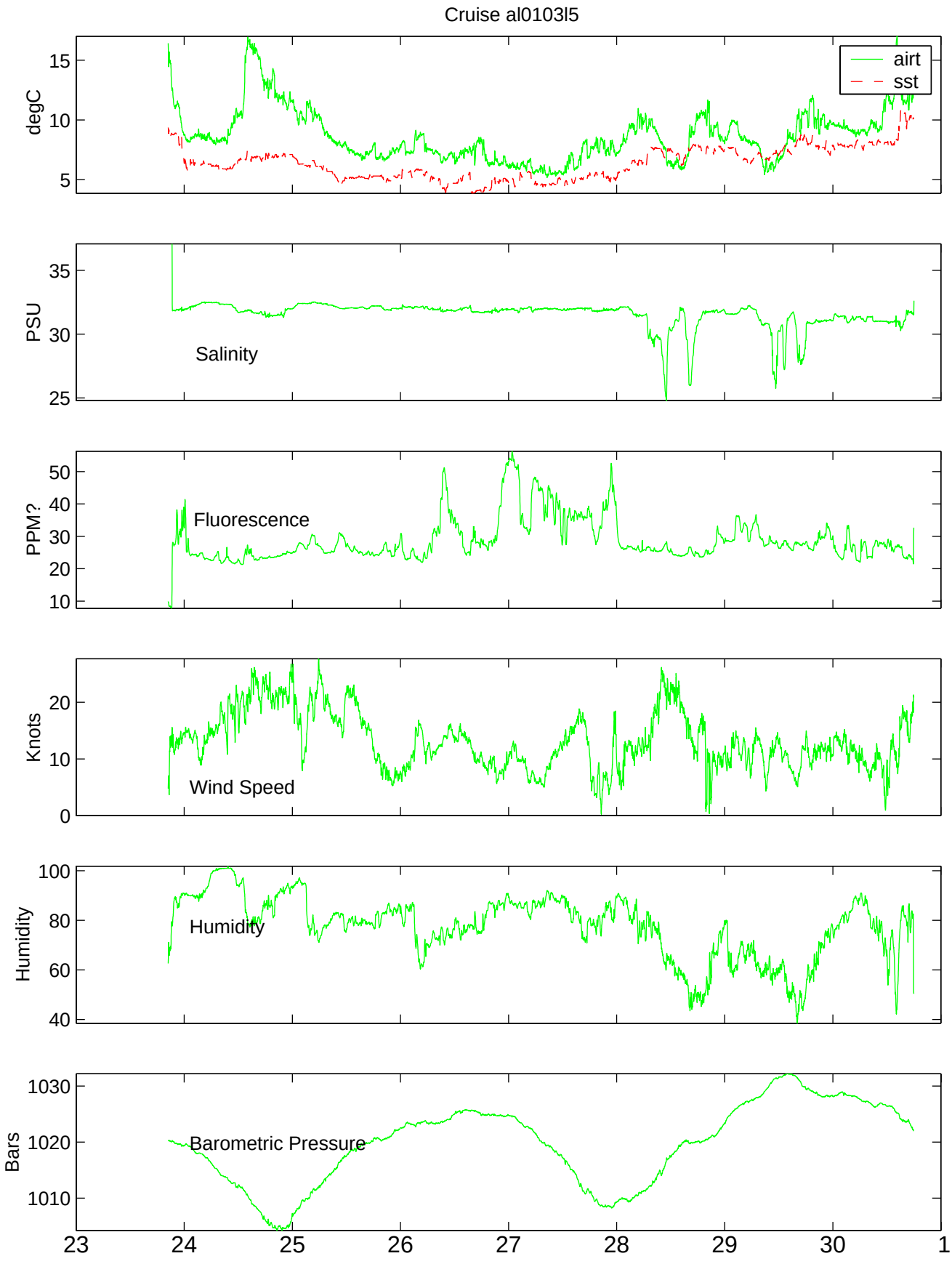
17
19
21
April 2001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Fluorescence
Knots
20
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Wind Speed
Humidity
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80
60
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1010
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1
April 2001
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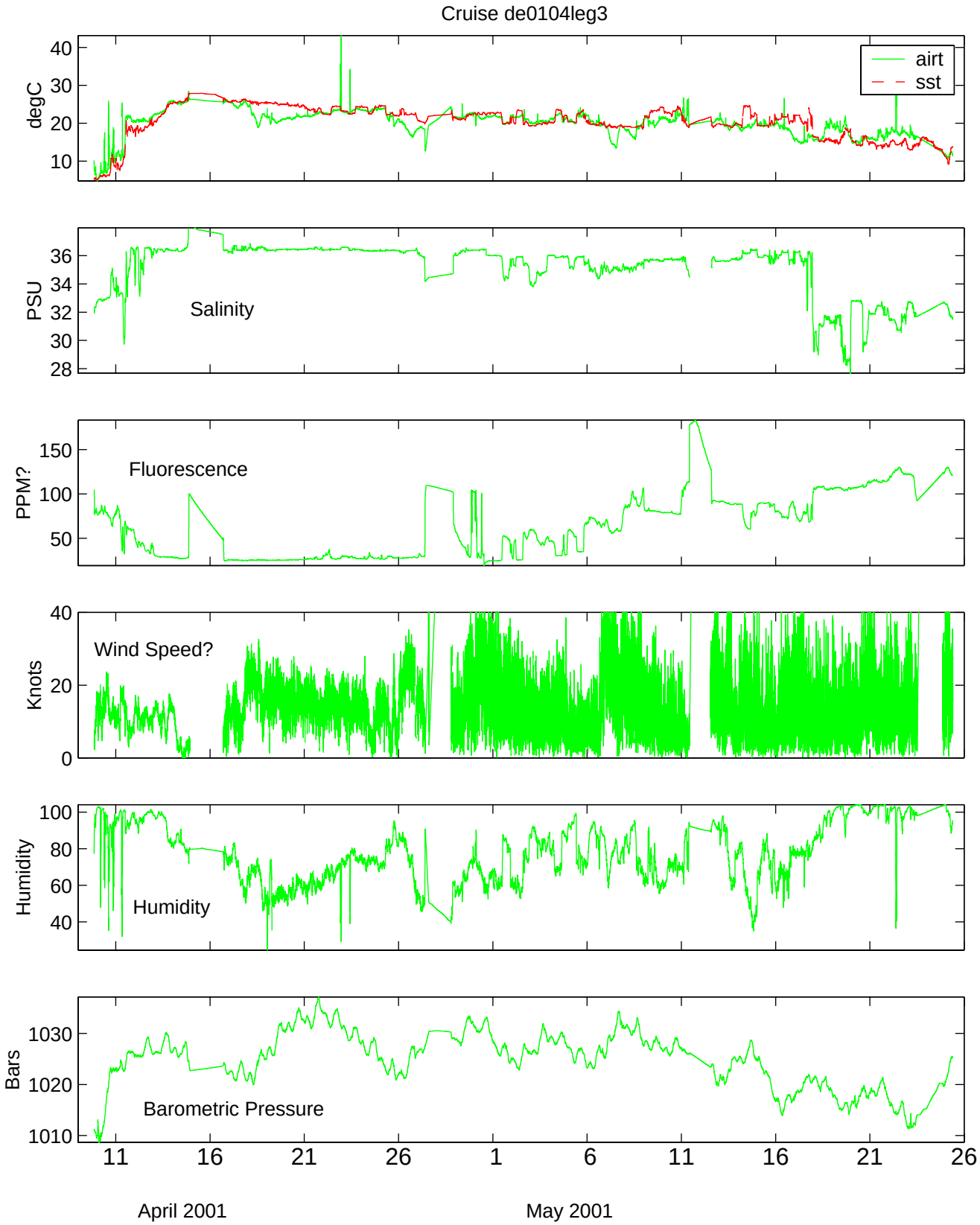
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Bars
Barometric Pressure
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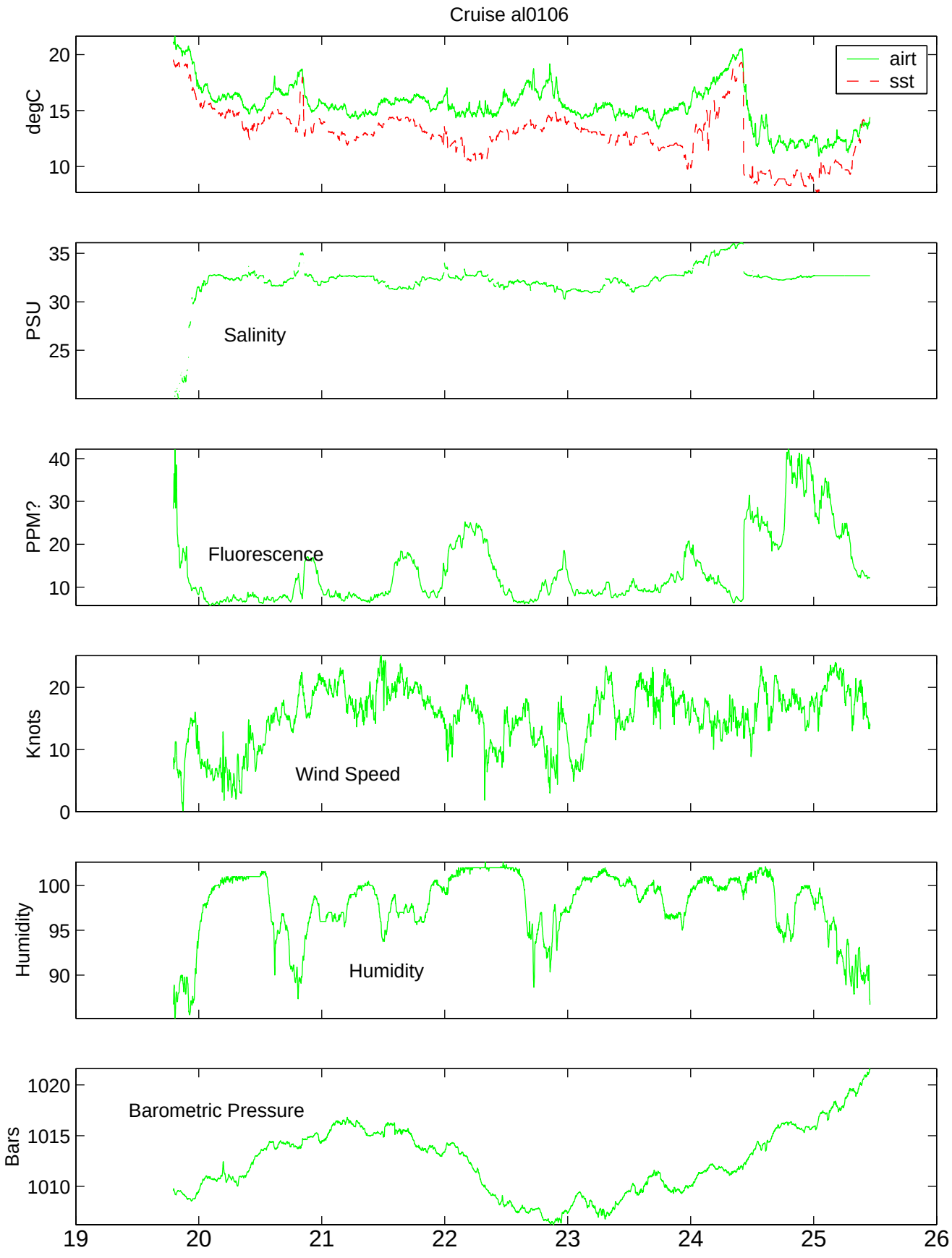
26
April 2001
May 2001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Knots
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Wind Speed
Humidity
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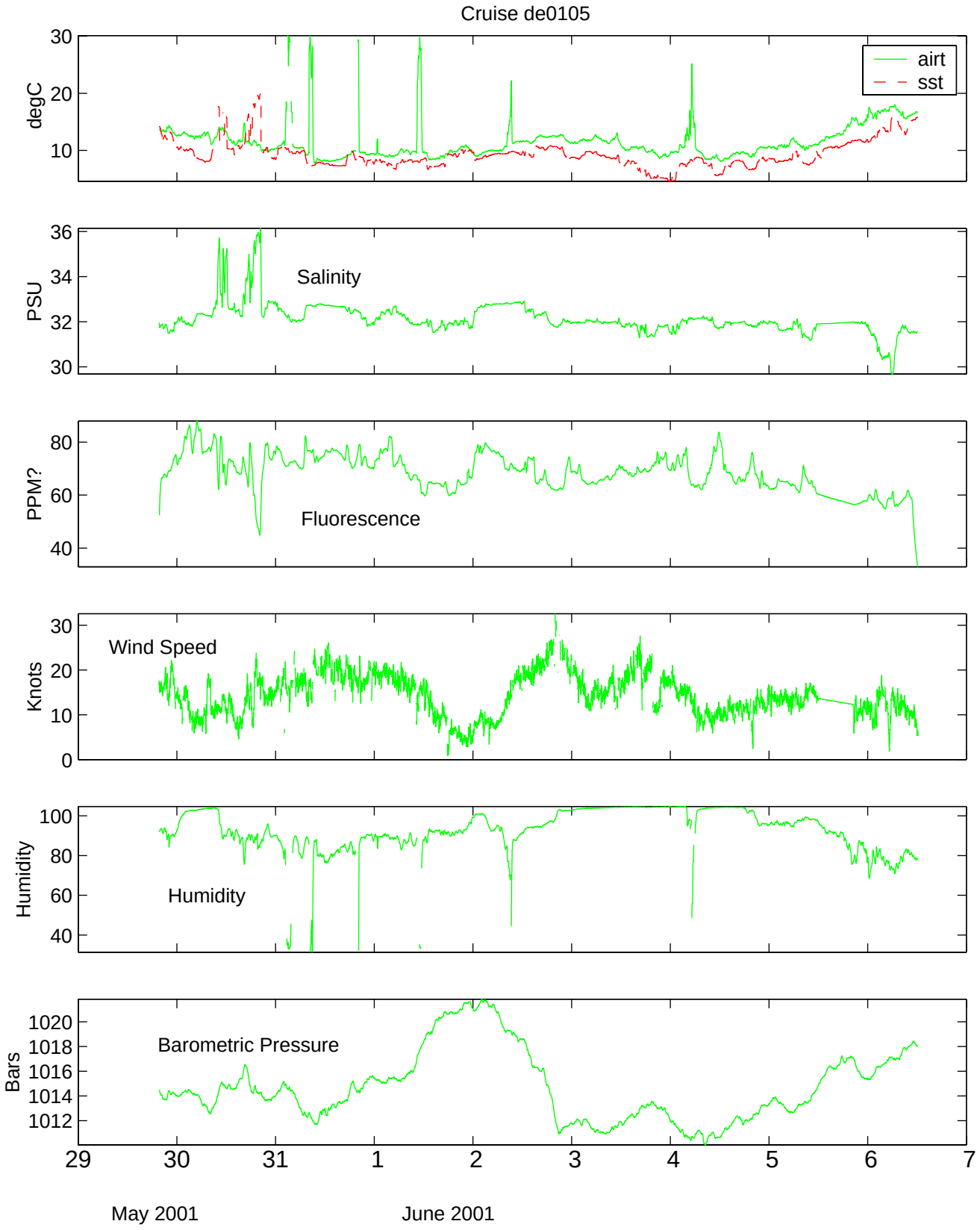
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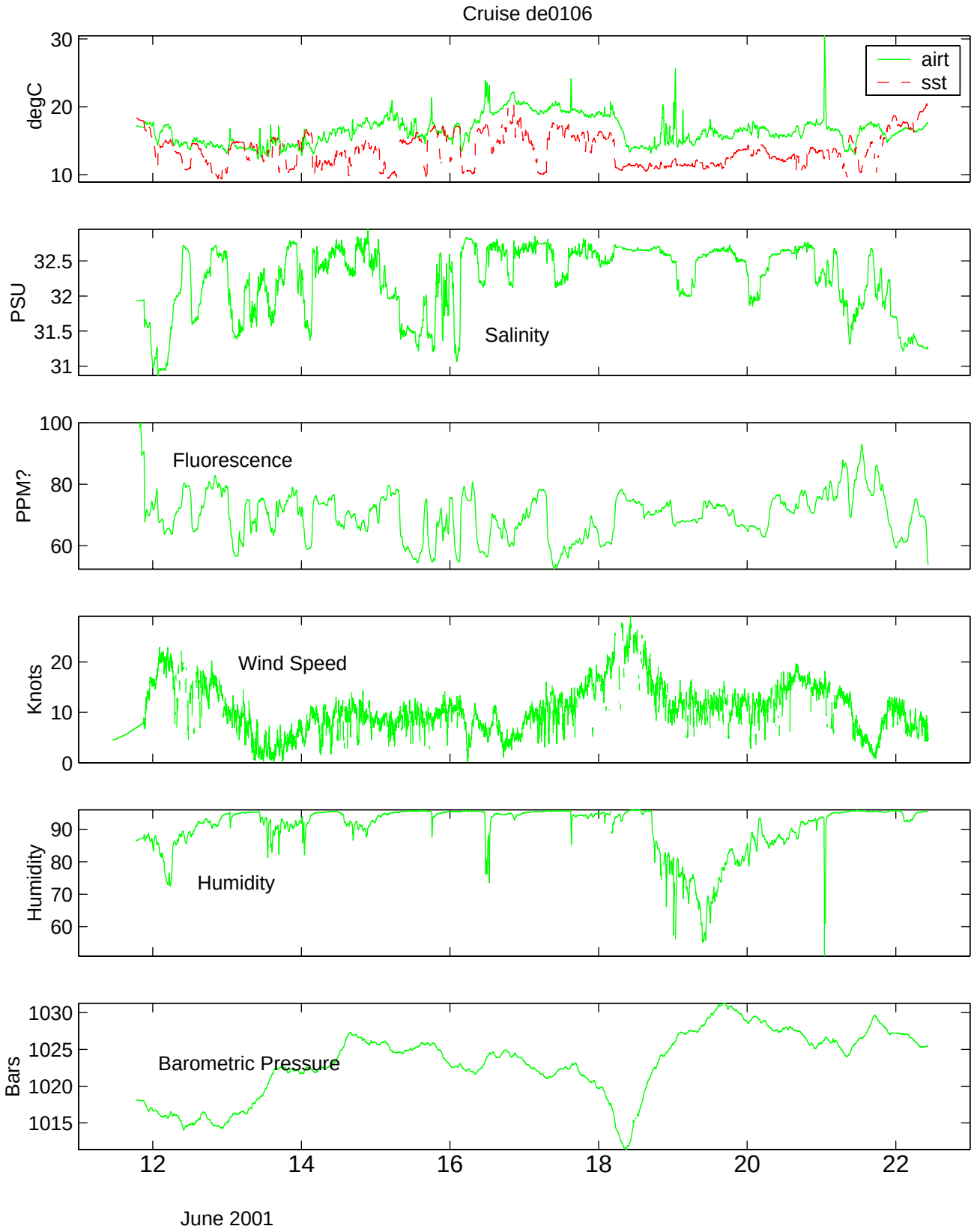
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Fluorescence
Knots
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Wind Speed
Humidity
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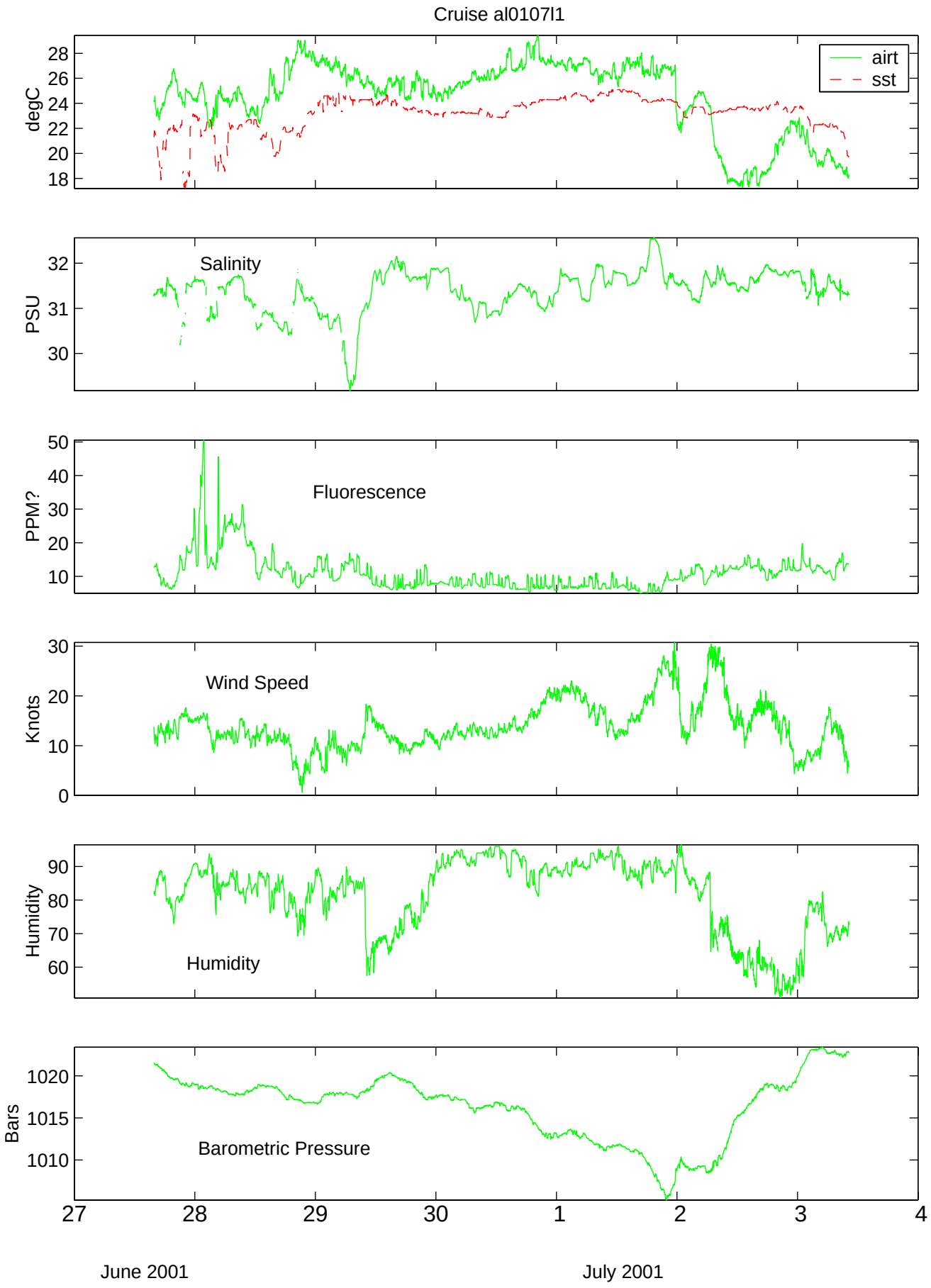
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Fluorescence
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Humidity
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Barometric Pressure
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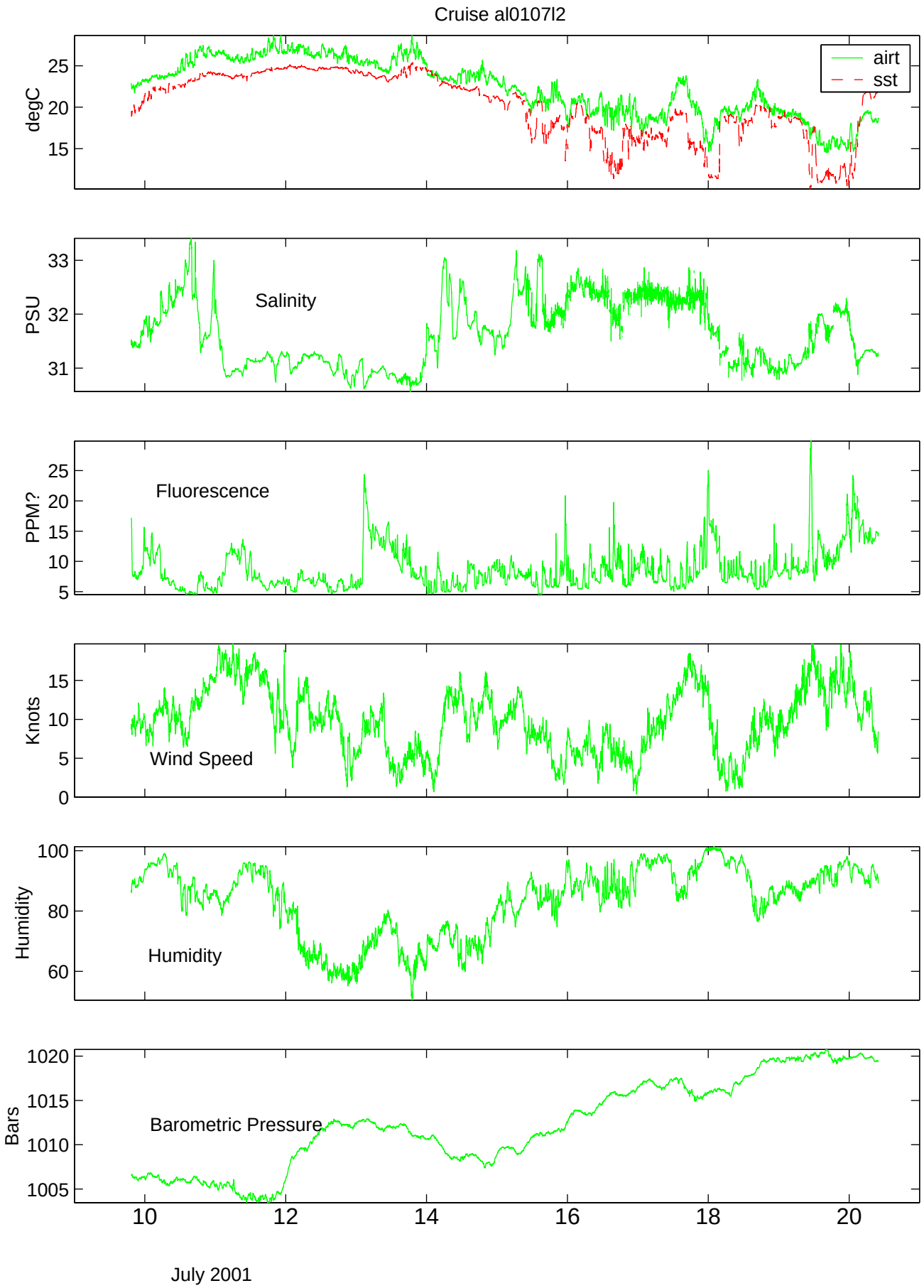
4
June 2001
July 2001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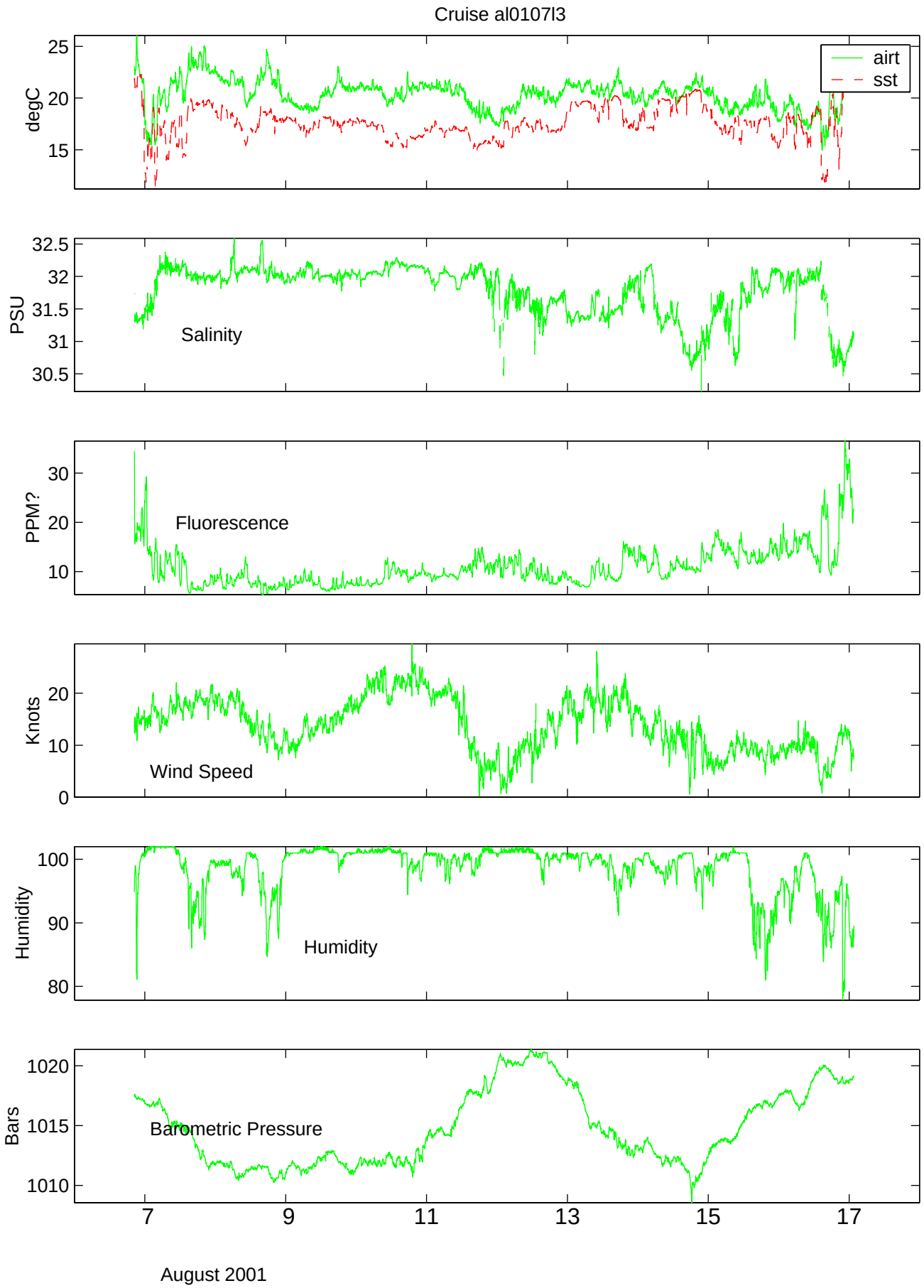
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PPM?
30
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Fluorescence
Knots
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Wind Speed
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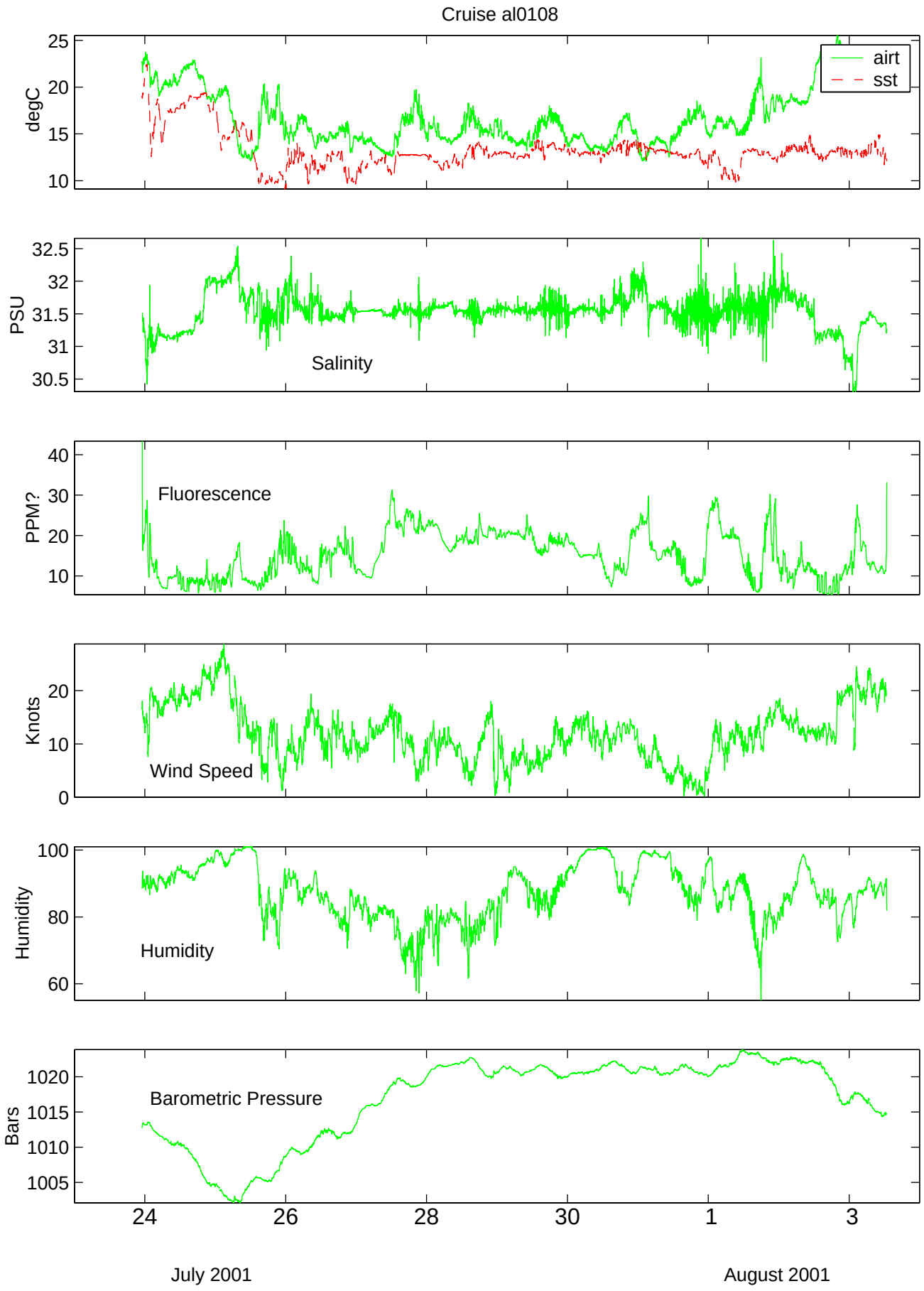
August 2001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Humidity
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Bars
Barometric Pressure
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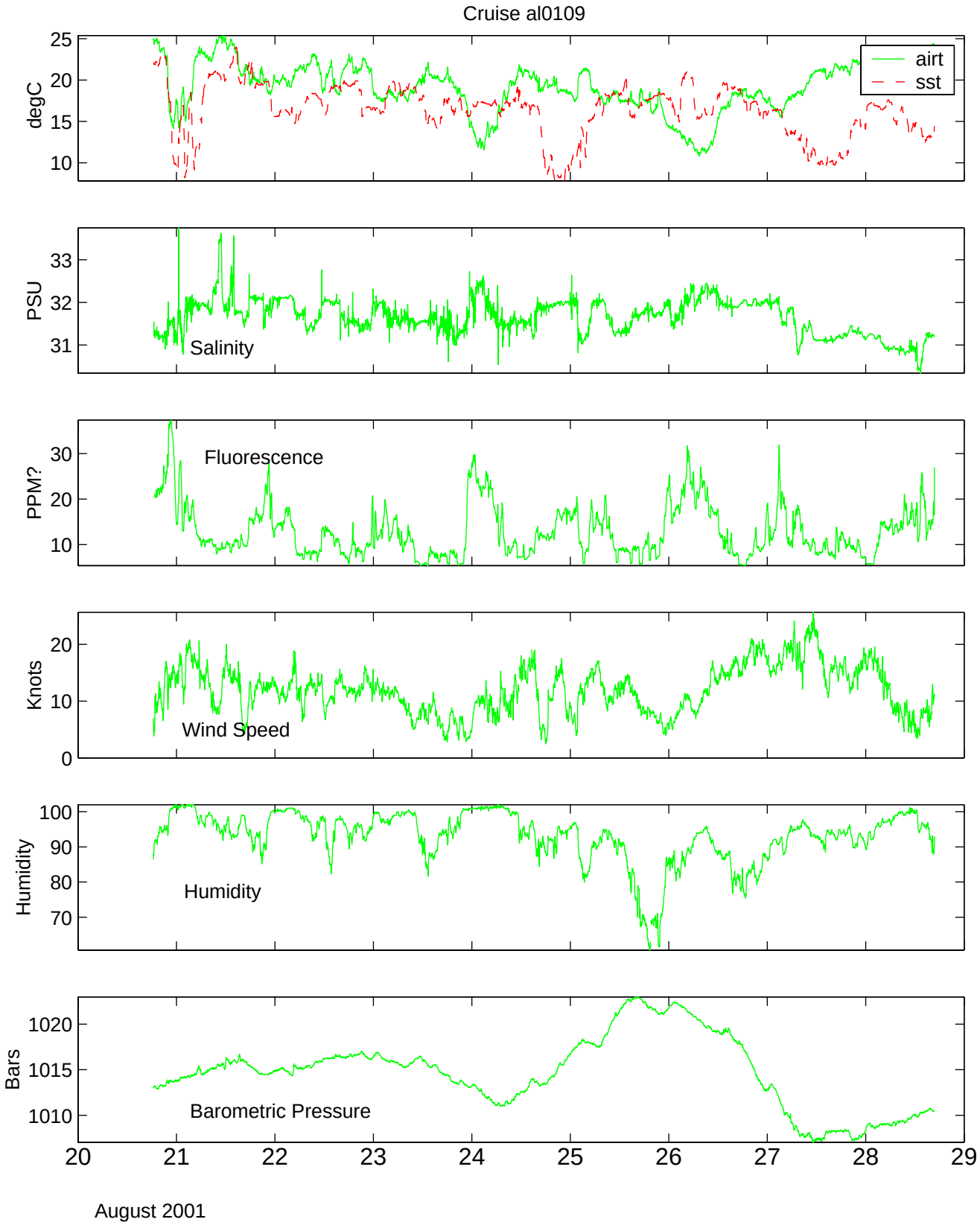
1
3
July 2001
August 2001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Wind Speed
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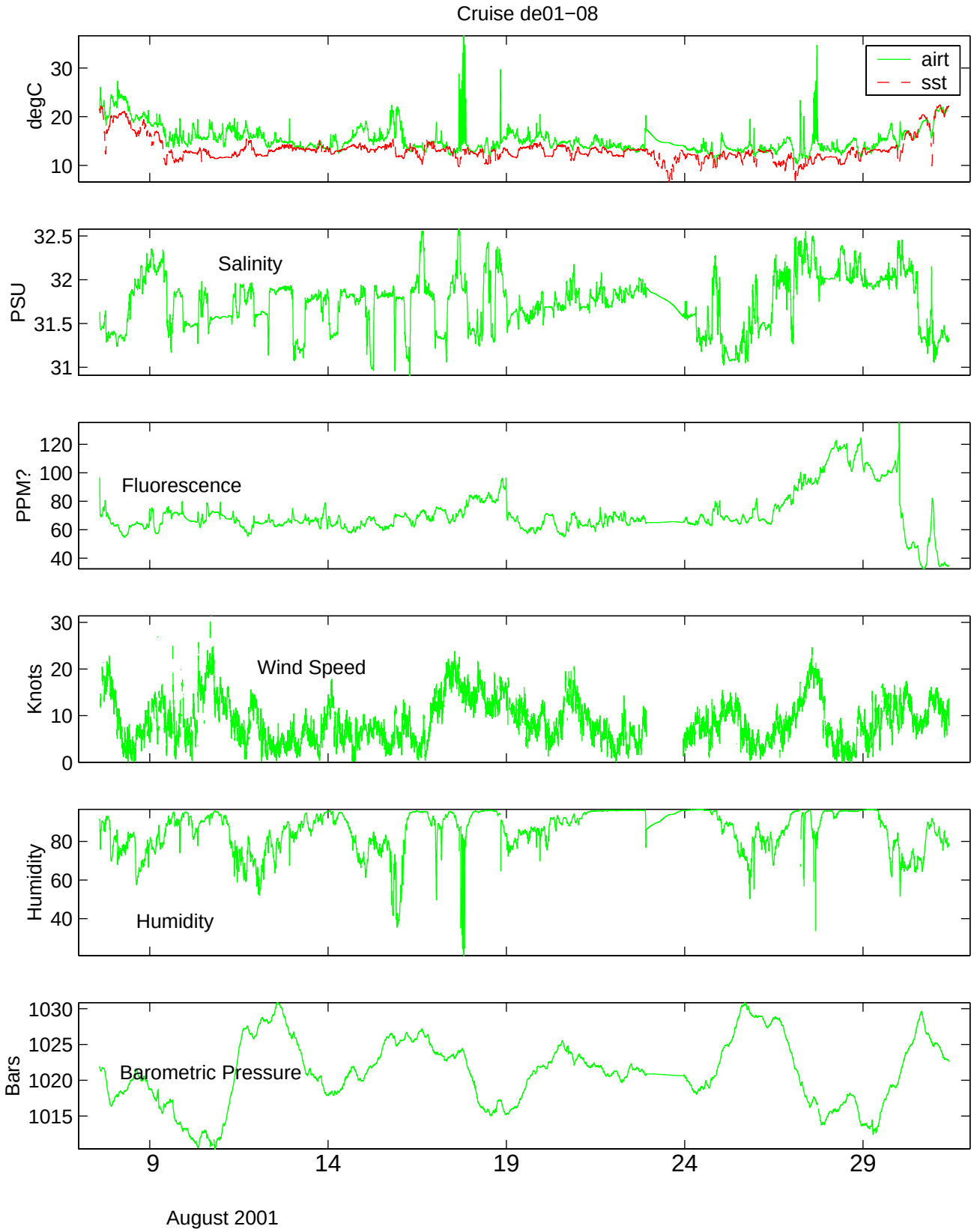
Bars
Barometric Pressure
August 2001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Fluorescence
Knots
30
20
10
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Wind Speed
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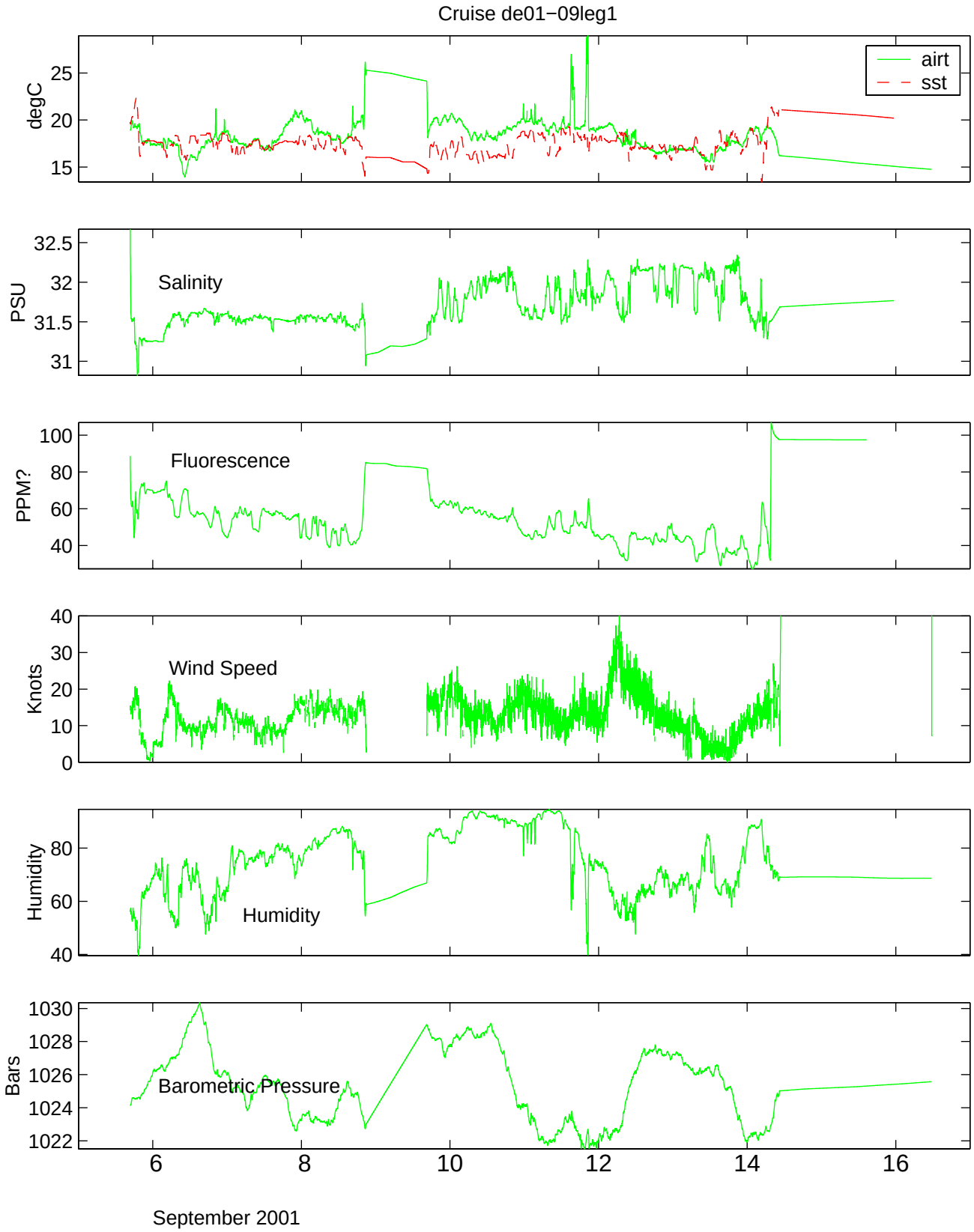
August 2001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40
Fluorescence
Knots
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Wind Speed
Humidity
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Barometric Pressure
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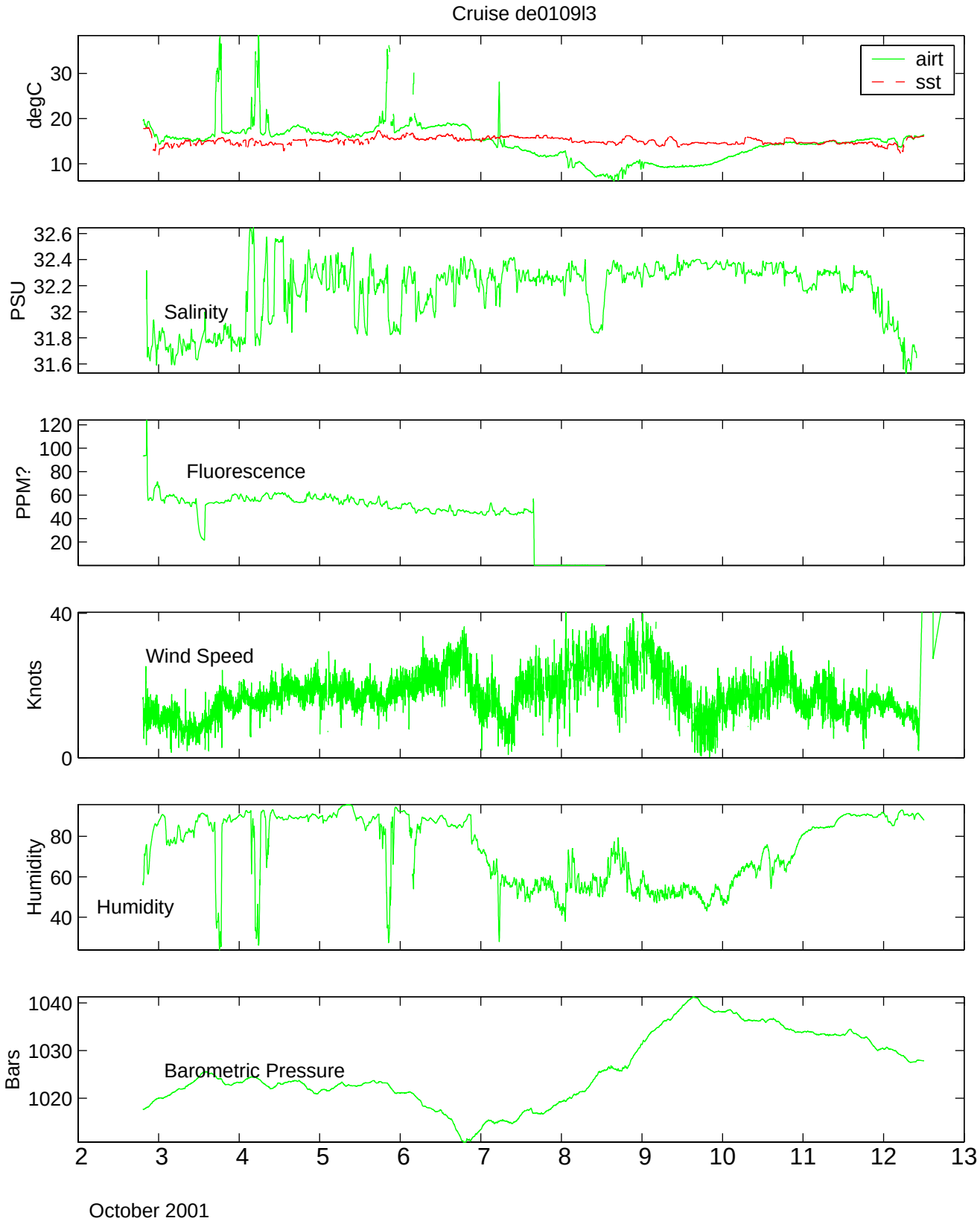
16
September 2001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Salinity
PPM?
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80
60
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20
Fluorescence
Knots
40
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Wind Speed
Humidity
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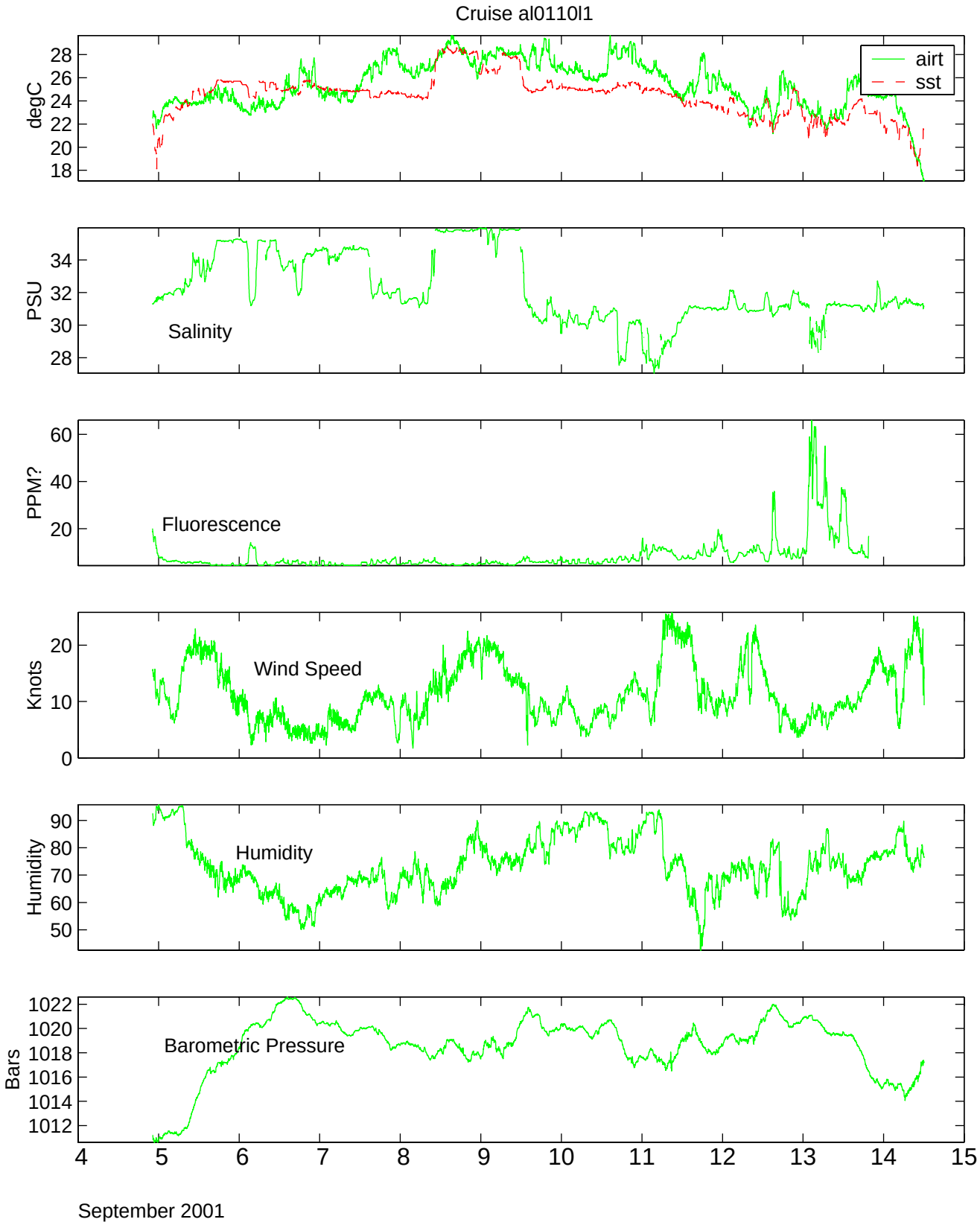
13
October 2001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PPM?
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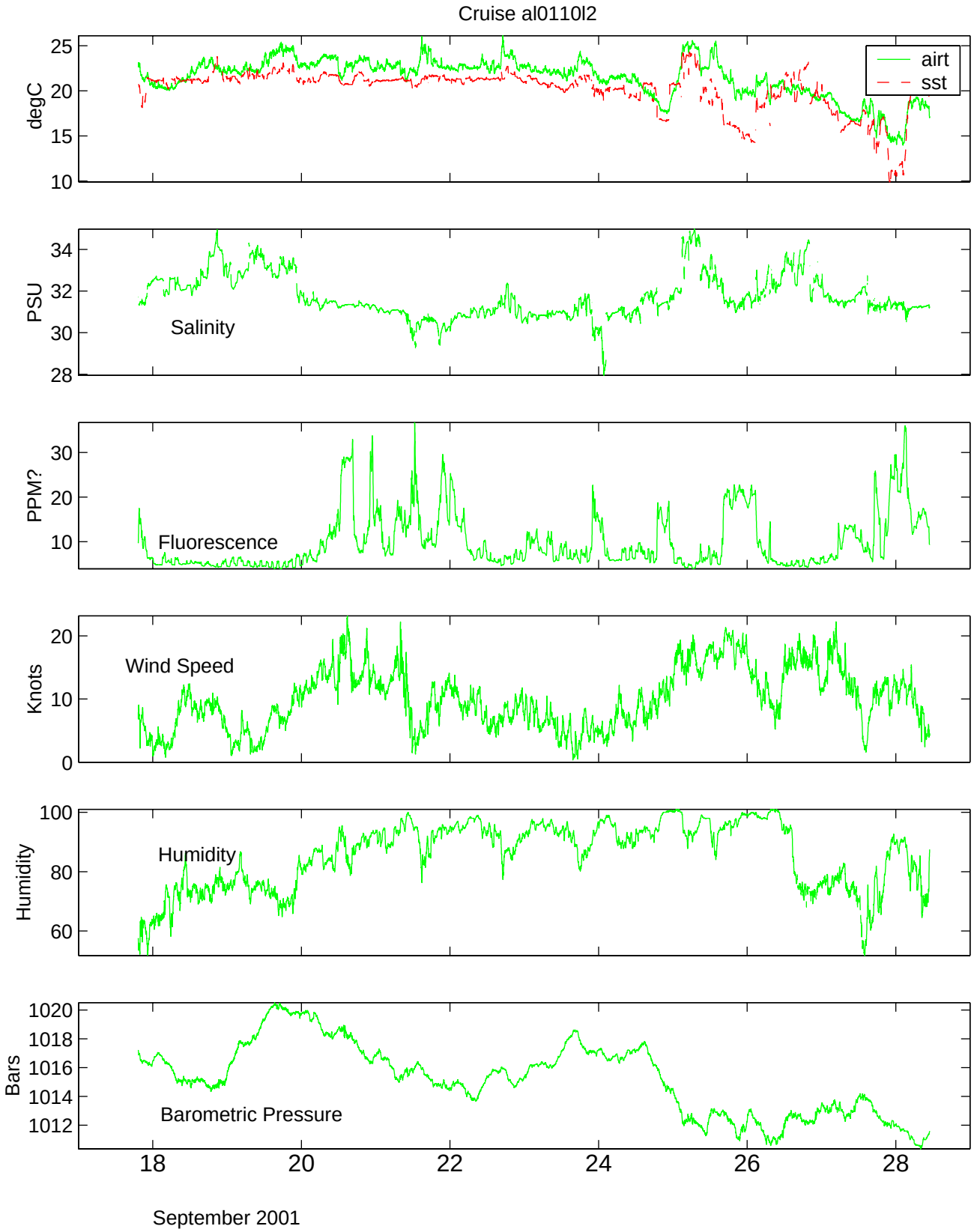
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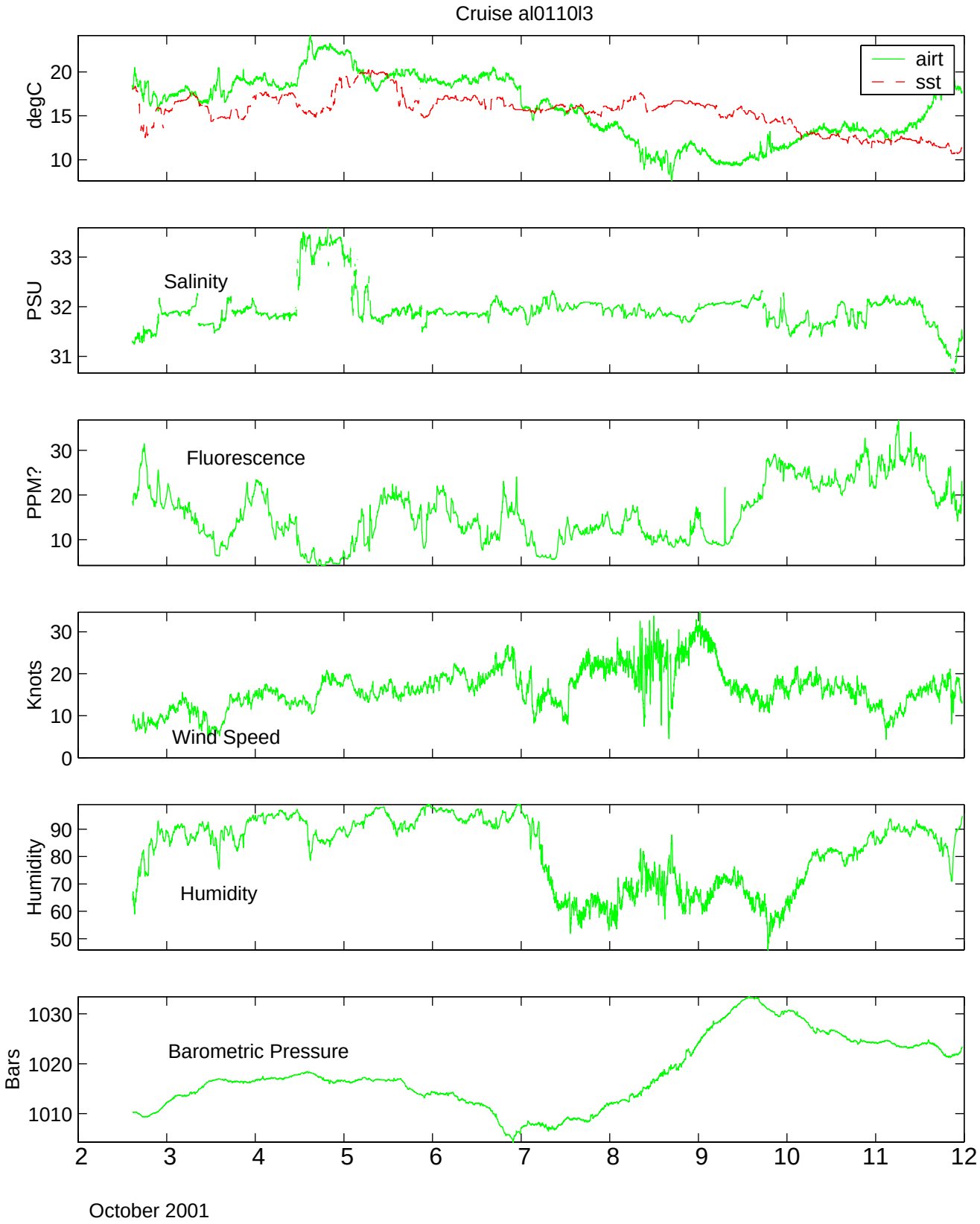
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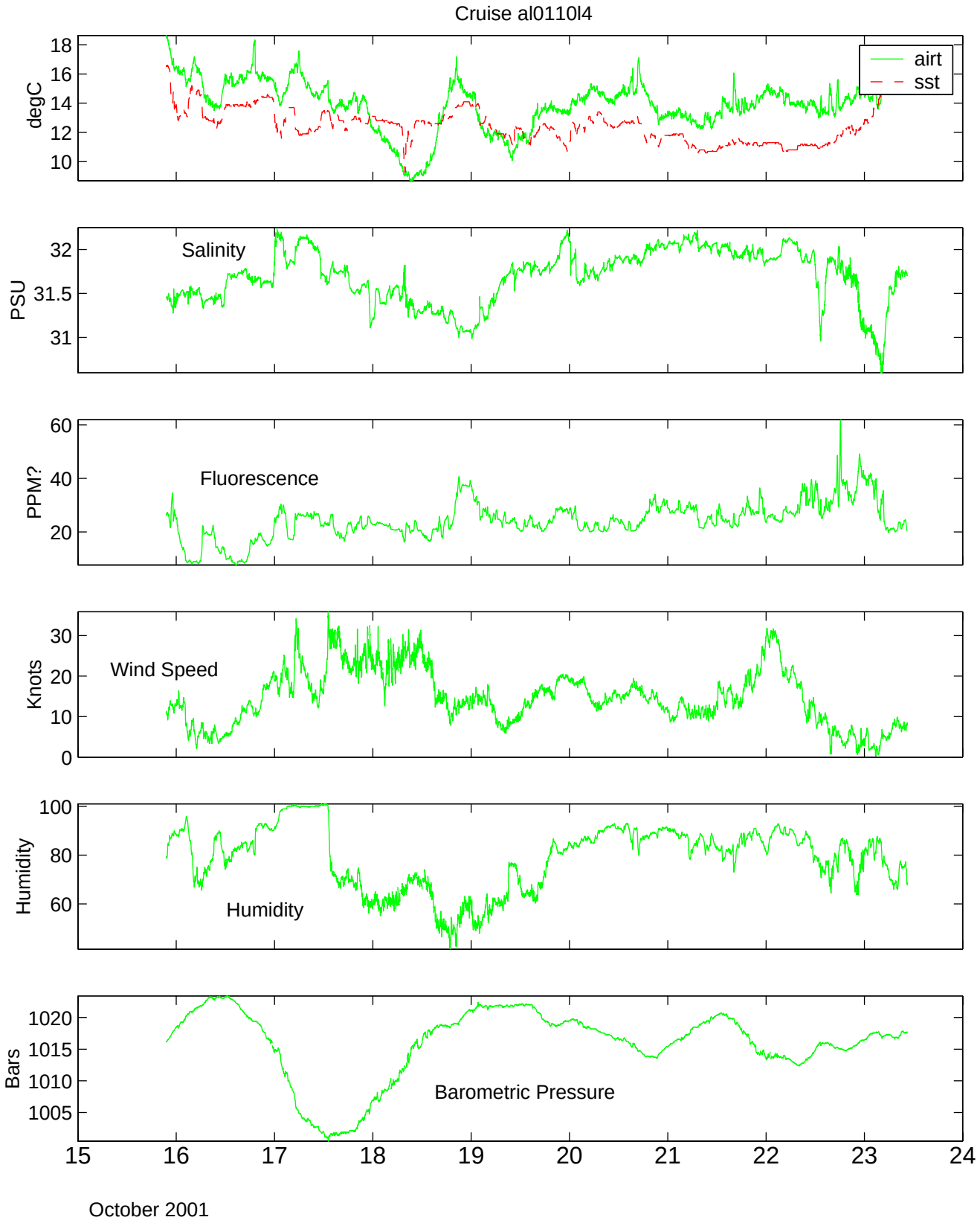
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Knots
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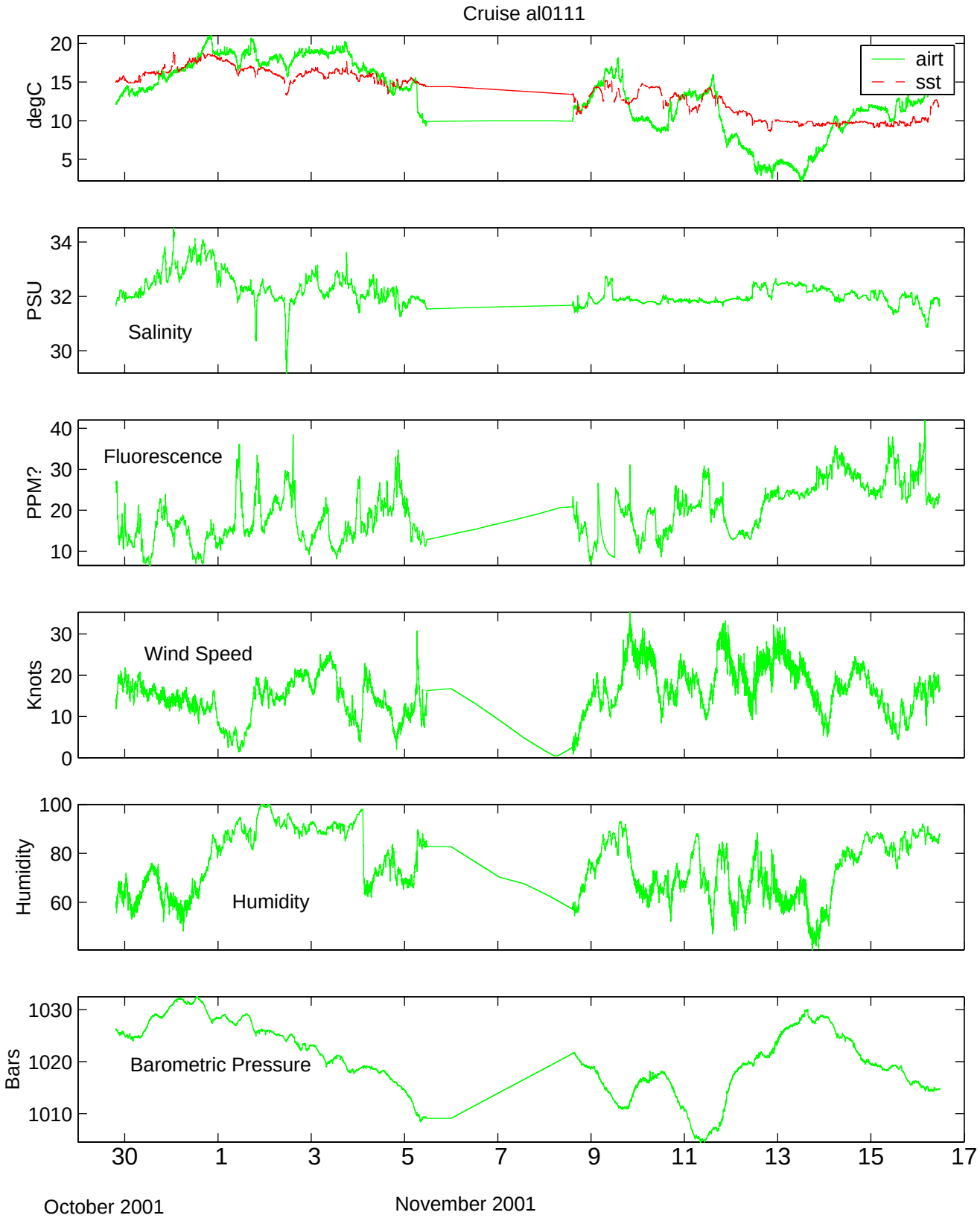
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Bars
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1010
Barometric Pressure
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October 2001
November 2001

Appendix C. Areal average surface and bottom temperature, salinity, and anomalies Presented by cruise using hydrographic data collected in 2001.

Table 4. Areal average surface and bottom temperature and temperature anomalies for the 2001 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1

		SURFACE					BOTTOM				
CRUISE	CD	#obs	Temp	Anomaly	SDV1	SDV2	#obs	Temp	Anomaly	SDV1	SDV2
(**)											
					Gulf of Maine West						
AL0103	117	53	5.79	0.46	0.19	0.96	50	5.87	0.81	0.14	0.63
ALB/DEL	156	12	10.15	-0.32	0.33	0.79	10	6.83	0.92	0.32	0.45*
AL0109	239	15	17.45	1.11	0.34	1.47	12	7.08	0.27	0.27	0.87*
DE0109	252	82	17.13	1.32	0.13	1.13*	81	6.64	0.27	0.12	1.10*
AL0110	292	48	12.79	0.47	0.18	0.99	45	7.50	0.09	0.13	1.46
AL0111	316	28	9.97	-0.03	0.25	0.92	20	7.45	0.16	0.21	1.14
					Gulf of Maine East						
AL0103	109	35	3.88	-0.87	0.21	1.04	32	6.71	0.18	0.20	0.85
ALB/DEL	154	21	7.95	-0.43	0.29	0.92	13	7.22	0.13	0.32	0.88
AL0109	237	25	14.41	-0.03	0.24	1.71	21	8.18	-0.58	0.26	1.85
DE0109	265	36	16.38	1.57	0.18	0.98*	35	9.43	0.28	0.16	0.97*
AL0110	283	31	13.06	0.28	0.24	1.27	29	8.60	-0.17	0.21	1.26
AL0111	313	17	10.01	-0.57	0.32	0.72	14	8.59	0.09	0.35	0.80
					Georges Bank						
AL0102	51	30	5.62	0.43	0.32	0.53*	21	5.90	0.31	0.29	1.32*
AL0103	102	52	5.21	0.31	0.18	0.68	44	5.56	0.34	0.25	0.83
ALB/DEL	152	33	9.80	0.59	0.22	1.83	29	8.16	0.49	0.26	0.96
DE0106	167	20	13.63	2.92	0.29	2.28*	20	8.18	0.38	0.30	1.51*
AL0107	211	71	17.28	1.90	0.17	1.82	70	9.96	-1.18	0.20	2.08
AL0109	235	37	18.16	2.13	0.23	1.82	33	12.31	0.14	0.27	1.69
DE0109	264	39	16.22	1.32	0.15	0.84*	38	13.46	0.85	0.15	2.23*
AL0110	274	53	16.97	1.71	0.18	1.45	45	13.15	0.41	0.22	1.92
AL0111	312	35	13.30	0.71	0.23	1.02	28	12.53	0.50	0.28	1.21
					MAB North						
AL0102	43	56	5.46	0.07	0.24	1.01	40	6.71	0.64	0.31	1.25
DE0101	49	26	5.45	0.13	0.38	0.96	23	6.67	0.11	0.46	1.34
AL0103	89	55	5.17	0.62	0.27	0.73	50	5.96	0.46	0.32	1.18
ALB/DEL	145	26	10.92	-0.09	0.34	1.29	24	7.22	0.31	0.39	1.77
AL0107	180	17	19.50	2.01	0.36	2.05*	17	9.23	1.52	0.38	2.01*
AL0110	266	55	20.88	2.75	0.29	1.26	52	14.52	1.32	0.22	2.62*
AL0111	307	29	15.49	1.25	0.34	0.75	27	13.79	0.56	0.38	1.58
					MAB South						
AL0102	33	68	6.77	-0.20	0.24	2.09	54	6.89	0.00	0.28	1.50
DE0101	45	11	7.11	-0.51	0.58	1.25*	7	8.21	0.78	0.73	1.14*
AL0103	69	92	6.74	0.64	0.22	1.18	83	6.97	1.03	0.28	1.36
ALB/DEL	141	41	13.45	-0.49	0.27	1.01*	38	8.34	-0.29	0.29	1.57*
AL0107	188	51	23.77	1.52	0.24	1.89*	50	7.67	0.21	0.29	2.20*
AL0110	252	88	23.60	1.50	0.24	1.13	80	13.57	-0.62	0.28	3.28
AL0111	304	36	16.85	0.80	0.32	0.74	33	15.94	1.20	0.36	1.26

(1) "CRUISE", the code name for a cruise: "CD", the calendar mid-data of all the stations within a region for a cruise: "# obs", the number of observations included in each average: "Temp", the areal average temperature: "Anomaly", the areal average temperature anomaly: "SDV1", the standard deviation associated with the average temperature anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived.

(*) A true areal average could not be calculated due to poor station coverage. The average values listed were derived from a simple average of the observations within the region.

(**) ALB/DEL = AL0106 + DE0105

Table 5. Areal average surface and bottom salinity and salinity anomalies for the 2001 NEFSC cruises in the five regions of the northeast continental shelf as shown in Figure 1

	SURFACE						BOTTOM				
CRUISE	CD	#obs	Temp	Anomaly	SDV1	SDV2	#obs	Temp	Anomaly	SDV1	SDV2
(**)											
					Gulf of Maine West						
AL0103	117	53	31.87	-0.57	0.08	0.65	50	33.22	-0.16	0.05	0.29
ALB/DEL	156	12	31.77	-0.44	0.14	0.26	10	33.25	-0.19	0.10	0.20*
AL0109	239	15	31.80	-0.25	0.15	0.25	12	33.73	-0.06	0.09	0.26*
DE0109	252	79	31.86	-0.14	0.06	0.24*	81	33.30	-0.09	0.03	0.27*
AL0110	292	48	32.36	-0.15	0.07	0.18	45	33.45	-0.14	0.05	0.34
AL0111	316	28	32.66	-0.06	0.11	0.21	20	33.69	0.05	0.08	0.27
					Gulf of Maine East						
AL0103	109	32	31.84	-0.63	0.12	0.34	32	33.81	-0.19	0.08	0.46
ALB/DEL	154	21	31.84	-0.57	0.14	0.24	13	33.74	-0.15	0.12	0.35
AL0109	237	25	32.11	-0.25	0.12	0.38	21	33.93	0.08	0.11	0.45
DE0109	265	36	32.19	-0.25	0.07	0.21*	35	34.32	-0.01	0.04	0.15*
AL0110	283	29	32.46	-0.14	0.12	0.20	29	34.29	0.05	0.09	0.24
AL0111	313	17	32.85	0.18	0.16	0.34	14	34.13	-0.08	0.10	0.40
					Georges Bank						
AL0102	51	30	32.84	-0.15	0.12	0.30*	21	33.01	-0.15	0.10	0.40*
AL0103	102	51	32.73	-0.17	0.07	0.23	44	32.97	-0.20	0.08	0.39
ALB/DEL	152	33	32.62	-0.20	0.08	0.65	29	32.87	-0.15	0.09	0.26
DE0106	167	20	32.38	-0.25	0.09	0.40*	20	32.74	-0.21	0.09	0.32*
AL0107	211	71	32.21	-0.49	0.06	0.34	70	32.67	-0.31	0.07	0.34
AL0109	235	37	32.16	-0.55	0.09	0.36	33	32.53	-0.39	0.09	0.25
DE0109	264	39	32.37	-0.16	0.05	0.16*	38	32.60	-0.13	0.05	0.19*
AL0110	274	52	32.71	-0.03	0.07	0.49	45	32.81	-0.14	0.08	0.39
AL0111	312	35	32.62	-0.17	0.09	0.28	28	32.70	-0.27	0.10	0.34
					MAB North						
AL0102	43	56	32.86	-0.27	0.12	0.33	40	33.30	-0.27	0.11	0.41
DE0101	49	26	32.90	-0.27	0.17	0.35	22	33.31	-0.46	0.14	0.46
AL0103	89	55	32.60	-0.25	0.13	0.87	50	33.01	-0.42	0.11	0.38
ALB/DEL	145	26	32.44	0.00	0.16	0.62	24	32.79	-0.27	0.14	0.25
AL0107	180	17	31.71	-0.11	0.18	0.56*	17	33.02	0.09	0.13	0.55*
AL0110	266	54	32.85	0.20	0.13	0.56	52	32.33	-0.53	0.08	0.39*
AL0111	307	27	32.98	-0.05	0.17	0.45	27	33.59	-0.13	0.13	0.53
					MAB South						
AL0102	33	68	33.37	-0.39	0.14	0.62	54	33.49	-0.23	0.11	0.48
DE0101	45	11	33.37	-0.61	0.27	0.37*	7	33.86	-0.12	0.26	0.46*
AL0103	69	91	32.77	-0.44	0.13	1.11	83	33.22	-0.29	0.10	0.63
ALB/DEL	141	41	32.09	-0.14	0.15	0.53*	38	32.66	-0.56	0.11	0.25*
AL0107	188	50	31.38	-0.56	0.12	0.51*	50	33.25	-0.07	0.10	0.50*
AL0110	252	86	32.47	0.32	0.13	1.12	80	32.89	-0.23	0.11	0.58
AL0111	304	34	33.48	0.59	0.19	0.51	33	33.68	0.35	0.13	0.50

(1) "CRUISE", the code name for a cruise: "CD", the calendar mid-data of all the stations within a region for a cruise: "# obs", the number of observations included in each average: "Salt", the areal average salinity: "Anomaly", the areal average salinity anomaly: "SDV1", the standard deviation associated with the average salinity anomaly: "SDV2", the standard deviation of the individual anomalies from which the average anomaly was derived.

(*) A true areal average could not be calculated due to poor station coverage. The average values listed were derived from a simple average of the observations within the region.

(**) ALB/DEL = AL0106 + DE0105

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