Cruise Report

R/V OCEANUS Cruise 344
to Georges Bank

U. S. GLOBEC

NW ATLANTIC/GEORGES BANK STUDY

6 - 11 July 1999

Acknowledgments
R/V OCEANUS Cruise OC344
U.S. State Department Cruise No. 99-015
6 – 11 July 1999

This cruise and preliminary data report was prepared by Jim Irish, and Jim Doutt from cruise logs and notes as a first draft of the activities, positions and data collected on R/V OCEANUS Cruise OC344. We acknowledge the excellent support of Captain Courtenay Barber and would especially like to thank Bos'n Jeff Stolp for his outstanding assistance during the mooring operations.

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OCE-9631468

Cruise Report
R/V OCEANUS Cruise OC344
U.S. State Department Cruise No. 99-015

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Purpose: The purpose of OC344 is to turn around the long-term moorings on Georges Bank. This includes cleaning the bio-optical sensors on the southern flank and Northeast Peak moorings, servicing the bottom pressures instrument, and dumping the high frequency data from the southern flank buoy. Also while the moorings are being serviced, our standard long-term moored program CTD sections would be made, and *in-situ* calibration profiles taken before and after each mooring recovery and deployment. As time permits, assistance would be given to the Northeast Peak crossover experiment moorings and additional CTD sections.

Accomplishments: The southern flank and Northeast Peak moorings, and bottom pressure instrument were recovered on 7 July 1999. Before mooring recovery a 1-hour yo-yo time series was taken as near the moorings as possible. The data were then dumped from all instruments, the bio-optical packages turned around, and the moorings assembled for deployment. The Northeast Peak mooring was deployed between two guard buoys in its original position on 8 July 1999. the Southern Flank science mooring was deployed on 9 July 1999, and the guard buoy missing since mid-June was replaced at the same time. The bottom pressure instrument was then deployed between the science buoy and a guard buoy. Finally, CTD *in-situ* calibration yo-yo profiles were made beside each of the moorings as a pre-cruise calibration check.

The standard CTD sections were made while the mooring servicing was taking place. First the Northeast Peak section was make from East to West. After the section was made, the Northeast Peak moorings were deployed. Then the southern flank long-term section was taken from offshore up onto the bank, and the southern flank mooring and bottom pressure instrument deployed. Then the southern flank long term section was again occupied from the crest of the bank running offshore. After the completion of this section, the cruise work was complete and the ship headed back to WHOI. The ship's track, mooring sites and CTD stations are shown in Figure 1.

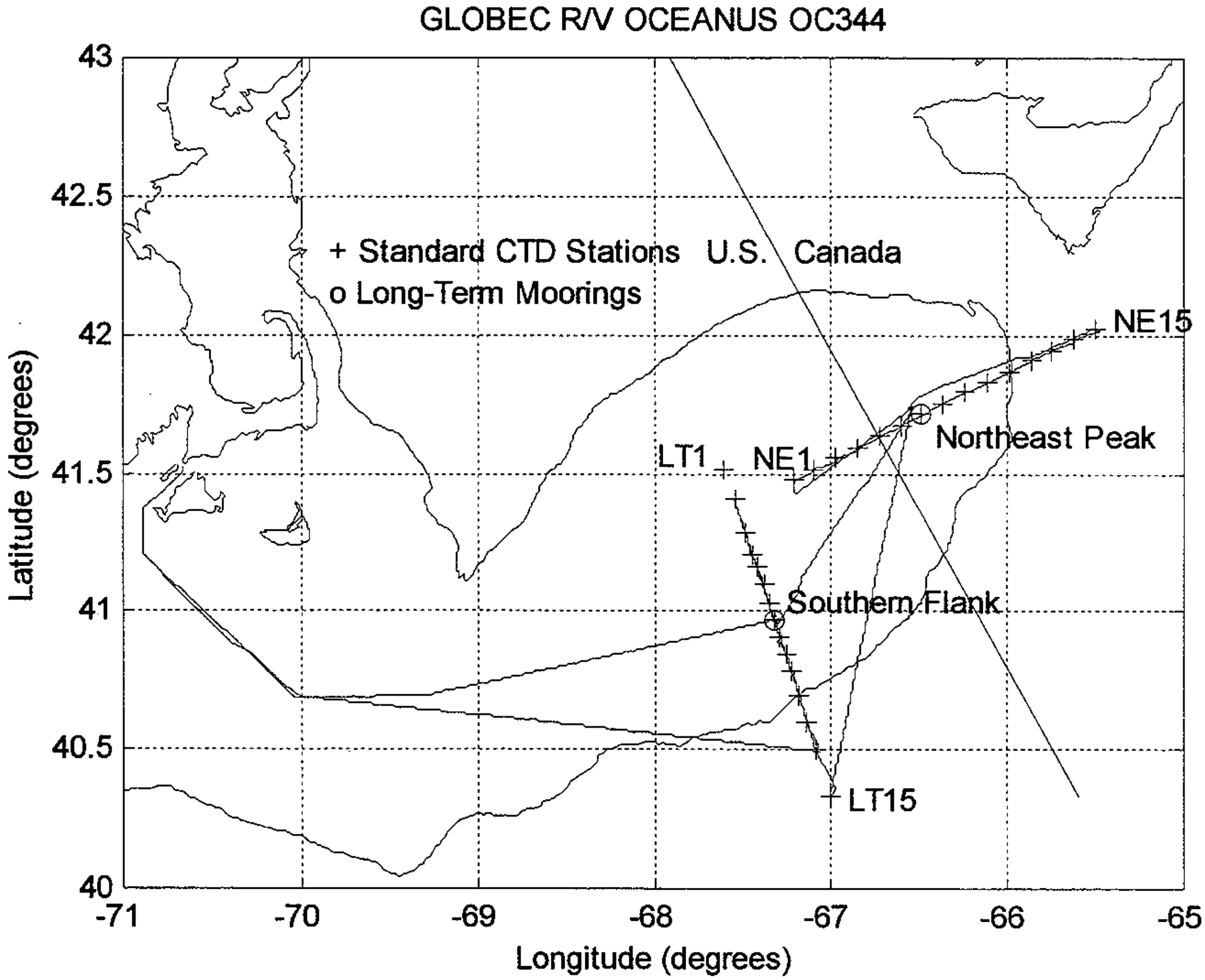


Figure 1. The R/V OCEANUS Cruise OC344 from Woods Hole to Georges Bank to Woods Hole on 6 to 11 July 1999. The cruise track is shown as the line, the southern flank and Northeast Peak long-term moorings are shown with a "O" and the CTD stations occupied with a "+". The Northeast Peak moorings and many CTD stations are located in Canadian waters.

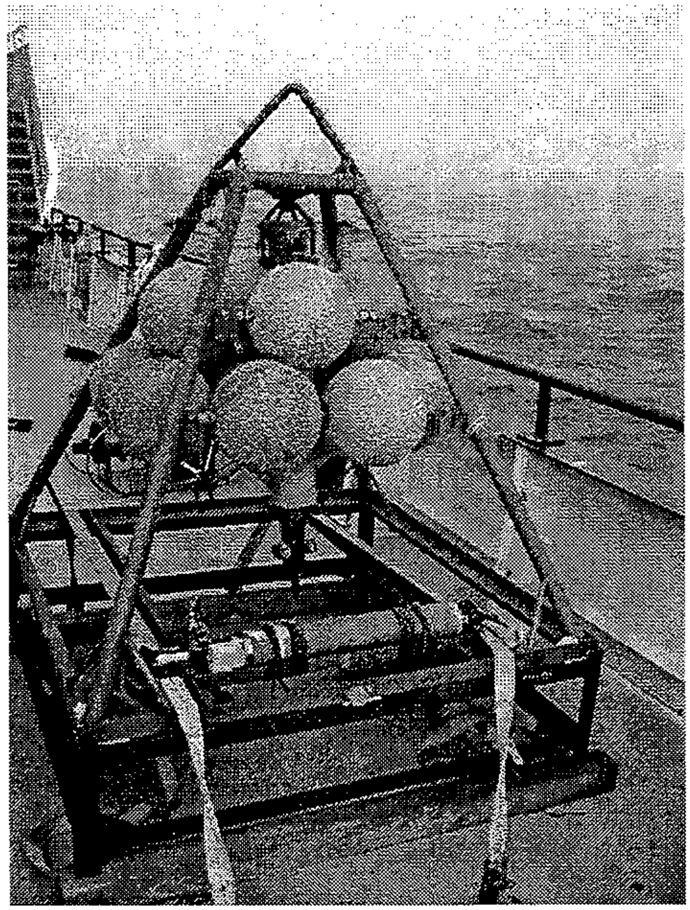
OC344 Cruise Results

Ship's Track

The cruise track sailed on OC344 is shown in Figure 1. Although the weather was excellent, the ship sailed around Nantucket shoals instead of through Vineyard Sound. The bottom pressure, southern flank science mooring E, and Northeast Peak science mooring B were recovered first and serviced while the Northeast Peak and southern flank long-term CTD sections were made and all moorings deployed in the same positions.

Mooring Recovery

Bottom Pressure: The bottom pressure instrument was the first to be recovered. It was released from its anchor by acoustic command to the acoustic release on the first try at 1013 UTC on 7 July 1999. The instrument was sighted a short time later on the surface to the North of the expected recovery site. It is not clear whether the instrument was deployed in the wrong position on the March deployment cruise, or it had been moved during the deployment. There was no sign of damage or rubbing of lines/wires/nets on the frame to indicate that it was hit and dragged by fishing activity.



Picture 1. The Bottom Pressure instrument after recovery showing the light hydroid growth on the frame and barnacle growth on the plastic flotation spheres.

The Sea Bird Electronics Seagauge on the instrument returned a full set of good data from the four month long deployment. The sensor serial numbers are given in Table 1. The instrument was lightly fouled by hydroid growth on the frame and sensor. The flotation spheres had a moderate to heavy growth of barnacles on them with some barnacles on the sensor and mounting brackets. The fouling and corrosion was not very different from previous deployments and did not affect the data.

The 15-minute sampled data (Figure 2) show the tides and weather forced sea level fluctuations in the pressure record and the seasonal heating in the temperature record. The salinity record looks very reasonable, and does not show the sediment related "sags" in salinity that have been seen in the past with the horizontally mounted conductivity sensor. The vertical mounting of the conductivity cell was tried for the first time this deployment, after seeing the drift or changes in salinity which appear as lower than expected readings which we attributed to the presence of sand (a non-conducting medium) in the sensor. This simple change improved the data, but at the expense of flushing. The horizontal cell would be optimally flushed by the water movement which would be parallel with the bottom. In the vertical orientation, the flushing would be minimized. However, in the horizontal position, sediment could settle out in the cell causing larger fluctuations in salinity than observed in the present record with the cell vertical. Therefore, the sediment effects are more significant than the reduced flushing effects and the conductivity sensors will be mounted vertically in the future.

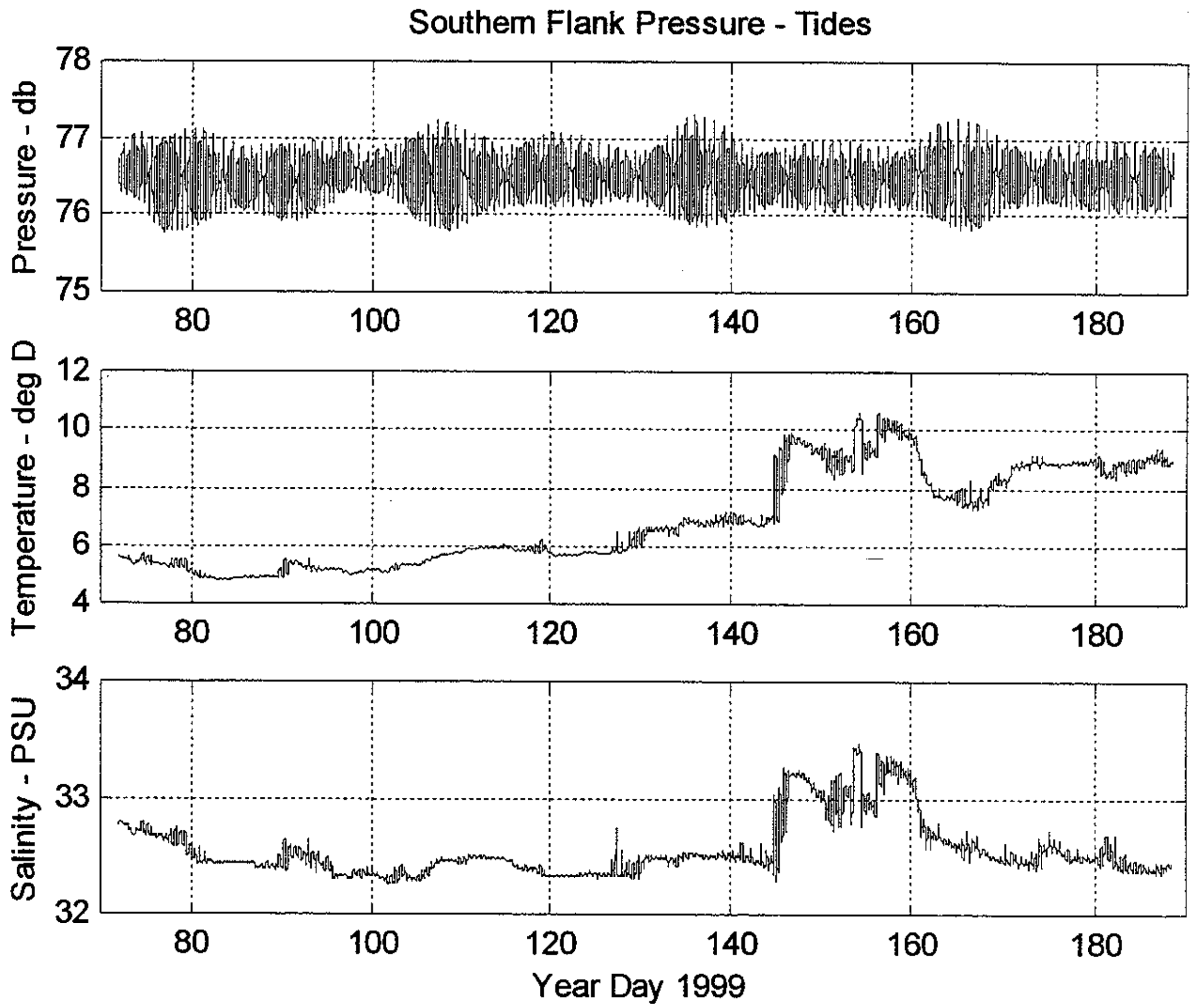


Figure 2. Bottom Pressure instrument data. The top panel shows the unedited, normalized pressure record in dbars relative to one standard atmosphere. The middle panel shows the unedited, normalized temperature in degrees Centigrade. The bottom panel shows the salinity calculated from raw temperature and conductivity. The sample interval in the tidal mode shown here was 15 minutes.

In addition to the 15-minute samples shown in Figure 2, the bottom pressure instrument also burst sampled for long wave activity once per day at 1530 UTC for about 10 minutes. Because of the attenuation of surface waves with depth, waves of period shorter than about 7 seconds would not be observed at the bottom. Each of the bursts consisted of 300 samples taken at 2-second intervals. The ½ Hz rate will resolve 7-second and longer waves and the 10-minute burst is the minimum that will obtain reasonable wave statistics.

The significant wave height (the highest 1/3 of the waves) is calculated by the instrument and shown in Figure 3 along with the estimated period of these waves. The standard correction for wave attenuation with depth was made in these records. As the waves are made up of a spectrum of different periods, this single height and period does not describe the full wave field. The individual burst records were saved and can be analyzed in a spectral sense if desired.

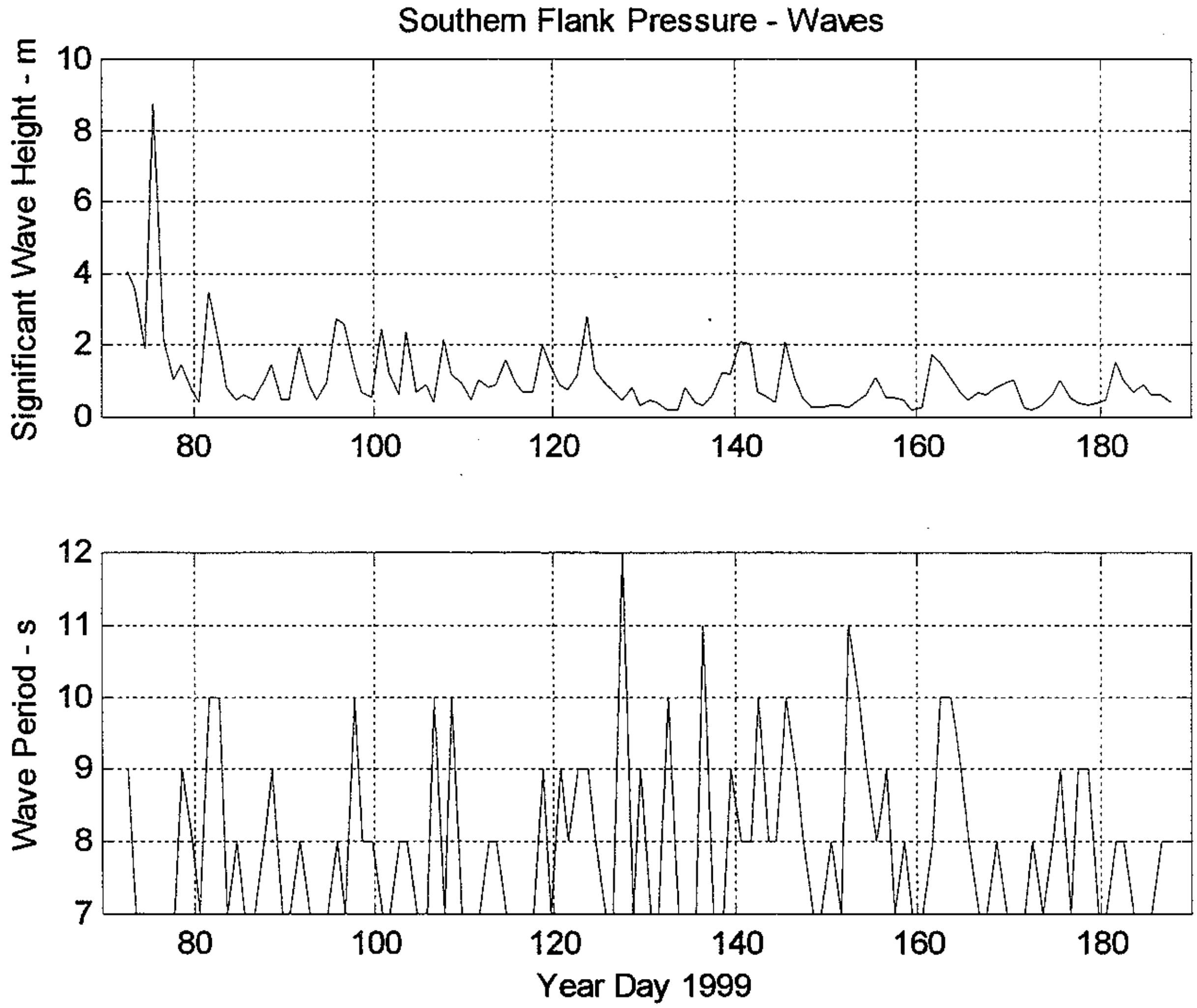


Figure 3. Wave statistics gathered once a day at 1530 UTC from the bottom pressure sensor as an indication of the long-wave activity that penetrated to the bottom in 76 meters of water. The minimum period of about 7 seconds reflects the attenuation with depth that removes the effects of waves of shorter period.

During the summer, a typical significant wave height during storm events is about 2 meters. In this record it is clear that the typical summer weather is being seen at the end of the record. Just after the mooring was deployed in March 1999, a significant wave event was recorded that is typical of many winter storms. The record shown in GLOBEC cruise report OC338, shows a storm with 12 meter significant wave height near the end of the deployment (just before this deployment). The longer period peaks are due to waves generated at more distant storms that have propagated into the region, or from storms with sufficient fetch to generate these long waves.

Science Mooring E: The southern flank science mooring (configuration shown in Figure 4 and the sensors, serial numbers and depths listed in Table 1) was recovered immediately after the bottom pressure instrument on 7 July 1999. The science mooring was released from its anchor

Table 1. Sensor Type, Depth and Serial Number

				Recovered	Deployed	Recovered	Deployed
				Buoy E	Buoy D	Buoy B	Buoy B
Measurement	**Sensor Type**	**Company**	**Model**	**Serial #**	**Serial #**	**Serial #**	**Serial #**
Buoy Met	Air Temperature	Rotronics		35851	17457	WHOI1	WHOI1
	Relative Humidity	Rotronics		35851	17457	N/S	N/S
	Wind Speed and Dir	RM Young		N/S	N/S	N/S	N/S
	PAR	LiCor	UWQ	5018	4949	4975	4975
	Short Wave Rad	Eppley		25418	28300	N/S	N/S
	Long Wave Rad	Eppley		27953F3	28379F3	N/S	205
Sea Surf	Temp at 1 m	Sea Bird	SBE-3	32176	32176	32488	32488
	Cond at 1 m	Sea Bird	SBE-4	N/S	N/S	41365	41365
Current Profiles	ADCP	RDInstruments	Workhorse	705	894	125	130
T/C at 5 m	Temp at 5 m	Sea Bird	SBE-3	477	477	32064	32173
	Cond at 5 m	Sea Bird	SBE-4	41333	41333	41367	41367
BIOP at 10 m		Luigi		1	1	2	2
	Temp at 10 m	Sea Bird	SBE-3	484	484	490	490
	Cond at 10 m	Sea Bird	SBE-4	59	59	42182	42182
	Trans at 10 m	Sea Tech		620	620	621	621
	Fluor at 10 m	Sea Tech		296	296	296	296
	PAR1 at 10 m	LiCor	SPQA	2146	2146	1793	1793
	PAR2 at 10 m	LiCor	SPQA	1972	1972	N/S	N/S
	OBS at 10 m	Sea Point	STM-1	31912	31912	1222	1222
T/C at 15 m	Temp at 15 m	Sea Bird	SBE-3	481	481	32431	32431
	Cond at 15 m	Sea Bird	SBE-4	41370	41370	41890	41890
T/C at 20 m	Temp/Cond at 20 m	Sea Bird	SBE-16	2006	2006	2360	2359
T/C at 25 m	Temp at 25 m	Sea Bird	SBE-3	482	482	N/S	N/S
	Cond at 25 m	Sea Bird	SBE-4	41377	41377	N/S	N/S
T/C at 30 m	Temp/Cond at 30 m	Sea Bird	SBE-16	1861	1861	2359	2360
T/C at 35 m	Temp at 35 m	Sea Bird	SBE-3	32178	32178	N/S	N/S
	Cond at 35 m	Sea Bird	SBE-4	41625	41625	N/S	N/S
BIOP at 40 m		Luigi		5	5	3A	3A
	Temp at 40 m	Sea Bird	SBE-3	478	478	31632	31632
	Cond at 40 m	Sea Bird	SBE-4	56	56	42186	42186
	Trans at 40 m	Sea Tech		628	628	143PR	143PR
	Fluor at 40 m	Sea Tech		306	306	290	N/S
	PAR at 40 m	LiCor	SQPA	1659	1659	1661	1661
T/C at 45 m	Temp at 45 m	Sea Bird	SBE-3	31629	31629	N/S	N/S
	Cond at 45 m	Sea Bird	SBE-4	41713	41713	N/S	N/S
T/C at 50 m	Temp at 50 m	Sea Bird	SBE-3	32177	32177	32432	32432
	Cond at 50 m	Sea Bird	SBE-4	41711	41711	41379	41379
T/C at 72 m	Temp/Cond at 72 m	Sea Bird	SBE-37	716	716	715	715
Acoustic Release		EG&G	BACS	18022	18022	17306	17306
Bottom Pressure Instrumentation							
	Pressure Instrument	Sea Bird	SBE-26	49	49	N/S	N/S
	Conductivity	Sea Bird	SBE-4	41596	41596	N/S	N/S
	Acoustic Release	EG&G	BACS	18021	18021	N/S	N/S

Southern Flank Mooring

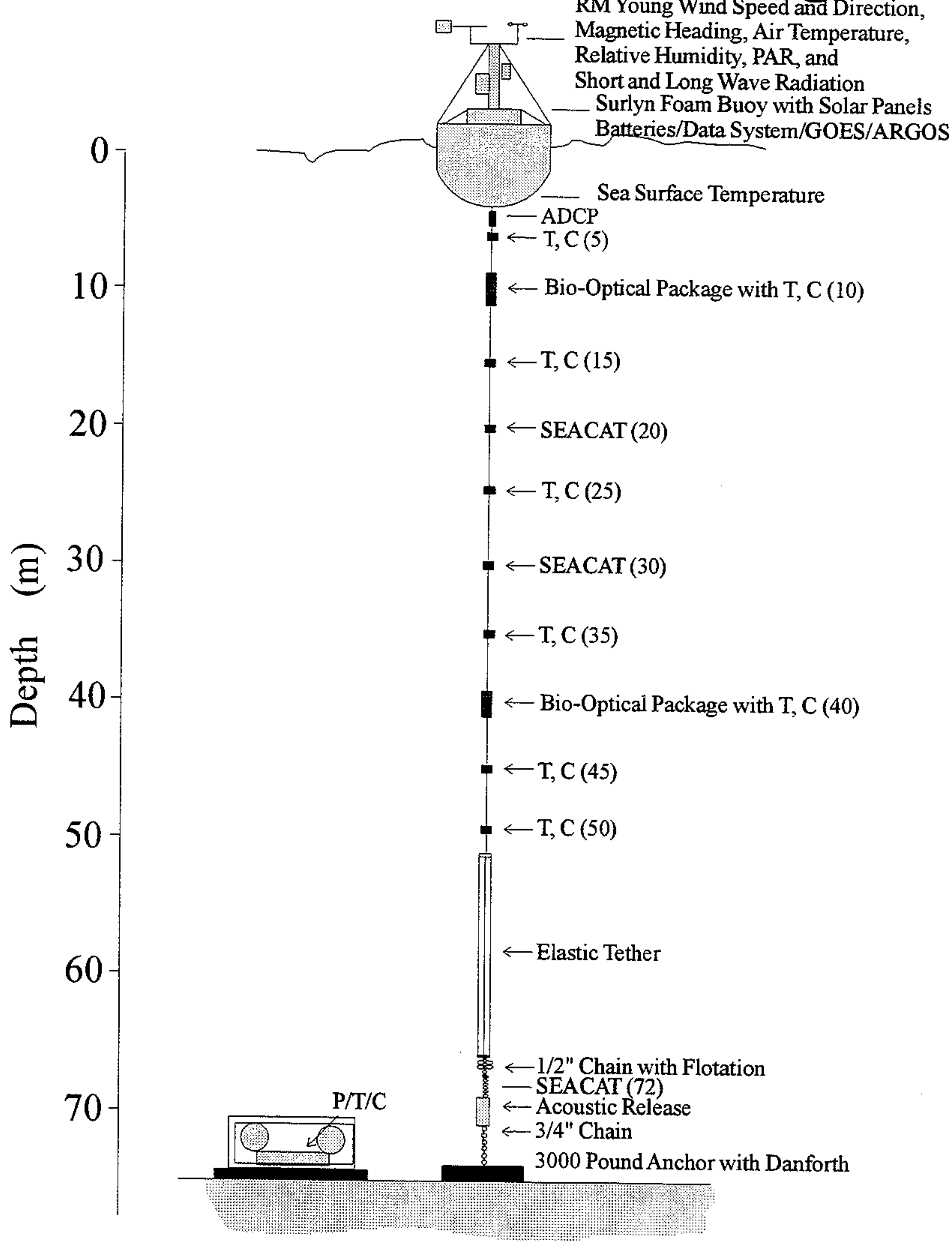


Figure 4. Configuration of the southern flank mooring during the spring and summer of 1999.

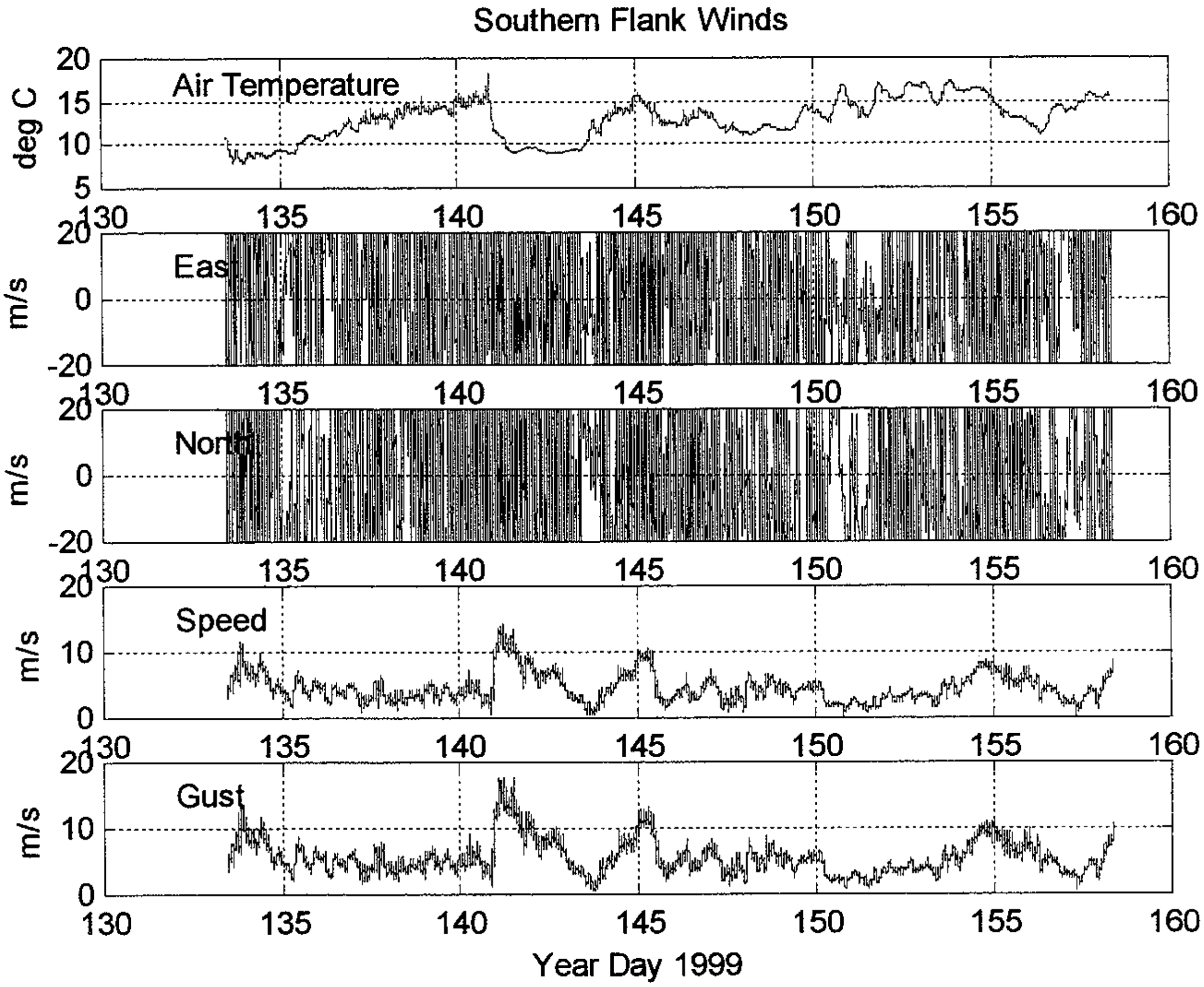


Figure 5. Southern flank winds. The normalized but unedited data (one-minute averages of 1 Hz samples) are plotted - air temperature, east and north winds (meteorology convention), average wind speed and gust (maximum 1 Hz sample in the one-minute interval.

by acoustic command on the first try at 1036 UTC. The subsurface float surfaced and the mooring was retrieved. The buoy was recovered first, and the mooring pulled in by hand with help from the crane lifting the bio-optical packages and the subsurface float/release.

The normalized and unedited plots of the buoy-recorded data are shown in Figures 5, 6, 7, and 8 as a first look at the data. The buoy's data system was modified over the winter with a 16 MBytes PCMCIA FLASH data storage card. This allows 6 months of the basic 1-minute data to be stored, rather than the 1-hour data previously stored on SRAM cards used during the first four years of GLOBEC. This additional recording of the 1-minute data will allow us to study the behavior of the data system and sensors. There is some apparent interference with the more sensitive sensors (e.g. long-wave radiation) with the GOES and maybe ARGOS transmissions. The high frequency data will allow us to look at the details of this interference and produce hourly averages of the quantities without the radio interference. Also the basic compass and a system zero voltage reference are recorded for additional studies of system behavior.

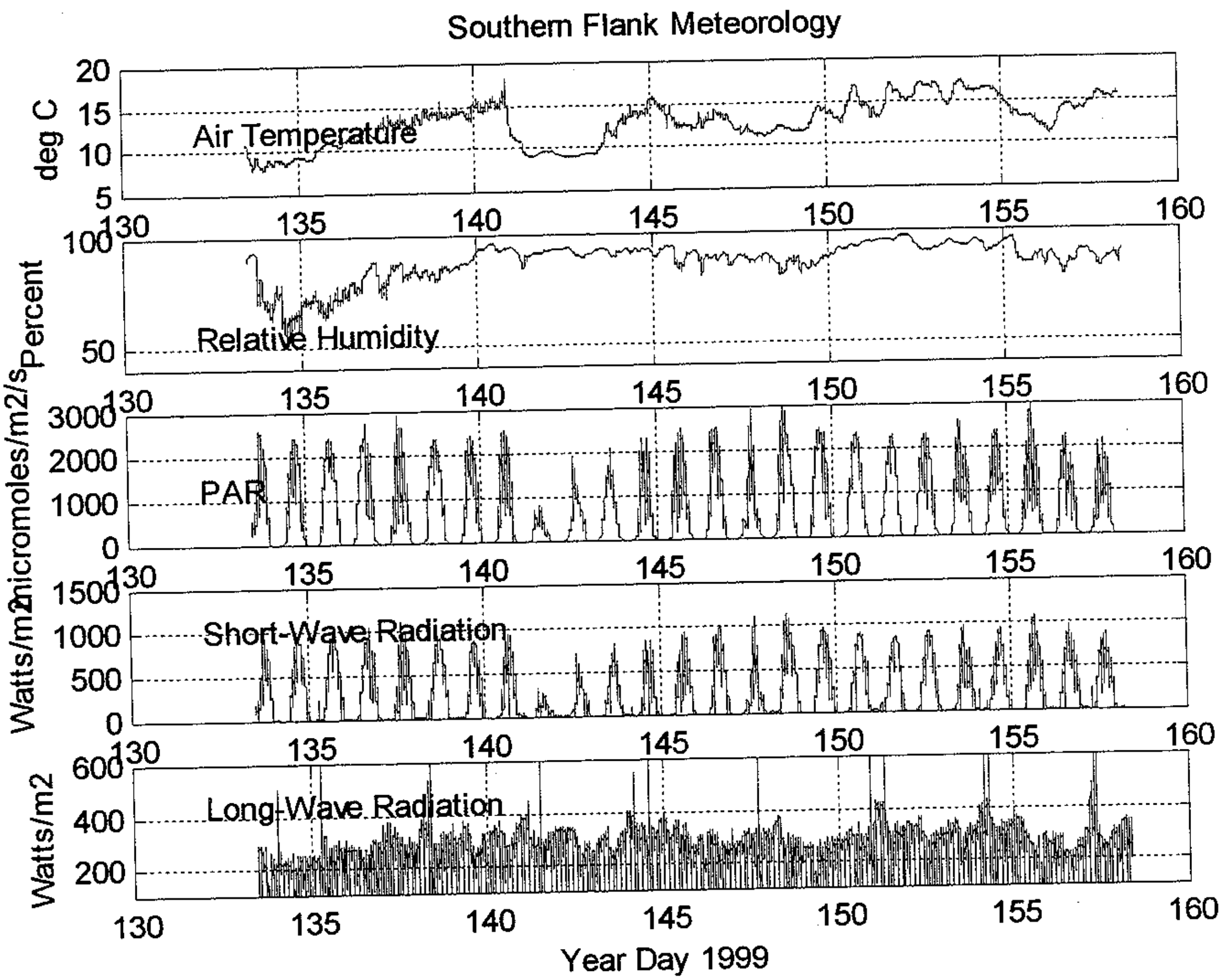


Figure 6. Southern flank meteorology. The normalized, but unedited air temperature, relative humidity, cosine PAR, short- and long-wave radiation are plotted. The pulse every GOES transmission is apparent , particularly in the long-wave radiation sensor.

The wind sensor was sampled at 1 Hz and the data system's autosample feature calculated vector components relative to the buoy as well as average and maximum (gust) wind speeds directly from the anemometer. Then once per minute, the compass was read and the components rotated into east and north velocity components relative to magnetic north. The convention is meteorological here with the direction being the direction from which the wind is blowing. The components, average speed and gust are plotted in Figure 5 with atmospheric temperature for reference at top. The eastgoing and northgoing components appear to have a lot of noise that is related to the satellite telemetry. The average and gust velocities don't use the compass correction and so don't have this problem. Corrections for these effects by eliminating the spikes every three hours should clean up the records considerably.

Unfortunately the data system had failed on year day 158 (7 June 1999) and a month of meteorology, temperature and salinity data was lost. The Seacats, bio-optical packages and ADCP were all internally recording and obtained data during this period.

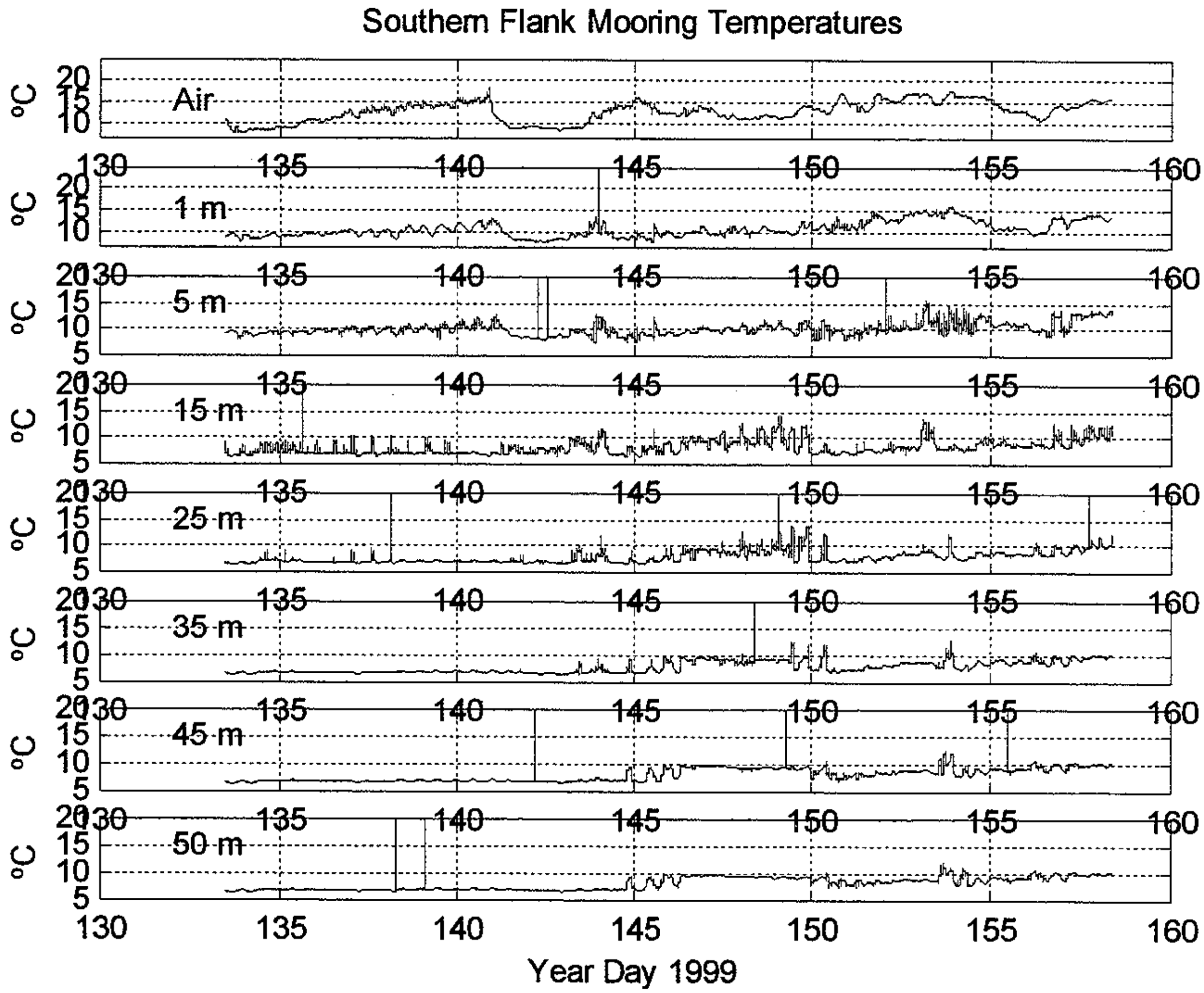


Figure 7. Southern flank buoy recorded temperatures. The normalized but unedited temperatures digitized in the buoy are shown at the depths listed in the panels. The air temperature is plotted in the top panel for reference. The summer warming is apparent at all levels with greater variability seen in the upper sensors.

The meteorology results (Figure 6) show good air temperature and relative humidity, PAR, short-wave radiation and long-wave radiation. The largest event is the year day 141 (21 May 1999) storm on which the air temperature dropped significantly, the PAR and short-wave radiation sensors showed low solar radiation input, and the upper water column temperatures showed cooling (Figure 7). The long-wave radiation sensor shows the effects of the GOES satellite telemetry system that is also apparent, but to a lesser extent in the short wave radiation, air temperature and relative humidity and PAR. The zero voltage reference for the analog voltages is also recorded and will be used to help remove these spikes in the data.

The buoy recorded water temperatures and salinities are shown in Figures 7 and 8. The data were sampled at 1-minute intervals. In the past these were averaged to hourly. The temperatures show a slight spring warming and the salinities a slight freshening. The wind-cooled event is evident in surface temperatures around year day 141. The salinity event on days

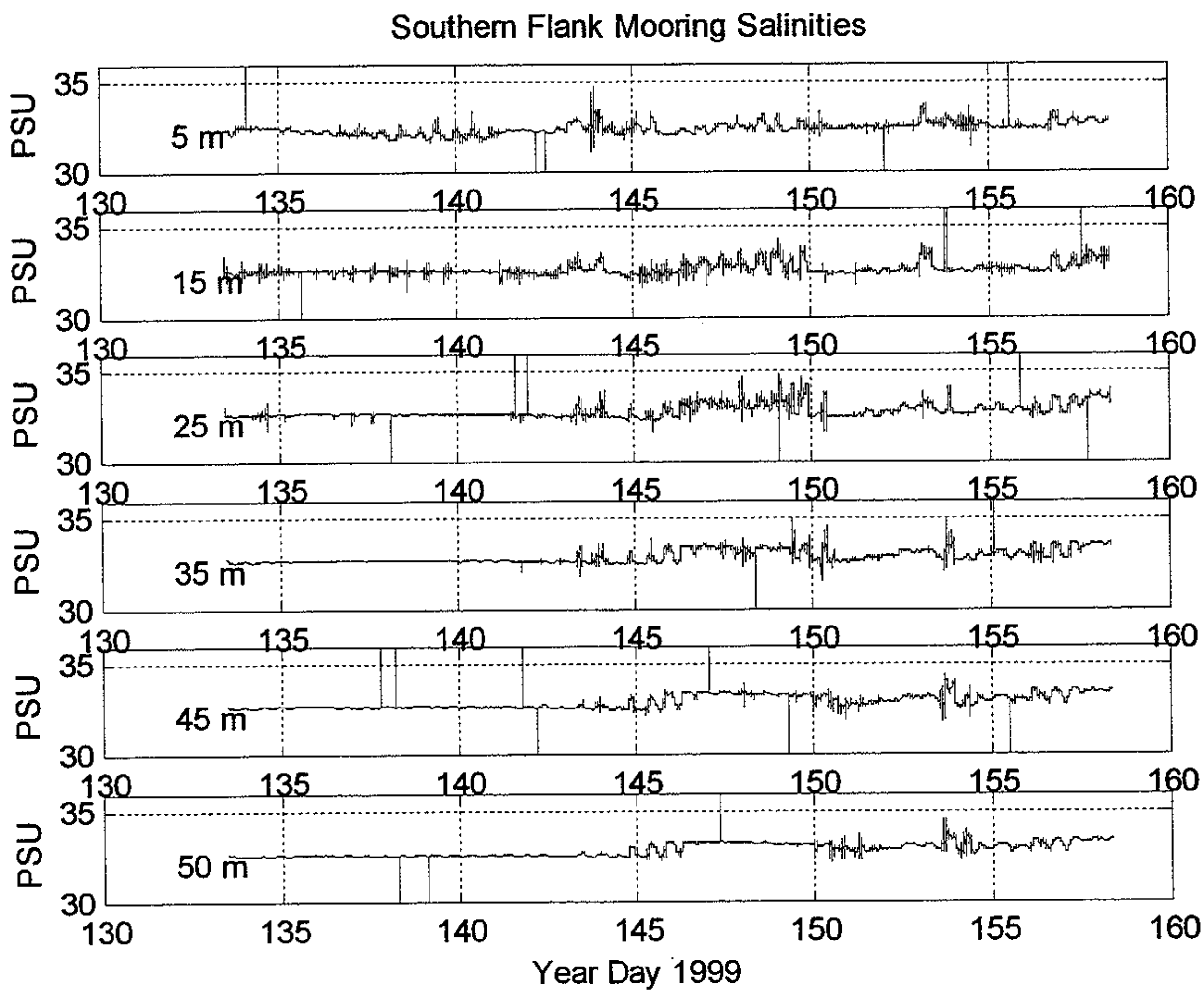


Figure 8. Southern flank buoy recorded salinity. The normalized but unedited salinity records were calculated from temperature and conductivity observations at each depth and converted using the Practical Salinity Scale of 1978. There is a salty event between year days 145 and 150 (also seen in temperature) at depths 15 to 25 and maybe 35 meters, indicating that warm core ring effects as seen in the past are present in these records.

145 to 150, and start of one at the end of the records are the main signals in salinity. The effects of the year day 145-150 intrusion are seen at all depths.

These same signals are seen in the moored Seacat records of temperature and conductivity shown in Figures 9 and 10. These records did not have the short records due to data system failure in the buoy, and provided continuous records from March to the July servicing. The temperature/salinity events (warm and salty water intrusions) are apparent in the record. The year day 145-150 event extends all the way to the bottom, and continues through a year day158-160 event. A strong warm/salty event was seen on 170-172 and its effects continue periodically through year day 181. In this event, the temperature jumped over 5° C and salinity 2 PSU. The effects were seen at 30 meters, but not at the bottom (72-meter Seacat or bottom pressure). Again these are typical signatures of warm core ring water, but the water being on the

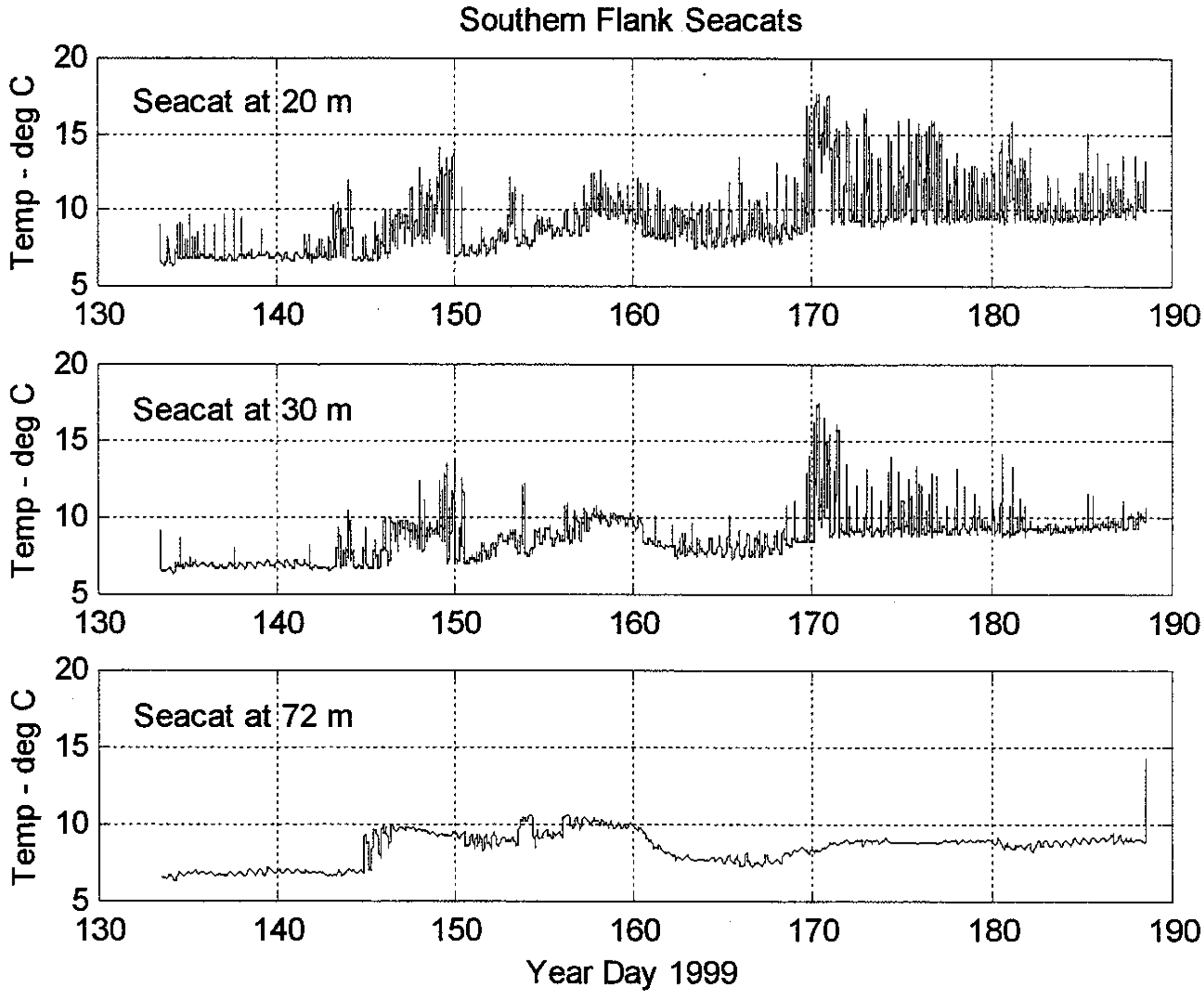


Figure 9. Southern flank Seacat temperatures. The normalized but unedited Seacat tempratures from 20, 30 and 72 meters depth are shown. The 20 and 30-meter sensors were sampled at 1 minute and the 72-meter at 3.75 minutes. Some of the regular spiking seen in the 20 and sometimes 30-meter records are due to the semidiurnal internal solitary wave bursts as seen previously.

surface around year day 171 is more typical of the filament that broke off and came across the shelf in July 1997.

Some of the high frequency signals seen in the upper water column Seacat data is due to the internal solitary waves created by the tidal currents at the shelf break which propagate up on the shelf and past the mooring. During this deployment, the sensor were set to sample at 2-minute intervals, so that the internal solitary wave signatures were poorly resolved, but during the summer deployment, the sample interval will be increased to 1 minute and these waves resolved adequately. Some of the apparent salinity spiking is probably due to these waves, and will also be studied with the higher frequency data during the next deployment.

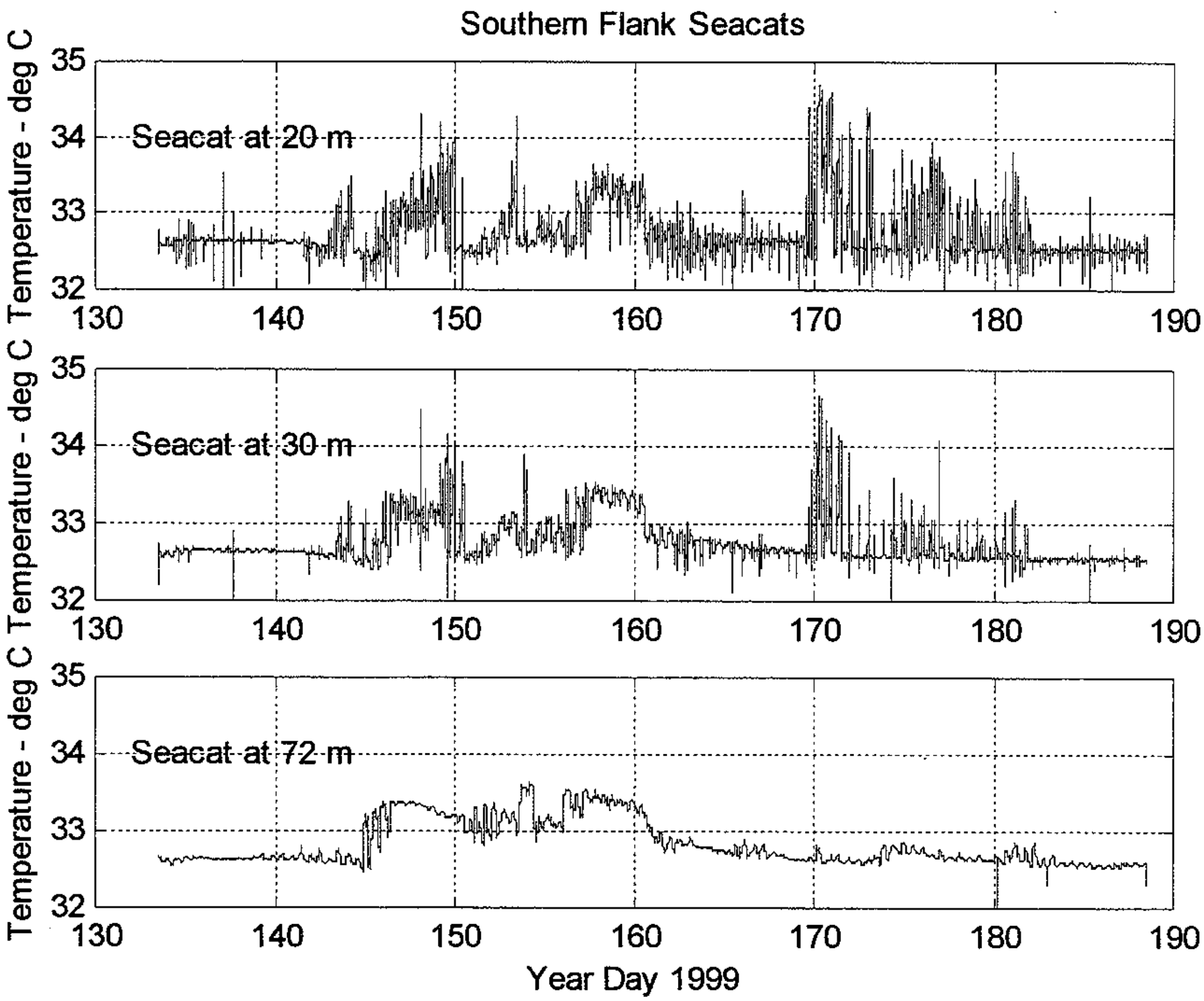


Figure 10. Southern flank Seacat salinities. The normalized but unedited Seacat salinities from 20, 30 and 72 meters depth are shown. The 20 and 30-meter sensors were sampled at 1 minute and the 72-meter at 3.75 minutes. The salinity records were calculated from temperature and conductivity observations at each depth and converted using the Practical Salinity Scale of 1978. Some of the regular spiking seen in the 20 and sometimes 30-meter records are due to the semidiurnal internal solitary wave bursts as seen previously. Three salinity intrusion events are observed - from year day 145 to 150, from 158-160 and 170-172. During these times some warm core ring effects, are seen in at 20 and 30 meters.

The RDInstruments ADCP moored under the buoy in a downward looking configuration collected good data for the duration of the deployment. The eastgoing and northgoing velocities at 6 selected depths are plotted - 8.6, 15.6, 21.6, 30.6, 47.6, and 60.6 meters. The values are half hourly averages of 800 pings to reduce the statistical uncertainty to below 1 cm/sec for the velocity estimate from Doppler frequency shift, and average over the long-wave variability. The components were calculated relative to magnetic north in the ADCP, and rotated to true north on retrieval and normalization. The current records (Figures 11 and 12) are dominated by the semidiurnal tide that is near resonance in the Bay of Fundy-Gulf of Maine system. This resonance causes larger tides than normally found on the continental shelf regions of the US. The eastgoing record is aligned in a somewhat along-bank direction, and the Northgoing component in a largely on-bank direction. Therefore, the around bank circulation, which fluctuates most strongly with the weather forced variability, is seen as a negative eastgoing component, and is most apparent in the surface waters. In the period year day 160-170 there appears to be a stronger tidal current and stronger along bank component. This is the time between intrusive events seen in the Seacat records, Figures 9 and 10.

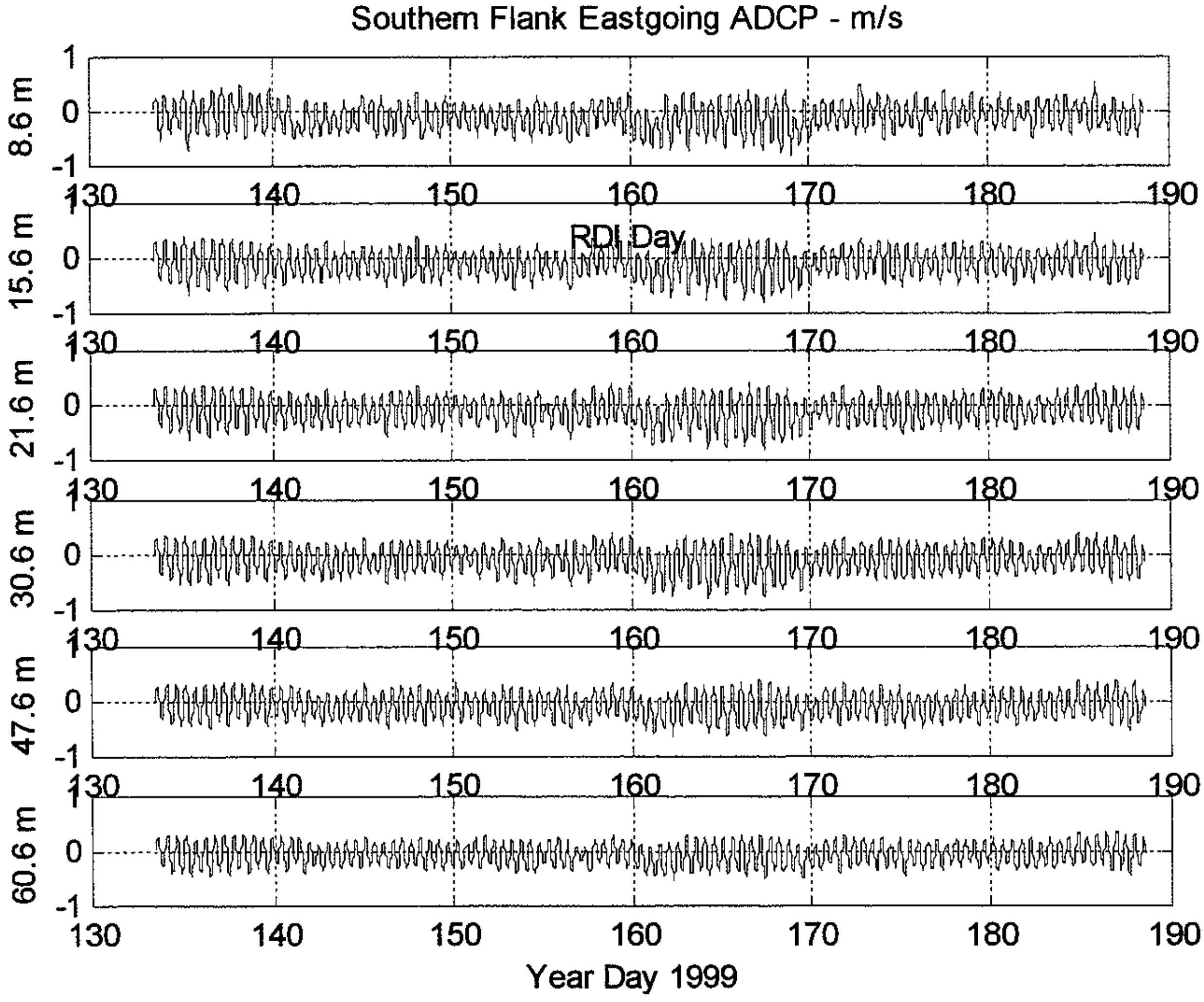


Figure 11. Eastgoing southern flank ADCP velocities at selected depths. The eastgoing ADCP record from 6 selected depths - 8.6, 15.6, 21.6, 30.6 47.6 and 60.6 meters are shown. The strong coherence with depth in the tidally dominated record is obvious. The offset toward downbank flow (negative eastgoing velocity) is most apparent in the upper part of the water column. Some weather induced fluctuations are observed - see low frequency "wiggle" around year days 160 and 170.

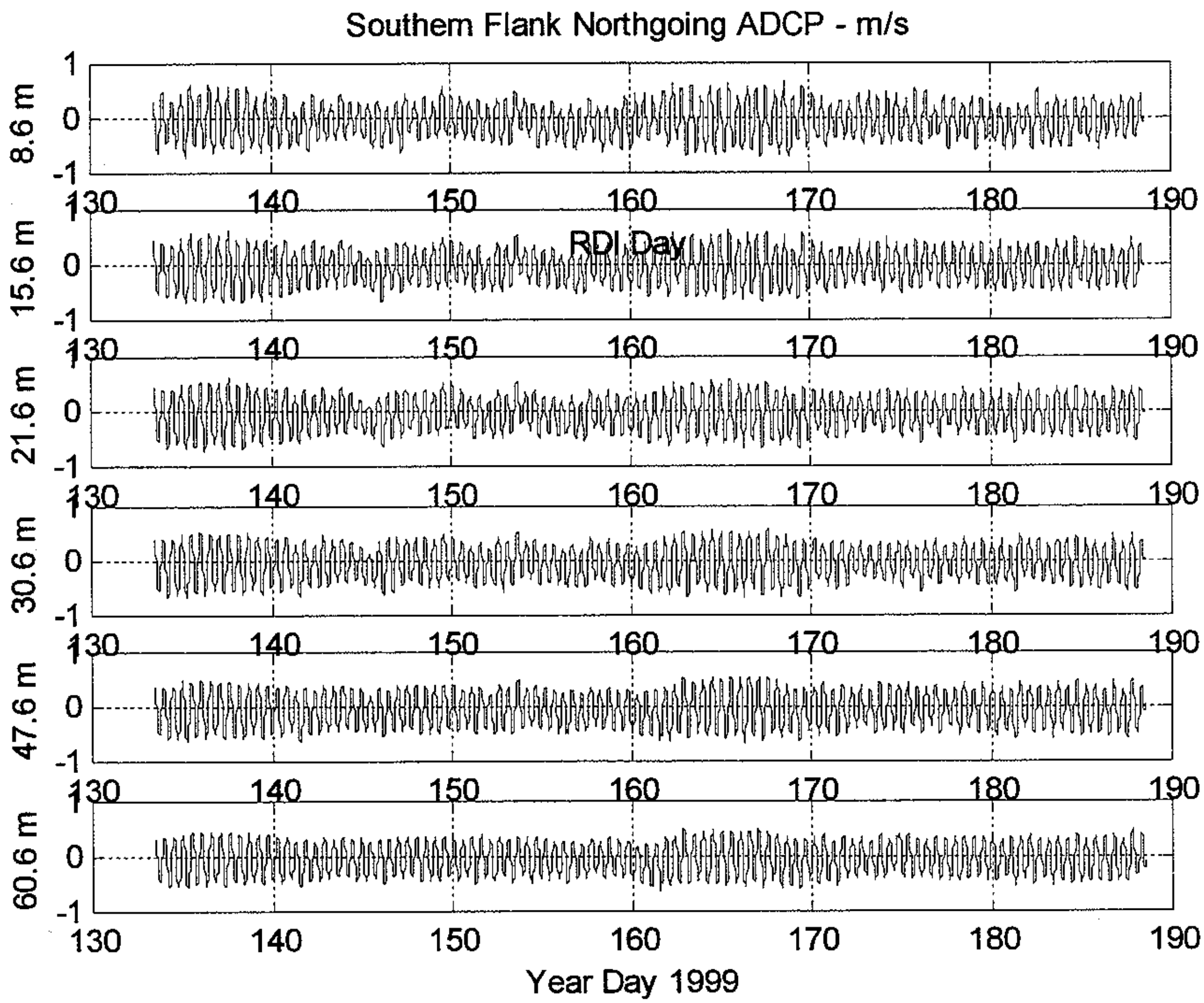


Figure 12. Northgoing southern flank ADCP velocities at selected depths. *The northgoing ADCP record form 6 selected depths - 8.6, 15.6, 21.6, 30.6 47.6 and 60.6 meters are shown. The strong coherence with depth in the tidally dominated record is obvious. The velocities are stronger than in the east-west component, and show less weather forced low frequency variability.*

The Northgoing velocity components are larger than the eastgoing, and more regular, showing less weather forced variability. The mean of the Northgoing component is small, and most of the flow in and out of the Gulf of Maine occurs through the Northeast Channel and around Georges Bank and down the shelf, so the on-off bank component shows reduced effects.

Data were also recovered from the bio-optical moorings on the Southern flank mooring for the whole deployment. These records were not recovered while the systems were at sea during the July servicing cruise, but the PCMCIA FLASH cards were removed and taken back to WHOI for reading. This has been done, but the data not normalized and plotted at this time.

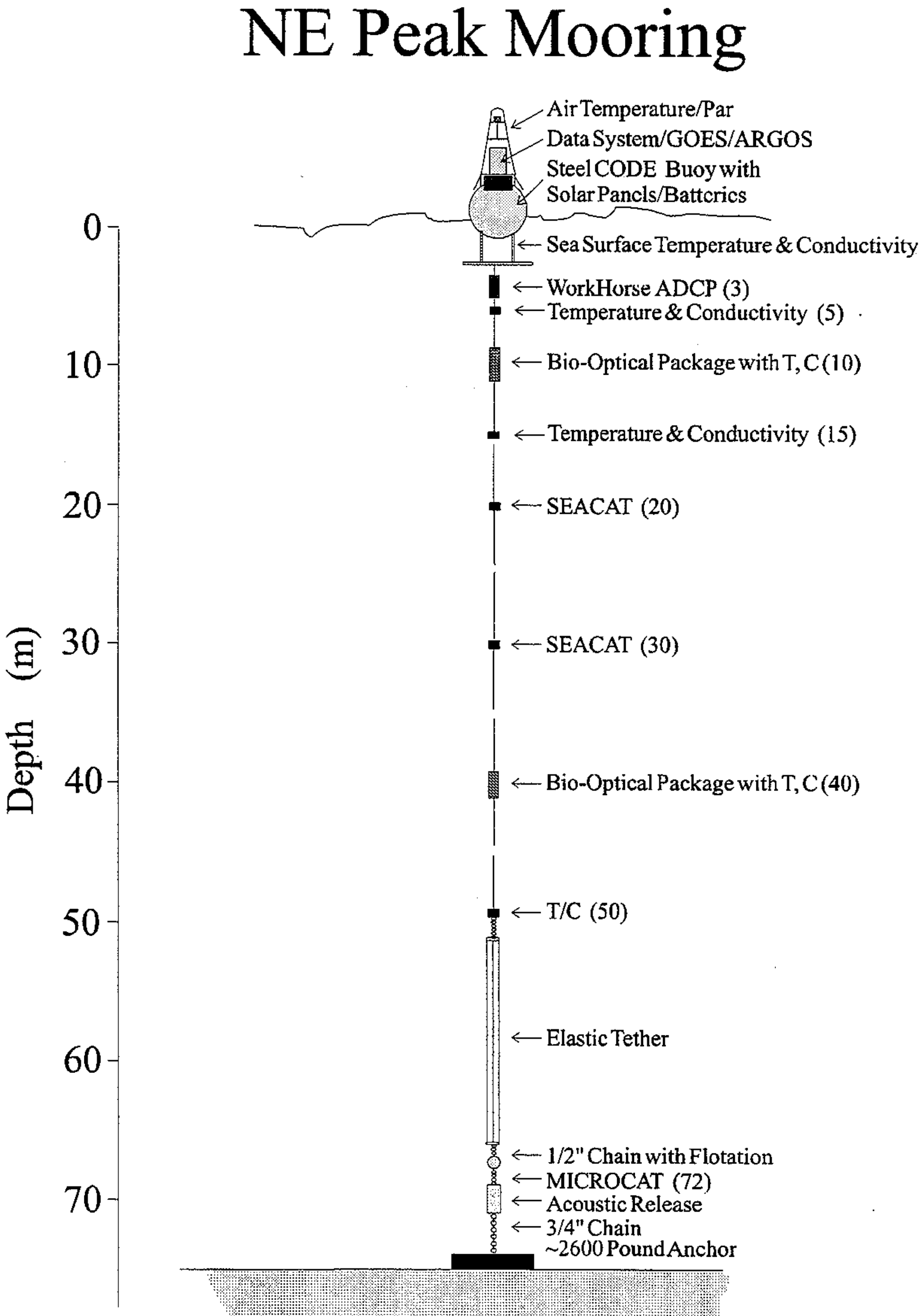


Figure 13. The Northeast Peak Mooring configuration during the 1999 deployment.

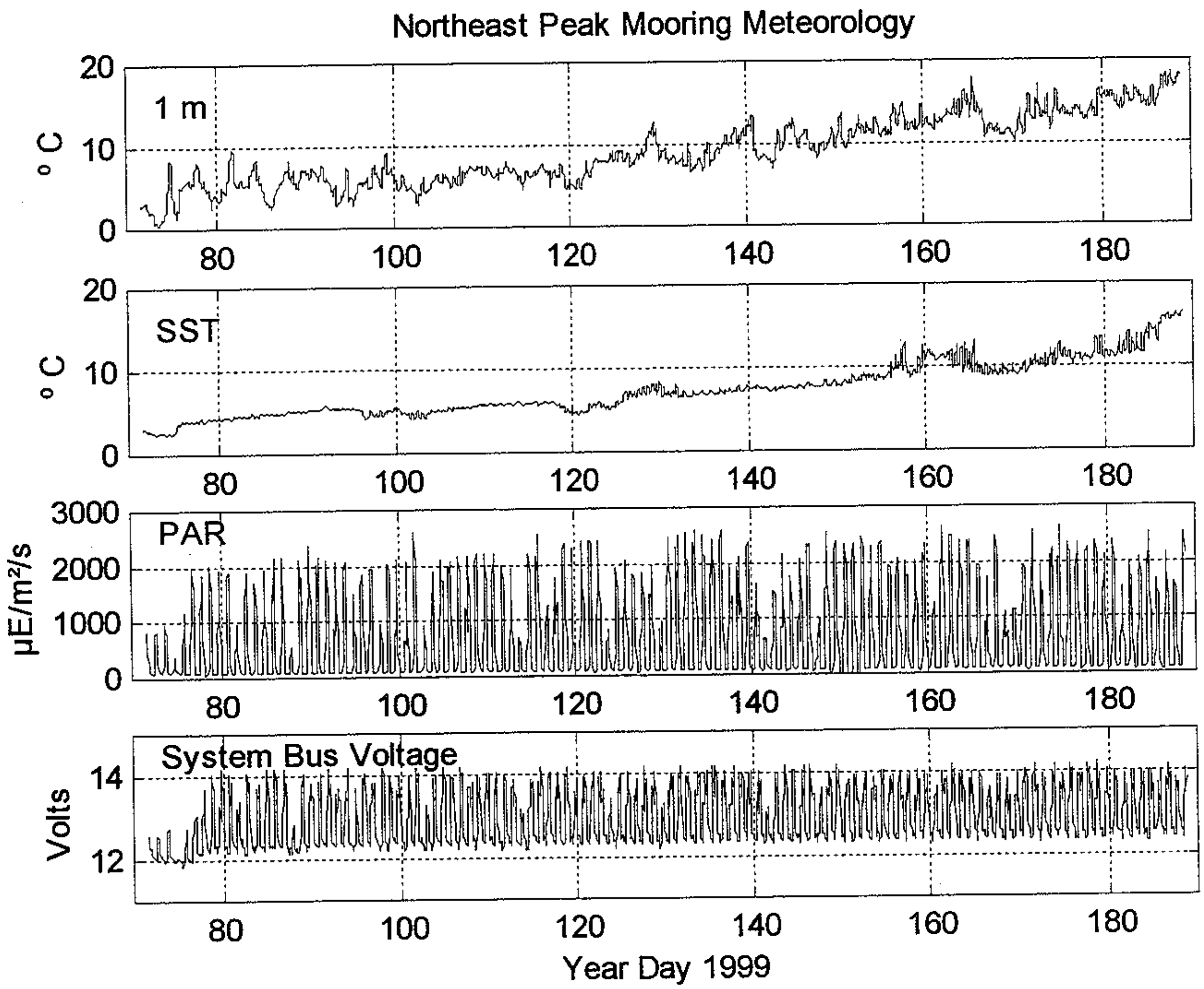


Figure 14. Northeast Peak Meteorology. The normalized, but unedited air temperatures, sea surface temperatures (at 1 meter under the buoy), PAR and system bus voltage are shown.

Northeast Peak Science mooring: The Northeast peak mooring (configuration shown in Figure 13 and sensor serial numbers and depths listed in Table 1). The mooring was released from its anchor by acoustic release late on 7 July 1999, and the subsurface float surfaced at once. The ship waited while the mooring floated free of the guard buoys before recovery. After the recovery of the steel buoy the rest of the mooring was easily recovered by hand with the assistance of the crane for the heavier packages. This mooring was more fouled than the Southern flank mooring. The sensors were mildly fouled and were cleaned. The temperature sensor at 5 meters was damaged (probably on recovery against the side of the ship) and the thermistor guard was missing and thermistor probe bent. The sensor was working properly and will be calibrated and repaired.

The zincs protecting the elastic tether bridles were gone, and there was some corrosion on the shackles on the top bridle. Again the lower part of the tether showed more fouling than the top, indicating a bottom intensified biofouling on Georges Bank. The buoy, electromechanical cable and subsurface float were in good shape. The mooring was serviced, and data dumped without stopping the data system. The mooring was readied for deployment with the sensors listed in Table 1.

The data was normalized with pre-cruise calibration constants. The meteorology and engineering data collected are plotted in Figure 14. The air temperature and sea surface temperature show the spring warming in the surface waters. The PAR sensor gives an indication of the incoming radiation, and is very coherent with the system bus voltage shown in the bottom panel of Figure 14. This is reasonable since the batteries supplying the system power are charged by solar panels, and the rate of charging (voltage) is an uncalibrated measure of the incoming radiation. The batteries sagged a bit when the system was on deck and the solar panels shadowed, but the system recovered quickly after deployment. The system power at no time became critically low (the cut off point for the system to shut down is 10.5 volts).

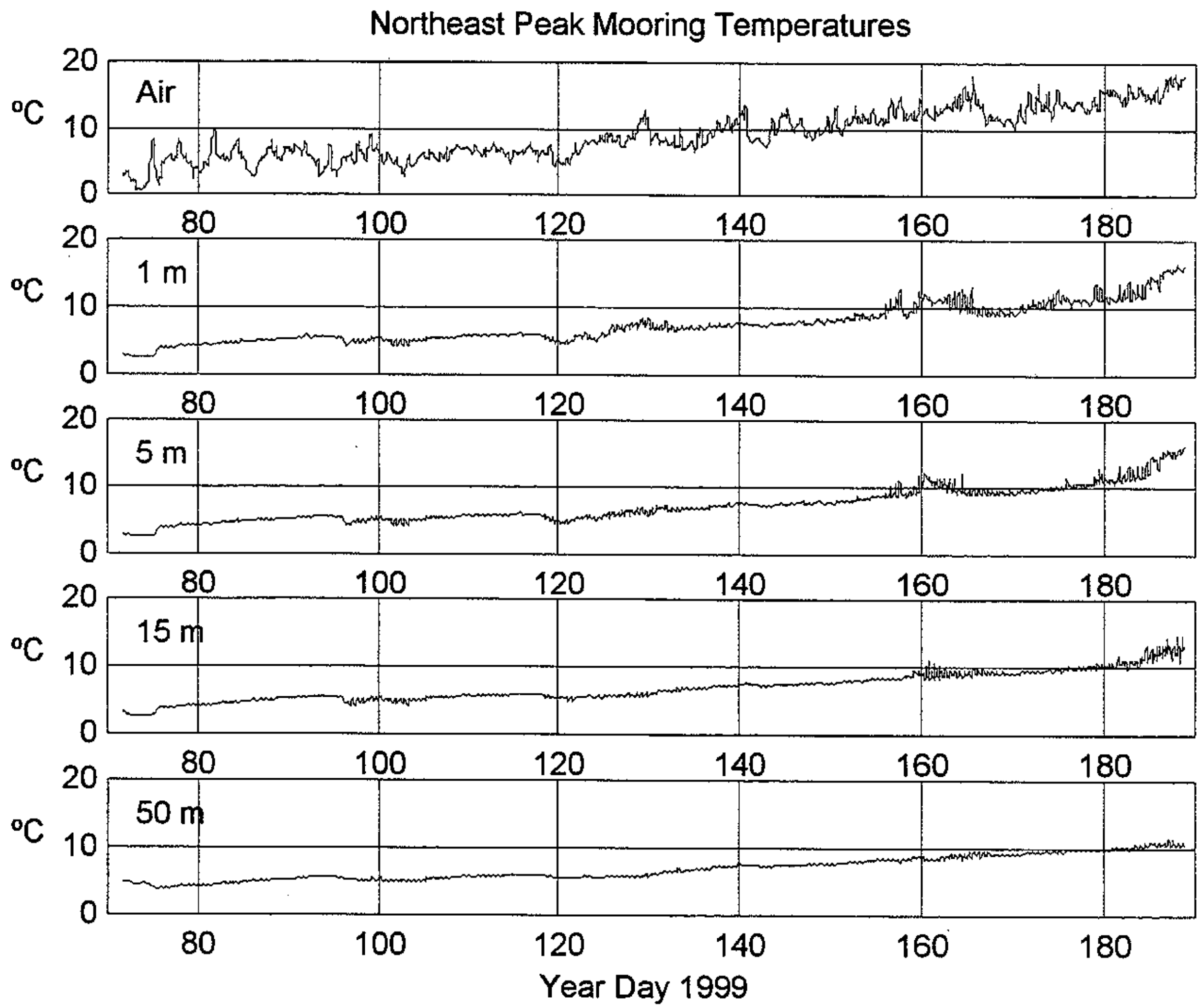


Figure 15. Northeast Peak mooring temperatures. The normalized, but unedited buoy recorded temperatures are shown for the depths listed. The seasonal warming is apparent at all levels.

The buoy recorded moored temperatures and salinities are shown in Figure 15 and 16. The temperatures show no significant intrusive events, but the salinity records do. There is the cooler fresher event seen when the buoy was deployed in March 1999. This is Scotial shelf water that has crossed the Northeast Channel onto Georges Bank. Later in the year around year day 100, and especially around year day 120 (30 April 1999), there was a significant freshening of the surface waters which did extend down to the bottom, but was strongest in the upper 20 meters of the water column. While the temperature did show the summer warming during the deployment, the salinity ended up about where it started showing no long-term trend or a reversal of the freshening of the water column that occurred during the spring of 1996. There have been variations with a 2-year period since that time, but always returning to about the 32.25 PSU level.

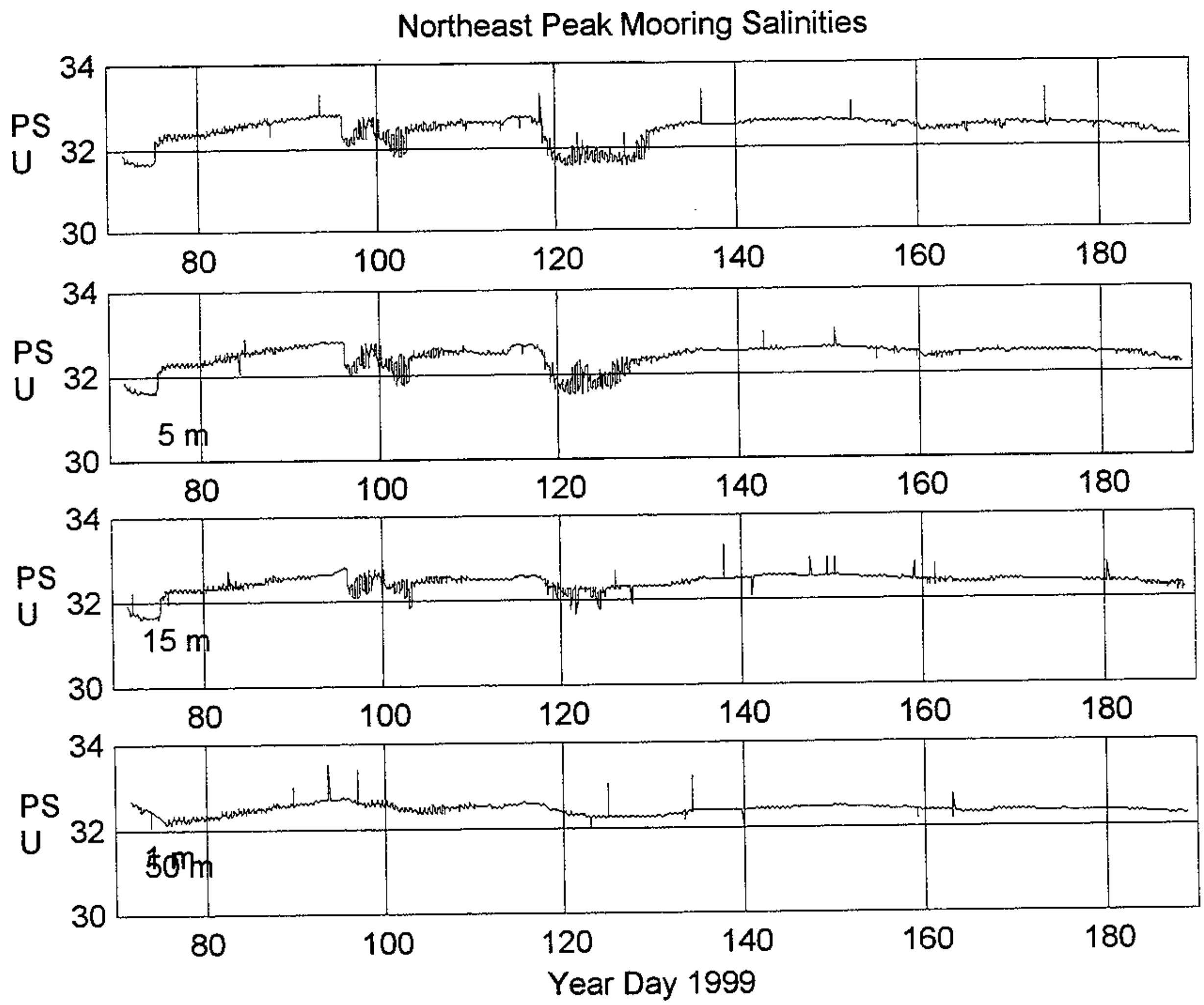


Figure 16. Northeast Peak mooring salinities. The normalized but unedited salinity records were calculated from observed temperature and conductivity observations at each depth and converted using the Practical Salinity Scale of 1978. Three fresher crossover events are apparent at the start of the record, around year day 100 and 120 to 130.

The moored Seacat records are shown in Figures 17 and 18 and show the same signature of temperature and salinity events as seen in Figures 15 and 16. Around year day 160 and the last week of the record, the data show stronger variability, especially in the temperature records in the Seacats which were sampled at 2 minute intervals (as opposed to the hourly averages in the buoy processed and recorded data). These high frequency signals appear to be internal solitary wave like features that have been regularly observed at the southern flank site. There has not been this clear internal wave signature at the Northeast peak mooring in the past. The Northern tip of Georges Bank is known for strong internal tidal signals that propagate into the Gulf of Maine, so there is no reason why they should not propagate back up onto the Northeast Peak as seen here. There is some apparent salinity spiking as seen in the Southern flank records that may be a sensor flushing problem in response to the high frequency internal waves.

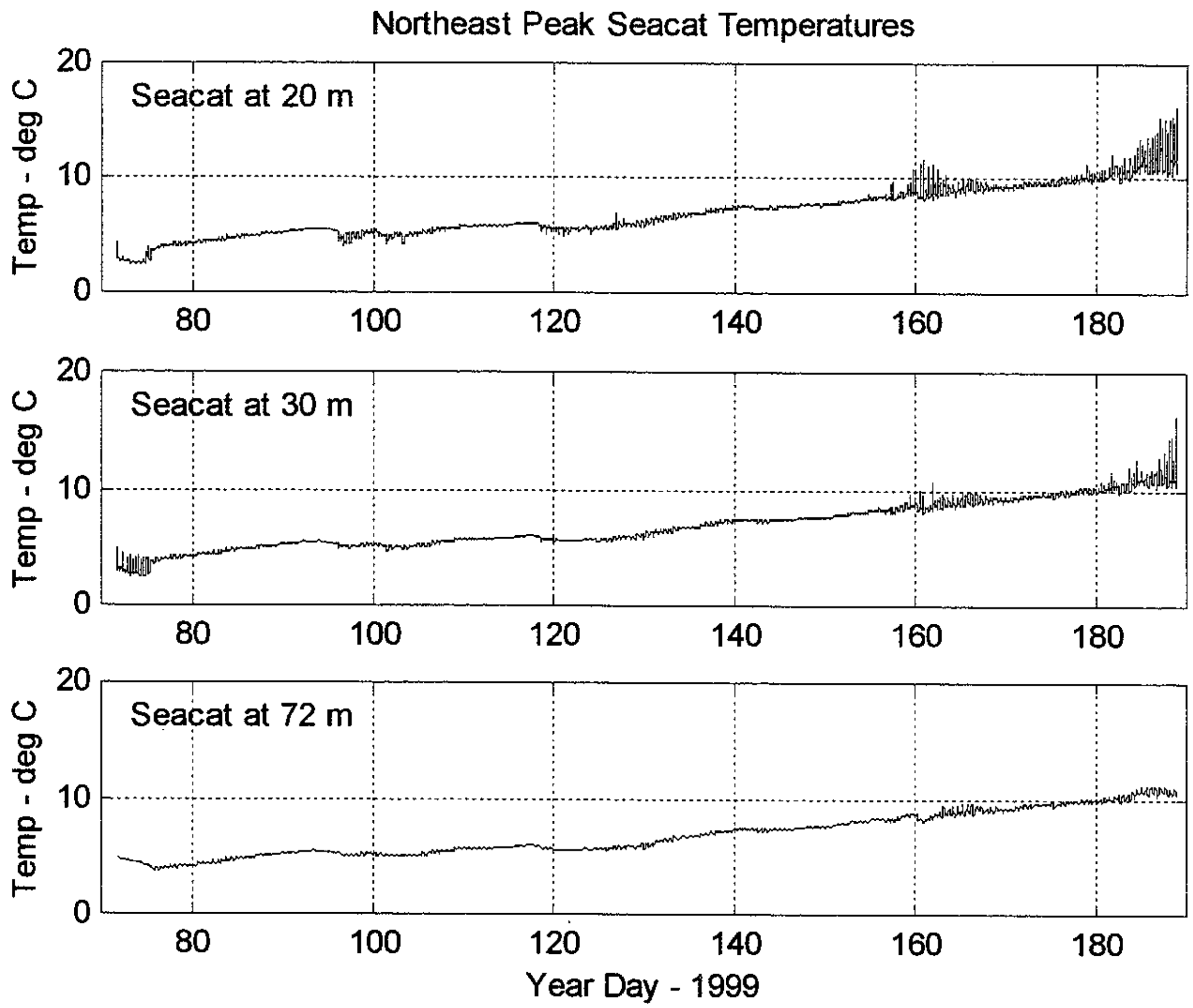


Figure 17. Northeast Peak Seacat Temperatures. The normalized but unedited temperatures from the Seacats at 20, 30 and 72 meters depth are shown. The 20 and 30-meter Seacats were sampled at 2-minute intervals, and the 72-meter Microcat at 3.75-minute intervals.

The water column velocities were measured with an RDInstruments moored ADCP. The instrument was mounted in a frame, and placed in the mooring line just below the buoy. It was connected to the buoy with a chain so as to decouple any tilting movement of the buoy from the ADCP. With the compliant elastic tether providing a constant downward pull on the mooring, the ADCP should ride at a fairly constant angle, and move up and down with the buoy in the wave field.

The ADCP was programmed to average half hourly ensembles of 800 pings each. This reduced the random statistical error in estimating the velocities from the Doppler frequency shift to less than 1 cm/sec. Also, the pings were spread evenly over the ensemble so that the effects of

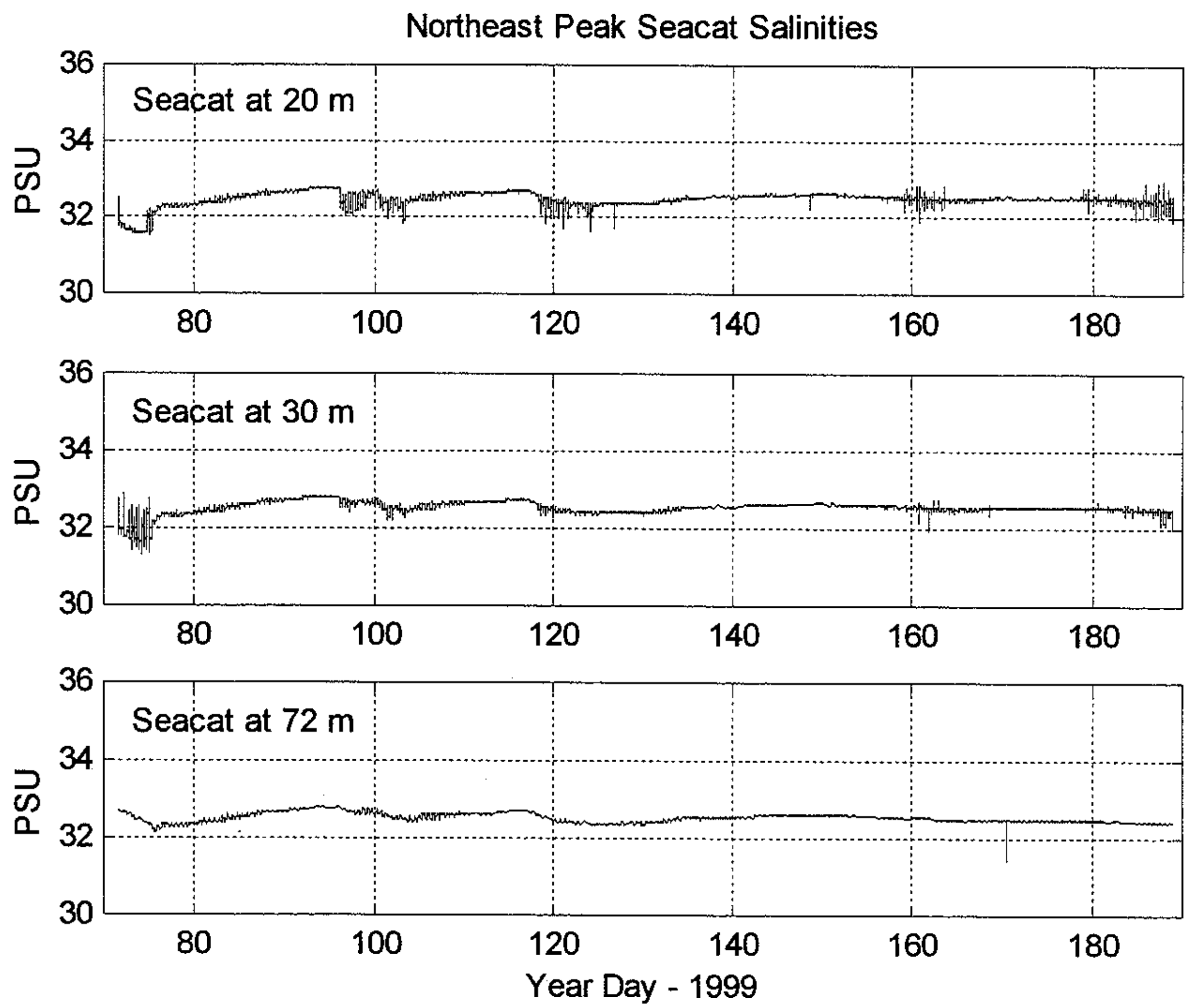


Figure 18. Northeast Peak Seacat Salinities. The normalized but unedited Seacat salinities from 20, 30 and 72 meters depth are shown. The 20 and 30-meter Seacats were sampled at 2-minute intervals and the 72-meter Microcat at 3.75-minute intervals. The normalized but unedited salinity records were calculated from observed temperature and conductivity observations at each depth and converted using the Practical Salinity Scale of 1978. Three fresher crossover events are apparent at the start of the record, around year day 100 and 120.

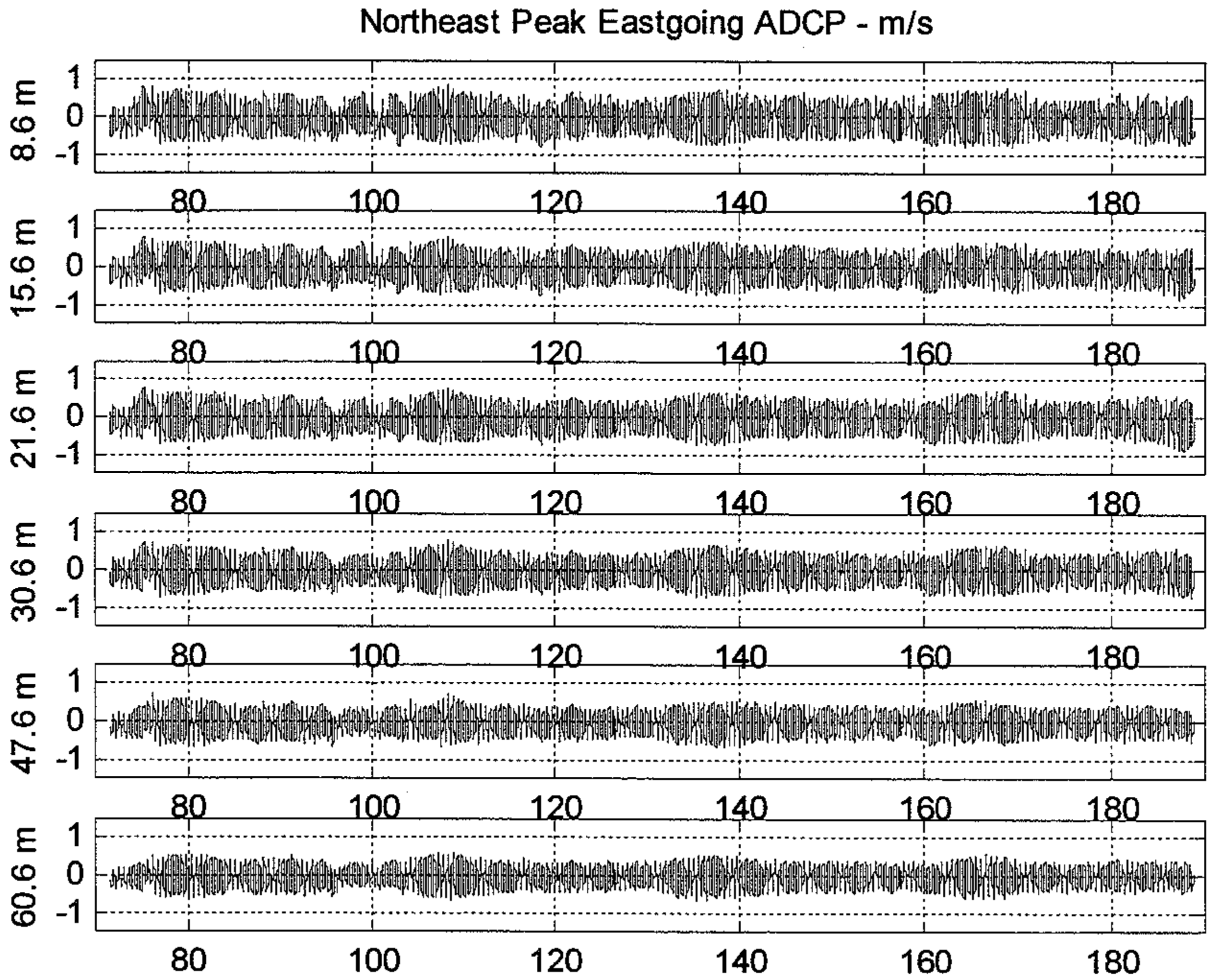


Figure 19. Northeast Peak Eastgoing ADCP velocities. The eastgoing ADCP record from 6 selected depths - 8.6, 15.6, 21.6, 30.6, 47.6 and 60.6 meters are shown. The strong coherence with depth in the tidally dominated record is obvious.

the surface waves would be averaged out as much as possible to provide an unbiased estimate of low frequency currents. The instrument resolved individual ping profiles into eastgoing, northgoing and vertical velocities relative to an internal compass and tilt indicator. During post cruise processing the correction for magnetic variation was applied.

The currents are stronger at the Northeast Peak, so the scale of the plots shown in Figures 18 and 19 are 1.5 times those shown in Figures 11 and 12. The time scale of the velocity plots shown in Figures 18 and 19 do not adequately resolve the daily tidal fluctuations with the resolution of the printer, but do show that good records were obtained and show the attenuation with depth and the fortnightly modulation of the amplitudes by the beating of the M2 and S2 tides. The Northgoing component is stronger because it has a component of the flow in and out of the Gulf of Maine due to the near semidiurnal resonance of the Gulf of Maine, Bay of Fundy system. The mean currents are low, showing low circulation, and different than the southern flank record that shows the down bank low-frequency circulation.

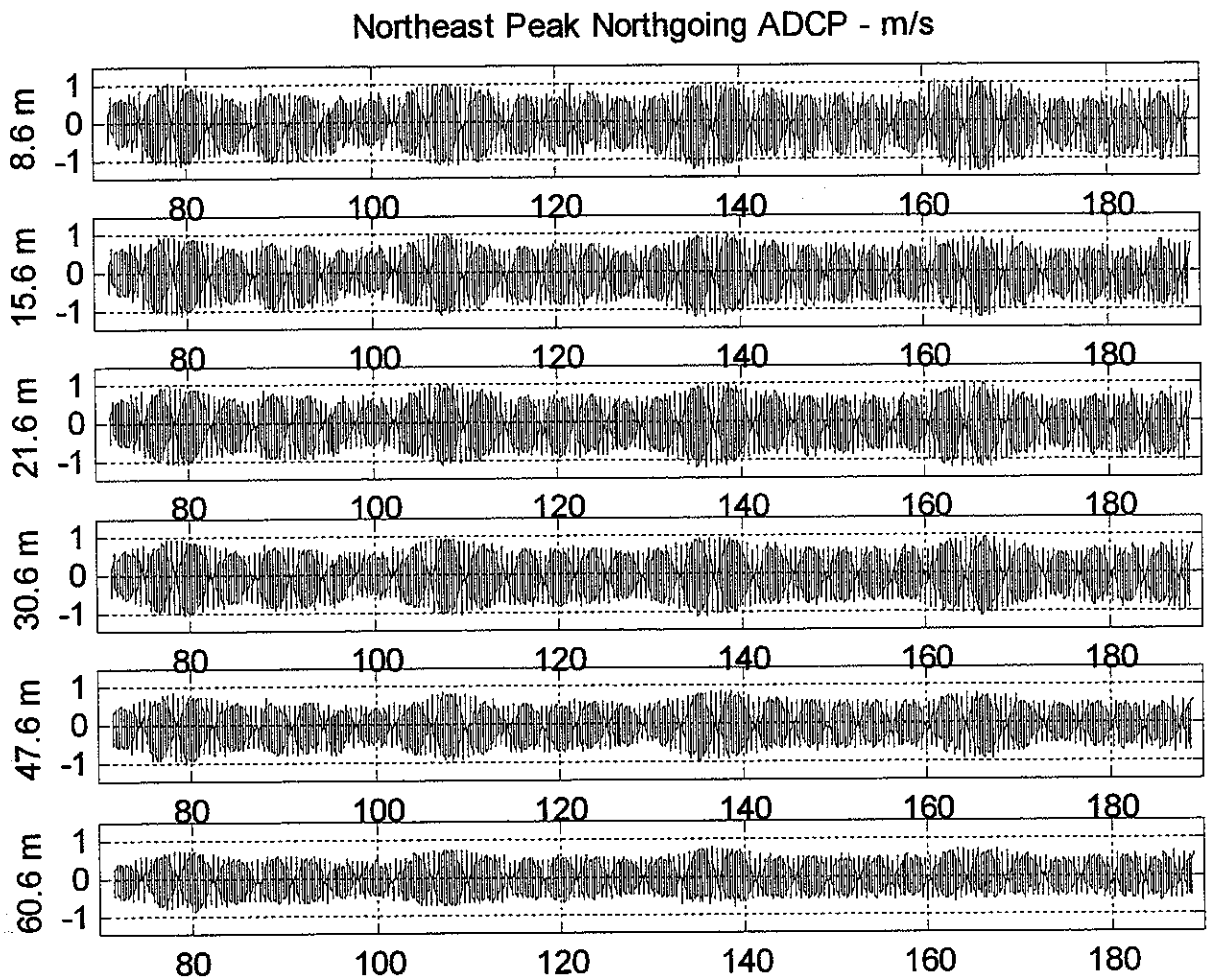


Figure 20. Northeast Peak Northgoing ADCP velocities. The northgoing ADCP record from 6 selected depths - 8.6, 15.6, 21.6, 30.6, 47.6 and 60.6 meters are shown. The strong coherence with depth in the tidally dominated record is obvious. The northgoing component is largest and associated with the strong tidal resonance in the Gulf of Maine Bay of Fundy system. The Northeast peak tides are stronger that the southern flank (Figures 11 and 12.)

Data were also recovered from the bio-optical moorings on the Northeast Peak mooring for the whole deployment. These records were not recovered while the systems were at sea during the July servicing cruise, but the PCMCIA FLASH cards were removed and taken back to WHOI for reading. This has been done, but the data not normalized and plotted at this time.

Mooring Deployment

Northeast Peak Mooring: The Northeast Peak science buoy B was the last to be recovered and the first to be deployed. It was left in position on deck, the sensors cleaned, ADCP replaced, bio-optical packages reworked and the whole system reassembled on deck for deployment. While the cleaning was taking place, the data was dumped from the buoy and recorder reinitialized.

data system was not stopped, as the times appeared to be good. The configuration of the mooring is shown in Figure 13, and the sensors, serial numbers and depths for the last deployment are listed in Table 1. The times and positions of the mooring deployment are given in Table 2. The buoy was visually positioned between the two guard buoys whose lights were operating properly and remained in position without servicing this cruise. ARGOS checks of mooring operation showed that all sensors were functioning properly and diagnostic were good.

Table 2. Mooring Deployment Positions:

Southern Flank	Date Deployed	GMT	N. Latitude	W. Longitude
Science Buoy D	9July 1999	2156	40° 58.02'	67° 19.28'
Foam Guard F	10 July 1999	0011	40° 58.086'	67°19.153'
Foam Guard Q	5 Oct 1999	2059	40° 57.692'	67° 19.014'
Bottom Pressure	10 July 1999	0037	40° 58.057'	67° 19.164
Northeast Peak				
Guard Buoy A	19 Nov 1998	1548	41° 43.947'	66° 32.262'
Science Buoy B	8 July 1999	2010	41° 43.894'	66° 32.188'
Guard Buoy S	19 Nov 1999	1647	41° 43.851'	66° 32.091'

The Northeast Peak science mooring was configured with ARGOS telemetry of all the moored temperature and conductivity data to assist the Northeast Peak Crossover experiment in determining the presence of cooler, fresher Scotian shelf water on Georges Bank. After the mooring was deployed a calibration CTD profile was taken, and a comparison was made with the

Table 3. Comparison of ARGOS telemetry and CTD

Quantity	Mooring Obs.	CTD Values	UNITS
Day of Hourly Avg	181.8750	181.875	Year Day
Cosine PAR	901.23	1928.	MicroE/m^2/s
Sea Surface Temperature	16.083	16.146	Deg C
Sea Surface Salinity	32.251	32.286	PSU
Temperature at 5 m	15.606	16.037	Deg C
Salinity at 5 m	32.264	32.250	PSU
Temperature at 15 m	12.620	14.362	Deg C
Salinity at 15 m	32.346	32.307	PSU
Temperature at 50 m	10.797	10.915	Deg C
Salinity at 50 m	32.419	32.473	PSU
Air Temperature	17.470	17.23	Deg C
Battery Voltages	13.668/13.668	N/A	Volts
System Status	1509	N/A	See below
Battery After GOES Tx	11.84	N/A	Volts

System Status Word: 1509

System Temperature	22 to 35 ° C
Forward/Reverse Power Error	None
Goes Transmitted Power	46 to 48 db
Battery voltage at end transmission	12.5 to 13.0 v

telemetered data received on the ship with an ARGOS uplink receiver. The comparison is shown in Table 3 and is typical of comparison results. The temperature sensors are good to ±0.001° C, so the observed differences are related to horizontal variability and different averaging in the hourly moored average, and the hourly yo-yo average on the drifting ship. In addition to the water properly values, the data system also sends back battery voltages and status checks to assure that the system is working properly.

Southern Flank Science Mooring D: The southern flank science mooring took the longest to service. The bio-optical packages needed considerable rework, and we exchanged buoys so that the buoy E which had failed in June was replaced by a new buoy with new data system and meteorology sensors. The old moored array and sensors were moved to the new buoy, attached and checked out. The ADCP was swapped with a new one to save time in dumping data and preparing the system. A RDInstruments workhorse was borrowed from Jim Lynch's ONR program for this mooring. The sensors deployed are listed in Table 1, and the instrument was deployed on 9 July 1999 at the time and position listed in Table 2.

After the science buoy deployment, while the guard buoy and bottom pressure instruments were being deployed, it was noted that the guard light on the science buoy did not turn on at dusk. It was working when the buoy was on deck, so some problem developed during the deployment process. Since the weather was flat calm, and we were not behind schedule, the small Zodiac boat was deployed, and the light changed. This process is shown in Picture 2 which shows Scott Worrilow standing on one side of the buoy. It illustrates the benefit of the elastic tether which puts some 700 pounds of downward force on the buoy that it was stable with Scott standing on one side.

Southern Flank Foam Guard Buoy F: The steel guard buoy initially deployed to the east of the Science buoy at the southern flank site was reported missing during a mid-June OCEANUS cruise. Therefore, a replacement buoy was readied and brought on OC344 for deployment. This buoy was deployed in the same position as the old buoy after deployment of the science buoy. The chain mooring was laid out on deck and tied off. When the buoy was set in the water, the chain was deployed section by section until it was paid out, and then the buoy was towed into position and the anchor deployed. It was deployed to the east of the science buoy D in the position listed in Table 2.

Bottom Pressure Instrumentation: The bottom pressure instrument was deployed as the light was fading on 9 July 1999. It was picked up on the crane, hung over the rail as the ship steamed slowly past the desired deployment position. When the ship was visually between the science buoy and guard buoy, the quick release was pulled to drop the frame that free fell to the sea floor for the last deployment in the GLOBEC long-term moored effort. The frame was deployed between Science Buoy D and Guard Buoy Q as listed in Table 2.

Picture 2. Scott Worrilow standing on the southern flank buoy at night to repair the faulty guard light while Jeff Lord and Jim Ryder stand by in the Zodiac.

CTD Sections

For all the CTD profiles made during OC344, the standard R/V OCEANUS Sea Bird Electronics 911 PLUS CTD was used. It was equipped with a single suite of pumped temperature and conductivity sensors. In addition a Sea Point optical backscattering sensor, a Sea Tech 25-cm path length transmissometer, and a Sea Tech chlorophyll-a fluorometer were mounted on the profiler. Finally, a Biospherical PAR (Photosynthetically Active Radiation) sensor was mounted above the Rossette sampler to measure radiation. For an incoming reference for this sensor a cosine PAR sensor was mounted on the ship. A Datasonics altimeter was used to facilitate profiling close to the bottom without running the CTD into the bottom. For tracking and correcting for any conductivity sensor drift during the cruise, a water sample was taken at the bottom of each profile and the results used to correct the conductivity sensor for drift. The Rosette sampler with a full suite of 24 5-liter bottles was used, even though only one bottle sample was normally taken. Because of some problems with the Rossette sampler, often three bottles were fired to assure that a sample was collected.

***In situ* yo-yo calibrations:** Before the recovery of the southern flank and Northeast Peak science moorings, a one hour yo-yo CTD series was made near the mooring as an *in-situ* calibration. Our experiences during previous deployments was that the temperature sensor calibration is drifting on the order of millidegrees each year and so is not a problem. However, the conductivity sensors are subject to fouling and could drift 0.05 PSU during a deployment. We discovered that post-cruise calibrations are not good indicators of sensor drift, because some of the bio-fouling was removed from the sensor when it was recovered, flushed and sent off to calibration. All the post-cruise calibrations indicate that the sensor does not drift as much as *in-situ* calibration and inter-sensor comparison implies. Therefore, we tried the one-hour yo-yo to get an average over the time that the mooring averages the data for comparison. These *in-situ* comparisons haven't proven as useful as we initially thought, because the horizontal environmental variability is fairly large, and the ship drifts a considerable distance from the mooring during the series of profiles, and so averages the water differently than the mooring. With the more rapid sampling of the 1-minute data, we hope that the profile closest to the mooring will provide a better check on sensor drift.

After the moorings were deployed, another yo-yo series of CTD profiles was made. The times and positions of the start and end of each yo-yo series before the recovery and after the deployment are shown in the event log (Table 4).

Northeast Peak Section: The standard northeast peak section (NEP) of 15 stations has been occupied during each long-term mooring cruise. This section extends from the Canadian side of the Northeast Channel up into the vertically well mixed water at the crest of Georges Bank (see Figure 1). The section was occupied on 8 July 1999. The data were normalized with the latest CTD calibrations, bottle data were taken at the bottom of each profile and used to apply a correction to the conductivity sensor, and all derived parameters were calculated. Contour plots of the data from this section are shown in Figures 21, 22, 23, 25, and 26 (temperature, salinity, potential density, light transmission, and chlorophyll-a fluorometer). A T-S plot of the data from this section is shown in Figure 24.

The temperature and salinity (Figures 21 and 22) show fairly well vertically mixed profiles at the crest of the Bank, and mainly temperature stratification over the flank. The salinity is freshest on the crest and gets saltier as one goes toward the Northeast Channel. The warm salty shelf water is seen deep on the North side of the channel. There is a hint of cooler water (6.5° C) just off the shelf break at 80 meters depth, which is the water seen at 8.5° C on the southern flank and is Gulf of Maine water with salinity below 33 being exported around Georges Bank and down into the New York Bight. The T/S (Figure 24) reflects this 6.3° and 32.7 PSU water source, as well as the saltier slope waters. The transmission and fluorometer results (Figures 25 and 26) show a peak in chlorophyll-a at 40 meters in the channel (at CTD 4), and up on the bank at 25 meters depth at CTD 17. The deeper water and Gulf of Maine water are high in transmission and low in chlorophyll-a.

Southern Flank Long-Term Section one: The standard long-term southern flank section (LT) of 15 stations (often LT01 and sometimes LT15 are dropped because the crest is well mixed, and the shelf slope front has been crossed and time is short) has been occupied at least once on each long-term mooring cruise. This section extends from the North Atlantic offshore of the shelf slope front, up into the region of vertically well mixed water at the crest of Georges Bank (see Figure 1). The section was first occupied on 9 July 1999, and was subsequently occupied again on 10 July 1999. The data were normalized with the latest CTD calibrations, bottle data were taken at the bottom of each profile and used to apply a correction to the conductivity sensor, and

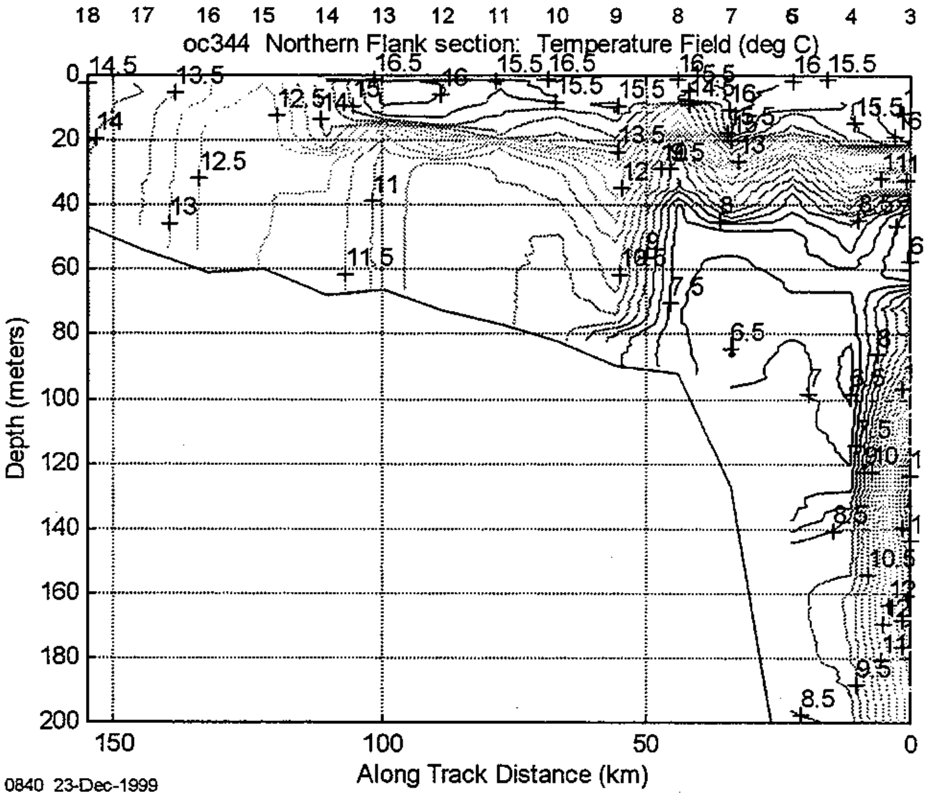


Figure 21. Northeast Peak Section - temperatures in 0.5° intervals from 8 July 1999.

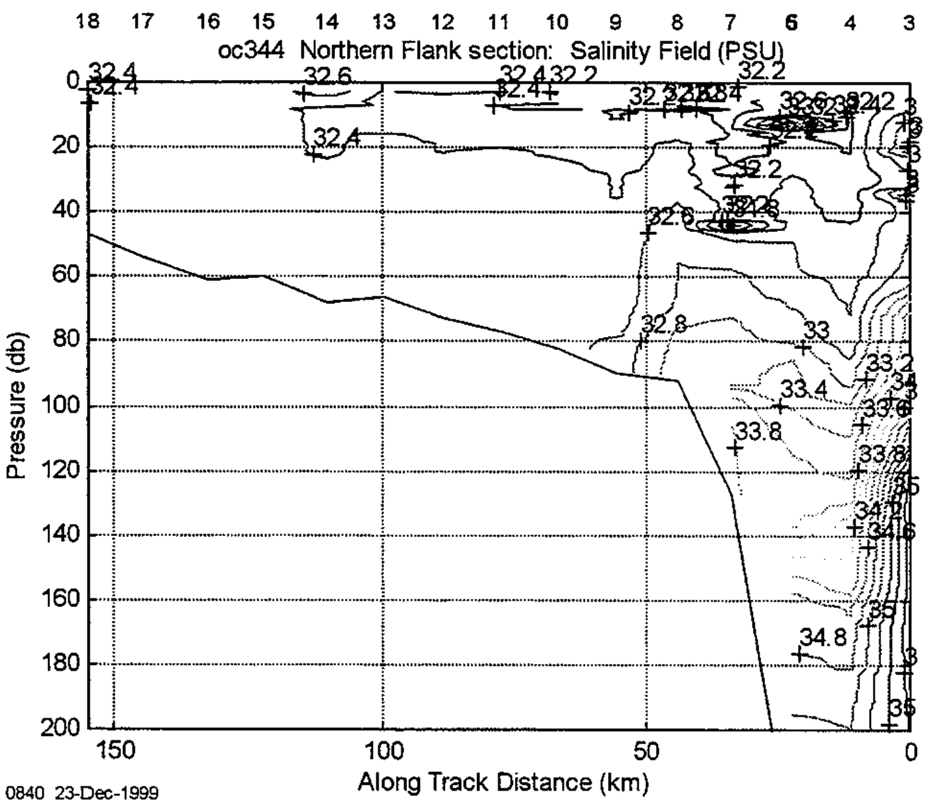


Figure 22. Northeast Peak Salinities - salinity in 0.2 PSU intervals from 8 July 1999.

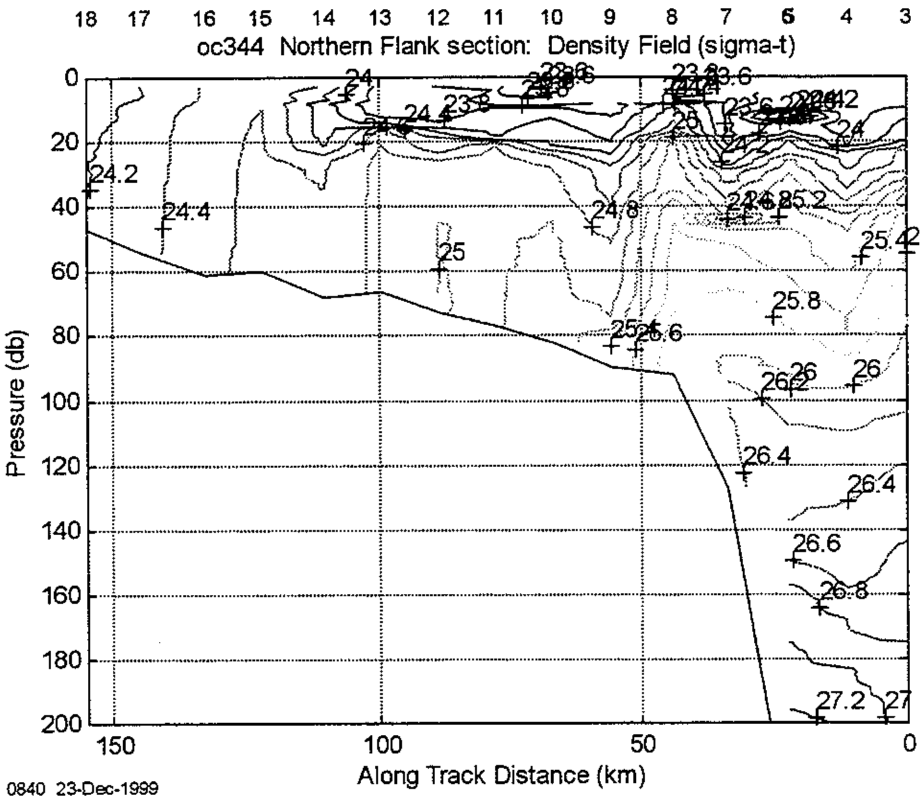


Figure 23. Northeast Peak Section - potential density in 0.2 kg/m³ intervals from 8 July 1999.

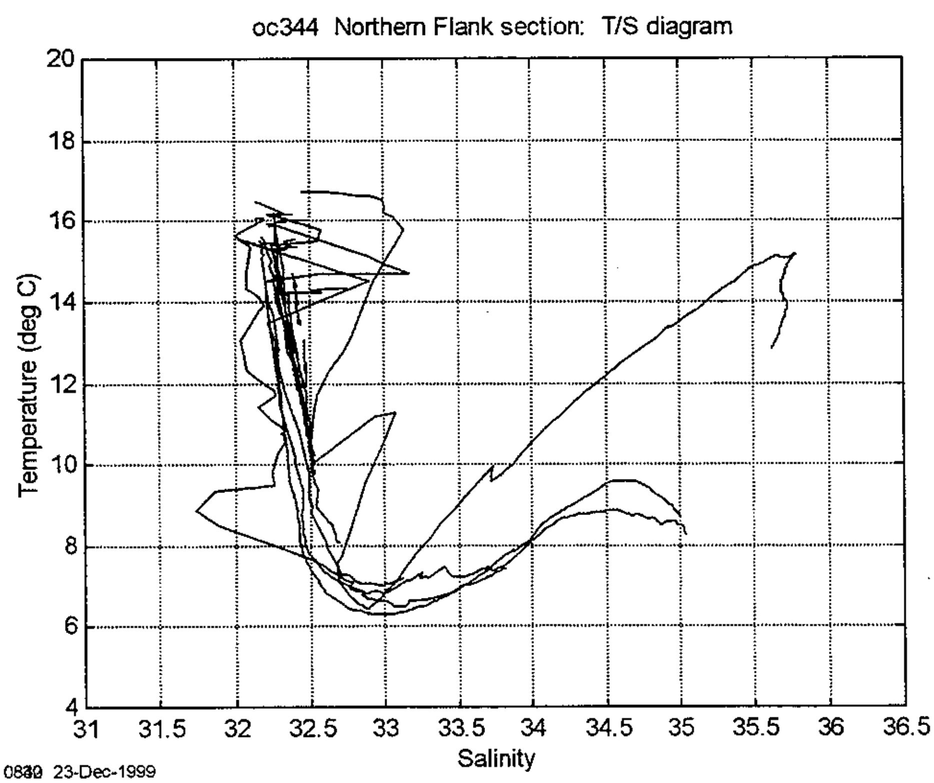


Figure 24. Northeast Peak Section - T/S diagram all section profiles from 8 July 1999.

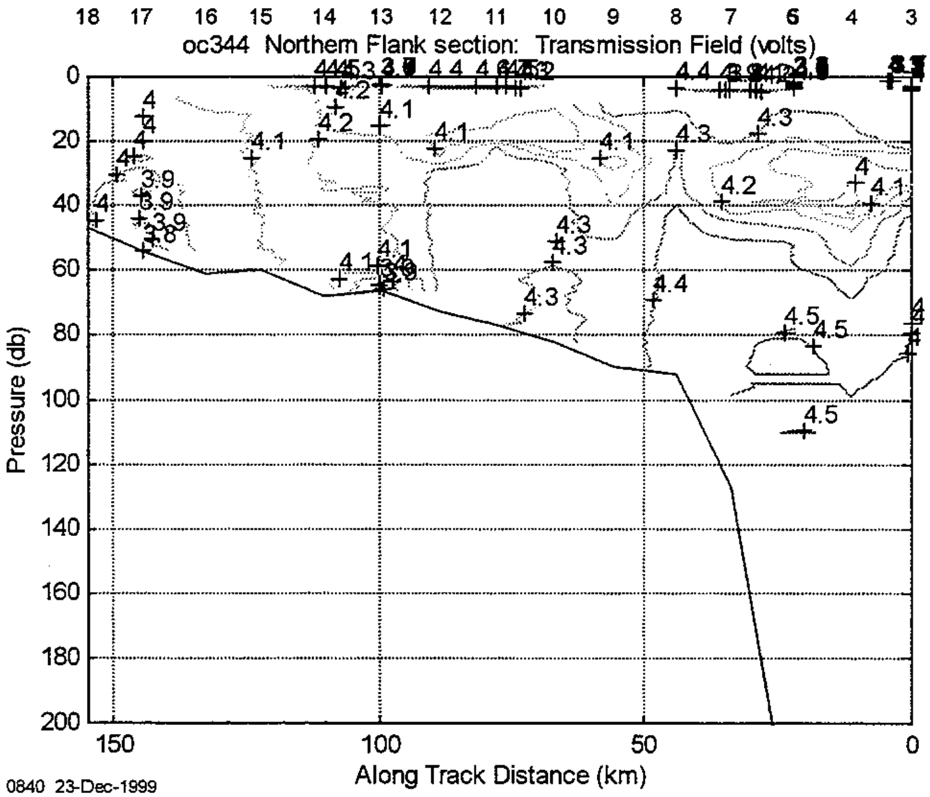


Figure 25. Northeast Peak Section - transmission in 0.1 volt intervals from 8 July 1999.

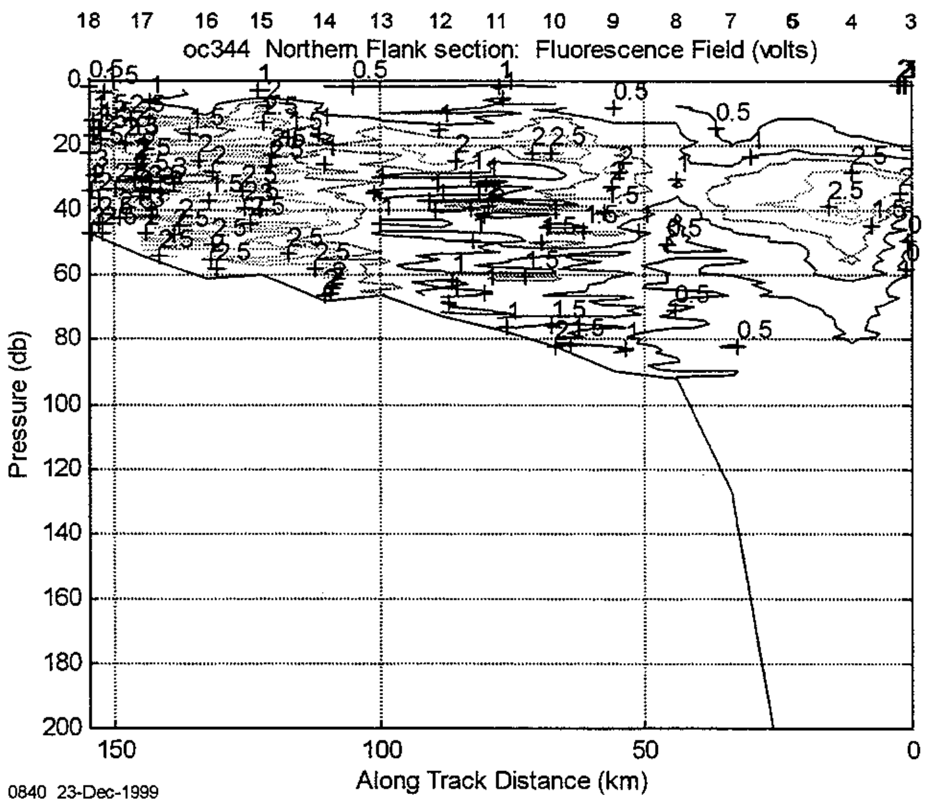


Figure 26. Northeast Peak Section - chlorophyll-a fluorescence in 0.5 v intervals from 8 July 1999.

all derived parameters were calculated. Contour plots of the data from this section are shown in Figures 27, 28, 29, 31 and 32 (temperature, salinity, potential density, light transmission, and chlorophyll-a fluorometer). A T-S plot of the data from this section is shown in Figure 30.

The temperature and salinity section (Figures 27 and 28) show a typical summer profile. The salinity has little stratification over the southern flank, and temperature contributes most of the stratification seen in the density field (Figure 29). The temperature is well mixed at the crest of the bank, and shows change to stratification at the tidal mixing front located about station 31 in just over 40 meters of water. There is an indication of the exported Gulf of Maine water (8.5° C and 32.7 PSU) at about 60 meters depth in 85 meters of water. There is a strong temperature front which slopes toward the crest of the bank from the shelf break. It divides the cooler Georges Bank water from the warm core ring water offshore with temperatures as high as 26° C. this is also seen in the T/S diagram in Figure 30 where this water type is well off the general scale used to show Georges Bank water properties. The transmissometer and fluorometer show clear, low chlorophyll-a water off shore associated with the warm core ring, and low transmission, high chlorophyll-a productivity at the crest of the bank (CTD 32 at 30 meters depth). There is a secondary peak at 50 meters depth in 90 meters of water.

Southern Flank Long-Term Section two: The standard long-term southern flank section (LT) of 15 stations (often LT01 and sometimes LT15 are dropped because the crest is well mixed, and the shelf slope front has been crossed and time is short) has been occupied at least once on each long-term mooring cruise. This section extends from the North Atlantic offshore of the shelf slope front, up into the region of vertically well mixed water at the crest of Georges Bank (see Figure 1). The section was first occupied on 9 July 1999, and was subsequently occupied again on 10 July 1999. The data were normalized with the latest CTD calibrations, bottle data were taken at the bottom of each profile and used to apply a correction to the conductivity sensor, and all derived parameters were calculated. Contour plots of the data from this section are shown in Figures 33, 34, 35, 37 and 38 (temperature, salinity, potential density, light transmission, and chlorophyll-a fluorometer). A T-S plot of the data from this section is shown in Figure 36.

The same section was repeated two days later (10 rather than 8 July), and some differences are evident. The salinity is still well mixed vertically well out from the crest of the bank. The temperature contributes most to the density stratification seen in Figure 35. The tidal mixing front has now moved out to 50-60 meters depth where the isopycnals change from horizontal to vertical. The strong temperature and salinity front is seen at the shelf break and is nearly vertical. There is an anomaly seen at CTD 43, where the isotherms (Figure 33) appear depressed at this station. This may be a perturbation due to the passage of an internal solitary wave that we just happened to catch, as it doesn't appear at stations 42 and 44. This type of disturbance makes interpreting these sections more difficult. The Gulf of Maine water is now at 75 meters at station 44, and the minimum in salinity is also seen, but not as clearly as in the first section as the front appearts to be poking its way onto the shelf in deep waters.

The transmission and chlorophyll-a sections (Figures 37 and 38) show the usual picture. There is high chlorophyll-a at the crest (station 36) and low seaward of the shelf break in the warm core ring water. There is a smaller secondary peak around 20 meters depth at about station 44 in 90 meters of water at the bottom of the thermocline. This spot is confused being located right in the middle of the possible internal wave as seen in best in the density field (Figure 35).

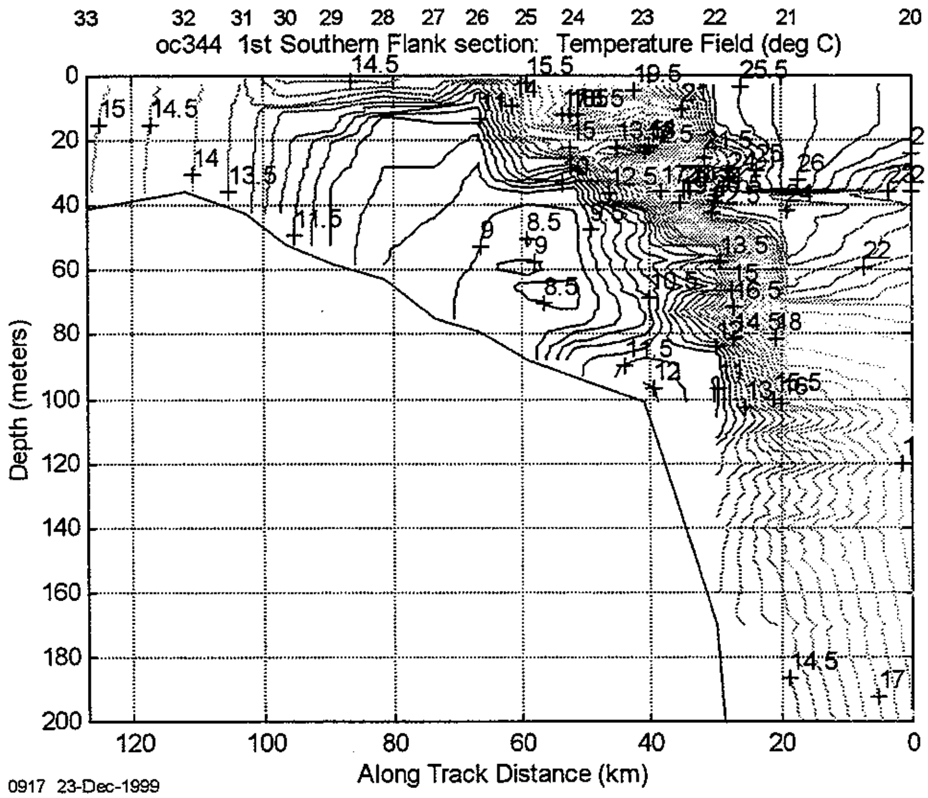


Figure 27. Southern Flank Section one - temperatures in 0.5° intervals from 9 July 1999.

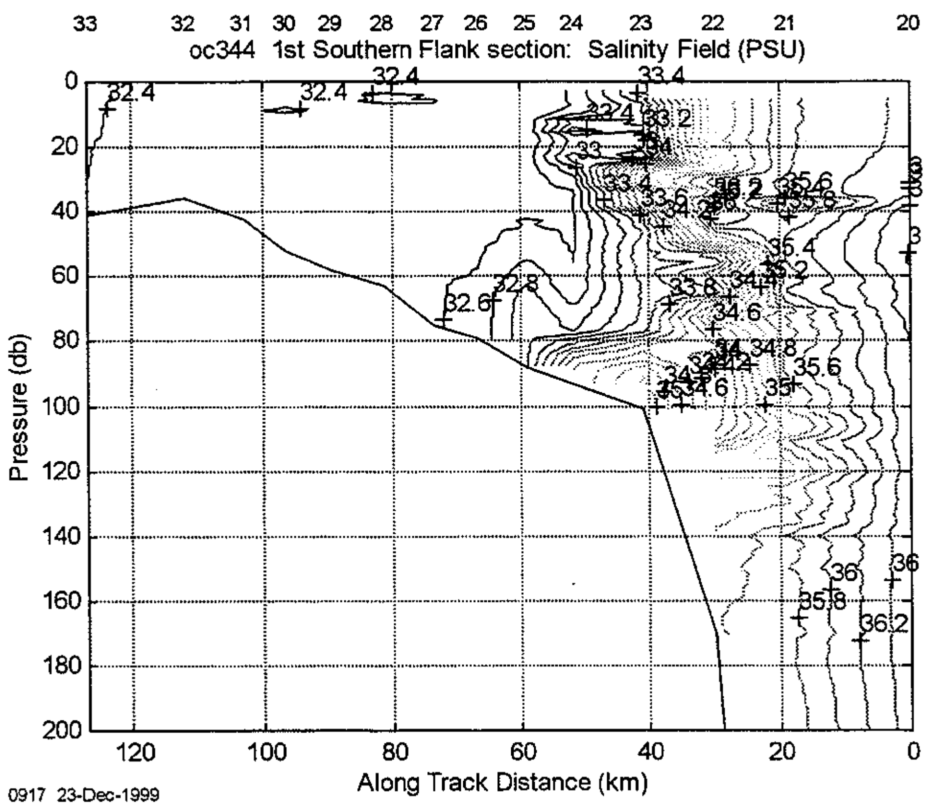


Figure 28. Southern Flank Section one - salinity in 0.2 PSU intervals from 9 July 1999.

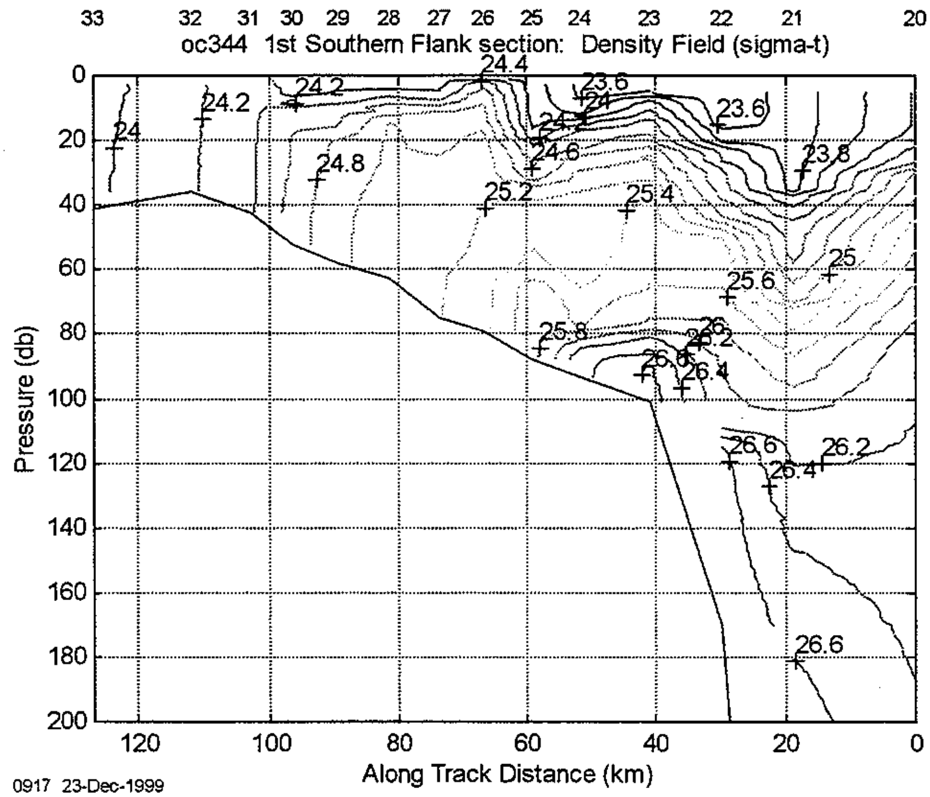


Figure 29. Southern Flank Section one - potential density in 0.2 kg/m³ intervals from 9 July 1999.

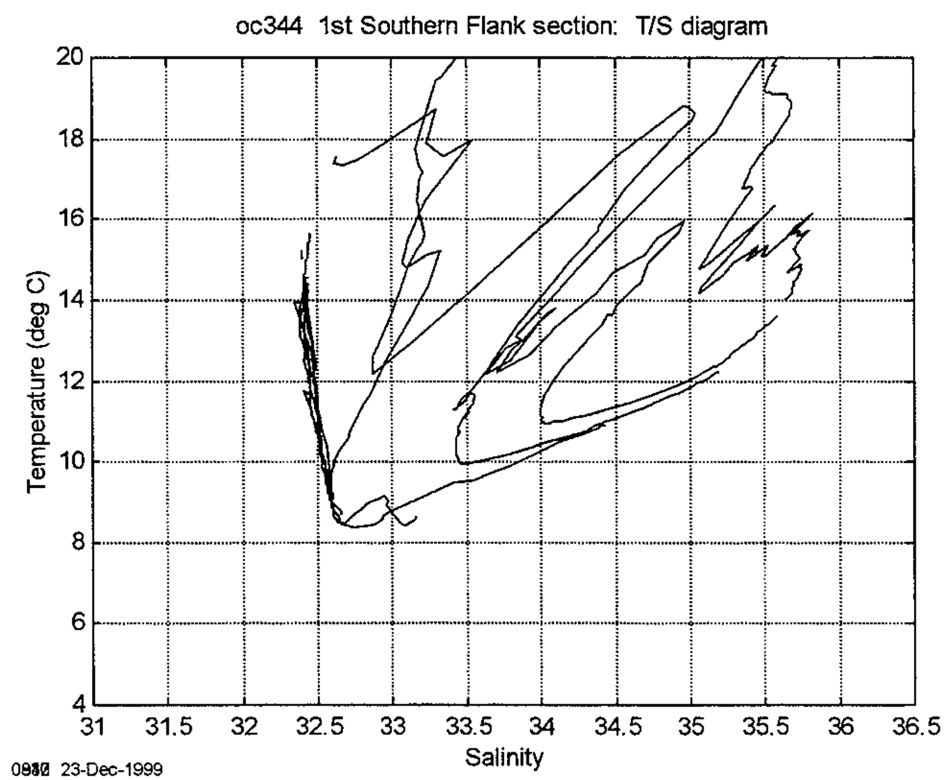


Figure 30. Southern Flank Section one - T/S diagram all section profiles from 9 July 1999.

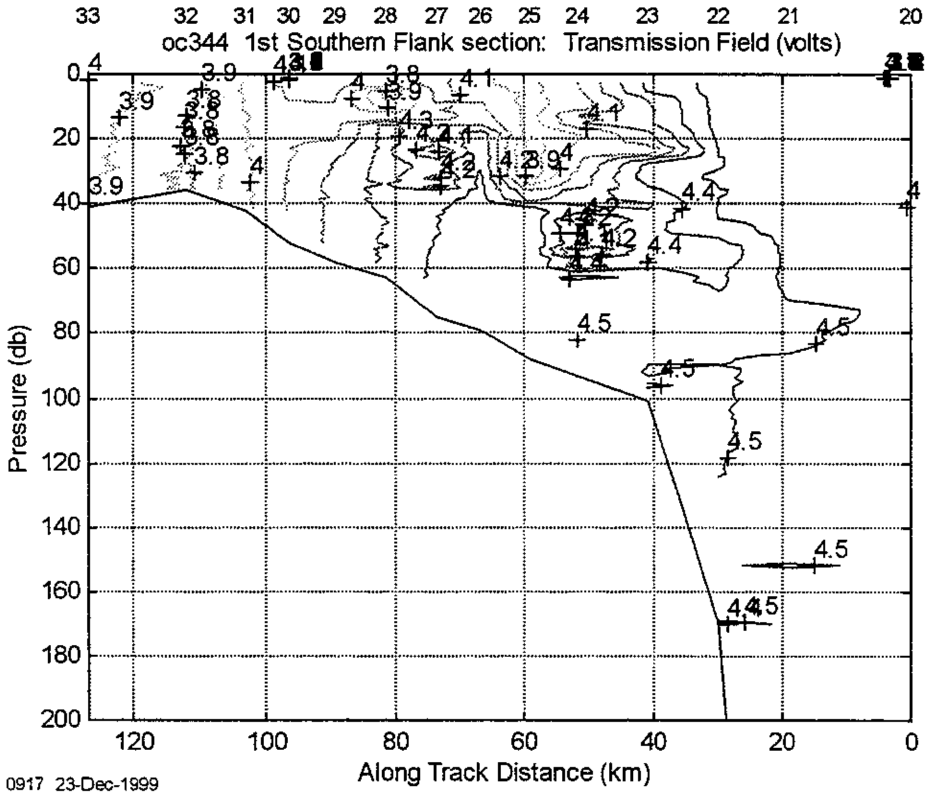


Figure 31. Southern Flank Section one - transmission in 0.1 volt intervals from 9 July 1999.

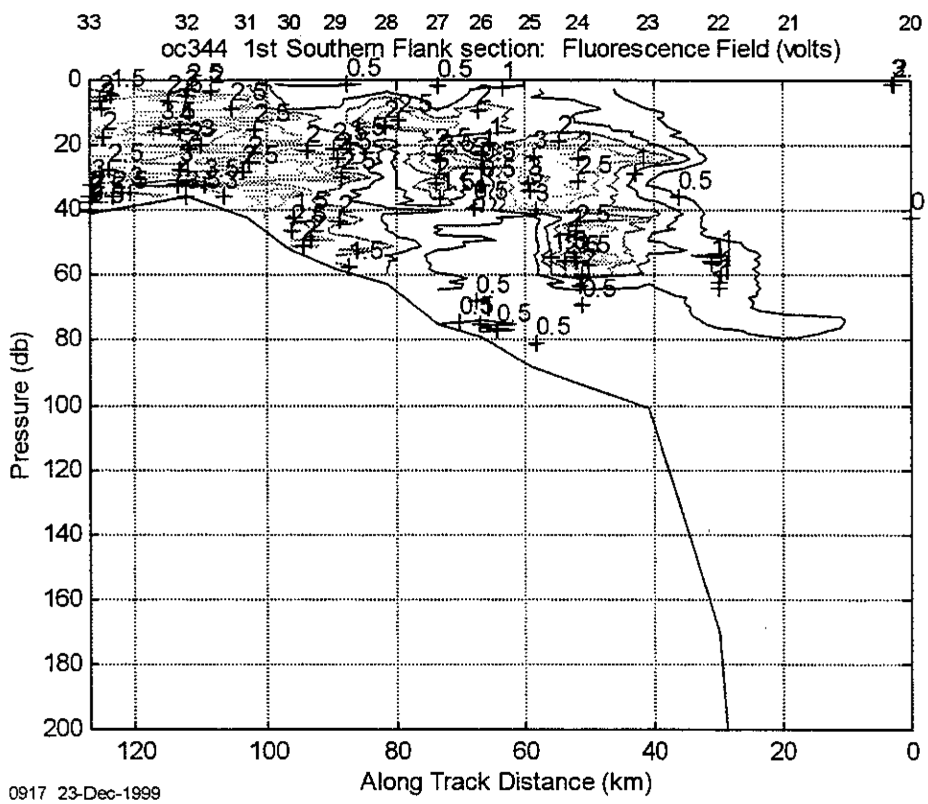


Figure 32. Southern Flank Section one - chlorophyll-a fluorescence in 0.5 v intervals from 9 July 1999.

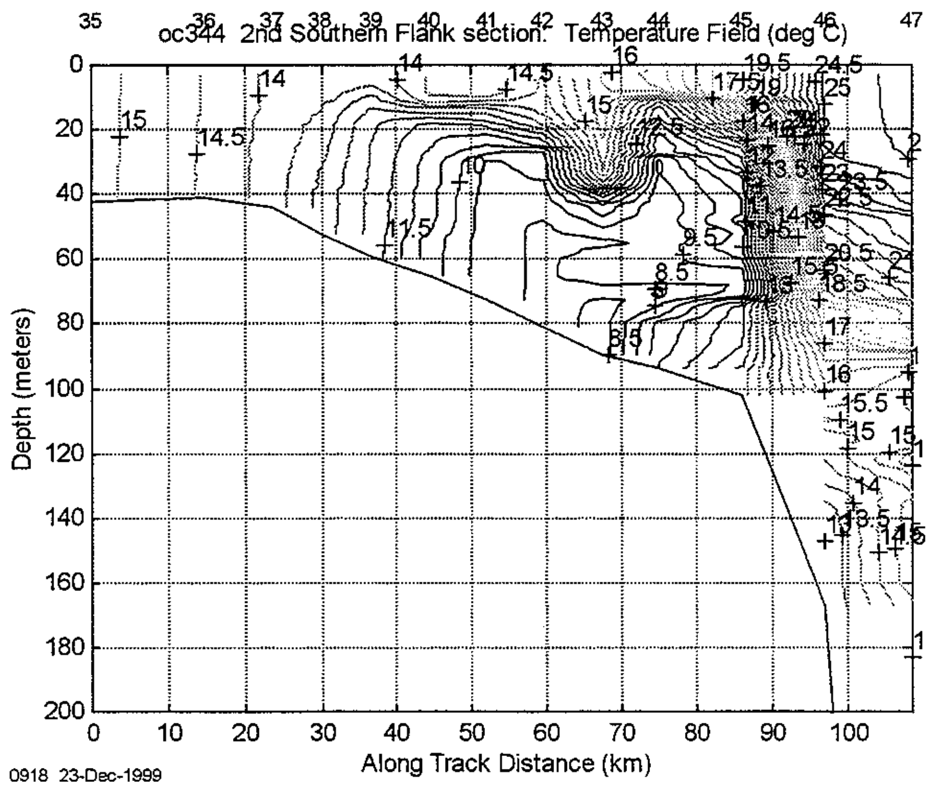


Figure 33. Southern Flank Section two - temperatures in 0.5° intervals from 10 July 1999.

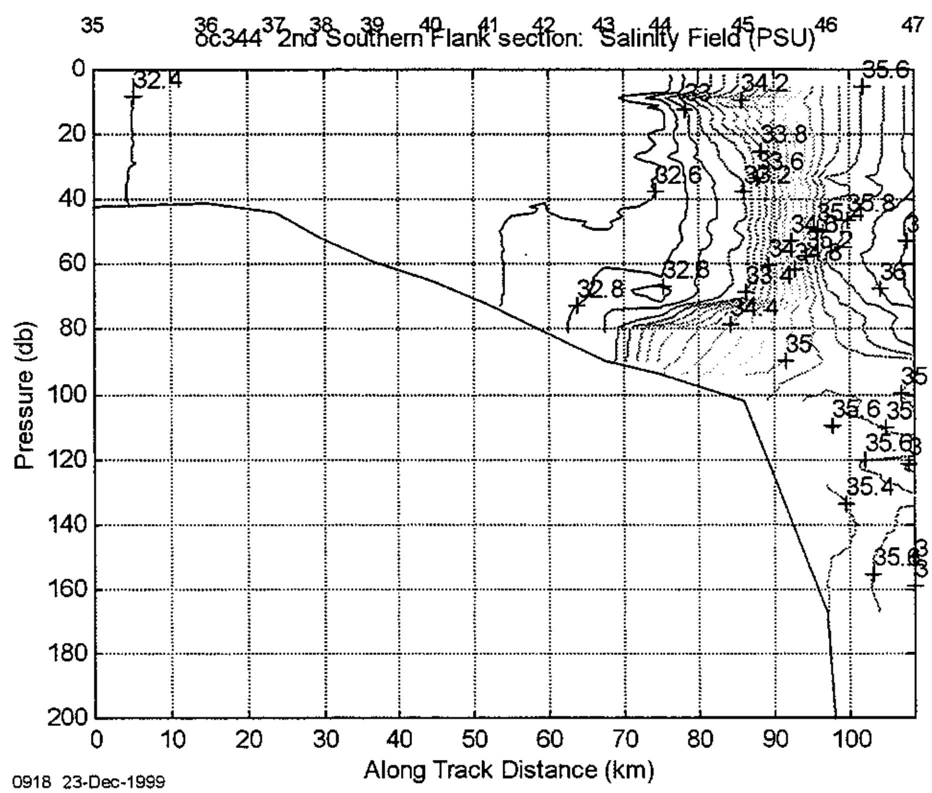


Figure 34. Southern Flank Section two - salinity in 0.2 PSU intervals from 10 July 1999.

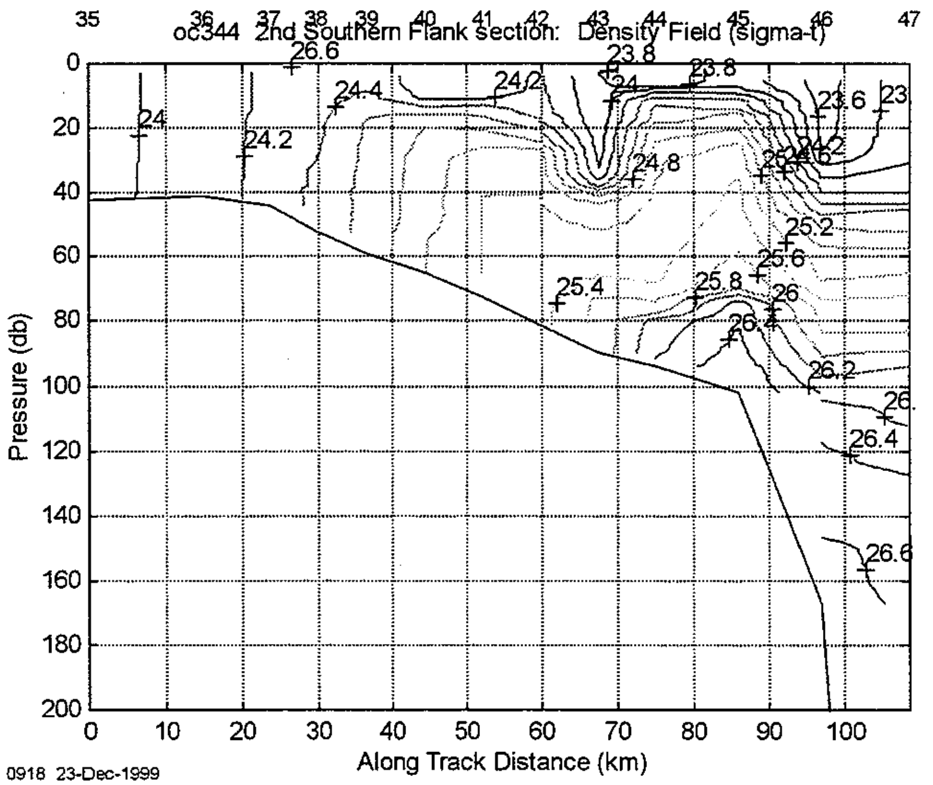


Figure 35. Southern Flank Section two - potential density in 0.2 kg/m³ intervals from 10 July 1999.

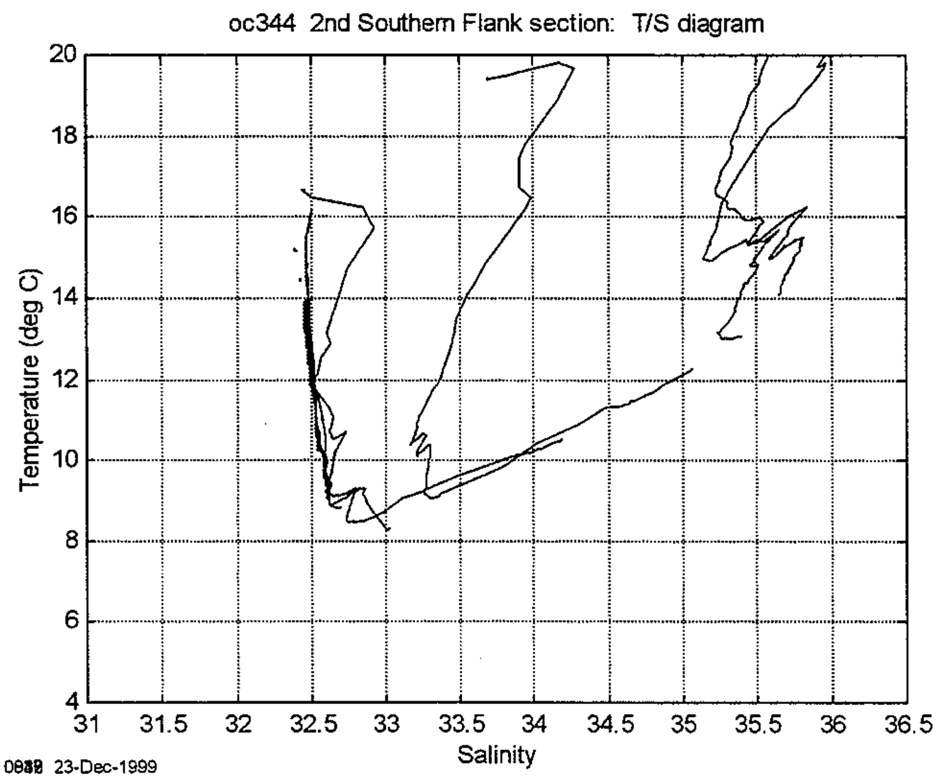


Figure 36. Southern Flank Section two - T/S diagram all section profiles from 10 July 1999.

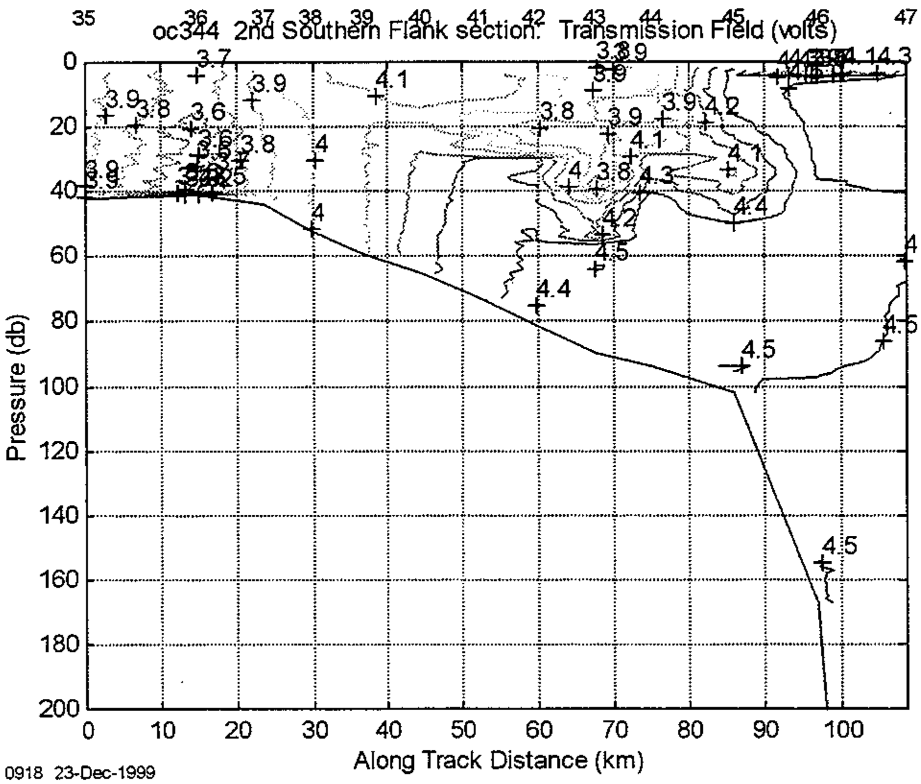


Figure 37. Southern Flank Section two - transmission in 0.1 volt intervals from 10 July 1999.

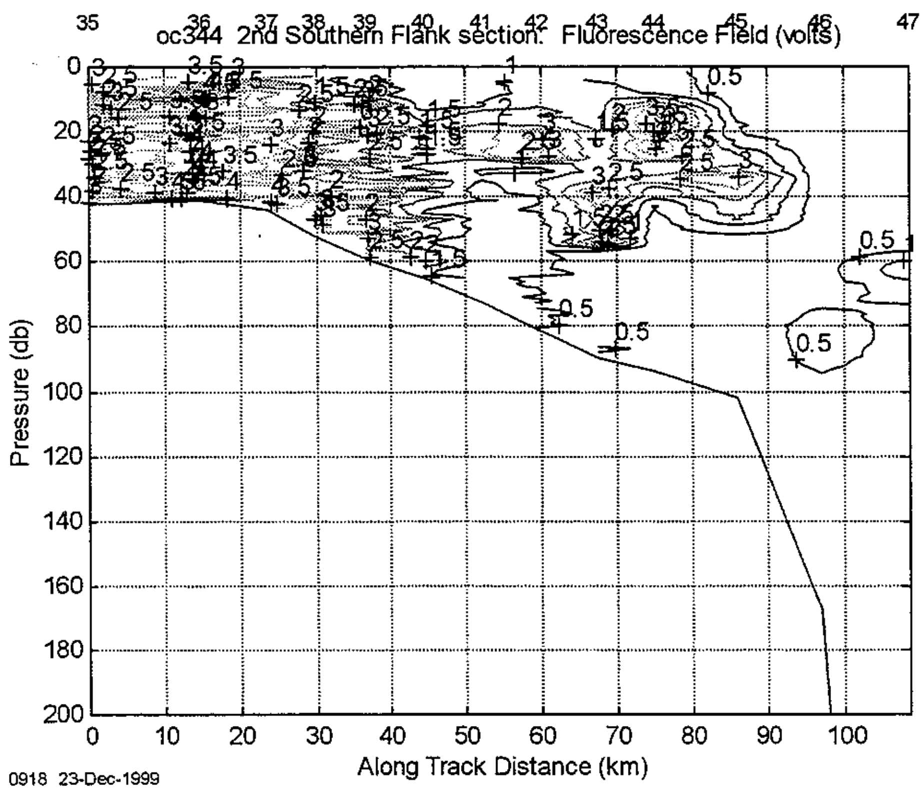


Figure 38. Southern Flank Section two - chlorophyll-a fluorescence in 0.5 v intervals from 10 July 1999.

Cruise Personnel:

Scientific Party:

- Jim Irish, Chief Scientist
- Jeff Van Keuren, CTDs, bio-optical, radiation
- Jim Doutt, CTDs
- Jeff Lord, deckwork, moorings
- Jim Dunn, assist deckwork, moorings
- Paul Fucile, bio-optical packages
- Nick Witzell, Seacats, ADCPs
- Dave Schroeder, cleaning, CTDs
- Scott Worrilow, acoustic releases
- Ryan Schraeder, acoustic releases
- Laura Goepfert, shipboard scientific services group

Ships Crew:

- Courtenay Barber III, master
- Richard Chase, chief mate
- Emily Sheasley, 2nd mate
- Jeffery Stolp, bosn
- James Ryder, AB
- Peter Liarikos, AB
- Colin Walcott, OS
- Richard Morris, chief engineer
- Kevin Kay, jr, engineer
- Alberto Collasius, Jr, jr. engineer
- Torii Corbett, Steward
- Raul Martinez, mess attendant

									N. Longitude		W. Longitude		cast	water	Sample	
Event	Instrument	Cast	Station	Year	Mnth	Day	Hr Mn	S/E	°	Min	°	Min	depth	depth	Bottles	Comments
1	SBE-911	1	LT08	1999	7	7	837	S	40	58.6	67	18.05	71	76	AJ1	
							943	E	40	58.4332	67	16.813		77		
2	Bottom Press		Sflank	1999	7	7	1013									Recovery for turnaround
3	Science Buoy E		Sflank	1999	7	7	1036									Recovery for turnaround
4	SBE-911	2	NE_Pe	1999	7	7	1734	S	41	43.8667	66	32.422	73	74	AJ2	
							1836	E	41	43.9537	66	32.961		74		
5	Science Buoy B		NE Pea	1999	7	7										Recovery for turnaround
6	SBE-911	3	NE15	1999	7	8	109	S	42	1.5152	65	29.712	997	959	E1	fire 3 bottles
								E						1091		
7	SBE-911	4	NE14	1999	7	8	255	S	41	59.1556	65	37.418	915	830	E2	fire 3 bottles
							337	E	41	58.8242	65	36.616		802		
8	SBE-911	5	NE13	1999	7	8	425	S	41	56.8225	65	44.367	234	240		downcast only
							437	E	41	56.905	65	44.266				
9	SBE-911	6	NE13	1999	7	8	437	S	41	56.905	65	44.266	234	239	E3	upcast only; fire 3 bottles
								E								
10	SBE-911	7	NE12	1999	7	8	531	S	41	54.537	65	51.902	126	132	E4	fire 3 bottles
								E	41	54.4907	65	52.091				
11	SBE-911	8	NE11	1999	7	8	623	S	41	52.2455	65	58.801	91	95	E5	fire 3 bottles
							634	E	41	52.3922	65	58.92				
12	SBE-911	9	NE10	1999	7	8	718	S	41	49.674	66	6.6277	88	92	AJ3	fire 3 bottles
							726	E	41	49.7852	66	6.8097				file name OC34409 (fixed)
13	SBE-911	10	NE09	1999	7	8	805	S	41	47.517	66	14.312	81	85	AJ4	fire 3 bottles
							814	E	41	47.479	66	14.354				
14	SBE-911	11	NE08	1999	7	8	858	S	41	45.1919	66	21.556	77	80	AJ5	fire 3 bottles
							906	E	41	45.2124	66	21.713				
15	SBE-911	12	NE07	1999	7	8	951	S	41	42.7922	66	28.582	72	76	AJ6	fire 3 bottles
							959	E	41	42.7605	66	28.646				
16	SBE-911	13	NE06	1999	7	8	1044	S	41	40.326	66	35.912	66	69	AJ7	fire 3 bottles
							1052	E	41	40.205	66	35.906		69		
17	SBE-911	14	NE05	1999	7	8	1135	S	41	38.1143	66	43.018	67	75	AJ8	fire 3 bottles
								E	41	37.9634	66	43.007		73		
18	SBE-911	15	NE04	1999	7	8	1233	S	41	35.4432	66	50.692	60	69	AJ9	fire 3 bottles
							1240	E	41	35.2857	66	50.628		66		
19	SBE-911	16	NE03	1999	7	8	1326	S	41	33.1957	66	57.64	61	65	AJ10	fire 3 bottles
							1334	E	41	32.9432	66	57.583		65		

20	SBE-911	17	NE02	1999	7	8	1420	S	41	30.7833	67	5.6913	53	57	AJ11	fire 3 bottles
							1426	E	41	30.5449	67	5.6478		57		
21	SBE-911	18	NE01	1999	7	8	1503	S	41	28.2326	67	12.033	46	51	AJ12	fire 3 bottles
							1510	E	41	27.7436	67	11.995		48		
22	Science Buoy B		NE Peak		7	8	2010		41	43.894	66	32.188		76		Deployed for final time
23	SBE-911	19	NE_Pe	1999	7	8	2041	S	41	44.0705	66	32.172	70	75	AJ13	fire 3 bottles
							2143	E	41	44.3212	66	32.023				1 hour yoyo
24	SBE-911	20	LT15	1999	7	9	606	S	40	20.3952	66	59.581	980	2000	AJ14	fire 3 bottles
							658	E	40	21.873	66	57.969		1900		
25	SBE-911	21	LT14	1999	7	9	804	S	40	30.2237	67	4.6904	448	475	AJ15 at 448 m	
							833	E	40	30.514	67	4.1085		461	AJ16 at 2.6 m	
26	SBE-911	22	LT13	1999	7	9	924	S	40	35.669	67	7.8418	168	168	AJ17	
							941	E	40	35.7534	67	7.5497		166		
27	SBE-911	23	LT12	1999	7	9	1025	S	40	41.4137	67	10.433	100	103	AJ19	1029 fire 3 bottles
							1033	E	40	41.3262	67	10.32		103		
28	SBE-911	24	LT11	1999	7	9	1117	S	40	46.9192	67	12.979	93	96	AJ20 at 93 m	
							1124	E	40	46.82	67	13.032			AJ21 at 3 m	
29	SBE-911	25	LT10	1999	7	9	1157	S	40	50.4668	67	15.085	89	91	AJ22	fire 3 bottles
							1203	E	40	50.5105	67	14.974				
30	SBE-911	26	LT09	1999	7	9	1238	S	40	54.455	67	16.969	79	83	AJ23	fired 3 bottles @ 79m
							1242	E	40	54.44	67	16.963		84		
31	SBE-911	27	LT08	1999	7	9	1330	S	40	57.8101	67	18.942	74	77	V1	fired 3 bottles @ 74m
							1336	E	40	57.8088	67	18.82		77		
32	SBE-911	28	LT07	1999	7	9	1410	S	41	1.895	67	20.785	64	68	V2	fired 3 bottles
							1417	E	41	1.8241	67	20.64		68		
33	SBE-911	29	LT06	1999	7	9	1450	S	41	5.8937	67	22.559	58	61	V3	fired btls 1, 2, 3
							1457	E	41	5.8082	67	22.442		62		
34	SBE-911	30	LT05	1999	7	9	1526	S	41	9.409	67	24.546	52	55	V4	fired btls 1, 2, 3
							1532	E	41	9.3241	67	24.515		56		
35	SBE-911	31	LT04	1999	7	9	1601	S	41	12.4142	67	26.718	42	46	V5	
							1608	E	41	12.2789	67	26.725				
36	SBE-911	32	LT03	1999	7	9	1647	S	41	16.9883	67	28.682	32	42	V6	fired 1, 2, 3 @ 32 m
							1652	E	41	16.9125	67	28.709		43		
37	SBE-911	33	LT02	1999	7	9		S	41	24.5093	67	32.716	40	43	V7	fired 1, 2, 3 @ 40 m
							1752	E	41	24.49	67	32.798		42		
38	Science Buoy D		Sflank	1999	7	9	2156		40	58.02	67	19.28		76		Deployed for final time
39	SBE-911	34	SFLAN	1999	7	9	2235	S	40	58.3011	67	19.056	73	77	V8	fired 1, 2, 3 @ 73 m

							2334	E	40	59.0274	67	18.38		75		1 hour yoyo
40	SBE-911	35	LT02	1999	7	10	501	S	41	24.513	67	32.645	40	42	V9	fired 3 bottles
							507	E	41	24.3936	67	32.775		42.5		3.5 meters ABOVE bottom
41	SBE-911	36	LT03	1999	7	10	556	S	41	17.1246	67	28.502	40	43	V10	fired 1,2 3, only 2 closed
							602	E	41	17.0979	67	28.662		44		
42	SBE-911	37	LT04	1999	7	10	636	S	41	12.5759	67	26.474	43.5	46	V11	fired 1, 2, 3 only 2 closed
							643	E	41	12.5729	67	26.716		47		
43	SBE-911	38	LT05	1999	7	10	712	S	41	9.5627	67	24.478	51.5	55		fired 1, 2, 3 none closed
							720	E	41	9.5992	67	24.809		55		
44	SBE-911	39	LT06	1999	7	10	825	S	41	6.1156	67	22.753	59	62		
							830	E	41	6.2108	67	22.945		62		
45	SBE-911	40	LT07	1999	7	10	909	S	41	2.132	67	20.865	64	68	V12	fire 15, 16, 17, 18
							914	E	41	2.283	67	20.98		69		bottle 18 OK
46	SBE-911	41	LT08	1999	7	10	952	S	40	58.2836	67	19.026	73	77	V13	fire 15, 16, 17, 18
							958	E	40	58.3526	67	18.974		77		
47	SBE-911	42	LT09	1999	7	10	1102	S	40	54.5456	67	16.94	80	84	V14	
							1108	E	40	54.6631	67	16.81		84		
48	SBE-911	43	LT10	1999	7	10	1155	S	40	50.4931	67	15.066	89	92	V15	fire 15, 16, 17, 18
							1202	E	40	50.5137	67	15.009		92		bottle 17 & 18 OK
49	SBE-911	44	LT11	1999	7	10	1245	S	40	46.9544	67	12.905	93	96	V16	fire 15, 16, 17, 18
							1253	E	40	46.841	67	12.641		97		bottle 16 & 17 OK
50	SBE-911	45	LT12	1999	7	10	1340	S	40	41.345	67	10.37	100	104	V17	fire 15, 16, 17, 18
							1349	E	40	41.1069	67	10.038		105		bottle 18 OK
51	SBE-911	46	LT13	1999	7	10	1435	S	40	35.6504	67	7.957	162	162	V18	fire 15, 16, 17, 18
							1446	E	40	35.4343	67	7.5932		166		bottle 18 OK
52	SBE-911	47	LT14	1999	7	10	1531	S	40	29.9529	67	4.9944	536	490	V19	fire 15, 16, 17, 18
							1602	E	40	29.7866	67	3.9413		646		bottle 17 & 18 OK

Chief Scientists Daily Log

Thursday – 1 July 1999

Start loading ship mid-morning
Most of deck load aboard and secured

Friday – 2 July 1999

Laboratory loaded and setup
1430 - Buoy moved to main dock by ship, sensors plugged in for test.

Monday – 5 July 1999

Buoy checked on dock – OK
Laboratory computers secured.

Tuesday – 6 July 1999

1045 – underway from WHOI dock to Southern Flank Mooring site
1100 – ship's orientation
1300 – fire and boat drill

Wednesday – 7 July 1999

0400 – on station southern flank site
two buoys seen, lights working
steel guard buoy "N" missing
0438 – CTD01 – hour long yo-yo
0610 – approaching science buoy for bottom pressure recovery
0611 – hyrdophone in enabling release 18021
0612 – range 563 m and opening
0613 – release commanded, acknowledge – vertical released
0614 – range 609 m and opening
0624 – sited on surface to north of expected site
0630 – aboard and secured on deck
0634 – enabling science buoy release – range 330 m
0635 – release commanded, acknowledged – vertical released
0700 – hook buoy on second pass
0713 – mooring aboard
Bio-optical package #1 at 10 meters, clean with only slight brown cast to PAR sensors. Moderate fouling on EM cable, brown patches on ADCP, not fully covered as previously seen. Transducers clean. Buoy hull clean, with some hydroid growth on base. Seacat 200 at 20 m and 1861 at 30 m. Bio-optical package #4 at 40 meters, PAR clean
0740 – deck secure, heading for Northeast Peak site.
1334 – CTD02 – yo-yo at Northern Flank mooring site
1435 – done with CTD, moving bottom pressure frame and southern flank science buoy E forward on starboard side to clear deck for recovery
1530 – three buoys at Northeast Peak site, moving up on science buoy B
1540 – by buoy, acoustic release 17306
1545 – enabled and listening for rely, noisy, betting range of 263 m

1548 – release commanded, noisy response
1550 – release commanded again, got some strong replies, hard to read
1552 – commanded release again, pulling hydrophone on board as subsurface float sited on surface.
1605 – buoy on board ship
1625 – mooring all aboard and clear of water
cleaning up mess. Whole mooring had more fouling than southern flank. Acoustic release moderate growth hydroids, no barnacles. Microcat 715 moderate growth hydroids. 1/3 sphere had moderate growth of hydroids. Bungies wer clean on top with some fouling on bottom. Zincs gone on both bridles, corrosion on shackles on top bridle. T50/C50 moderate growth, sensors OK. Biop@40 m moderate fouling on fluorometer, PAR clean. T15/C15 heafily fouled as well as T5/C5/ T5 thermistor guard missing and thermistor probe bent. ADCP transducers clean, and case 2/3 fouled. T1/C1 both relatively clean. Bolt on clamp for wire tube on buoy rusty. Cracked aluminum weld on tower top.
2109 – start Northeast Peak CTD section at NE15
2253 - CTD 04 - NE14

Thursday – 8 July 1999

0023 - CTD05 - NE13
0035 - CTD06 - NE13 restared at bottom of profile
0129 - CTD07 - NE12
0222 - CTD08 - NE11
0316 - CTD09 - NE10
0404 - CTD10 - NE09
0457 - CTD11 - NE08
0551 - CTD12 - NE07
0643 - CTD13 - NE06
0734 - CTD14 - NE05
0834 - CTD15 - NE04
0900 – replaced T5 sensor (#32064 with #32173) on Northeast Peak mooring
Zinc on C5 needed replacing also. Zincs somewhat going on all sensors but should be OK for 1 month. Jeff Van Keruen had to replace some zincs on the Northeast Peak bio-optical packages.
0925 - CTD16 - NE03
1019 - CTD17 - NE02
1101 - CTD18 - NE01
10:52:30 - Started ADCP #130 for NEP - dt = 15 min.
1100 – complete Northeast Peak CTD section at NE01
moving buoy into launch position, removing mooring bit, moving subsurface float to launch position. Stringing out cable, attaching ADCP 130 to string, microcat 715and acoustic release 17306.
NEP sensors PAR(5975), LWR(205), ADCP(130), BIOP#2(PAR 1793,T490,C2182,TR621),T/C15 (2431/1890),SC20(2359),SC30(2360),T/C50(2432/2\1379),Microcat715,BIOP3A (T1632/C2186),PAR(1661).