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A COMPILATION OF MOORED CURRENT METER AND WIND RECORDER 1/2

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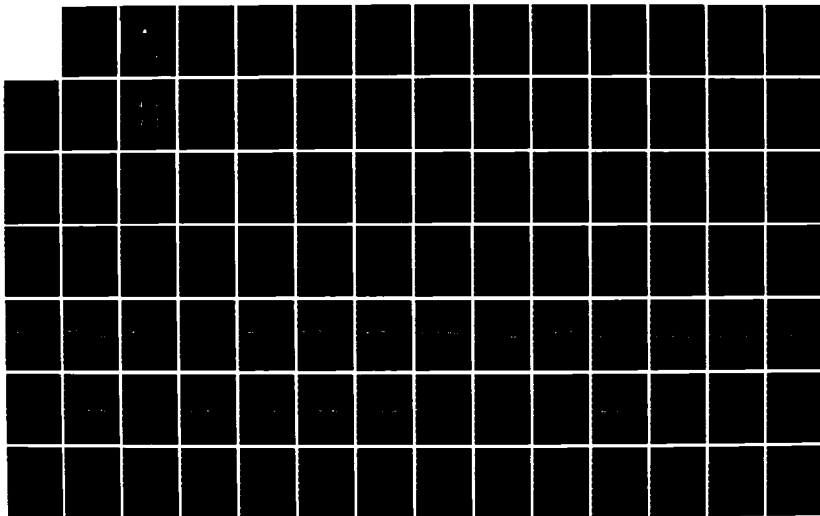
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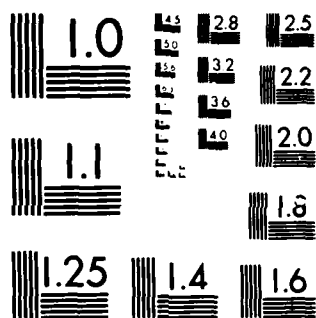
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Woods Hole Oceanographic Institution



A Compilation of Moored Current Meter and Wind Recorder Data Volume XXXVIII, Long-Term Upper Ocean Study (LOTUS) (Moorings 787, 788, 789, 790 792) April 1983 - May 1984

by

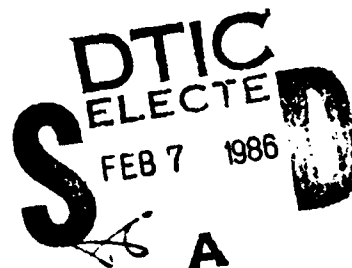
Susan A. Tarbell
Ellyn T. Montgomery
Melbourne G. Briscoe

December 1985

Technical Report

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WHOI-85-39

A Compilation of Moored Current Meter and Wind Recorder Data

**Volume XXXVIII, Long-Term Upper Ocean Study (LOTUS)
(Moorings 787, 788, 789, 790, 792)
April 1983 - May 1984**

by

Susan A. Tarbell
Ellyn T. Montgomery
Melbourne G. Briscoe

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

December 1985

Technical Report

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Robert C. Beardsley, Chairman
Department of Physical Oceanography

Abstract

The Long-Term Upper Ocean Study (LOTUS) was a two-year field experiment near 34°N, 70°W, designed to acquire a continuous set of measurements of currents and temperatures in the upper, open ocean together with local hydrography, meteorology, and mesoscale oceanographic features. The first scientific moorings were deployed in May 1982. The first year of mooring data, from May 1982-April 1983, is presented by Tarbell, Pennington and Briscoe (1984, W.H.O.I. Tech. Rept. 84-36). The second year of mooring data, from April 1983-May 1984, when the final mooring recovery occurred, is presented here.

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PREFACE

This volume is the thirty-eighth in a series of Data Reports presenting mooring current meter and associated data collected by the WHOI Buoy Group.

Volumes I-XVI present data prior to 1976 and are not listed below.

Volumes XVII through XXXVII present data obtained during the years 1972-1984, either by year or experiment (see notes).

A data directory and bibliography for the years 1963-1978 has been published, as WHOI Technical Report 79-88.

Volume XXXVIII presents data from the second year of the two-year Long-Term Upper-Ocean Study (LOTUS), namely May 1983-May 1984.

Volume No.	WHOI Ref. No.		Notes	
			Year	Experiment
XVII	78-49	Tarbell, S., A. Spencer and R. E. Payne	1975-1977	POLYMODE Array II
XVIII	79-65	Tarbell, S., M. G. Briscoe and R. A. Weller	1978	JASIN
XIX	79-34	Spencer, A., C. Mills and R. Payne	1974-1975	POLYMODE Array I
XX	79-56	Spencer, A.	1974	Rise Array
XXI	79-85	Mills, C. and P. Rhines	1978	W.B.U.C.
XXII	79-87	Tarbell, S. and R. Payne	1973	measurements
XXIII	80-40	Tarbell, S. and R. Payne	1978	POLYMODE Array III
XXIV	80-41	Spencer, A., K. O'Neill and J. Luyten	1976	INDEX
XXV	81-12	Spencer, A., E. D'Asaro and L. Armi	1977	B.B.L. Expt.
XXVI	81-45	Chausse, D. and R. Payne	1972	measurements
XXVII	81-68	McKee, T., E. Francis and N. Hogg	1975, 1978	topographic expts.
XXVIII	81-73	Mills, C., S. Tarbell, W. B. Owens and R. Payne	1978	L.D.E.
XXIX	82-16	Levy, E., A. Spencer, G. Needell, G. Hund, and J. R. Luyten	1979	INDEX
XXX	82-43	Levy, E., S. A. Tarbell, N. P. Fofonoff	1979-1980	GSE/NSOI
XXXI	83-30	Levy, E. and S. A. Tarbell	1980-1982	WesPac
XXXII	83-46	Levy, E.	1979-1980	Vema Channel
XXXIII	84-6	Spencer, A., D. Chausse, and W. Owens	1981-1982	N. Pacific Boundary Current
XXXIV	84-16	Levy, E. and P. L. Richardson	1983,	Atlantic North Equatorial Counter- current
XXXV	84-36	Tarbell, S. A., N. J. Pennington, and M. G. Briscoe	Year 1	LOTUS Current Meter & Wind Recorder
XXXVI	84-37	Levy, E. and P. L. Richardson	SEQUAL II	
XXXVII	85-7	Levy, E. and P. L. Richardson	SEQUAL III	

LOTUS-related WHOI Technical Reports.

PRESENTLY AVAILABLE REPORTS

Title	WHOI No.	Date
Long-Term Upper Ocean Study (LOTUS) A Summary of the Historical Data and Engineering Test Data.	82-53	Dec 82
The Long-Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 119 - May 1982.	83-7	Feb 83
The Long-Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 129, Oct 1982.	83-29	Aug 83
Long-Term Upper Ocean Study (LOTUS) at 34°N, 70°W Meteorological Sensors, Data, and Heat Fluxes for May-October 1982 (LOTUS-3 and LOTUS-4).	83-32	Sept 83
The Long-Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, ENDEAVOR 97, April 1983.	83-33	Oct 83
The Long-Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 141, November 1983, and OCEANUS 145, January 1984.	84-26	June 84
Compilation of Moored Current Meter and Wind Recorder Data, Volume XXXV, Long-Term Upper Ocean Study (LOTUS) (Moorings 764, 765, 766, 767, 770) May 1982-April 1983.	84-36	Aug 84
The Long-Term Upper Ocean Study (LOTUS) Cruise Summary and Hydrographic Data Report, OCEANUS 154, May 1984.	84-39	Sept 84
Compilation of Moored Current Meter and Wind Recorder Data, Volume XXXVIII, Long-Term Upper Ocean Study (LOTUS) (Moorings 787, 788, 789, 790, 792) April 1983-May 1984.	85-39	Dec 85

PLANNED FUTURE REPORTS

Subject	Expected Availability
A summary of the LOTUS experiment.	Spring 86

ACKNOWLEDGMENTS

The Long Term Upper Ocean Study (LOTUS) has required the interest and help of almost everyone connected with the Buoy Group, since its inception in 1979. We especially wish to thank the mooring engineering effort led by Bob Walden, the instrument engineering effort led by Jerry Dean, the mooring and instrument preparation and operations led by David Simoneau and Joe Poirier, and the data processing led by Ann Spencer. In addition Peter Clay, Matthew Gould, Clayt Collins, Brian Skelly, Scott Worrilow, Willy Ostrom, Rick Trask, and Bob Weller, from WHOI, and Bob Reid from C. S. Draper Labs, have been on many cruises or spent many hours in special efforts for the project.

This work has been supported by the Office of Naval Research under Contracts N00014-76-C-0197, NR 083-400, and N00014-84-C-0134, NR 083-400.

INTRODUCTION

The Long Term Upper Ocean Study (LOTUS) began in 1979 when it became clear that even massive one to two month upper-ocean experiments (e.g., JASIN) could not provide the large variety of possible environmental conditions, nor could they provide any insights into seasonal effects or give long-term statistical response models.

The LOTUS experimental area (Figure 1) was at 34°N, 70°W (the old Woods Hole site L). The mooring array used in LOTUS was designed to sample the surface meteorology and the full water column, as well as some of the larger scale properties of the mesoscale field. The arrays consisted of a surface mooring; a nearby subsurface mooring; and two intermediate moorings, one approximately 20 km east, and one approximately 20 km south of the subsurface mooring. The surface moorings were replaced every six months during the two years of LOTUS, so four surface moorings were used. The subsurface and intermediate moorings were each replaced annually, making the total number of Woods Hole moorings during LOTUS, ten. Figure 2a shows the duration of deployment of each mooring, and Figure 2b shows the position of each mooring. Also during LOTUS, a C. S. Draper Labs profiling current meter (PCM) was deployed for three six-month periods in the LOTUS area, by C. Eriksen (Scripps). A description of the PCM can be found in section C2, but the data will be detailed elsewhere.

The first eleven months of LOTUS (called year 1) and associated current meter data are described in Tarbell *et al.* (1984). The remaining thirteen months (called year 2) of LOTUS current meter data are presented in this report. The hydrographic data (XBT and CTD) are described in the individual cruise reports (see References) and are only summarized here.

Data collection for year 2 began in April 1983, when the entire mooring array was recovered and replaced by the moorings described here: surface mooring 787 (designated LOTUS 5), subsurface mooring 788, and intermediate moorings 789 and 790. Surface mooring 787 was recovered in October 1983, but due to damage to the replacement discus buoy during deployment, the new mooring, 792 (designated LOTUS 6) was not deployed until January 1984. In May 1984, the entire array was recovered, ending the data collection phase of LOTUS.

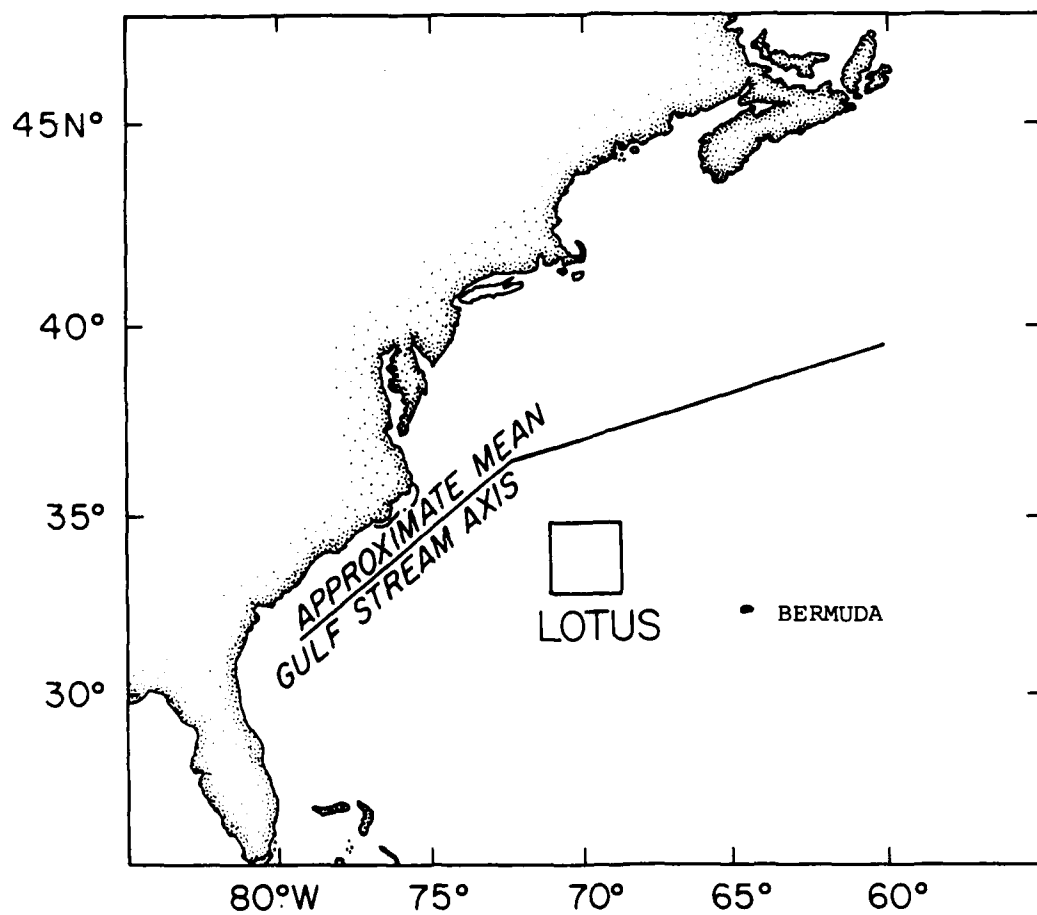
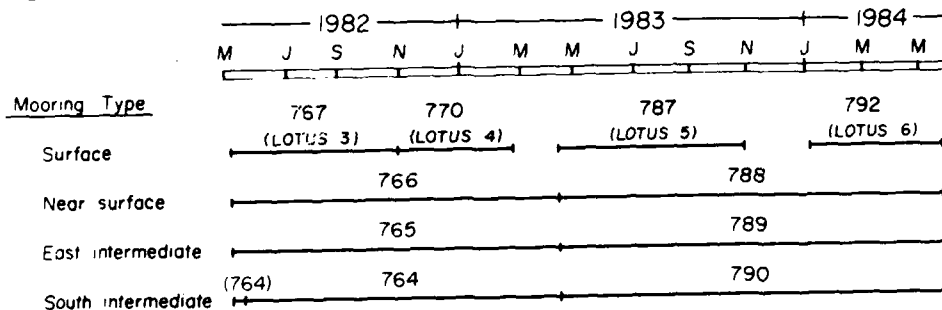


Figure 1. The location of the Long Term Upper Ocean Study area.

2a.

LOTUS MOORING DEPLOYMENTS



2b.

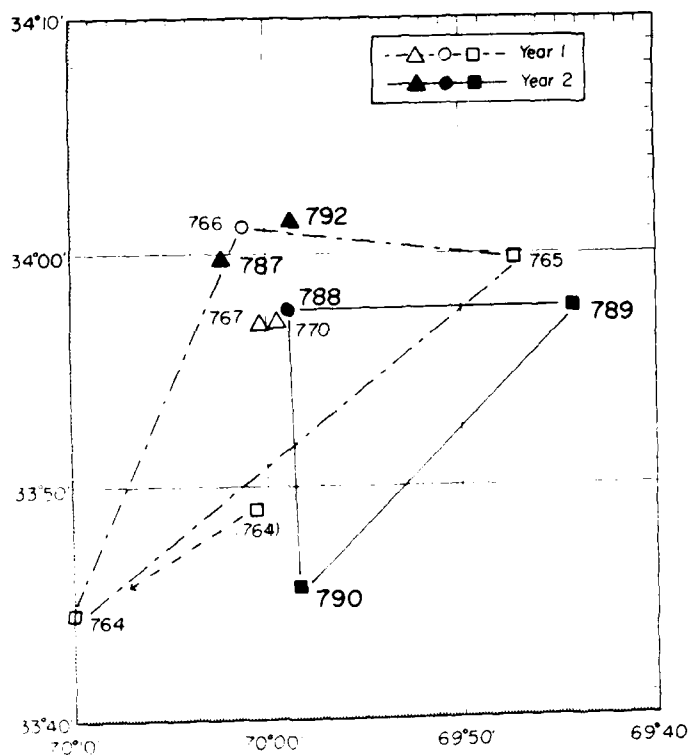


Figure 2a. (Top) Deployment times of each Woods Hole mooring used during the two years of LOTUS.

Figure 2b. (Bottom) Chart of the LOTUS area showing mooring locations for both arrays deployed during the two years of LOTUS. Surface moorings ($\triangle$ year 1, $\blacktriangle$ year 2), subsurface moorings ($\circ$ year 1, $\bullet$ year 2), and intermediate moorings ($\square$ year 1, $\blacksquare$ year 2) are shown here. Mooring 764 moved, shortly after deployment. The position shown is the final resting position.

A. Moorings

Three kinds of moorings were used in LOTUS: surface, near surface, and intermediate. Table 1 provides the location and duration of each mooring's deployment. The mooring diagrams (Figure 3) show six different kinds of sub-surface instrumentation (see next section) on the moorings. The bottom in the area is essentially flat and featureless sand and silt, with a nominal depth of 5368 m (corrected).

The two intermediate moorings (789 and 790) and the near-surface mooring (788) are constructed entirely of chain and wire rope, except for a short length of braided nylon line directly under the acoustic release.

The surface moorings (787 and 792) are chain and wire rope in the top 2000 m to guard against fishbite, and braided nylon beneath for compliance. The surface moorings are slightly longer than the water depth, but the constant presence of a current at the site prevents any slack and subsequent entanglement in the mooring line. Tension measurements just under the surface buoy usually show 2000-4500 pounds tension, depending on the large-scale current field. Local wind and current effects at the surface have little effect on the mean line tension. See also Clay (1983).

All moorings recovered from the site have shown evidence of fishbite (teeth marks in or even removal of the PVC jacket on the wire rope), especially in the 500-1000 m depth range. Further information on fishbite may be found in reports by Prindle (1981, 1982).

B. Instrumentation

1. Current Meters

The primary current meters used in the LOTUS experiment are Vector Averaging Current Meters (VACM) and Vector Measuring Current Meters (VMCM) (Figure 4). They differ mainly in their flow-sensing elements: the VACM uses a Savonius rotor and a vane to give speed and direction which are resolved against an internal compass to East and North components whereas the VMCM uses orthogonal cosine-response propellers that sense directly the flow components which are then rotated, relative to an internal compass.

Both instruments provide a continuous vector-averaging during a recording interval by sampling 8 (VACM) or 4 (VMCM) times per rotation of the sensor;

Table 1: Mooring Positions

<u>Mooring #</u>	<u>Days at Sea</u>	<u>Duration</u>	<u>Loran C position*</u>
790 LOTUS 5 Intermediate-South	398	15 Apr. 1983 - 18 May 1984	33°45.55' 67°58.90'
789 LOTUS 5 Intermediate-East	399	14 Apr. 1983 - 18 May 1984	33°57.41' 69°44.34'
788 LOTUS 5 Near Surface	401	13 Apr. 1983 - 19 May 1984	33°57.56' 69°58.91'
787 LOTUS 5 Surface	201	12 Apr. 1983 - 31 Oct. 1983	33°59.63' 70°02.23'
792 LOTUS 6 Surface	115	24 Jan. 1984 - 20 May 1984	34°01.29' 69°58.63'

* Updated from the original cruise reports (WHOI-TR's 83-33, 84-26, and 84-39).

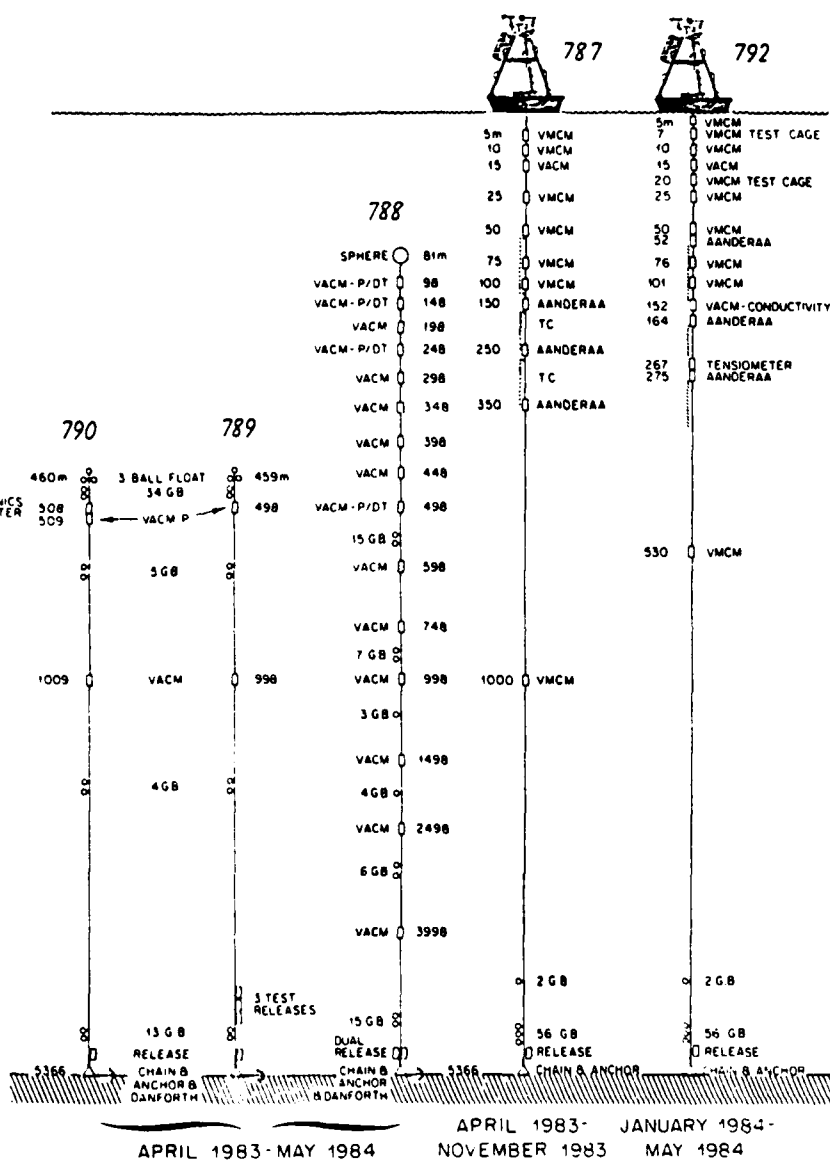
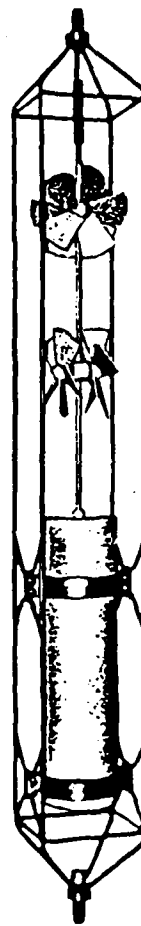


Figure 3. Diagrams of the five LOTUS moorings used in the second year of the experiment.

Current Meters



VACM



VMCM

Figure 4. Diagrams of the two primary kinds of current meters used in the LOTUS experiment.

both cases correspond to sampling and vector-averaging at least several times per second.

The recording interval of an instrument depends on the planned deployment period of the mooring. The one year moorings had current meters with recording intervals of 7.5 minutes whereas those on the 6 month (surface) moorings had 3.75 minute recording intervals.

Additional technical information on the VACM and its sensors may be found in Pofonoff and Ercan (1967), McCullough (1975), Payne et al. (1976), and Dean (1979). The VMCM is described in Weller and Davis (1979). Intercomparisons of these instruments are given in Halpern et al. (1981).

Both current meters record on Phillips-type cassettes by means of Sea Data recorders. The cassettes are removed ashore and transcribed to 9-track computer tapes for further processing.

During the second year of the LOTUS experiment, a General Oceanics current meter was deployed adjacent to the top VACM on mooring 790, for testing purposes. The General Oceanics current meter uses a large vane and compass to measure direction, and the speed is derived from instrument tilt. Details of this current meter intercomparison will be described elsewhere.

Temperature measurements were made by both the VACMs and VMCMs. The VACM temperature sensor (a thermistor embedded in its end cap just above the vane) has an accuracy of approximately $.01^{\circ}\text{C}$ (Payne et al., 1976), and resolution of $.07 \times 10^{-3}^{\circ}\text{C}$ (Tarbell et al., 1979). Some VACMs have either a pressure sensor (VACM-P) (located just above the vane) or a pair of thermistors separated by approximately one meter to give the vertical temperature gradient (VACM-DT) (Dean, 1979). The time response of the end-cap thermistor is approximately 94 sec, whereas the thermistor system used in the VACM-DT has a 12 sec response (Levine, 1981); this difference could affect certain kinds of data comparisons.

Only the temperature and pressure sensors were calibrated prior to deployment; the rotor and vane weights, sizes and bearing clearances were simply kept within narrow specifications to permit the nominal calibrations (McCullough, 1975) to be used.

The VMCM also senses temperature with a thermistor embedded in the upper end cap of the pressure case. According to the manufacturer's specifications a calibrated thermistor has an accuracy of $.01^{\circ}\text{C}$. For the temperature range

selected for the LOTUS VMCMs (17°C to 30°C) the resolution of the system is 1.4×10^{-3} °C. The statistics tables (p. 158) give the instrument identification numbers for each depth and mooring.

2. VMCM Variations

The VMCM is a relatively new instrument still undergoing tests to perfect its long term performance. One component of the instrument which was under examination was the material used for the orthogonal propellers. Propellers fabricated of black Delrin (a Dupont Co. Acetal homopolymer resin) have had the best performance record, and were used on the LOTUS 5 and 6 VMCMs. The color black was chosen to decrease their visibility and thus discourage any interference by fish.

During the first year of LOTUS, various antifouling compounds were used on LOTUS 3 propellers, and nothing used on those of LOTUS 4. A significant difference in the amounts of growth on LOTUS 3 and LOTUS 4 was observed, consequently, antifouling agents were used on both LOTUS 5 and LOTUS 6 VMCMs.

LOTUS 5 and LOTUS 6 VMCMs were made using dovetail joints to fit the rotor blades into the hubs, as dovetail joints increased rotor life on LOTUS 4 VMCMs. Balancing the rotors also contributed to increased instrument life, and so all rotors on LOTUS 5 and 6 VMCMs were balanced.

Another aspect of the VMCM under study is the type of bearings used on the propeller shaft. All LOTUS 5 VMCMs had a 1/4" propeller shaft, used 1/4" bearings and had a type 18-8 stainless steel retainer ring, first used in LOTUS 4. Instruments shallower than 75 meters had bearings made of type 440 stainless steel, and instruments deeper than 75 meters used bearings made of type 316 stainless steel.

The LOTUS 5 and 6 VMCMs at 75 meters and deeper were identical. The shallow instruments on LOTUS 6 were modified slightly to increase the durability of the instruments. The propeller shaft and bearings of these instruments were 3/8" instead of 1/4". Type 440 stainless steel was used on the 5, 10, and 25 meter instruments, and the 50 meter instrument had bearings coated with Armaloy. The shallow instruments used in LOTUS 6 also had anodes, made of type 6-32 aluminum acorn nuts, bolted to the ends of each propeller shaft. The

aluminum was oxidized more readily than the stainless steel of the bearings, so functioned to lessen the corrosion of the bearings.

Table 2 summarizes the differences between the LOTUS 5 and LOTUS 6 VMCs.

3. Aanderaa Temperature Recorders

Both of the second year LOTUS surface moorings (LOTUS 5 and LOTUS 6) had three 100 m long thermistor cables with Aanderaa TR-1 or TR-2 recorders situated to give 10 m resolution between 50 and 350 m. This placement of the thermistors was planned to allow the depth of the mixed layer to be monitored.

The temperature range of the thermistor chains used during LOTUS was 10.08° to 36.04°C; the resolution was .025°C. The 6 month deployment period and the limited tape capacity restricted the sampling interval to 60 minutes.

Calibration of the thermistor cables was performed at WHOI. The procedure involved immersing the entire cable into a calibration bath and then decreasing the bath temperature in a series of steps from 30° to 10°C. Calibration coefficients were calculated for each thermistor using a second order polynomial.

The data return from LOTUS 5 and LOTUS 6 Aanderaa temperature recorders was much less than expected. Most of the instruments failed within 50 days of deployment; the primary cause of failure was that the battery packs cracked and leaked, causing loss of power; in one case the encoder went bad. The batteries were manufactured by Leclanché.

There was only about 30 percent overall data return from the LOTUS 5 Aanderaas. However, most of the thermistors on the 50-100 m instrument worked for about six months, so there was fair data coverage for that time period and depth range. The overall data return for LOTUS 6 (22 percent) was only a little worse than that for LOTUS 5, but only one thermistor of 33 produced a record longer than two months. The rest of the data was short pieces, all of which occur in the first two months of the deployment. Due to the small amount of data available, a composite plot of the Aanderaa temperature data will not be presented.

4. Vector-Averaging Wind Recorder

The Vector-Averaging Wind Recorder (VAWR), a modification of the Vector Averaging Current Meter (VACM), has been used at WHOI for making high quality, long duration observations of meteorological parameters from moored oceanic

TABLE 2: VMCM Variations

	Propeller Material	Antifouling Compounds		Bearings
LOTUS 5	Black Delrin Blades dovetail jointed at hub; balanced	None	0-50 m	1/4", 440 stainless; 1/4" bore shaft with 18-8 retainer ring; no anodes.
			75, 100, 1000 m	1/4", 316 stainless; 1/4" bore shaft with 18-8 retainer ring; no anodes.
LOTUS 6	Black Delrin Blades dovetail jointed at hub; balanced	None	0-50 m	3/8" 440 stainless; 3/8" bore shaft with 18-8 retainer ring; with anodes.
			75, 100, 530 m	1/4" 316 stainless; 1/4" bore shaft with 18-8 retainer ring; no anodes.

buoys. The VAWR contains averaging and recording circuitry that computes vector-averaged wind velocity. The VAWR also allows for recording additional measurements such as: air and sea temperatures, barometric pressure, relative humidity, insolation, and compass orientation.

The VAWRs used in LOTUS were fitted with several different sensors. The integral direction and speed sensors used in LOTUS 5 were developed for use in the Coastal Ocean Dynamics Experiment (CODE) (Dean and Beardsley, in preparation). All sensors were positioned on the discus buoy's tower so that interactive effects such as shading, and wind diversion would be minimized. The relative humidity measurement was adversely affected by salt that accumulated on the sensors, and the barometric pressure measurement was affected by the wind.

Table 3 gives a summary of the meteorological sensors used in LOTUS 5 and 6; the values (mostly estimates) in the "system accuracy" category are partially due to environmental effects on the sensor, and partially due to mechanical and electronic system effects.

Because of the difference in planned lengths of deployment, the VAWRs in LOTUS 5 and 6 used different sampling rates. VAWR No. 141 (LOTUS 5) recorded data averaged over 7.5 minutes, but since VAWR No. 177 (LOTUS 6) was to be out for only four months instead of seven, a sampling interval of 3.75 minutes was used. These sampling rates are long enough to average out the bulk of buoy motion, but short enough to retain high frequency variability in the meteorological data.

As well as having a VAWR on each LOTUS surface mooring, there was also an independent set of sensors that telemetered their data via the ARGOS system. On LOTUS 5 there was also a meteorological recorder (MR) that measured similar parameters to those measured by the VAWR, using different sensors (Payne, in press). For additional information on the meteorological data acquisition systems used in LOTUS, consult Deser et al. (1983).

C. Other Data

1. XBT and CTD

During each cruise to the site, an XBT section was made along approximately 70°W from about 40°N to 34°N, and CTD stations were made near the moorings and around the array. The XBT and CTD data are all given in detail in each cruise report.

TABLE 3. Summary of Meteorological Instruments Used During Year Two of the LOTUS Experiment.

TELEMETERING								
Parameter	Sensor	Manufacturer	Range	Sensor Accuracy	System Accuracy	L5	L6	Comments
1) Wind Spd.	Gill 3 cup anemometer	R.M. Young Co 6301	0-54 m/s	*	0.2 m/s (r)	X	X	
2) Wind Dir.	Vane w/RVDT Vane w/POT	R.M. Young Co. 6101	0-360°	5° d 5° d	5° (s) 5° (s)	X	X	LOTUS 5 RVDT failed after 6 months
3) Air Temp.	Thermistor w/ Thaller shield	Yellow Springs Instr. 44034	+35°C	0.1°C	0.5°C (s)	X	X	
4) Sea Temp.	Thermistor	Yellow Springs Instr. 44034	+30°C	0.1°C	0.3°C (s)	X	X	
5) Barometric Pressure	Aneroid	Yellow Springs Instr. 2014-28-35	984-1084mb	3mb	5mb (r)	X	X	
6) Relative Humidity	Humicap	Vaisala HMP-146	10-100%RH	+3%	*	X	X	
7) Tension	Hydraulic piston	W. Swift Co.	0-9300 lba	< 40 lbs	40 lbs (r)	X	X	LOTUS 5 tensiometer failed after 3 mos.

VAMR								
1) Wind Spd.	Gill 3 cup anemometer	R.M. Young Co. 6301	0-54 m/sec	*	0.1 m/sec	X	X	LOTUS 5, sampling rate: 7.5 min.
2) Wind Dir.	Integral vane Gill micro-vane	WHOI R.M. Young Co. 6101	0-360° 0-360°	5° d 5°	5° (s) 5° (s)	X	X	LOTUS 6, sampling rate 3.75 min.
3) Air Temp.	Thermistor w/ Thaller shield	Yellow Springs Instr. 44034	+35°C	0.1°C	0.5°C (s)	X	X	
4) Sea Temp.	Thermistor	Thermometrics	+30°C	0.004°C	0.01°C (s)	X	X	
5) Barometric Pressure	Digiquartz	Paroscientific 215-A5-U02	0-1034mb	.2mb	.5mb (m)	X	X	LOTUS 6 barometer failed after 1 week
6) Relative Humidity	Humicap	Vaisala HMP 14	10-100%RH	+3% (m)	*	X	X	LOTUS 5 sensor failed after 3 mos.
7) Solar Radiation	Pyranometer	Hycal P-6405-A Eppley 8-48	0-4200W/m ² 0-1400W/m ²	+3% +3%	+5% (m) +5% (m)	X	X	

Payne Meteorological Recorder								
1) Wind Spd. & direction	Propeller anemometer	R.M. Young Co. 5102	0-43 m/sec	*	+2%, (m) +2°		X	
2) Air Temp.	Thermistor in Young multiple plate radiation	Yellow Springs Instr. 44034 R.M. Young Co.	+35°C	0.1°C	0.3°C	X		
3) Sea Temp.	Thermistor	Yellow Springs Instr. 44034	+30°C	0.1°C	0.3°C	X		
4) Barometric Pressure	Digiquartz	Paroscientific	0-1034mb	.2mb	.5mb (m)	X		malfunctioned immediately after
5) Relative Humidity	Humicap	Vaisala HMP 14	10-100%RH	+2%	*	X		Broken during launch
6) Solar Radiation	Pyranometer	Eppley 8-48	0-1400W/m ²	+3%	+5% (m)	X		

(r) ARGOS digitization resolution

(s) Scatterplot estimate

(m) Manufacturers estimate

(d) Direction measurements are more a function of vane follower accuracy than vane accuracy.

(*) Many of the problems that came up as a result of leaving these instruments at sea for approximately six months have not been fully resolved so therefore there is either no value available, or an estimate based on previous experience has been made.

The positions of all the CTD stations taken during the second year in the LOTUS area are shown in Figure 5. For general reference, Figures 6a and 6b show typical CTD profiles at the LOTUS site for each season. Below 200 m there is little seasonal influence, but the mesoscale effect of a variable eddy field is visible especially in the main thermocline.

2. Profiling Current Meter (PCM)

The M.I.T.-Draper Labs Profiling Current Meter (PCM) is a programmable moored upper ocean current and density profiler capable of making over 1000 repeated profiles from 20-200 m depth along the upper section of a barely subsurface mooring; Dr. Charles Eriksen (now at Scripps) is the Principal Investigator for the PCM. The PCM is free to move along the guideline portion of its mooring by adjusting its buoyancy using a computer controlled electric oil pump/swim bladder assembly. As the instrument ascends, it measures current with a spherical 2-axis electromagnetic current probe, temperature with a thermistor, electrical conductivity with an inductive cell, and pressure with a strain gauge. Samples are accumulated at 1 Hz and averaged into pre-programmed depth bins, typically 5 m thick. Magnetic field and tilt information are used to vector-average horizontal current data. The instrument maintains a rise rate of 10-15 cm/s during ascents so that profiles can be repeated as often as 1 hour. Battery and tape recorder storage provide the principal limitations to the duration of the PCM deployments. The instrument is not from Woods Hole and the data are not presented here.

3. Engineering Data

The VACM pressure sensors on the subsurface moorings provide useful engineering data: during low current periods they confirm the nominally calculated depths of instruments, and during high current periods they help relate the currents to mooring tilt-over.

Surface mooring 787 (LOTUS 5) had, at the base of the discus buoy's rigid bridle, a tensiometer that telemetered data to the ARGOS system. This tensiometer stopped working after approximately two months, so there is no tension data available between June and November 1983. The LOTUS 6 surface mooring was deployed in January 1984 with a tensiometer at 267 meters, as well as the telemetering tensiometer at the base of the rigid bridle. Both instruments functioned until final recovery of LOTUS in May 1984.

LOTUS CTD STATIONS - YEAR 2

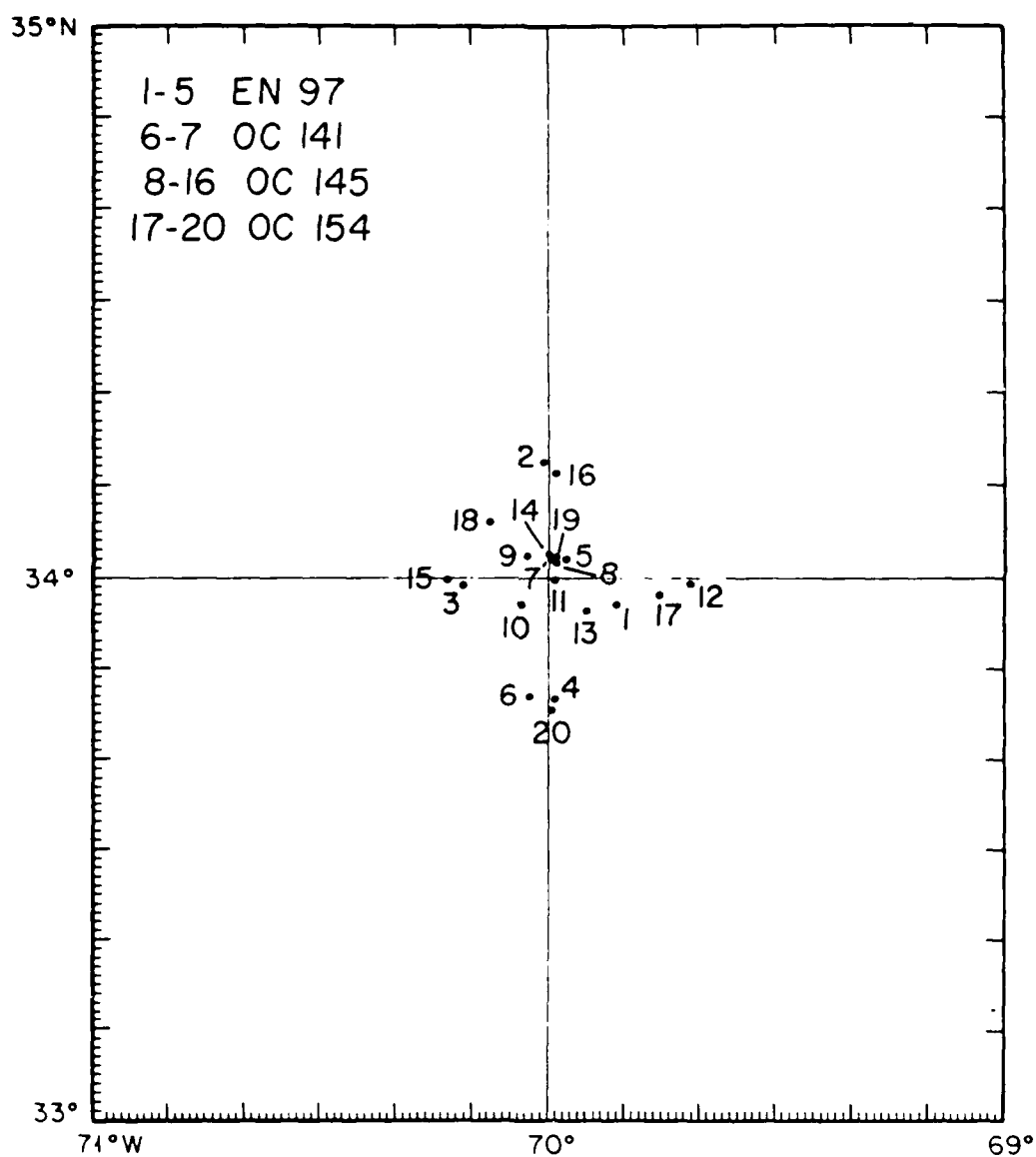


Figure 5. Locations of CTD stations in the LOTUS area taken during the second year of LOTUS.

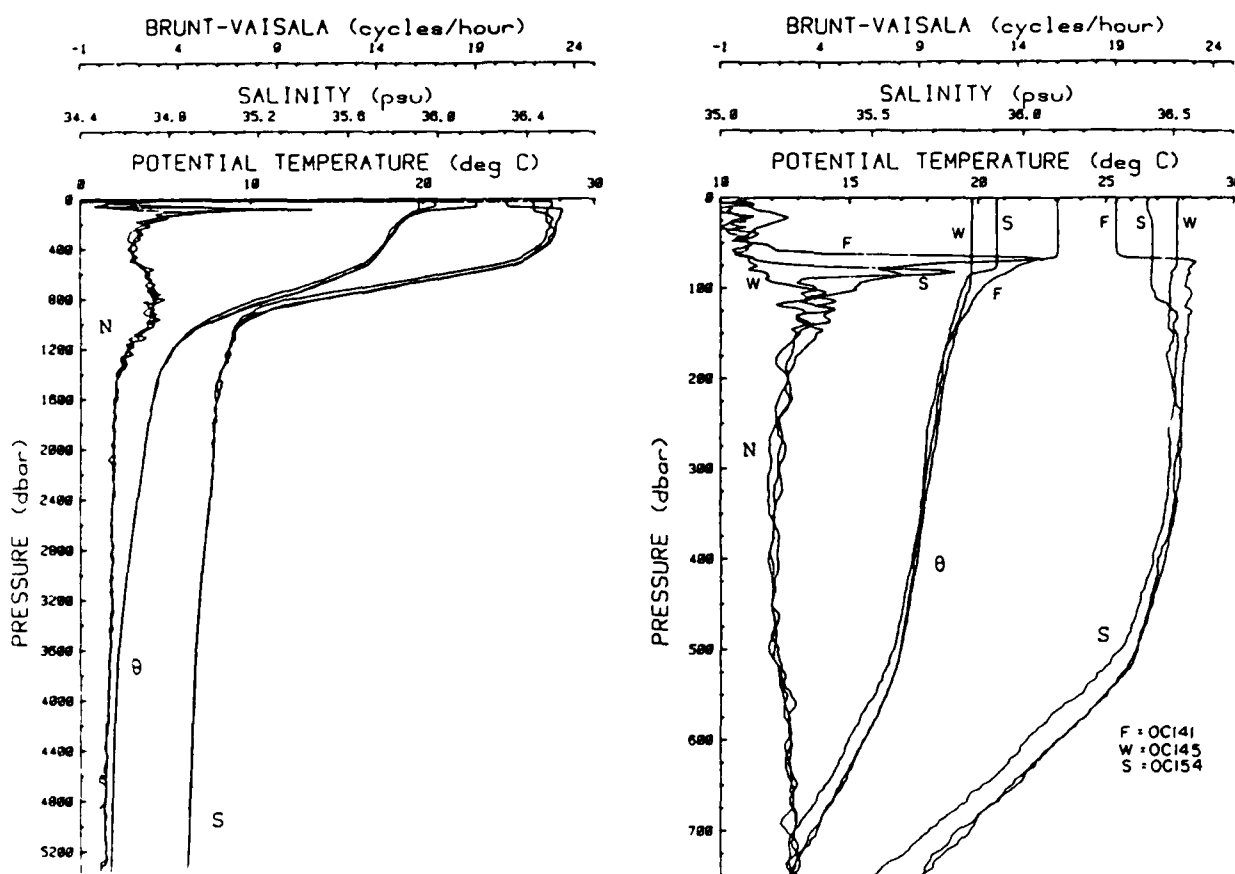


Figure 6. a) Complete CTD profiles from the LOTUS area.
b) Blowup of upper 750 m.

D. Data Quality

Figure 7 shows all the data considered good that were returned from the two years of LOTUS. Bar graphs are for current meter data, meteorological data and Aanderaa thermistor chain data. Table 4 lists problems encountered causing instruments to have less than 100 percent data return.

E. Data Processing

Time series are identified by a three digit mooring number, a sequential instrument position number, a letter to indicate the data version, and a number to indicate the time sampling interval of that data set. Sequential position numbers, if preceded by an "S", indicate that the instrument was set on the surface buoy. 787S1E1DG24 is the first instrument set on the surface flotation of mooring 787. It has been edited to the Eth version and was sampled at one point per day from a Gaussian filter having a half width of 24 hours. Similarly, 7892C450 is the second instrument on mooring 789. It has been processed to the Cth version and is sampled every 450 seconds (or 7 1/2 minutes).

Data from cassettes were transcribed onto 9-track magnetic tapes, converted to scientific units, and edited to remove launch and retrieval transients and erroneous data values. All the directional values have been converted from the Magnetic North coordinate system to True North.

Low passed versions of the data series were formed by passing the data through a Gaussian filter with a 24 hour half-width, then subsampling the resultant series once a day. The unfiltered series all start at noon, therefore the filtered series also present noon data points.

F. Data Presentation

Following the text, composite plots summarizing the second year's data are presented. Current meter temperatures, current meter speeds, and progressive vector diagrams of the current meter data are shown.

The data are broken into three groups. The meteorological data are presented first; time series, histograms and spectra for the VAWRs (Vector Averaging Wind Recorders) are shown. The second group of data is the current meter data for the two second-year surface moorings. The third group is the

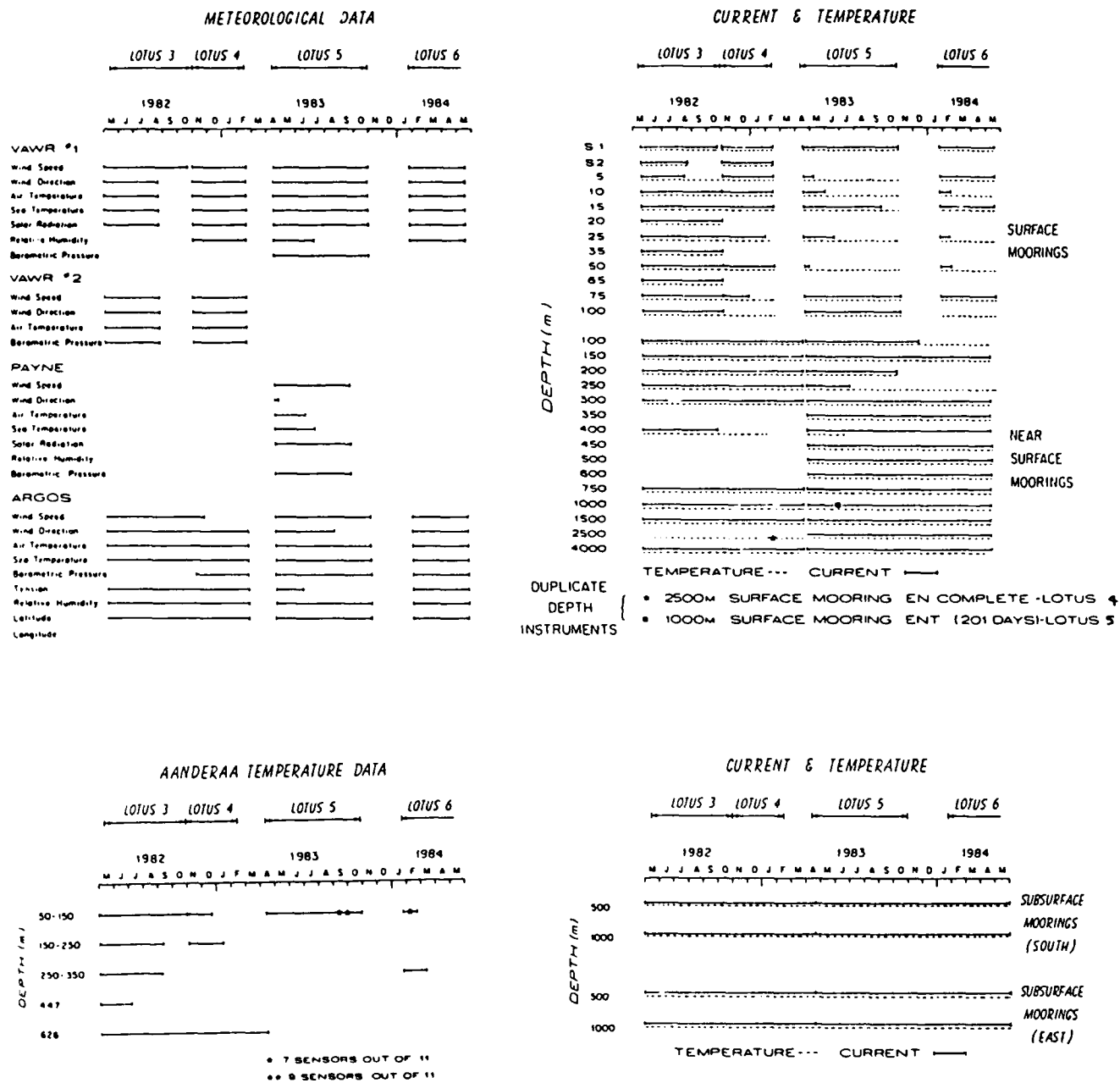


Figure 7. Bar charts showing data return for the first and second years of LOTUS.

TABLE 4

Post-recovery comments on instruments and data

Data name	type of instru	depth	samp rate	data days	problem

Surface mooring			34 00.79N	70 03.61W	April 13 1983 to Oct 30 1983
- - - - -					
787S1	V-141WR	-3	450	200	East and North components derived from scalar speed and the unaveraged bearing.
7873	VM-016	5	225	T(200) V(20)	
7874	VM-017	10	225	T(200) V(41)	
7875	V-5110	15	225	T(200) V(165)	
7876	VM-014	25	225	T(200) V(62)	
7877	VM-008	50	225	T(200) V(7)	
7878	VM-009	75	225	200	
7879	VM-012	100	225	200	
78713	VM-028	1000	225	200	

Subsurface mooring			33 58.55N	70 00.36W	Apr 15 1983 to May 01 1984
- - - - -					
7881	V-588	98	450	T(383) V(233)	Rotor slowly went bad about Dec 6.
7882	V-112P	148	450	382	Tape crinkled at end Broken rotor pivot. Part of Lithium battery 2 year test. Differential temp died July 15th. Ran out of tape at sea. Temperature and differential temperature problems: water leaked into thermistor pad. Broken rotor pivot. 1 week of no speeds in Dec. Ran out of tape at sea. Ran out of tape at sea.
7883	V-185dt	198	450	175	
7884	V-109P	248	450	V(88) TP(396)	
7885	V-201dt	298	450	VT(382) dt(89)	
7886	V-107	348	450	381	
7887	V-120dt	398	450	V(382) T(74) dt(236)	
7888	V-5108	448	450	386	
7889	V-435P	498	450	382	
78810	V-5101	598	450	383	
78811	V-127dt	748	450	381	
78812	V-537	598	450	380	
78813	V-119	598	450	381	
78814	V-117	598	450	385	
78815	V-380	598	450	380	

Data name	type of instru	depth	samp rate	data days	problem

Subsurface mooring		33	58.67N	69 45.45W	Apr 16 1983 to May 01 1984

7891	V-107P	498	450	377	Ran out of tape at sea.
7892	V-5104	998	450	381	
Subsurface mooring		33	46.74N	69 59.76W	Apr 17 1983 to May 01 1984

7902	V-115P	509	450	286	Crinkled tape at end.
7903	V-5102	1009	450	380	
Surface mooring		34	02.10N	69 59.55W	Jan 26 1984 to May 19 1984

792S1	V-177WR	-3	225	114	Upper rotor died.
7922	VM-012	5	225	114	
7923	VM-022	10	225	V(14) T(144)	
7924	V-590P	15	225	114	Lower rotor died.
7925	VM-025	25	225	V(15) T(114)	
7926	VM-042	50	225	V(9) T(114)	Upper rotor died 4 hours after Lower.
7928	VM-044	76	225	114	Temperature & conductivity questionable. Severely bent sting, 1 broken blade.
7929	VM-039	101	225	114	
79210	V-598C	152	225	114	
79214	VM-040	530	225	114	

m = VMCM
 a = VACM
 D = DT-VACM

data from the near surface moorings and two subsurface moorings, which are presented by depth. All the time series are followed by the histograms, then by the spectra in each group. The statistics for all the instruments are presented at the end of the data section.

The following is a brief description of the different plots.

Progressive Vector Diagrams

Current vectors from the filtered time series are placed tail-to-head so as to show the path that a particle in a perfectly homogeneous flow would have traveled. The plots for each time series begin with an asterisk and are annotated monthly. Moorings 787 and 792 were set consecutively, so the progressive vector diagrams representing data from mooring 792 are shown on the same page as plots from mooring 787. In those cases where there is a time separation of greater than a few days the positioning of the following Provec is arbitrary but subjectively reasonable.

Variables vs. Time Plots

Individual variables and the stick plots are plotted against time from one day Gaussian filtered time series.

The plots have been done to the same scales to facilitate comparisons. In the case of the deepest temperature measurements, the temperature has been plotted on two scales, first the general scale then at a scale selected for that data set, which shows details. Pressures have been plotted against a negative decibar scale to invert the trace to facilitate comparisons with temperature and speed.

The plots for time series from consecutive moorings 787 and 792 are combined for appropriate depths.

Histograms

Data are taken from the unfiltered time series. For each class interval the frequency value is a percentage of the total count. For the 'weighted direction' histogram each value is weighted by the corresponding speed value before assigning to a class interval. All histograms have 50 class intervals per inch.

The plots have been done to the same scales to facilitate comparisons. In the case of the deepest temperature measurements, the temperature has been

plotted on two scales, the general scale as indicated below, then at a scale selected for the individual data set, which shows details.

Spectral Plots

Table 5, in the Spectra section of this report, shows the exact number of cycles per piece and number of pieces used to create the spectra. Generally speaking the 225 second sampled current meters have a piece length of 32000 points. All LOTUS 6 instruments had 1 piece used, and LOTUS 5 was evenly split between 1 and 2 piece spectra. The year long subsurface and intermediate current meters have four 16000 point pieces. NOTE: No preprocessing (e.g., prewhitening or windowing) has been done to any spectra, so these plotted results should not be used for any detailed scientific analyses.

Statistics

The statistics are created from the unfiltered time series. See Volume XVII (POLYMODE Array II) of this series for a description of the various types of statistical parameters.

The coding in the first column of the statistics tables stand for the following instruments:

- m - VMCM
- v - VACM
- a - VACM with Pressure
- D - VACM with DT

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DATA PRESENTATIONS

COMPOSITES

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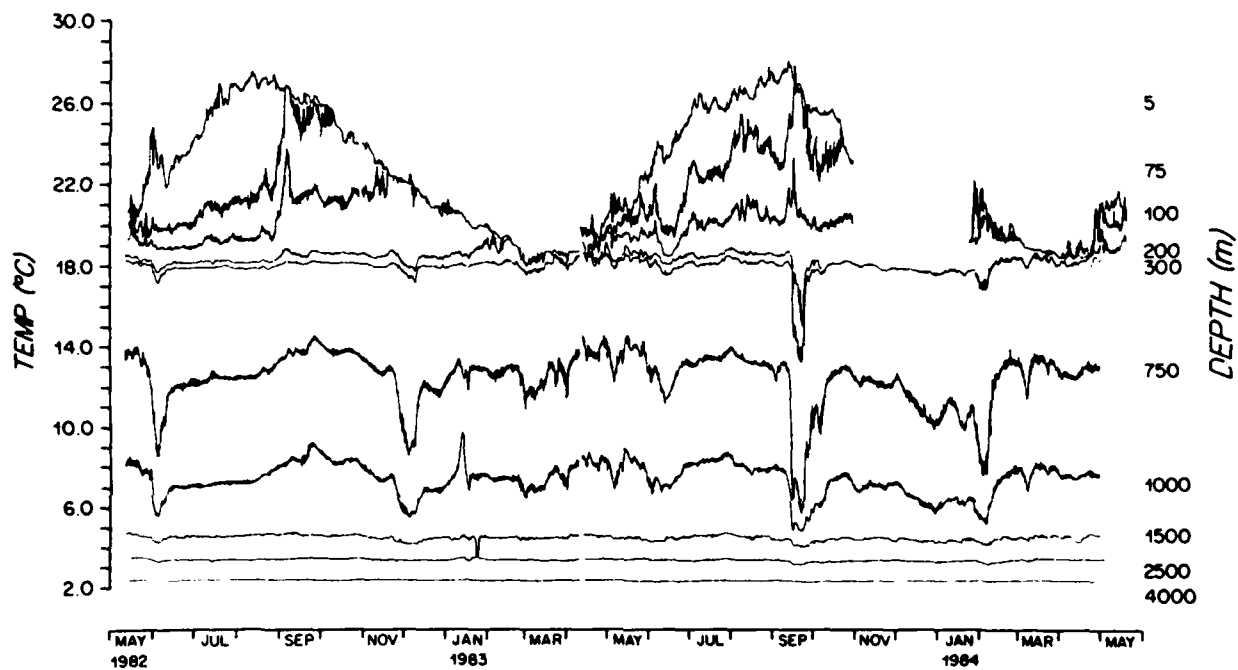


Figure 8. Composite plot of current meter speeds for LOTUS 5 and LOTUS 6.

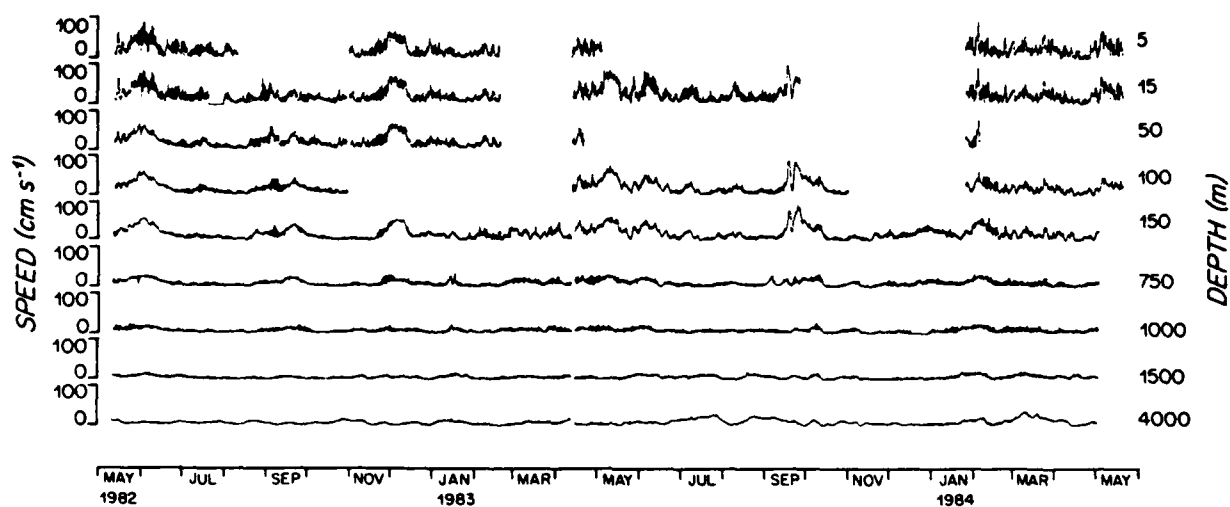
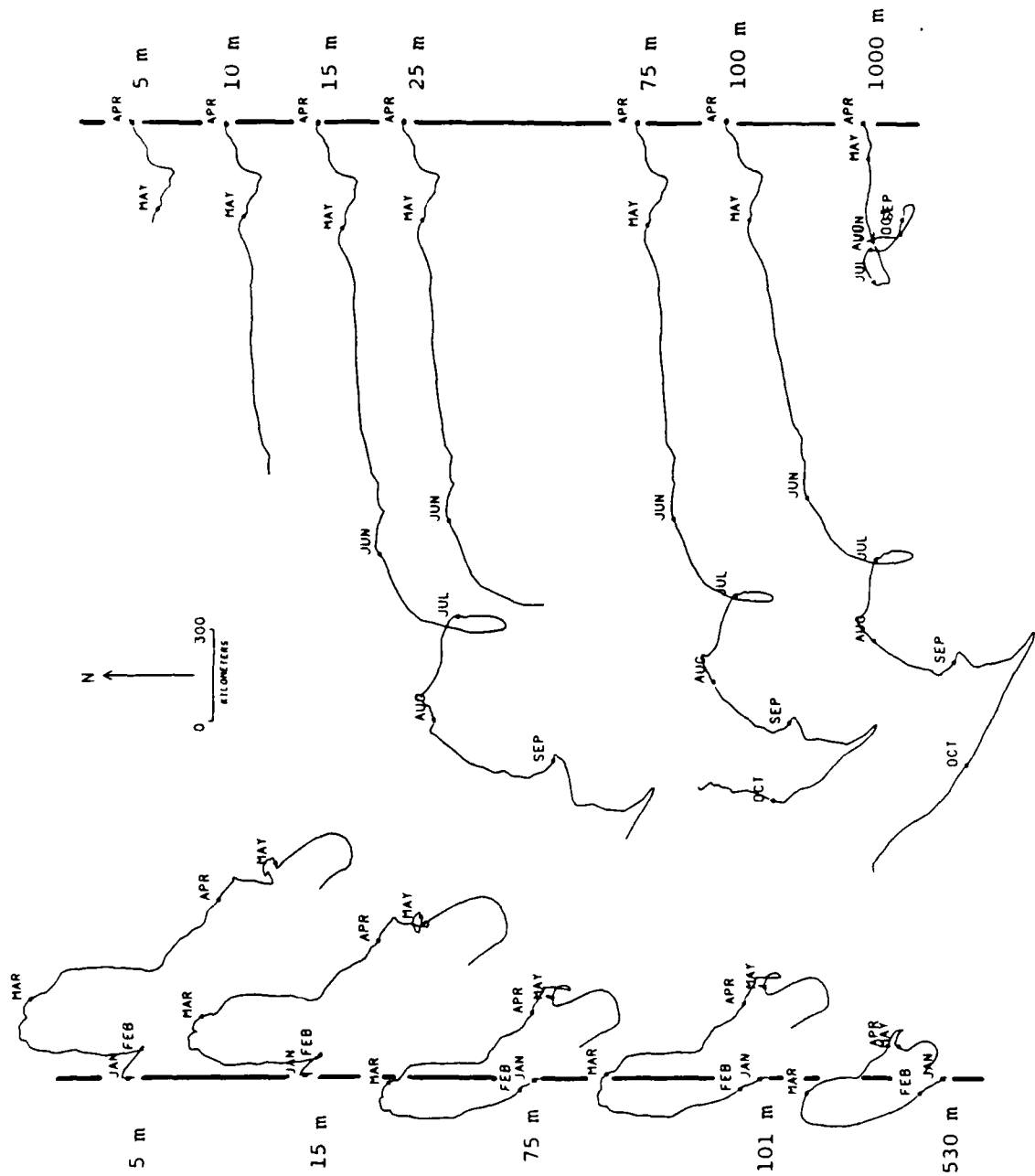


Figure 9. Composite plot of current meter temperatures for LOTUS 5 and LOTUS 6.



787

792

Figure 10. Composite Proveys for the surface mooring 787 and 792 for the second year of LOTUS.

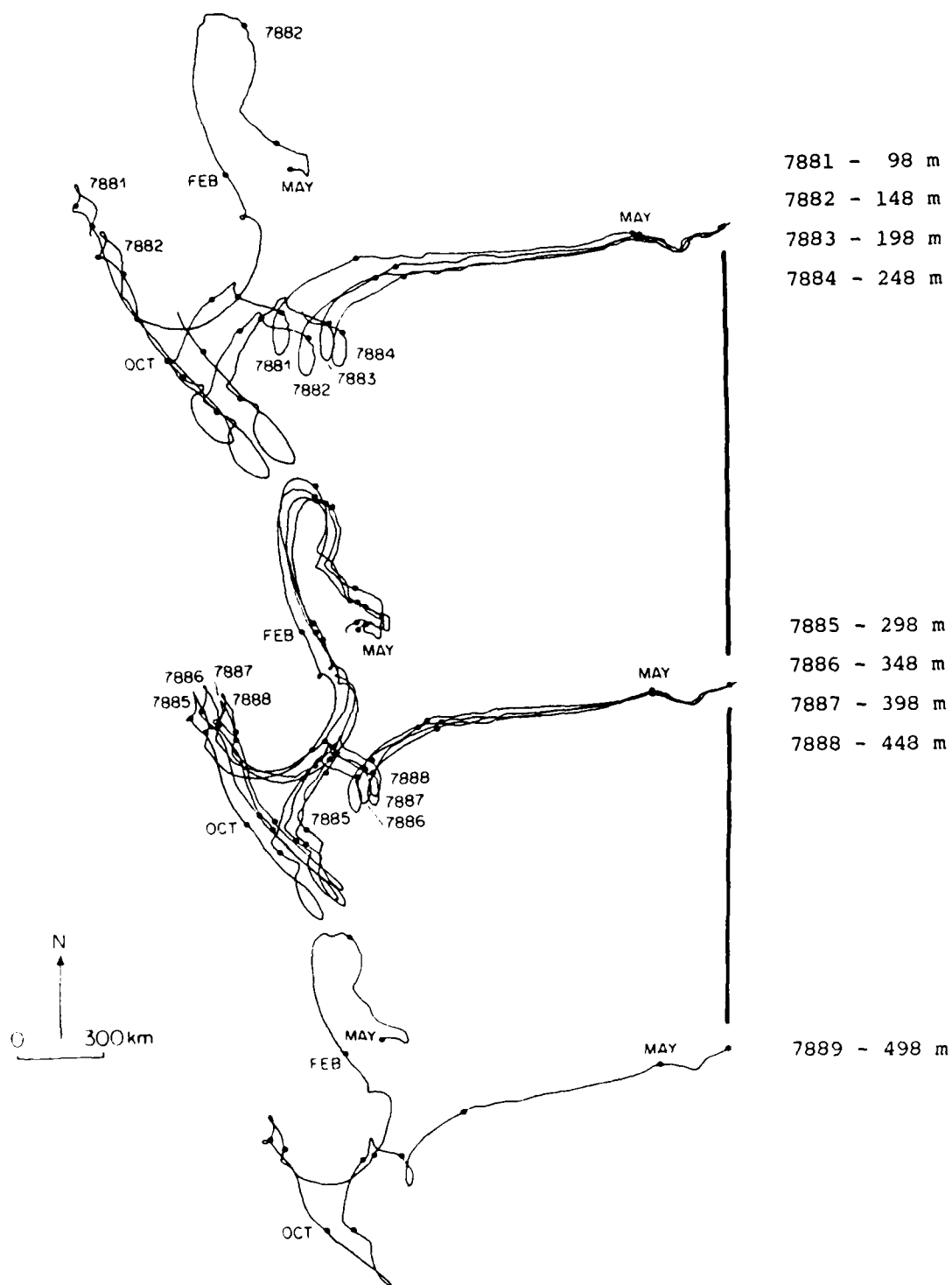


Figure 11a. Composite proves for the year long near-surface mooring 788: instruments shallower than 500 m.

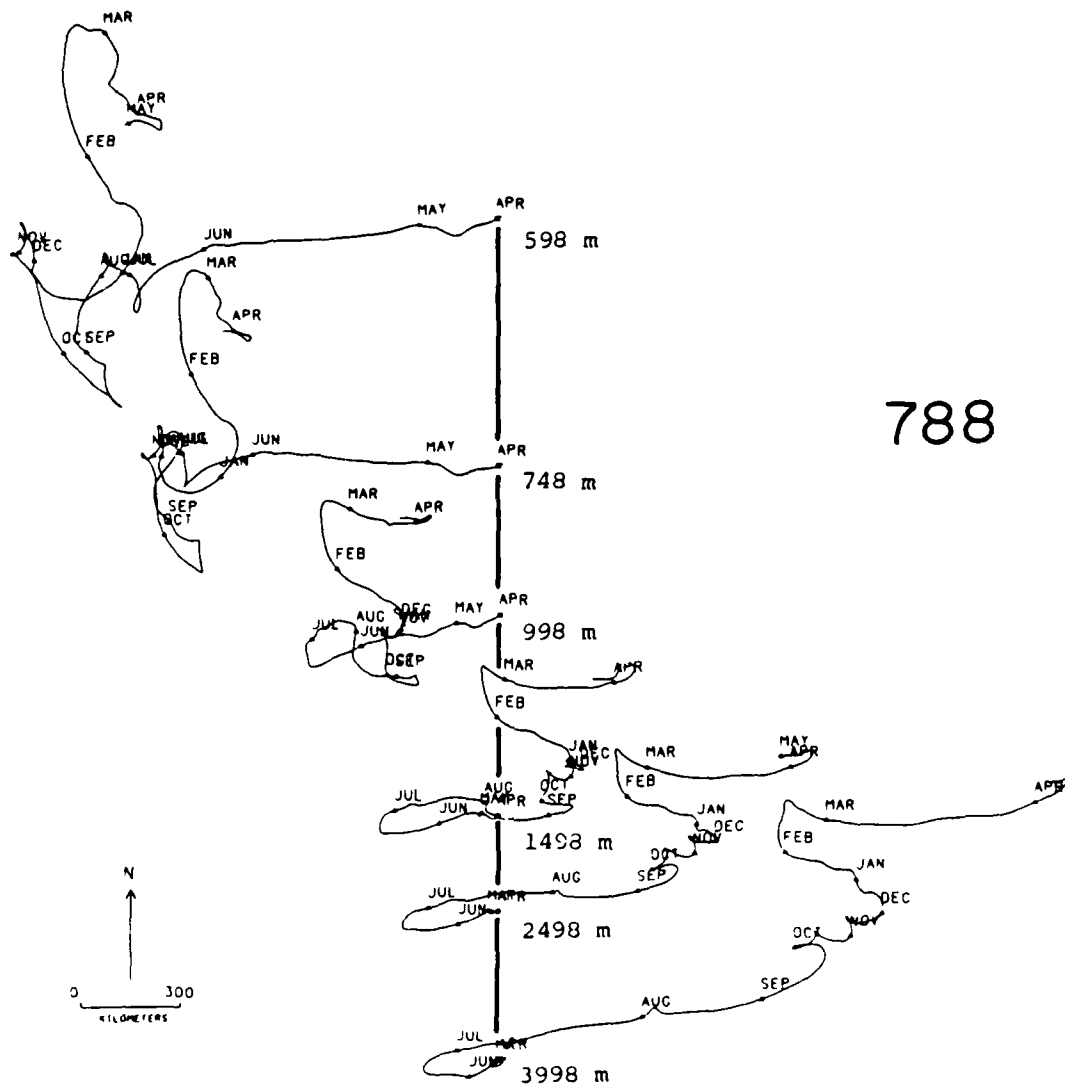


Figure 11b. Composite proves for the year long near-surface mooring 788: instruments deeper than 500 m.

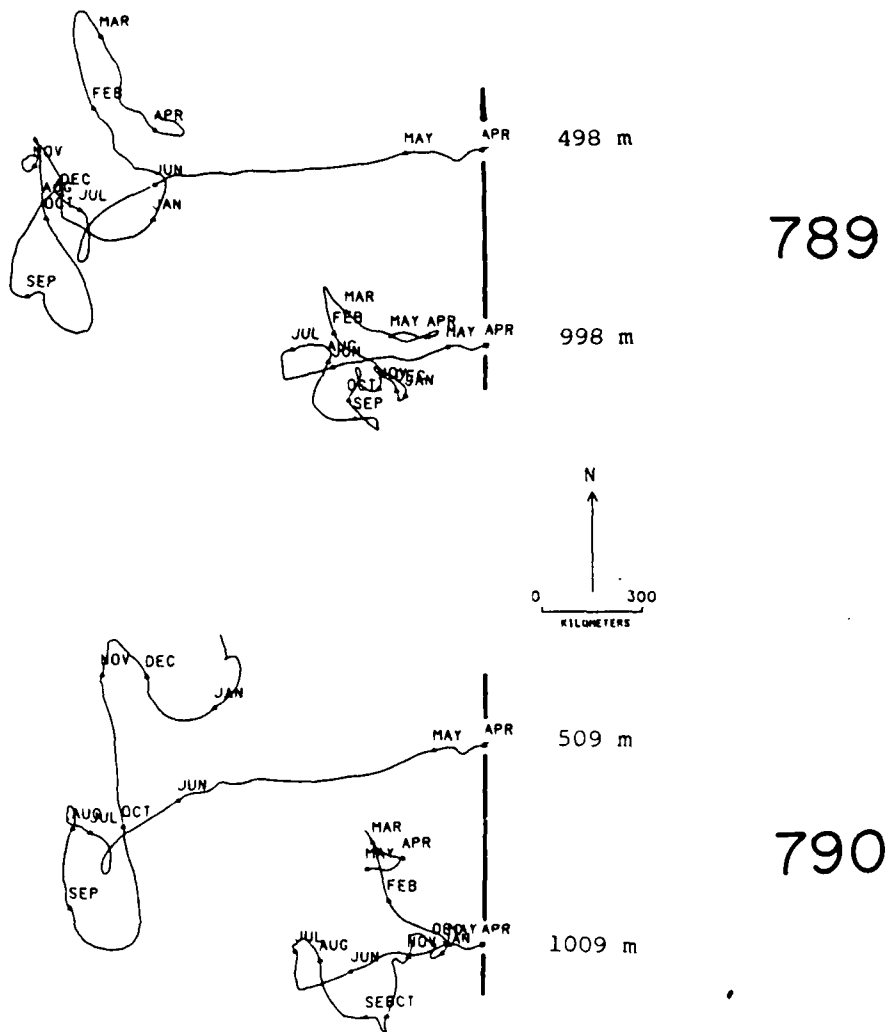


Figure 12. Composite Provecs for year long subsurface moorings 789 and 790.

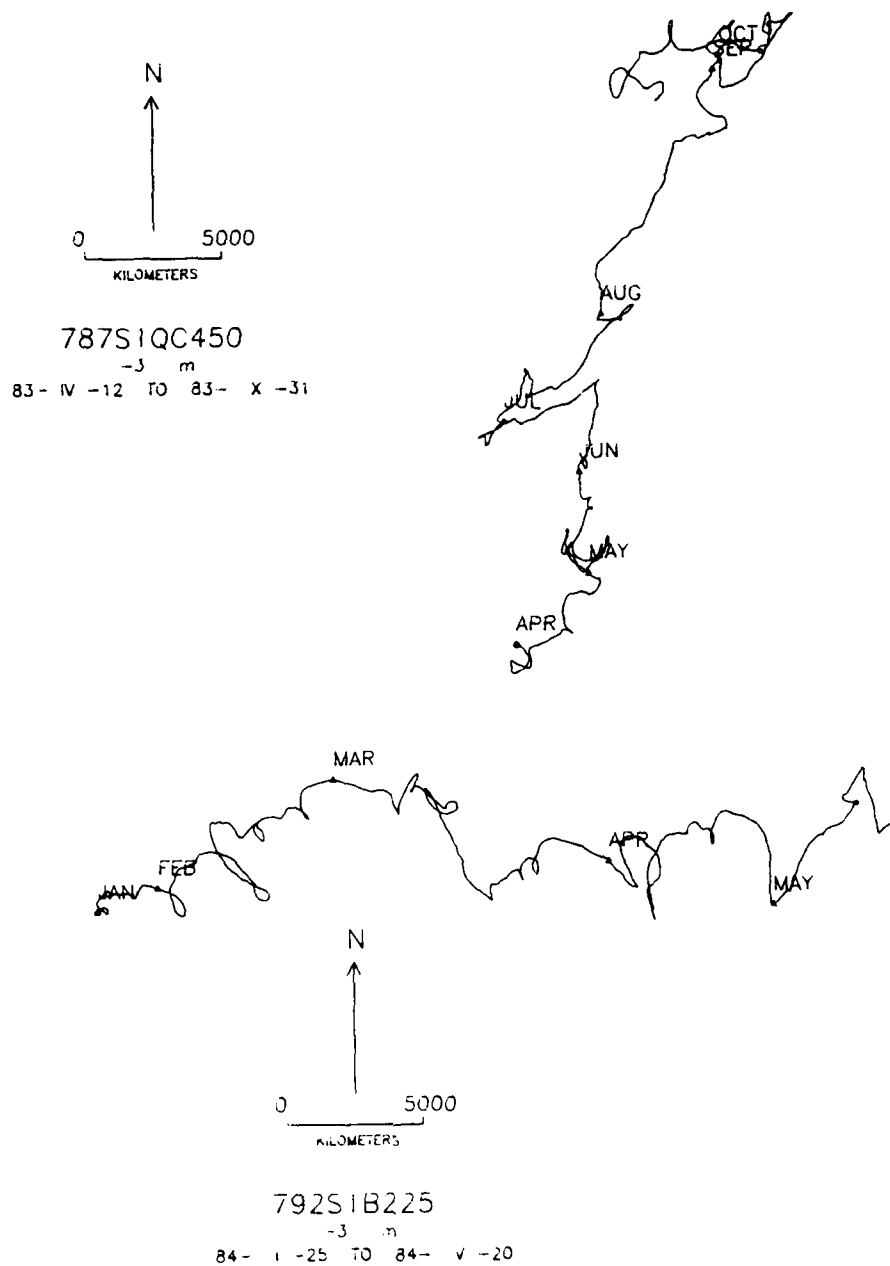
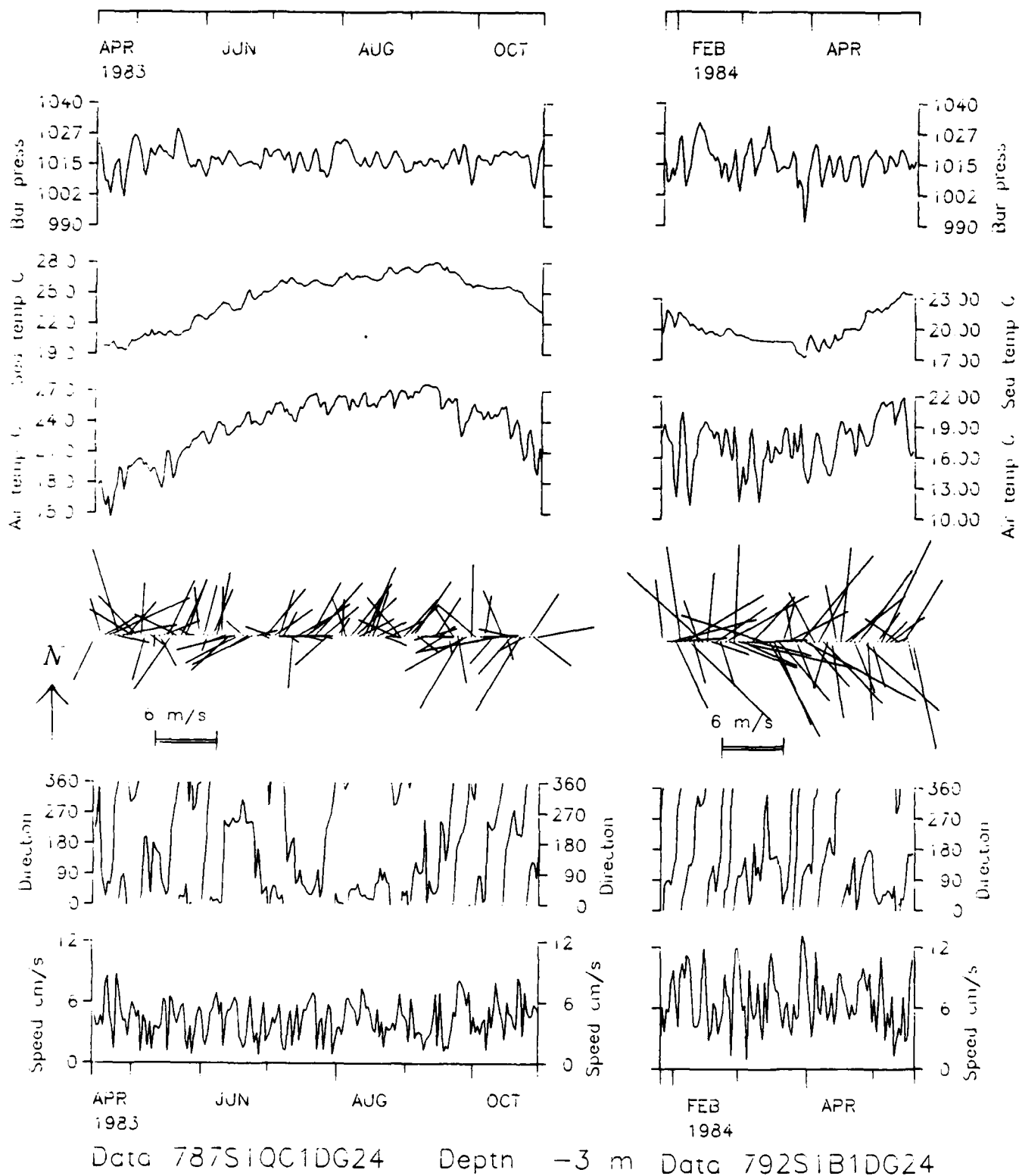


Figure 13. Proveys for the wind sensors on moorings 787 (LOTUS 5) and 792 (LOTUS 6).

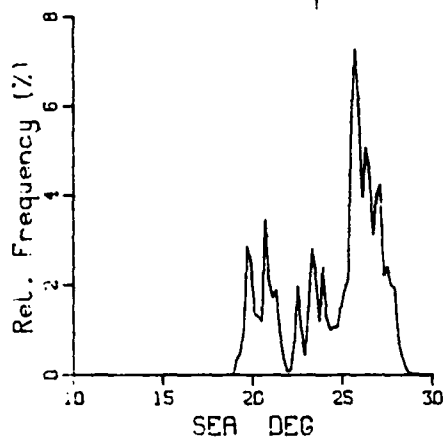
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SURFACE MOORINGS 787 AND 792

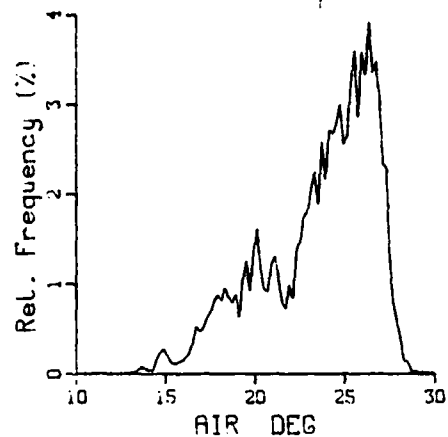
METEOROLOGICAL DATA



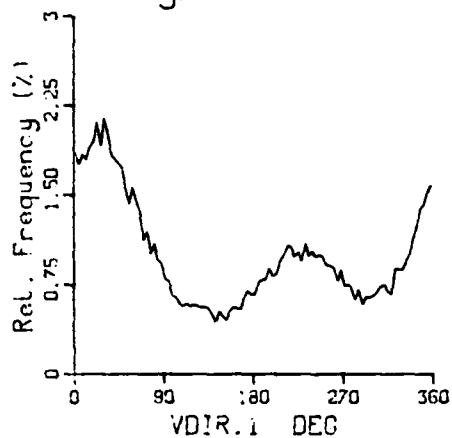
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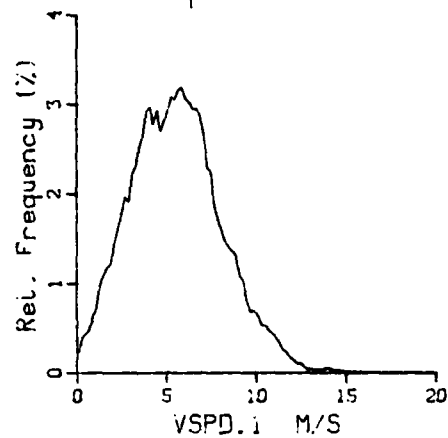
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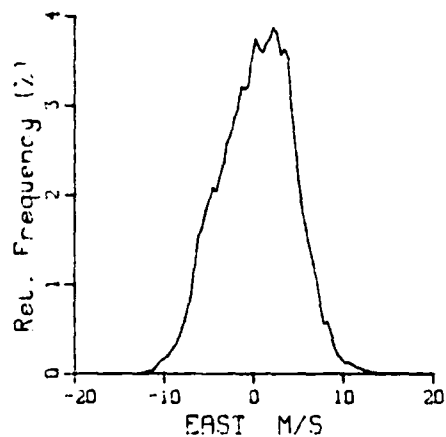
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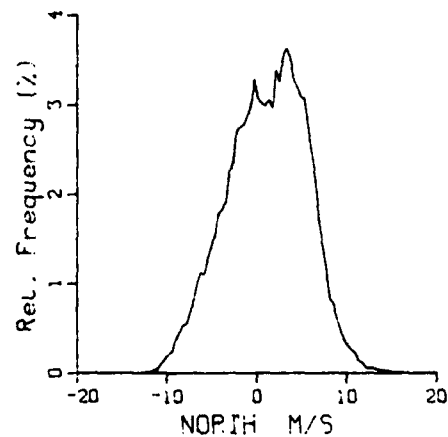
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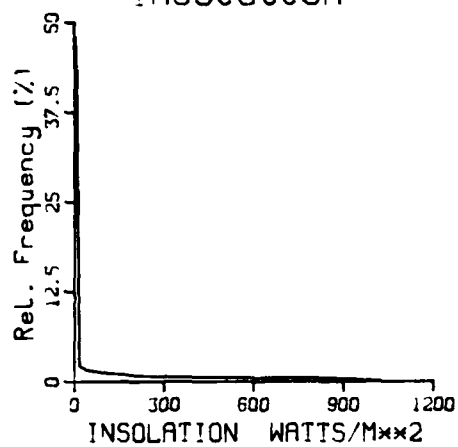


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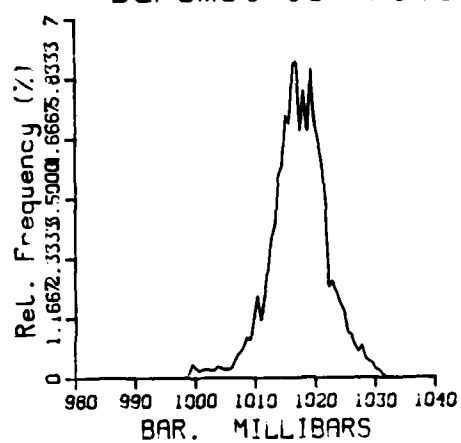


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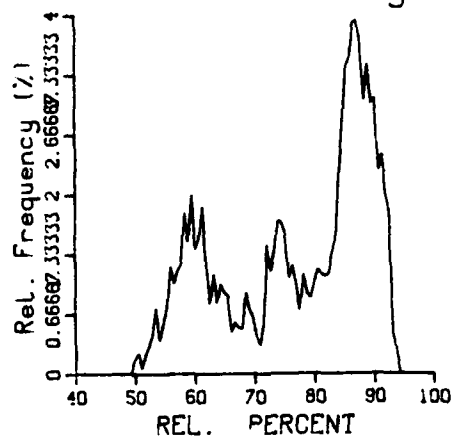
Insolation



Barometric Press

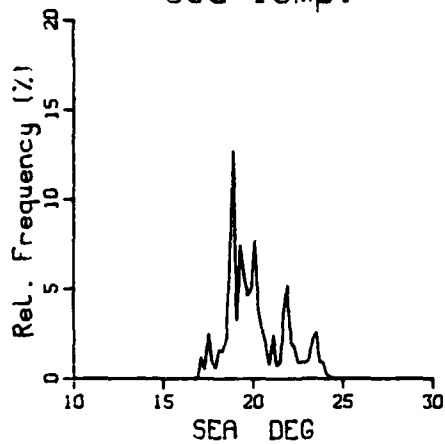


Rel. Humidity

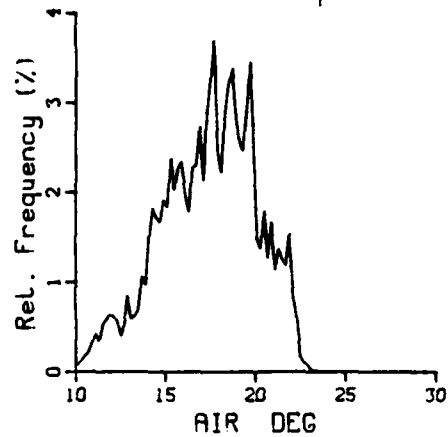


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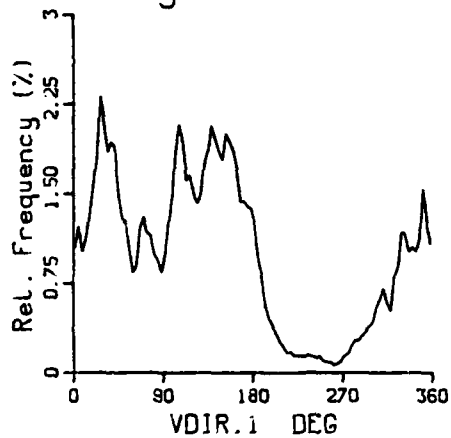
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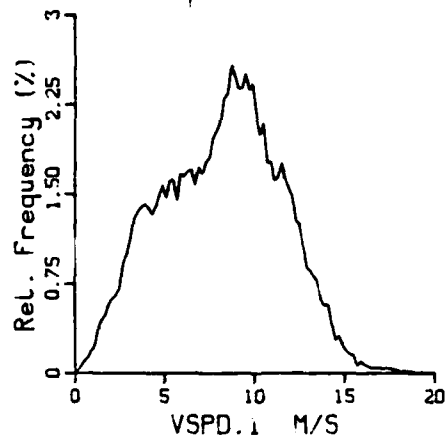
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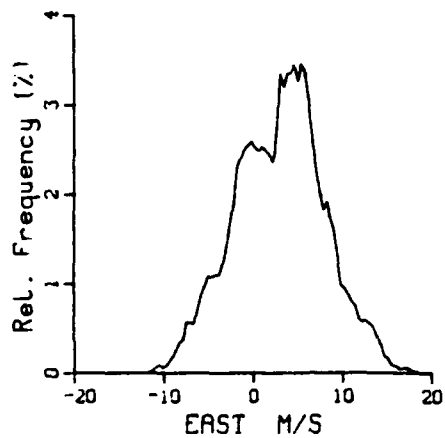
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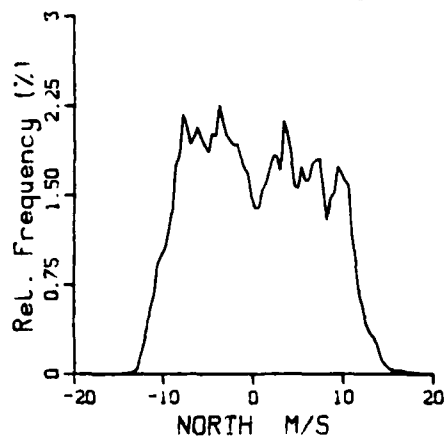
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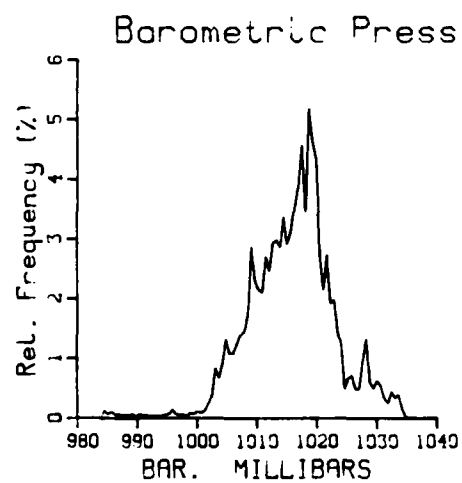
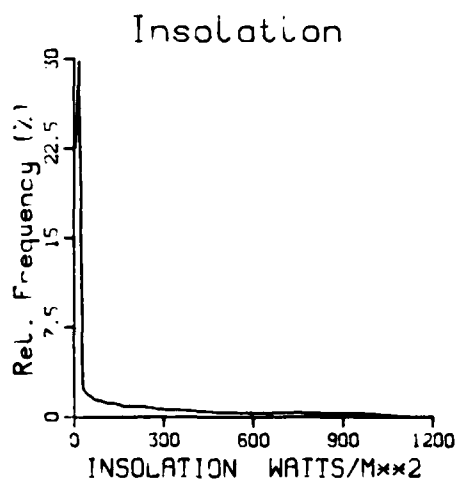
West East



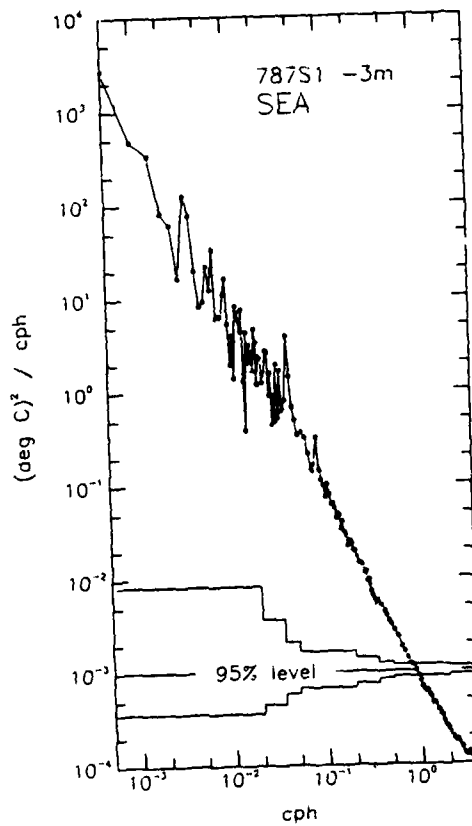
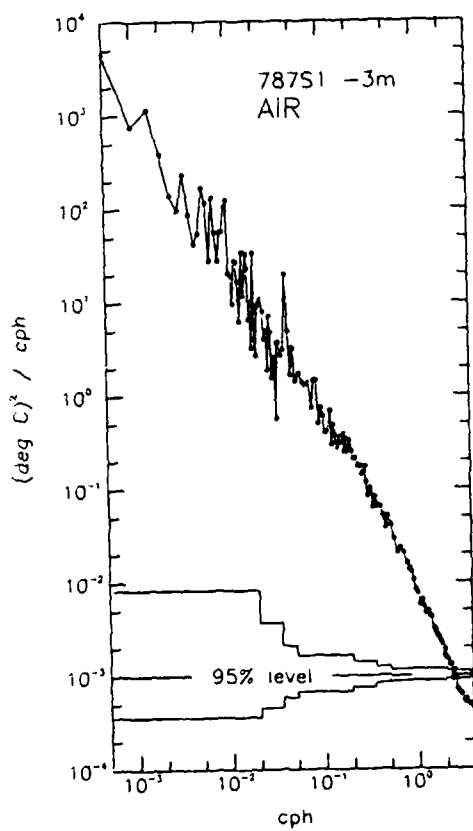
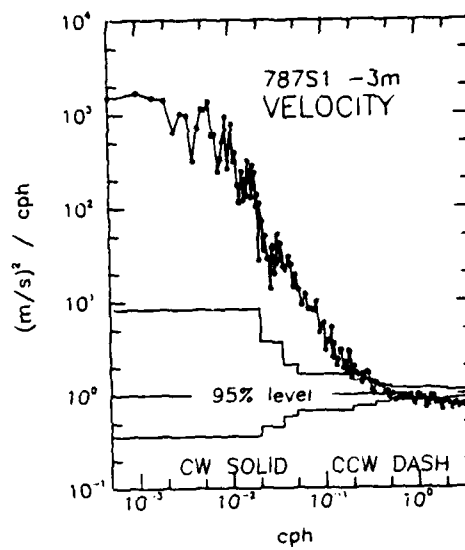
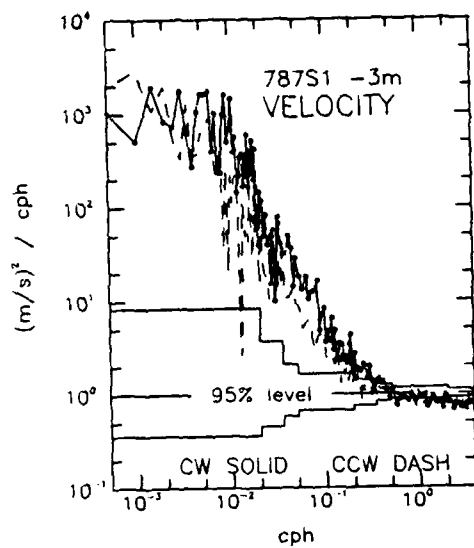
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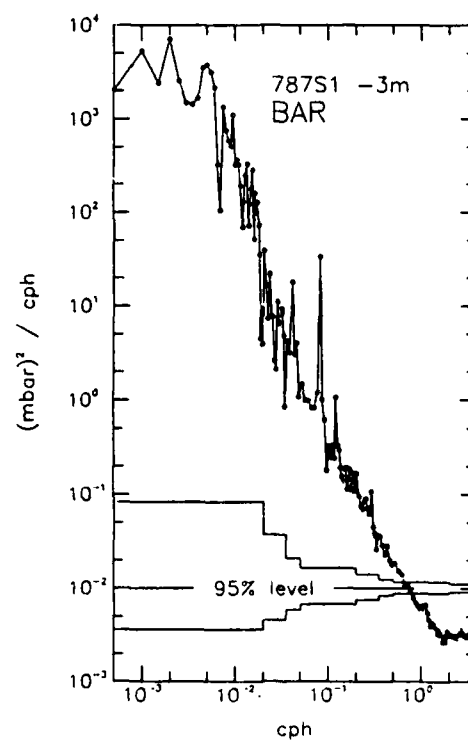
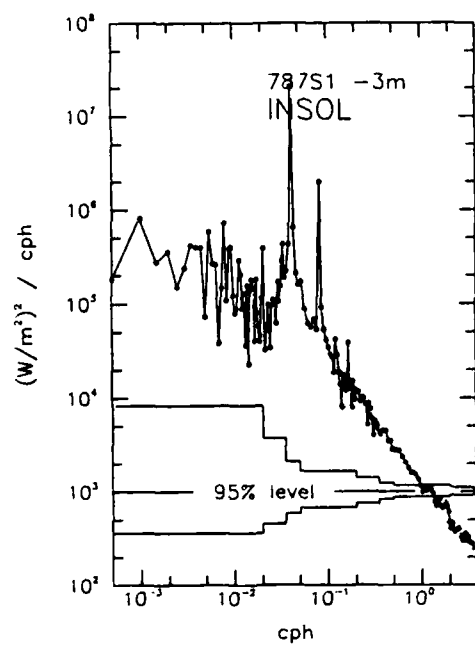
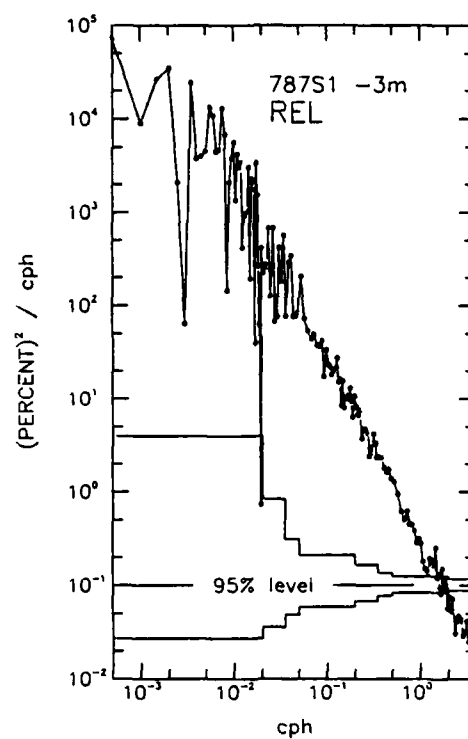


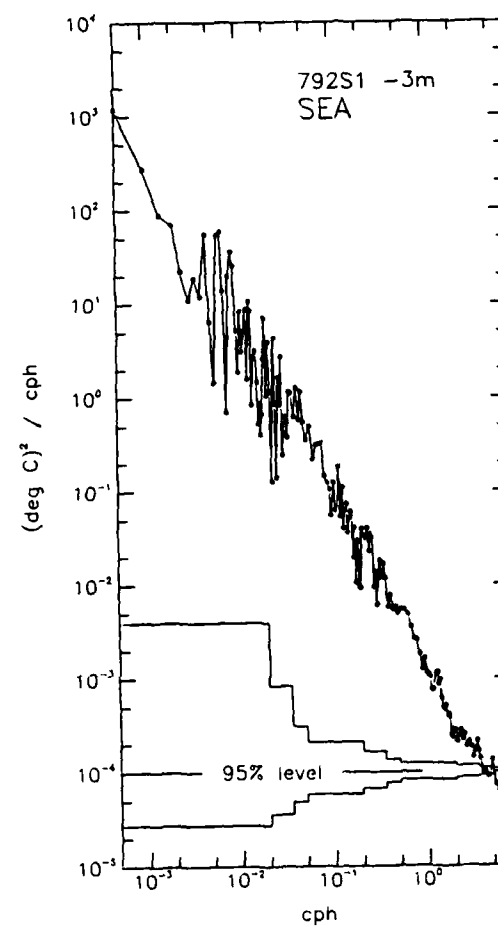
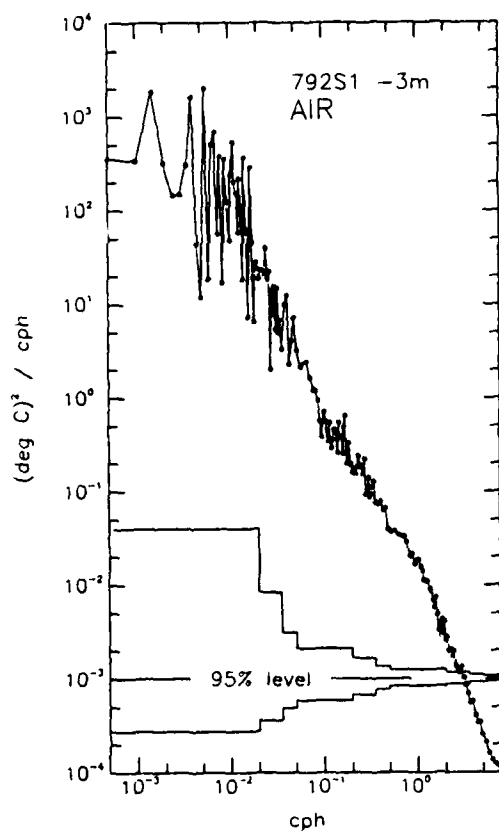
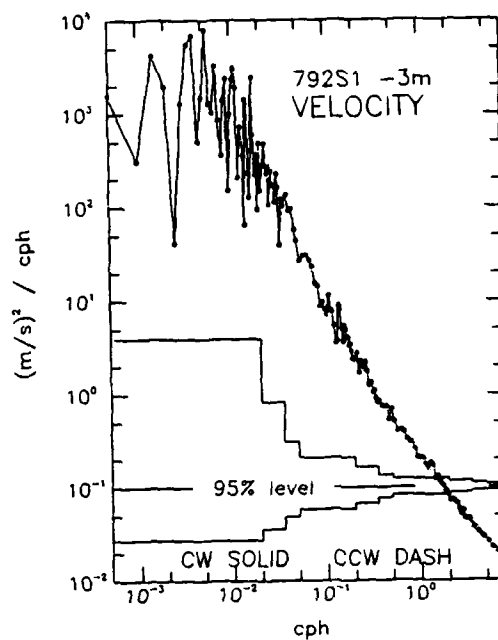
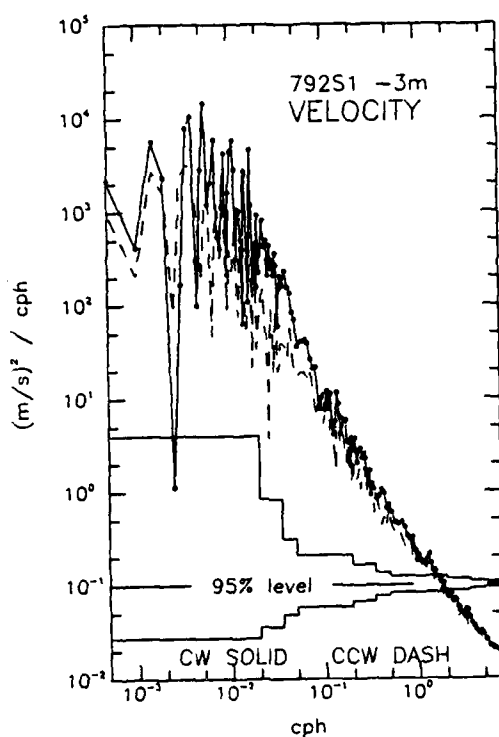
Data File 792S1B225 : Depth = -2m

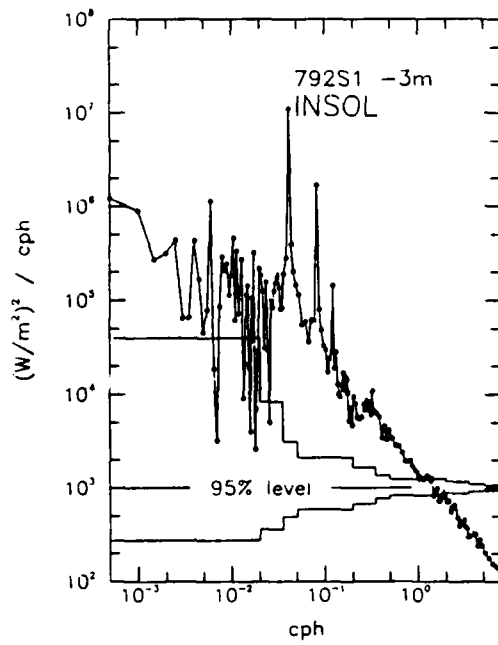


Data File 792S1B225 : Depth = -2m



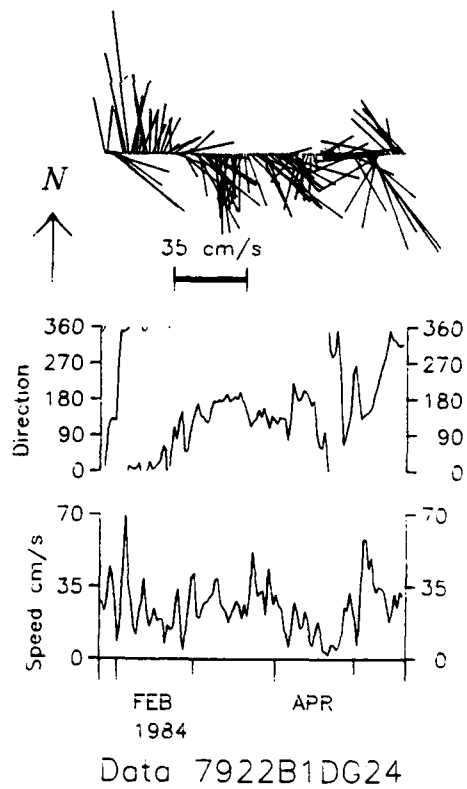
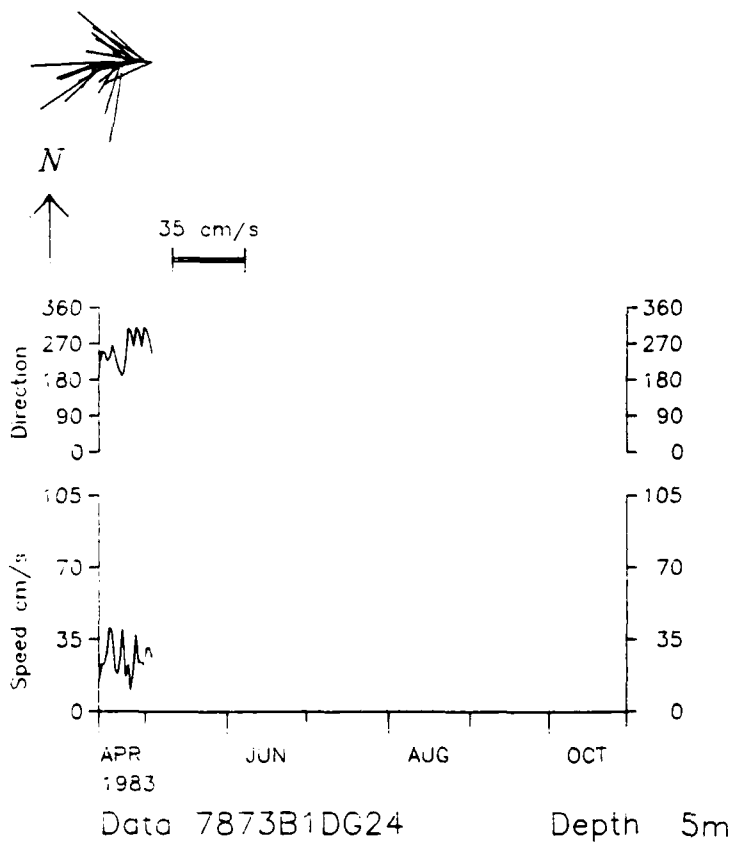
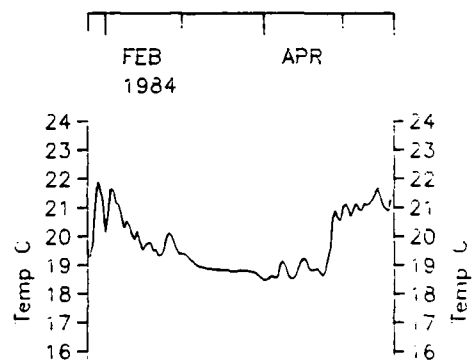
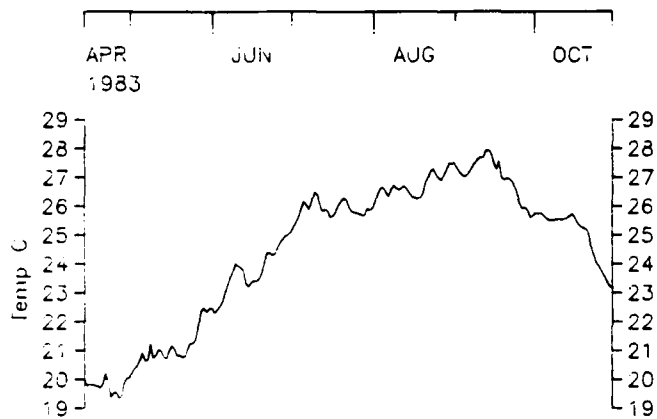


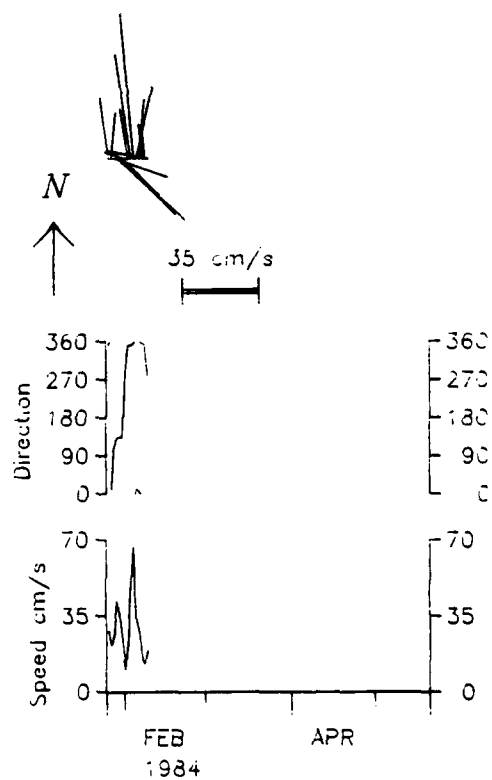
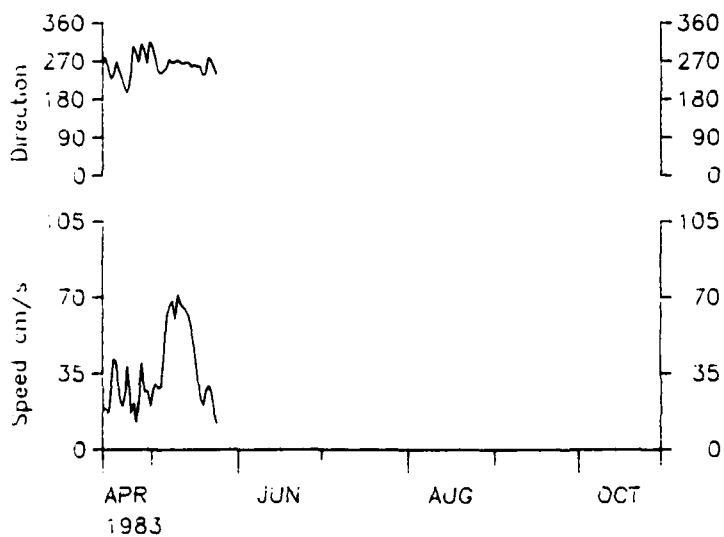
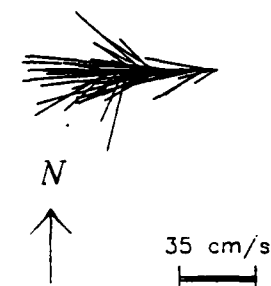
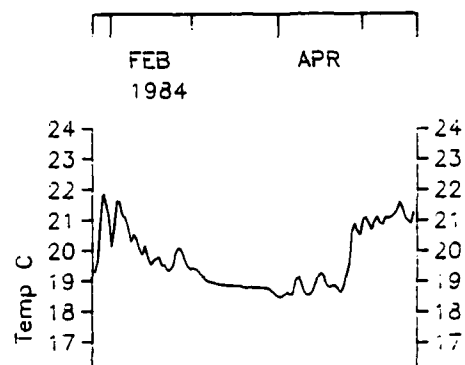
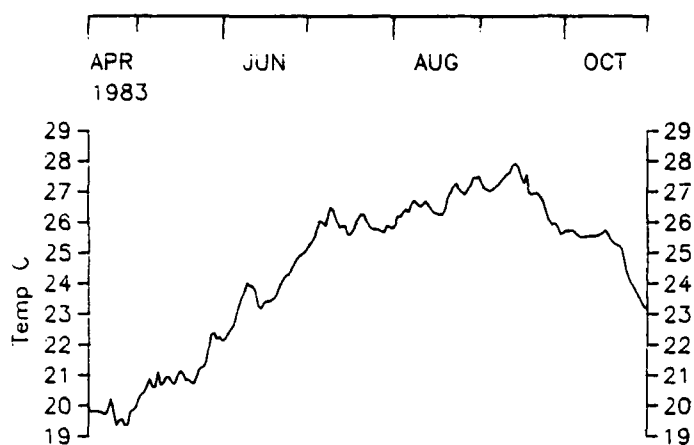




SURFACE MOORINGS 787 AND 792
NEAR-SURFACE MOORING 788
WITH SUBSURFACE MOORINGS 789 AND 790
INCLUDED BY DEPTH.

TIME SERIES

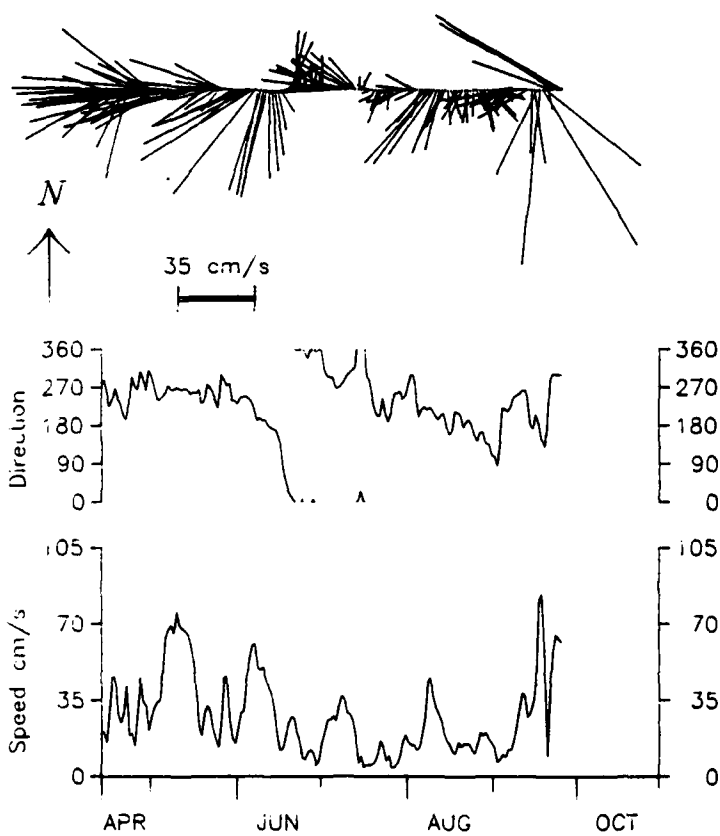
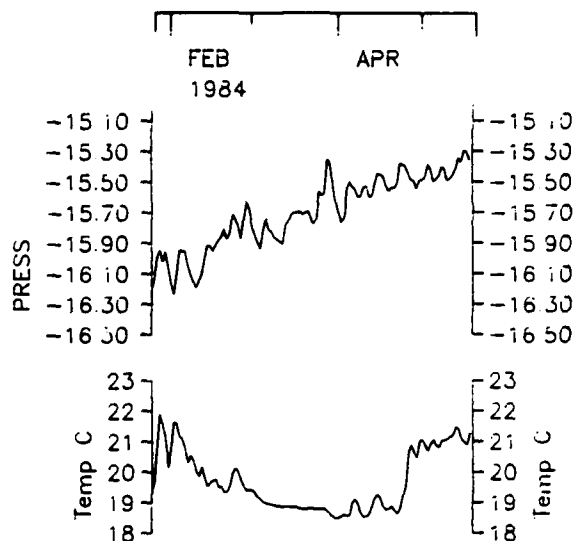
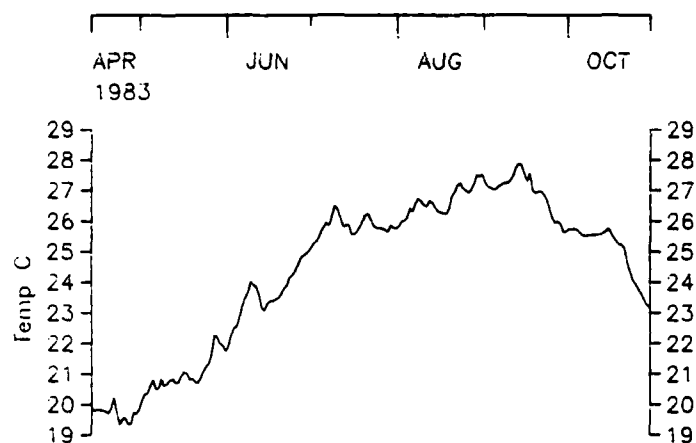




Data 7874B1DG24

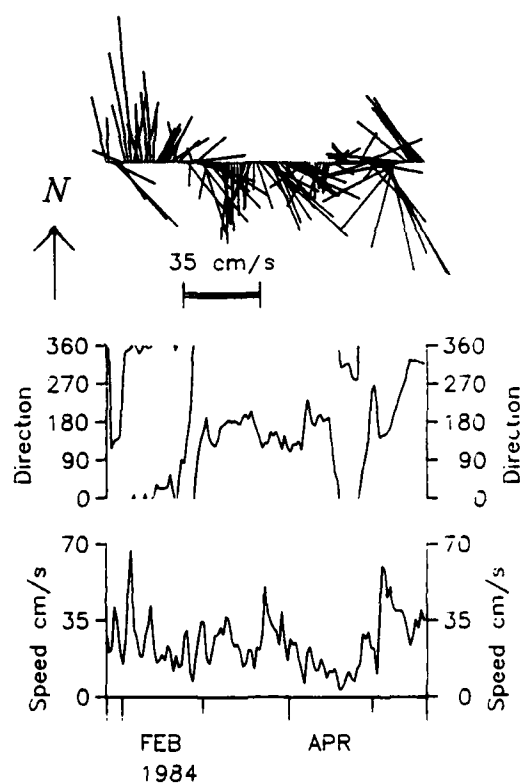
Depth 10m

Data 7923A1DG24

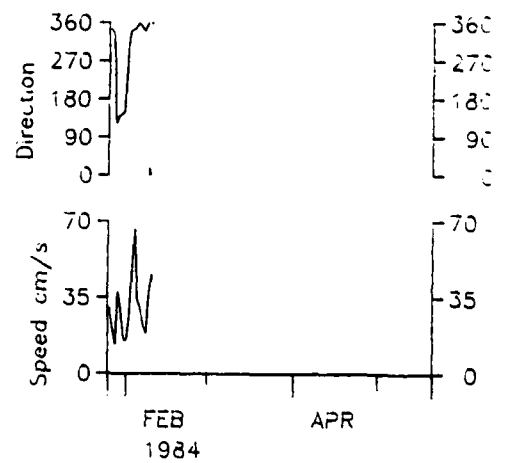
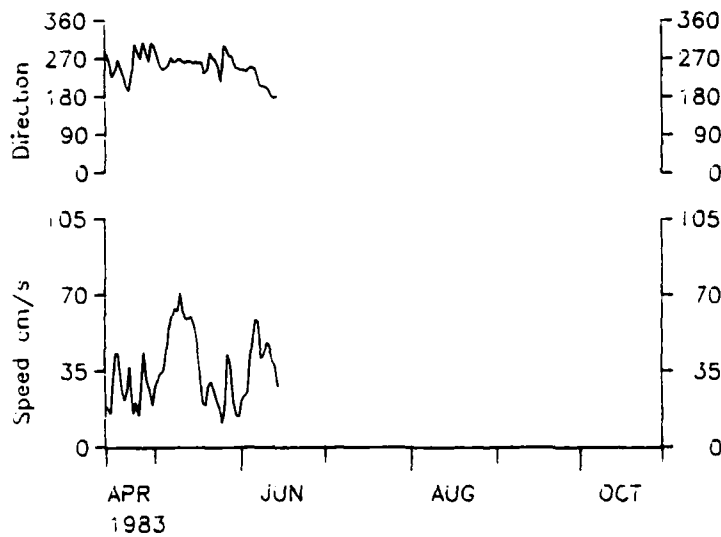
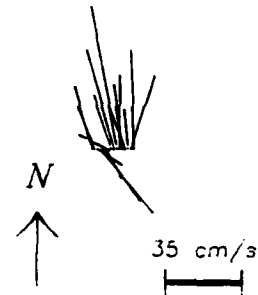
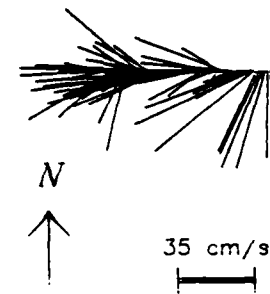
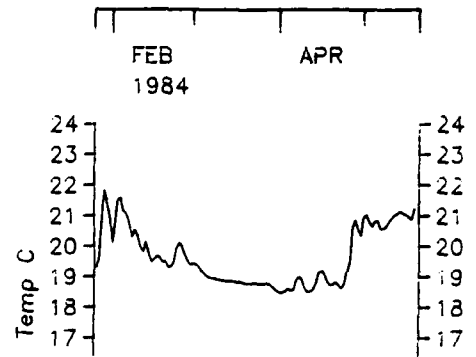
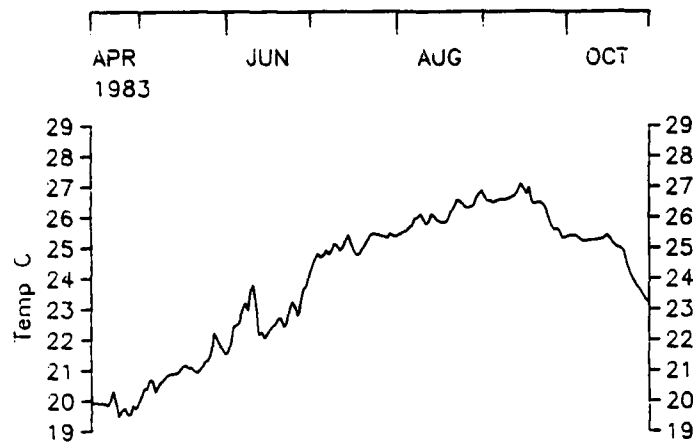


Data 7875B1DG24

Depth 15m



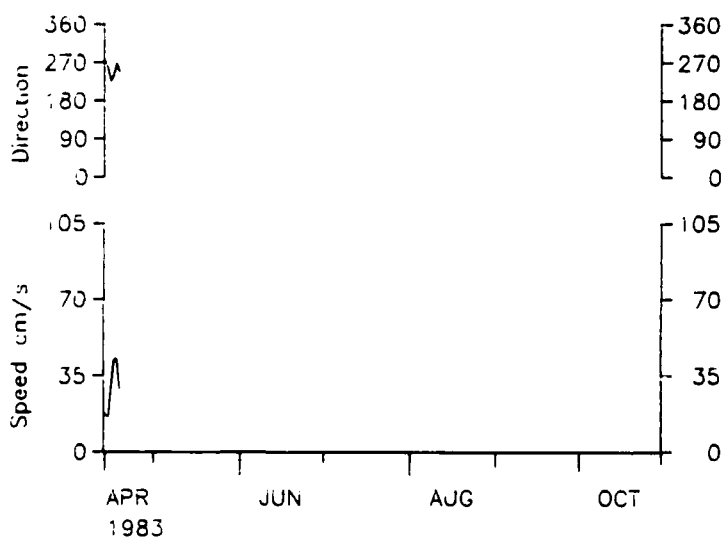
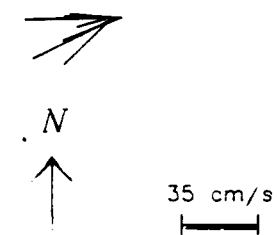
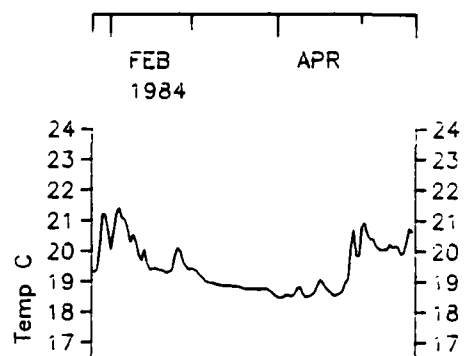
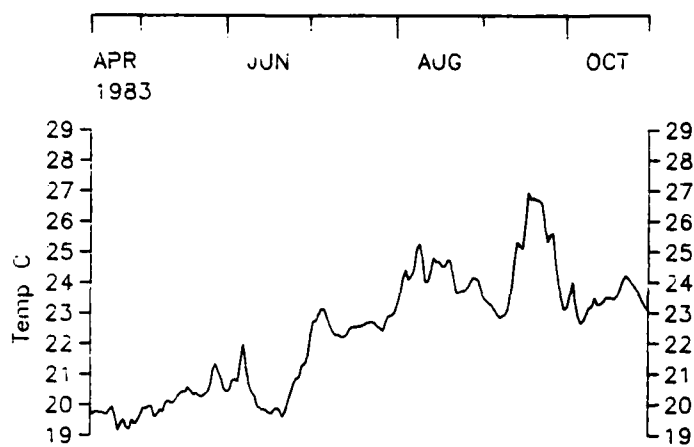
Data 7924B1DG24



Data 7876B1DG24

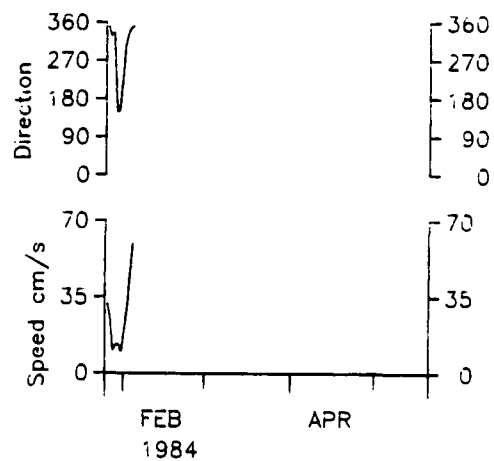
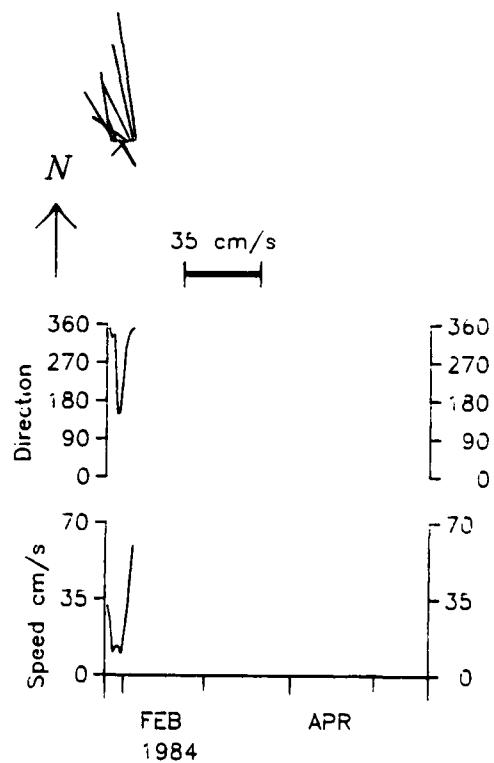
Depth 25m

Data 7925A1DG24

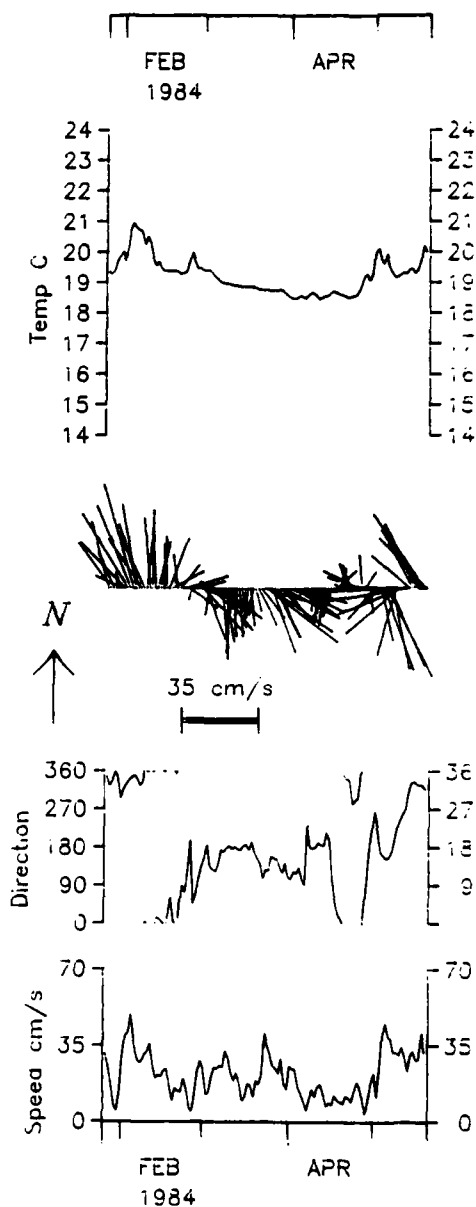
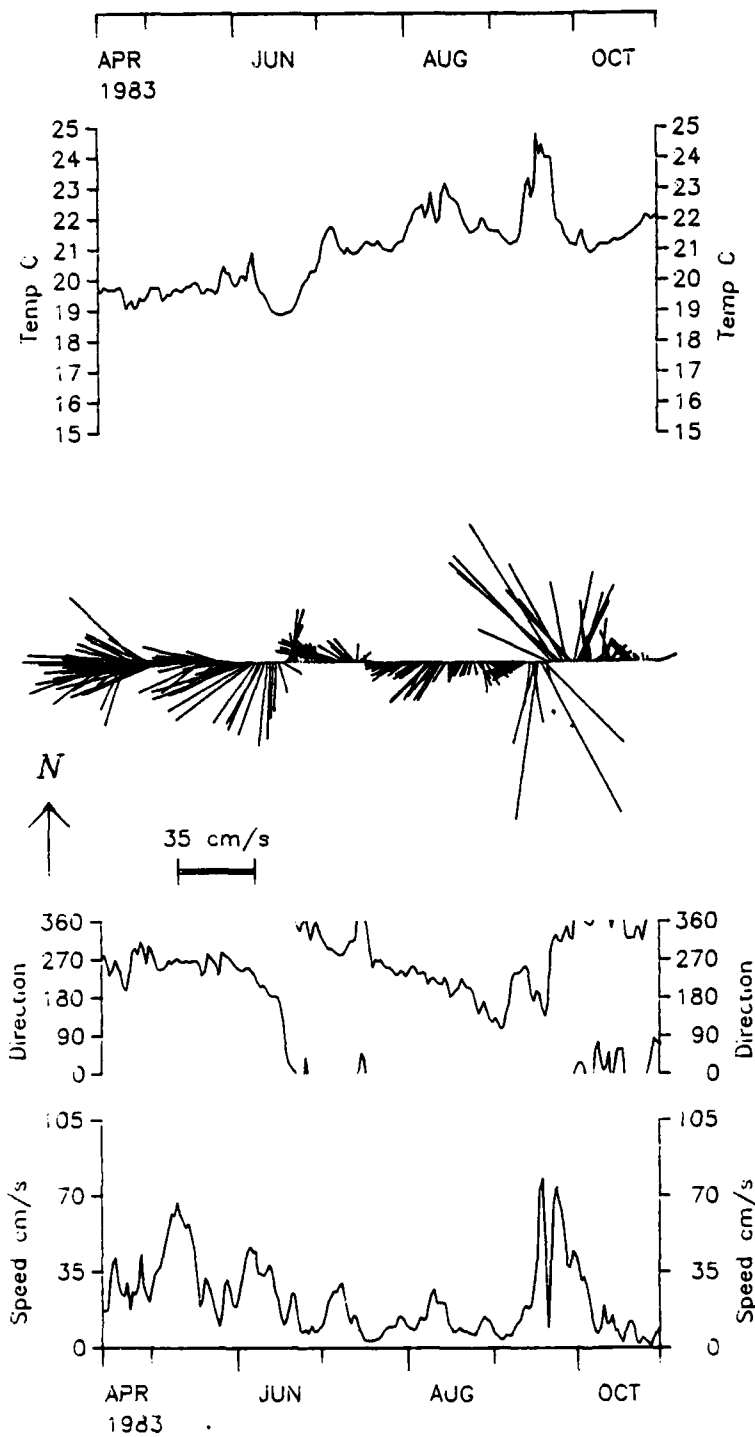


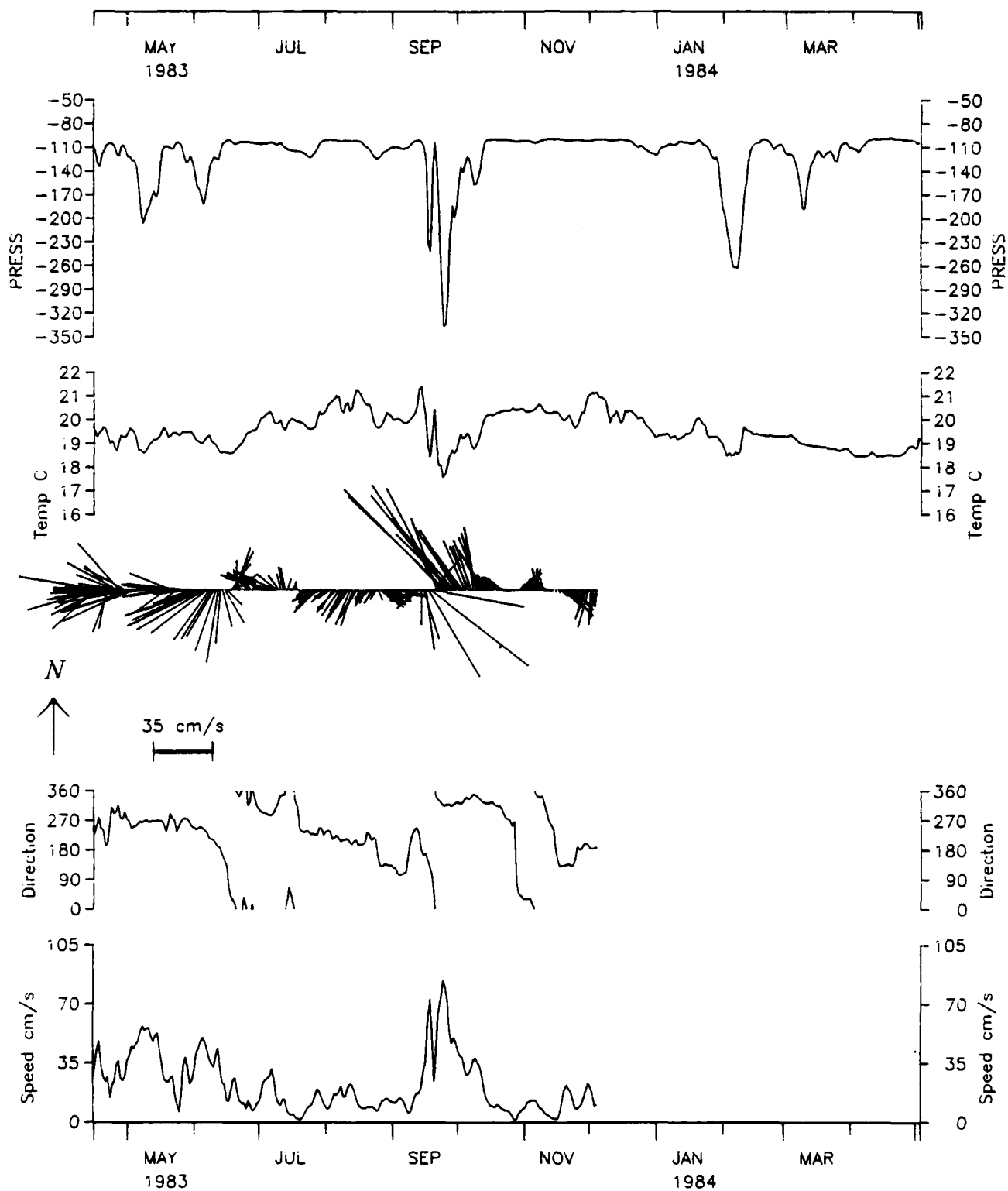
Data 7877B1DG24

Depth 50m



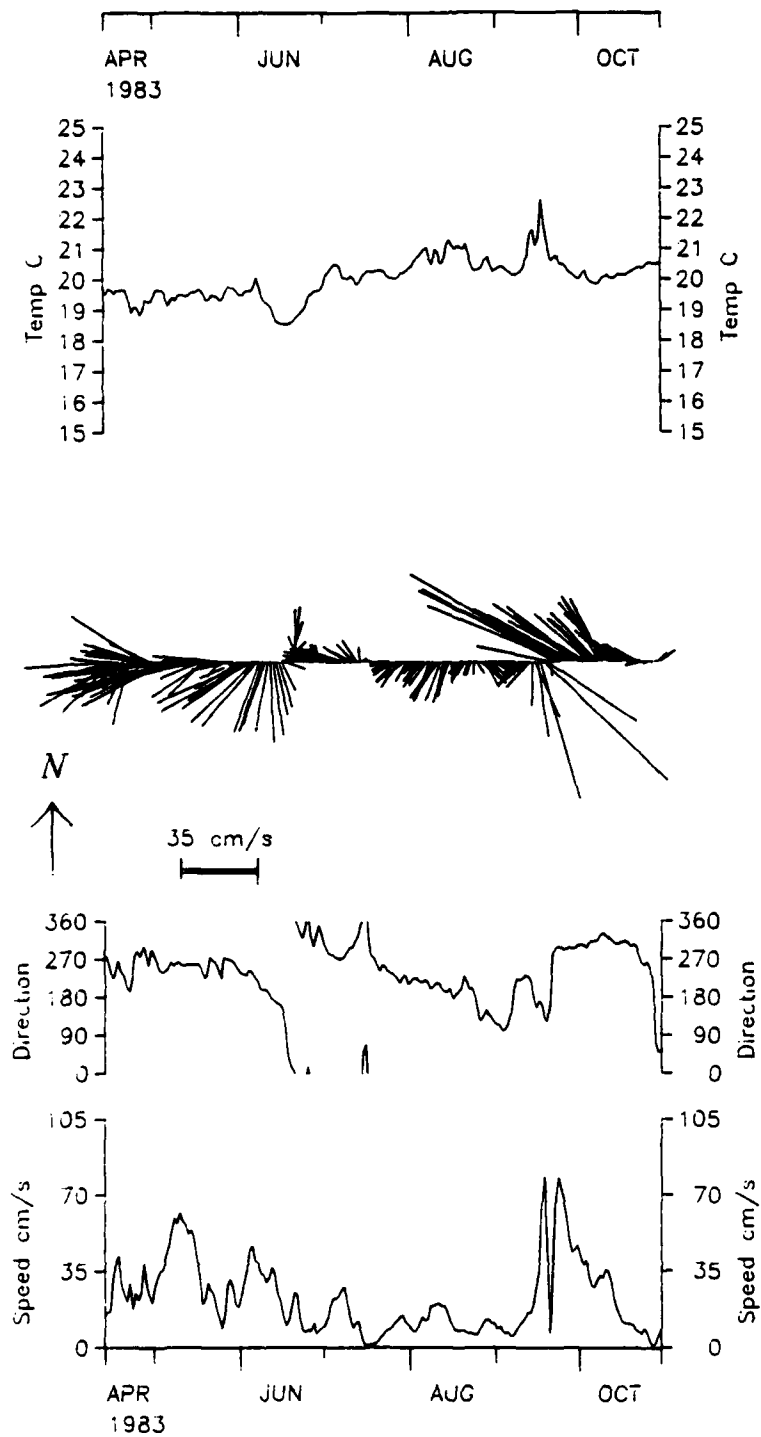
Data 7926A1DG24





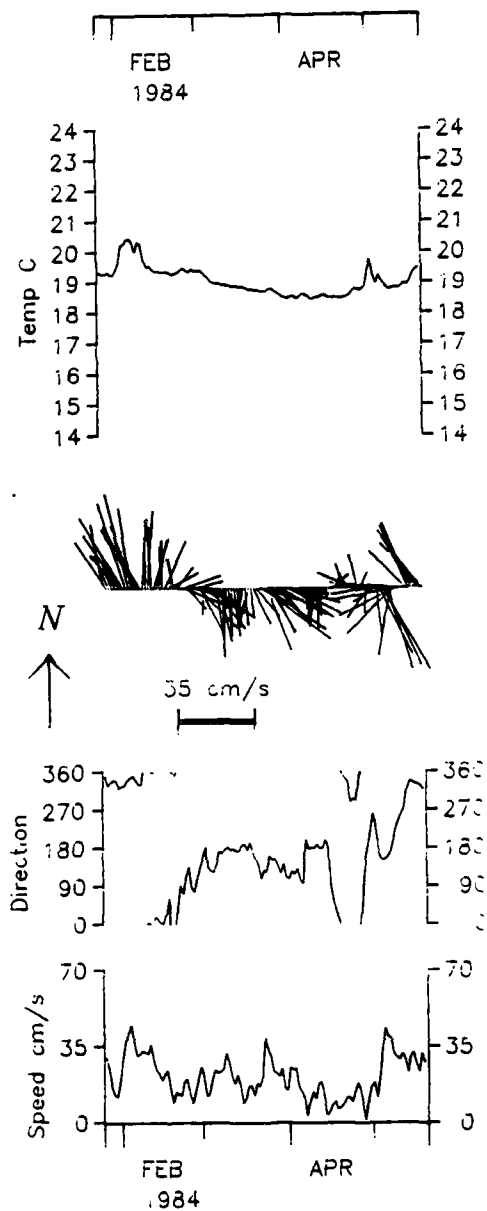
Data 7881B1DG24

Depth 98m

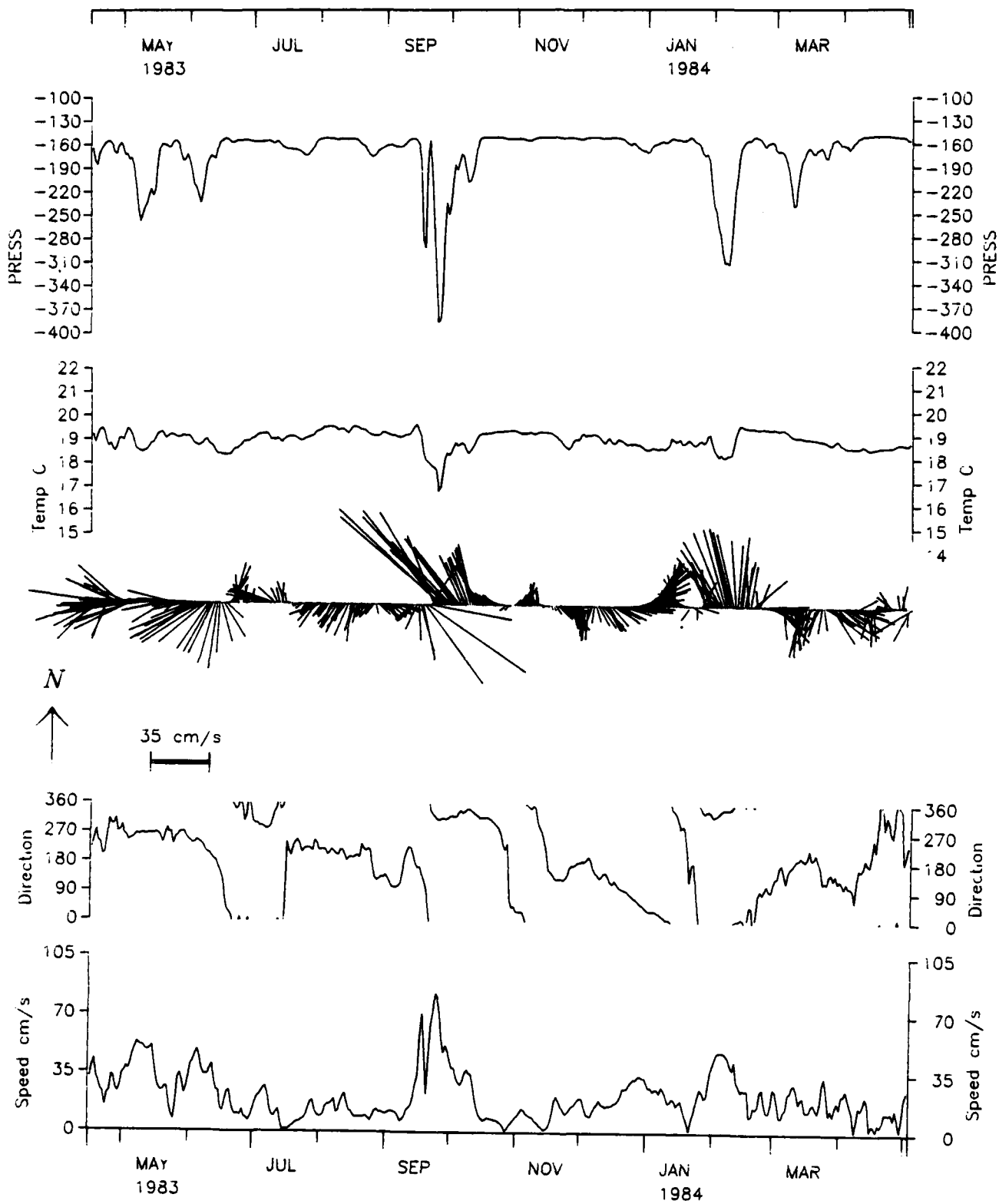


Data 7879B1DG24

Depth 100m

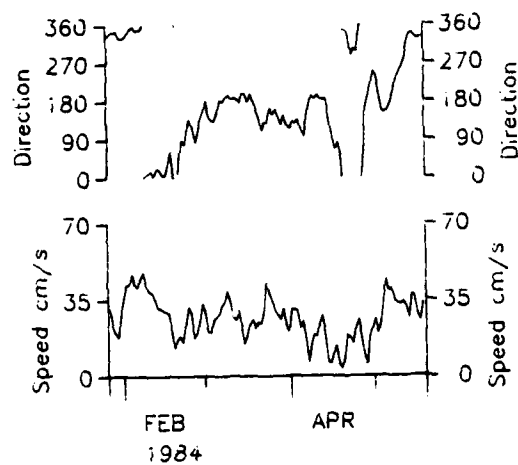
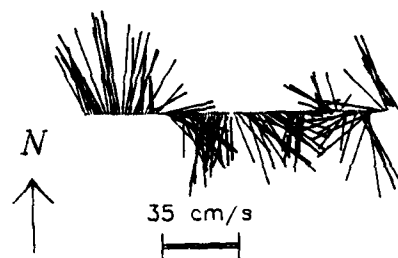
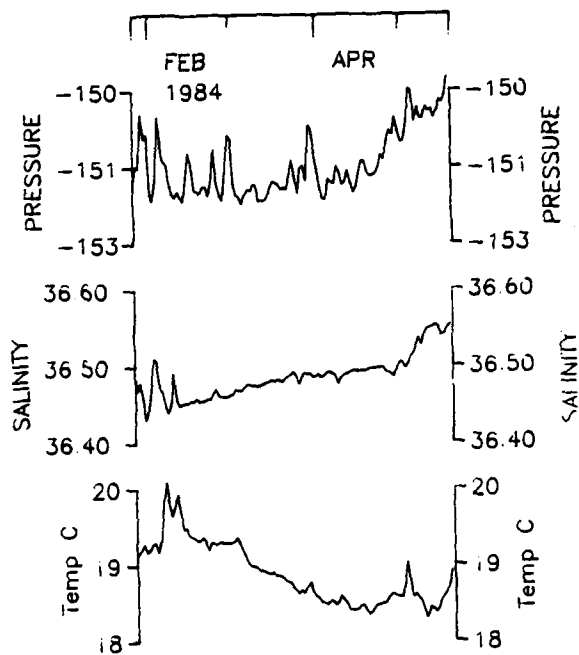


Data 7929A1DG24

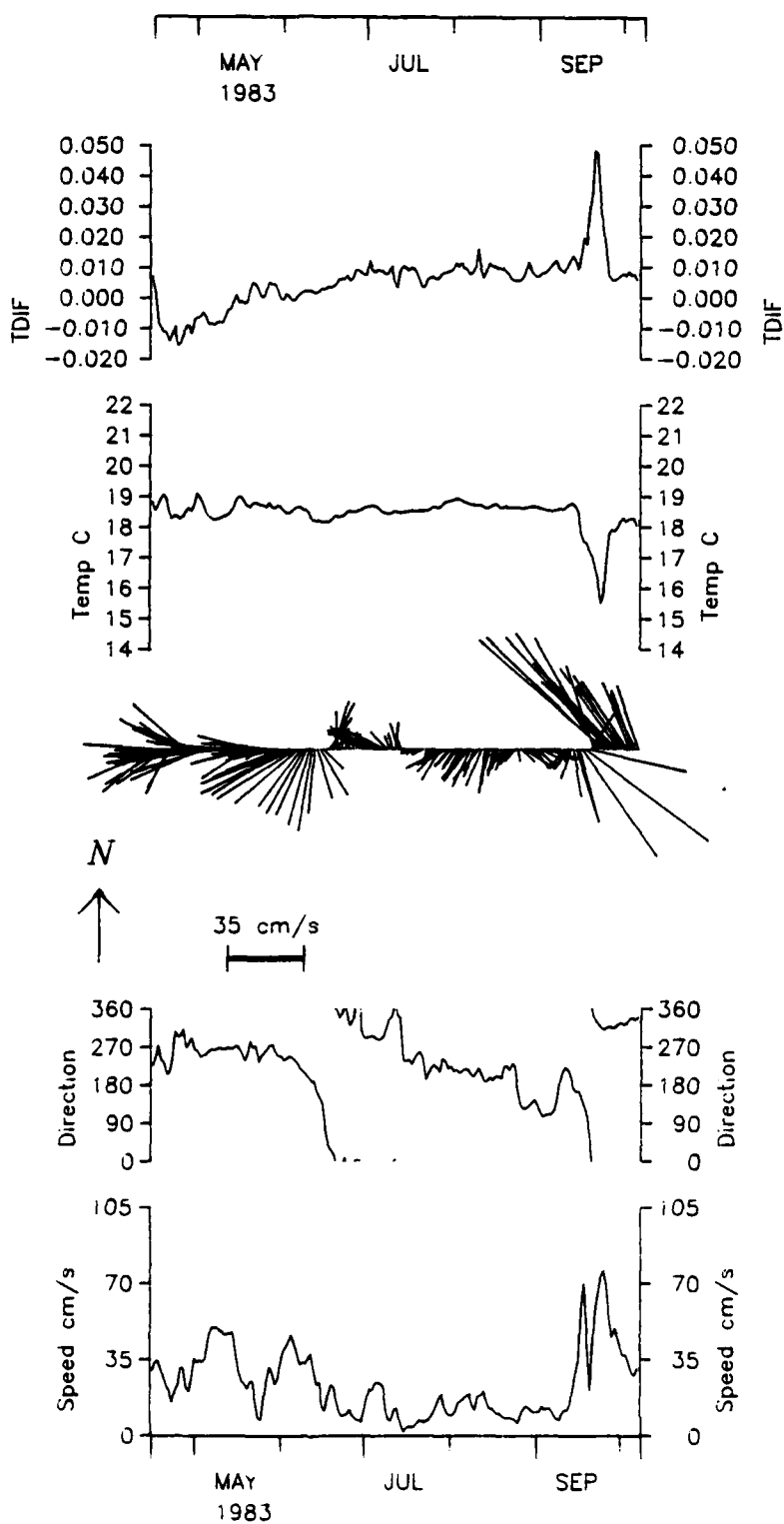


Data 7882B1DG24

Depth 148m

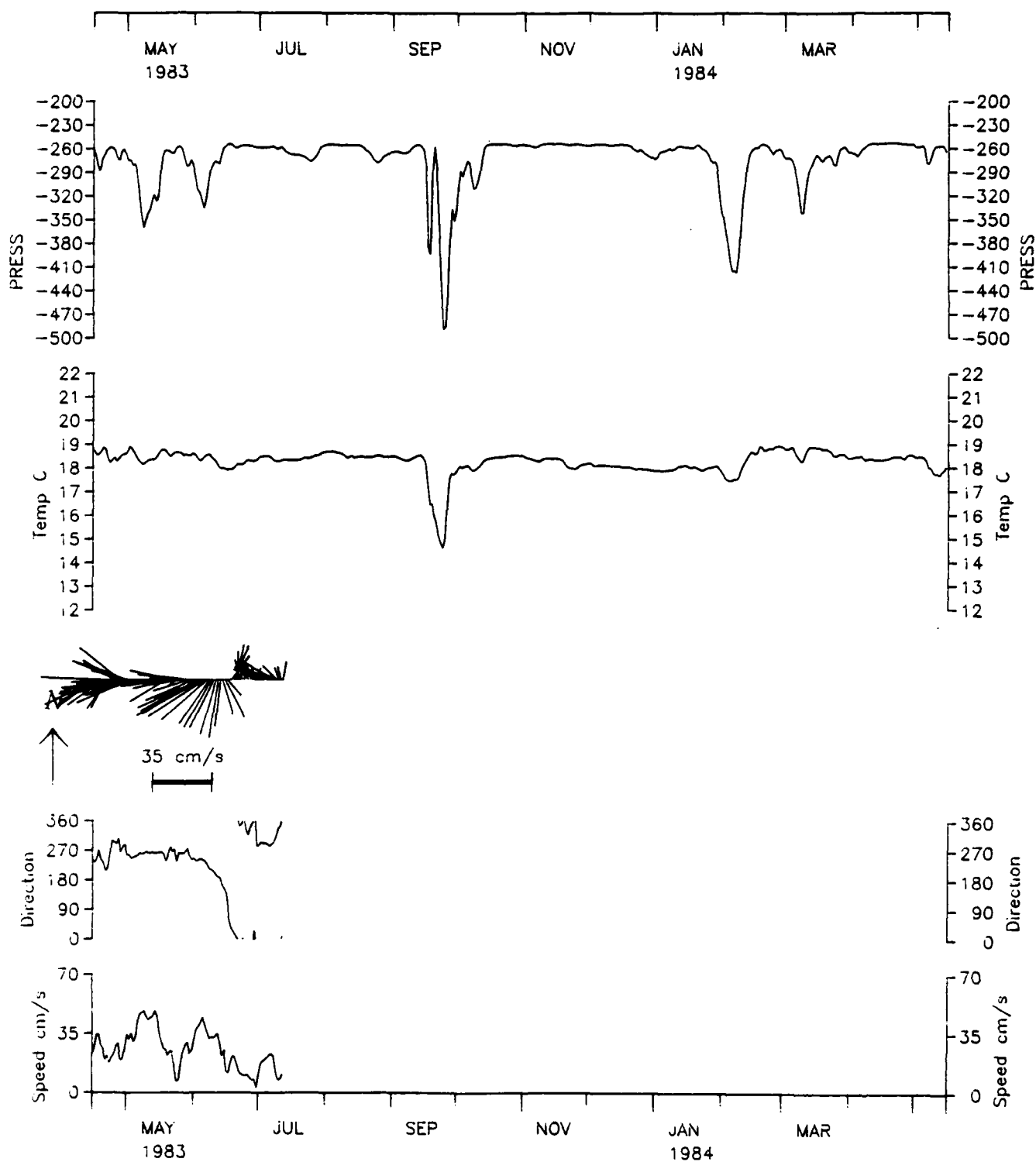


Depth 152m Data 79210B1DG24



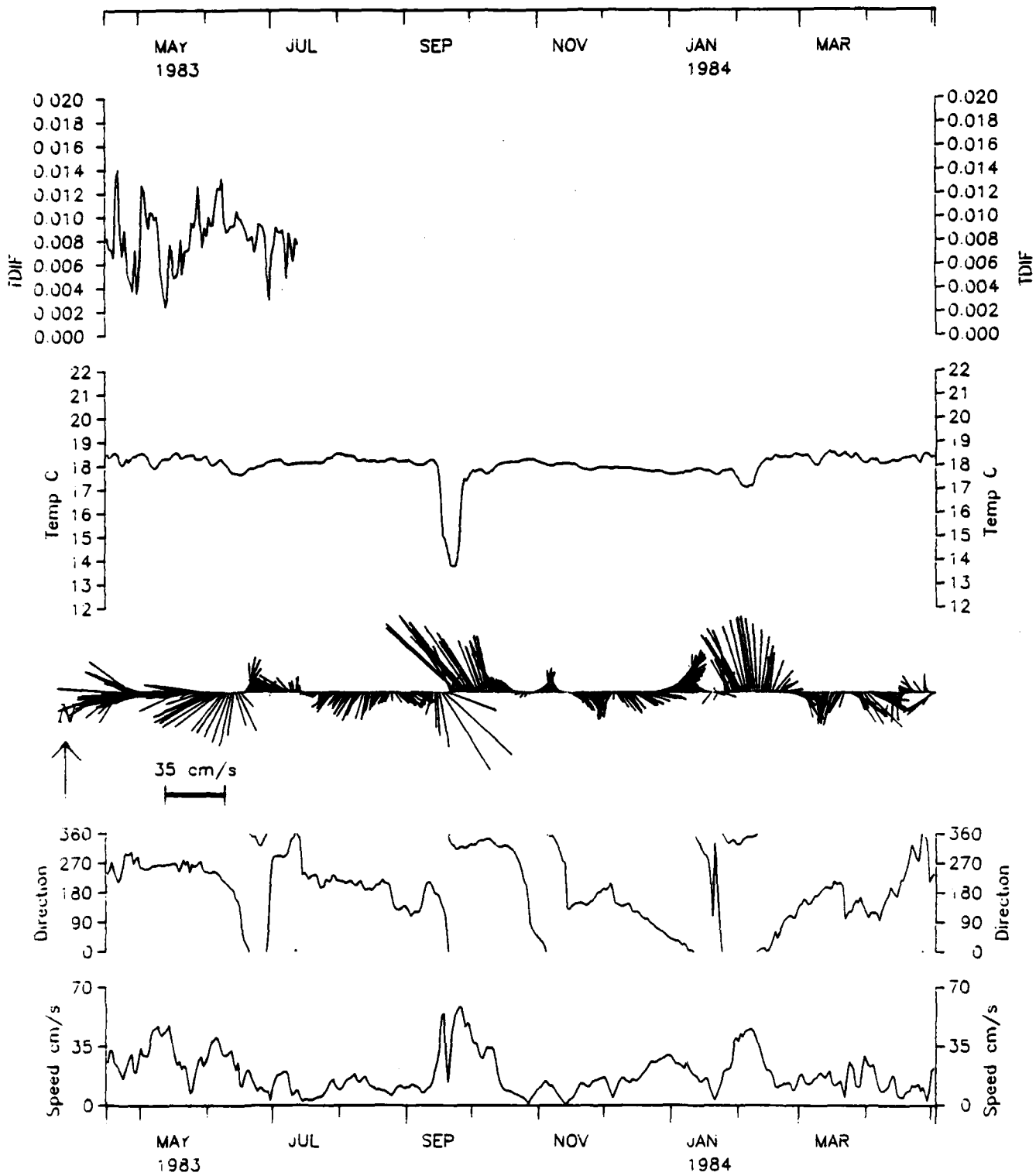
Data 7883B1DG24

Depth 198m



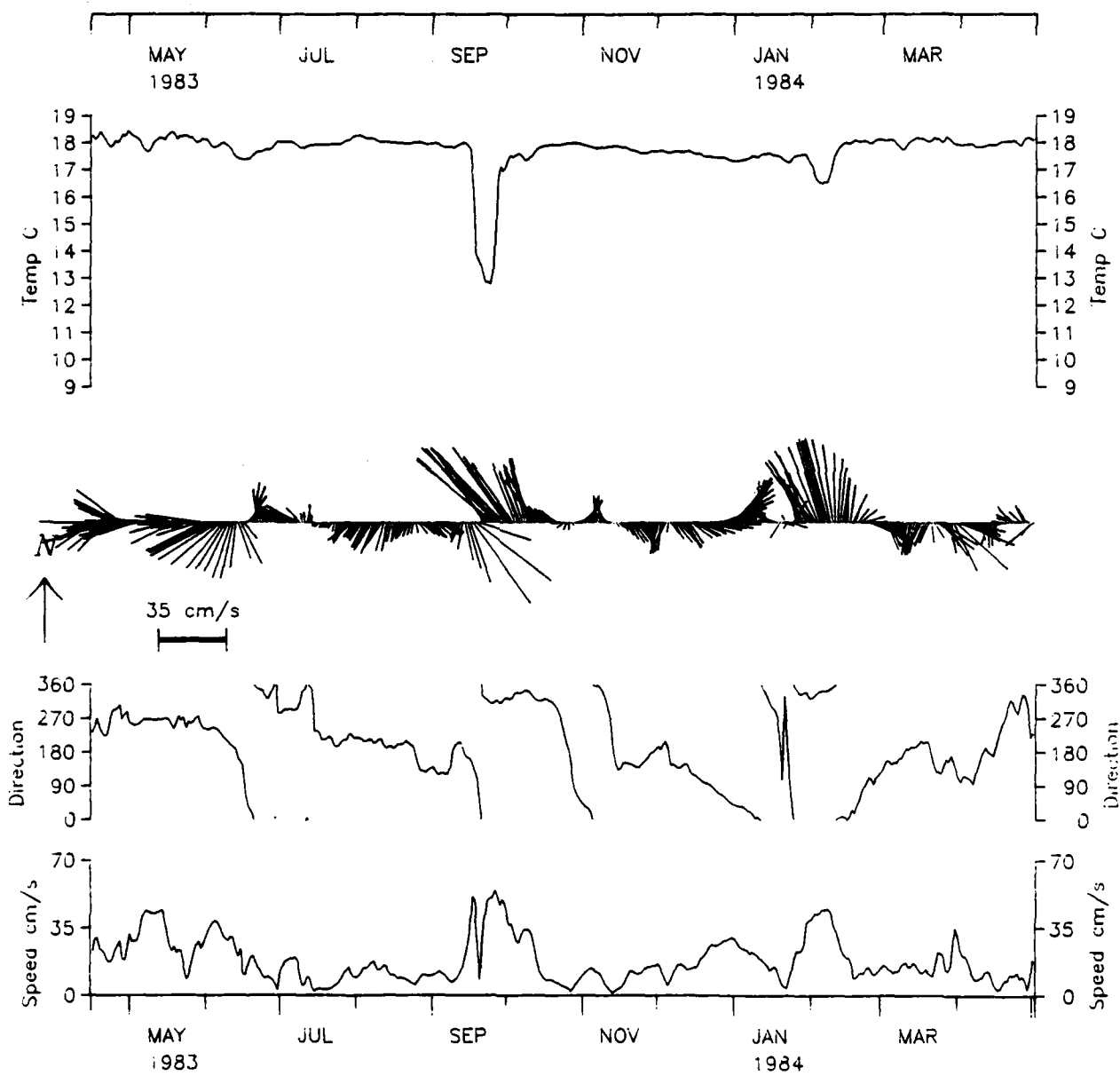
Data 7884B1DG24

Depth 248m



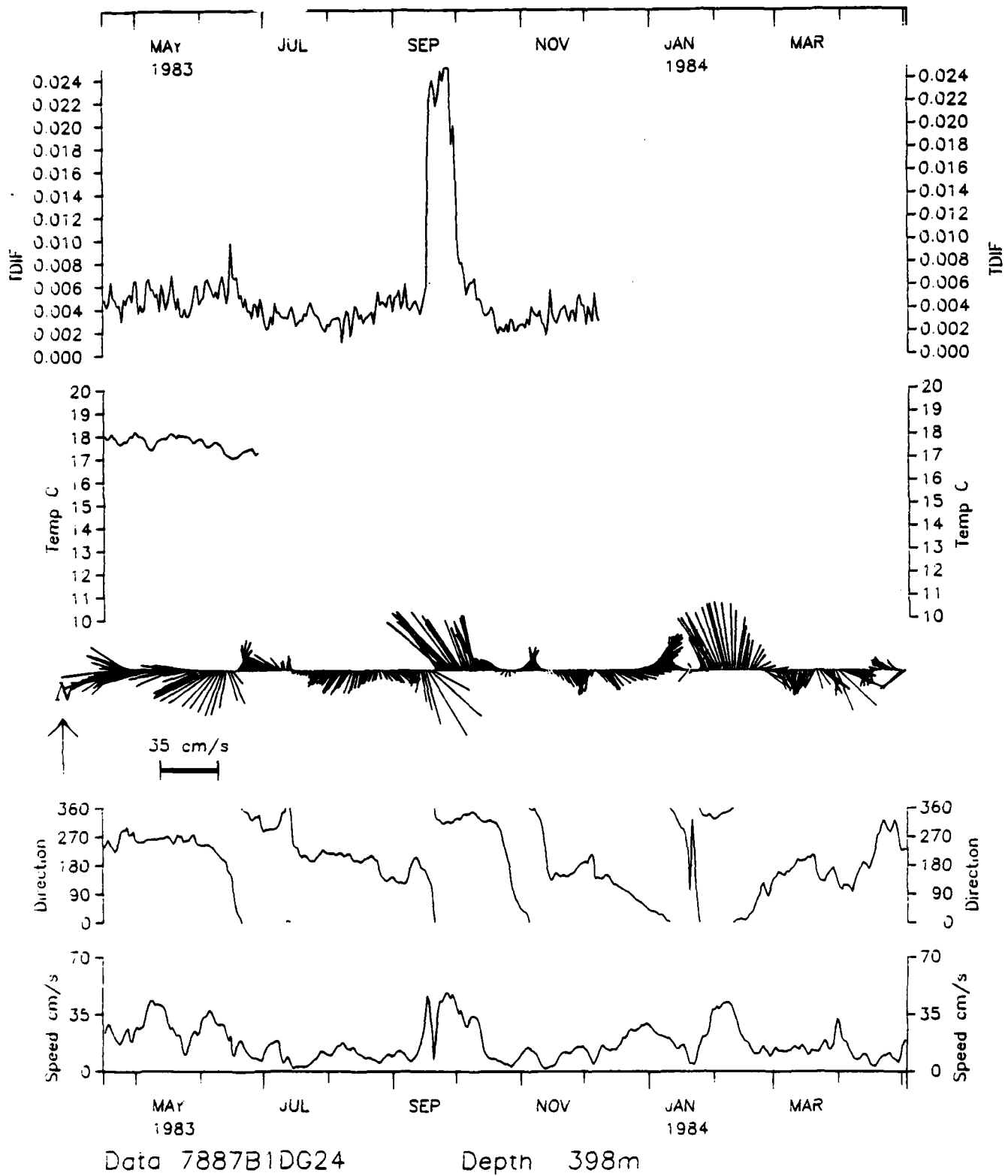
Data 7885A1DG24

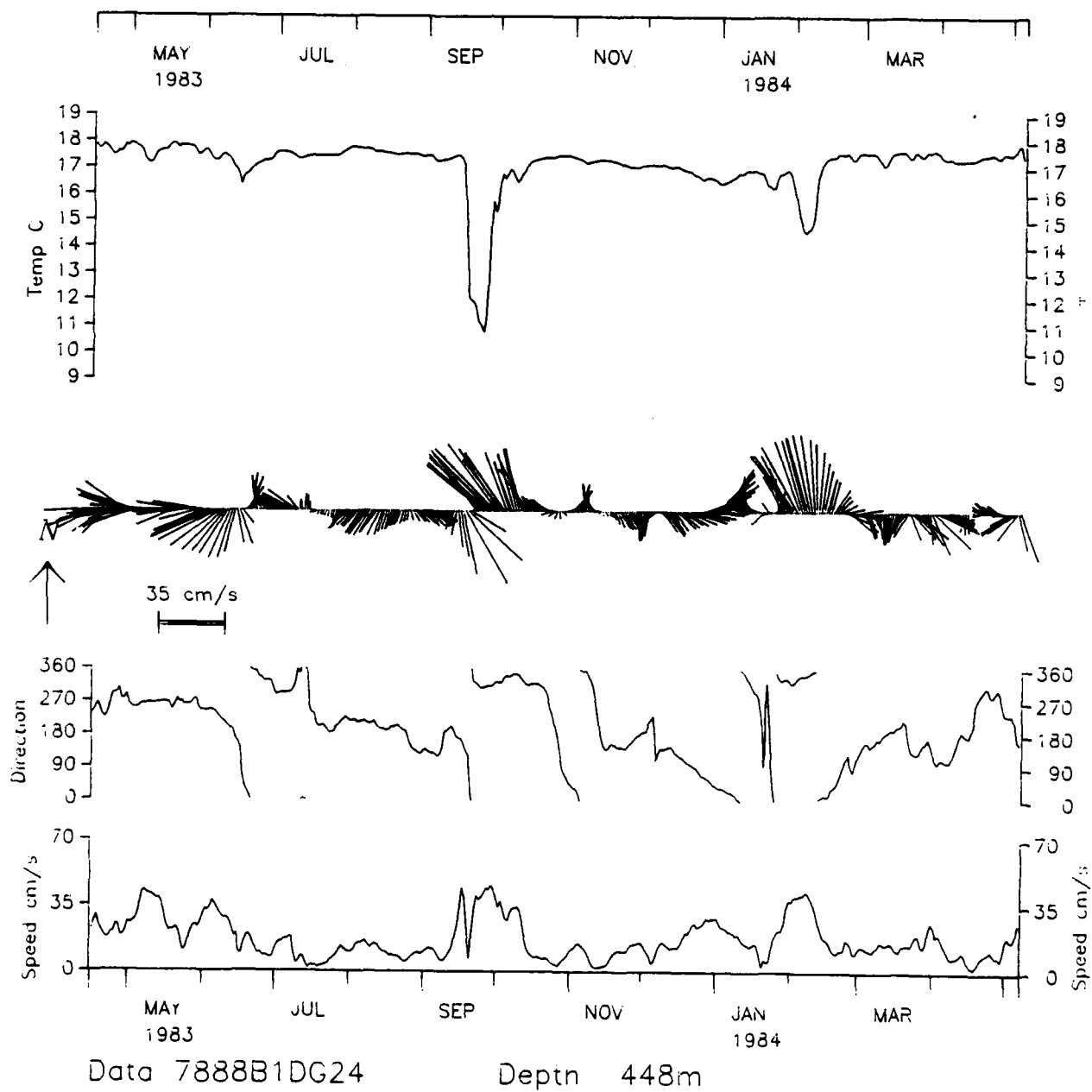
Depth 298m

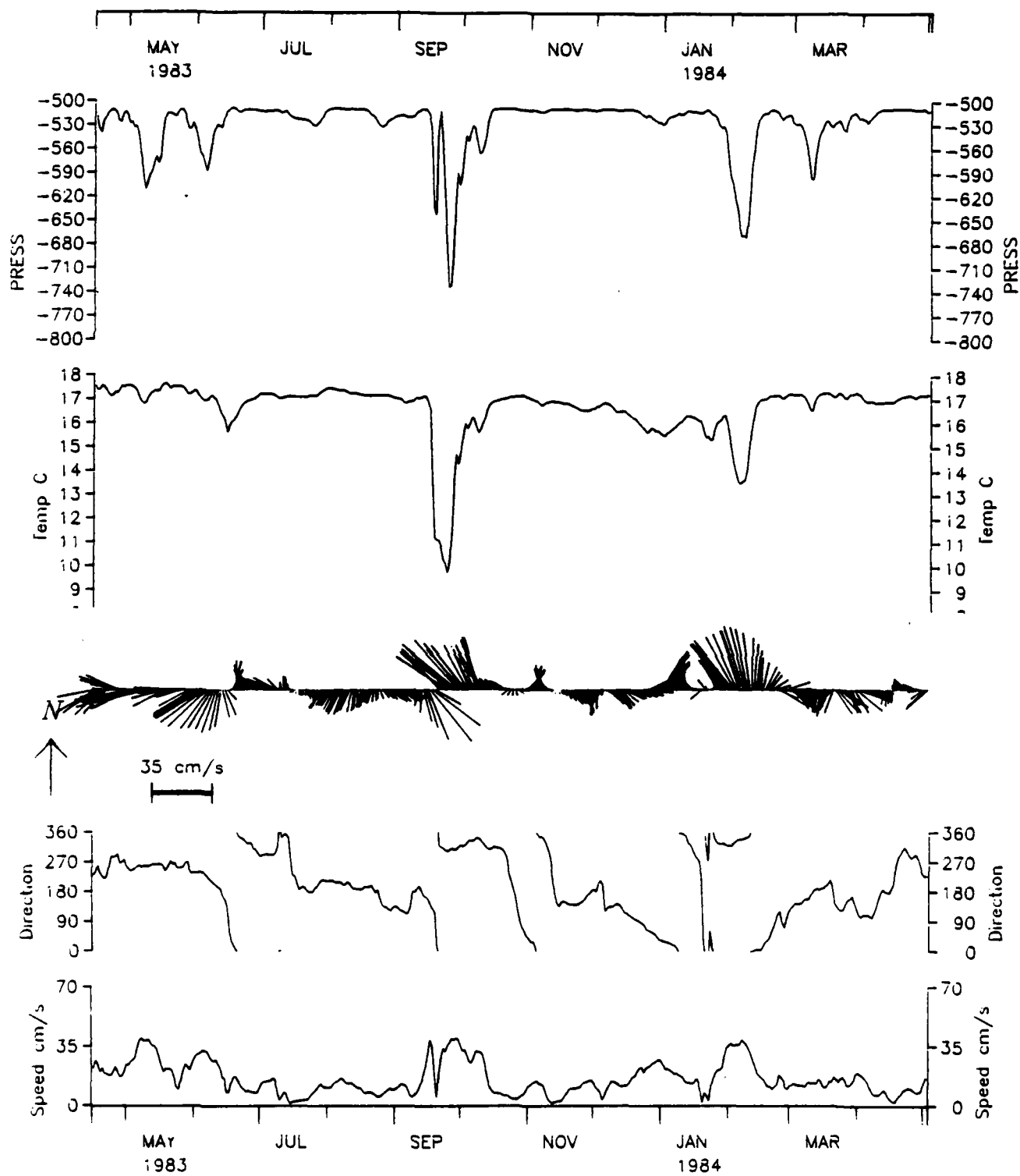


Data 7886A1DG24

Depth 348m

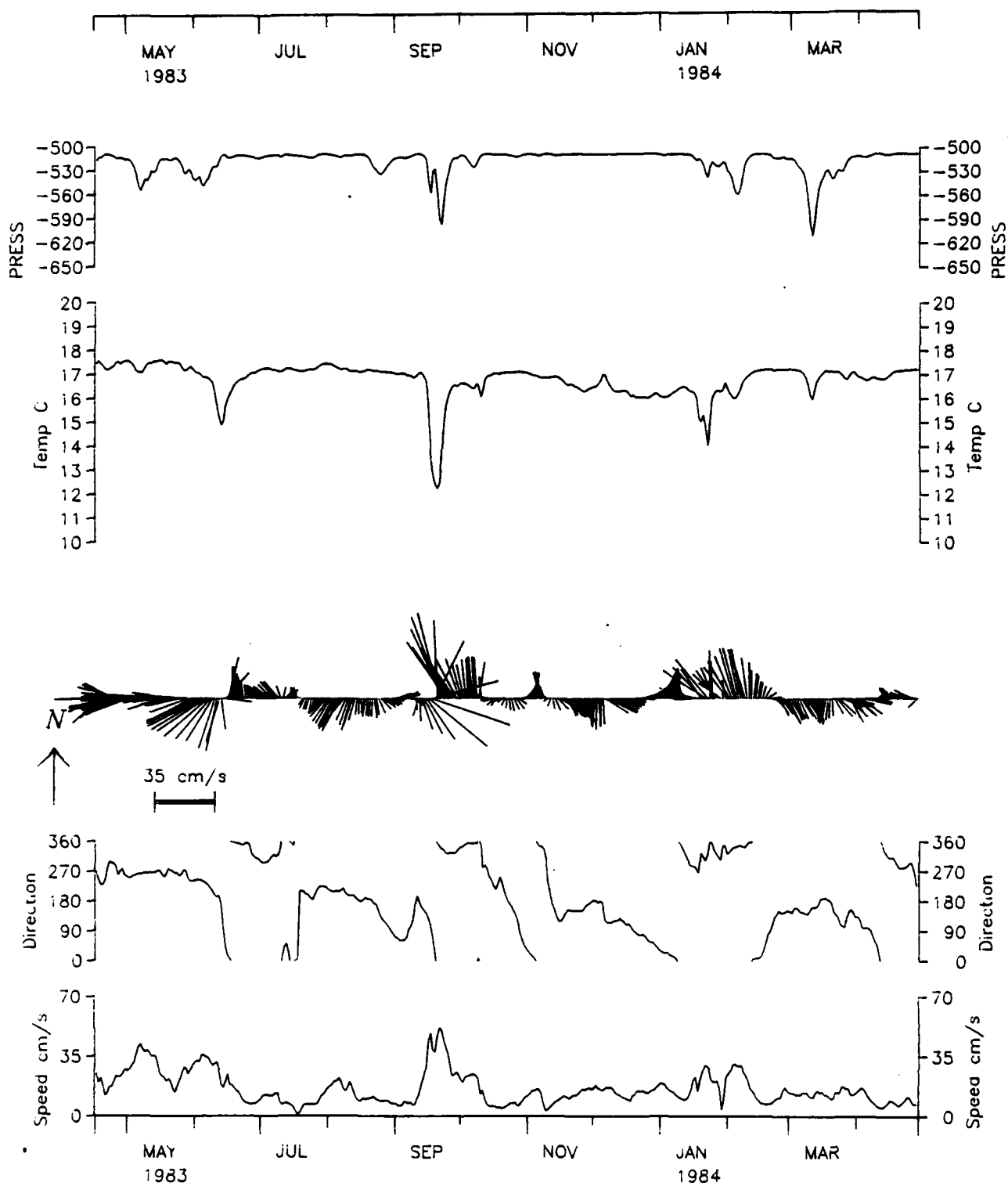






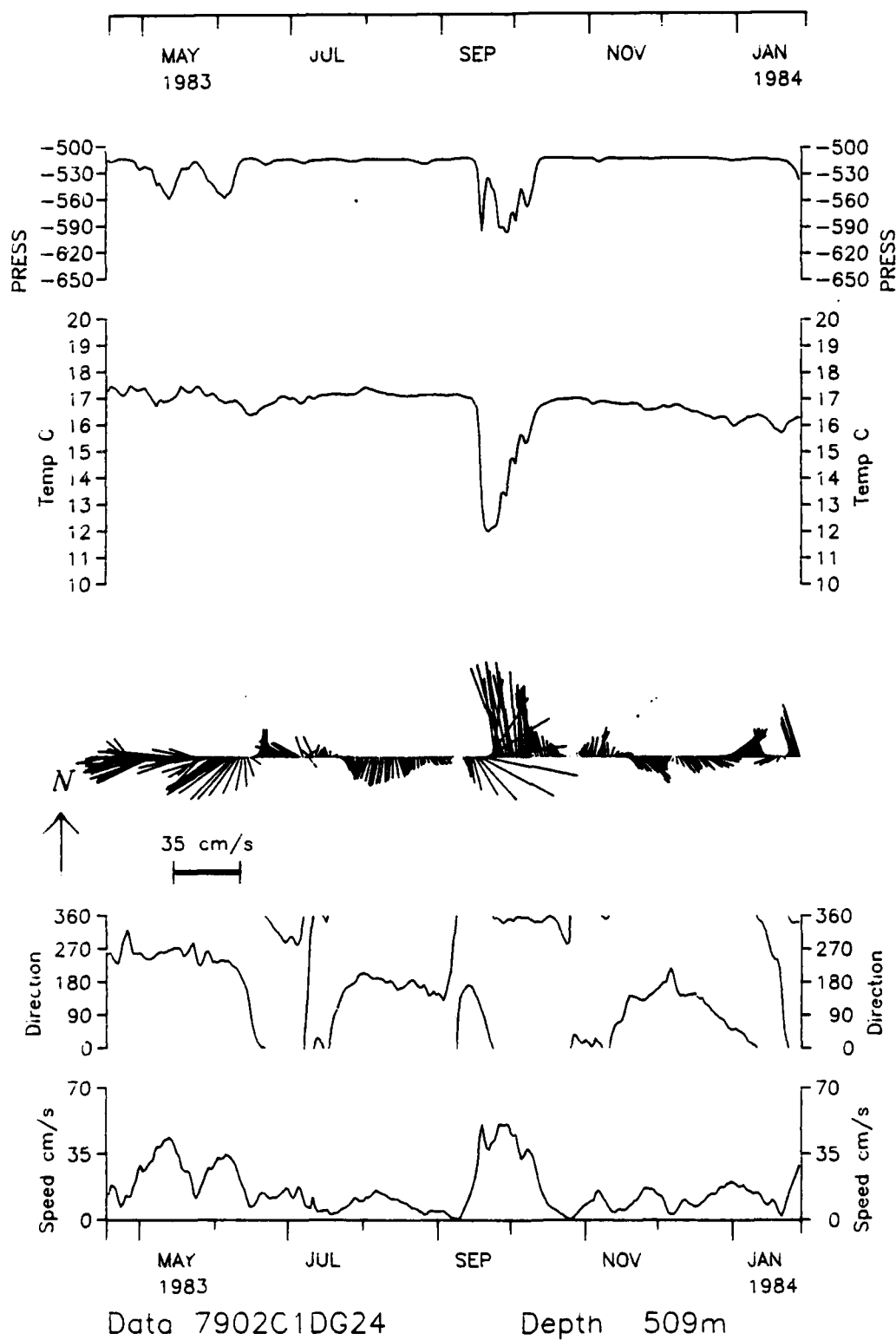
Data 7889B1DG24

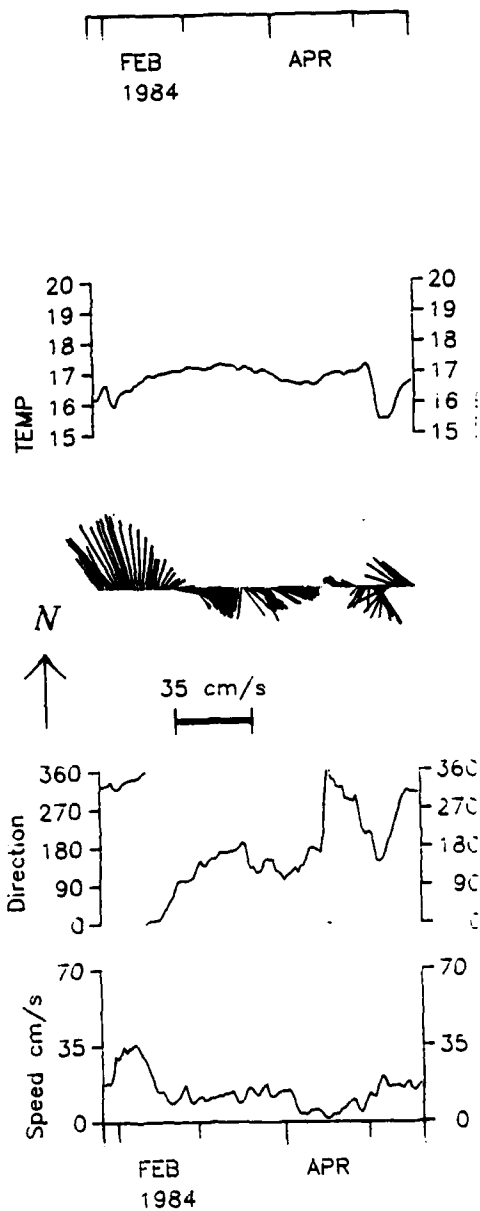
Depth 498m



Data 7891C1DG24

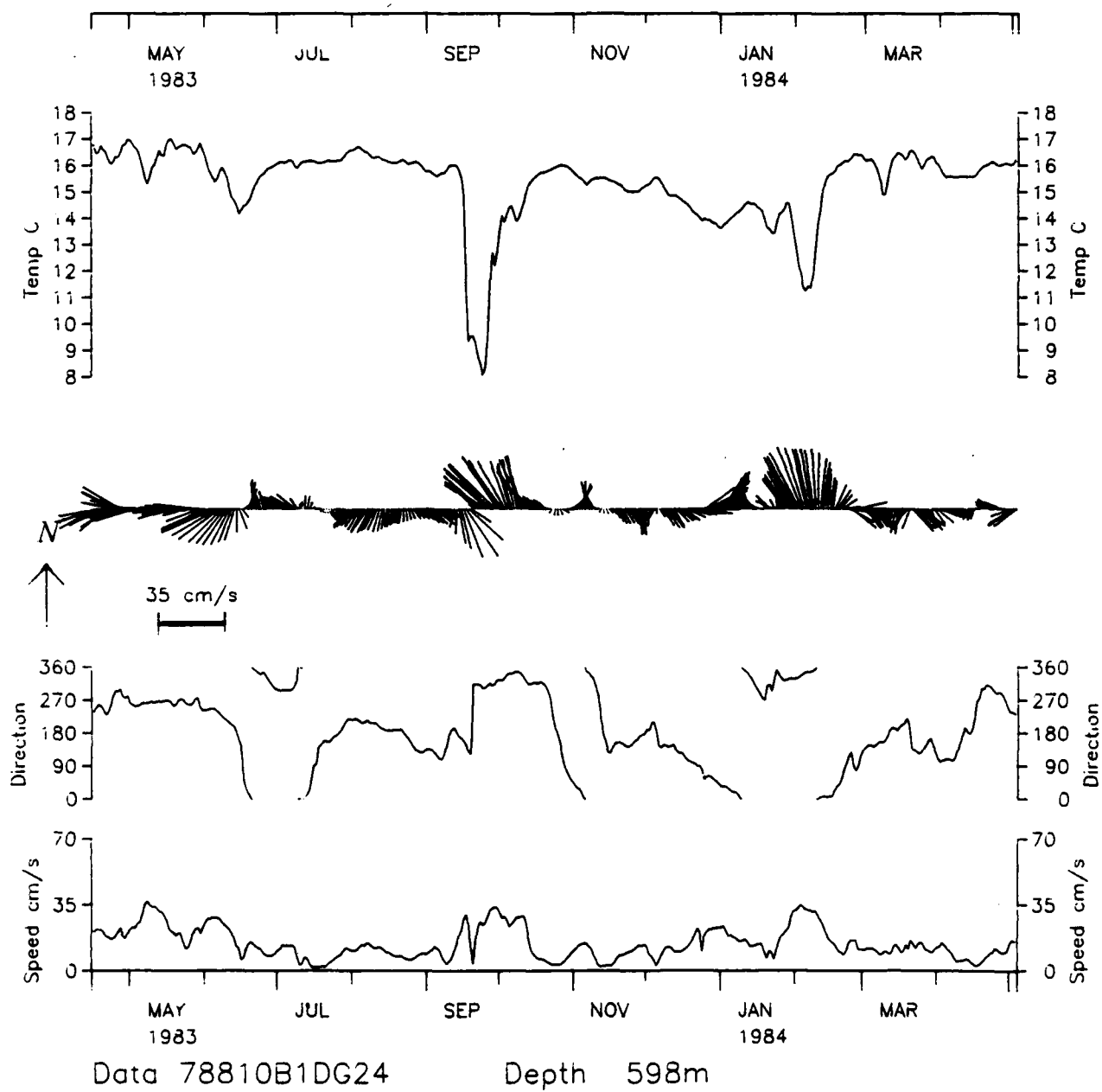
Depth 498m

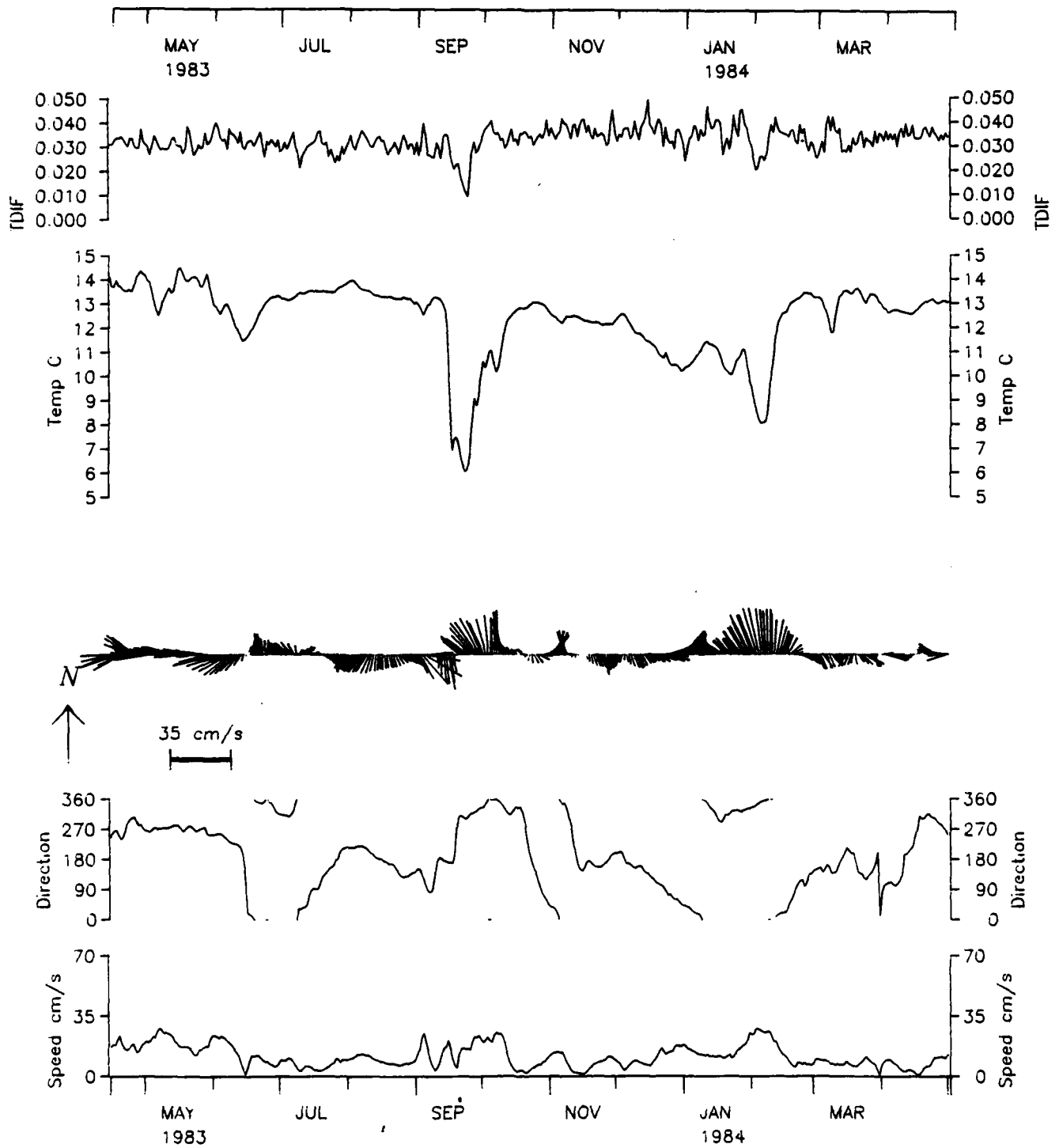




Depth 530m

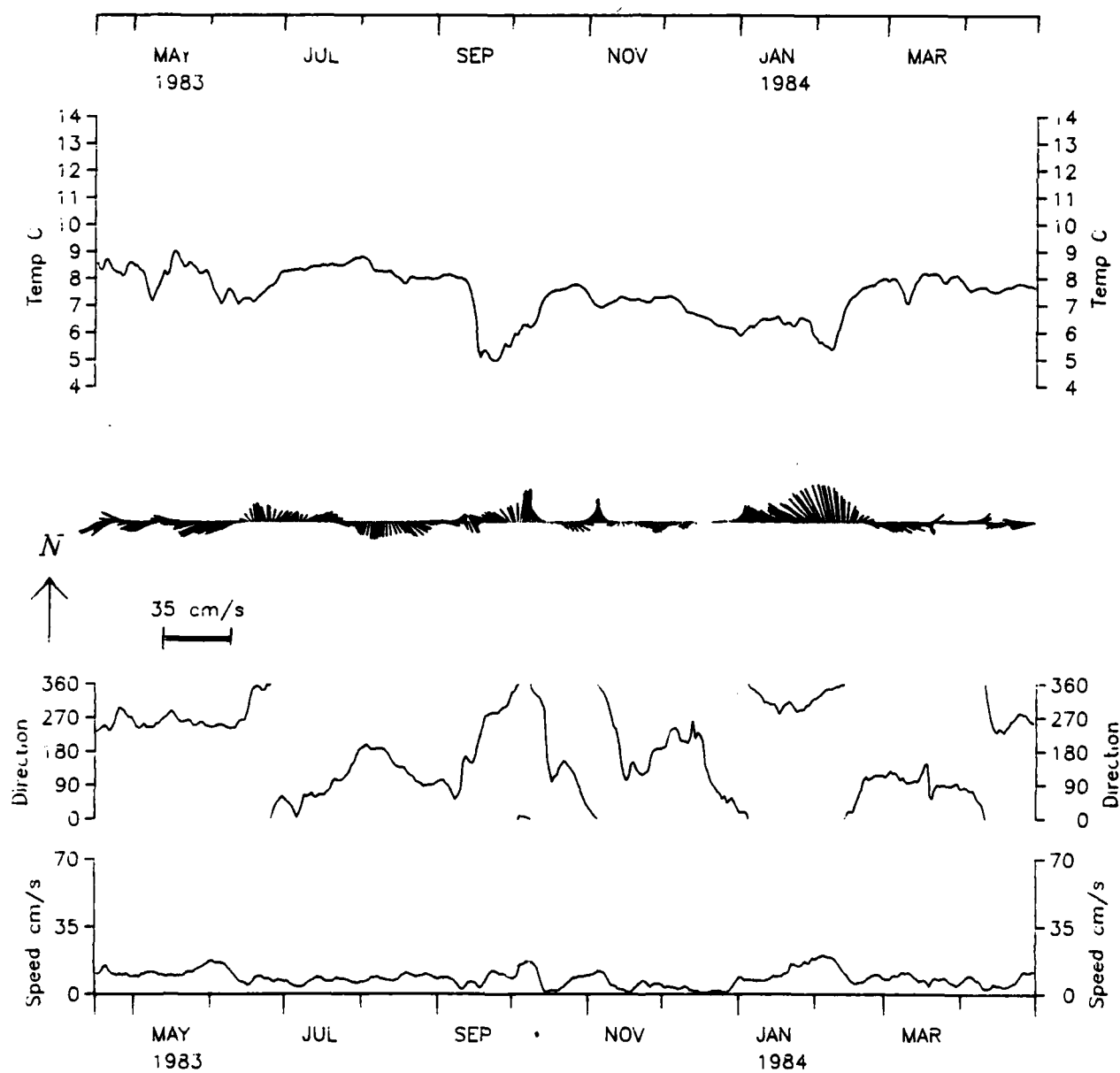
Data 79214A1DG24





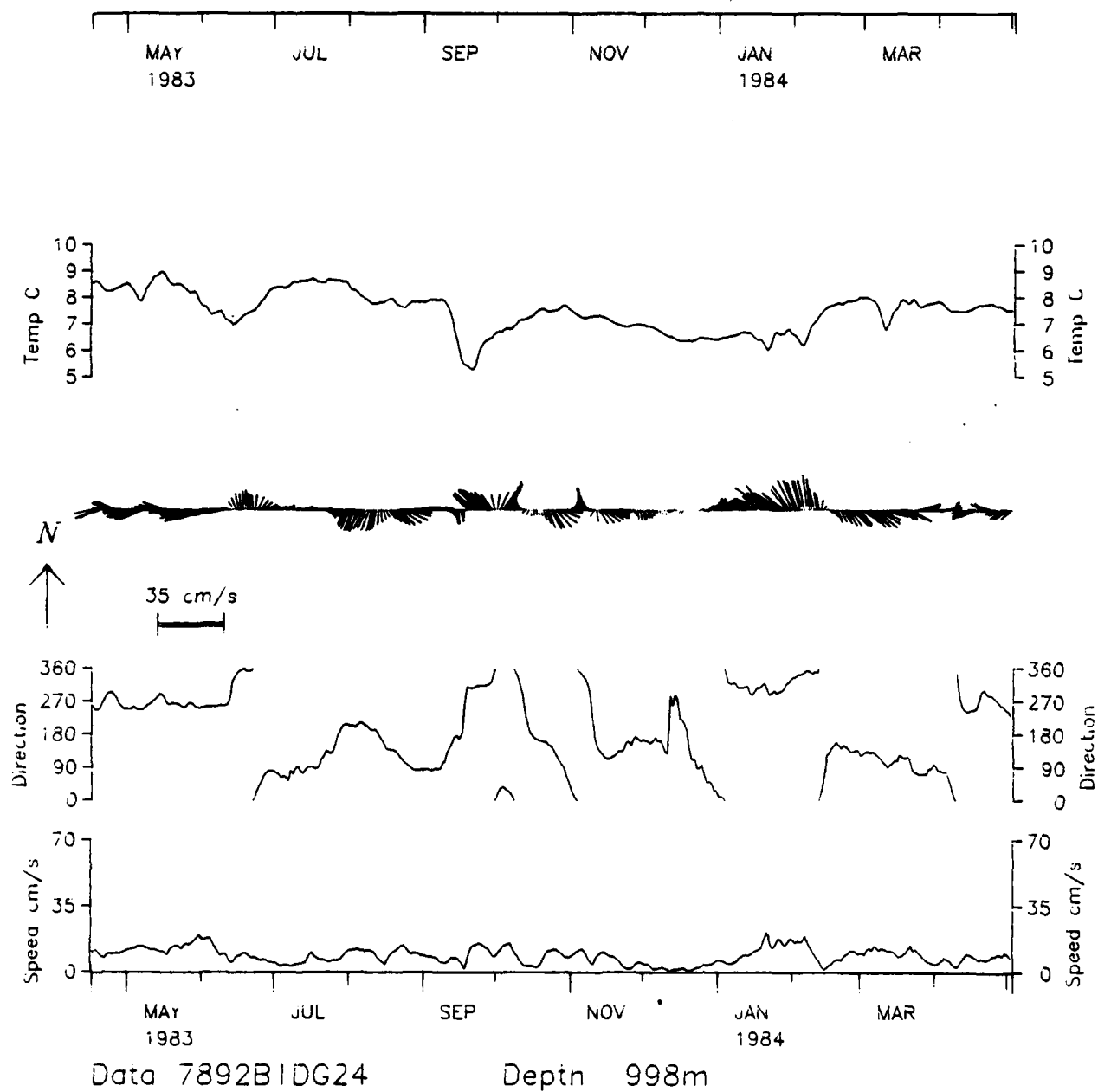
Data 78811B1DG24

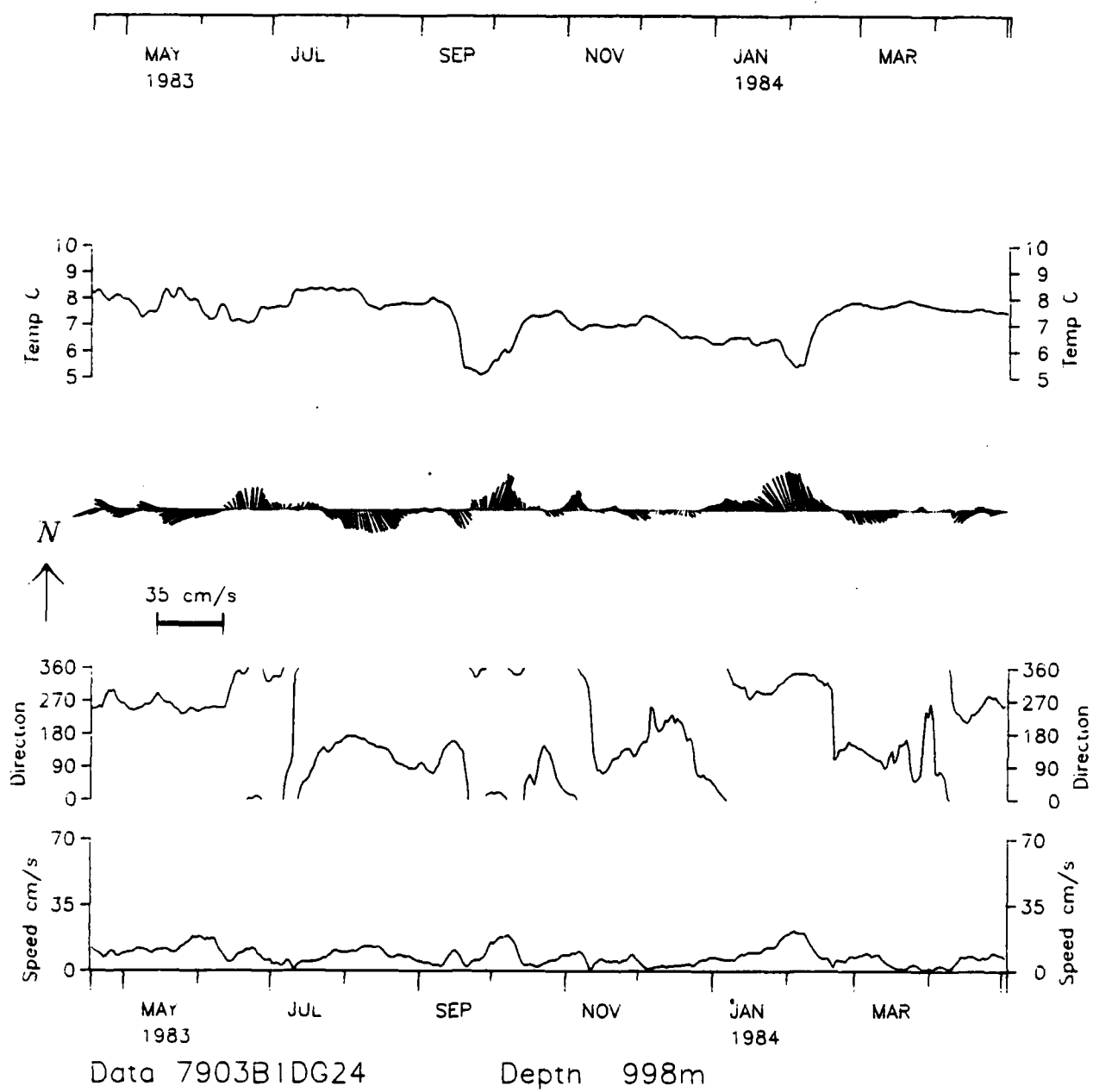
Depth 748m



Data 78812A1DG24

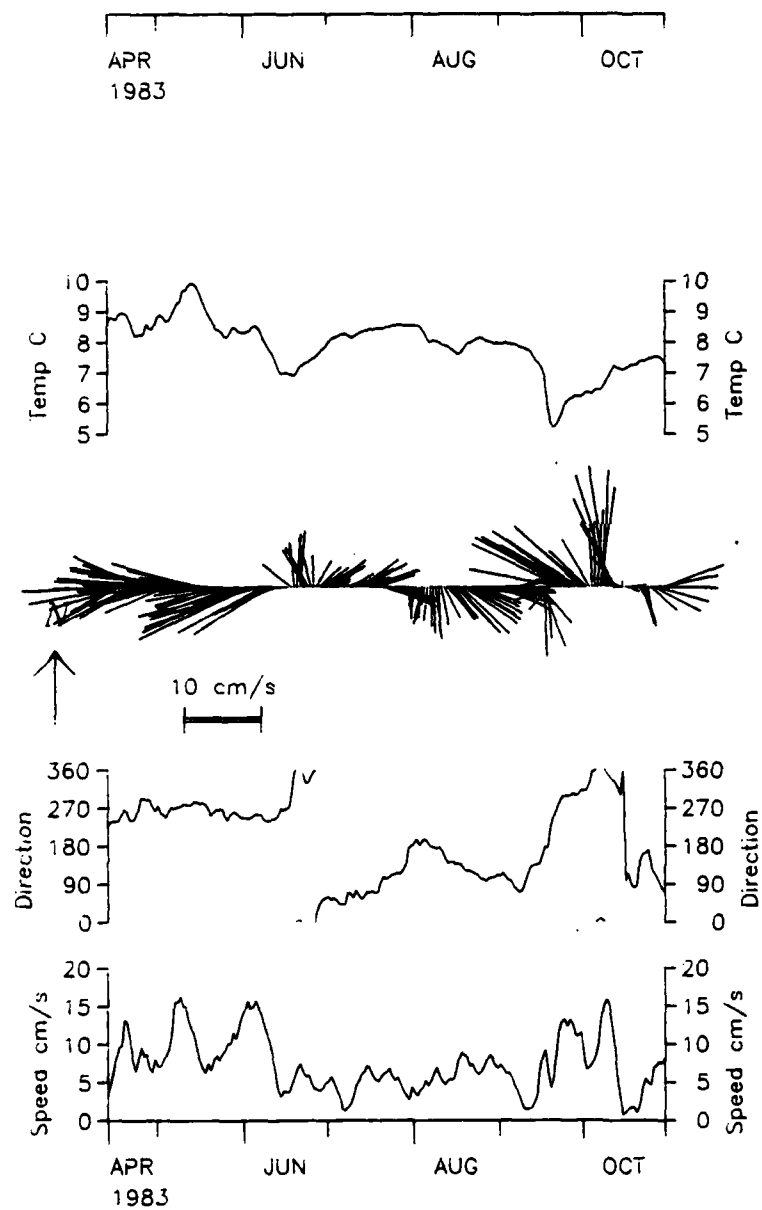
Depth 998m





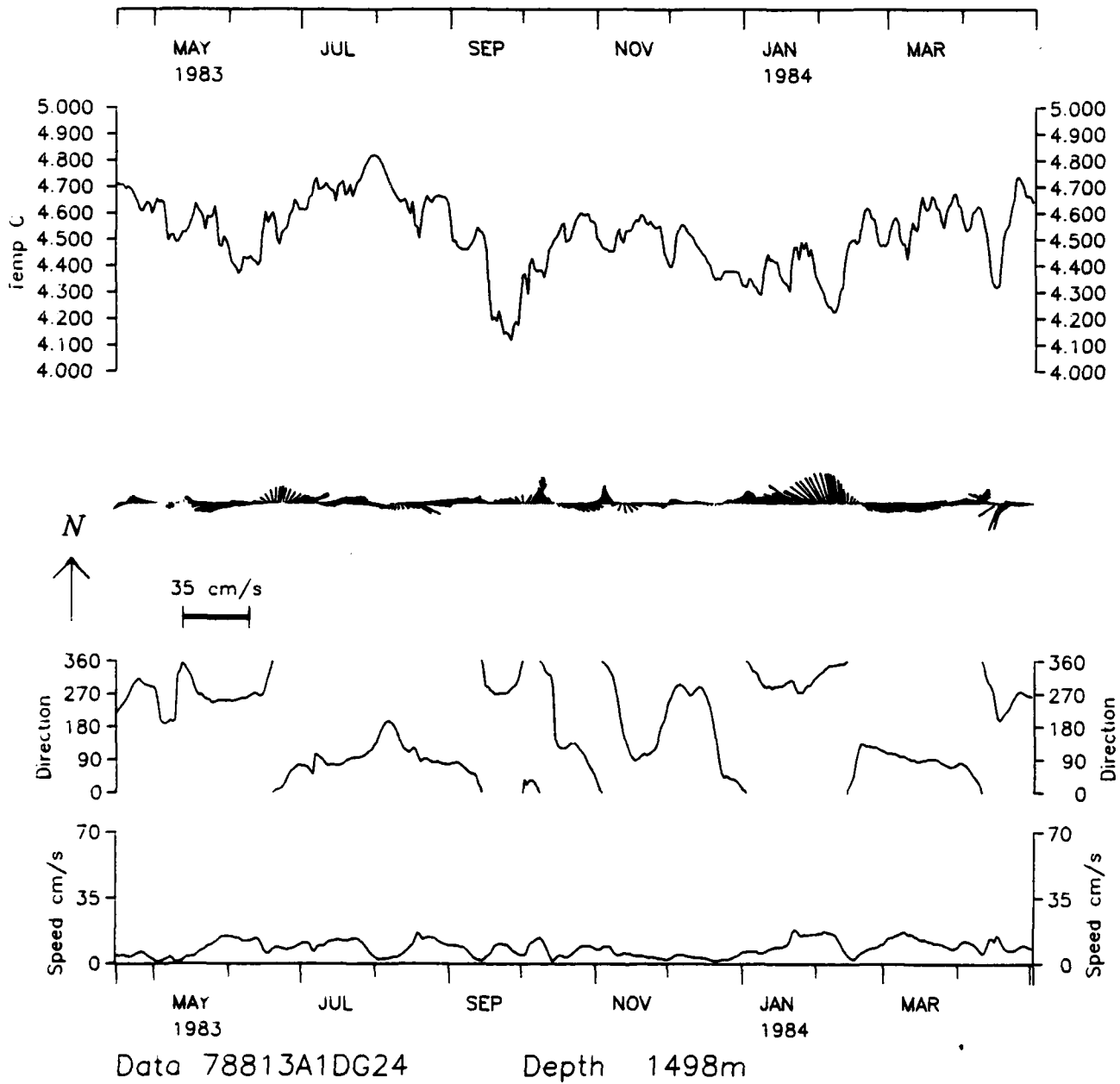
Data 7903B1DG24

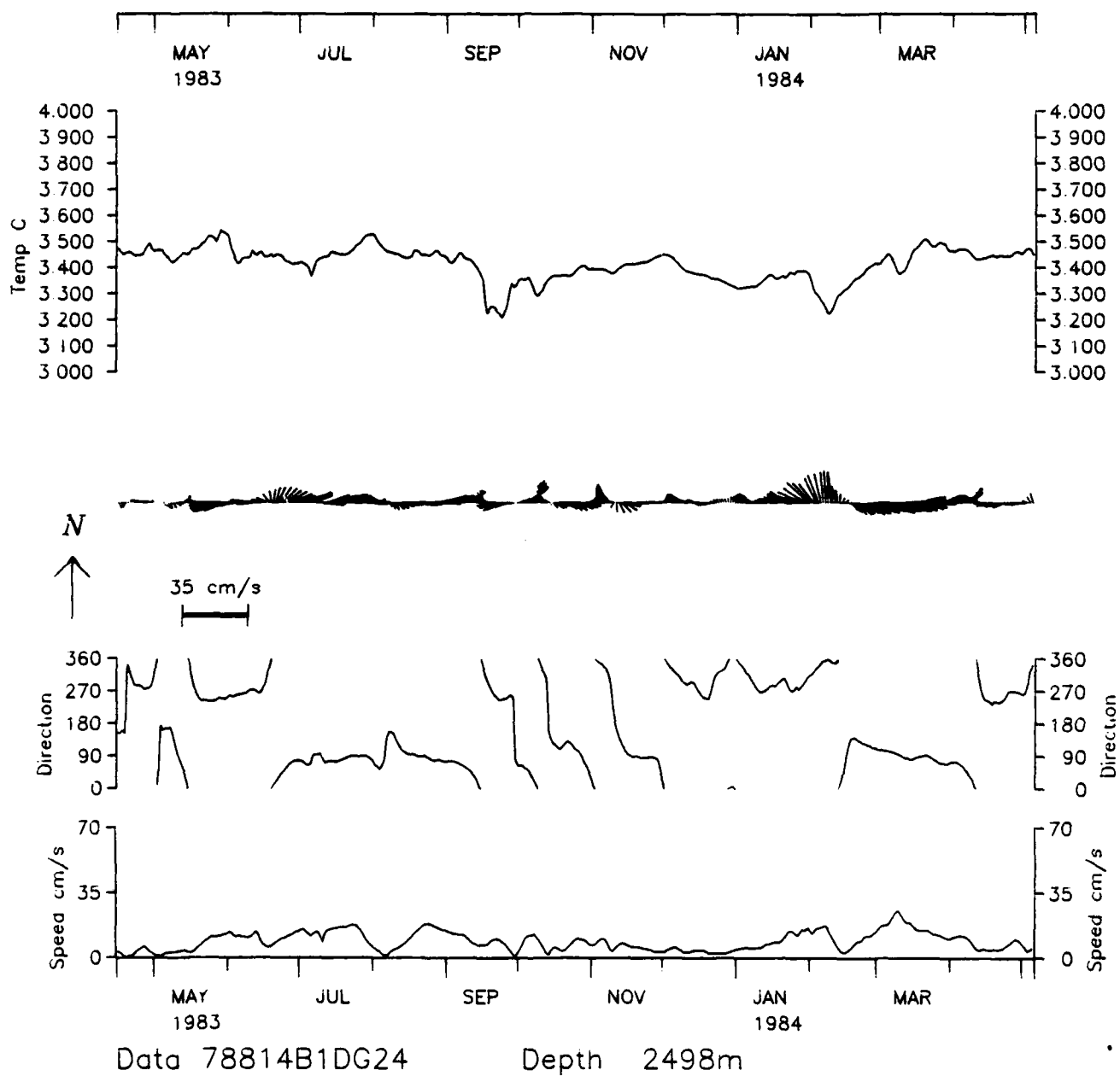
Depth 998m

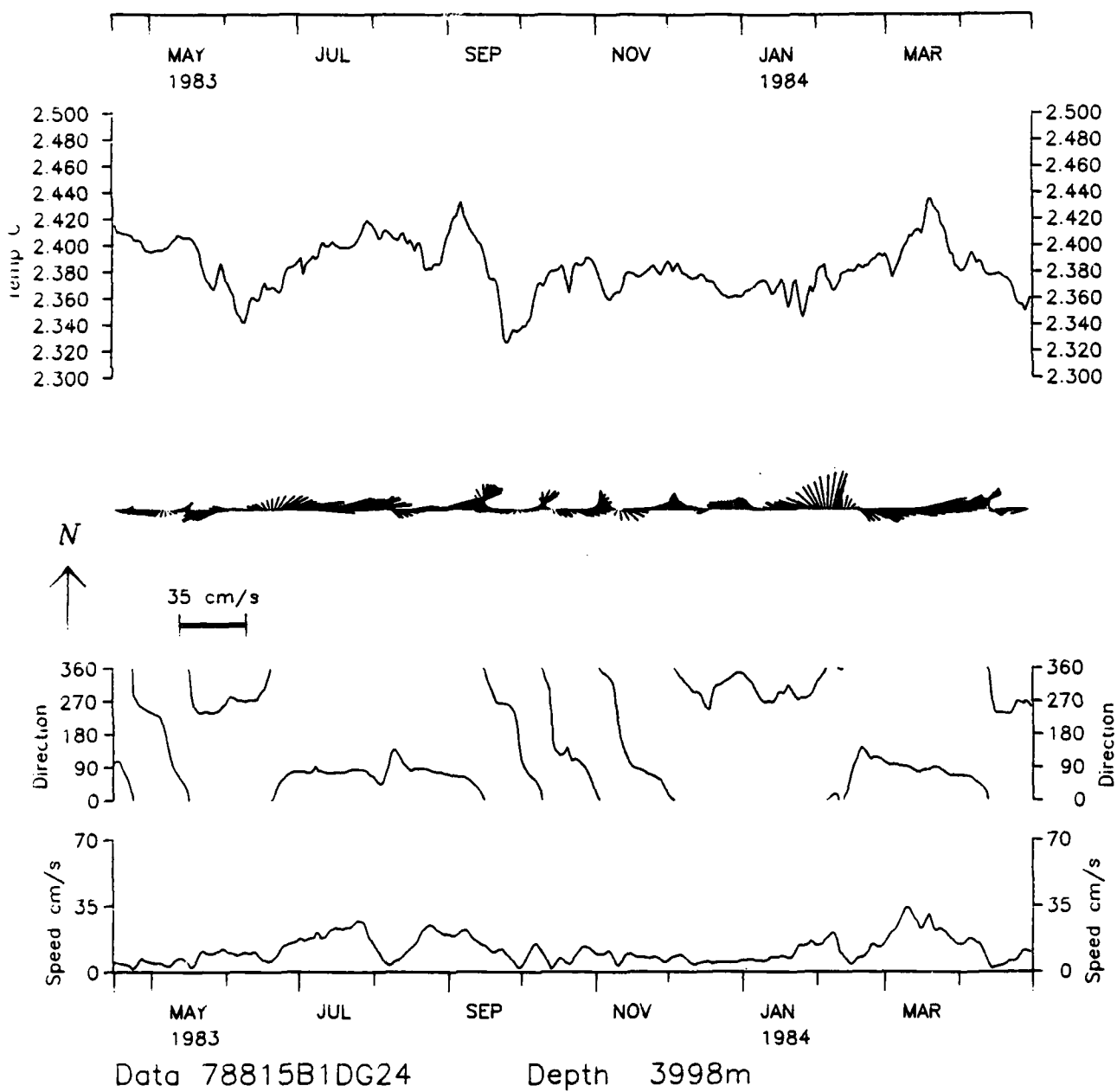


Data 78713A1DG24

Depth 1000m

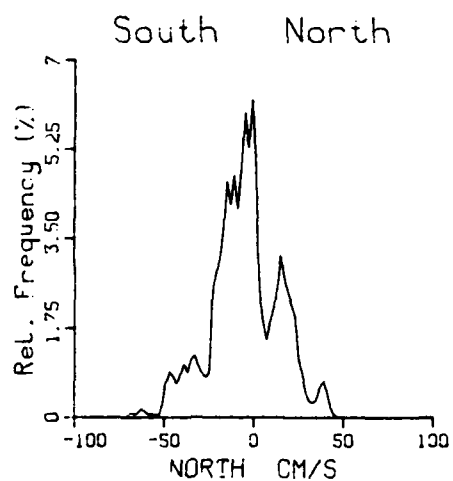
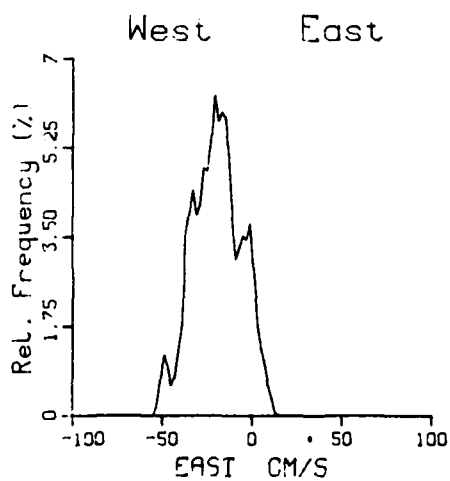
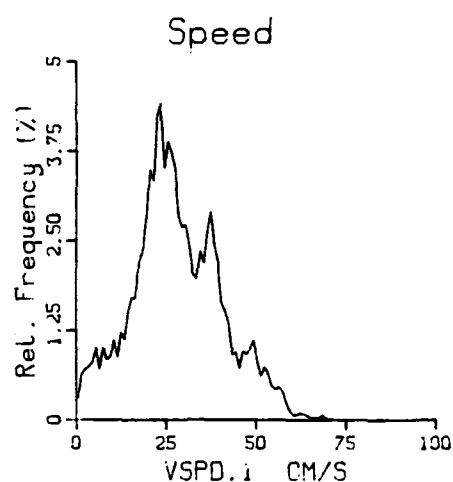
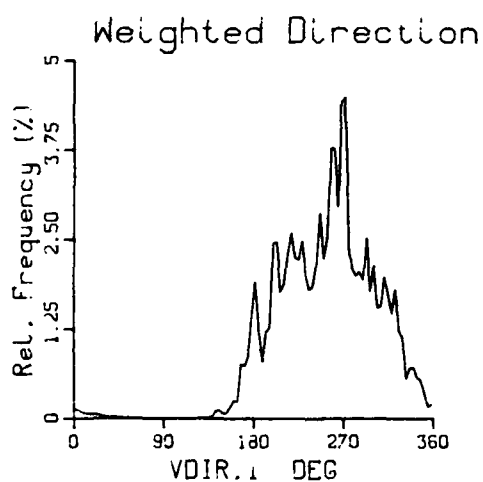
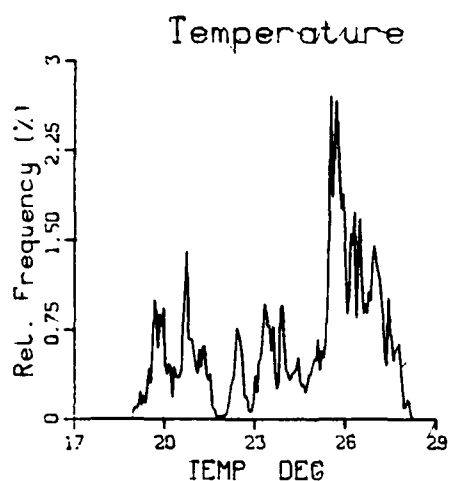






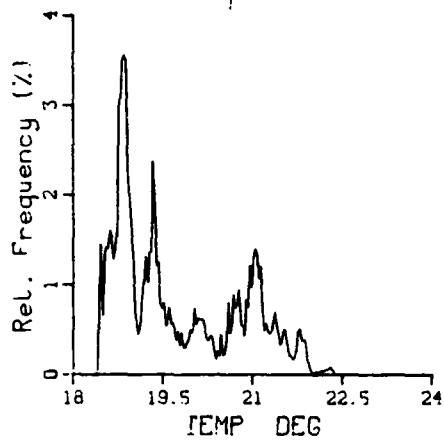
SURFACE MOORINGS 788 AND 792
NEAR-SURFACE MOORING 788
WITH SUBSURFACE MOORINGS 789 AND 790
INCLUDED BY DEPTH.

HISTOGRAMS

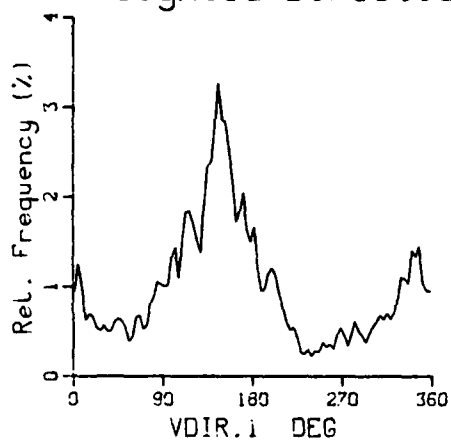


Data File 7873B225 : Depth = 5m

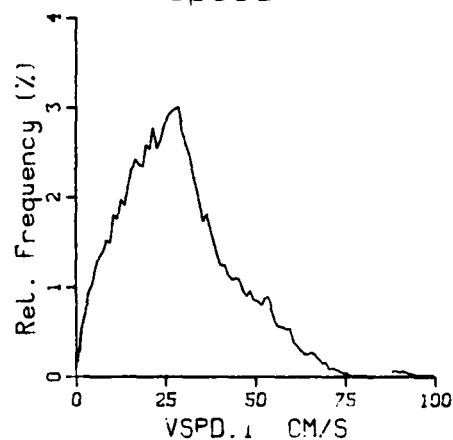
Temperature



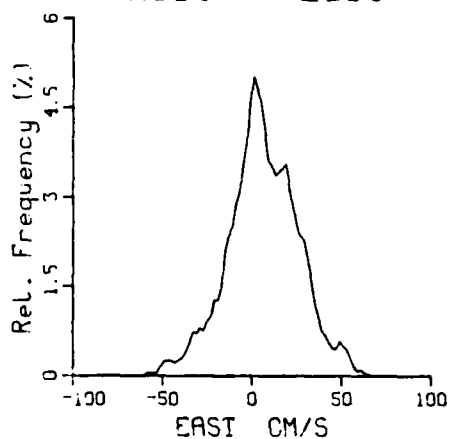
Weighted Direction



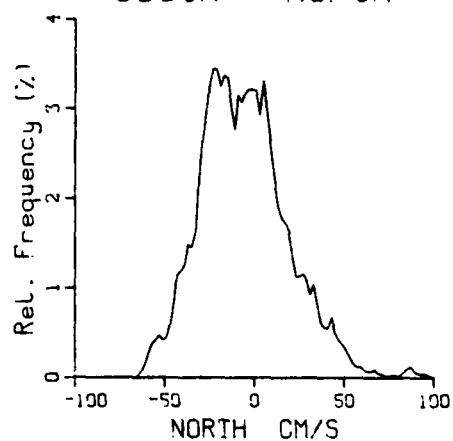
Speed



West East

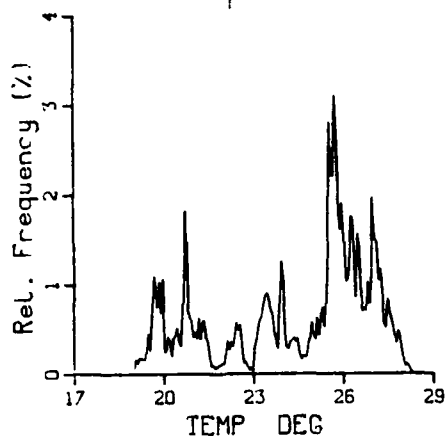


South North

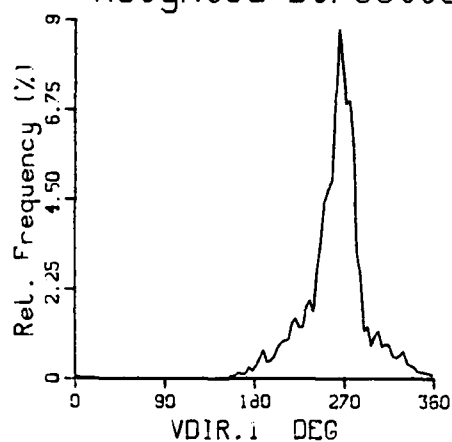


Data File 7922B225 : Depth = 5m

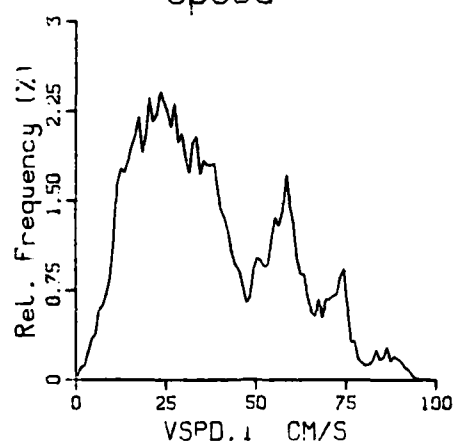
Temperature



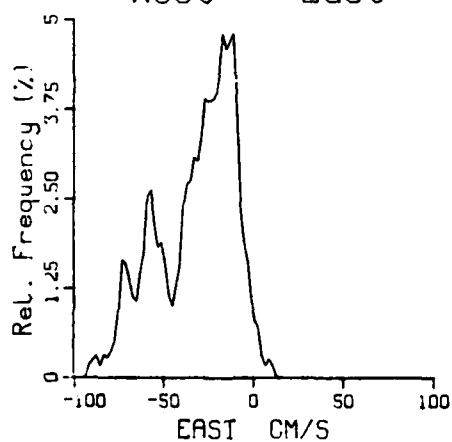
Weighted Direction



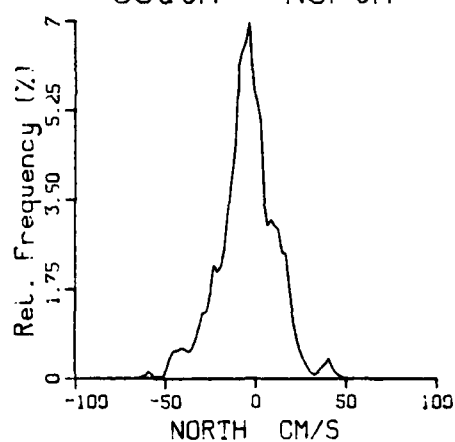
Speed



West East

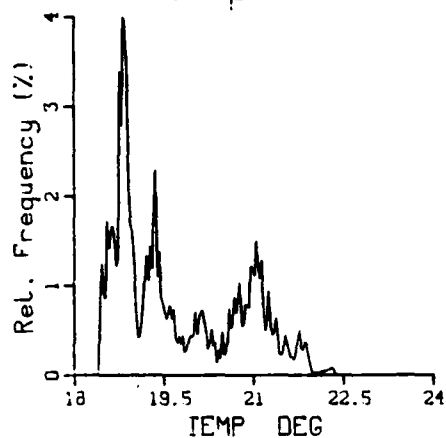


South North

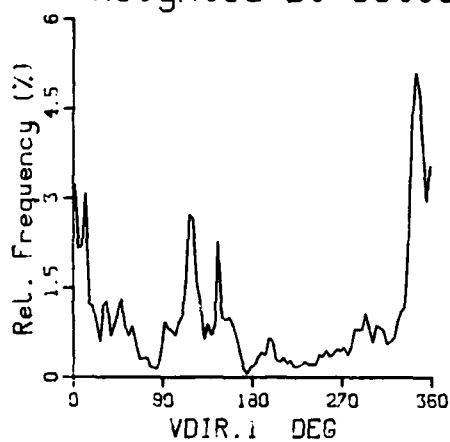


Data File 7874B225 : Depth. = 10m

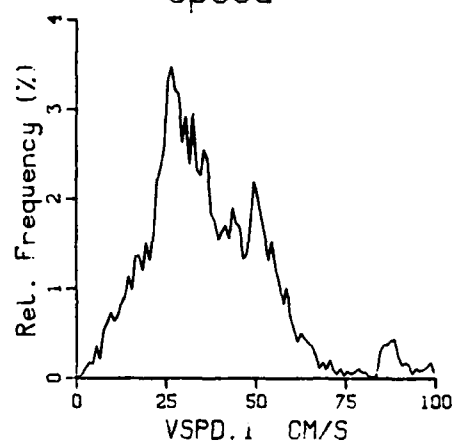
Temperature



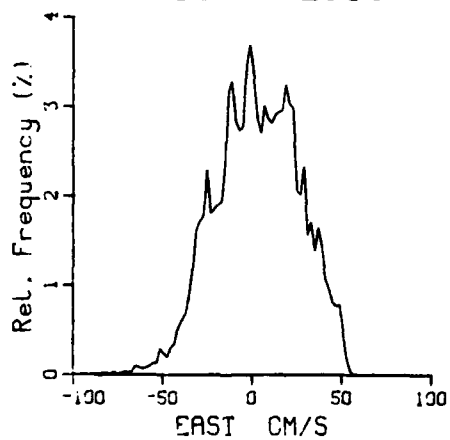
Weighted Direction



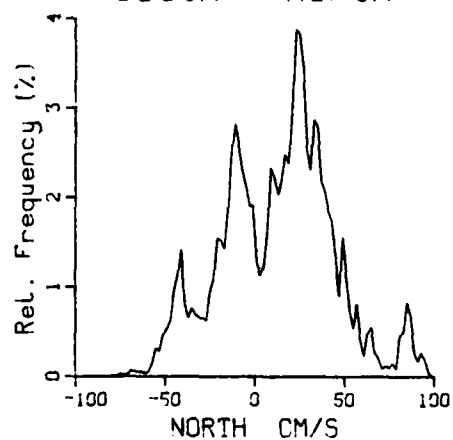
Speed



West East

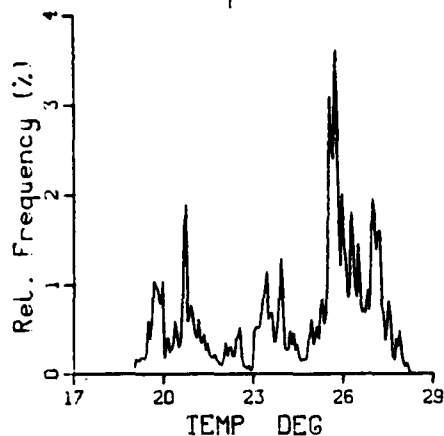


South North

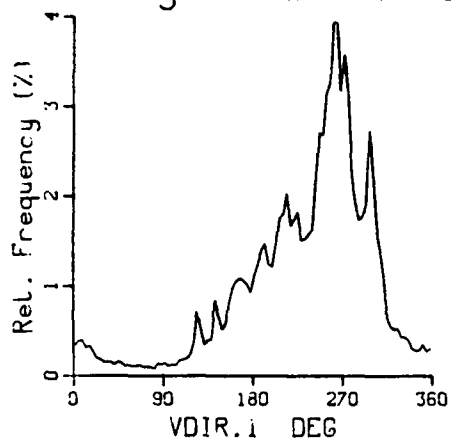


Data File 7923A225 : Depth = 10m

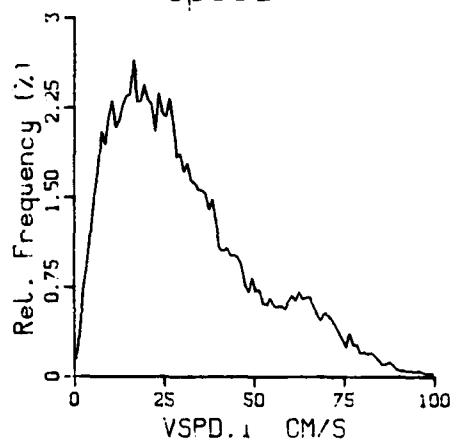
Temperature



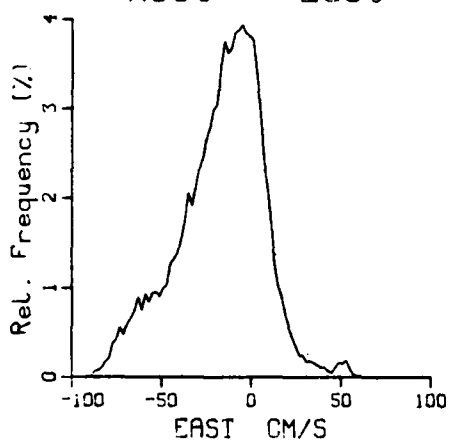
Weighted Direction



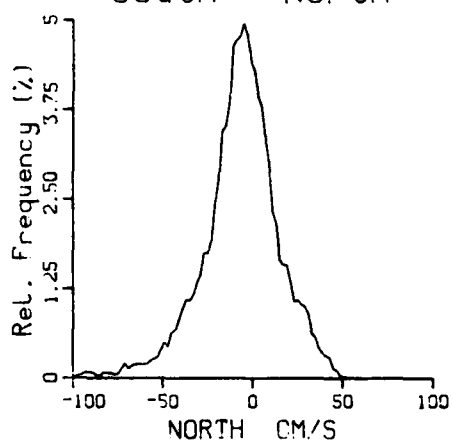
Speed



West East

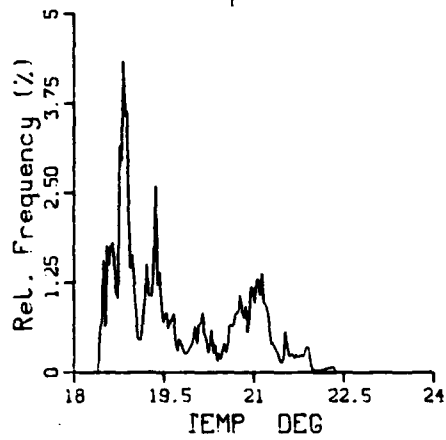


South North

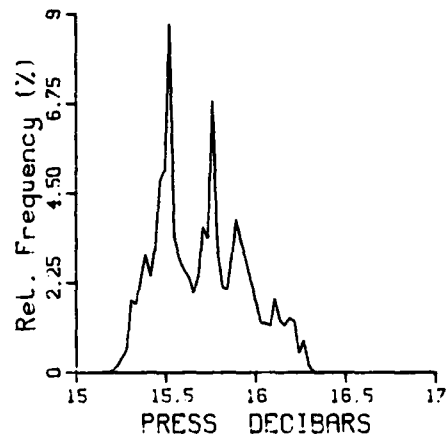


Data File 7875B450 : Depth = 15m

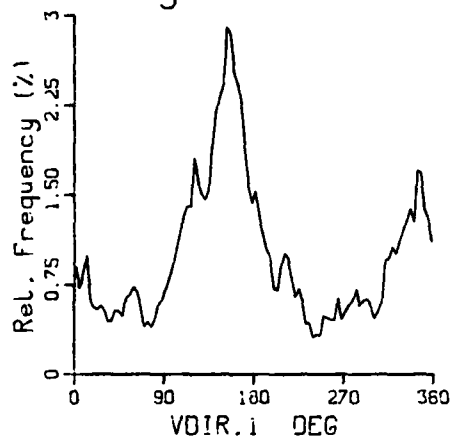
Temperature



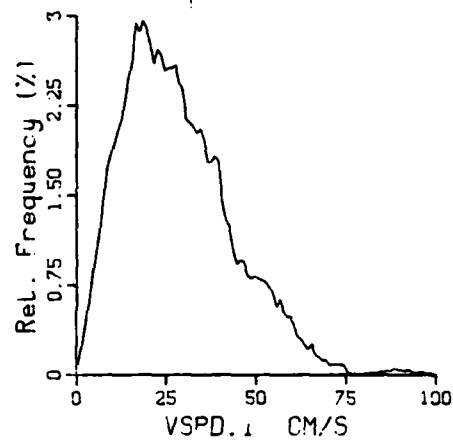
Pressure



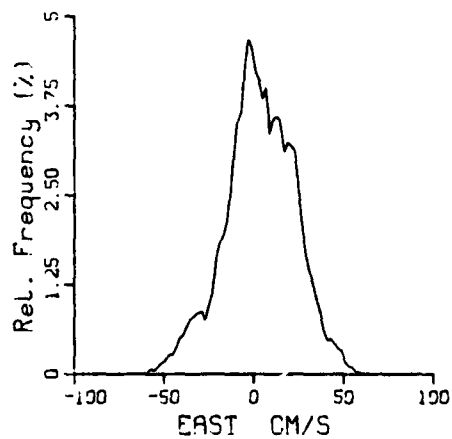
Weighted Direction



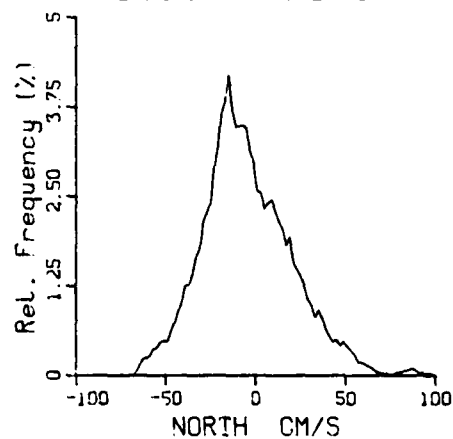
Speed



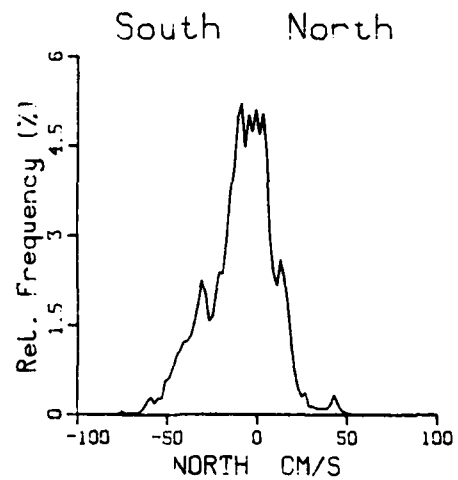
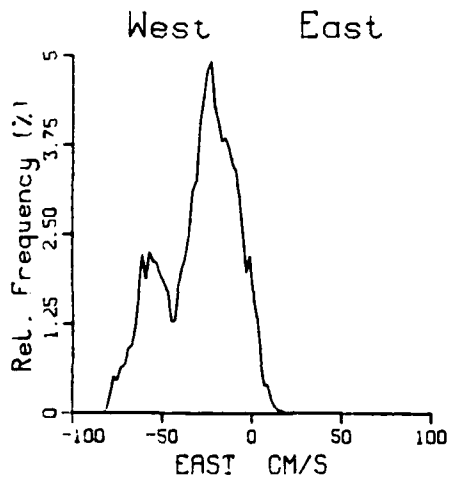
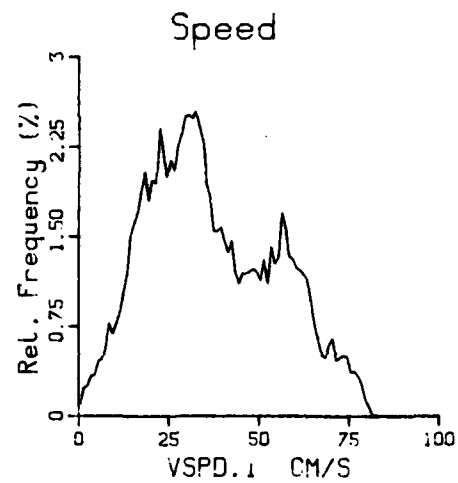
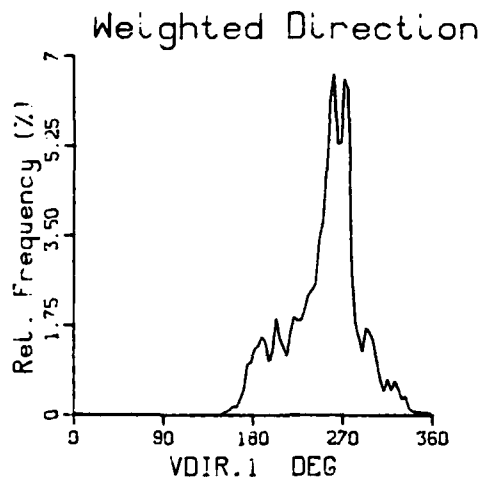
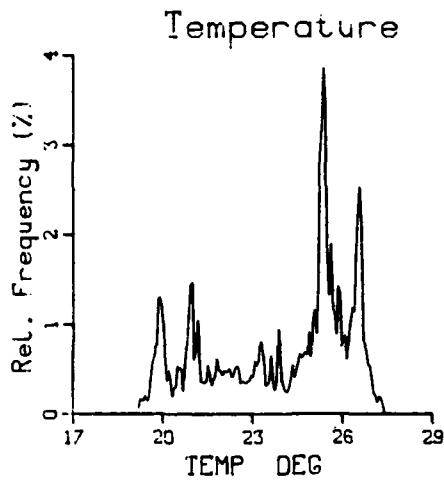
West East



South North

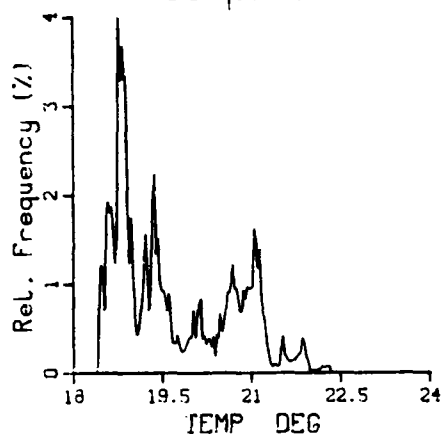


Data File 7924A225 : Depth = 15m

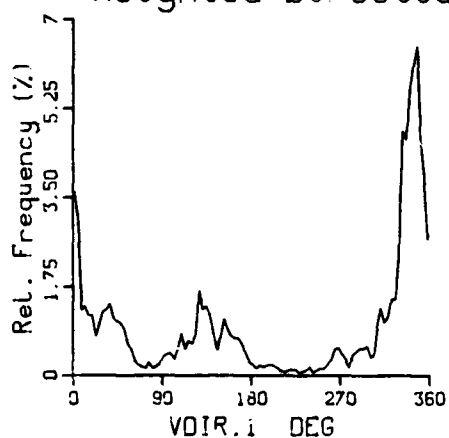


Data File 7876B225 : Depth = 25m

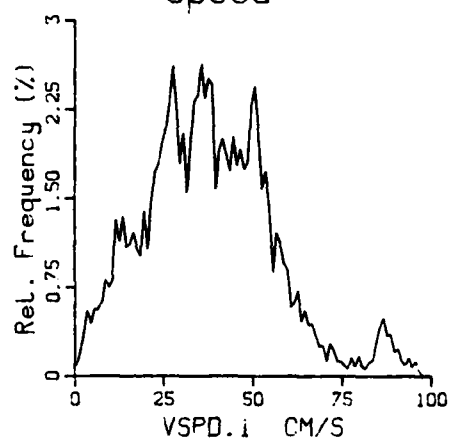
Temperature



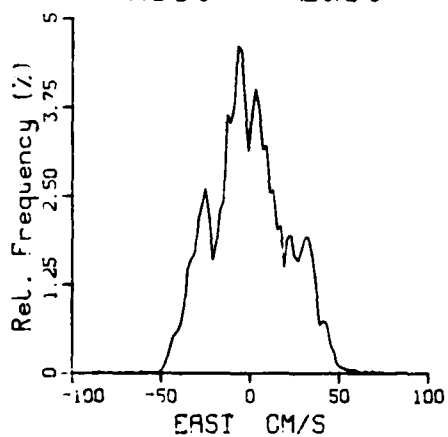
Weighted Direction



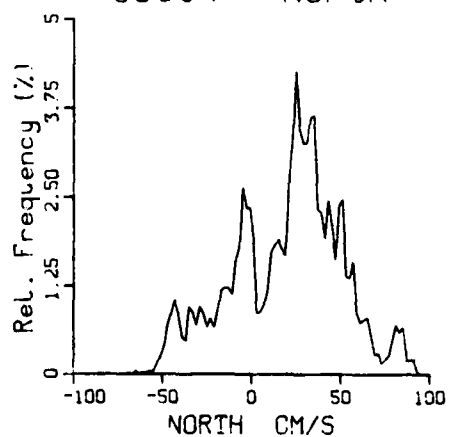
Speed



West East

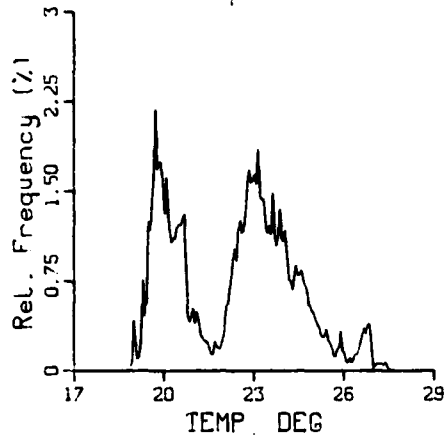


South North

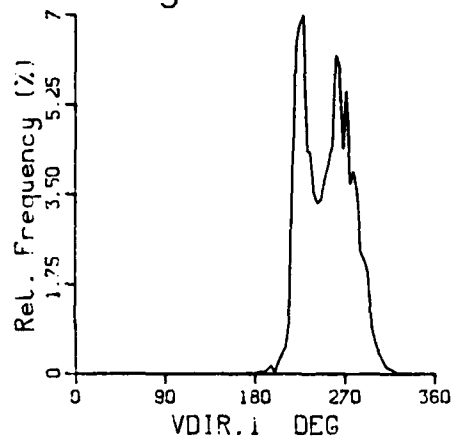


Data File 7925A225 : Depth = 25m

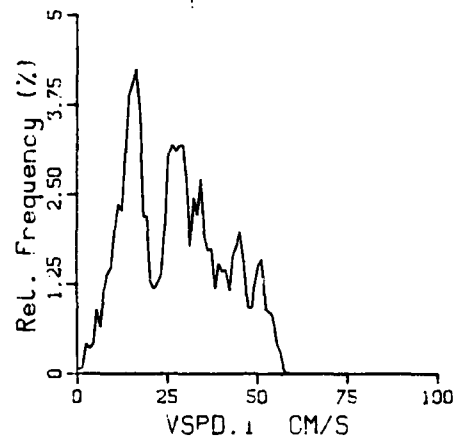
Temperature



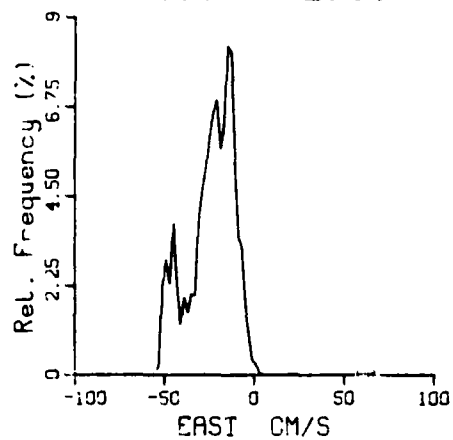
Weighted Direction



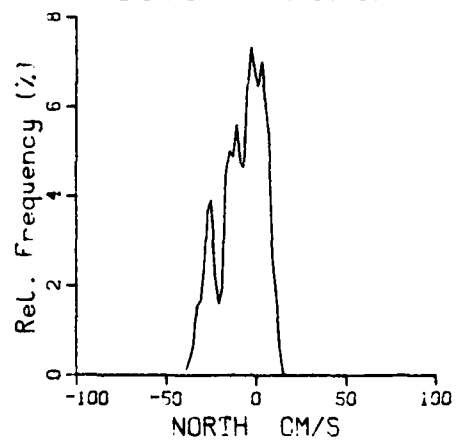
Speed



West East

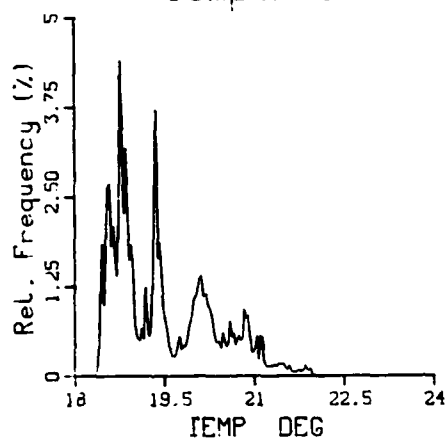


South North

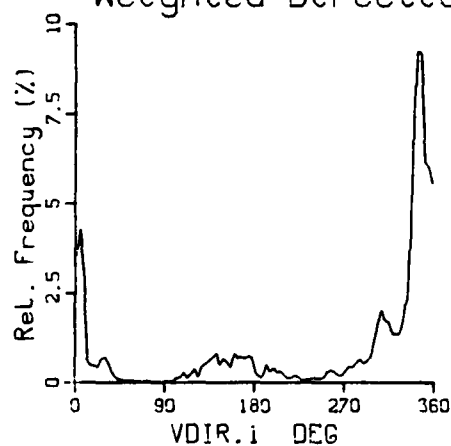


Data File 7877B225 : Depth = 50m

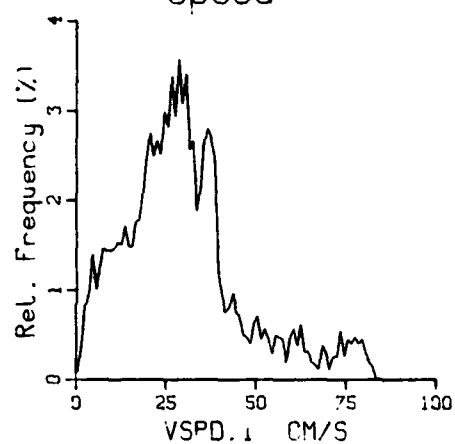
Temperature



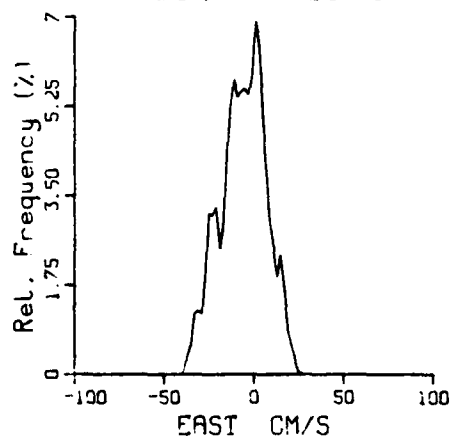
Weighted Direction



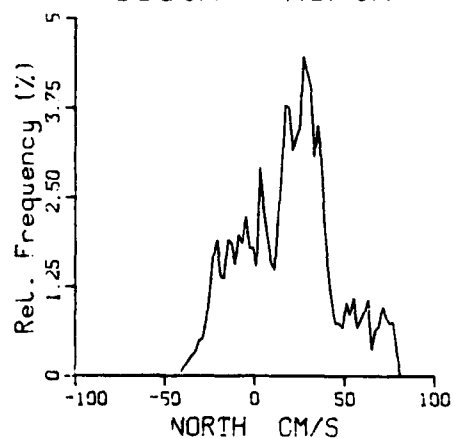
Speed



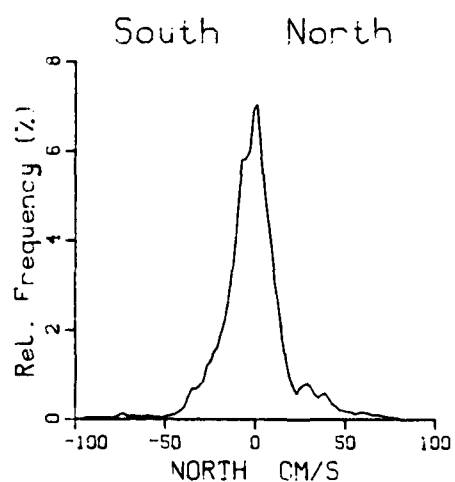
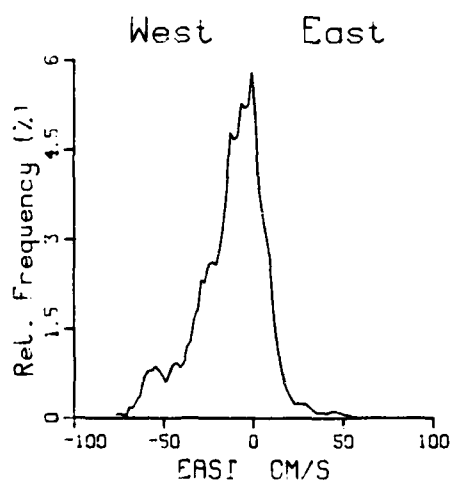
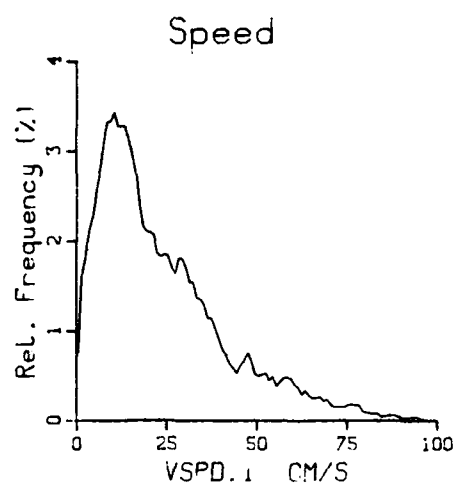
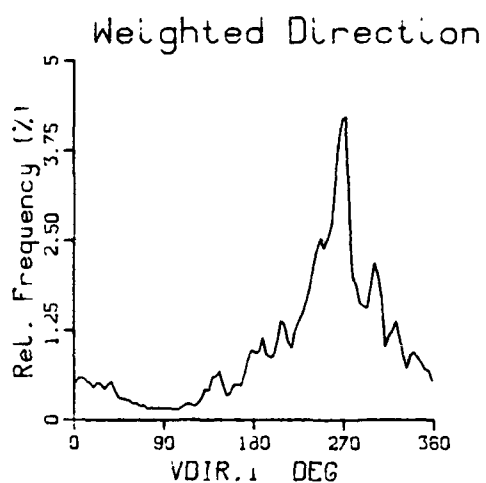
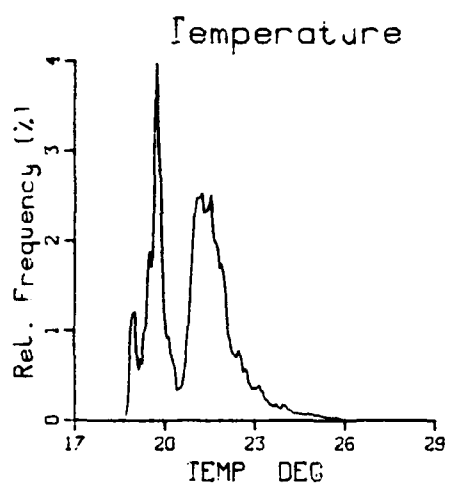
West East



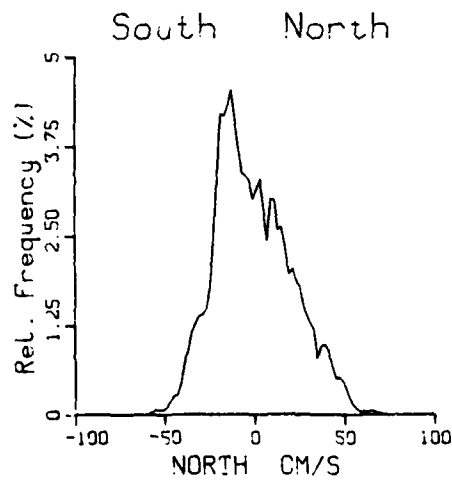
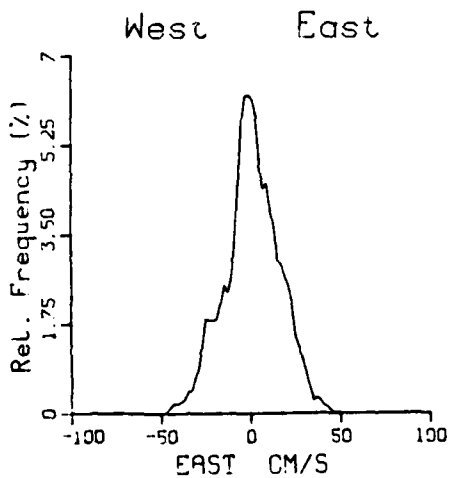
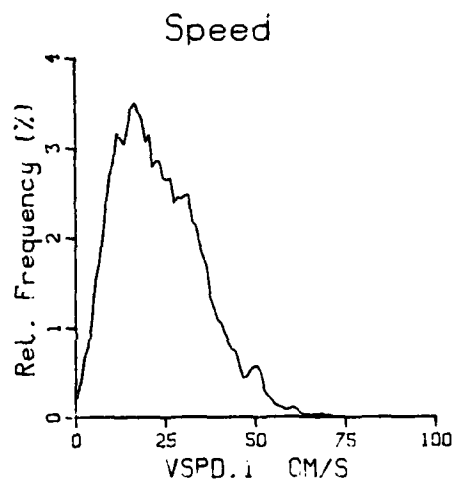
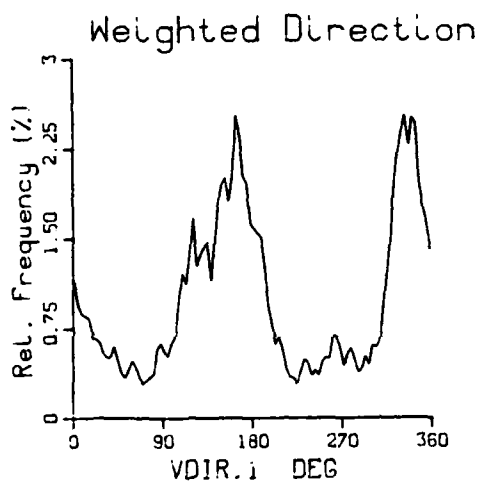
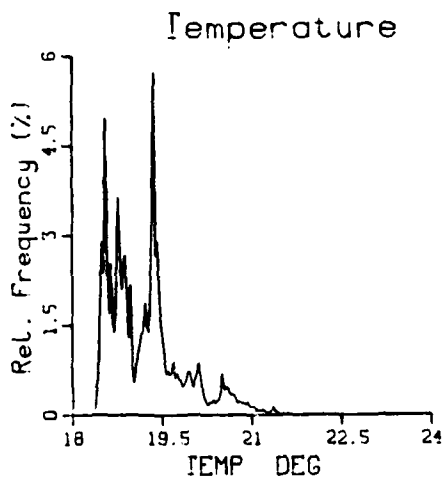
South North



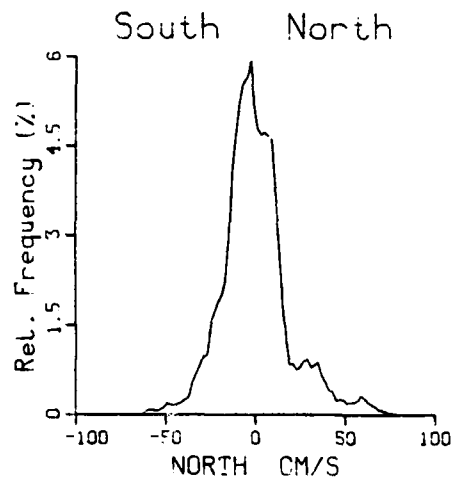
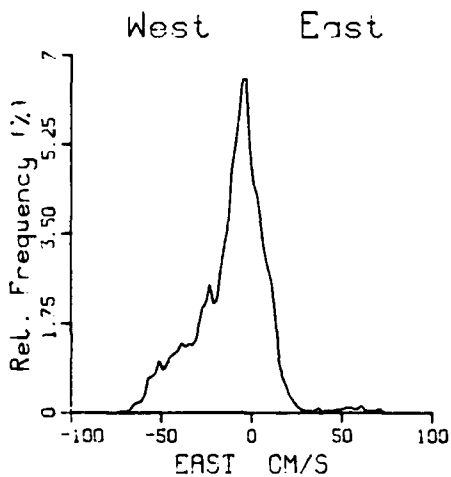
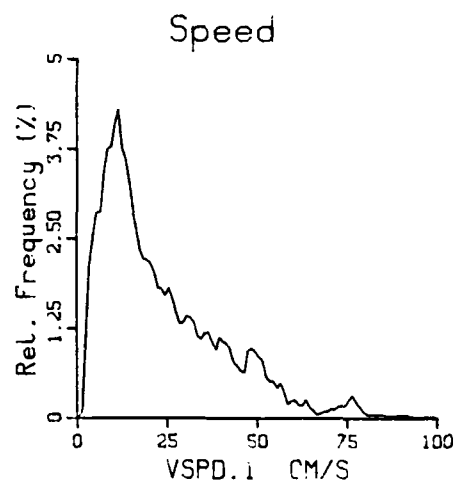
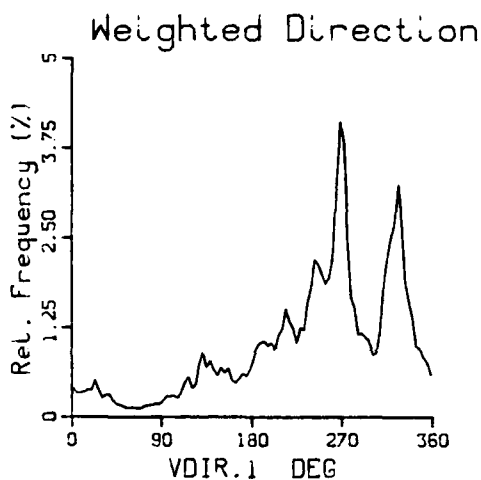
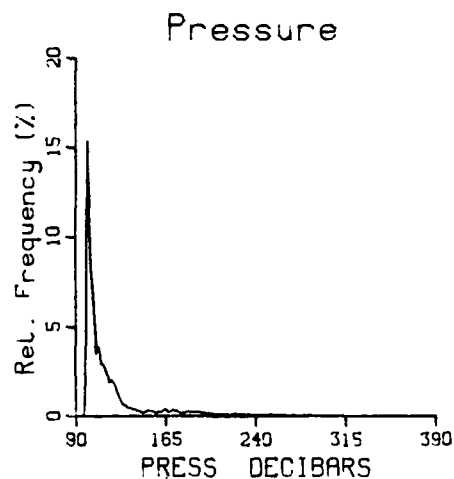
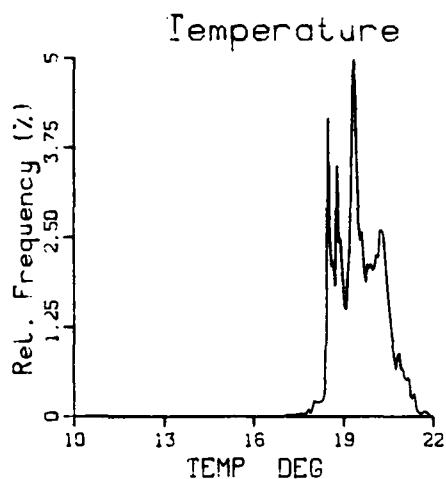
Data File 7926A225 : Depth = 50m



Data File 7878B225 : Depth = 75m



Data File 7928A225 : Depth = 76m



Data File 7881B450 : Depth = 98m

A COMPILATION OF MOORED CURRENT METER AND WIND RECORDER
DATA VOLUME 38 L.O. (U) WOODS HOLE OCEANOGRAPHIC
INSTITUTION MA 5 A TARBELL ET AL. DEC 85 WHOI-85-39

2/2

INSTITUTION NA
N00014-76-C-0197

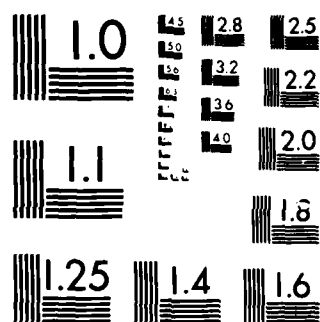
F/G 8/3

NL

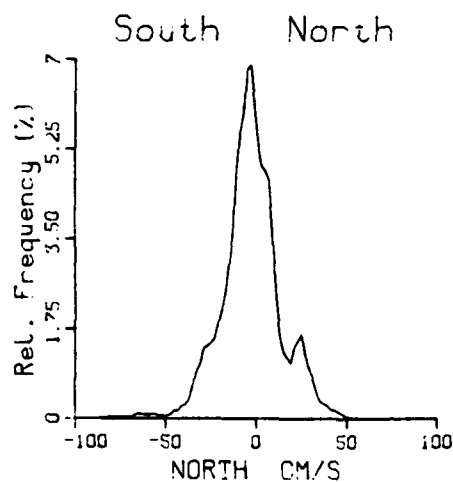
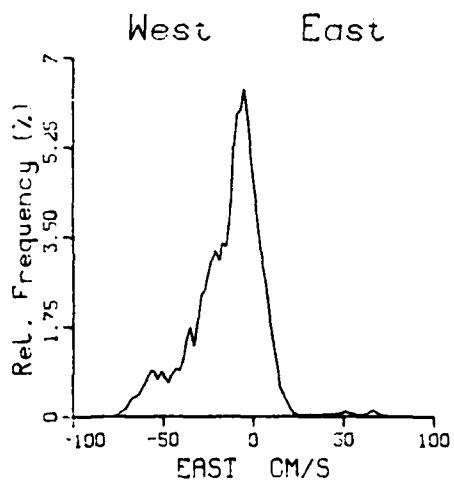
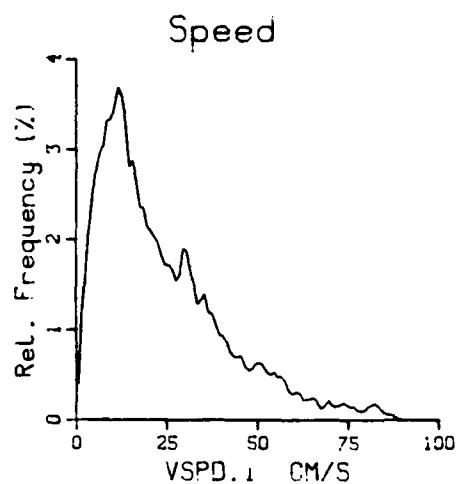
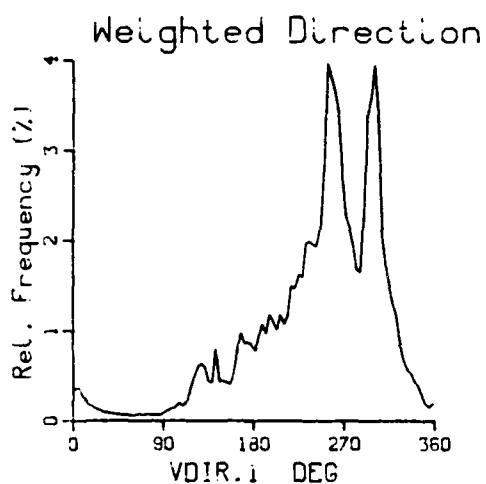
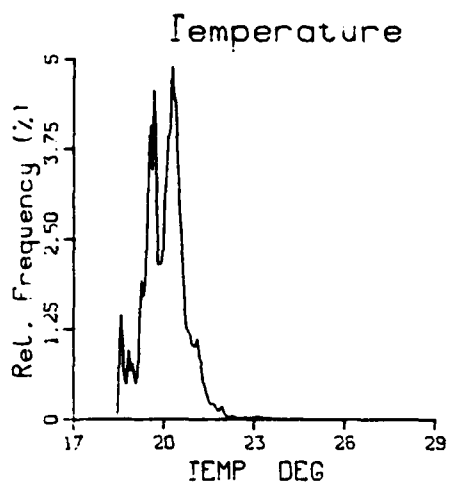
END

FILMED

GTP+G

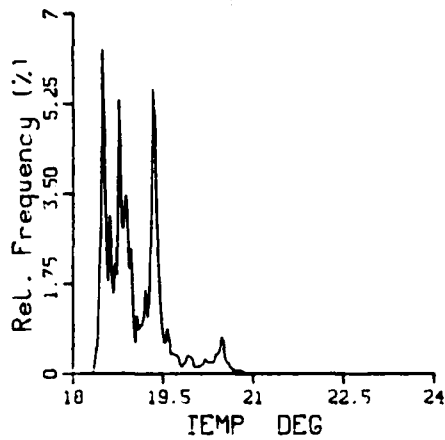


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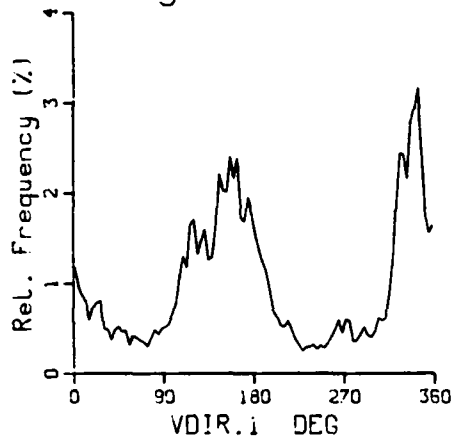


Data File 7879B225 : Depth = 100m

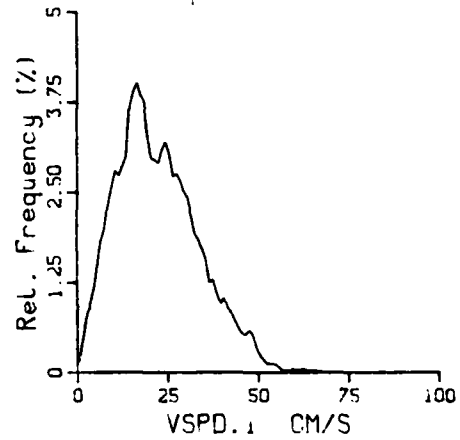
Temperature



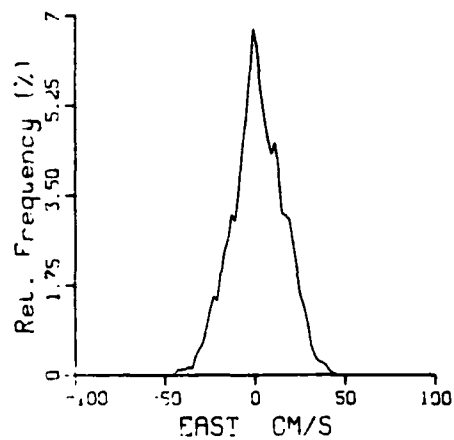
Weighted Direction



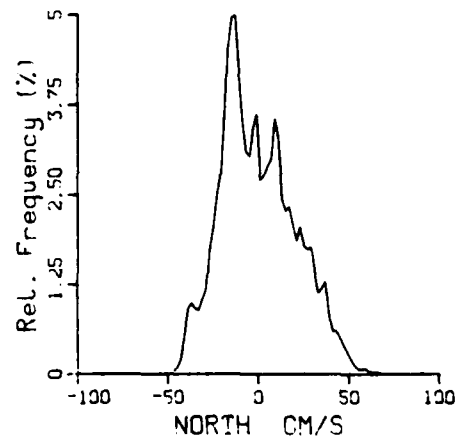
Speed



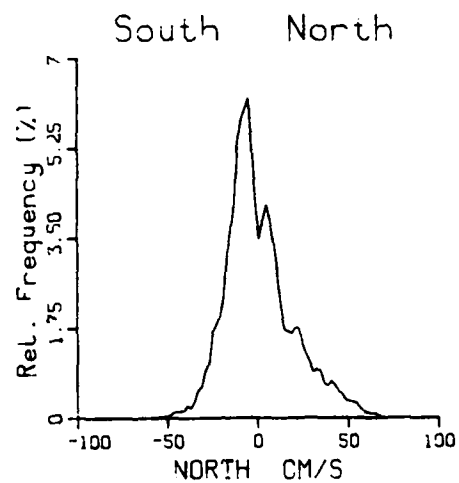
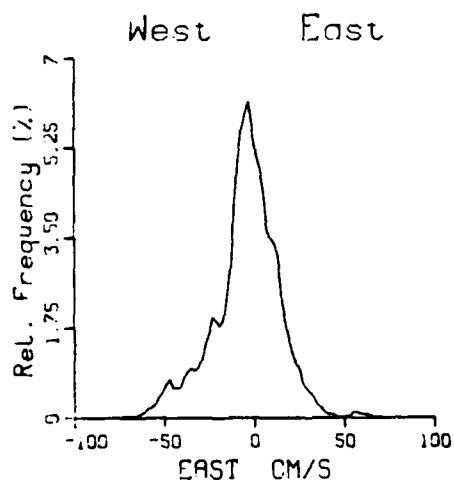
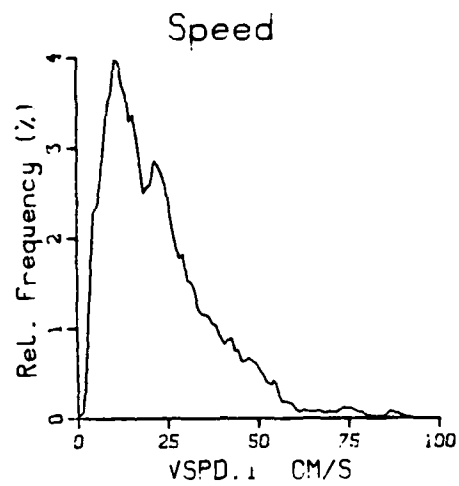
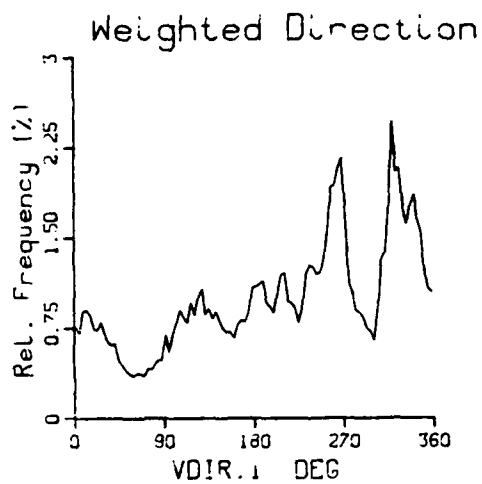
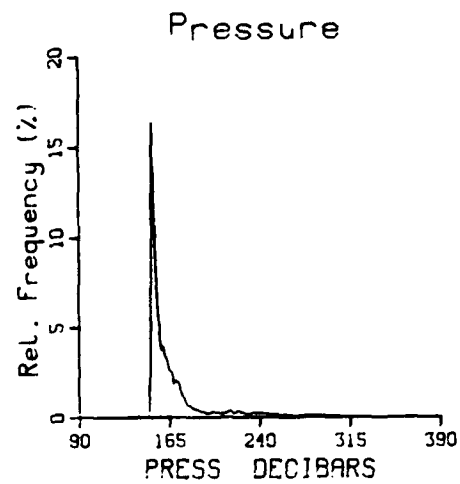
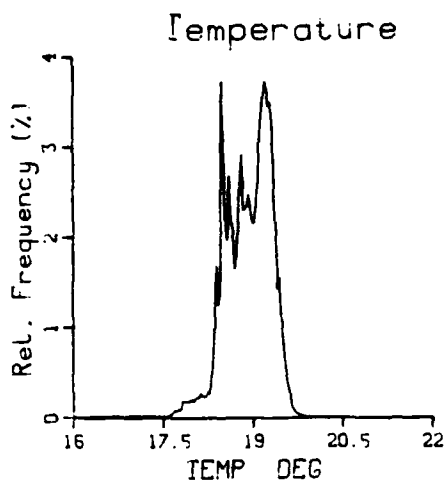
West East



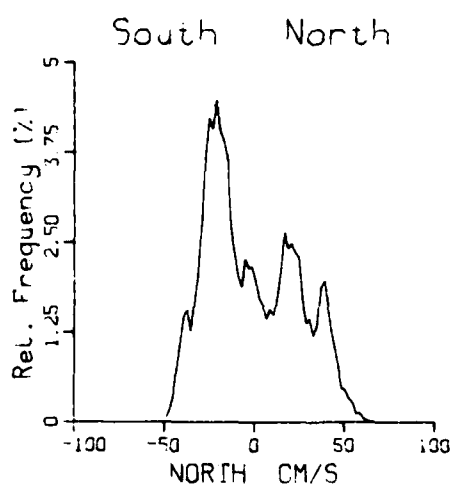
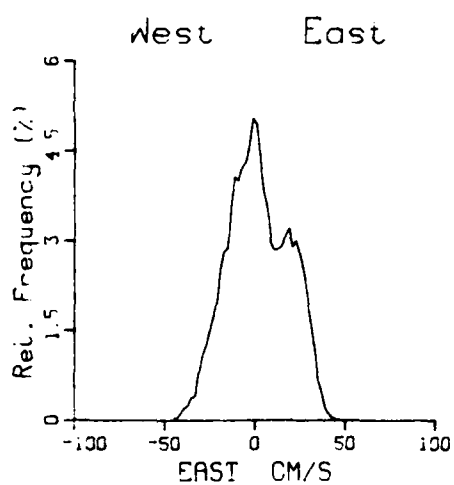
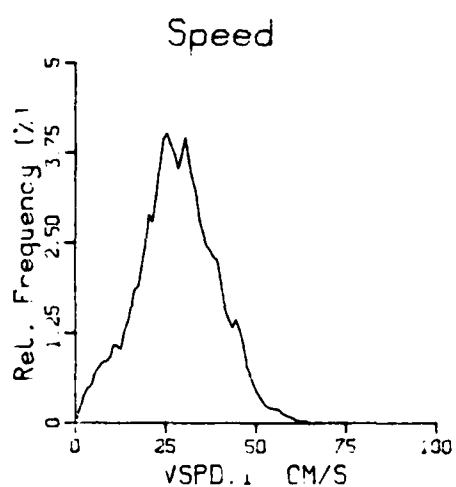
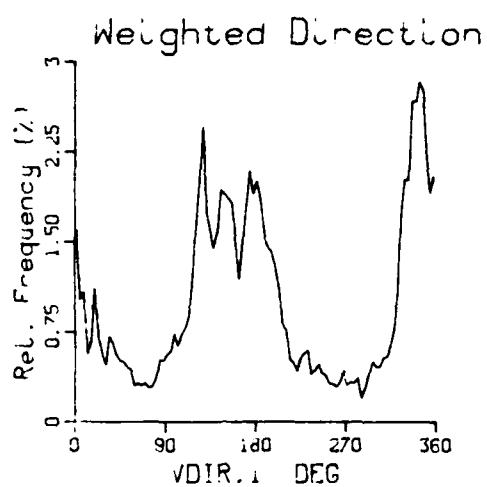
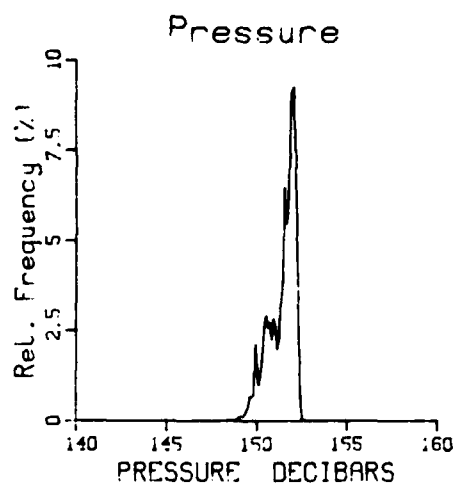
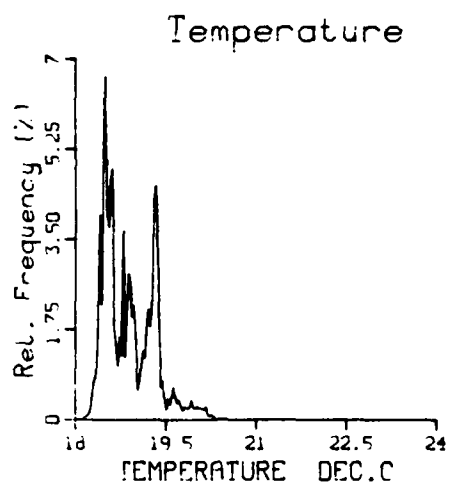
South North



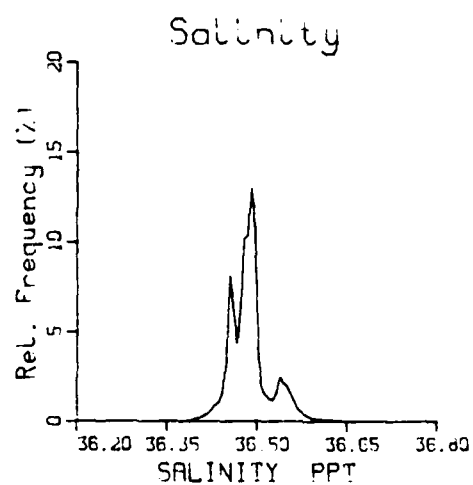
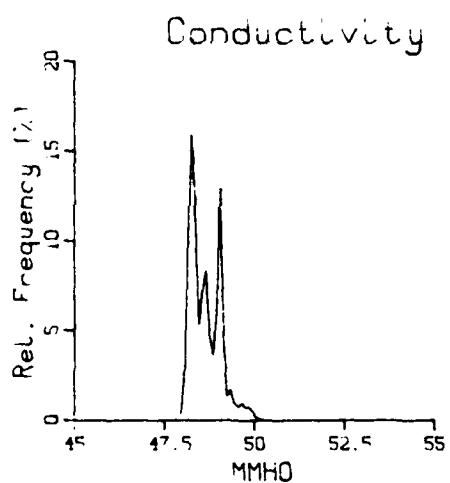
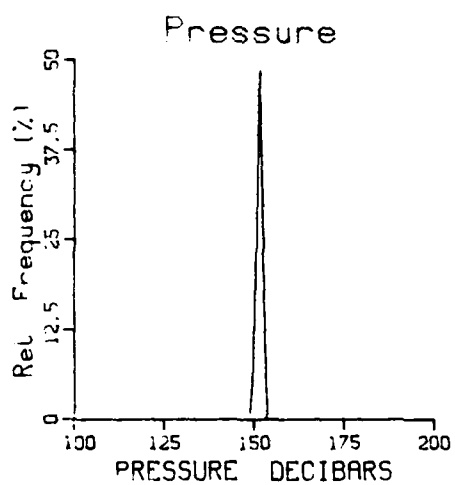
Data File 7929A225 : Depth = 101m



Data File 7882B450 : Depth = 148m

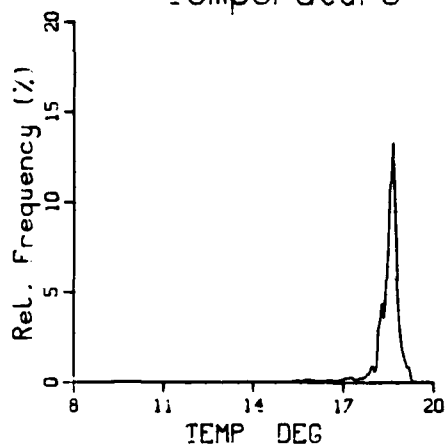


Data File 79210B225 : Depth = 152m

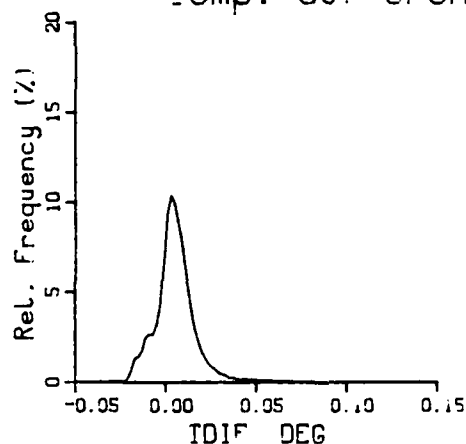


Data File 79210B225 : Depth = 152m

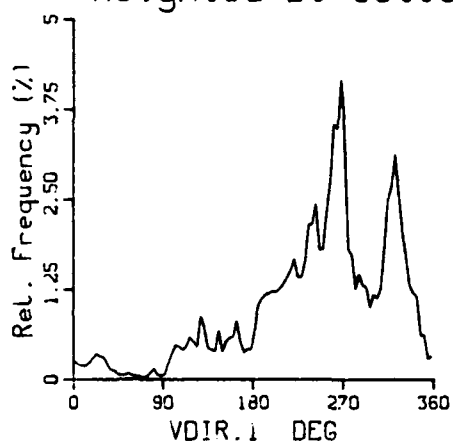
Temperature



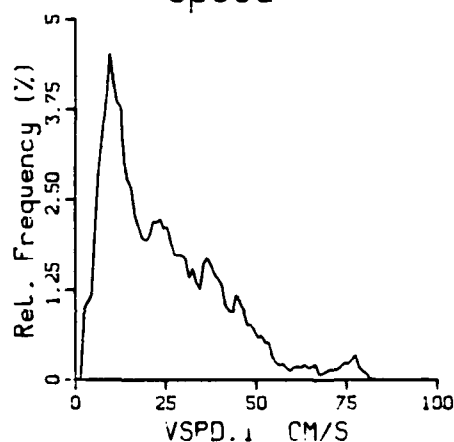
Temp. difference



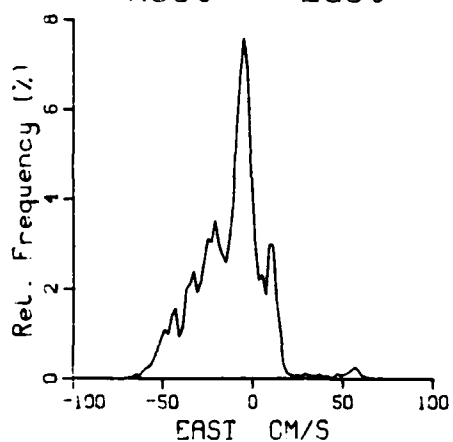
Weighted Direction



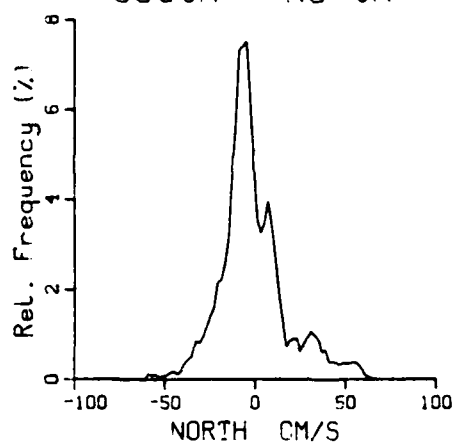
Speed



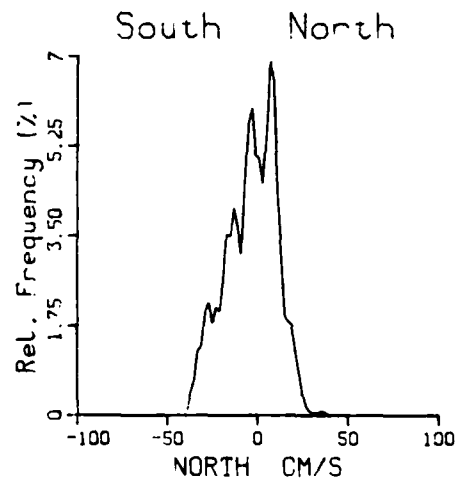
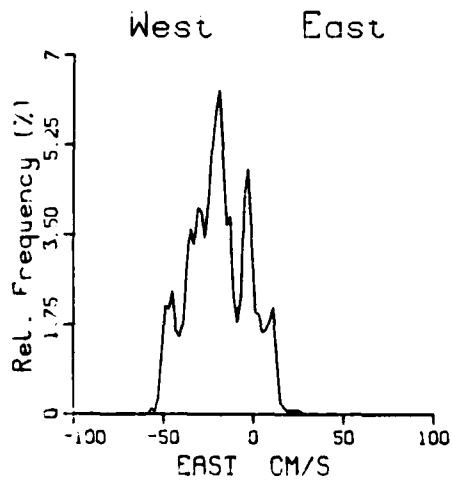
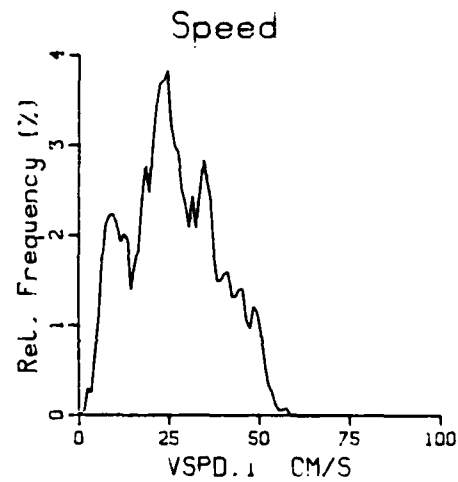
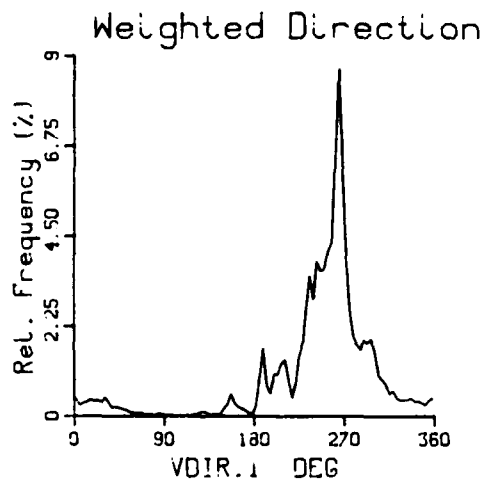
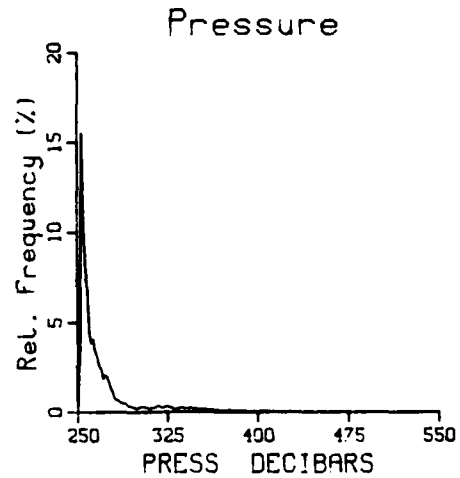
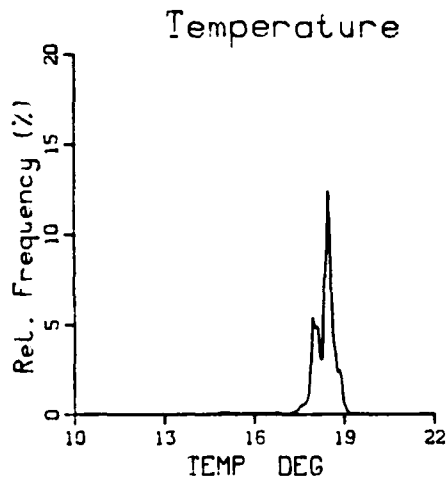
West East



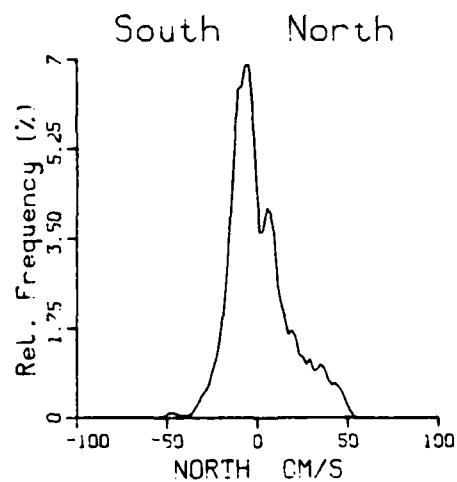
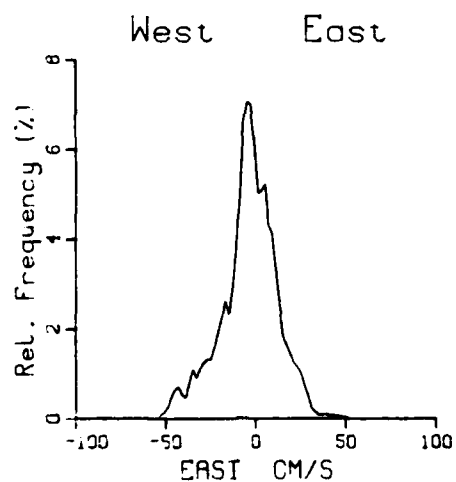
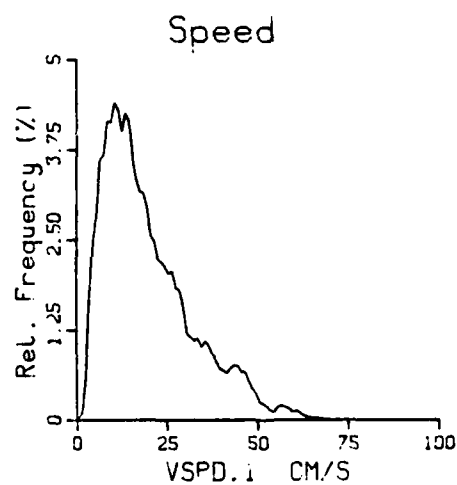
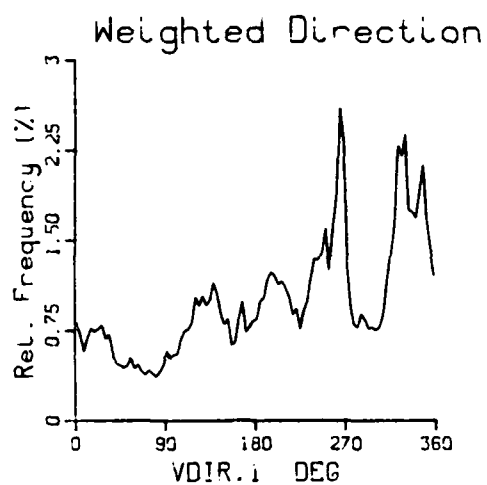
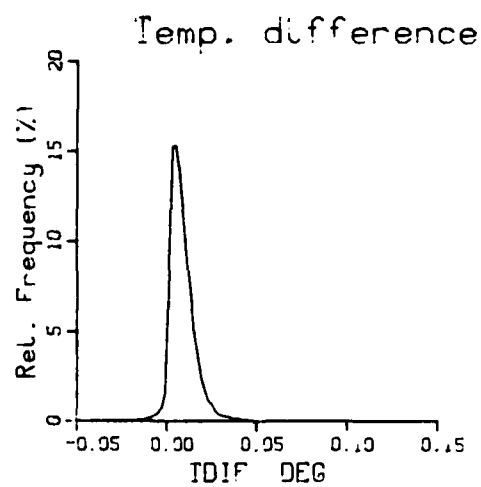
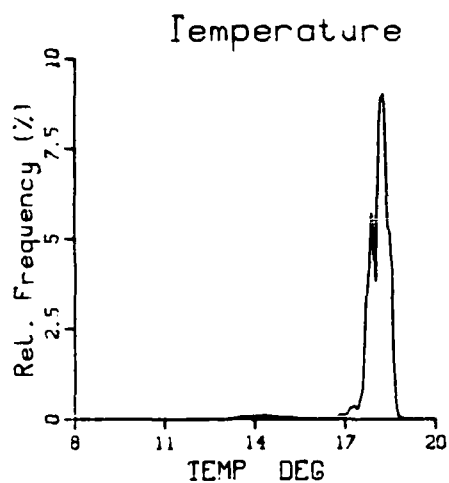
South North



Data File 7883B450 : Depth = 198m

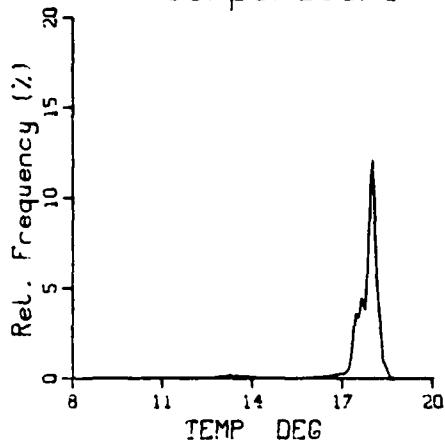


Data File 7884B450 : Depth = 248m

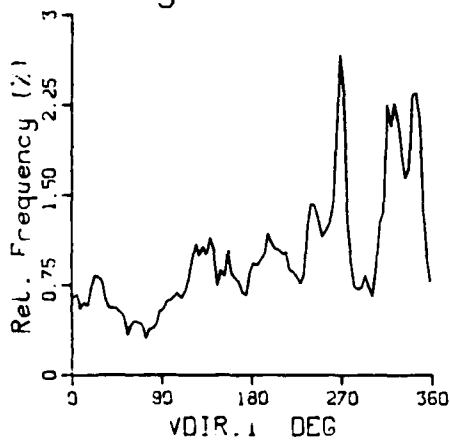


Data File 7885A450 : Depth = 298m

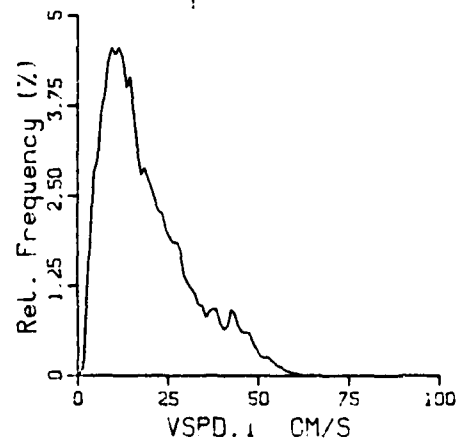
Temperature



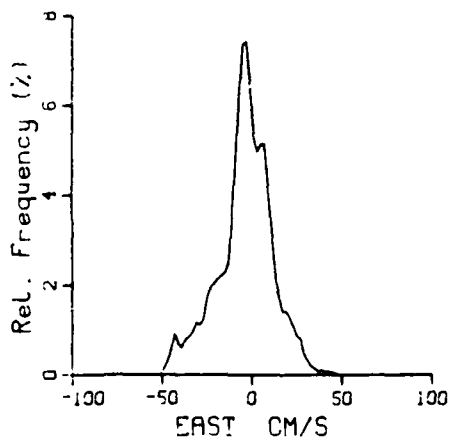
Weighted Direction



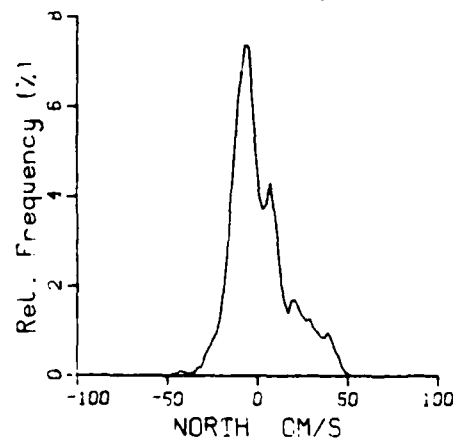
Speed



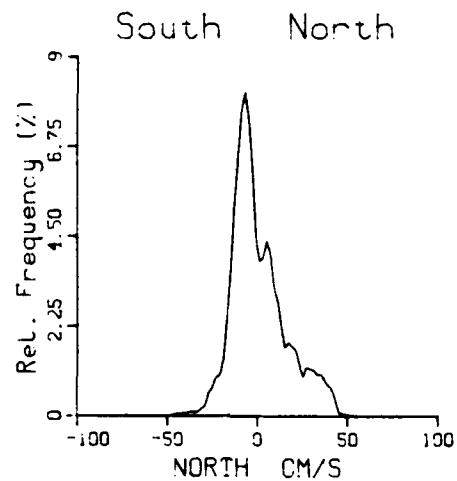
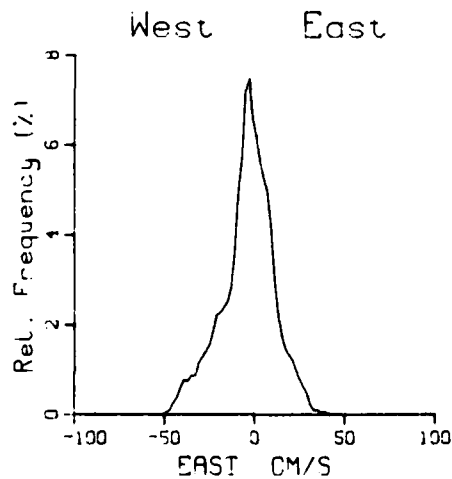
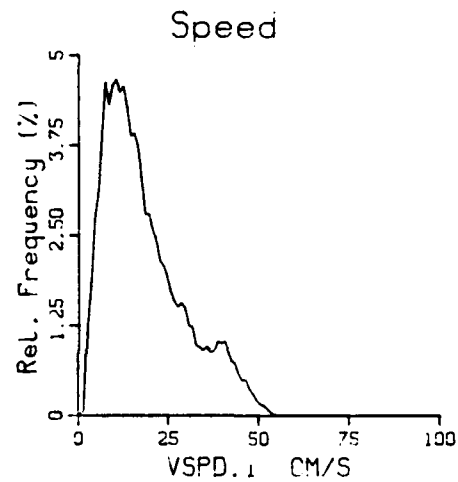
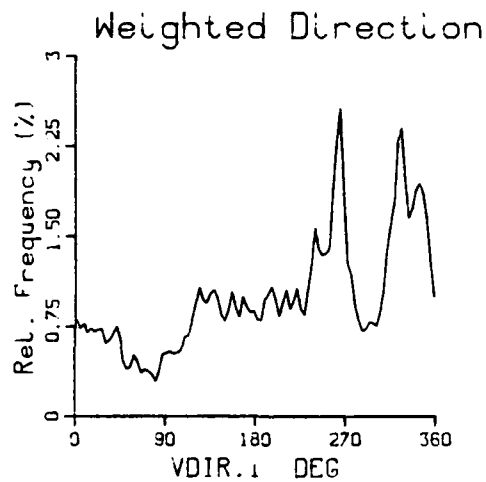
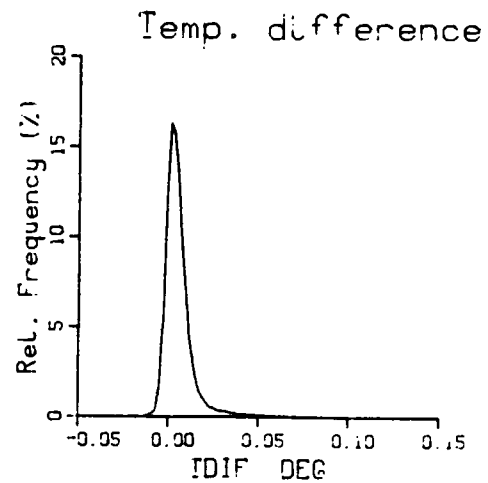
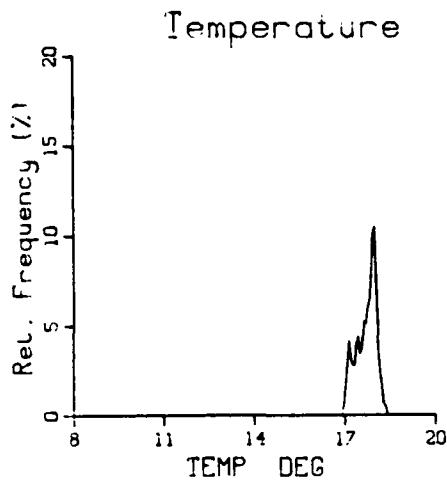
West East



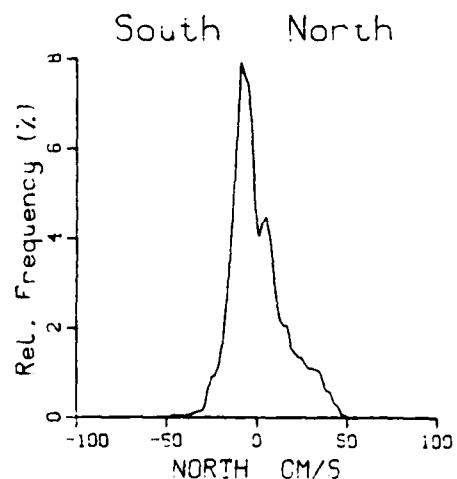
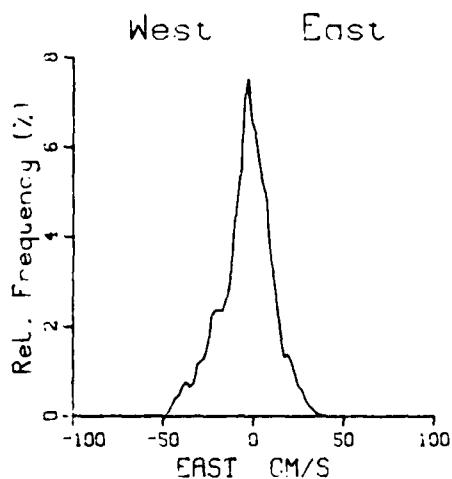
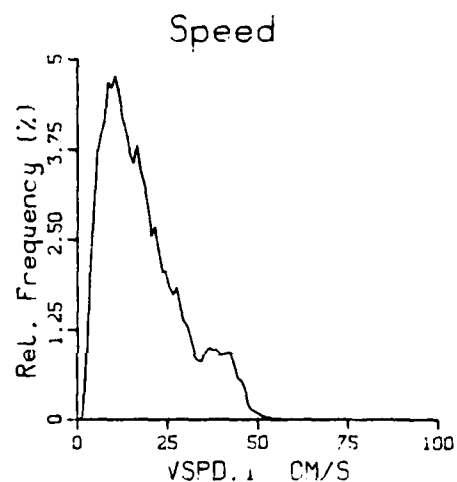
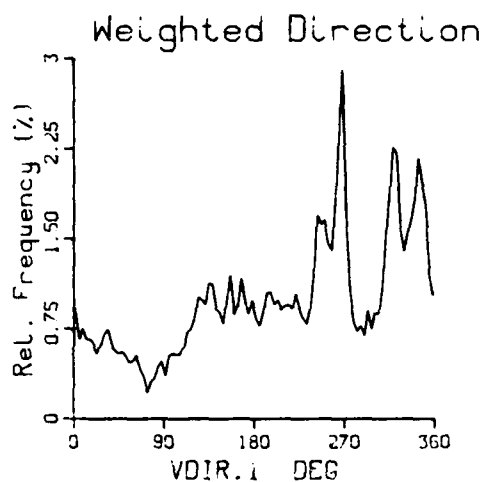
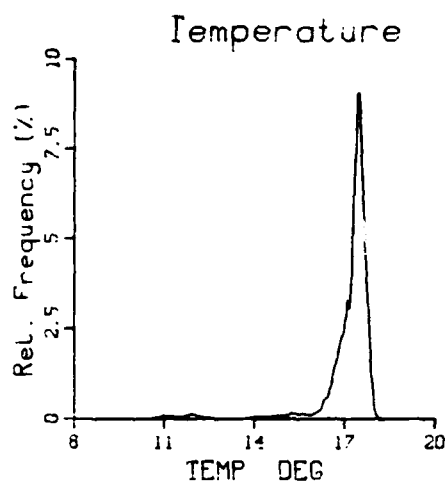
South North



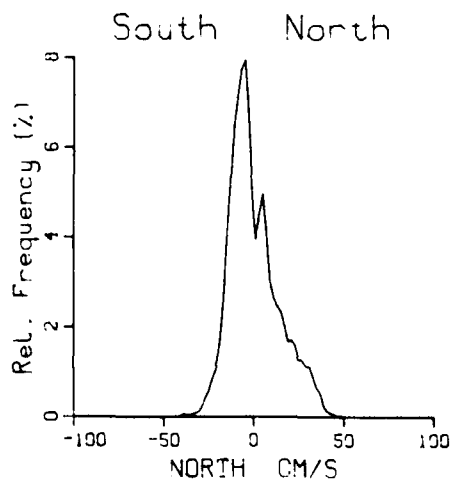
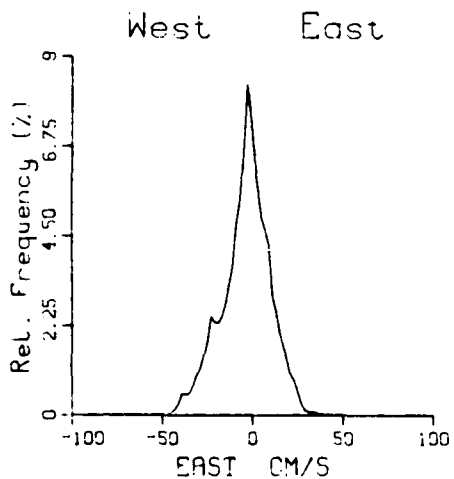
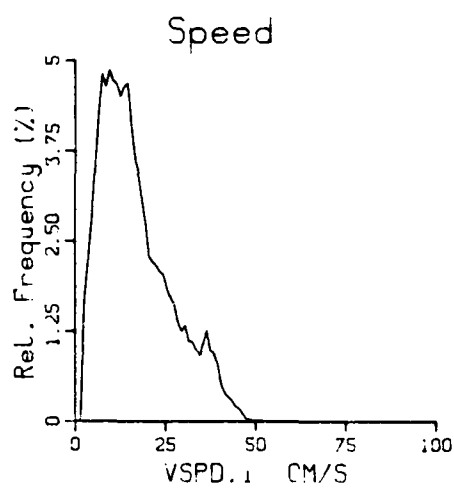
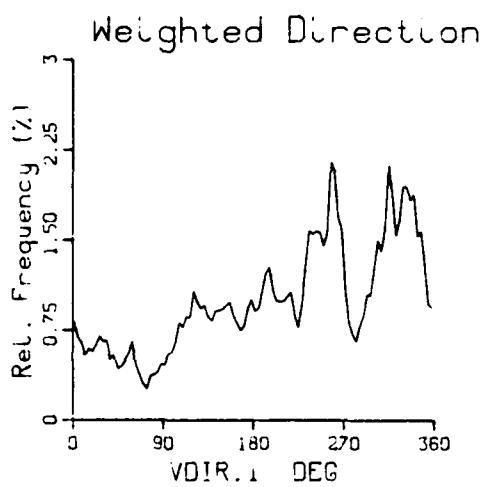
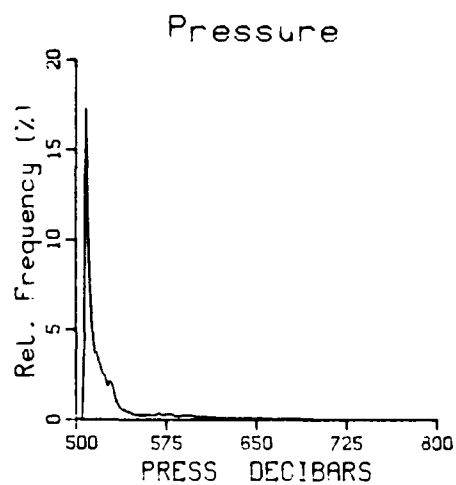
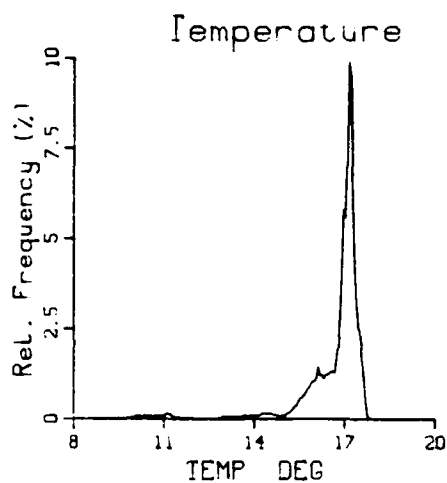
Data File 7886A450 : Depth = 348m



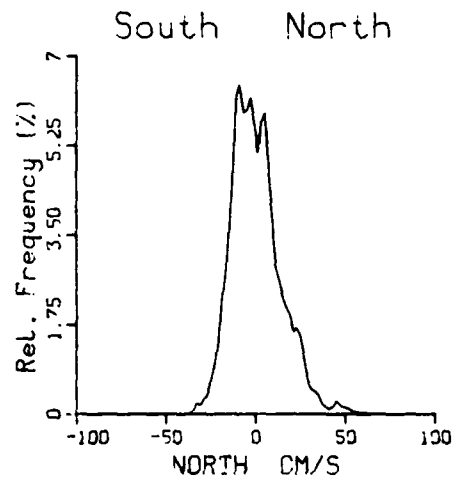
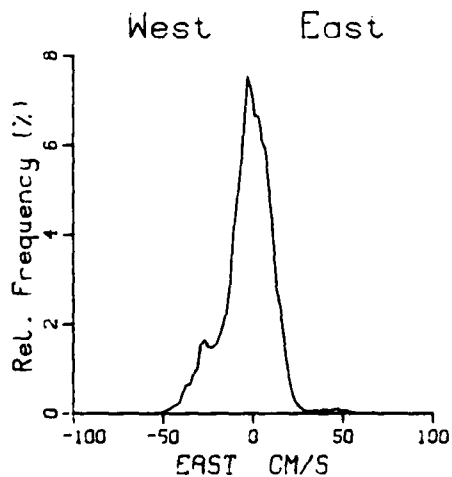
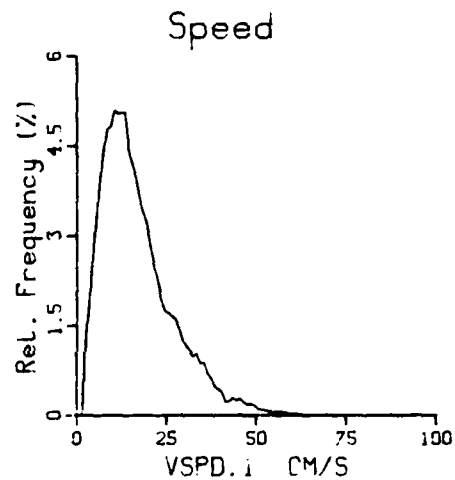
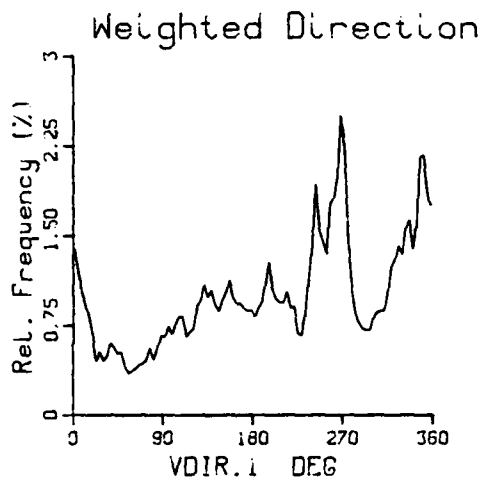
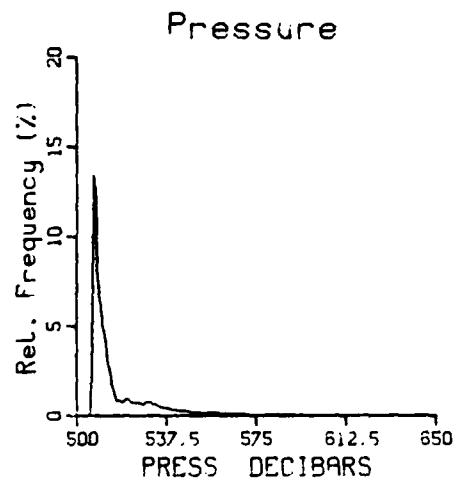
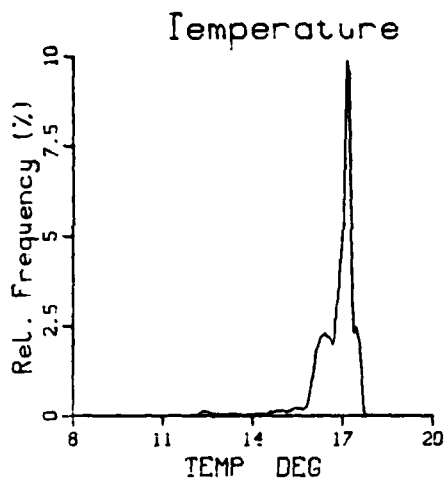
Data File 7887B450 : Depth = 398m



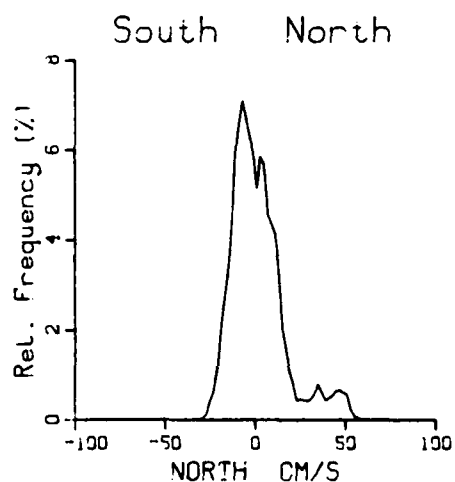
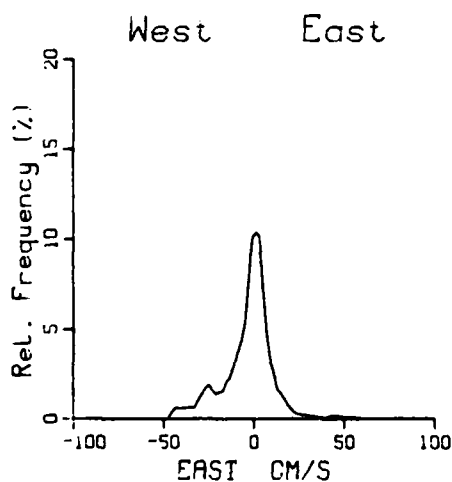
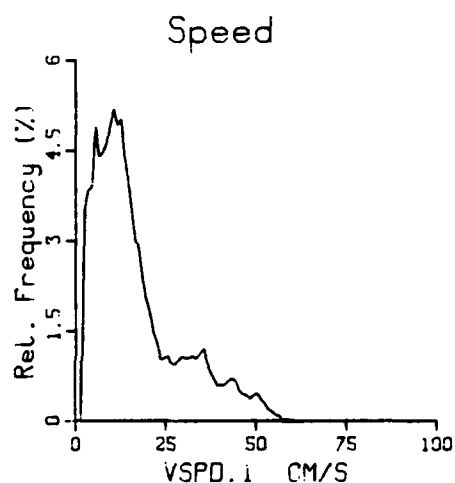
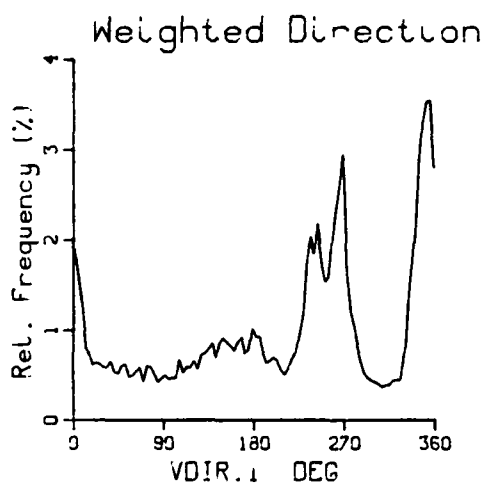
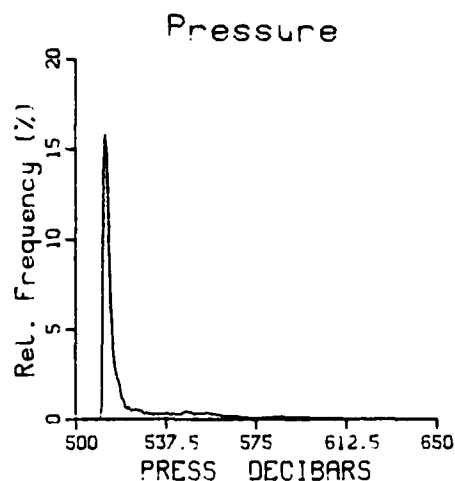
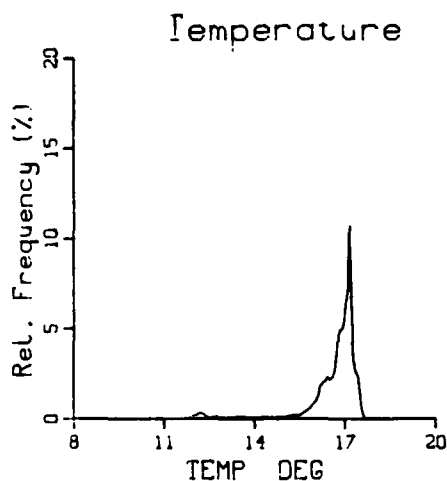
Data File 7888B450 : Depth = 448m



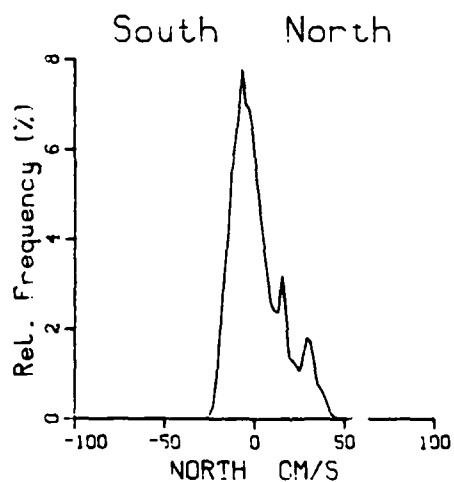
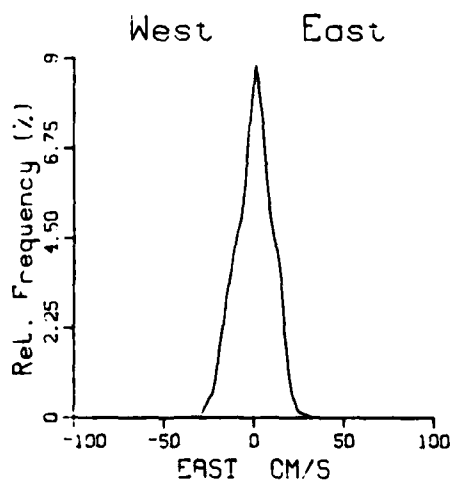
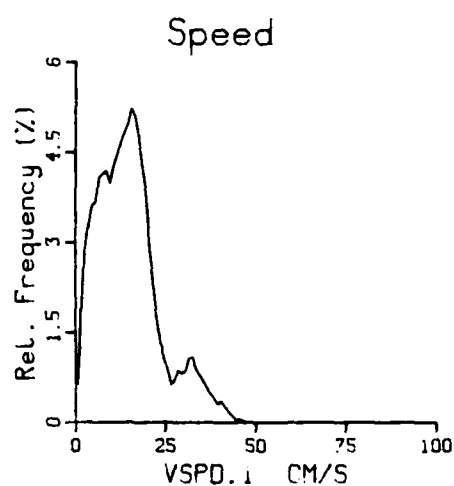
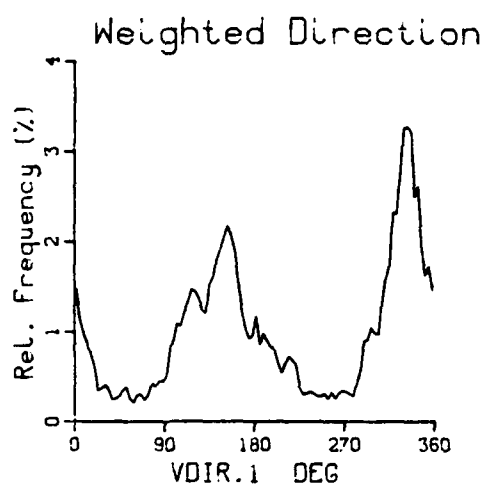
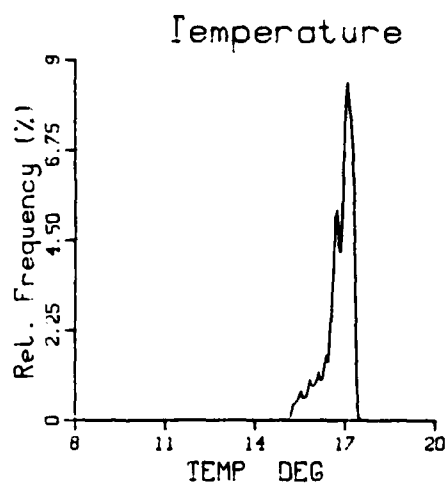
Data File 7889B450 : Depth = 498m



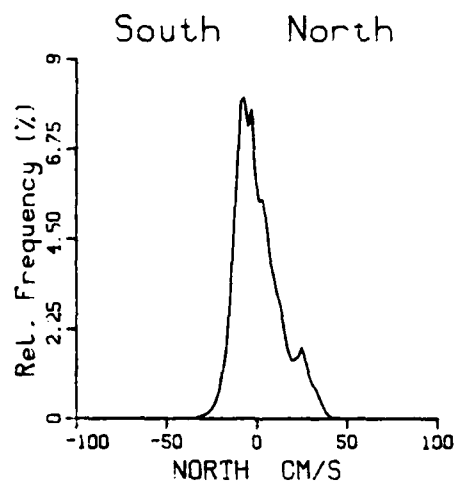
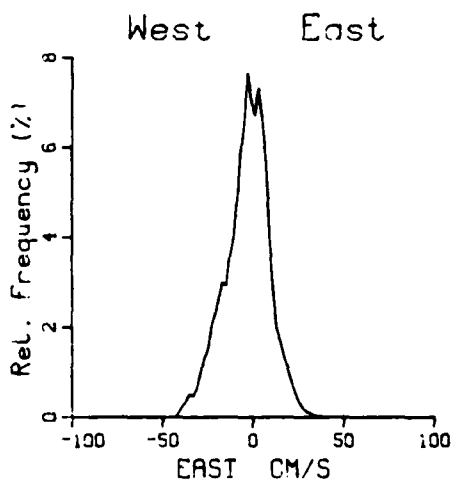
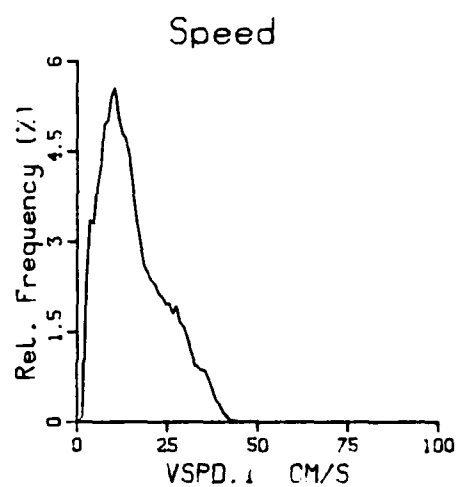
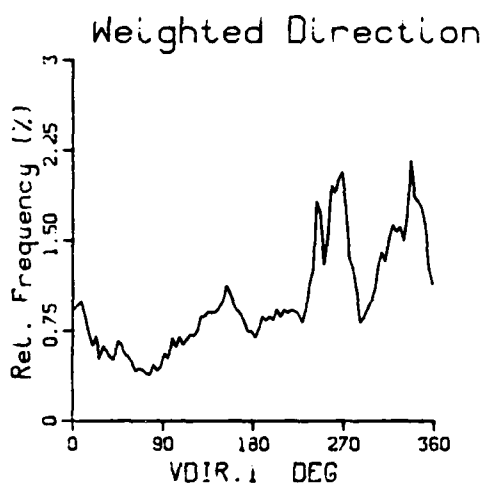
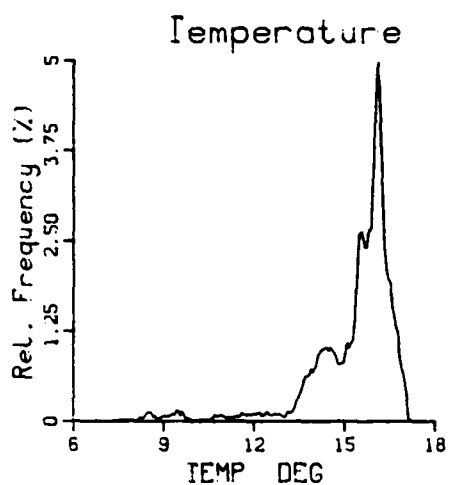
Data File 7891B450 : Depth = 498m



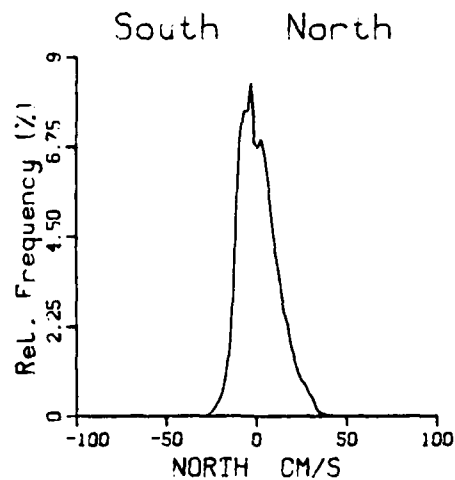
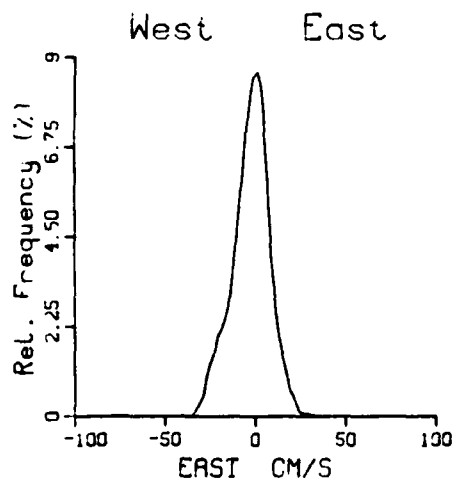
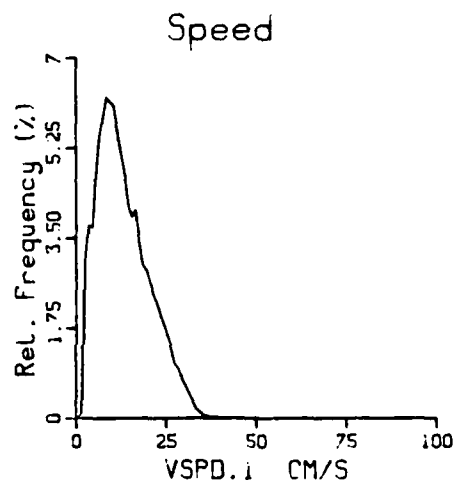
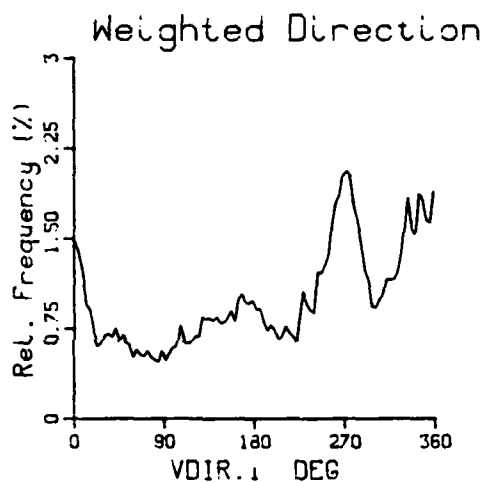
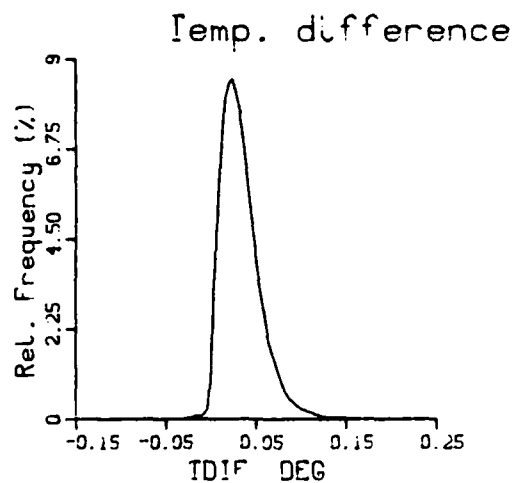
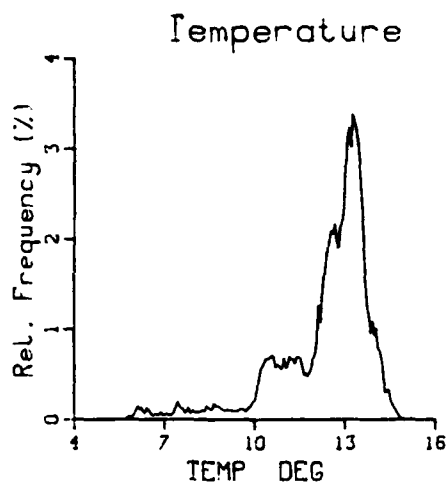
Data File 7902B450 : Depth = 509m



Data File 79214A225 : Depth = 530m

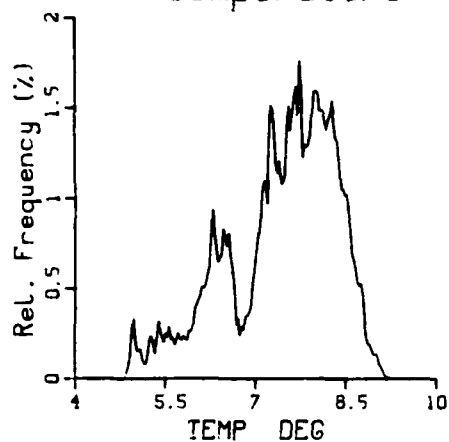


Data File 78810B450 : Depth = 598m

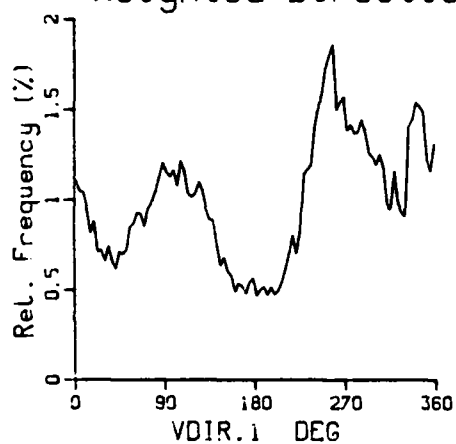


Data File 78811B450 : Depth = 748m

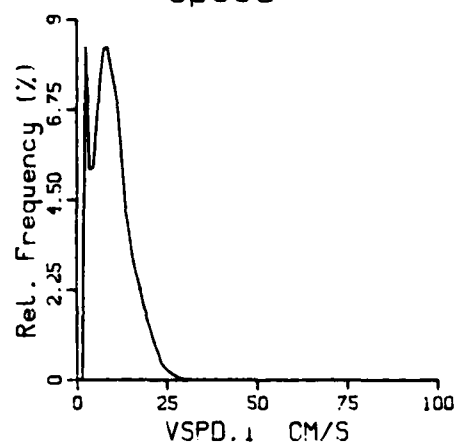
Temperature



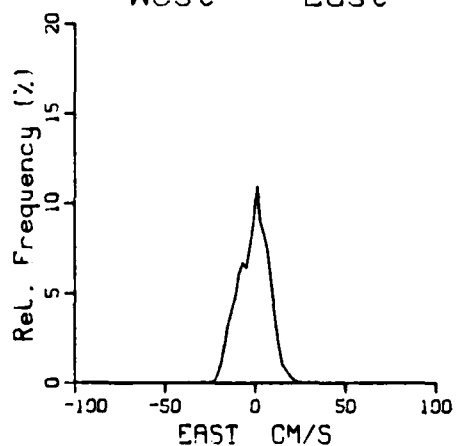
Weighted Direction



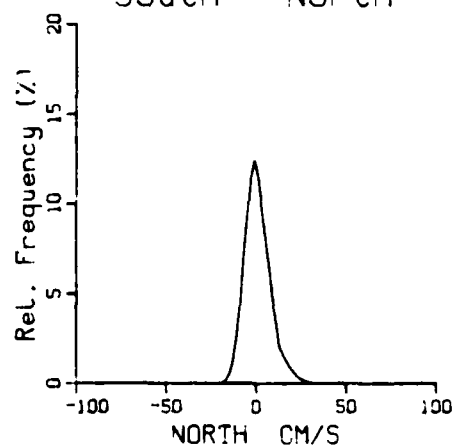
Speed



West East

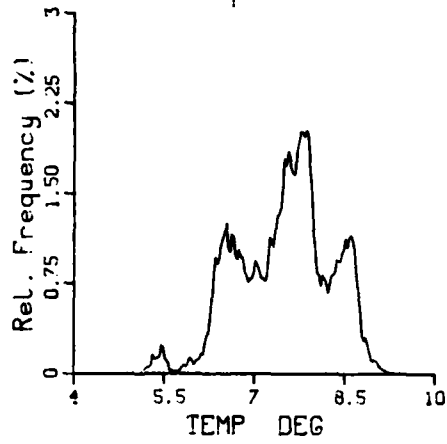


South North

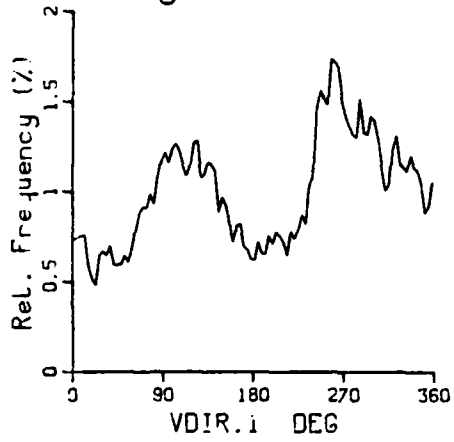


Data File 78812A450 : Depth = 998m

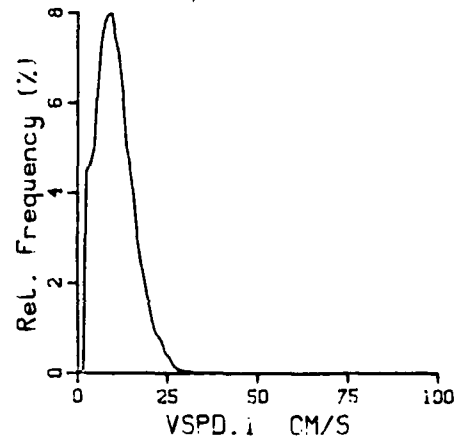
Temperature



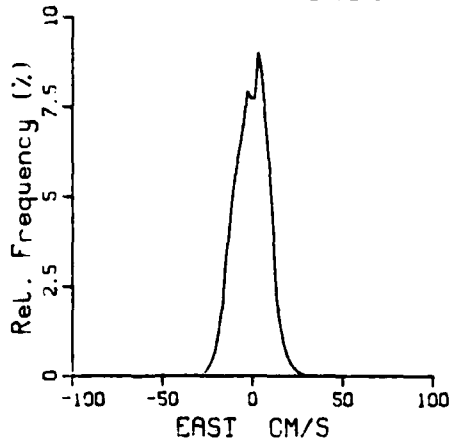
Weighted Direction



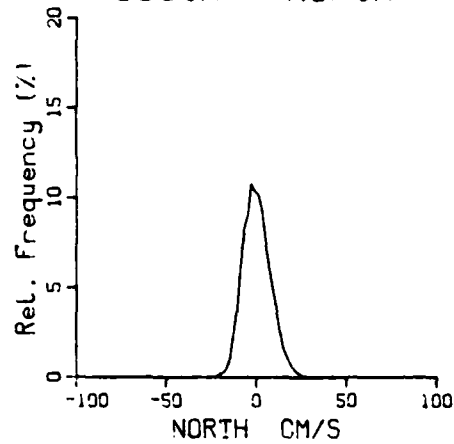
Speed



West East

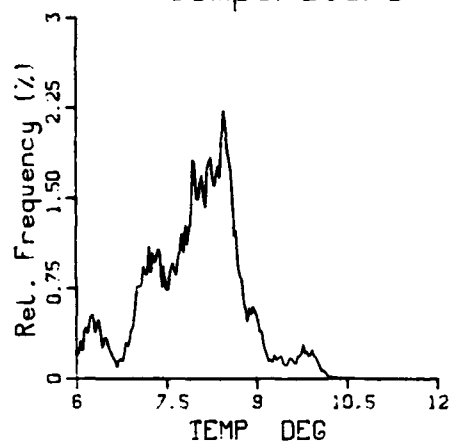


South North

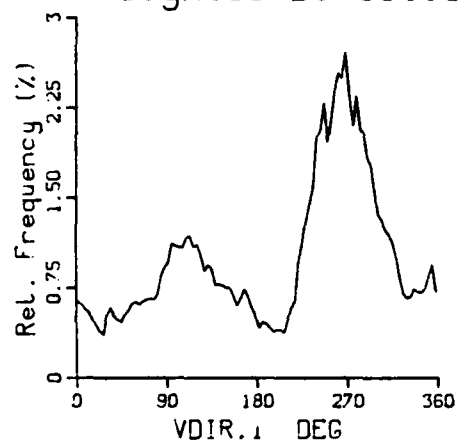


Data File 7892B450 : Depth = 998m

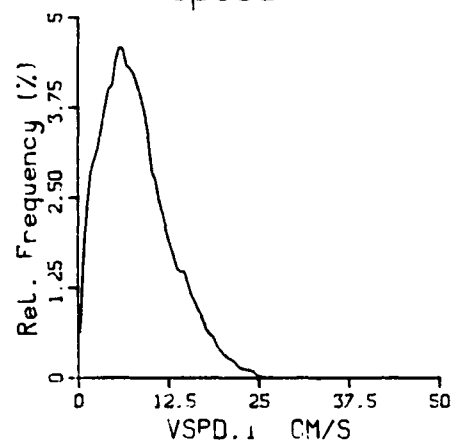
Temperature



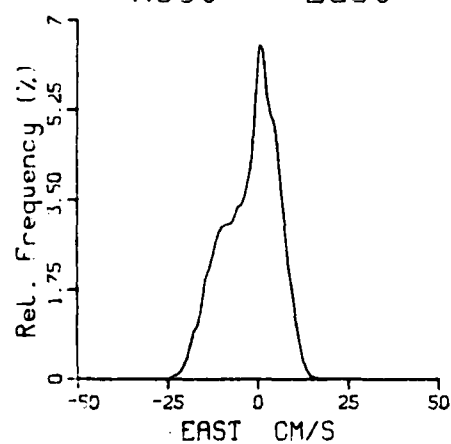
Weighted Direction



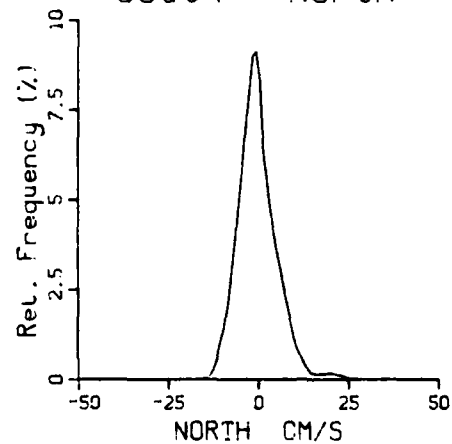
Speed



West East

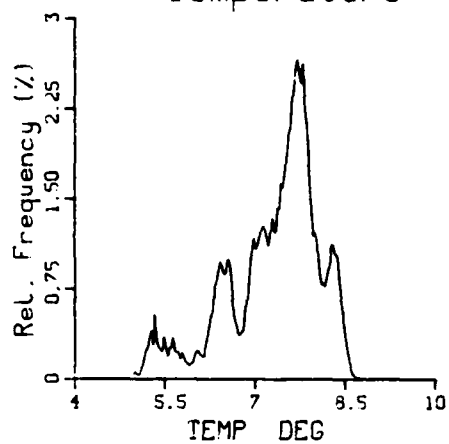


South North

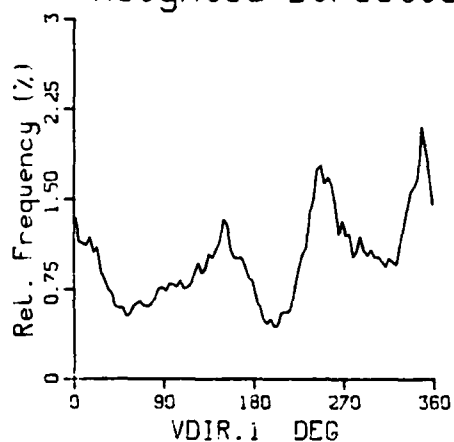


Data File 78713A225 : Depth = 1000m.

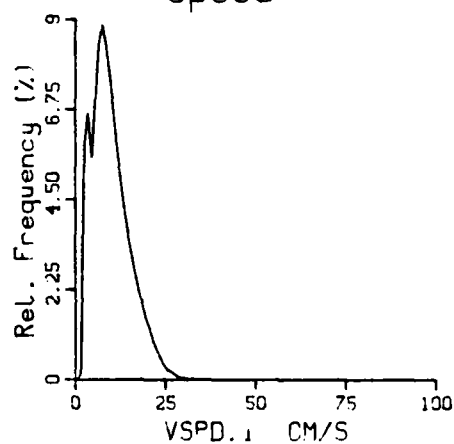
Temperature



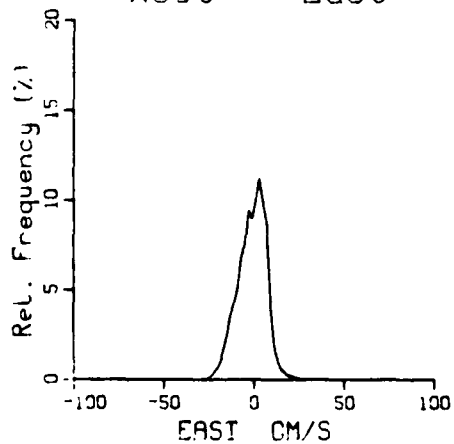
Weighted Direction



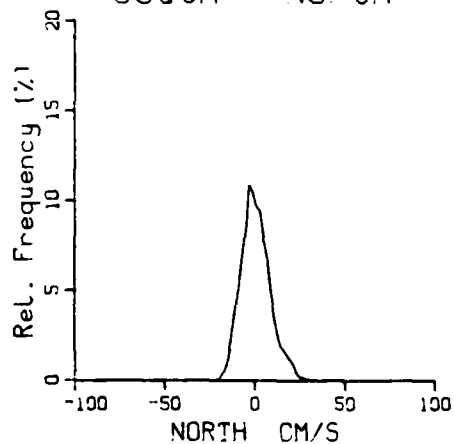
Speed



West East

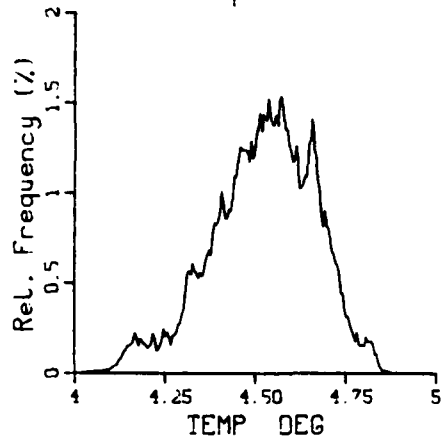


South North

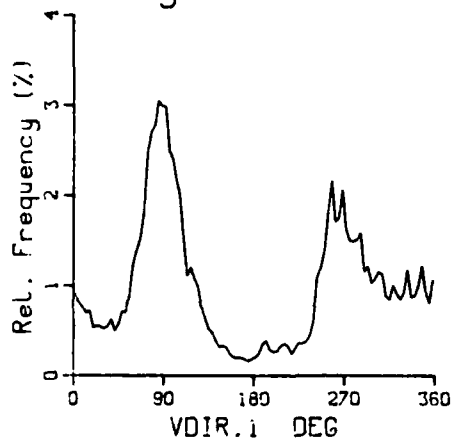


Data File 7903B450 : Depth = 1009m

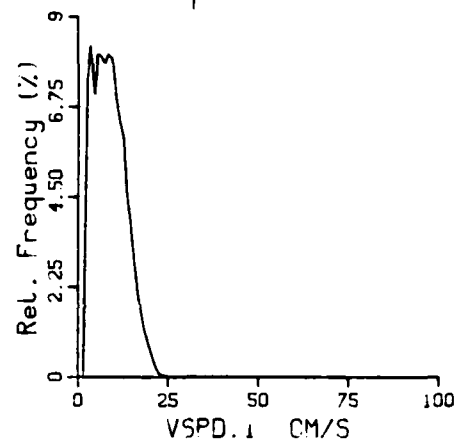
Temperature



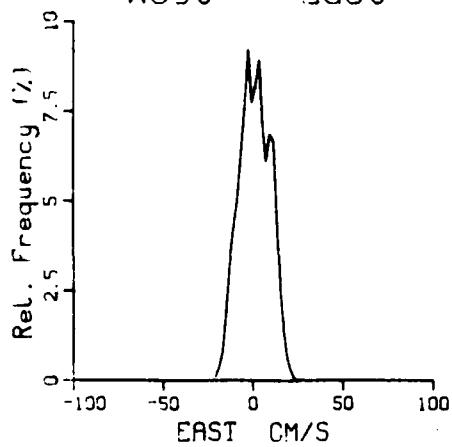
Weighted Direction



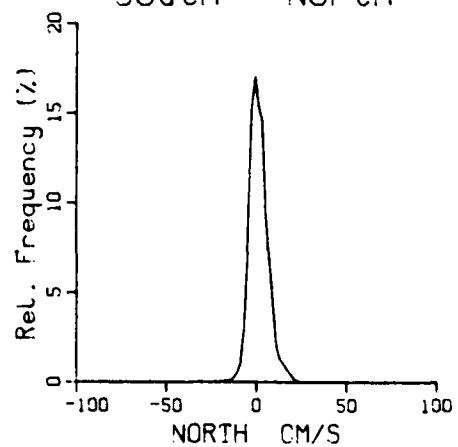
Speed



West East

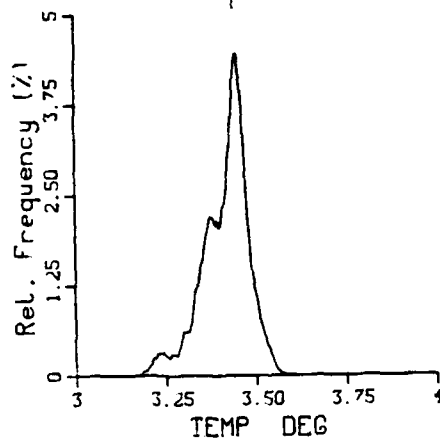


South North

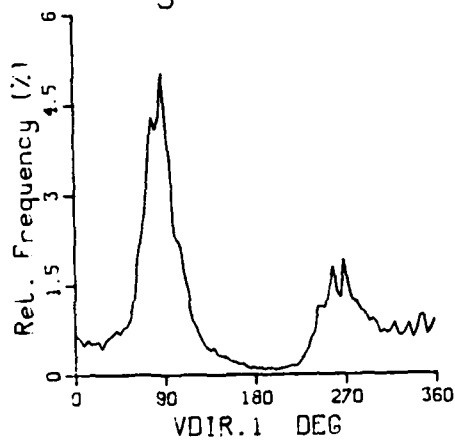


Data File 78813A450 : Depth = 1498m

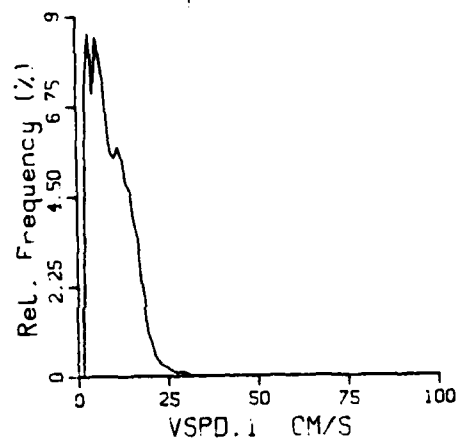
Temperature



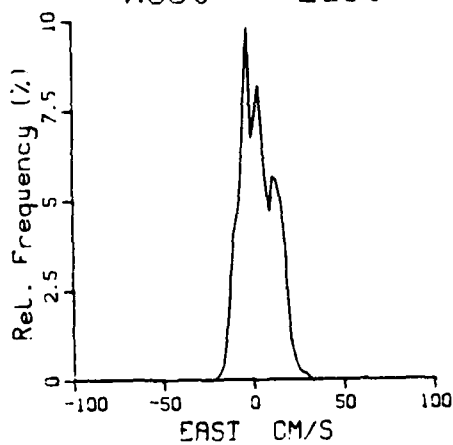
Weighted Direction



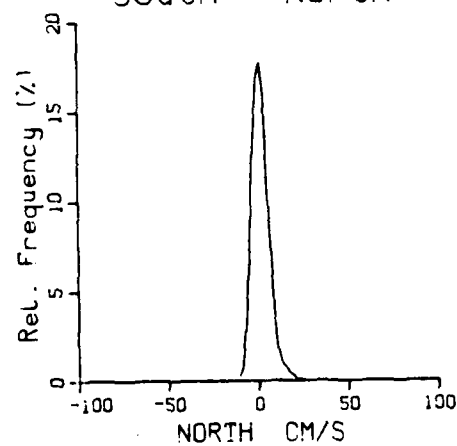
Speed



West East

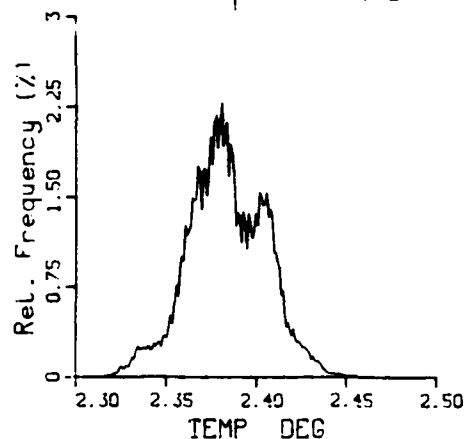


South North

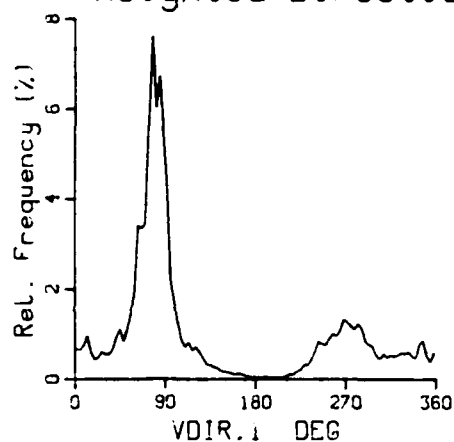


Data File 78814B450 : Depth = 2498m

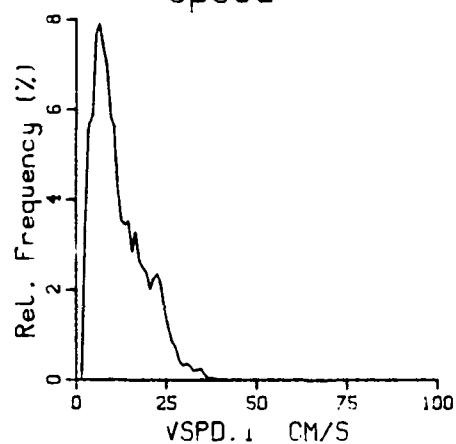
Temperature



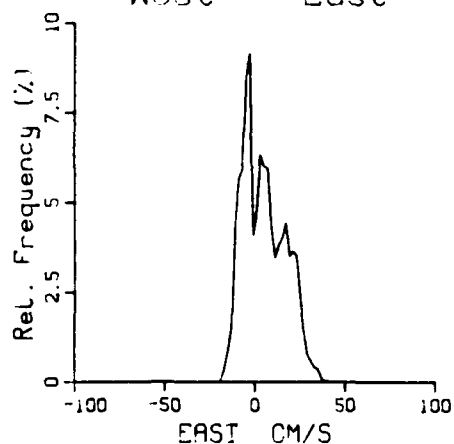
Weighted Direction



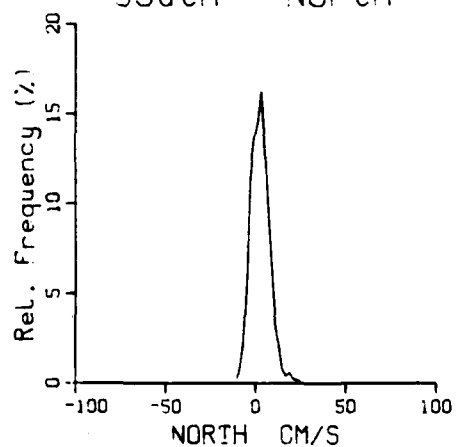
Speed



West East



South North



Data File 78815B450 : Depth = 3998m

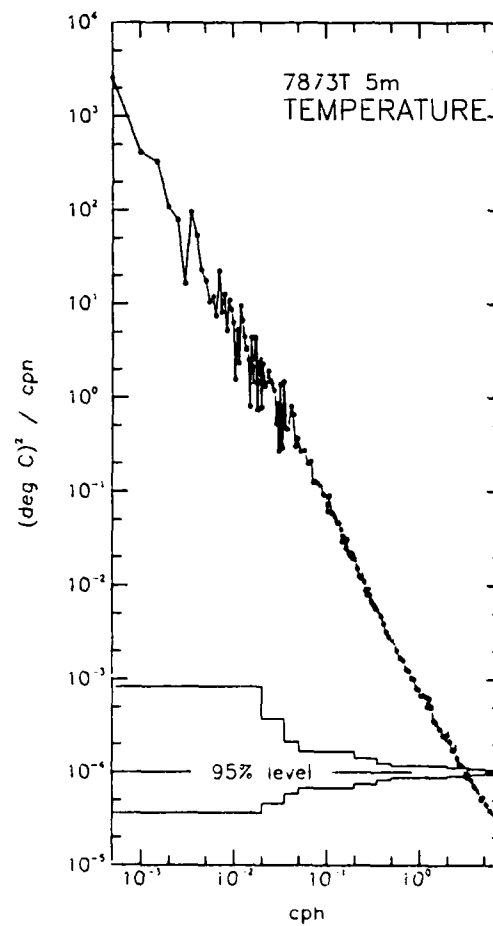
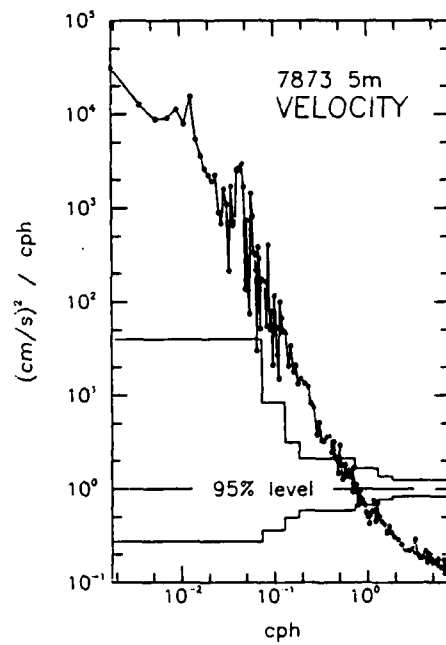
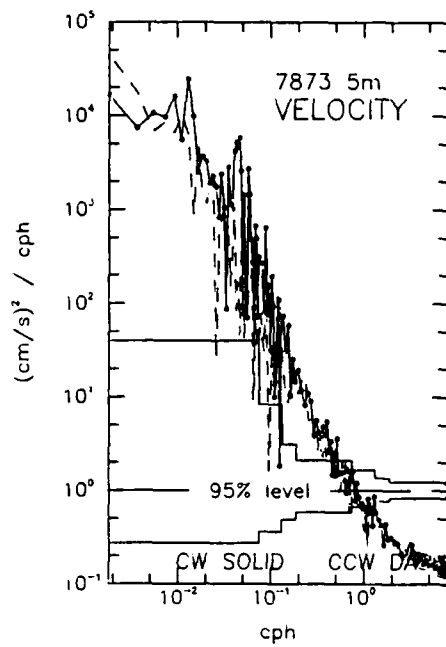
SURFACE MOORINGS 787 AND 792
NEAR-SURFACE MOORING 788
WITH SUBSURFACE MOORINGS 789 AND 790
INCLUDED BY DEPTH.

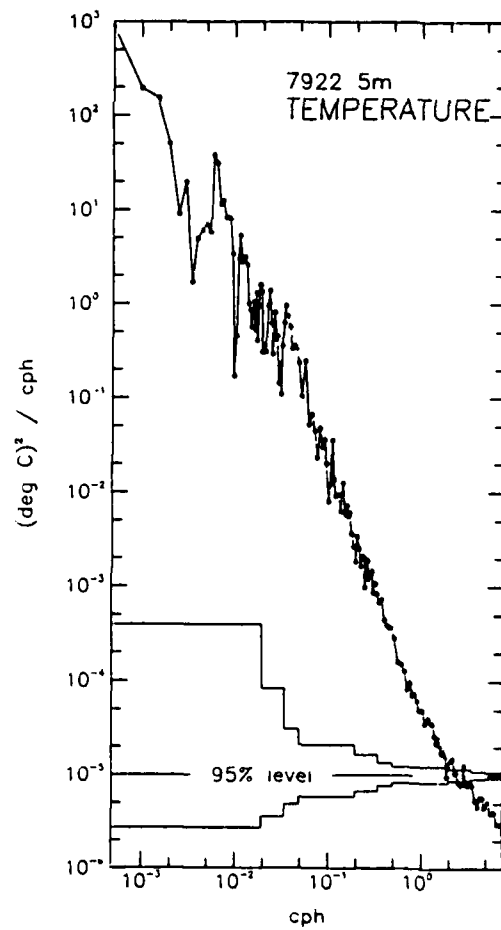
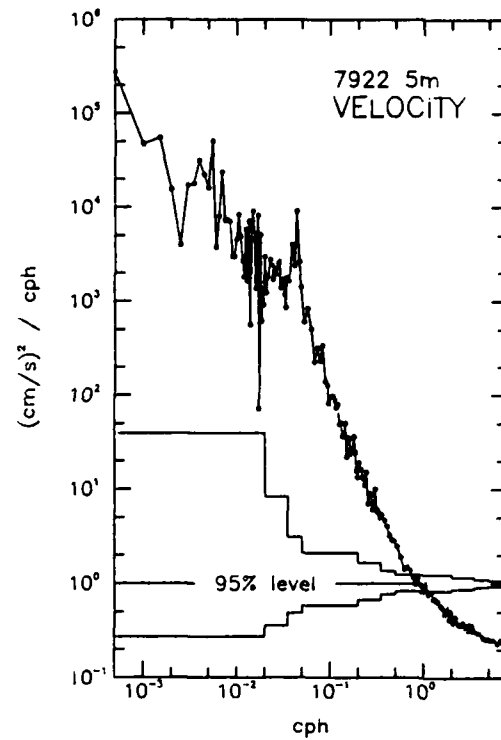
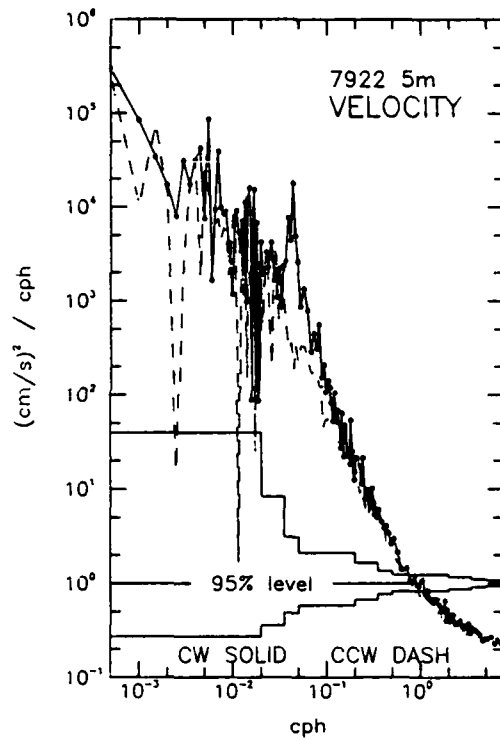
SPECTRA

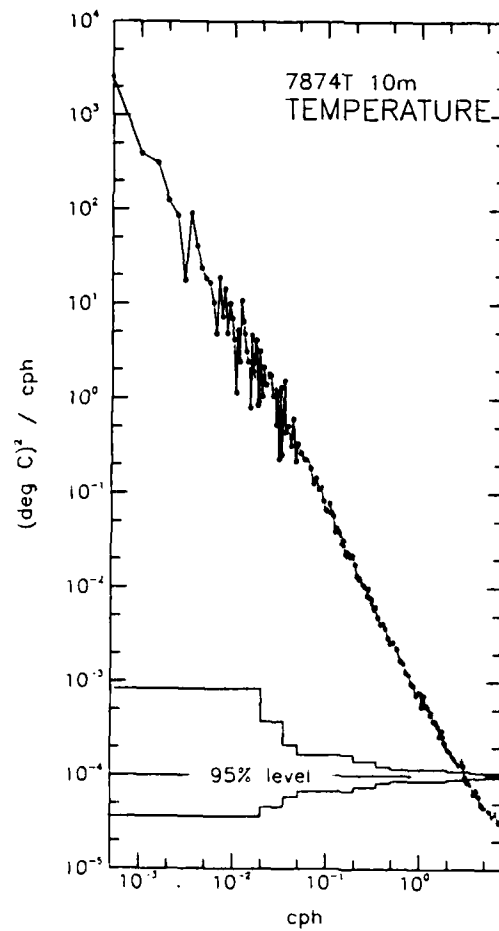
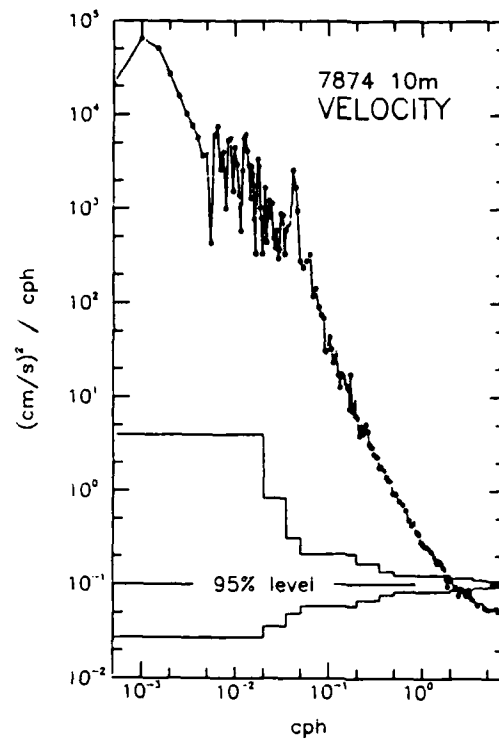
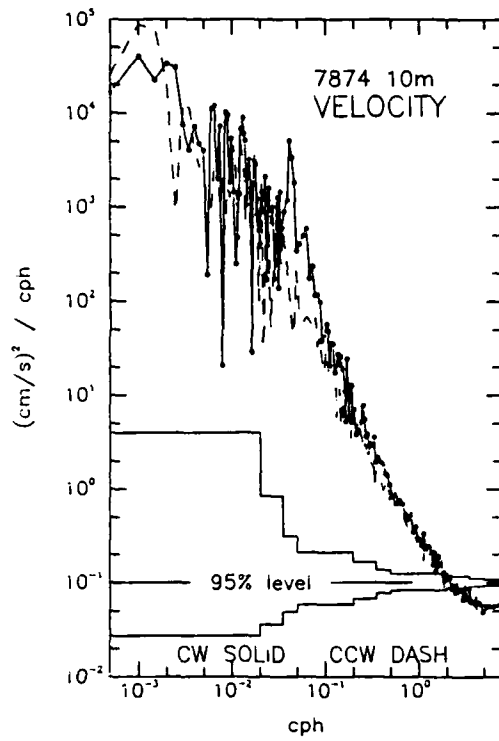
Table 5

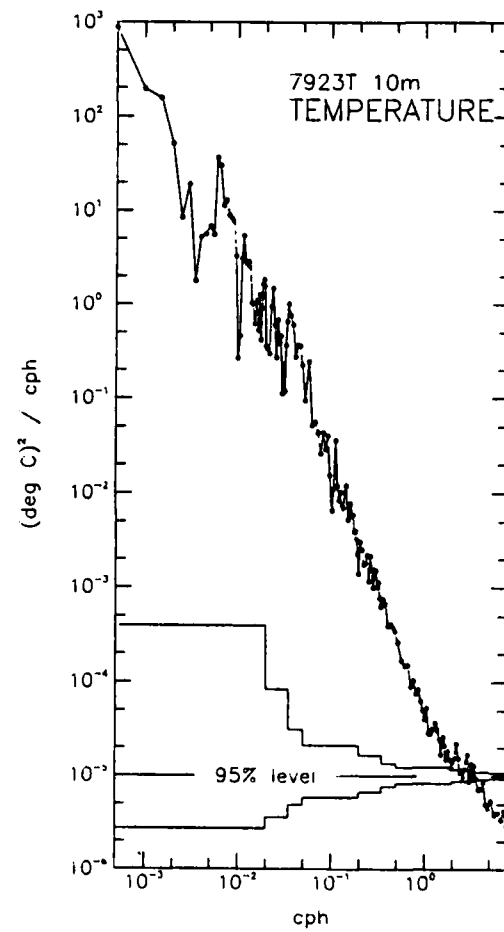
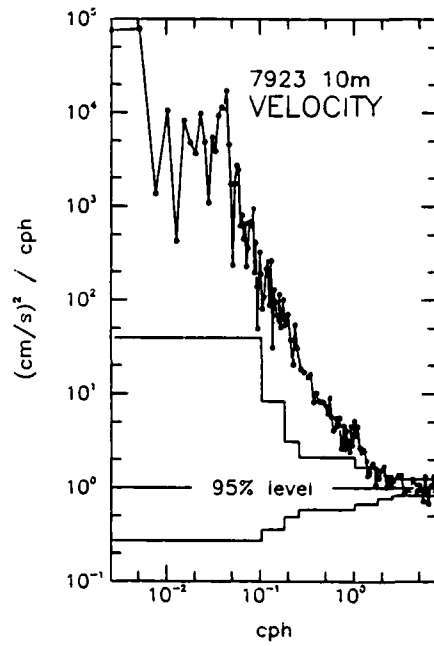
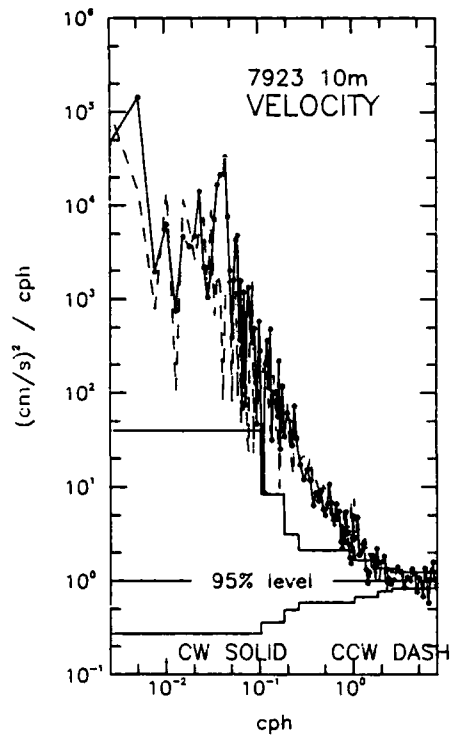
Spectral Plots 450 second sampled data has a piece length of 16000.
 225 second sampled data has a piece length of 32000.
 A table of the number of pieces, number of data cycles follows.

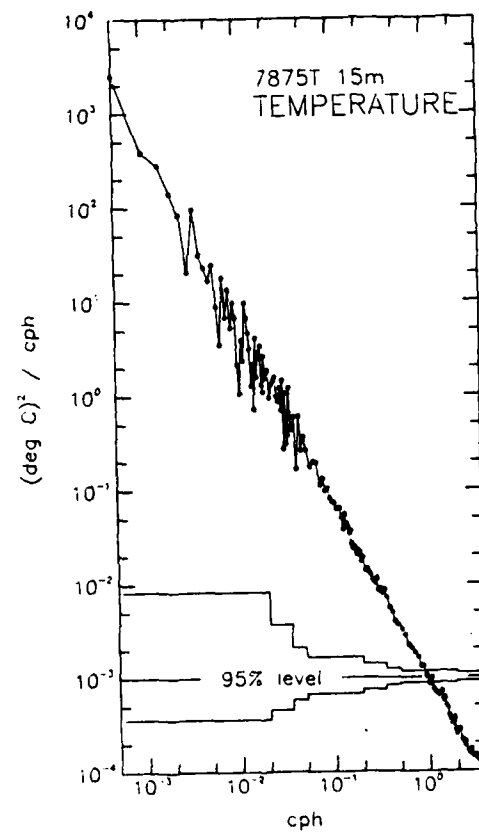
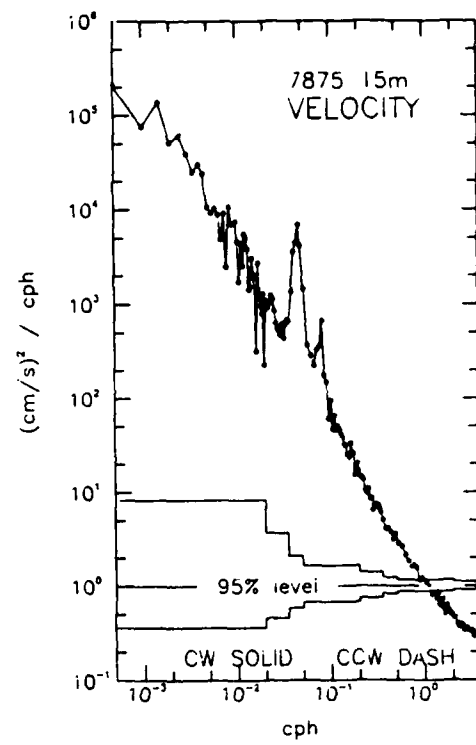
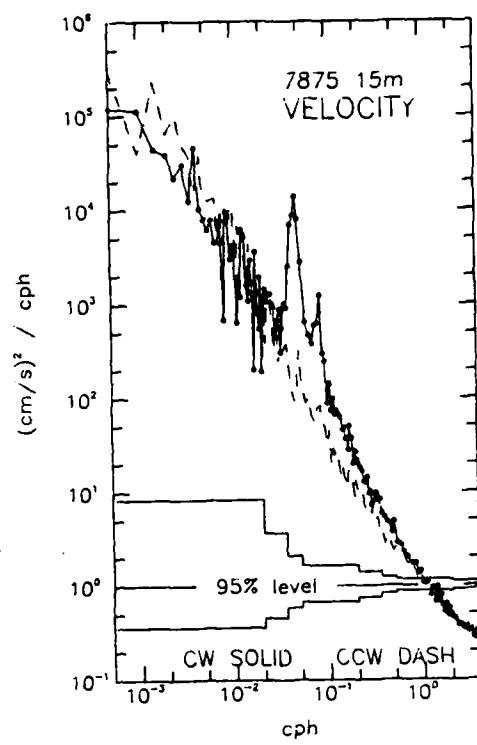
Data Name	Samp Rate (sec)	Var	Number of Points	Number of Pieces
767S1	225	all	61934	1
767S2	225	all	38677	1
7673	225	vel	34800	1
	225	temp	65296	2
7674	225	all	65296	2
7675	225	all	65296	2
7676	225	all	65296	2
7677	225	all	65296	2
7678	225	all	65296	2
7679	225	all		2
76710	225	all	65296	2
76711	225	all	65296	2
76712	225	all	65296	2
770S1	450	all	21113	1
770S2	450	all	21113	1
7703	225	all	42225	1
7704	225	all	42225	1
7705	225	all	42225	1
7706	225	temp	42225	1
	225	vel	38033	1
7707	225	all	42225	1
7708	225	temp	42225	1
	225	vel	19208	1
7709	225	temp	42225	1
77014	225	vel	42225	1
7641	450	all	65000	4
7642	450	all	65000	4
7651	450	all	65000	4
7652	450	all	65000	4
7661	450	all	64500	4
7662	450	all	64500	4
7663	450	all	64500	4
7664	450	all	64500	4
7665	450	all	64500	4
7666	450	all	64500	4
7667	450	temp	50121	3
		tdif	50121	3
		vel	30729	1
76611	450	all	64500	4
76612	450	all	64500	4
76613	450	all	64500	4
76614	450	temp	64500	4
76615	450	all	64500	4

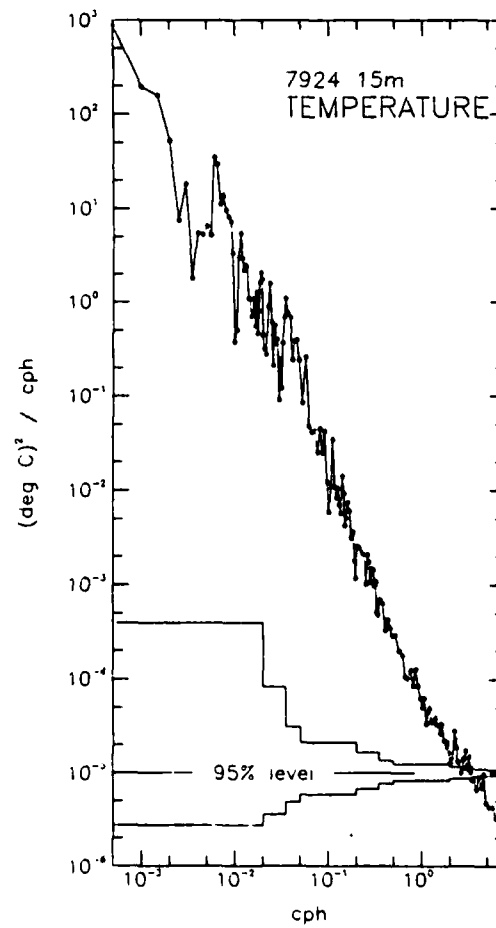
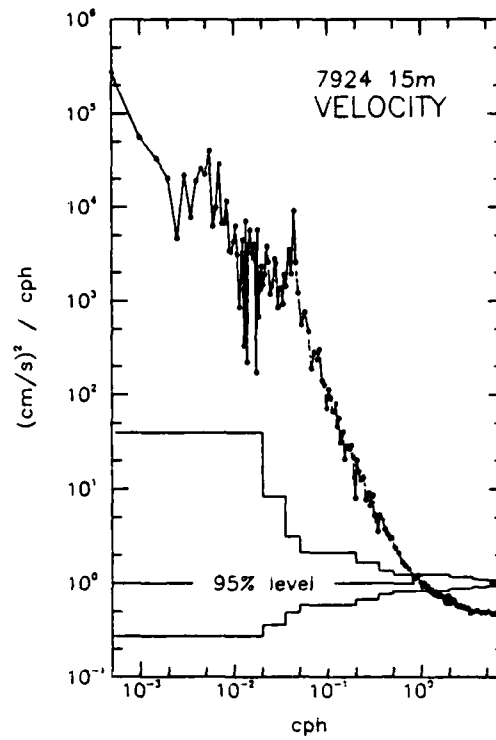
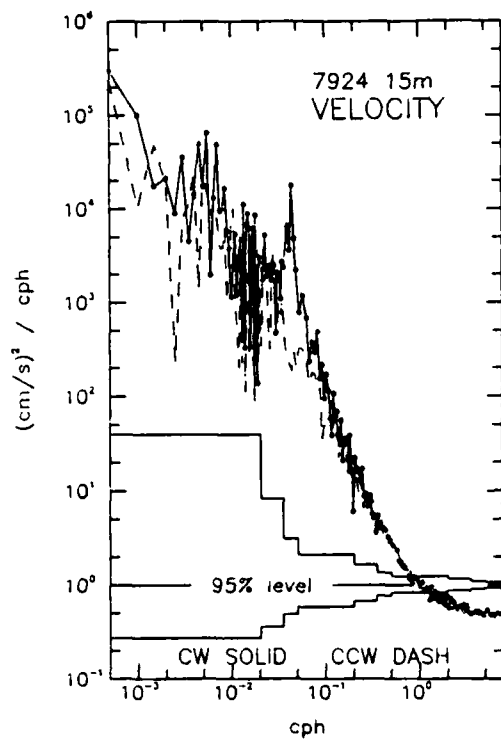


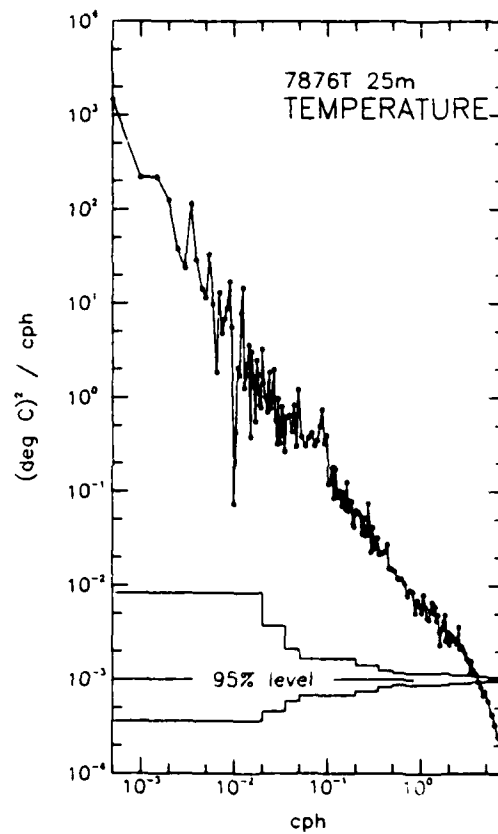
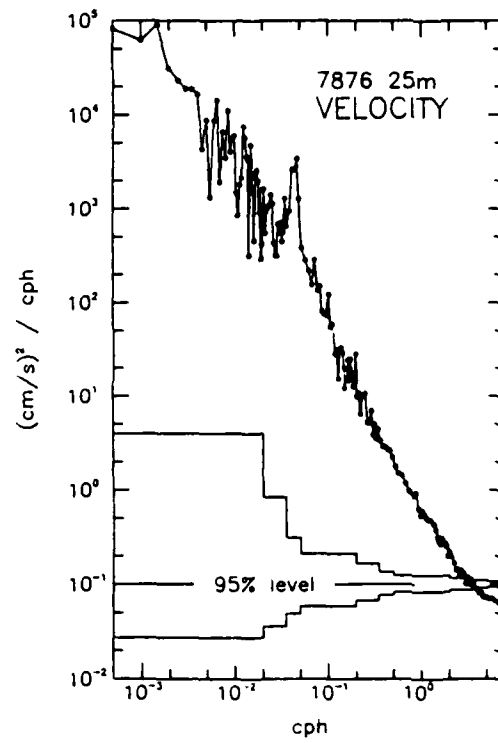
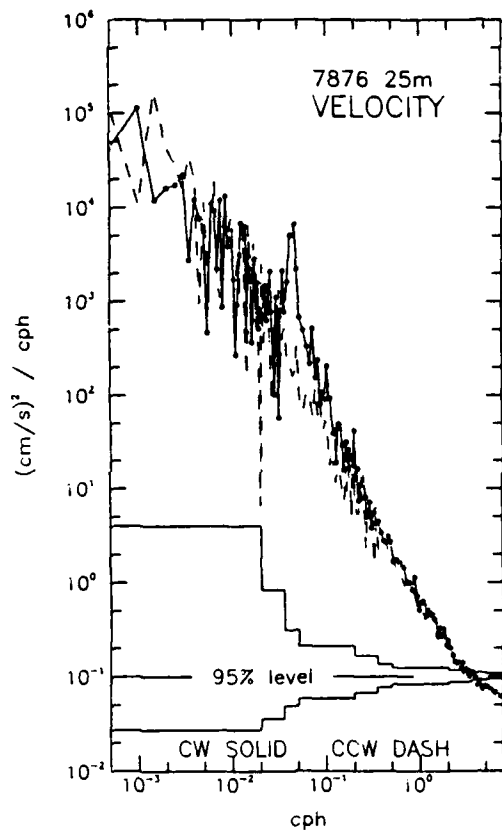


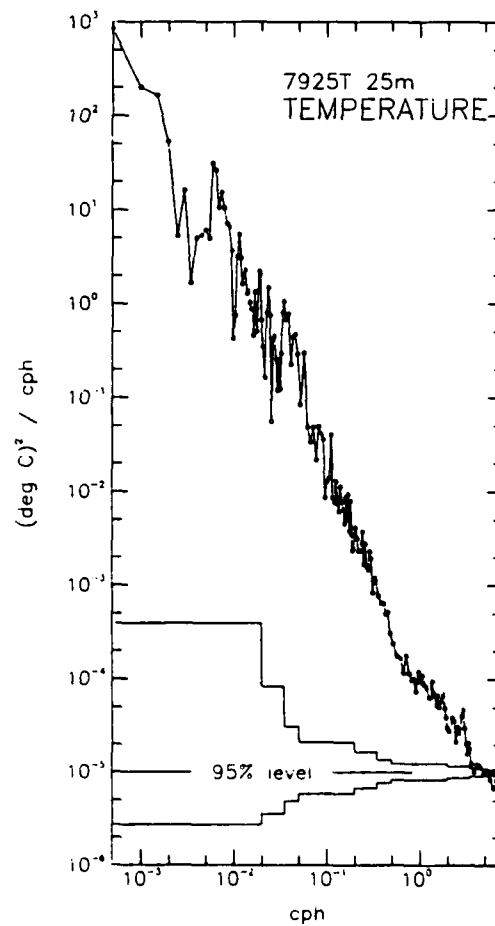
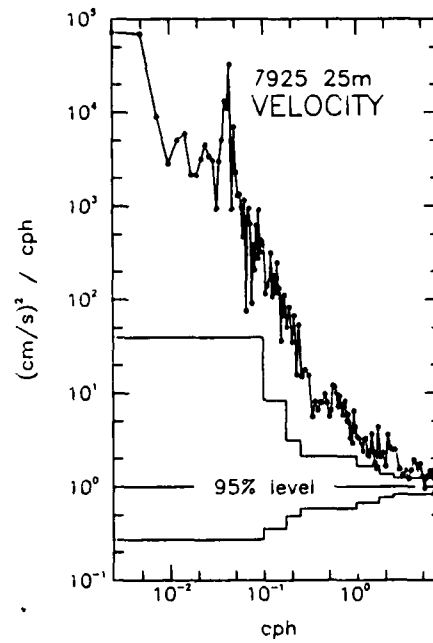
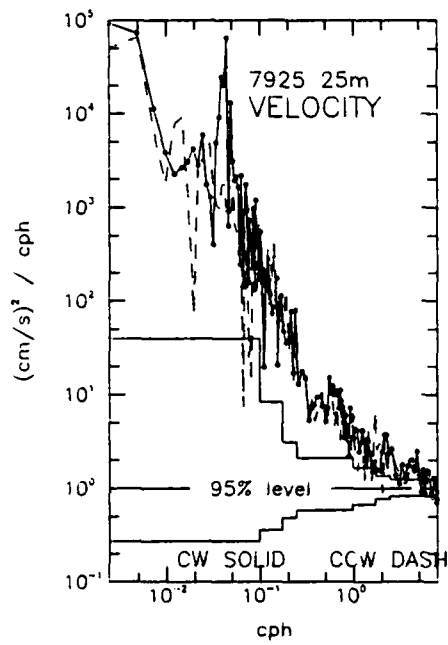


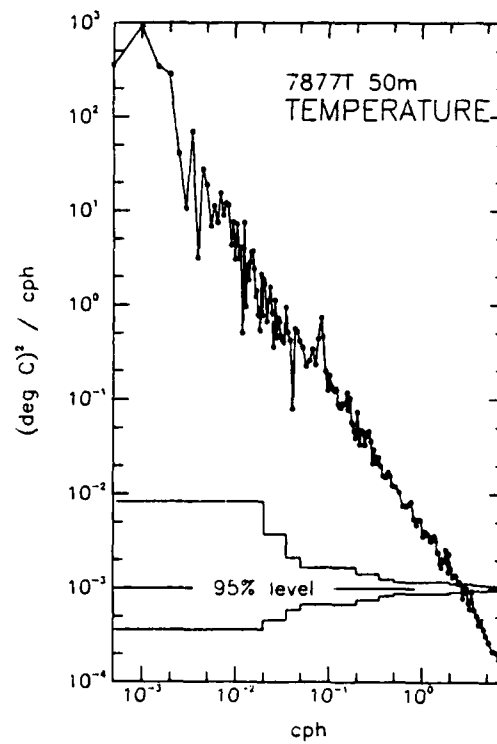
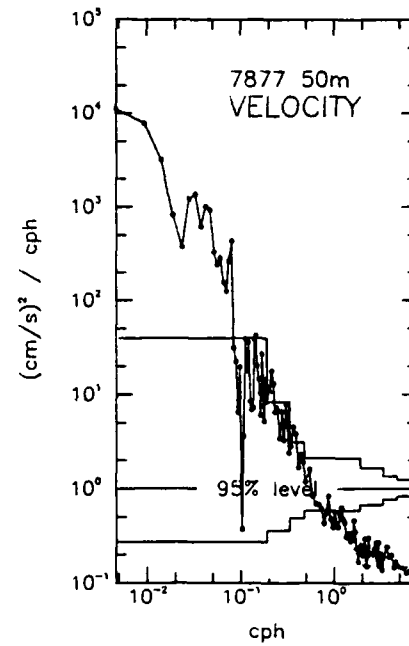
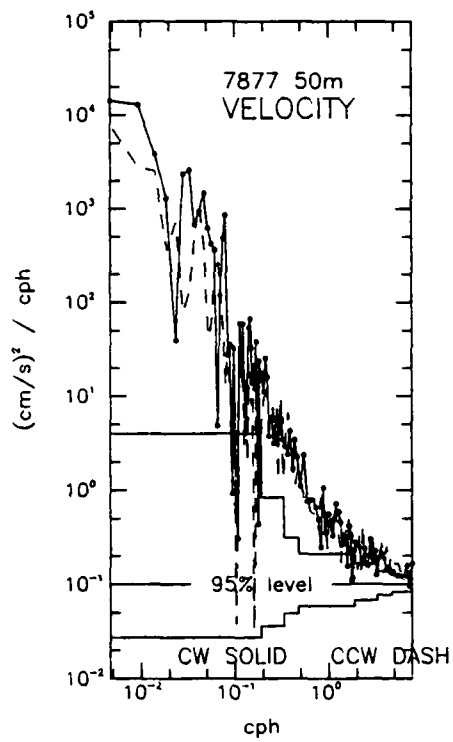


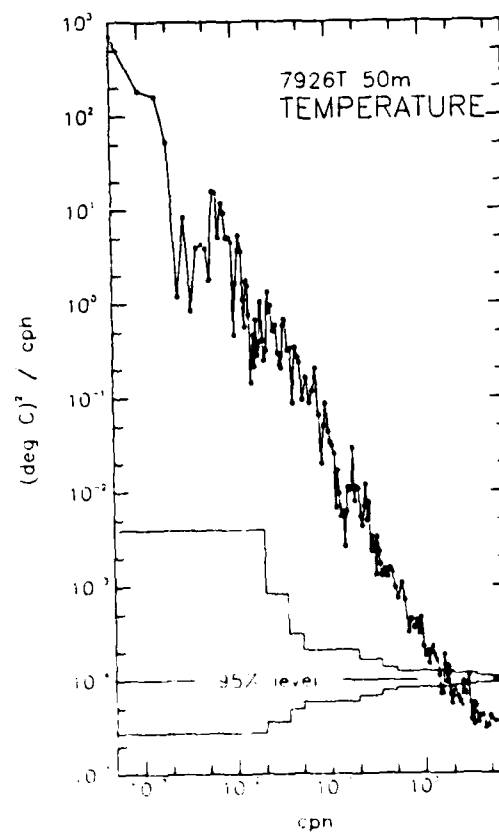
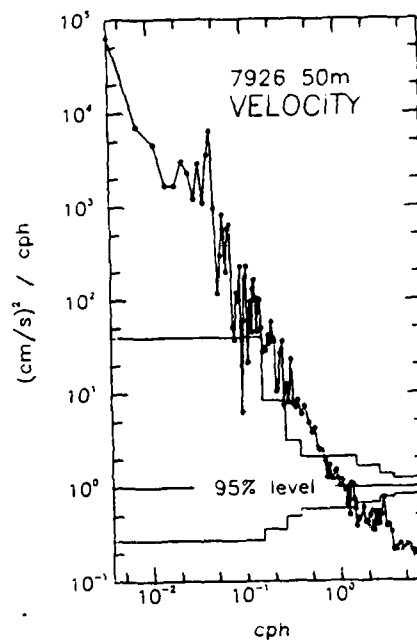
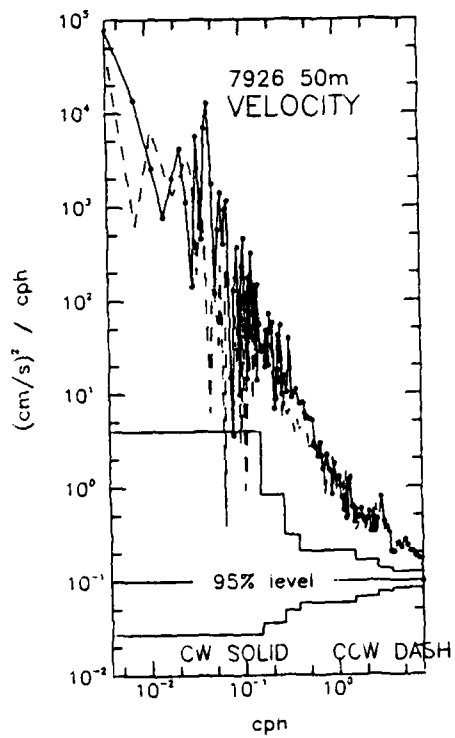


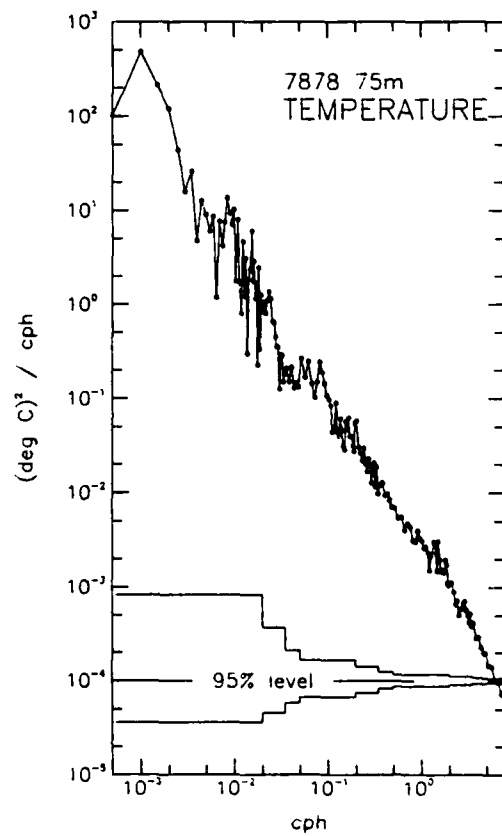
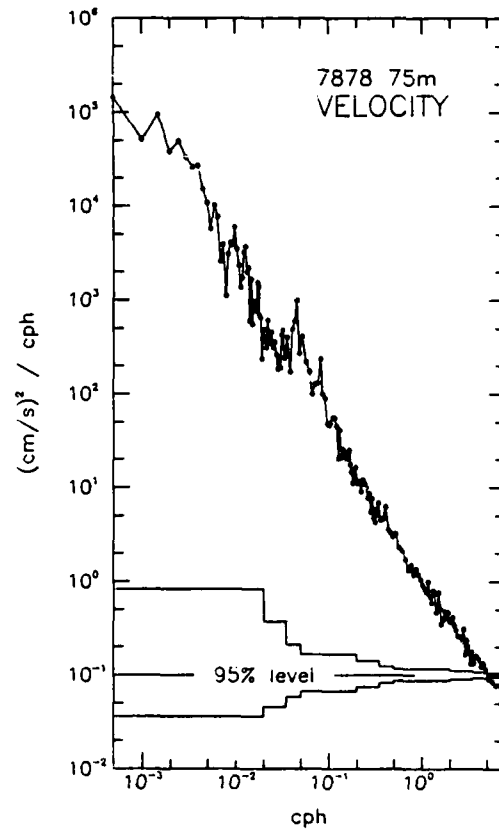
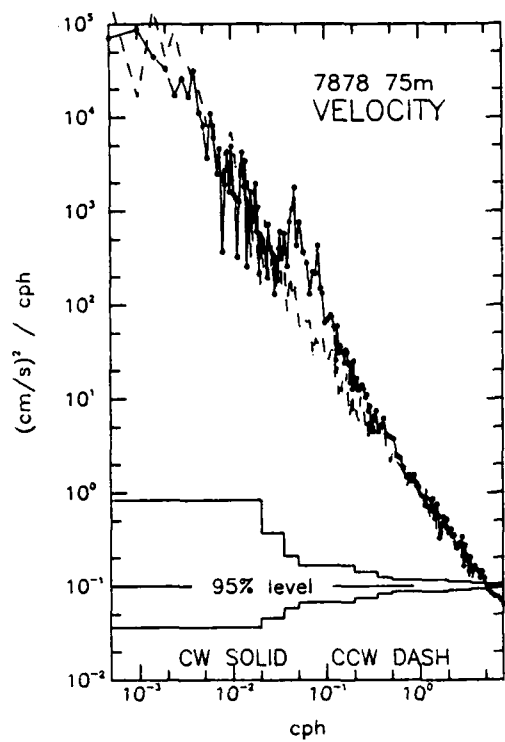


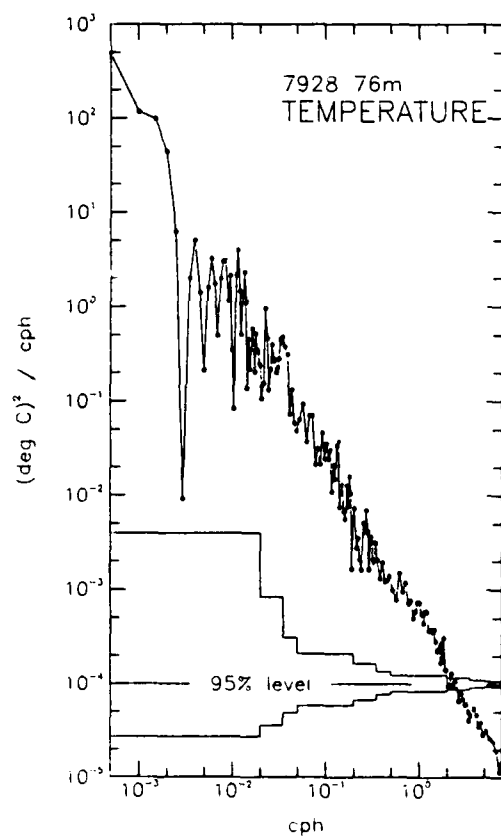
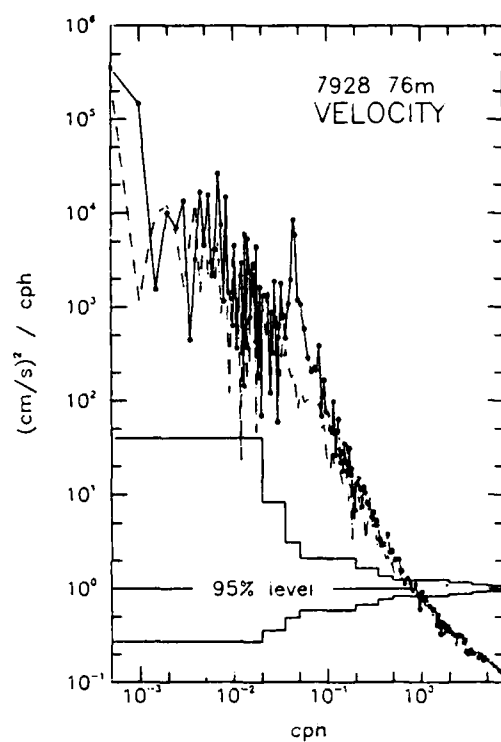
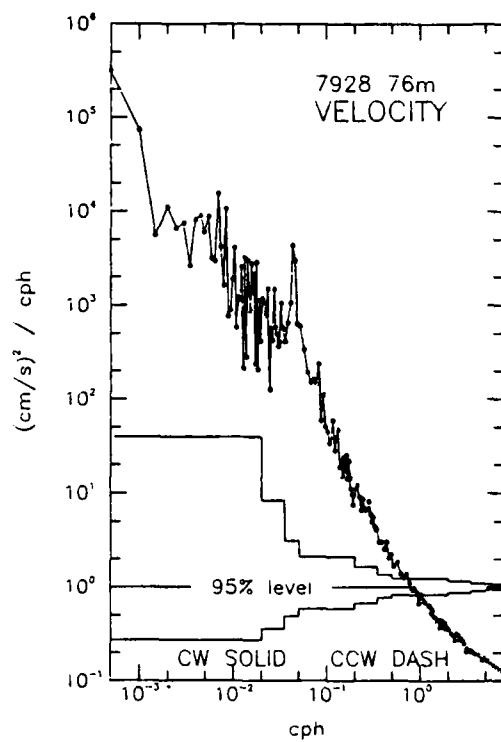


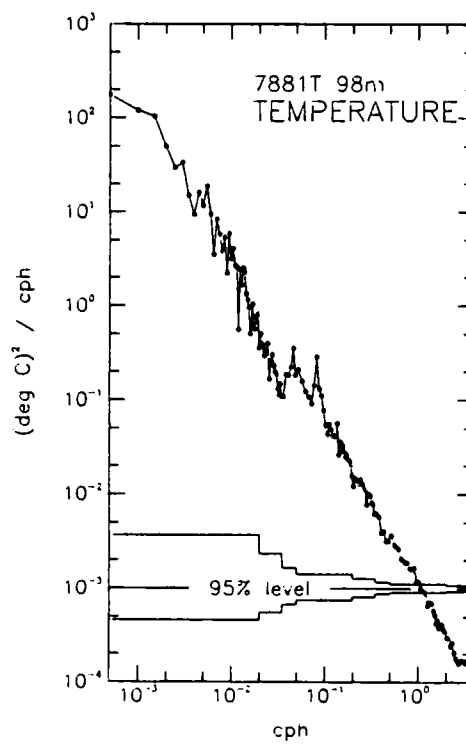
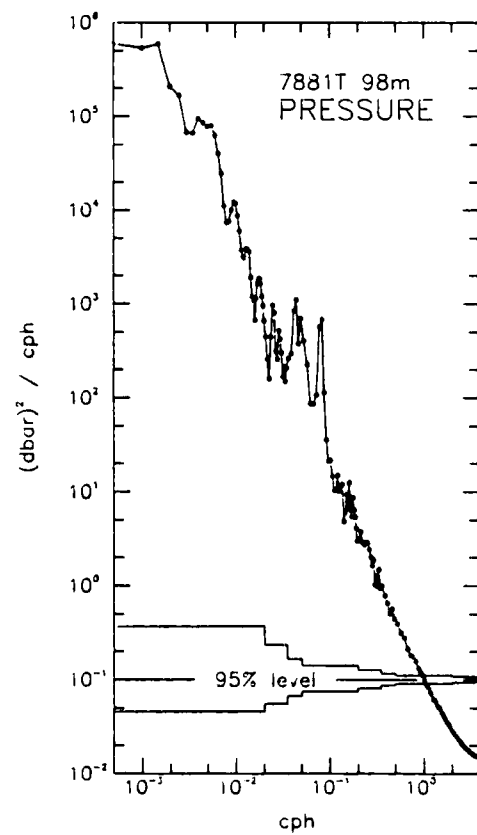
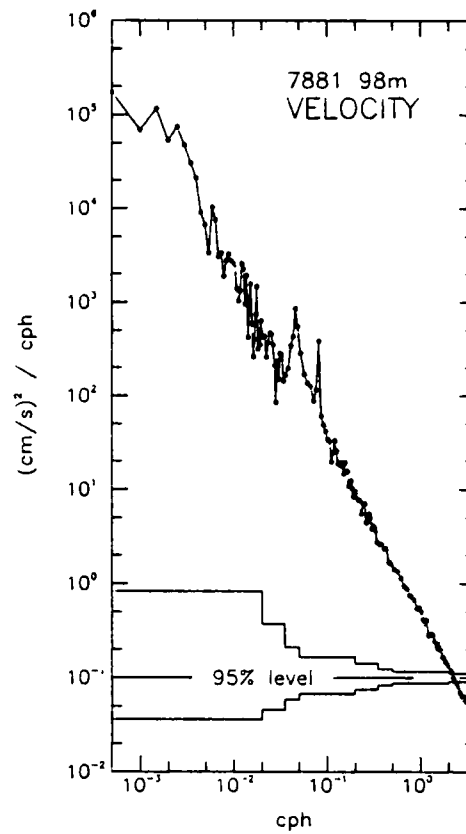
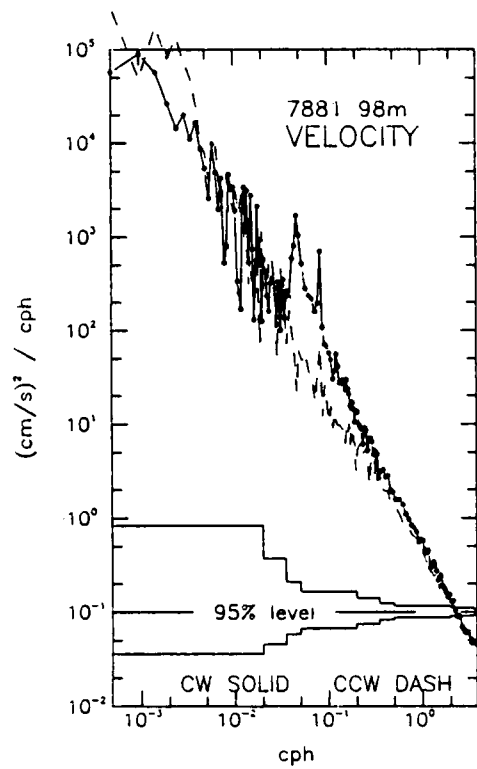


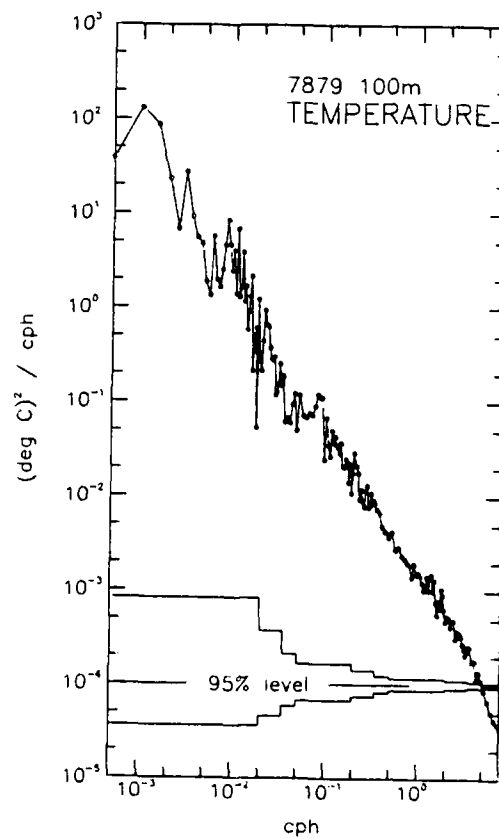
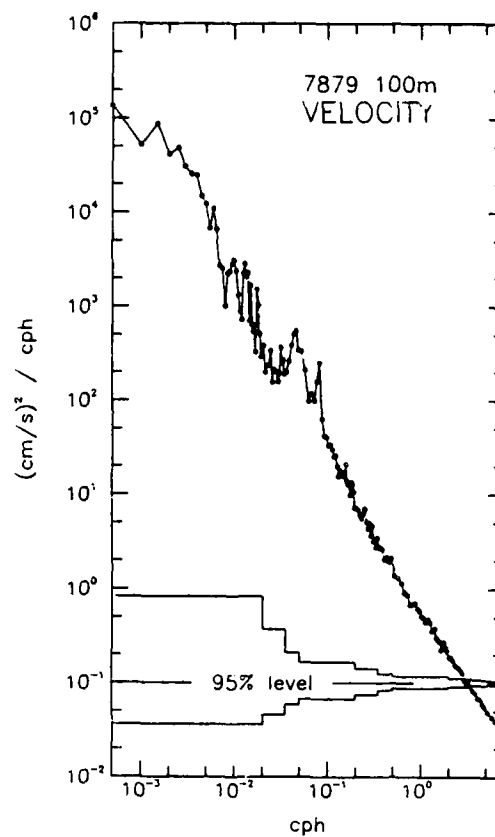
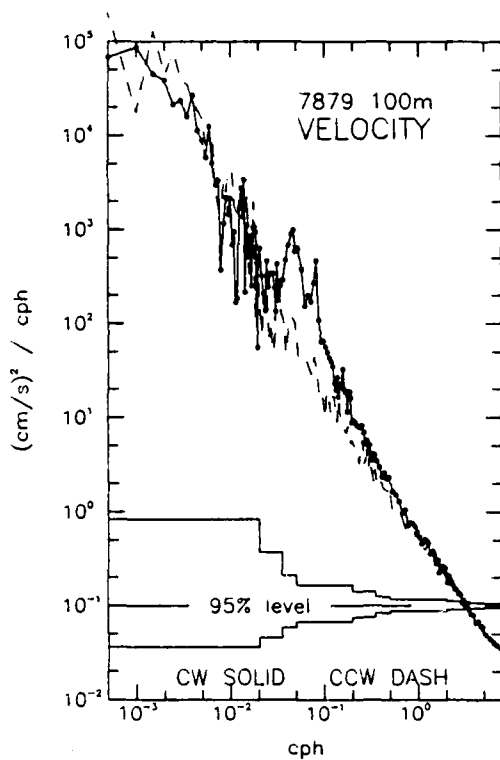


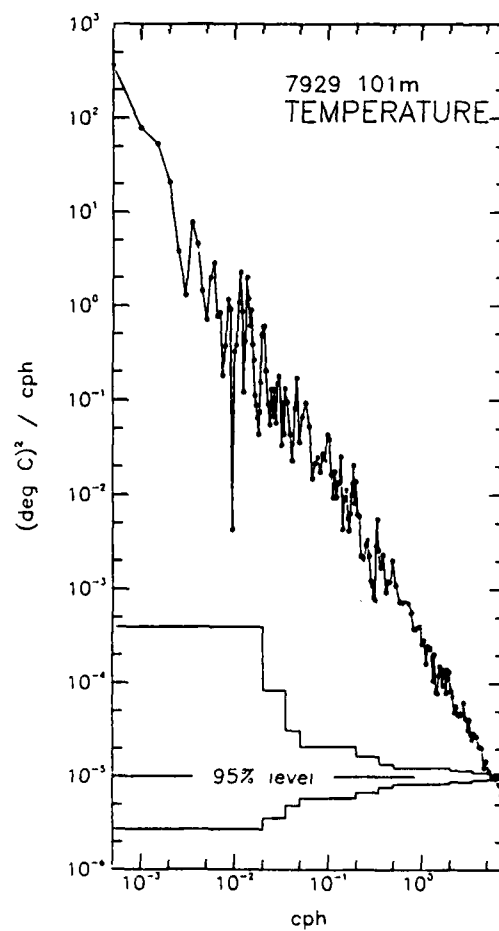
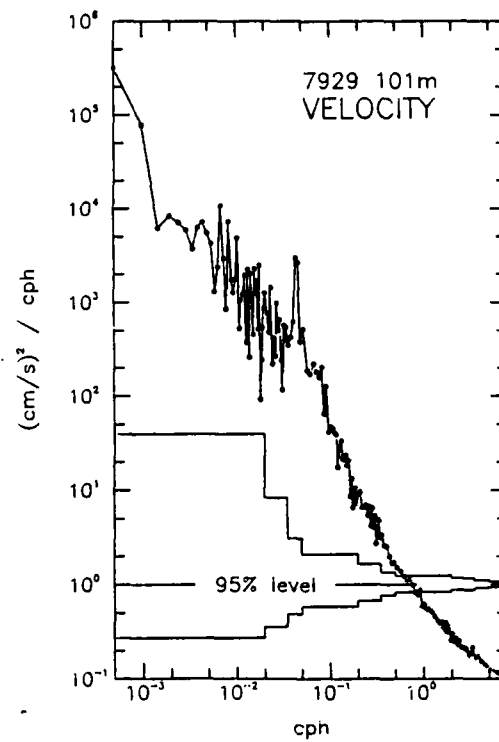
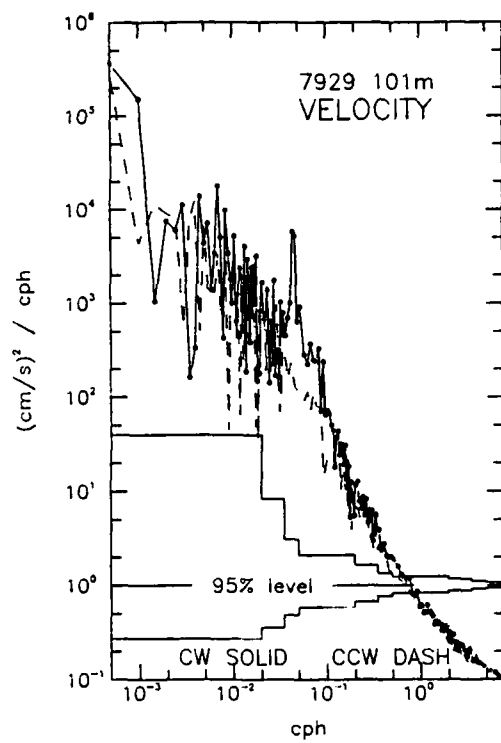


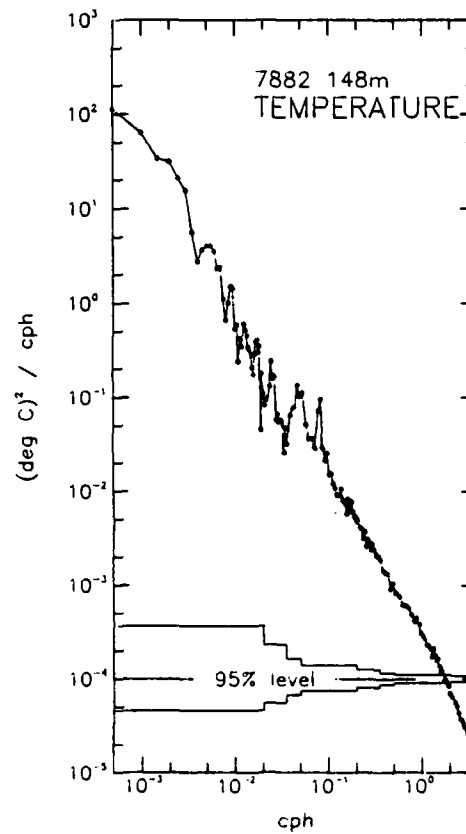
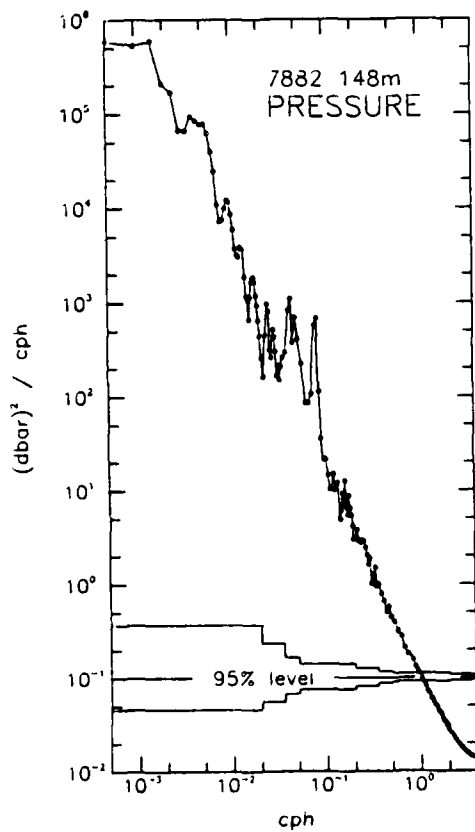
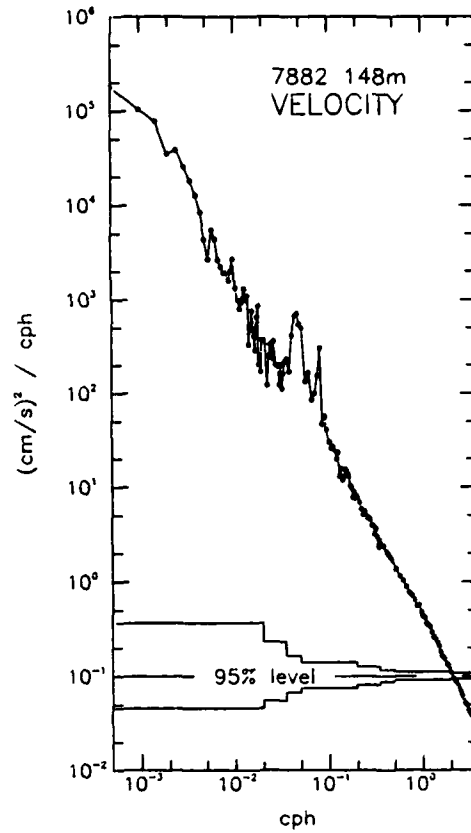
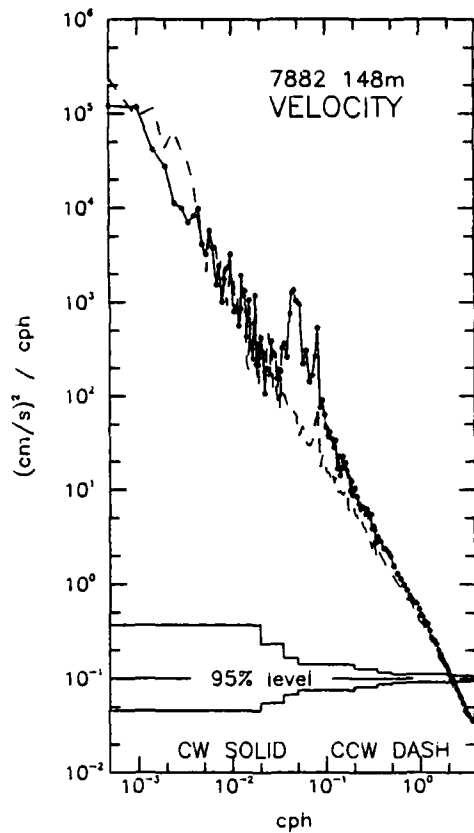


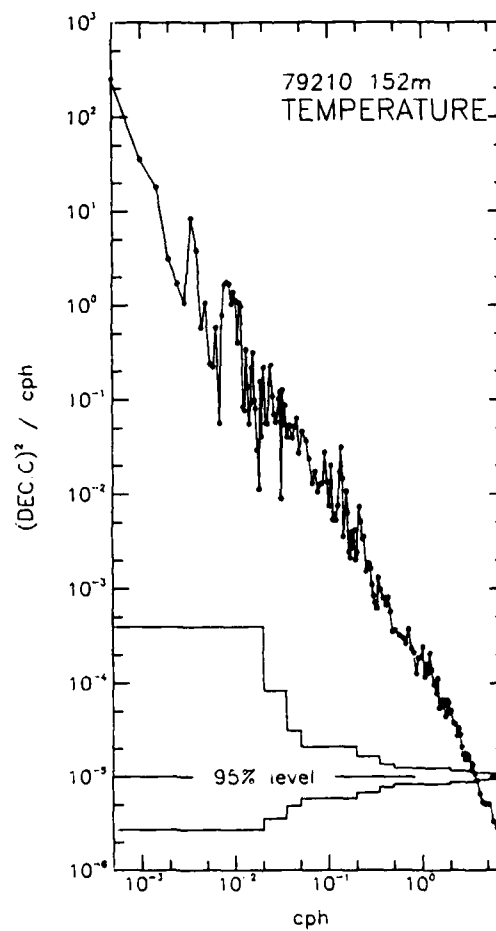
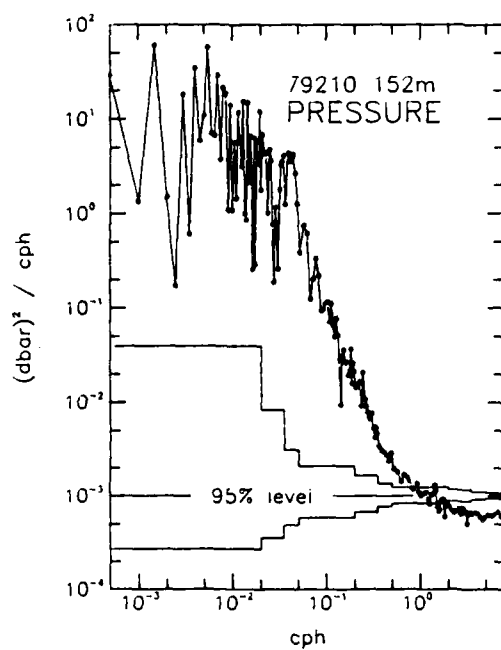
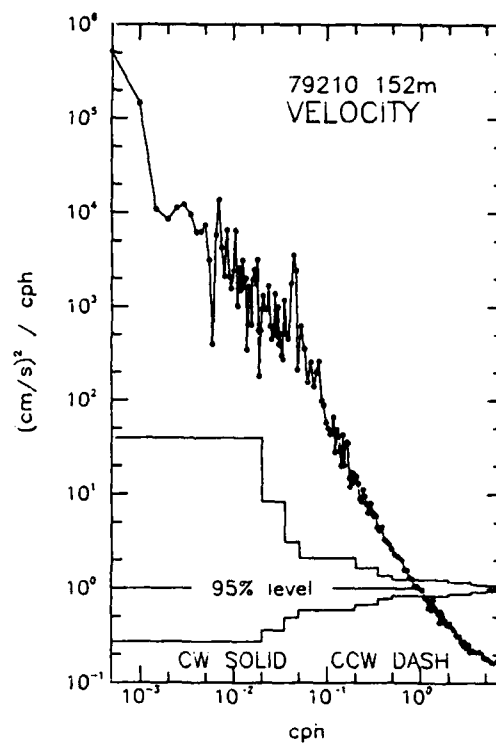
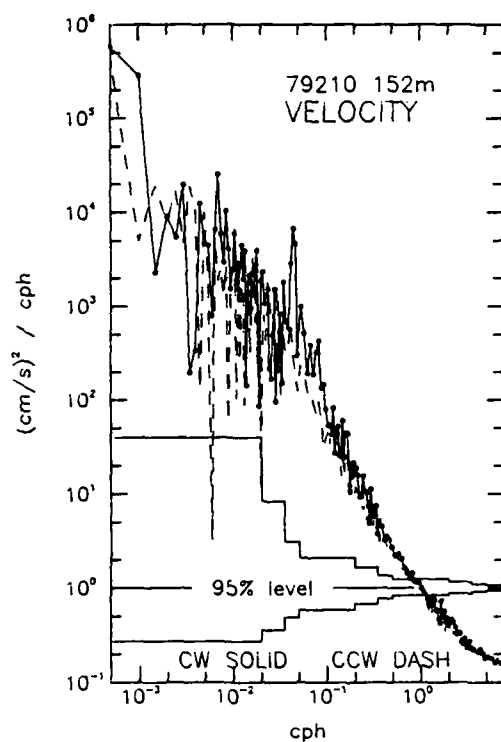


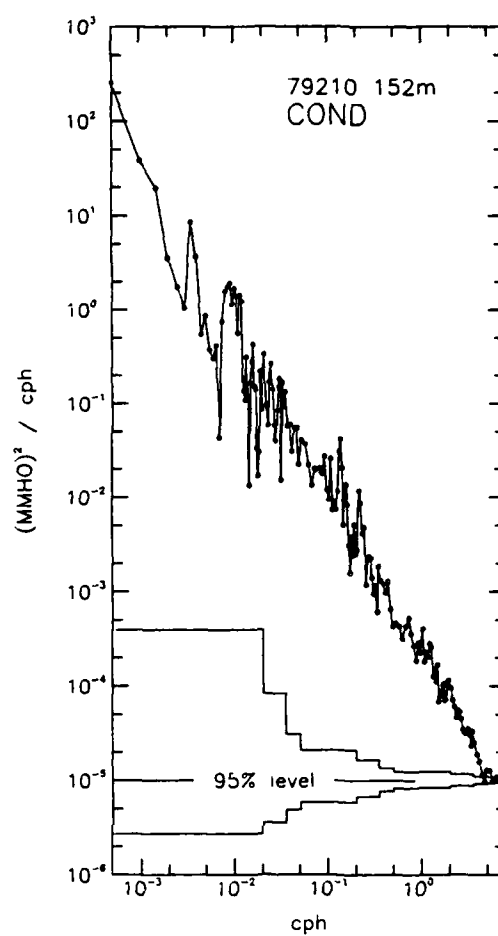
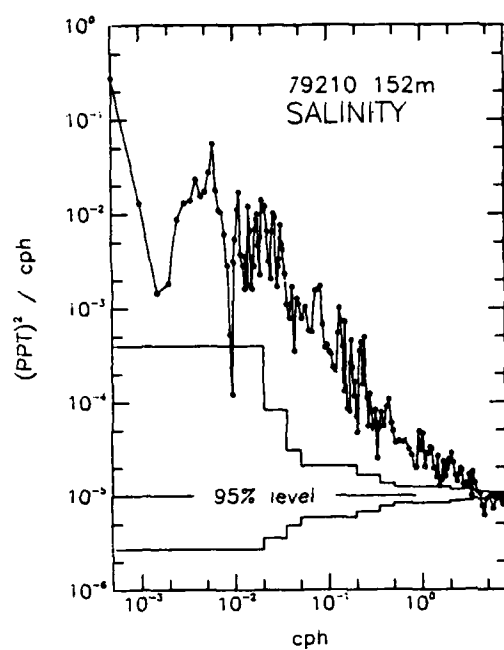


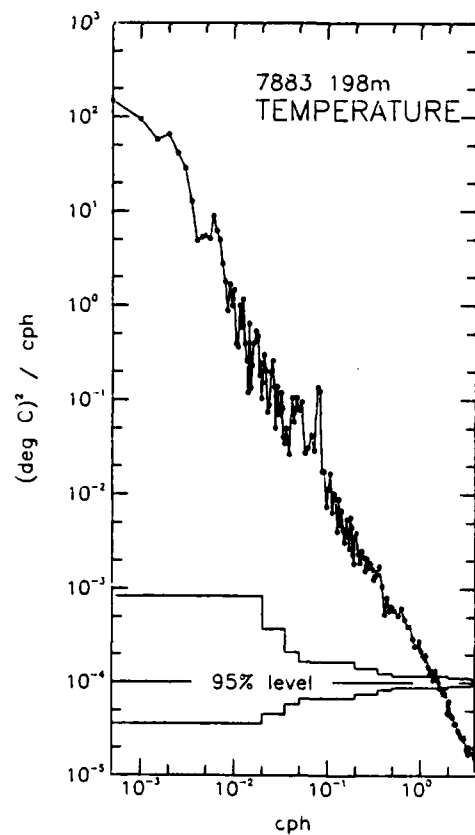
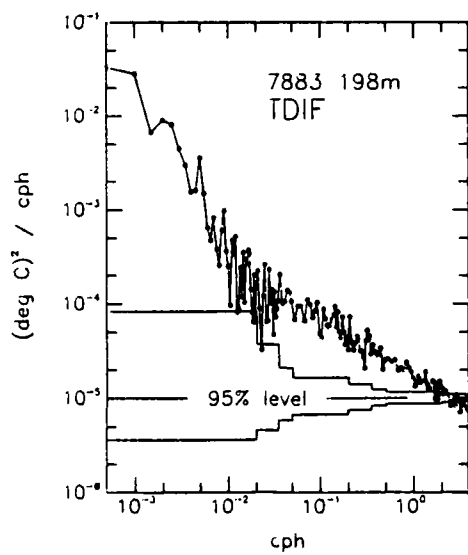
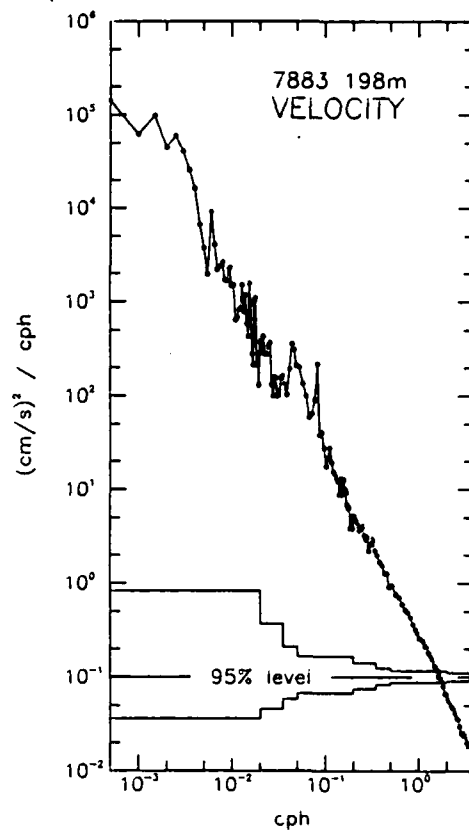
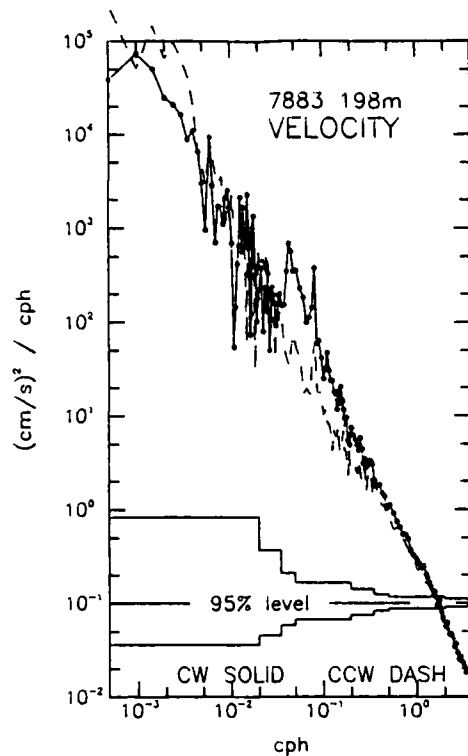


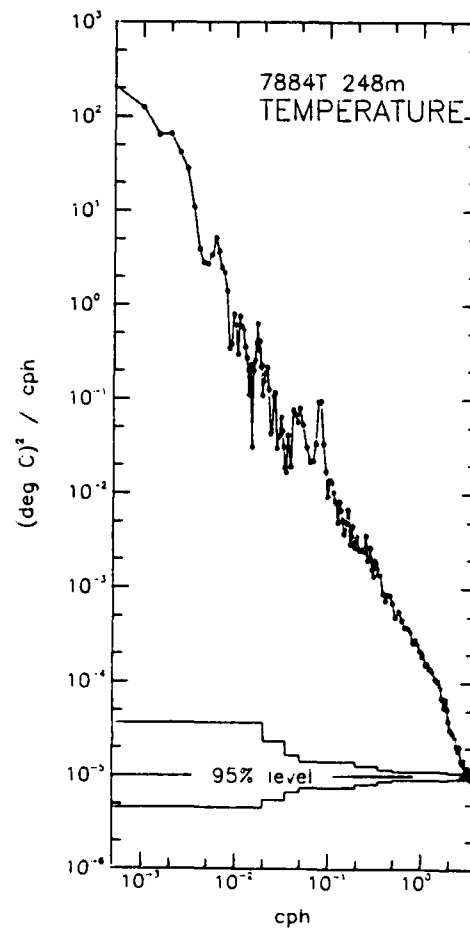
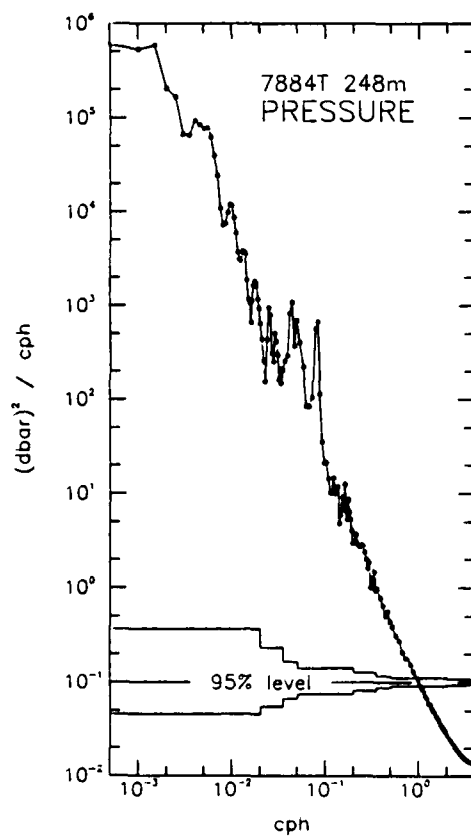
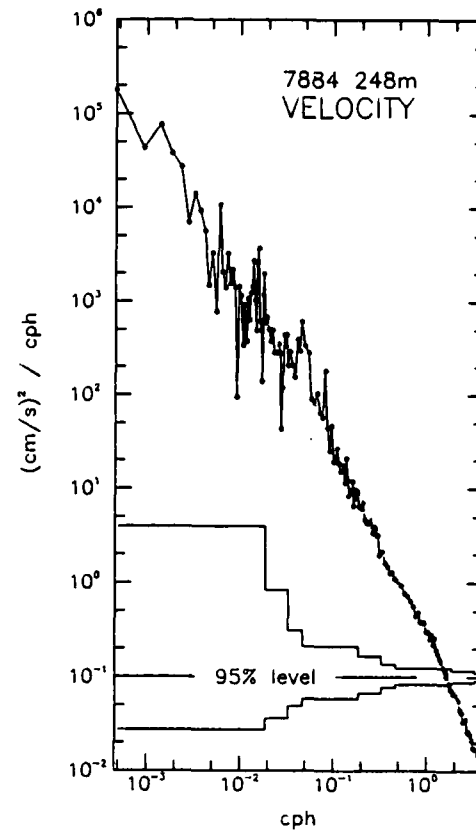
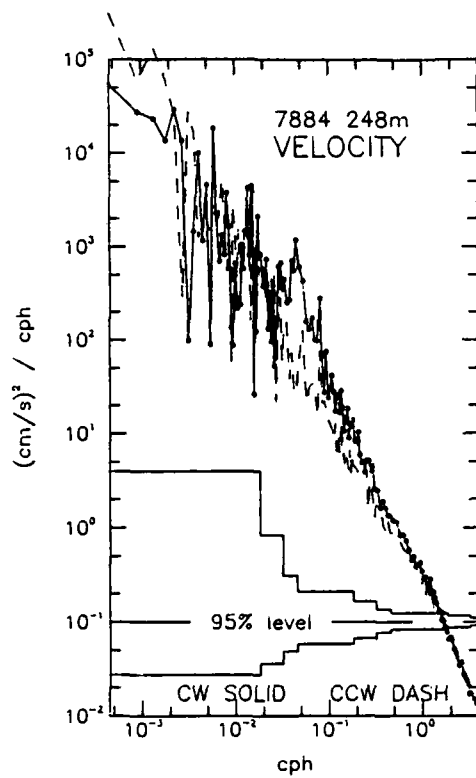


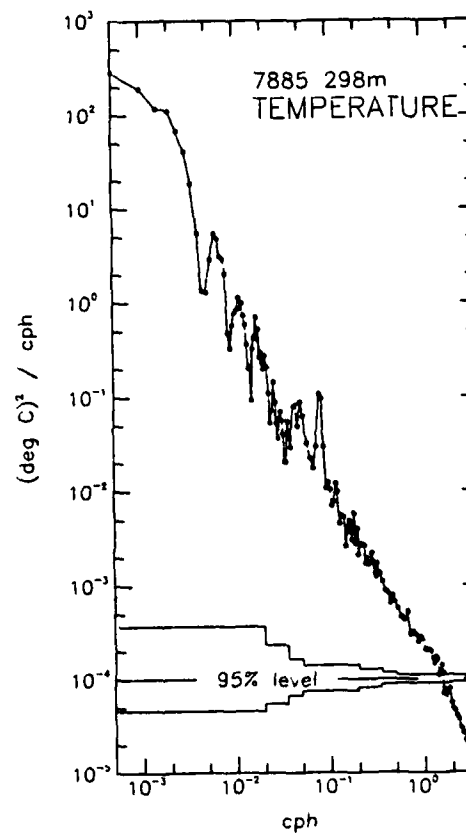
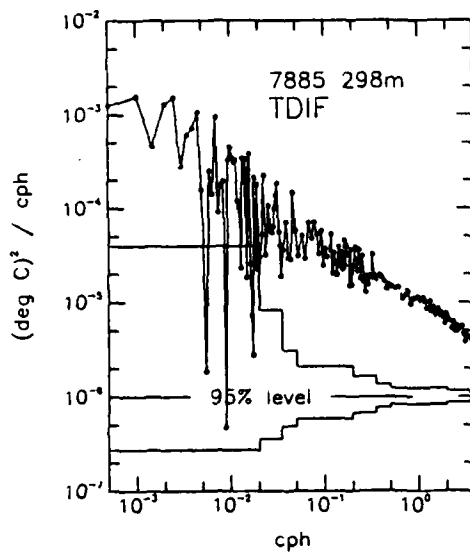
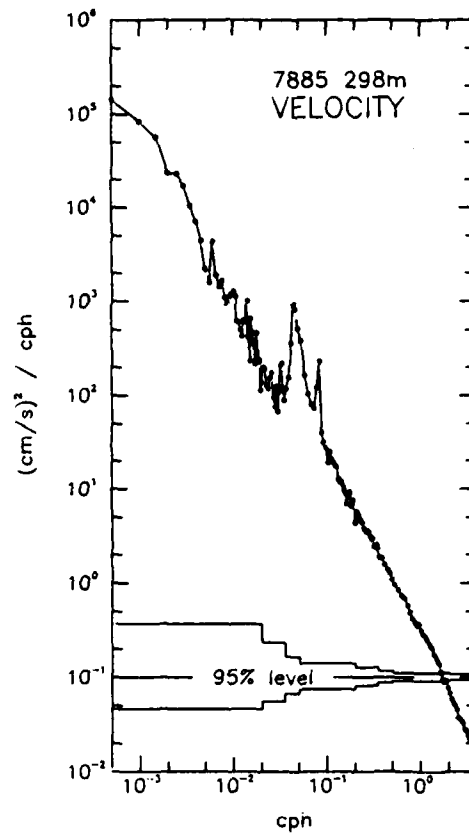
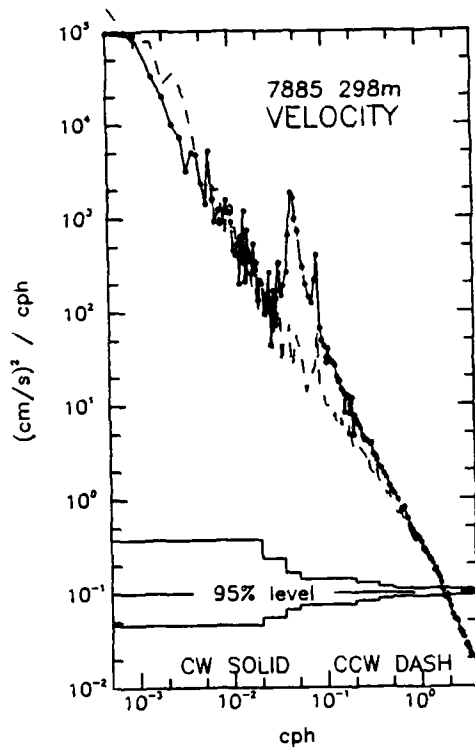


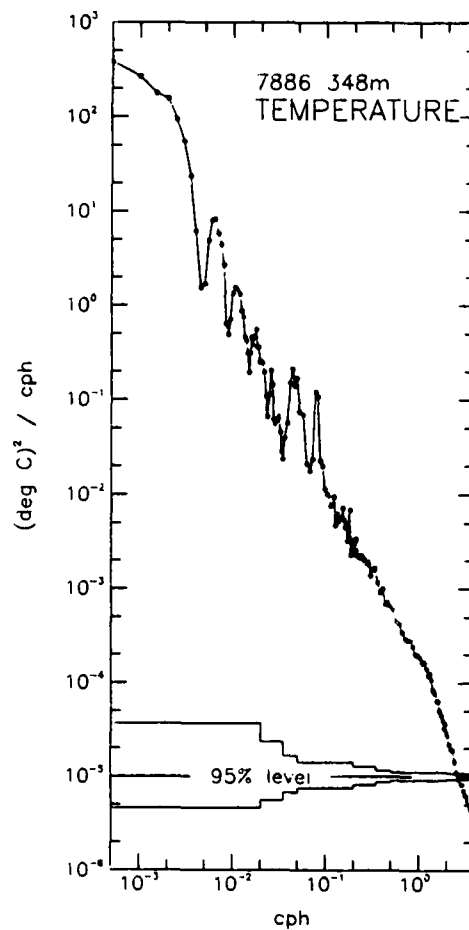
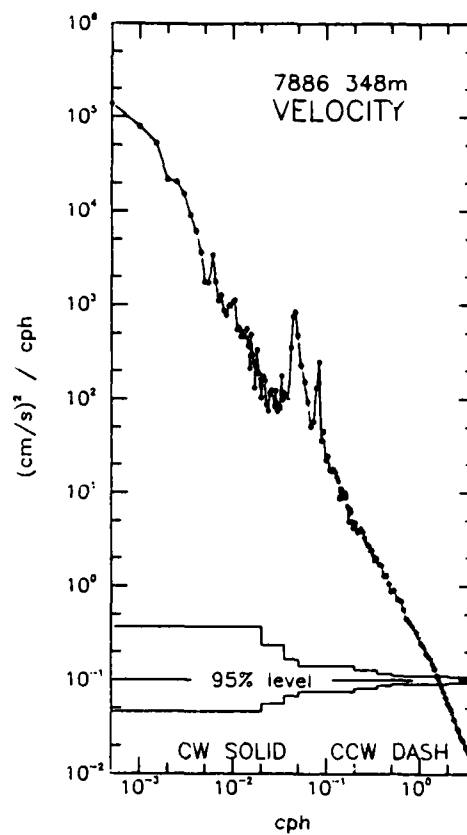
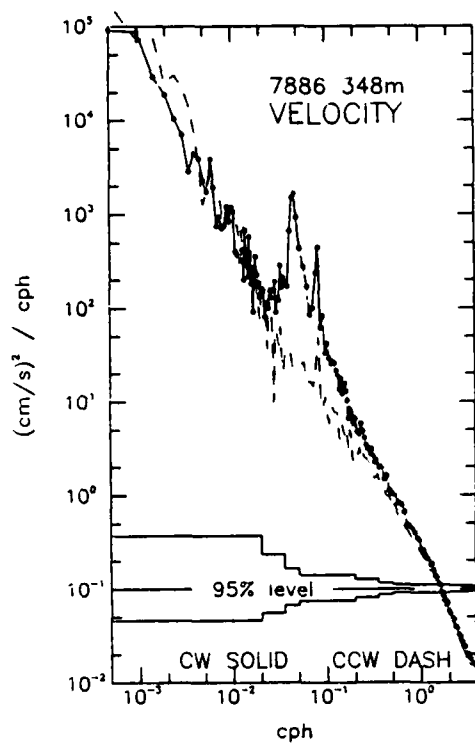


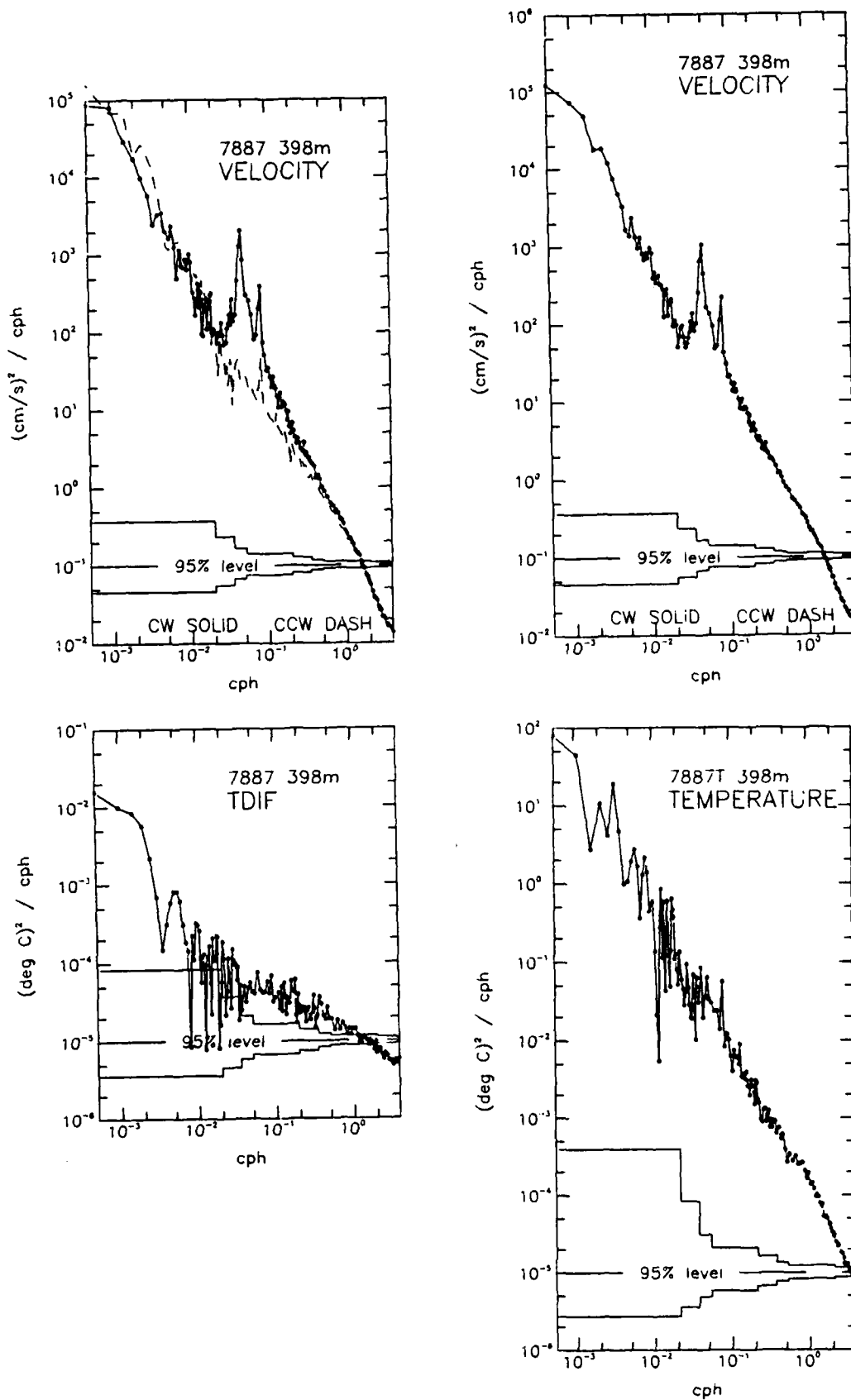


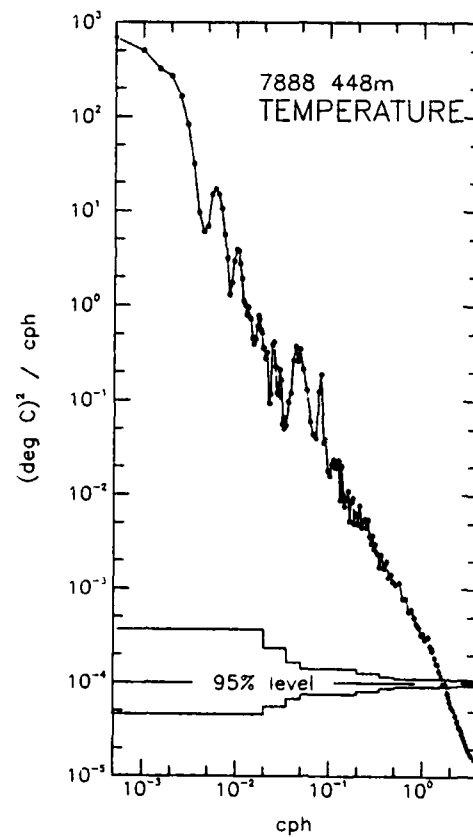
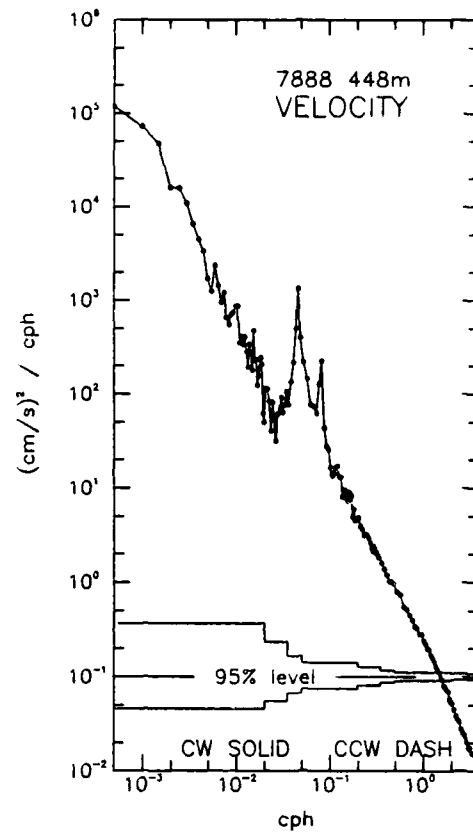
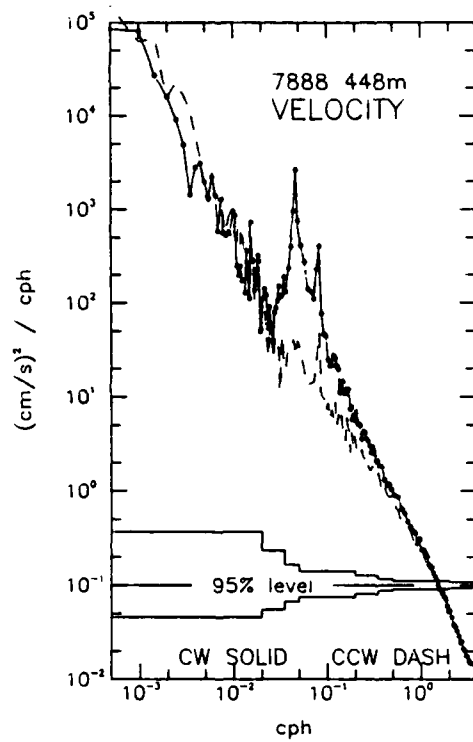


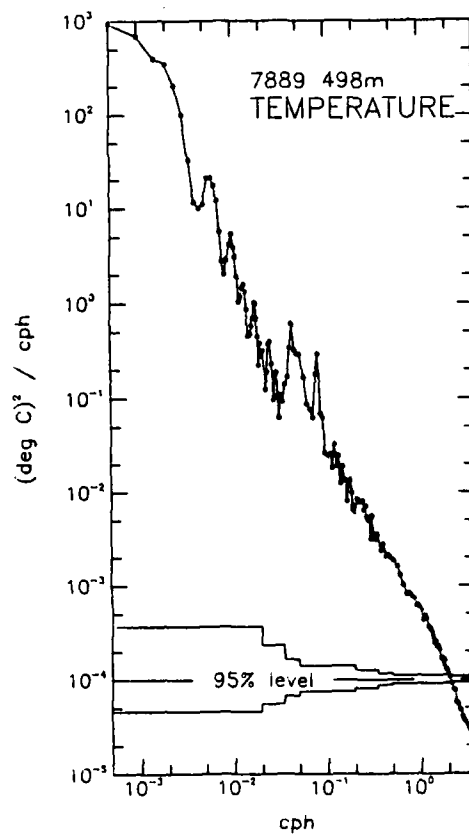
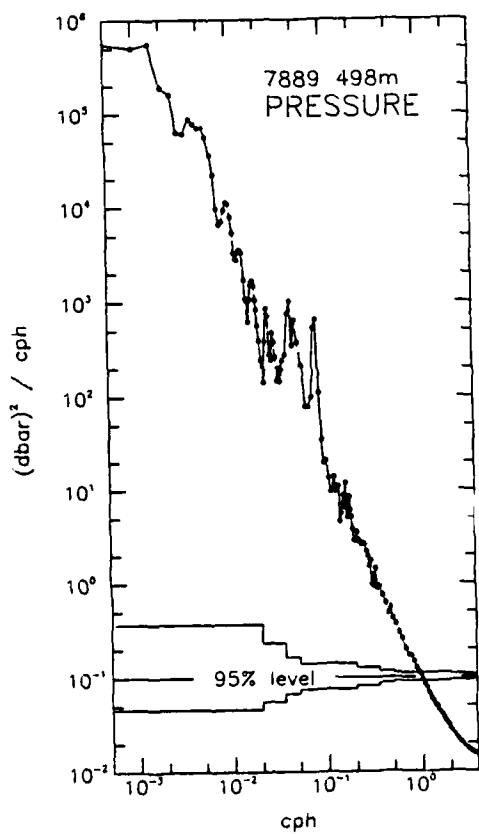
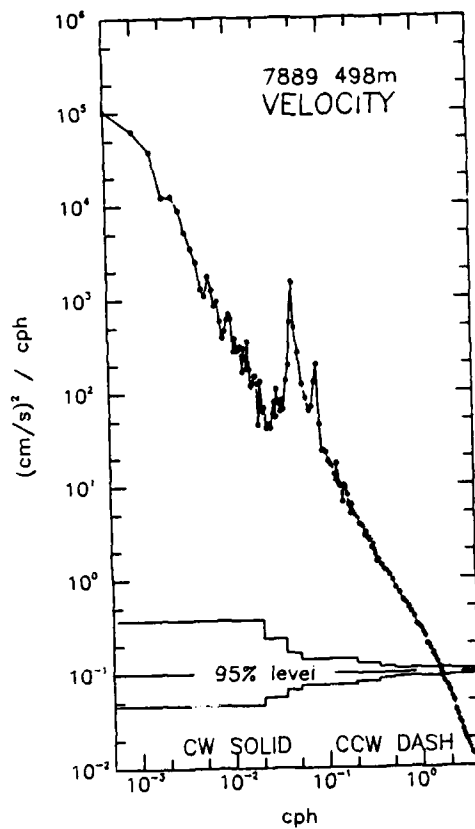
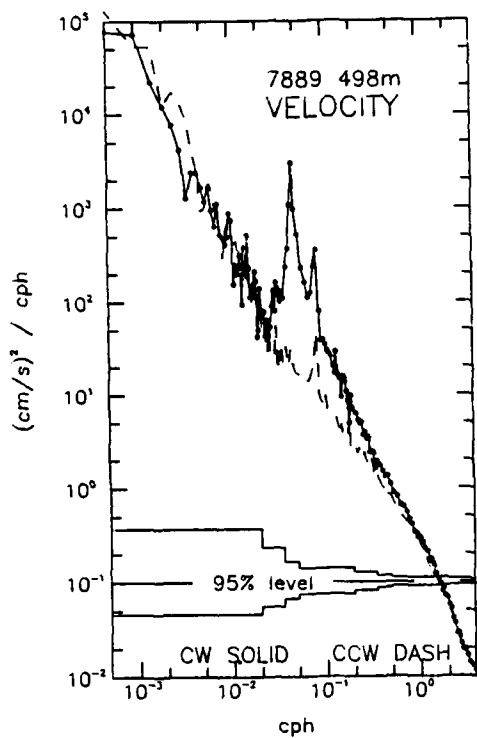


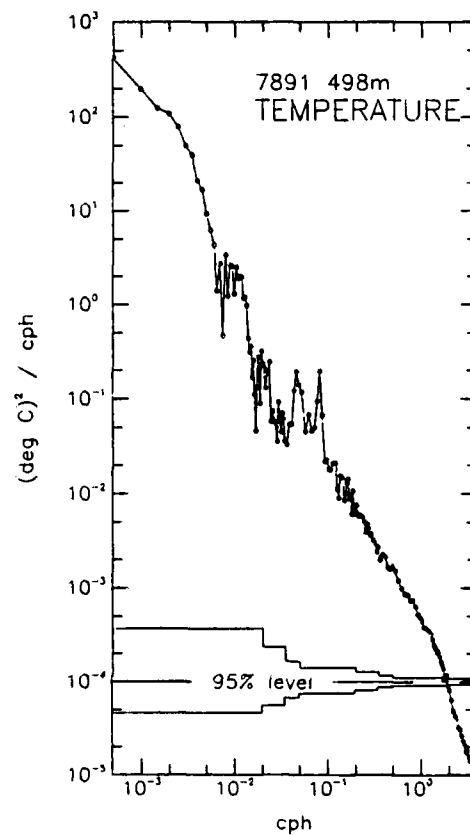
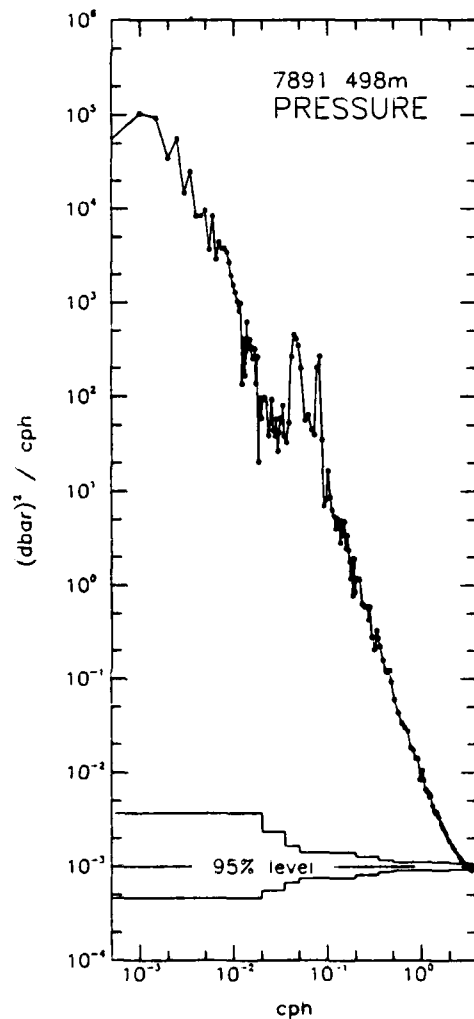
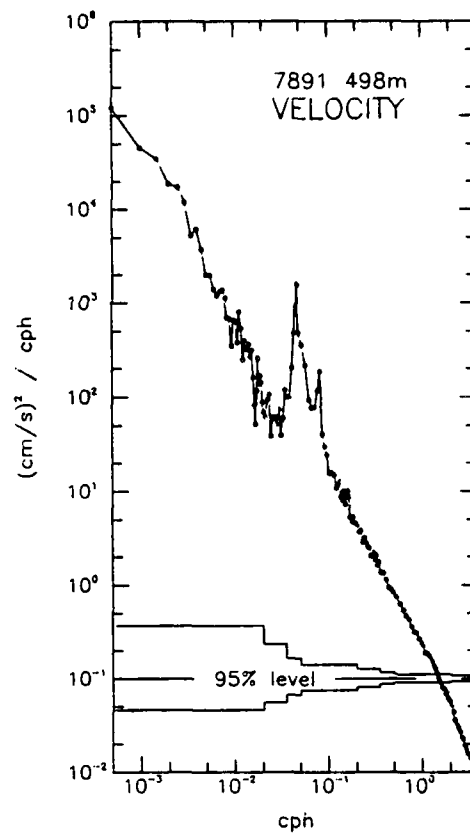
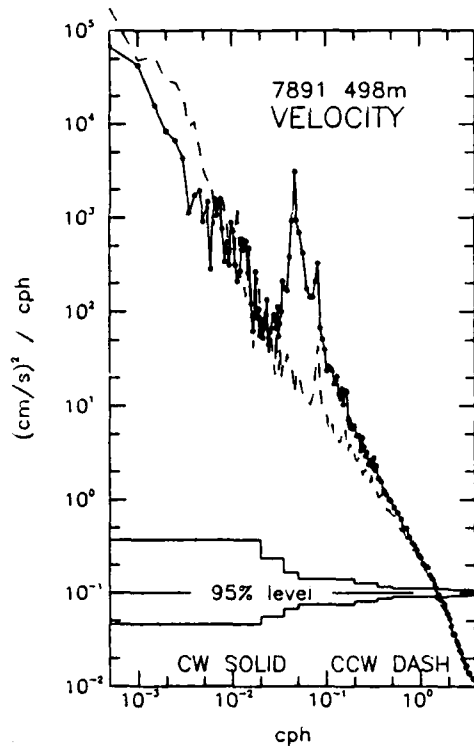


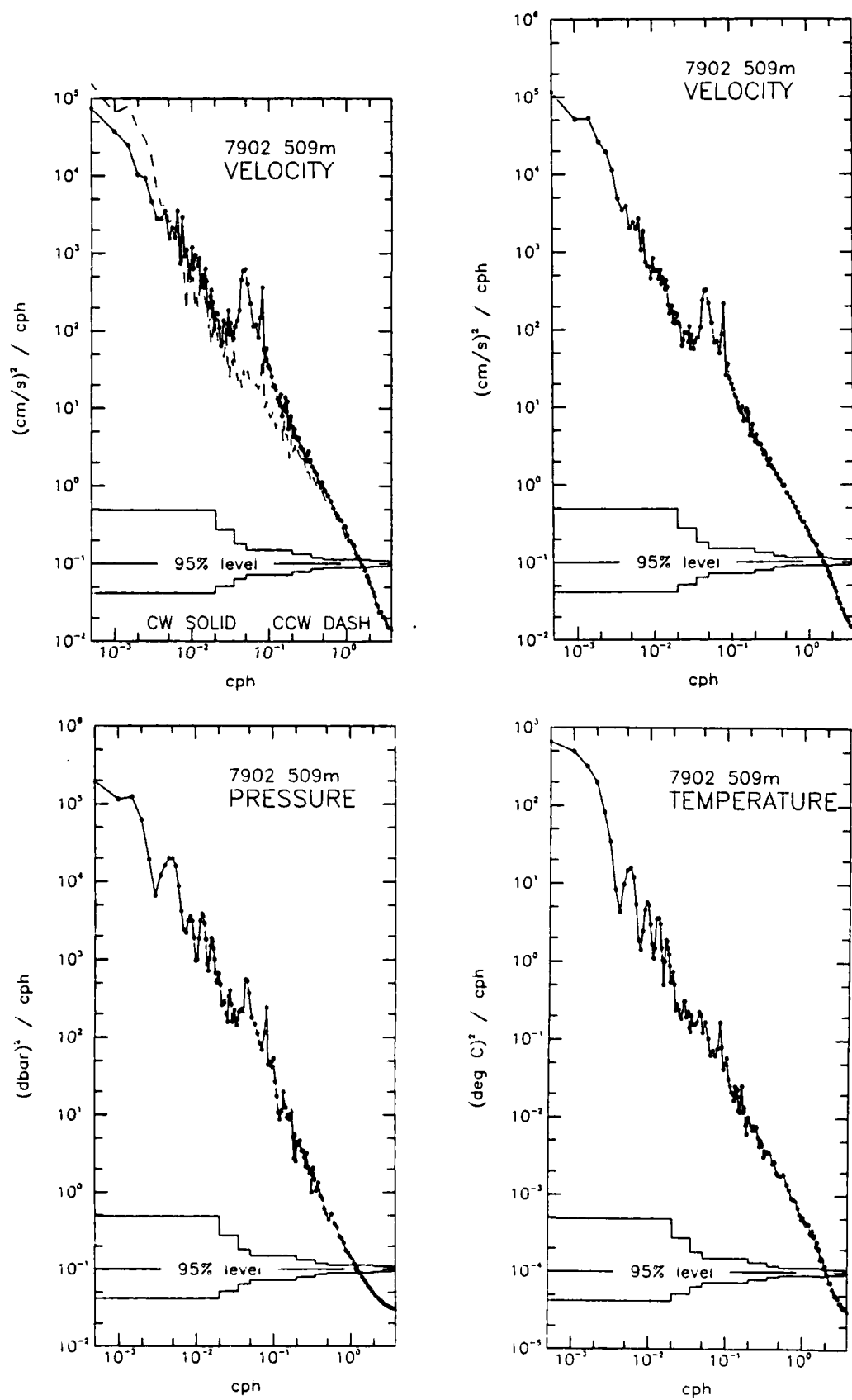


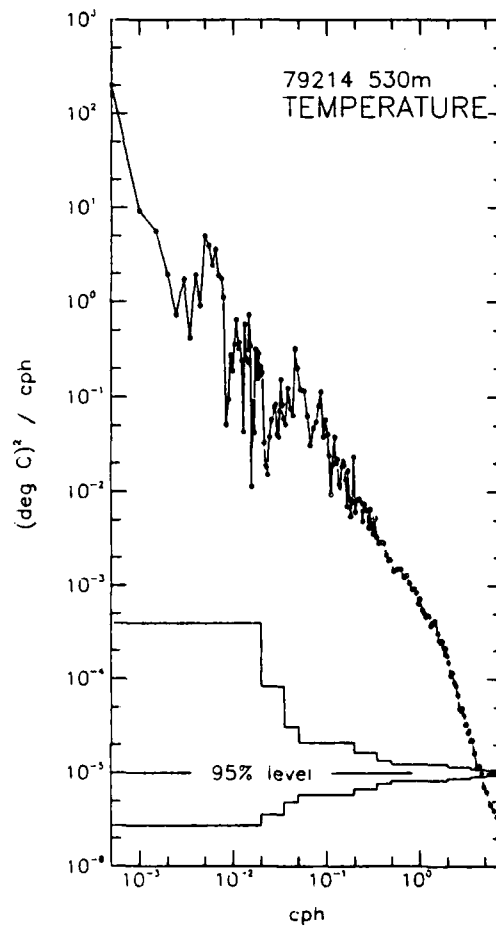
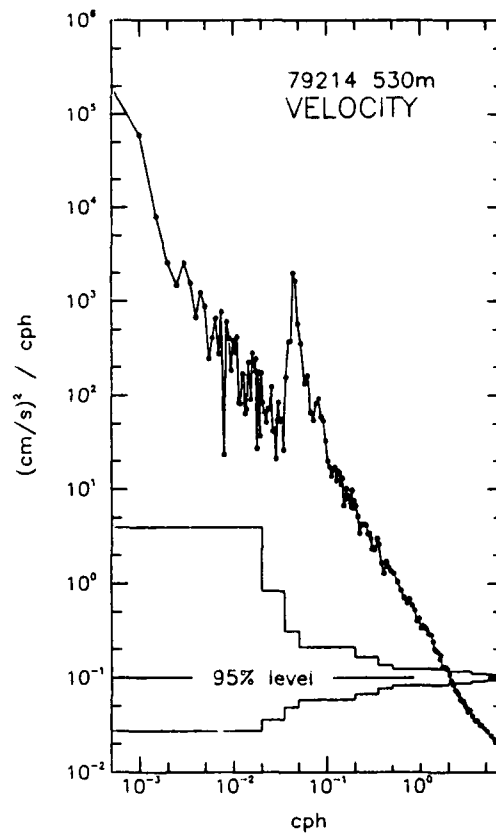
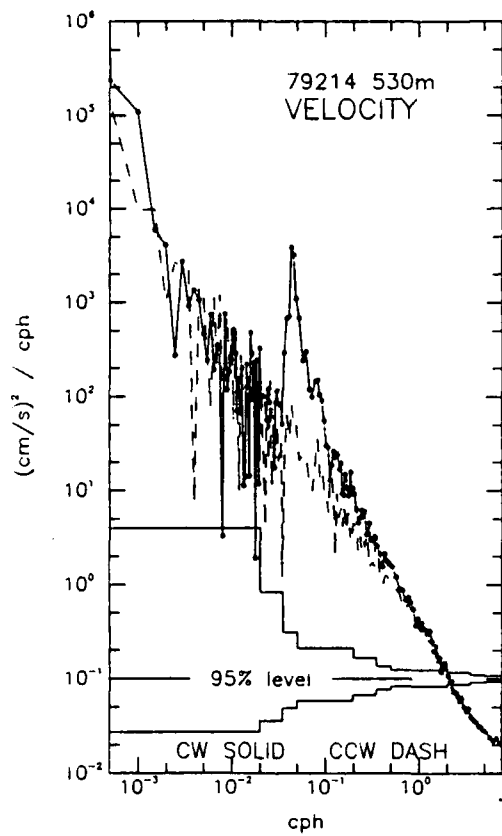


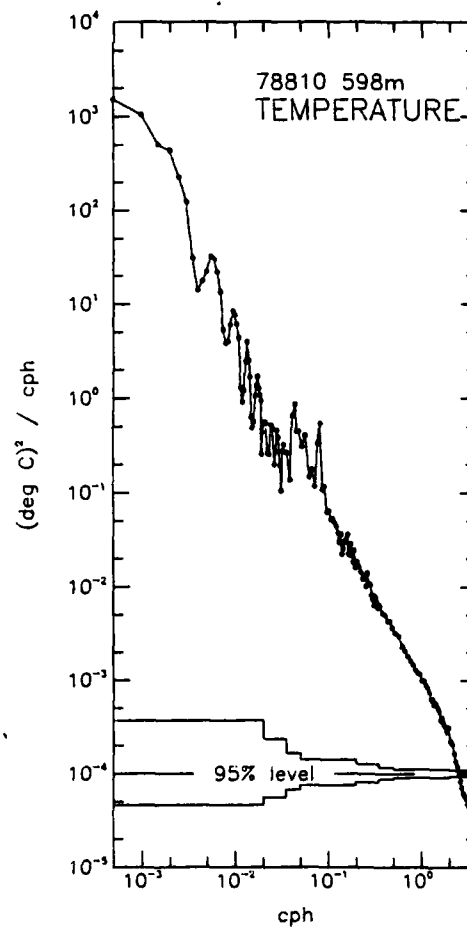
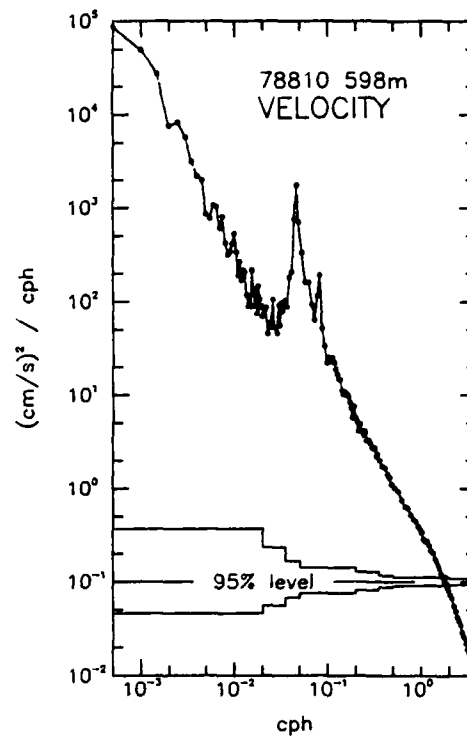
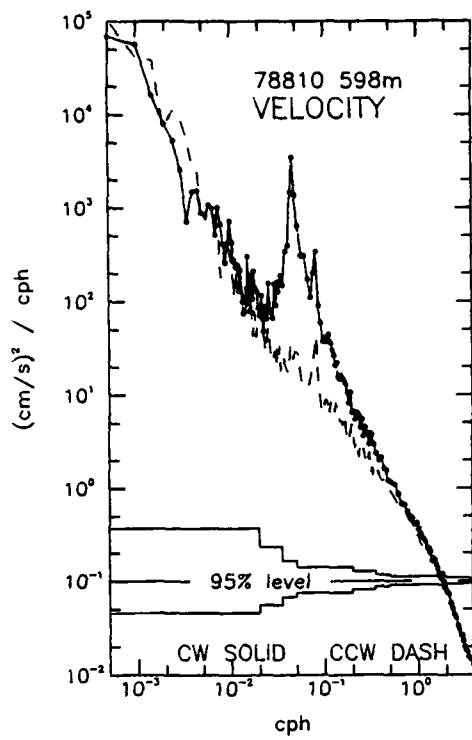


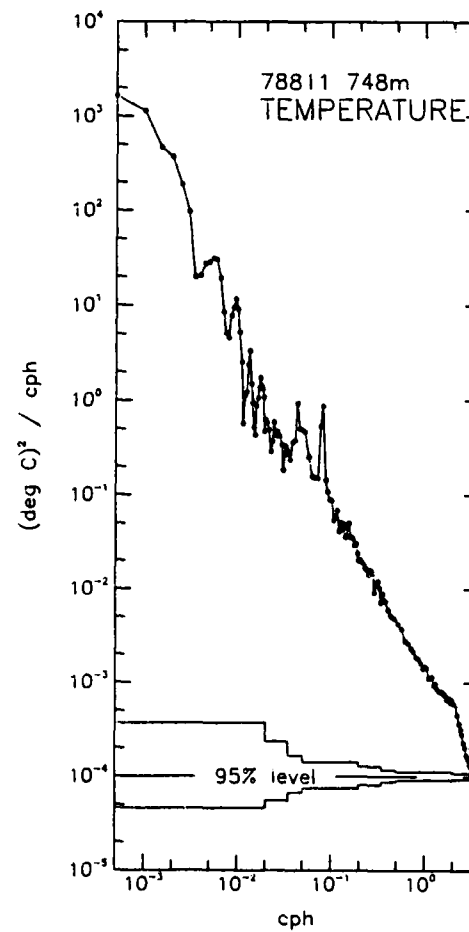
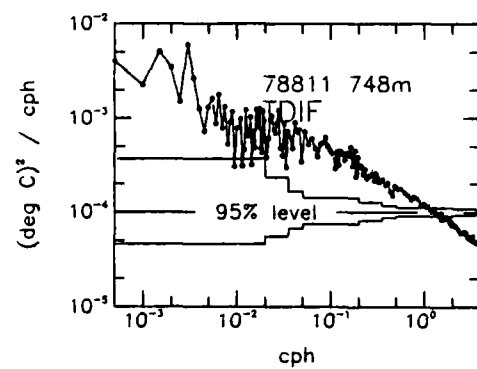
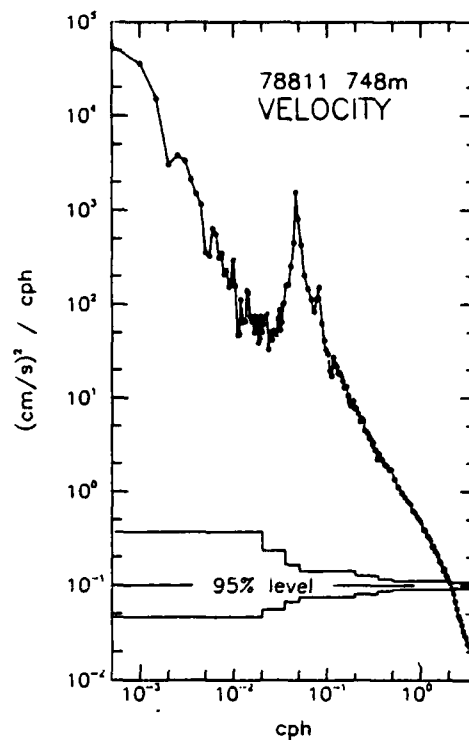
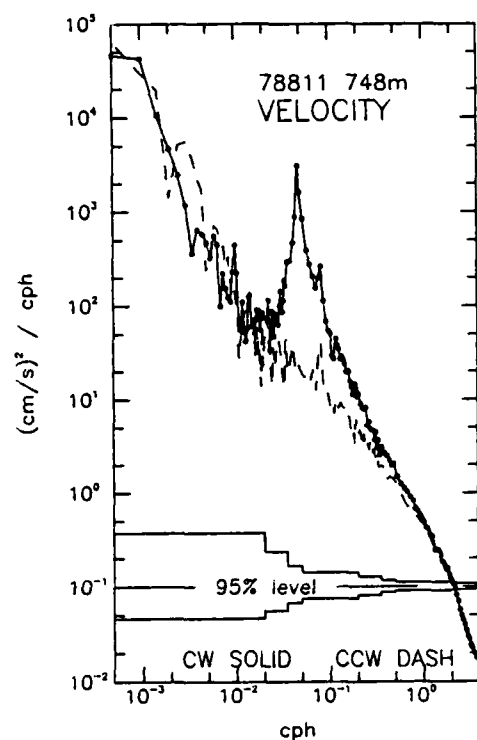


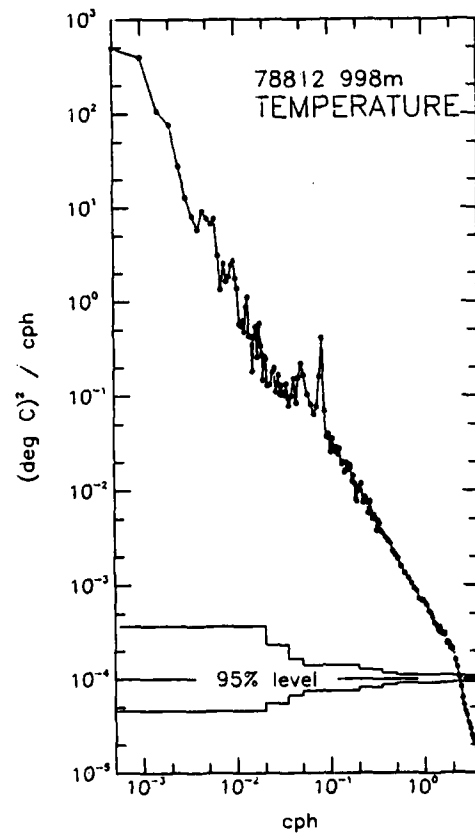
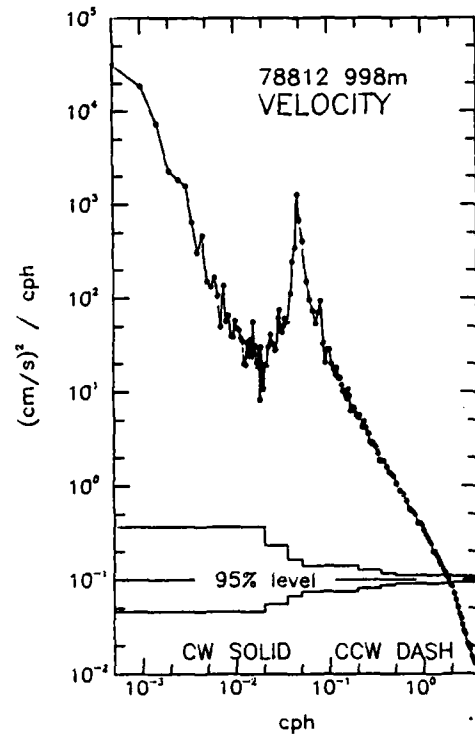
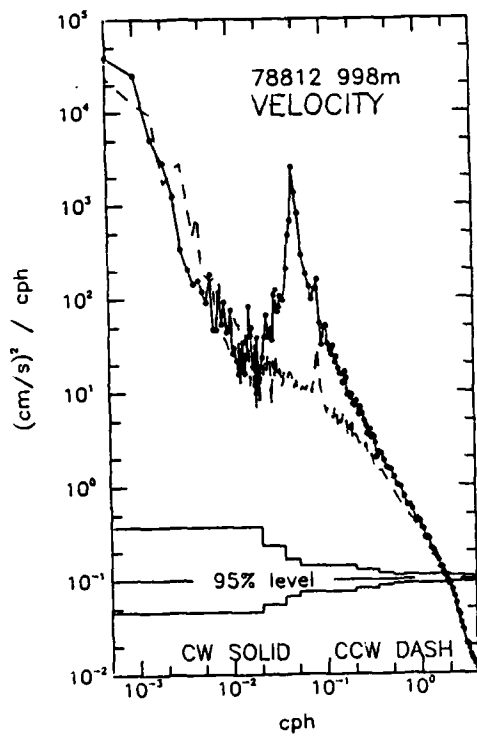


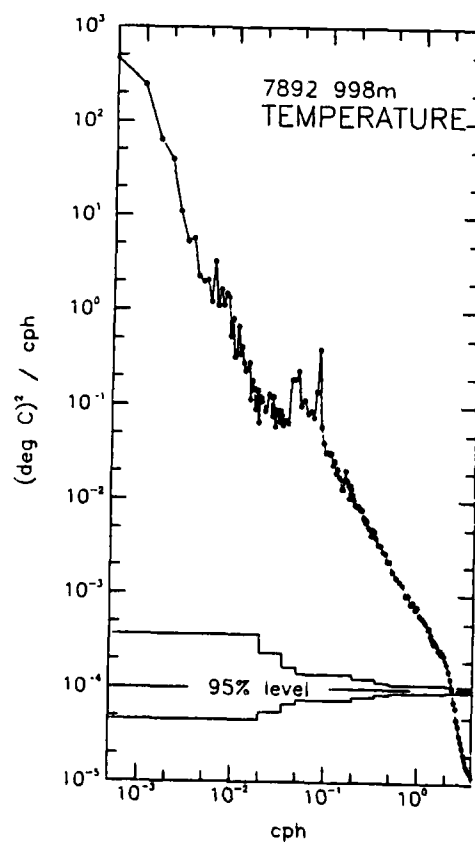
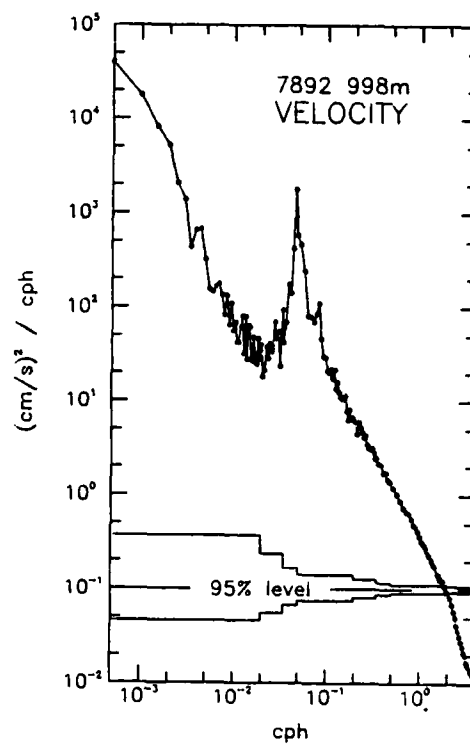
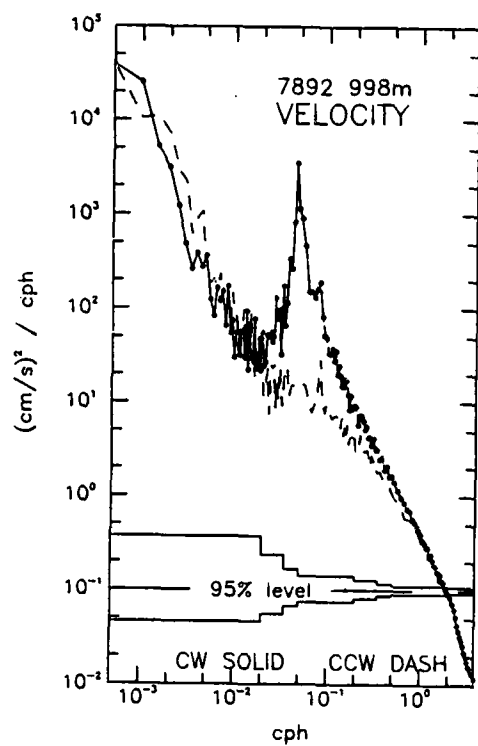


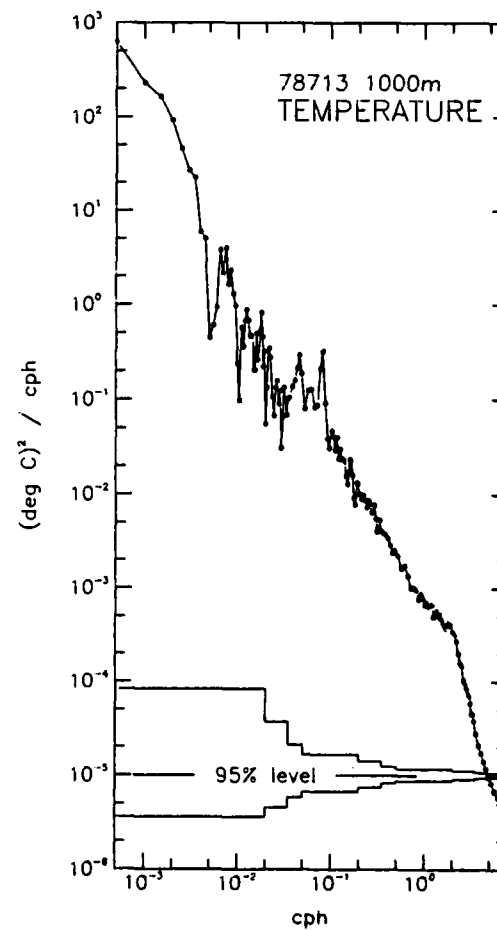
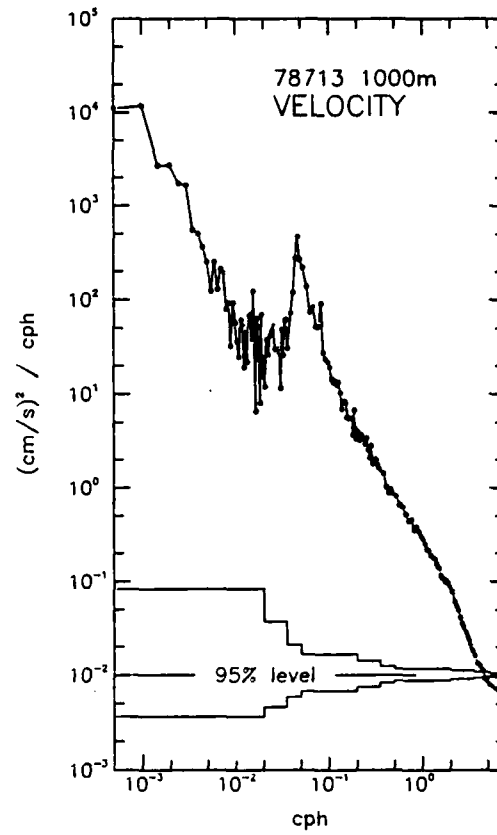
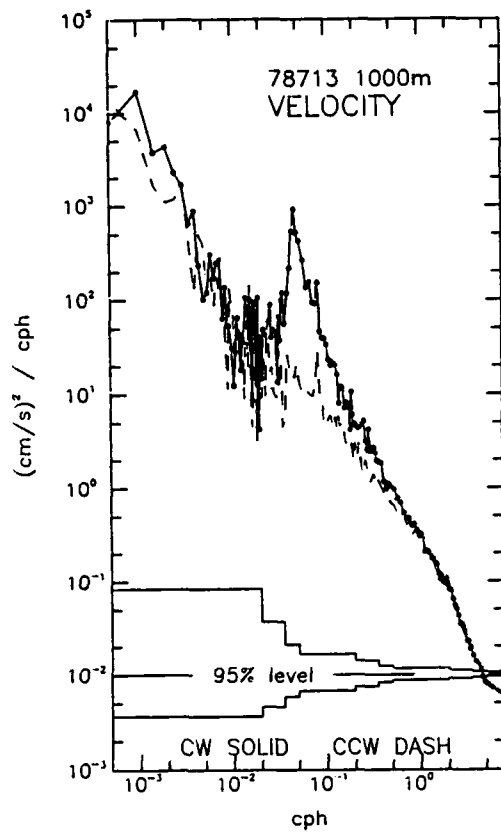


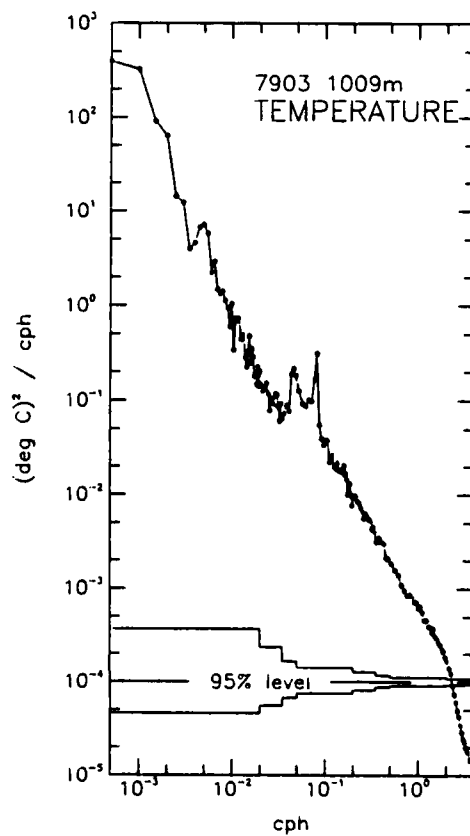
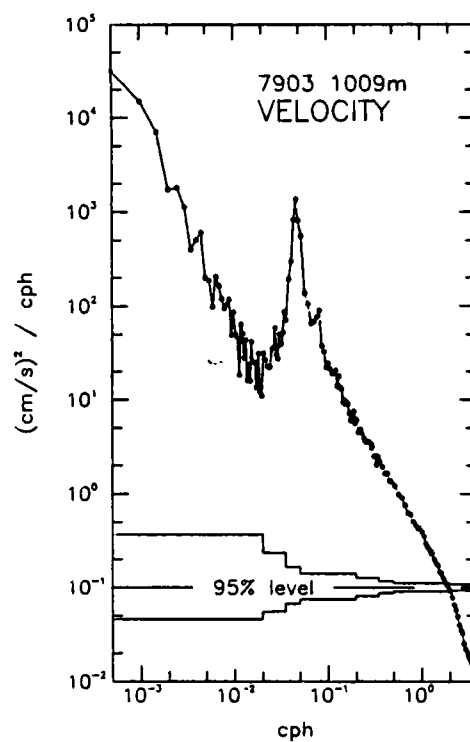
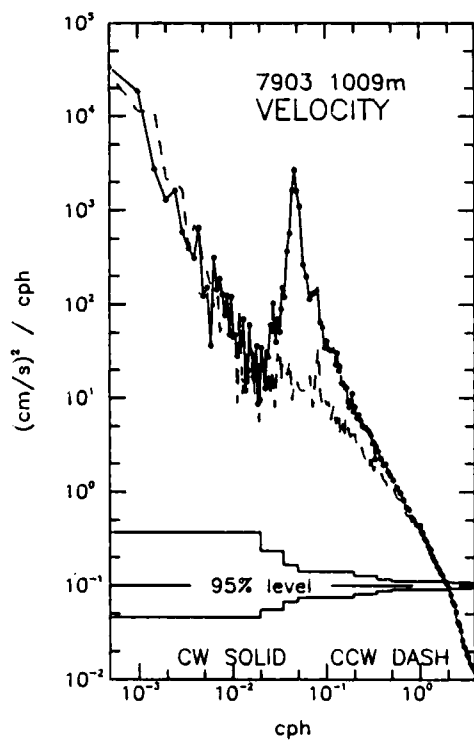


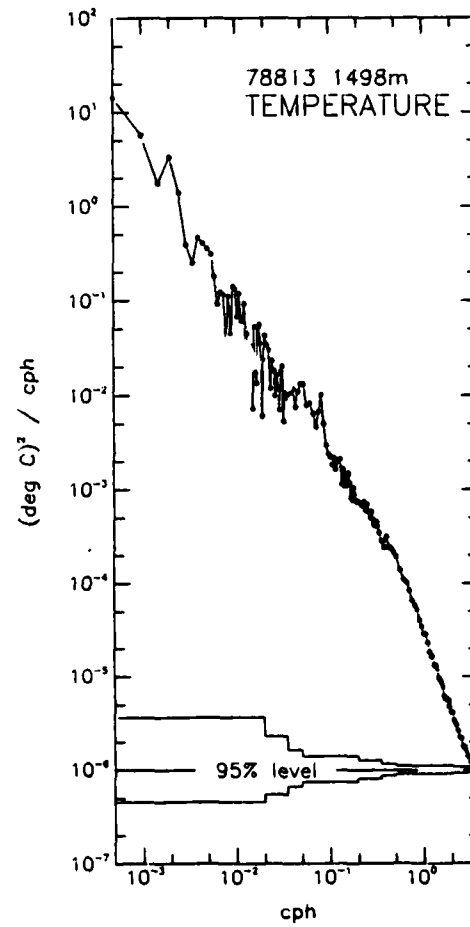
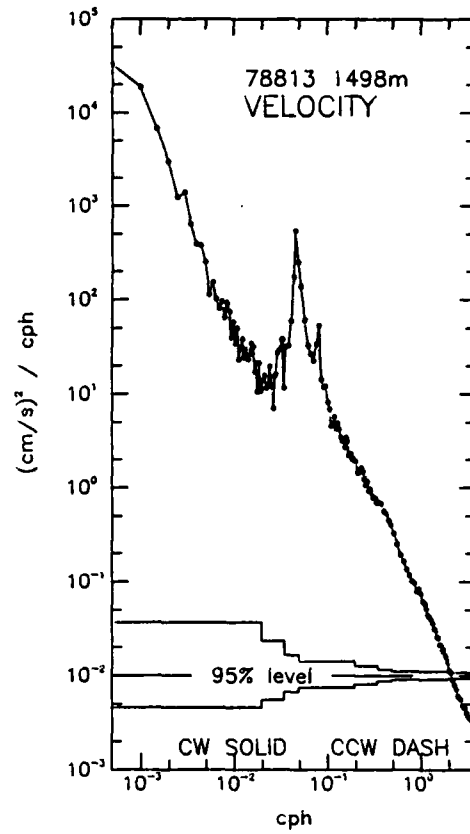
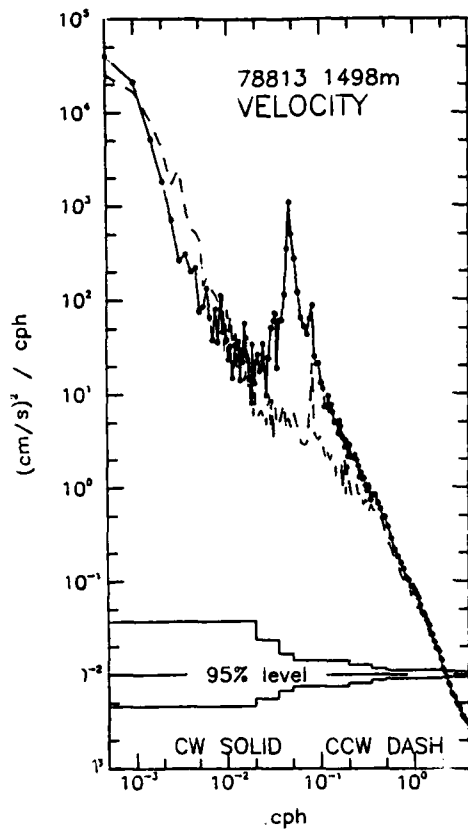


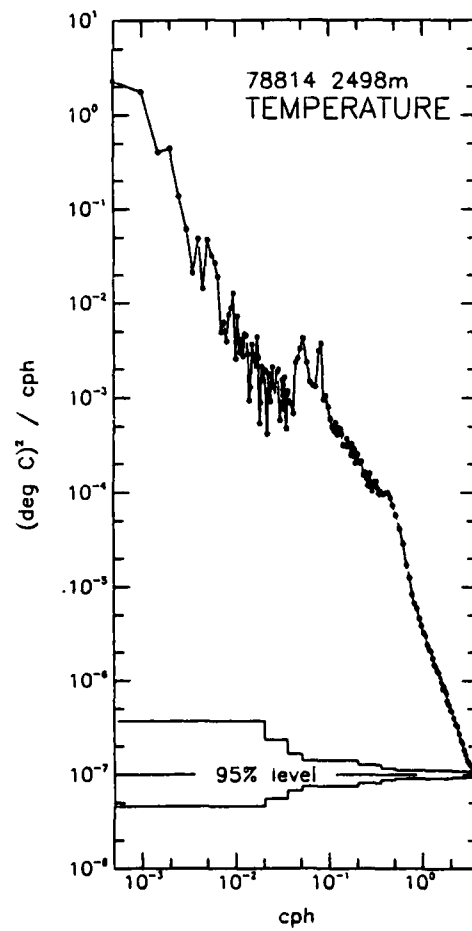
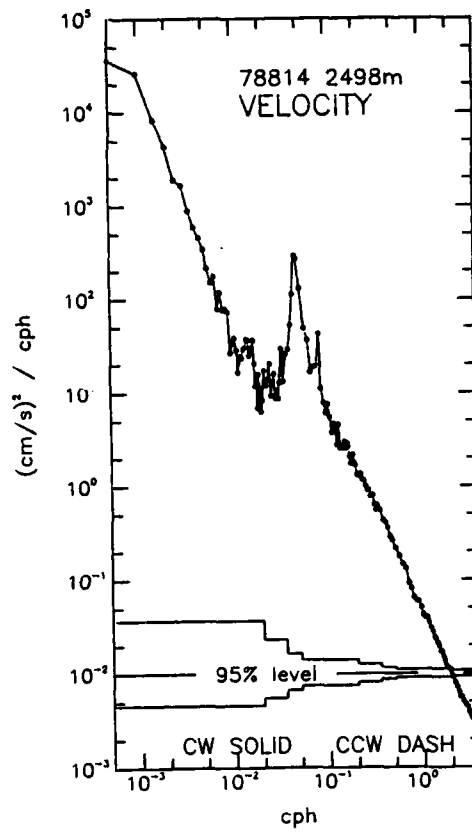
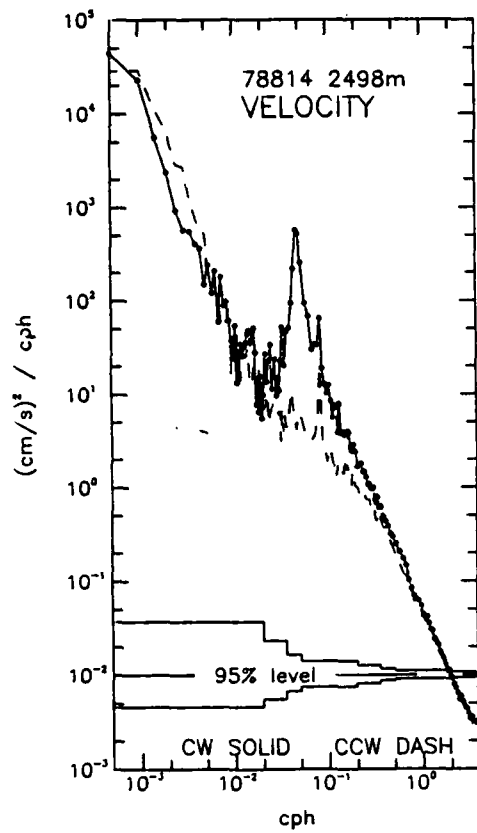


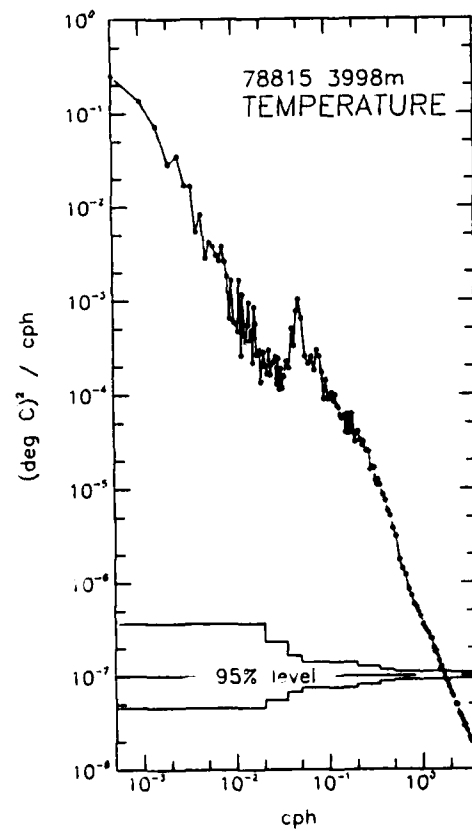
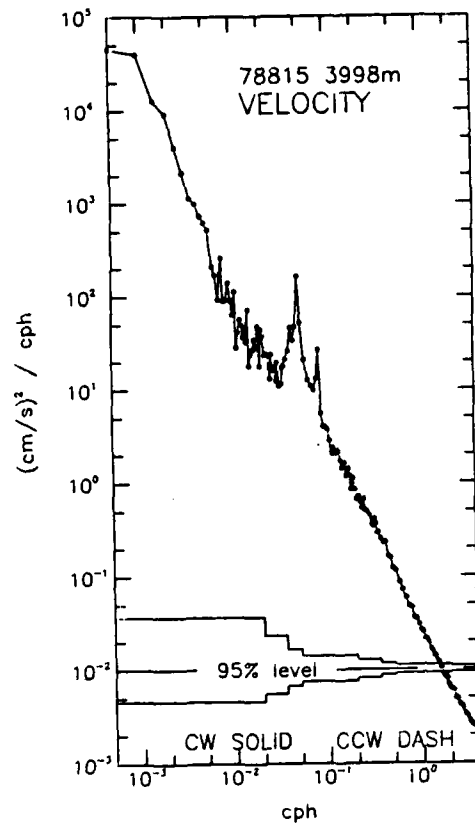
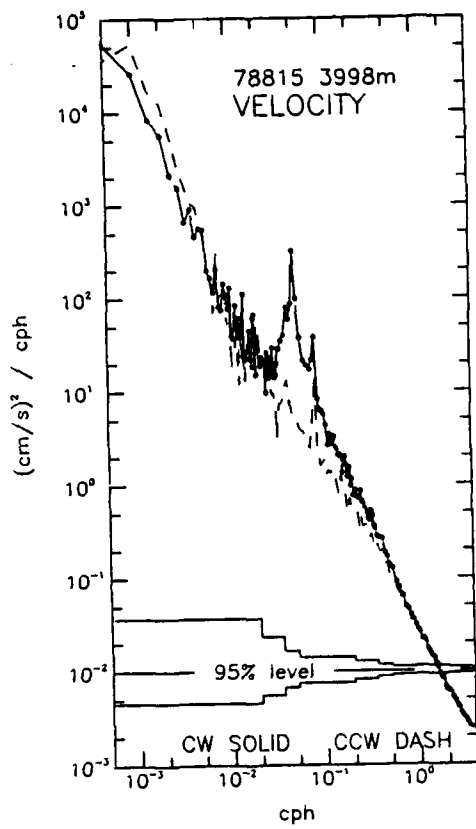












SURFACE MOORINGS 787 AND 792
NEAR-SURFACE MOORING 788
WITH SUBSURFACE MOORINGS 789 AND 790
INCLUDED BY DEPTH.

STATISTICS

WIND RECORDER DATA

Data name	East	North	Speed	Sea Temp	Air Temp	Insol	Rel Humidity	Bar Press
units	(m/s)	(m/s)	(m/s)	(degrees C.)	(degrees C.)	(watts/m**2)	(%)	(mbars)
*** - Mean -	*	*	*	*	*	*	*	*
787S1	0.305	1.141	5.539	24.527	23.553	194.108	77.266	1017.249
792S1	2.944	0.322	8.142	20.102	17.388	177.922	-	1014.270
*** - Variance -	*	*	*	*	*	*	*	*
787S1	16.335	19.158	6.210	6.366	9.608	75321.289	147.326	22.918
792S1	24.726	43.676	10.879	2.543	7.097	70407.367	-	54.179
*** - Skewness -	*	*	*	*	*	*	*	*
787S1	-.137	-.203	.305	-.657	-.838	1.291	-.560	-.421
792S1	-.0573	.102	-.0417	.630	-.393	1.675	-	.507
*** - Kurtosis -	*	*	*	*	*	*	*	*
787S1	2.652	2.601	2.897	2.136	2.900	3.368	1.904	4.259
792S1	2.730	1.927	2.403	2.644	2.715	4.714	-	2.335
*** - Minimum Value -	*	*	*	*	*	*	*	*
787S1	-13.255	-13.749	.013	18.946	12.523	.0000	49.647	998.322
792S1	-11.881	-14.582	.0846	17.078	7.734	5.287	-	1001.706
*** - Maximum Value -	*	*	*	*	*	*	*	*
787S1	14.532	15.595	15.886	28.695	30.194	1158.350	94.000	1031.419
792S1	18.325	19.609	20.764	24.286	23.057	1144.501	-	1030.741

***** EAST AND NORTH *****

CORR.

COVAR. COEFF. ELLIPSE ORIENT MAJAX MINAX

787S1	3.636	.206	.200	34.390	4.653	3.721
792S1	-5.858	-.178	.287	164.137	6.733	4.802

** 787S1QC450 * 38792 POINTS FROM 83- IV -12 TO 83- X -31 (all var)

** 787S1C450 * 16537 POINTS FROM 83- IV -12 TO 83- VII-07 (Rel Hum)

** 792S1B225 * 44560 POINTS FROM 84- I -25 TO 84- V -20 (all var)

** 792S1BAR225 * 4801 POINTS FROM 84- I -25 TO 84- II -07 (Bar Press)

Data name	(m)	Means				Variance				Skewness				Data depth	
		East	North	Speed	Temp	Press/dt	East	North	Speed	Temp	Press/dt	East	North		Temp
m 7873	5	-19.526	-5.032	28.070	24.456		177.217	359.099	4.939	6.276		-.048	-.160	-	.654
m 7874	10	-32.041	-4.440	36.940	24.421		464.150	246.930	2.791	6.285		-.569	-.214		.648
a 7875	15	-16.987	-6.783	30.831	24.381		567.924	450.519	2.464	6.344		-.376	-.614		.640
m 7876	25	-29.121	-9.142	36.862	23.950		403.811	341.510	8.108	5.226		-.431	-.346		.532
m 7877	50	-23.875	-7.986	27.478	22.357		155.254	139.130	3.119	3.961		-.584	-.468		.133
m 7878	75	-12.554	-1.155	23.734	20.952		376.455	341.914	3.982	1.577		-.537	.023		.483
m 7879	100	-14.159	-2.812	23.534	20.036		373.409	269.015	6.982	.473		-.354	-.196		.375
m 78713	1000	-1.988	-0.189	8.043	7.893		54.158	28.636	2.092	.818		-.403	.676	-	.554
a 7881	98	-10.983	-0.154	23.429	19.559	120.197	367.534	348.130	287.378	.561	1325.352	-.268	.644	.206	3.238
a 7882	149	-4.704	0.611	22.287	18.903	171.156	339.503	344.145	209.441	.165	1324.533	-.386	.657	-1.241	3.231
d 7883	198	-12.756	-1.447	24.271	18.470	.00536	346.050	337.400	259.365	.259	.000148	.072	.733	-3.384	1.820
a 7884	248	-19.282	-3.477	26.300	18.290	273.365	261.134	192.896	146.225	.273	1269.126	.057	-.307	-3.755	3.299
d 7885	298	-4.067	0.583	19.657	18.020	.00827	243.773	274.733	148.979	.420	.0000466	-.405	.694	-4.574	.908
a 7886	348	-4.000	0.843	19.024	17.731		235.972	250.960	141.747	.580		-.368	.699	-4.749	
d 7887	398	-3.937	0.633	18.194	17.709	.00527	209.190	229.746	123.797	.105	.0000630	-.365	.715	-.486	2.853
a 7888	448	-3.960	0.470	18.005	17.106		201.998	222.808	116.527	1.041		-.363	.706	-4.187	
a 7889	498	-3.752	.856	16.798	16.658	527.749	177.495	186.820	96.234	1.411	1240.464	-.336	.655	-3.522	3.187
a 78810	598	-3.461	0.755	15.411	15.323		148.381	154.963	78.391	2.149		-.323	.698	-2.438	
d 78811	748	-2.635	1.183	13.169	12.377	.0331	105.979	108.757	49.662	2.407	.000467	-.319	.522	-1.713	1.083
a 78812	998	-1.011	0.837	9.685	7.435		66.935	50.751	25.618	.812		-.139	.543	-.722	
a 78813	1498	0.820	1.221	8.811	4.522		68.411	26.108	19.053	.0202		-.023	.519	-.419	
a 78814	2498	2.519	1.409	9.371	3.414		83.648	21.841	26.008	.00428		.181	.605	-.774	
a 78815	3998	4.910	2.519	11.771	2.383		131.363	25.850	49.118	.000448		.402	.535	-.035	
a 7891	498	-3.099	0.230	16.787	16.799	516.669	181.947	187.641	97.434	.546	241.760	-.413	.650	-3.120	3.079
a 7892	998	-0.915	.471	10.418	7.491		77.734	55.764	25.798	.579		-.098	.281	-.322	
a 7902	509	-3.318	1.482	16.805	16.644	521.516	193.781	222.275	146.845	.931	322.032	-.360	1.218	-3.141	2.629
a 7903	1009	-1.134	0.675	9.764	7.312		57.510	62.461	26.377	.583		-.345	.375	-.898	
m 7922	5	6.074	-5.749	28.409	19.725		386.556	591.022	240.435	1.037		-.118	.531	.598	
m 7923	10	3.017	12.842	36.965	19.720		528.601	962.602	298.638	1.021		-.169	.023	.594	
a 7924	15	3.317	-4.780	28.064	19.715	15.700	372.184	613.999	232.440	1.002	.0598	-.203	.466	.591	0.355
m 7925	25	-0.492	19.473	37.819	19.670		445.707	936.243	330.985	.945		.139	-.286	.602	
m 7926	50	-5.987	18.593	29.951	19.472		157.732	643.902	285.994	.684		-.181	.114	.732	
m 7928	76	-0.761	-0.816	23.089	19.226		231.500	445.517	145.148	.379		-.139	.347	1.012	
m 7929	101	1.401	-0.403	22.244	19.051		203.621	414.146	125.106	.248		-.099	.341	1.116	
a 79210	152	1.908	-1.454	28.218	18.895	151.420	281.826	627.701	119.011	.175	.540	-.0172	.364	.713	-1.032
m 79214	530	-0.108	0.986	14.775	16.794		99.475	194.277	76.426	.214		-.163	.822	-1.325	

Data	depth	Kurtosis				Minimum Value				Maximum Value					
		East	North	Temp	Press/dt	East	North	Speed	Temp	Press/dt	East	North	Speed	Temp	Press/dt
7873	5	2.469	3.210	2.106		-53.874	-69.391	.048	18.941		12.634	44.835	69.396	28.240	
7874		2.420	3.793	2.083		-92.354	-65.357	.325	18.950		12.924	47.599	95.031	28.230	
7875	15	3.209	4.490	2.047		-90.195	-103.613	.146	18.970		60.637	52.132	111.597	28.211	
7876	25	2.374	3.264	1.879		-81.124	-76.612	.150	19.175		17.143	50.323	81.138	27.382	
7877	50	2.492	2.307	2.098		-53.591	-39.407	.800	18.882		2.747	13.621	57.074	27.651	
7878	75	3.635	6.370	3.170		-78.379	-95.436	.000	18.699		55.484	80.558	96.443	25.948	
7879	100	4.486	4.494	4.259		-79.432	-85.489	.083	18.460		72.143	57.246	89.366	23.940	
78713	1000	2.434	4.366	3.577		-24.797	-16.054	.000	5.129		15.971	25.911	26.713	10.331	
7881	98	4.164	4.647	2.543		-79.021	-61.860	.370	16.708	97.920	72.760	77.052	99.520	21.875	385.036
7882	148	3.988	3.572	7.402		-75.905	-60.826	.289	15.802	149.519	70.647	71.592	92.805	19.921	435.495
7883	198	4.100	4.297	18.220		-68.393	-60.926	.1234	14.845	- .0489	62.885	64.450	81.046	19.284	.115
7884	248	2.339	2.483	23.914		-57.226	-39.443	.894	13.875	251.974	25.722	37.275	57.726	19.335	536.468
7885	298	3.456	3.456	28.148		-54.058	-54.607	.318	13.080	- .0473	50.011	53.908	68.962	18.880	.729
7886	348	3.378	3.310	28.553		-50.368	-48.838	.268	12.064		47.898	50.699	61.186	18.603	
7887	398	3.257	3.318	2.254		-51.351	-47.728	.448	16.808	- .0352	41.255	50.416	54.330	18.368	.0985
7888	448	3.217	3.339	22.861		-50.248	-49.511	.271	9.968		37.572	49.584	55.976	18.114	
7889	498	3.065	3.100	17.479		-45.796	-42.959	.774	9.093	504.120	38.714	48.030	52.158	17.763	778.187
78810	598	3.100	3.104	10.454		-43.898	-33.400	.250	7.317		36.427	42.118	43.990	17.245	
78811	748	3.047	3.025	6.306		-36.203	-28.429	.106	5.688	-0.113	32.353	38.689	40.383	14.876	.241
78812	998	2.524	3.478	2.889		-26.332	-20.559	.403	4.833		23.999	30.418	30.779	9.191	
78813	1498	2.311	4.038	2.974		-21.384	-19.733	1.305	4.018		25.082	21.735	25.093	4.872	
78814	2498	2.322	3.972	3.663		-22.339	-13.441	1.119	3.172		31.009	24.549	31.009	3.578	
78815	3998	2.237	3.618	2.903		-18.762	-11.052	1.477	2.316		38.196	23.555	38.204	2.455	
7891	498	3.876	3.700	16.798		-49.964	-36.922	1.789	11.844	504.514	55.501	62.153	63.326	17.760	636.506
7892	998	2.660	2.949	2.648		-30.830	-24.852	.512	5.102		31.507	26.637	31.920	9.222	
7902	509	4.841	4.764	13.856		-48.596	-31.738	.475	11.651	510.953	58.186	56.946	60.351	17.653	633.741
7903	1009	2.970	3.127	3.352		-33.021	-26.982	.472	4.938		26.703	30.432	34.793	8.753	
7922	5	3.199	3.596	1.976		-62.605	-64.730	.042	18.411		64.999	112.393	112.567	22.329	
7923	10	2.658	2.867	1.977		-87.928	-79.608	.973	18.418		54.473	96.475	100.813	22.334	
7924	15	3.008	3.494	1.983		-60.299	-68.453	.179	18.425	15.151	59.544	98.197	101.161	22.341	16.321
7925	25	2.599	2.687	2.044		-84.855	-84.094	.543	18.406		82.473	92.490	104.632	22.327	
7926	50	2.482	2.613	2.524		-38.689	-40.769	.118	18.375		24.821	79.526	82.666	21.961	
7928	76	2.955	2.690	3.683		-48.047	-59.665	.083	18.374		45.688	68.915	71.541	21.652	
7929	101	2.852	2.531	4.126		-46.209	-49.741	.118	18.363		43.672	66.936	67.147	21.163	
79210	152	2.322	2.020	2.880		-46.662	-50.521	.159	18.130	147.165	44.635	63.198	65.289	20.307	
79214	530	2.641	3.010	4.337		-29.984	-25.683	.059	15.098		30.585	46.346	46.380	17.465	152.496

EAST AND NORTH								
Data name	depth (m)	instru no.	COVAR.	CORR. COEFF.	ELLIPSE	ORIENT	MAJAX	MINAX
m 7873	5	VM-016	-59.386	-.235	.349	163.427	19.409	12.630
7874	10	VM-017	-17.476	-.052	.274	94.570	21.576	15.669
7875	15	V-5110	-79.569	-.157	.179	116.791	24.659	20.257
7876	25	VM-014	-65.170	-.175	.178	122.226	21.092	17.333
7877	50	VM-008	17.970	.122	.126	57.081	12.917	11.290
7878	75	VM-009	-27.583	-.077	.087	118.974	19.792	18.073
7879	100	VM-012	-95.167	-.300	.297	120.628	20.730	14.583
78713	1000	VM-028	-1.299	-.033	.274	92.907	7.364	5.345
7881	98	V-588	-81.549	-.228	.208	131.608	20.975	16.604
7882	148	V-112P	-56.080	-.164	.153	136.185	19.949	16.902
7883	198	V-185MXD	-98.294	-.288	.256	133.740	20.979	15.599
7884	248	V-109P	50.918	.227	.242	61.912	16.979	12.873
7885	298	V-201MXD	-37.552	-.145	.146	146.202	17.317	14.786
7886	348	V-5107	-44.809	-.184	.172	139.747	16.997	14.072
7887	398	V-120MXD	-29.536	-.135	.134	144.594	15.835	13.718
7888	448	V-5108	-30.199	-.142	.141	144.506	15.631	13.434
7889	498	V-435P	-21.406	-.118	.114	141.144	14.285	12.659
78810	598	V-5101	-13.808	-.091	.090	141.703	12.879	11.879
78811	748	V-127MXD	-7.501	-.070	.069	140.246	10.724	9.987
78812	998	V-537	-2.754	-.047	.136	99.399	8.209	7.092
78813	1498	V-199	-3.076	-.073	.386	94.137	8.284	5.088
78814	2498	V-117	-1.167	-.027	.489	91.081	9.147	4.671
78815	3998	V-380	8.043	.138	.563	85.666	11.488	5.024
7891	498	V-107P	-9.957	-.054	.055	142.978	13.970	13.207
7892	998	V-5104	-7.528	-.114	.183	107.211	8.948	7.310
7902	509	P-45096	13.916	.067	.092	22.163	15.098	13.715
7903	1009	V-5102	-3.419	-.057	.068	152.951	8.013	7.467
7922	5	VM-021	147.188	-.308	.319	152.391	25.845	17.595
7923	10	VM-022	260.040	-.365	.387	154.922	32.926	20.170
7924	15	V-590P	146.594	-.307	.334	154.758	26.136	17.409
7925	25	VM-025	285.603	-.442	.457	155.328	32.669	17.773
7926	50	VM-042	105.043	-.330	.548	168.315	25.797	11.661
7928	76	VM-044	118.672	-.370	.401	156.021	22.322	13.368
7929	101	VM-039	109.783	-.378	.417	156.898	21.470	12.521
79210	152	V-598C	-114.541	-.272	.389	163.241	25.733	15.727
79214	530	VM-040	-65.507	-.471	.462	152.945	15.091	8.125

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