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WIND, CURRENT AND TEMPERATURE DATA AT 0°, 165°E: JANUARY 1986 TO MARCH 1991

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CONTENTS

PAGE

Section I. DATA COLLECTION AND PROCESSING

A. INTRODUCTION 1

B. INSTRUMENTATION 1

1. Currents 1

2. Winds 5

3. Temperatures 5

C. DATA PROCESSING 7

D. DATA PRESENTATION 10

E. ACKNOWLEDGMENTS 14

F. REFERENCES 15

Section II. DATA TABLES AND PLOTS

A. TIME SERIES 17

B. STICK PLOTS 23

C. SUMMARY STATISTICS 25

D. HISTOGRAMS 29

E. SPECTRA 45

Wind, Current and Temperature Data at 0°, 165°E: January 1986 to March 1991

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I. DATA COLLECTION AND PROCESSING

A. INTRODUCTION

The data presented in this report were collected from a current meter mooring nominally located at 0°, 165°E as part of the United States/People's Republic of China Bilateral Air-Sea Interaction Program. The field phase of this program consisted of 8 approximately semi-annual research cruises to the western equatorial Pacific between January 1986 and July 1990. The purpose of the US/PRC Bilateral was to study air-sea interaction in the western equatorial Pacific warm pool on time scales of relevance to the El Niño/Southern Oscillation phenomenon. Bilateral activities were conducted within the overall framework of the International Tropical Ocean-Global Atmosphere (TOGA) program. Portions of the data discussed in this report have appeared in several recent publications dealing with the dynamics and thermodynamics of the western equatorial Pacific Ocean (e.g., McPhaden *et al.*, 1988, 1990; McPhaden and Picaut, 1990; Hayes *et al.*, 1990).

The moorings were deployed in water depths of 4366–4407 m at the positions shown in Fig. 1. Record lengths for various instruments on the mooring are plotted in Fig. 2. Deployment dates, recovery dates, and mooring locations are listed in Table 1. Mooring operations were conducted mainly from the RV *Xiangyanghong #14* operated by the State Oceanic Administration of the PRC. Mooring CU2 however was deployed by SOA's RV *Xiangyanghong #5* in December 1986. CU2 was recovered and CU3 was deployed by the NOAA ship *Oceanographer* in July 1987, and CU9 was recovered by the French ship *Le Noroit* in March 1991.

B. INSTRUMENTATION

1. Currents

Current velocity and temperature were measured primarily by EG&G Model 610 Vector Averaging Current Meters (VACM) and also by a few EG&G Model 630 Vector Measuring Current Meters (VMCM). The instruments recorded zonal and meridional velocity components at 15-minute intervals with the exception of VMCM's at 10-m depth which recorded at a 2-hour rate. Both instruments sampled at high rates and computed vector means which limited the amount of high frequency noise induced by mooring motion and surface waves. The VMCM is relatively more effective at high frequency noise reduction because of the response characteristics of its orthogonal propellers as compared to the VACM's rotor and vane (Halpern *et al.*, 1981).

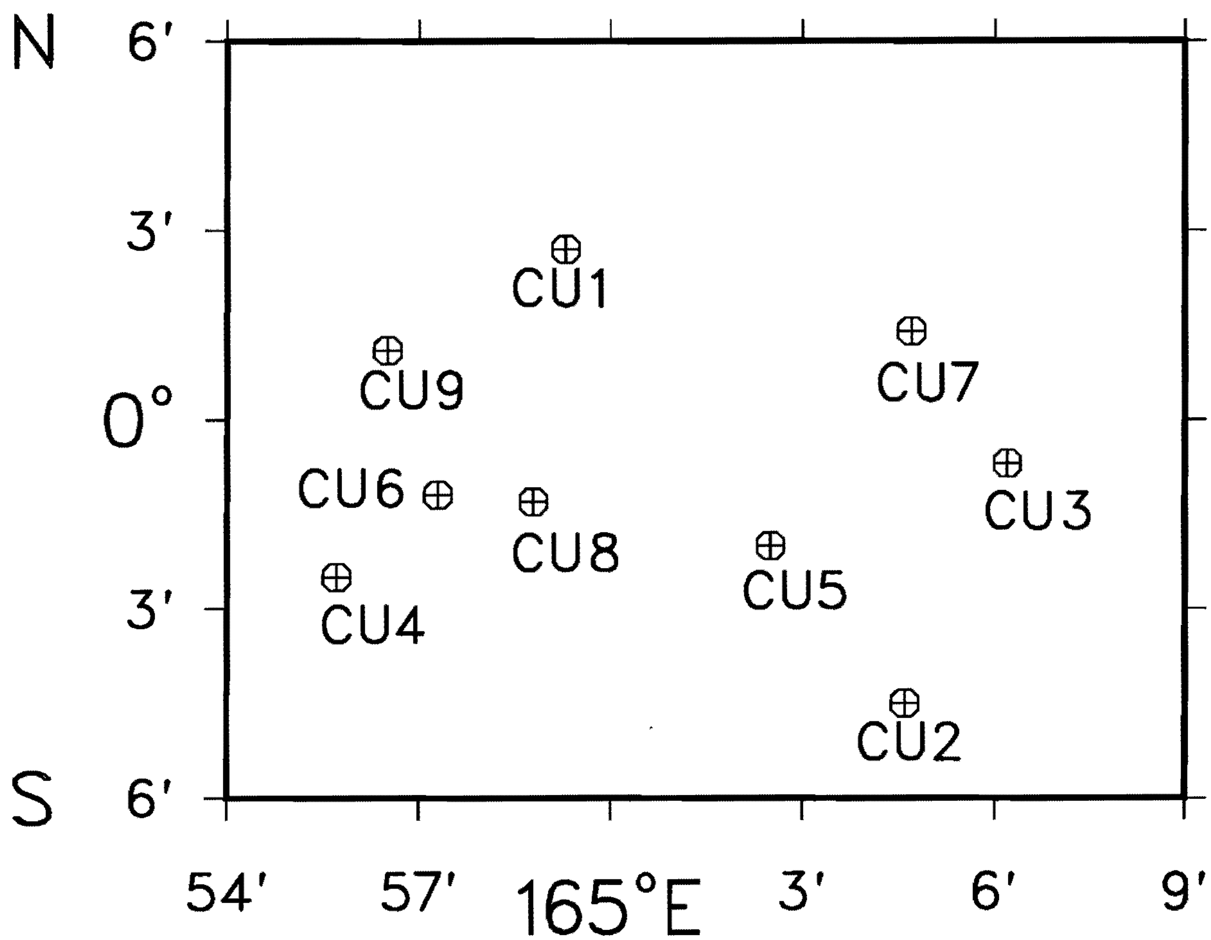

Fig. 1. Mooring locations.

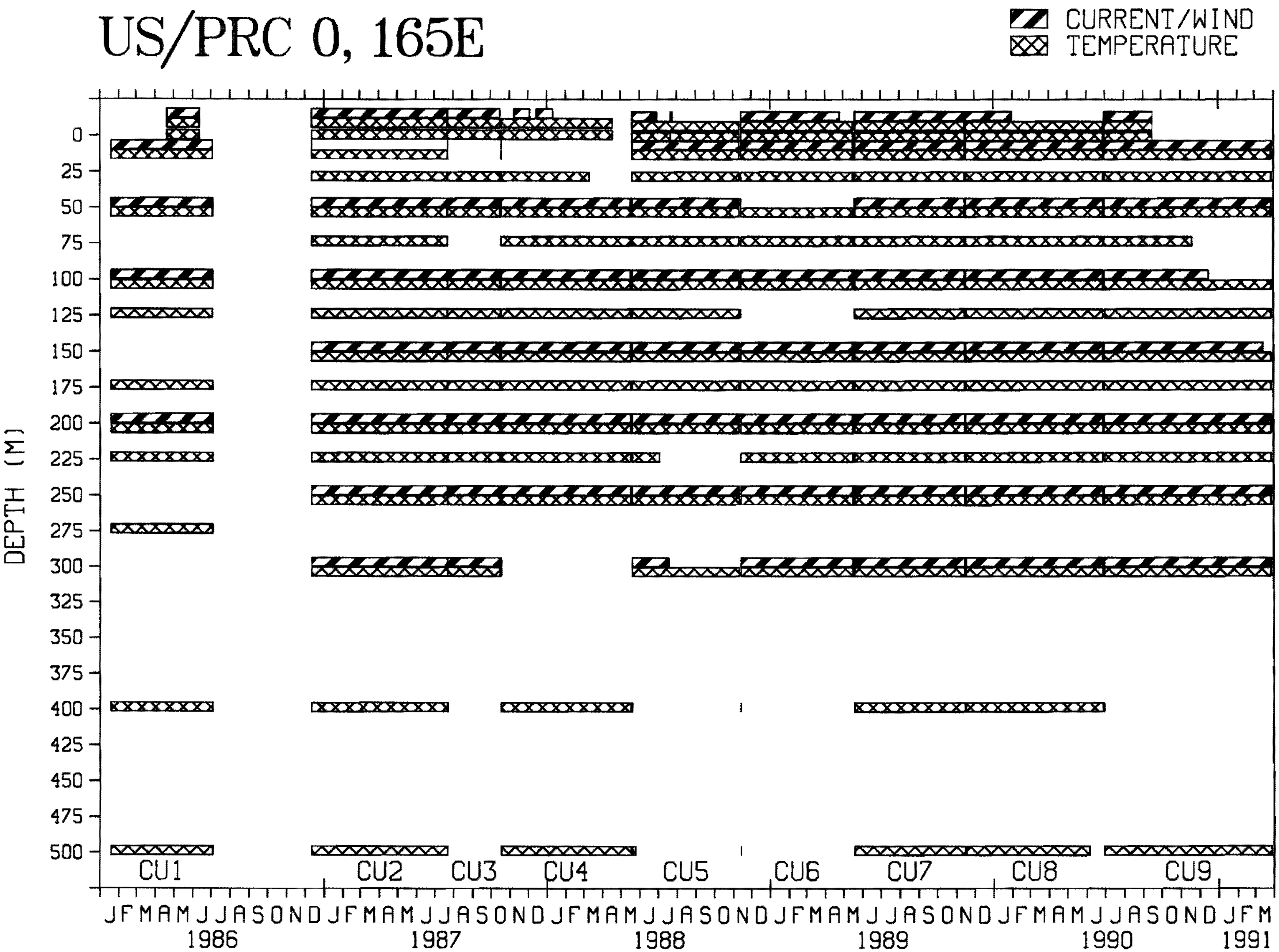

Fig. 2. Data distribution for moorings near 0°, 165°E.

TABLE 1. Mooring locations, deployment dates and recovery dates.

Mooring	Latitude	Longitude	Deployment	Recovery
CU1	0° 2.7′N	164° 59.3′E	19 Jan 86	3 Jul 86
CU2	0° 4.5′S	165° 4.6′E	12 Dec 86	22 Jul 87
CU3	0° 0.7′S	165° 6.2′E	23 Jul 87	16 Oct 87
CU4	0° 2.5′S	164° 55.7′E	18 Oct 87	18 May 88
CU5	0° 2.0′S	165° 2.5′E	20 May 88	11 Nov 88
CU6	0° 1.4′S	164° 57.3′E	14 Nov 88	17 May 88
CU7	0° 1.4′N	165° 4.7′E	20 May 89	15 Nov 89
CU8	0° 1.3′S	164° 58.8′E	17 Nov 89	28 Jun 90
CU9	0° 1.1′N	164° 56.5′E	30 Jun 90	28 Mar 91

Both instruments, however, give similar results when closely spaced on toroidal moorings. For example, from VACM/VMCM pairs separated by 1 m on taut-line equatorial moorings, Halpern (1987) reported RMS differences in 15-minute average zonal (meridional) current components ranging from 7.9 (10.0) cm s^{-1} at 13 m to 3.9 (2.5) cm s^{-1} at 160 m. These differences are from 14% to 4% of the scalar mean speeds (69.2 cm s^{-1} at 13 m and 67.8 cm s^{-1} at 160 m).

VACM velocity calibration coefficients used were based on tow-tank runs made by John Cherriman at the Institute of Ocean Sciences in England. RMS differences between speeds computed using these coefficients and calibrations performed by PMEL were 1.2 cm s^{-1} or less. VMCM velocity calibration coefficients used were given by the manufacturer.

The VMCM used a flux gate compass which was specified to have an accuracy of ±5°. Each VMCM was checked at a USGS magnetic benchmark to confirm that its compass met this criteria. The absolute accuracy of the VACM compasses was not checked, but they did pass the standard VACM compass check which requires linearity and drag to be within 2 bits (5.6°). The VACM compass resolution was 2.8°.

2. Winds

Wind velocity was measured primarily by Vector Averaging Wind Recorders (VAWR) and on occasion by an Argos Meteorological Platform (AMP), both of which were constructed at PMEL. The VAWR consisted of an inverted EG&G VACM with a Climet model 011-2B three-cup anemometer and a 9 cm by 17 cm balanced wind vane replacing the Savonius rotor and vane. The AMP, which was designed as well as built at PMEL, used a R.M. Young model 05103 propeller-vane wind monitor which consisted of a four-blade, 18 cm diameter propeller and 12 cm by 24 cm vane. The AMP used a flux gate compass identical to that in the VMCM. VAWRs were set to record vector average wind components, air temperature and sea-surface temperature at 15-minute intervals. AMPs recorded the same parameters at 2-hour intervals and transmited them to shore via the Argos system.

Nominal height of the wind sensors above the sea surface was 4 m, but the center of the VAWR vane was 0.5 m below the cups while the propeller and vane of the AMP were at the same height.

Both types of wind sensors were calibrated in PMEL's wind tunnel before each deployment. The maximum residuals of the resultant calibration equations were 0.2 m s^{-1} or less for any individual sensor. Speed differences between time series from a closely spaced VAWR and AMP pair were found to be less than the residuals of the calibrations (Freitag *et al.*, 1989).

3. Temperatures

Air temperature sensors were situated on the buoys at a height of 3 m above the sea surface and were in multiplated, self-aspirated radiation shields to reduce the effects of wind and solar radiation. Sea-surface temperature was measured by a thermistor at 1 m depth. Generally two sets of air and sea-surface temperature measurements were made, one set on all buoys with sensors cabled to a VAWR or AMP, and a second set on most buoys with sensors connected to a Telonics temperature transmitter. Subsurface temperatures were measured by VACMs, VMCMs, SeaData model TDR-2 temperature recorders and Sea-Bird SBE-16 Seacats.

VACM, VMCM, VAWR and AMP temperatures were measured by Yellow Springs model 44032 thermistors and averaged over the same time period as currents. VACM, VAWR and AMP temperature circuitry was calibrated at PMEL. Temperature circuitry calibration coefficients supplied by the manufacturer were used on VMCMs. Thermistors were calibrated at either PMEL or Northwest Regional Calibration Center (NRCC) in Bellevue, Washington, with the exception of VAWR air temperature sensors which were not calibrated, but were interchangeable to within ±0.1°C. Combined temperature accuracy for calibrated sensors was 0.01°C or better; response time for VACM thermistors was 100 s (Levine, 1981).

Sea Data Temperature Recorders also used a Yellow Springs Instruments model 44032 thermistor. The sample rate was set at 30 minutes and the data were recorded in blocks of 96 samples (48 hours). Measurements from TDR-2s were "spot" samples rather than means over the sample period. Least significant bit resolution was an increasing function of temperature for the TR and had a value of 0.016°C at 30°C. The TDR-2s were calibrated in a salt-water bath at NRCC with maximum calibration residuals limited to ±0.05°C or less, and pre/post-deployment differences of ±0.06°C or less.

SeaBird SBE-16 SEACATS were used instead of SeaData temperature recorders from November 1989 until March 1991 at 30 m and 75 m depth. SEACATs recorded both conductivity and temperature, the latter with a resolution of 0.001°C. Seacats were calibrated in a fashion similar to the TDR-2s at NRCC. Comparison of pre- and post-deployment calibrations confirm Sea-Bird's stated temperature accuracy of 0.01°C over 6 months. Like the TDR-2, the Seacat recorded "spot" samples rather than means over the sample period. A report dealing exclusively with Seacat temperature, conductivity and salinity data collected at 4–8 depths on the 165°E current meter mooring will appear in the future.

Telonics temperatures were measured with Yellow Springs model 44204 thermolinear thermistor networks and averaged over one hour. The data stream transmitted to shore via Argos contained only the previous hour's mean temperature values. Data were not internally recorded. Because of the relative infrequency of satellite overpasses at the equator, a typical daily average was computed from nine hourly samples spaced throughout the day. Daily means were flagged as bad if less than six samples were received.

Telonics sensors were calibrated at PMEL. Calibration residuals were typically ±0.04°C or less, and pre/post-deployment calibration differences were within ±0.06°C or less, in the range 25–30°C. The hourly Telonics temperatures had a resolution of 0.025°C. Data from these instruments have been used in this report only where temperatures were not recorded by the wind systems. For air temperature this included portions of moorings CU4 and CU5. For sea-surface temperature this included moorings CU1, CU2, CU4 and a portion of CU5.

Comparisons have been made between AMP/VAWR and Telonics temperatures whenever both were available and the results are summarized in Table 2. In general mean temperatures agreed to within 0.1°C. An exception to this was the SST from CU8 which had a mean difference of 0.21°C. Comparison of these two time series with others at nearby depths (3 m, 10 m, 11 m) indicated that the Telonics SST was in error in this instance.

C. DATA PROCESSING

Data recorded internally on cassettes were transferred to a Digital Equipment Corporation (DEC) VAX Cluster. The raw data were converted to engineering units using calibration coefficients obtained as described above. Internal quality checks were performed as well as windowing to eliminate obviously bad data points. A small number of data gaps created by editing procedures were filled by linear interpolation.

The data were then averaged to hourly and daily means, the latter of which are the focus of this report. Gaps due to mooring replacement (generally of 1 to 2 days duration) and instrumental failure (up to 30 days in length and between relatively long sections of good data) were filled by linear interpolation. Interpolation was performed in order to provide time series of maximum length for analysis (e.g., spectra) without significantly compromising statistical content. Gaps of greater than 30-day duration were flagged as missing data.

Percent data return by parameter (wind, current or temperature) and instrument type is given in Table 3 as an indication of instrument performance. These values were computed before interpolation was performed between data segments or over data gaps. Air and sea-surface temperature statistics are shown for AMP and VAWR data alone, and for records in which Telonics temperature data were substituted for missing AMP and VAWR data.

Velocity data from mooring CU6 required additional processing to remove the effects of mooring drift. The mooring drifted for 37 days after deployment presumably due to insufficient anchor mass. In addition, the mooring drifted for 22 days before recovery due to an intruder pulling on the mooring line until it parted about 100 m from the ocean bottom.

A correction for this drift has been computed and applied in the following manner: Argos locations (Fig. 3) for the mooring were interpolated to hourly values, from which hourly velocities were computed and smoothed with a 97-hour Hanning filter (Fig. 3). These mooring velocities were then added to the hourly current meter velocities to correct for mooring drift. No correction was applied during the time when the mooring was anchored, but the velocities computed for this period are shown in Fig. 3 as an indication of noise in the computed mooring velocity due to movement of the mooring within its watch circle and errors due to uncertainty in Argos locations.

TABLE 2. Comparison statistics of SST and air temperatures from VAWR/AMP wind recorders and Telonics transmitters. Tabulated are the number of daily averages in the comparison (N), RMS and mean differences (in °C), the cross correlation coefficient between the 2 series (R).

	SST				AIR T			
	N	RMS	MEAN	R	N	RMS	MEAN	R
CU1					52	0.25	–0.12	0.93
CU2					214	0.18	–0.03	0.97
CU3	67	0.08	0.07	0.99	67	0.23	–0.01	0.94
CU4					74	0.13	0.04	0.98
CU5	59	0.09	0.08	0.99	58	0.06	–0.02	0.98
CU6	152	0.17	–0.04	0.93	176	0.13	–0.04	0.94
CU8	95	0.22	0.21	0.97	95	0.17	0.04	0.97

TABLE 3. Percent data return by parameter and instrument type. Percent return for air temperature and SST is based on AMP and VAWR measurements. Numbers in parentheses indicate percent of time daily averaged SST and air temperature values are available after filling data gaps with Telonics measurements.

Data Type	Percent good data
Wind	54
Current	89
SST	52 (81)
Air temperature	68 (81)
Sub-surface temperature	90
from VACM/VMCM	95
from TDR-2	86
from SeaCat	87

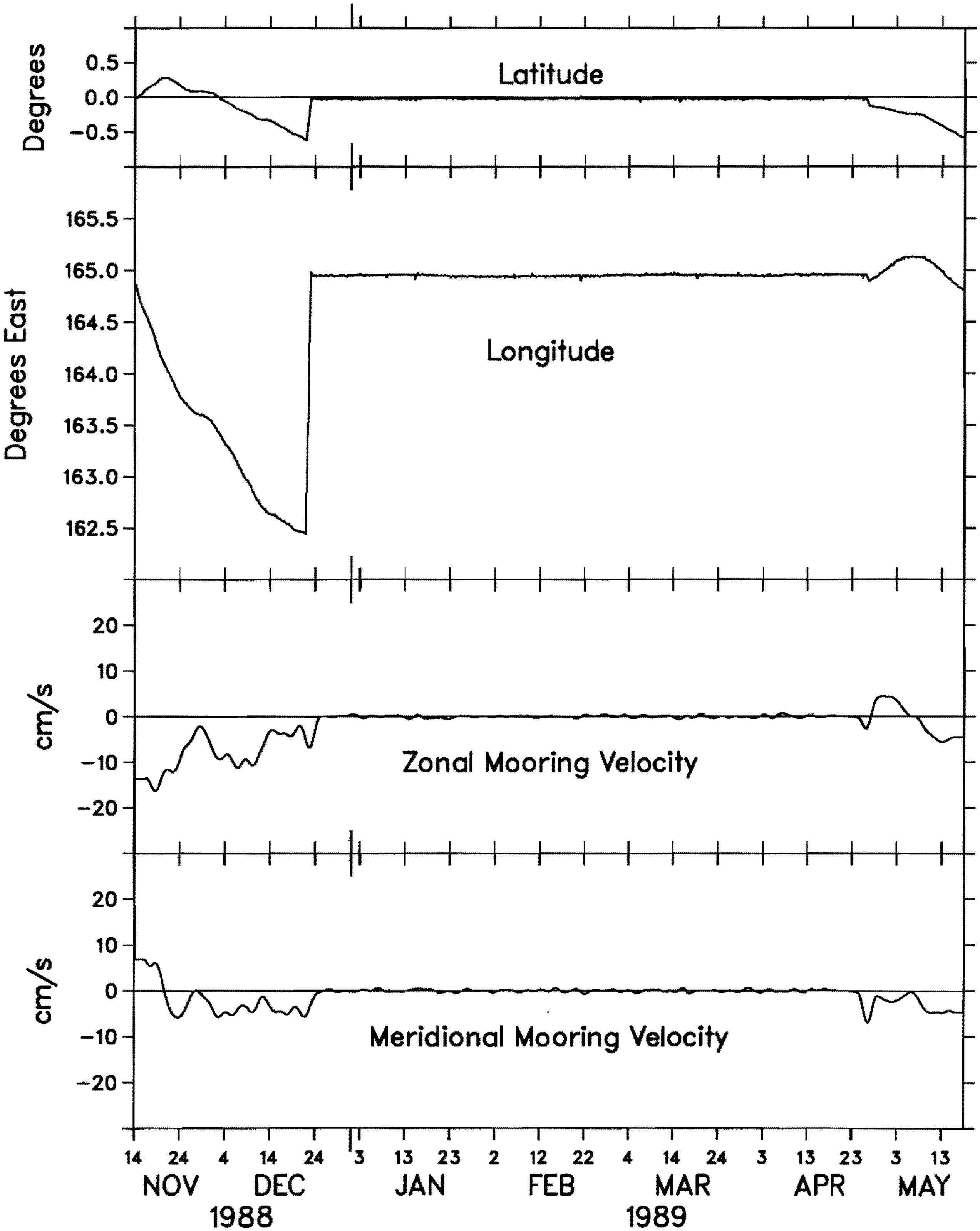

Fig. 3. Mooring CU6 location and velocity.

The 50-m velocity record for mooring CU8 also required special processing. Visual inspection indicated that it was out of phase with both the 10 m and 100 m velocity records in late 1989. Currents at 10 m and 100 m were eastward, presumably in response to a westerly wind burst event, but the 50-m currents were westward. In addition the 50-m velocity record did not agree with shipboard Acoustic Doppler Current Profiler (ADCP) measurements made near the mooring in November 1989, nor did it agree with shipboard current profiles in December 1989 (du Penhoat, *et al.*, 1990). Curiously, though, the 50-m velocity record did agree with shipboard ADCP measurements made near the mooring at the end of the record in June 1990.

From earlier mooring data at this site it was determined that the 10-m and 50-m velocity records are highly correlated and in phase at high frequency, particularly at the M2 tidal period in the meridional component. For mooring CU8 though, the M2 tidal component at 50 m was 180° out of phase with that at 10 m for most of the record. Near the end of the record the phase difference shifted to zero, which was consistent with the later ADCP measurements. The phase shift appeared to occur over a period of about 6 days. The 50-m velocity was corrected by rotation of direction by 180° up to that time. The point at which to end the correction was chosen at a time of near zero velocity to reduce any sharp jump in the record.

D. DATA PRESENTATION

The means and standard deviations of zonal and meridional current velocity and temperature at each depth for the entire period from January 1986 through March 1991 have been plotted as profiles (Fig. 4). Temperature data at 275 m were omitted in this plot since it was available for less than 6 months.

Current velocity components and temperature have been plotted as contours after smoothing daily values with a 51-day Hanning filter (Fig. 5). Areas where data are unavailable and where interpolation or extrapolation would result in clearly erroneous values have been left blank.

Individual velocity components and temperature have been plotted against time and depth for each site (Section II.A). Velocity components have been combined and plotted as vectors (stick diagrams) on the same time scale (Section II.B). The vectors have been rotated such that east is towards the top of the page.

Mean, variance, skewness and extrema of the current components, speed and temperature were computed for each daily averaged time series and are tabulated in section II.C. Where gaps in the records occurred, statistics have been computed for each segment separately. Sections of less than 30 days have been omitted.

Histograms of velocity components and temperature are in section II.D. Starting and ending dates for the time period covered are listed above the plots. Total number of daily values used (NPOINTS) and the number of missing values (NOUT) for incomplete time series are also shown.

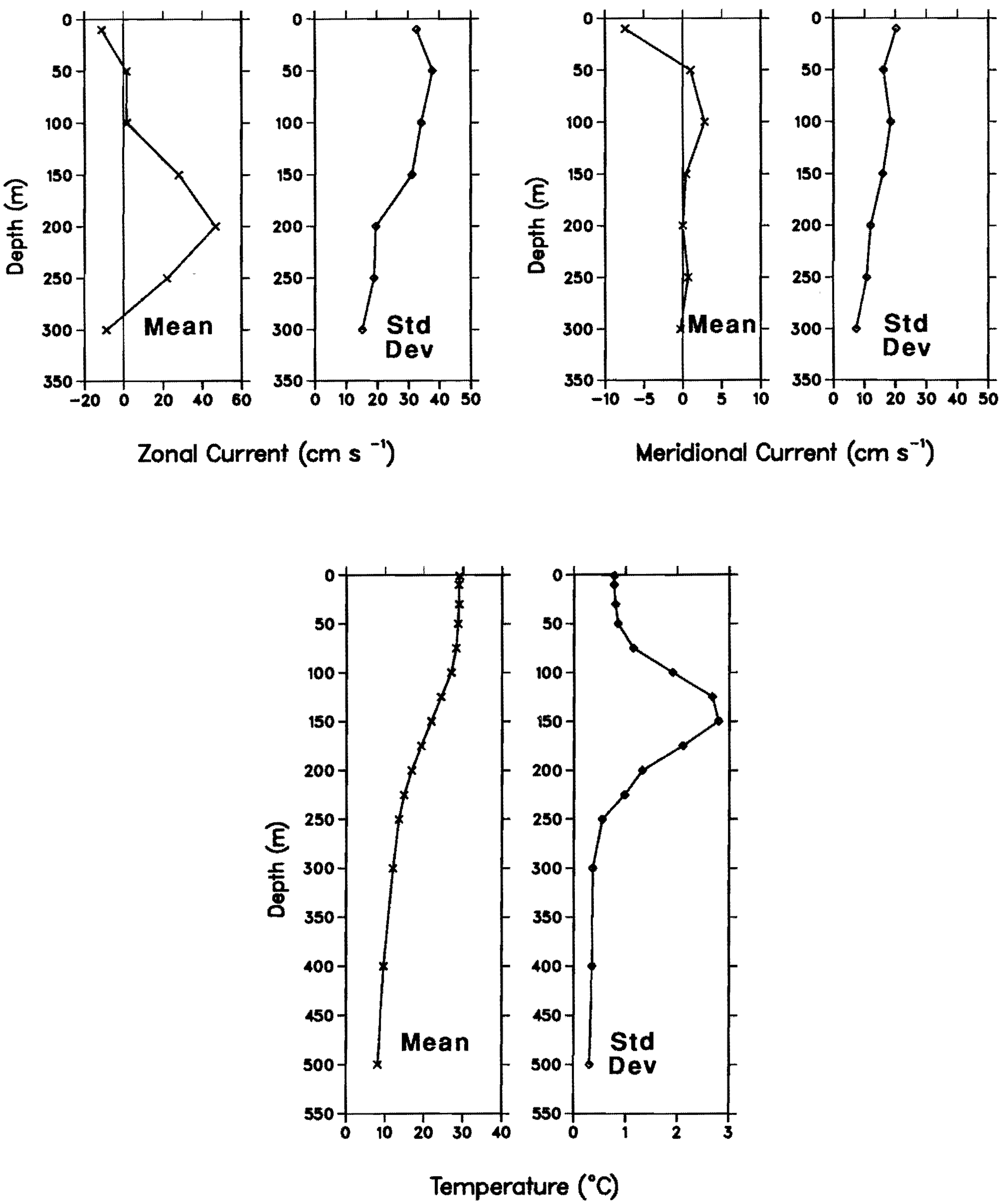

Fig. 4. Mean and standard deviation of current velocity and temperature computed over the time period January 1986 to March 1991 at 0°, 165°E.

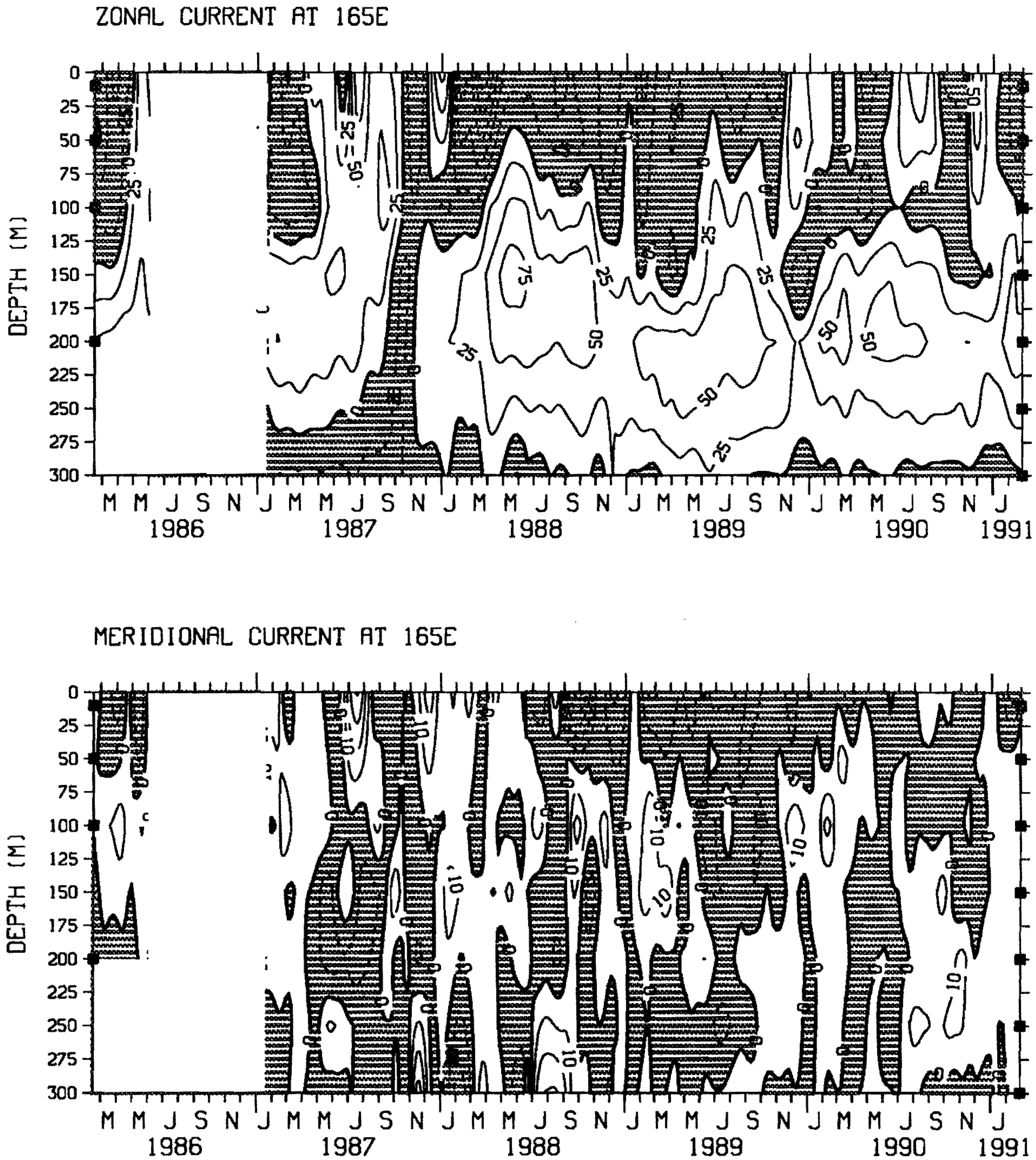

Fig. 5a. Contours of velocity at 0°, 165°E. Contour interval is 25 cm s^{-1} for zonal velocity and 10 cm s^{-1} for meridional velocity. Westward and southward flow is shaded. Squares on the vertical axis indicate the depth of current meters on CU1, while squares on the right vertical axis indicate the depth of current meters on CU2 to CU9.

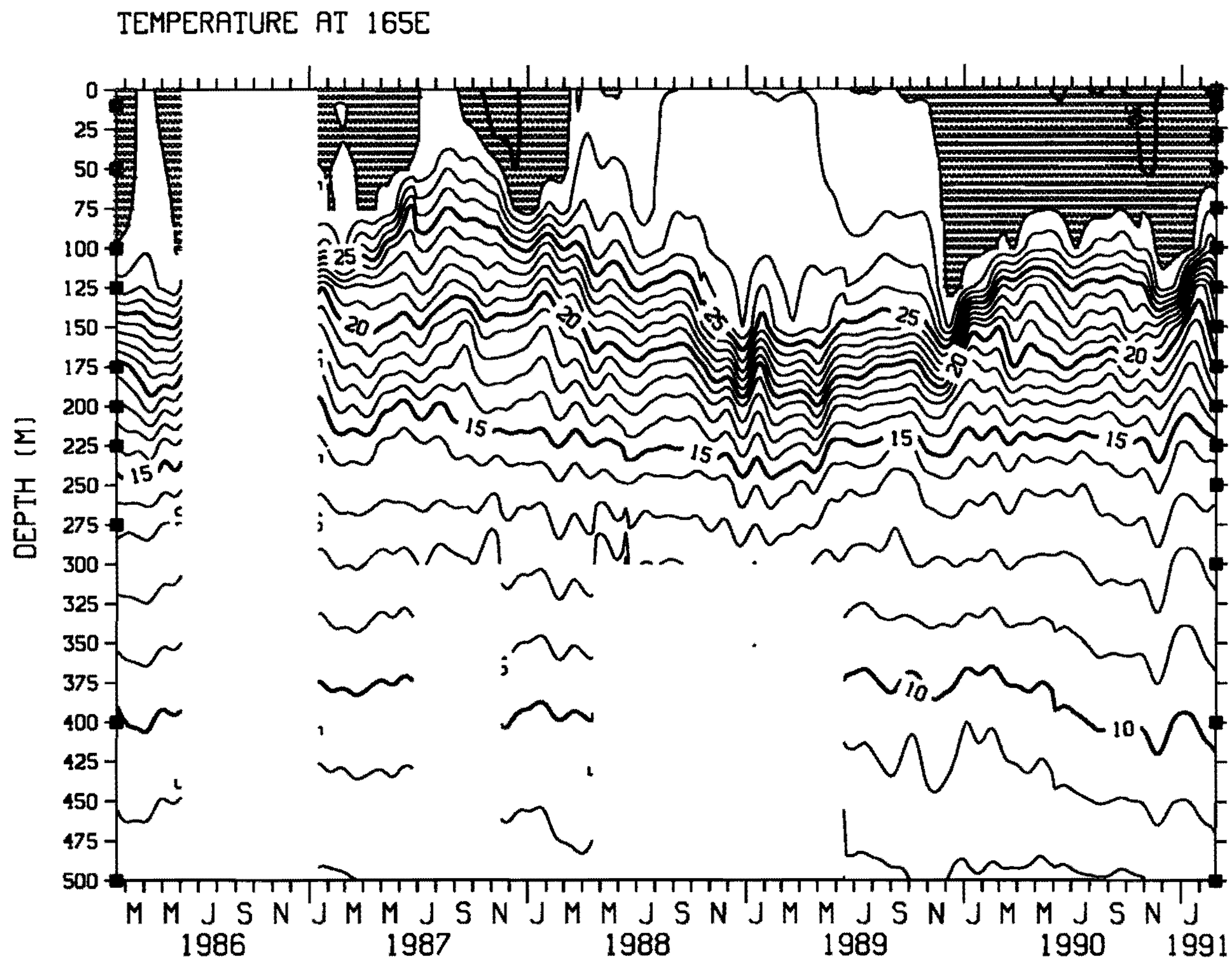

Fig. 5b. Contours of temperature at 0°, 165°E. Contour interval is 1 °C. Temperature greater than 29°C is shaded. Squares on the left vertical axis indicate the location of temperature sensors on CU1, while squares on the right vertical axis indicate the depths of temperature sensors on CU2 to CU9.

Spectral density of velocity components and temperature were computed using a Cooley-Tukey Fourier transform and are plotted in log-log format in section II.E. The number of periodogram points per spectral estimate along with the 95% confidence interval for the corresponding number of degrees of freedom are indicated in the lower portion of the plots. Where gaps occurred in the time series, the spectra of each segment of the record have been plotted. Spectra of sections of less than 90 days have been omitted.

E. ACKNOWLEDGMENTS

We are indebted to Bruce Taft of PMEL who inaugurated the collection of moored measurements as part of the US/PRC Bilateral Program. We are also grateful to Doug Fenton of SeaMarTec, Inc., Seattle, Washington, and Carol Coho of PMEL for instrument and mooring hardware preparation; and for participation in mooring deployment and recovery operations at sea. Our thanks to Margie McCarty of PMEL for programming assistance in producing this report. We likewise acknowledge Frank Bahr and Eric Firing of the University of Hawaii for providing us ADCP data which was instrumental in identifying and correcting problems in the 50 m velocity record from CU8. All mooring data were gathered as a contribution to the US/PRC Bilateral Air-Sea Interaction Program jointly supported by the National Atmospheric and Oceanic Administration in the US, and the State Oceanic Administration in the PRC. We are grateful to NOAA's US TOGA Project Office for providing the funds to collect the data and to produce this data report. Our special thanks also to the captains and crews of the Xiangyanghong #14 and Xiangyanghong #5 for their efforts in ensuring the success of the program.

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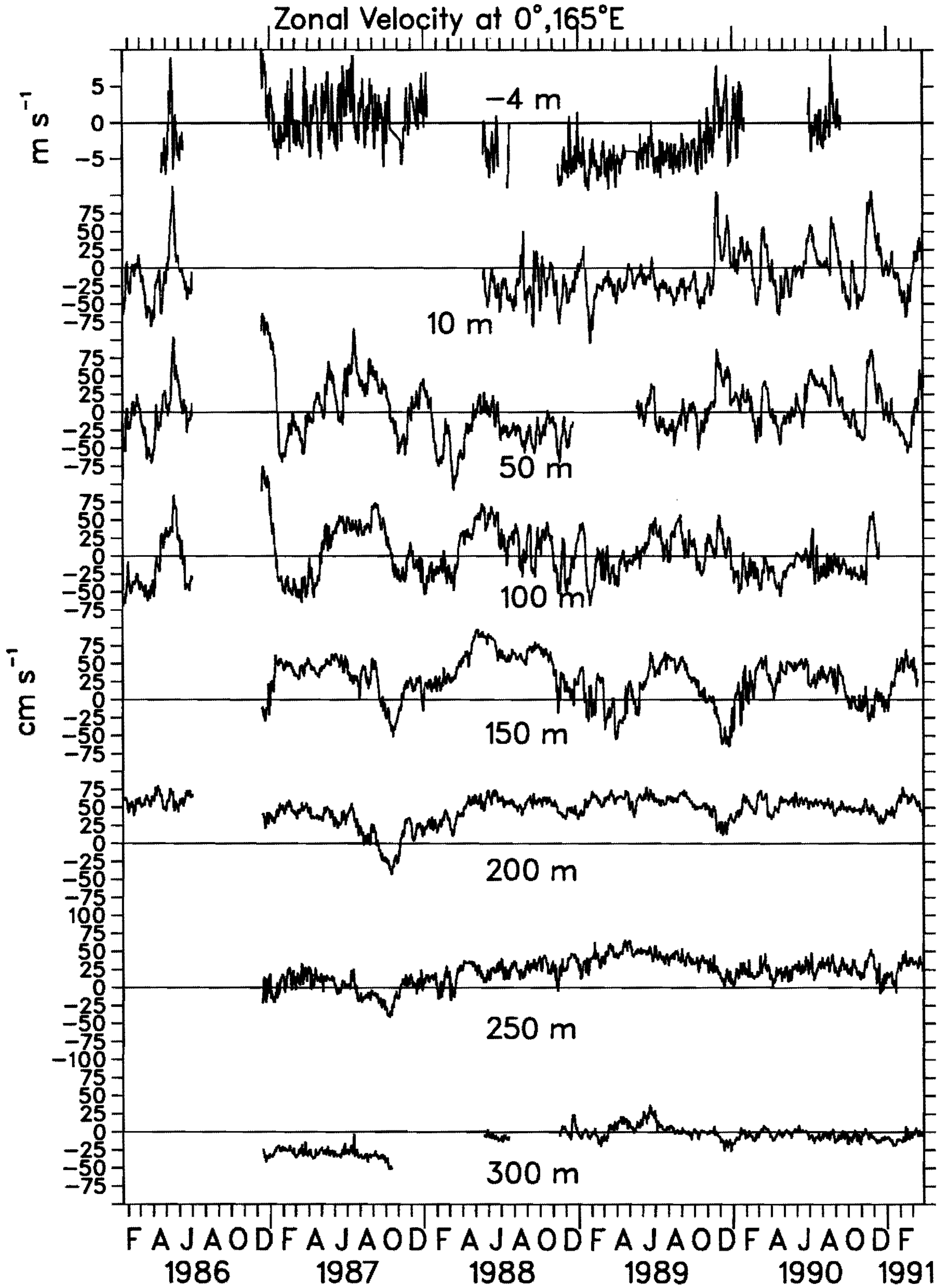
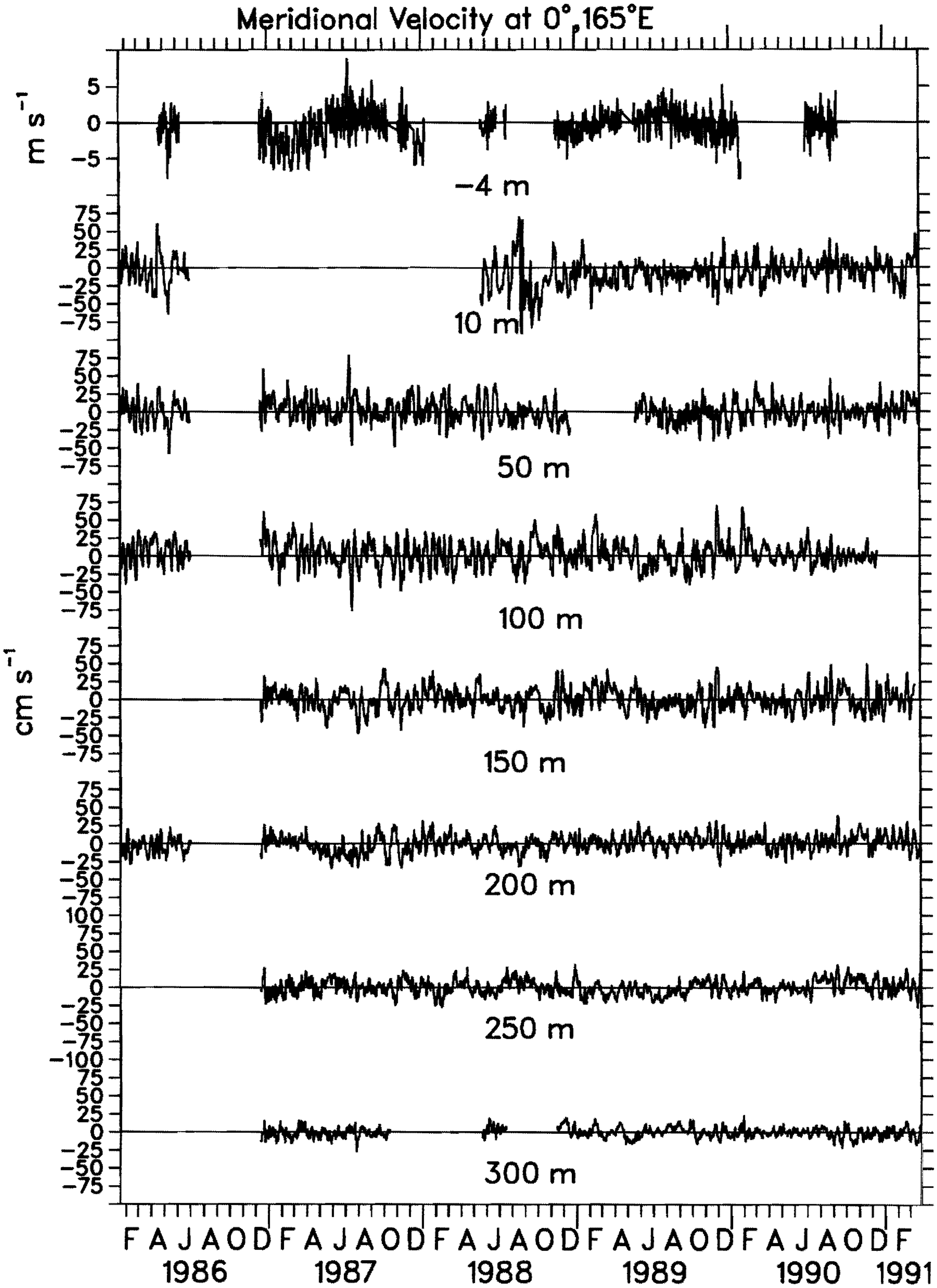
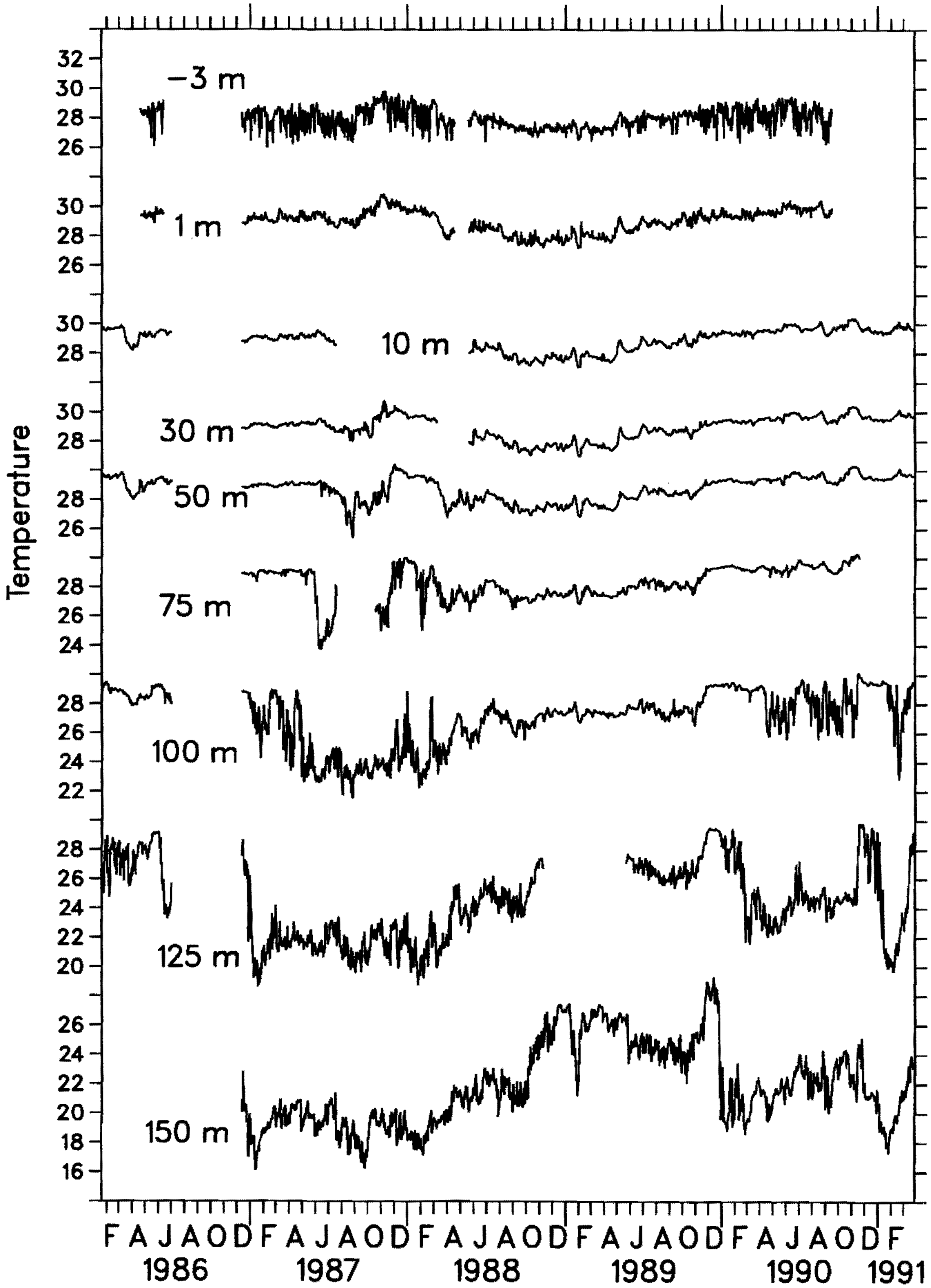
Section II.A: TIME SERIES

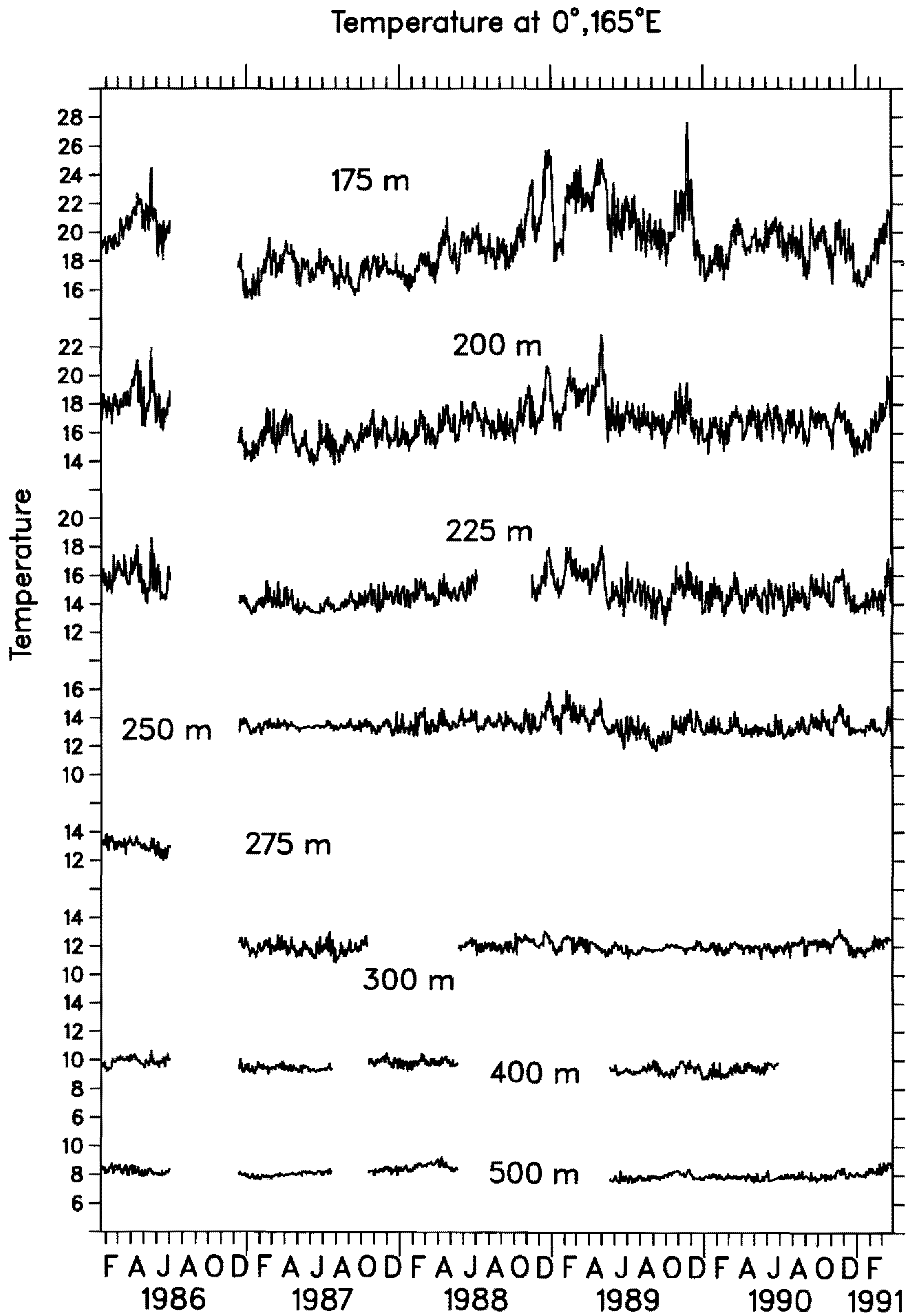


Zonal Velocity at 0°,165°E
m s^{-1}
cm s^{-1}
−4 m
10 m
50 m
100 m
150 m
200 m
250 m
300 m
F A J A O D F A J A O D F A J A O D F A J A O D F A J A O D F
1986
1987
1988
1989
1990
1991


Meridional Velocity at 0°,165°E
m s⁻¹
cm s⁻¹
−4 m
10 m
50 m
100 m
150 m
200 m
250 m
300 m
F A J A O D F A J A O D F A J A O D F A J A O D F A J A O D F
1986
1987
1988
1989
1990
1991

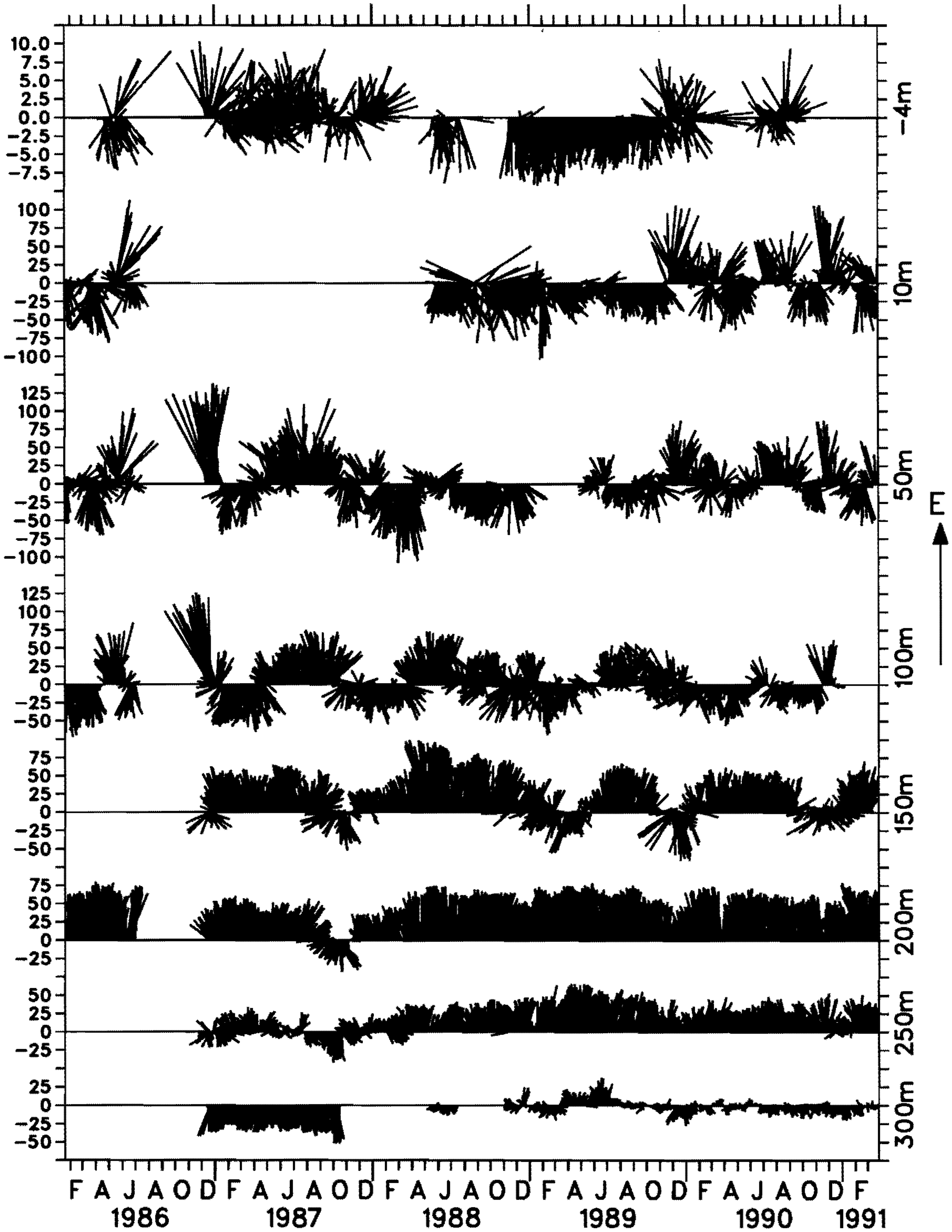
Temperature at 0°,165°E




Temperature at 0°,165°E
Temperature
175 m
200 m
225 m
250 m
275 m
300 m
400 m
500 m
F A J A O D F A J A O D F A J A O D F A J A O D F A J A O D F
1986
1987
1988
1989
1990
1991

Section II.B: STICK PLOTS

0°, 165°E Wind and Current



Section II.C: SUMMARY STATISTICS

ZONAL VELOCITY AT 0, 165E

Depth	FROM	TO	N	MEAN	VAR	SKEW	MIN	MAX
-4 m	21 4 86	11 6 86	52	-1.9	16.3	1.17	-7.1	9.0
-4 m	13 12 86	10 1 88	394	1.0	10.3	0.39	-6.1	10.3
-4 m	21 5 88	28 6 88	39	-3.5	5.3	0.23	-7.6	1.0
-4 m	15 11 88	30 1 90	442	-3.7	9.5	1.22	-9.3	8.0
-4 m	1 7 90	16 9 90	78	0.3	6.4	1.14	-4.0	9.4
10 m	20 1 86	2 7 86	164	-14.4	1340.2	0.92	-81.1	112.6
10 m	21 5 88	27 3 91	1041	-10.7	1023.3	0.80	-103.9	105.7
50 m	20 1 86	2 7 86	164	-2.4	1204.7	0.45	-70.2	104.0
50 m	13 12 86	20 12 88	739	-2.8	1963.2	0.70	-108.1	137.8
50 m	21 5 89	27 3 91	676	6.9	853.8	0.39	-56.4	87.0
100 m	20 1 86	2 7 86	164	-15.1	1430.2	0.72	-71.4	85.1
100 m	13 12 86	15 12 90	1464	3.4	1104.7	0.47	-68.5	125.8
150 m	13 12 86	14 3 91	1553	28.0	966.0	-0.49	-65.4	98.7
200 m	20 1 86	2 7 86	164	59.4	74.5	0.07	38.2	79.9
200 m	13 12 86	27 3 91	1566	45.5	392.7	-1.58	-42.8	78.6
250 m	13 12 86	27 3 91	1566	22.1	355.4	-0.54	-41.9	65.4
300 m	13 12 86	15 10 87	307	-30.2	42.8	-0.21	-52.0	-2.9
300 m	21 5 88	18 7 88	59	-6.9	11.8	0.50	-13.7	3.5
300 m	15 11 88	27 3 91	863	-1.4	89.0	0.83	-26.8	37.7

MERIDIONAL VELOCITY AT 0, 165E

Depth	FROM	TO	N	MEAN	VAR	SKEW	MIN	MAX
-4 m	21 4 86	11 6 86	52	-0.8	4.1	-0.61	-7.7	2.8
-4 m	13 12 86	10 1 88	394	-0.9	7.2	0.15	-6.7	8.8
-4 m	21 5 88	28 6 88	39	-0.3	1.8	0.17	-3.8	3.0
-4 m	15 11 88	30 1 90	442	-0.2	3.5	-0.55	-7.9	5.2
-4 m	1 7 90	16 9 90	78	-0.2	3.9	-0.05	-5.4	4.3
10 m	20 1 86	2 7 86	164	-3.5	481.5	-0.02	-64.4	61.1
10 m	21 5 88	27 3 91	1041	-8.0	399.4	-0.23	-91.9	70.5
50 m	20 1 86	2 7 86	164	0.2	306.8	-0.24	-58.1	39.5
50 m	13 12 86	20 12 88	739	2.3	299.5	0.36	-48.4	79.1
50 m	21 5 89	27 3 91	676	-0.2	208.2	0.06	-40.4	46.1
100 m	20 1 86	2 7 86	164	5.8	297.0	-0.31	-39.7	36.1
100 m	13 12 86	15 12 90	1464	2.5	346.9	0.16	-76.6	70.5
150 m	13 12 86	14 3 91	1553	0.4	252.9	0.12	-47.2	50.7
200 m	20 1 86	2 7 86	164	-3.9	128.6	0.03	-28.9	23.3
200 m	13 12 86	27 3 91	1566	0.4	144.5	-0.03	-34.9	38.7
250 m	13 12 86	27 3 91	1566	0.7	114.6	0.12	-28.4	32.7
300 m	13 12 86	15 10 87	307	-1.7	48.3	-0.03	-27.9	16.5
300 m	21 5 88	18 7 88	59	3.8	47.4	-0.13	-12.0	19.4
300 m	15 11 88	27 3 91	863	0.0	54.7	0.06	-21.6	23.5

SPEED AT 0, 165E

Depth	FROM			TO			N	MEAN	VAR	SKEW	MIN	MAX
-4 m	21	4	86	11	6	86	52	4.5	5.0	0.55	0.8	11.8
-4 m	13	12	86	10	1	88	394	3.9	4.3	0.65	0.3	10.4
-4 m	21	5	88	28	6	88	39	3.9	4.3	-0.10	0.3	7.7
-4 m	15	11	88	30	1	90	442	4.8	3.2	-0.01	0.8	9.3
-4 m	1	7	90	16	9	90	78	2.7	3.1	1.39	0.2	9.4
10 m	20	1	86	2	7	86	164	38.1	590.3	0.82	1.9	114.3
10 m	21	5	88	27	3	91	1041	34.9	383.0	0.85	0.5	106.0
50 m	20	1	86	2	7	86	164	32.3	476.9	1.04	1.8	106.4
50 m	13	12	86	20	12	88	739	40.7	623.3	1.44	2.0	138.0
50 m	21	5	89	27	3	91	676	28.7	287.8	0.94	1.1	88.3
100 m	20	1	86	2	7	86	164	42.1	217.1	0.21	11.1	87.8
100 m	13	12	86	15	12	90	1464	33.8	326.6	1.23	0.6	126.8
150 m	13	12	86	14	3	91	1553	40.5	359.2	0.47	1.8	101.6
200 m	20	1	86	2	7	86	164	60.7	71.4	0.07	41.0	81.1
200 m	13	12	86	27	3	91	1566	49.0	205.0	-0.51	4.4	81.2
250 m	13	12	86	27	3	91	1566	28.2	165.2	0.35	1.2	65.8
300 m	13	12	86	15	10	87	307	31.0	41.5	0.22	2.9	52.0
300 m	21	5	88	18	7	88	59	10.3	15.2	0.12	2.7	20.1
300 m	15	11	88	27	3	91	863	10.5	36.1	0.79	0.4	37.7

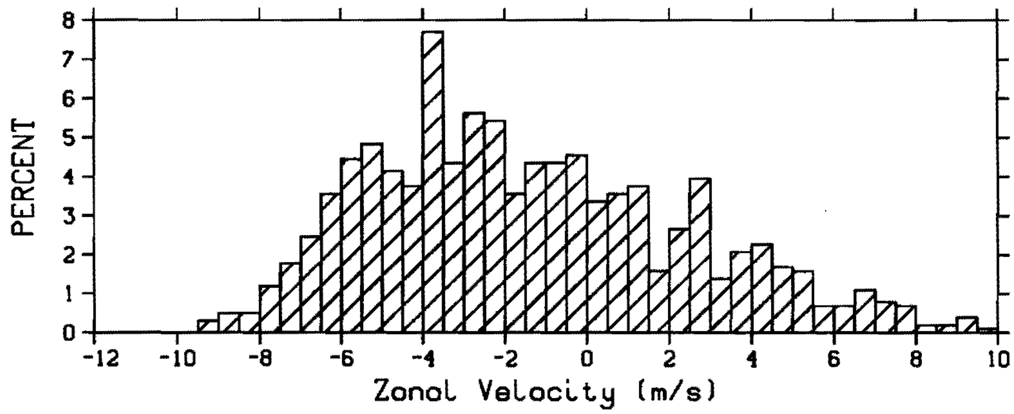
TEMPERATURE AT 0, 165E

Depth	FROM			TO			N	MEAN	VAR	SKEW	MIN	MAX
-3 m	21	4	86	14	6	86	55	28.35	0.331	-1.883	26.10	29.17
-3 m	13	12	86	18	4	88	493	28.12	0.577	-0.259	26.03	29.82
-3 m	20	5	88	16	9	90	850	27.86	0.410	0.296	26.25	29.46
1 m	21	4	86	14	6	86	55	29.45	0.046	-0.117	28.85	29.94
1 m	13	12	86	18	4	88	493	29.34	0.311	0.014	27.74	30.91
1 m	20	5	88	16	9	90	850	28.79	0.639	-0.113	27.19	30.45
10 m	20	1	86	2	7	86	164	29.29	0.186	-0.997	28.19	29.89
10 m	13	12	86	21	7	87	221	29.05	0.036	-0.267	28.51	29.56
10 m	21	5	88	27	3	91	1041	28.86	0.750	-0.289	27.08	30.44
30 m	13	12	86	10	3	88	454	29.27	0.217	0.330	28.01	30.76
30 m	21	5	88	27	3	91	1041	28.83	0.764	-0.285	27.00	30.43
50 m	20	1	86	2	7	86	164	29.15	0.224	-0.771	28.01	29.86
50 m	13	12	86	27	3	91	1566	28.69	0.757	-0.401	25.41	30.42
75 m	13	12	86	21	7	87	221	28.10	2.719	-1.560	23.72	29.17
75 m	19	10	87	18	11	90	1127	28.31	1.031	-0.191	25.00	30.34
100 m	20	1	86	2	7	86	164	28.68	0.179	-0.171	27.82	29.50
100 m	13	12	86	27	3	91	1566	26.87	3.687	-0.629	21.55	30.17
125 m	20	1	86	2	7	86	164	27.19	2.414	-0.902	23.30	29.19
125 m	13	12	86	10	11	88	699	22.61	3.751	0.579	18.60	28.65
125 m	21	5	89	27	3	91	676	25.60	5.206	-0.217	19.67	29.83
150 m	13	12	86	27	3	91	1566	21.91	7.797	0.422	16.11	29.33
175 m	20	1	86	2	7	86	164	20.46	1.407	0.654	18.05	24.50
175 m	13	12	86	4	5	90	1239	19.15	4.643	0.913	15.37	27.65
200 m	20	1	86	2	7	86	164	18.24	1.069	0.872	16.16	21.94
200 m	13	12	86	27	3	91	1566	16.63	1.572	0.776	13.77	22.93
225 m	20	1	86	2	7	86	164	15.88	0.891	0.358	14.02	18.62
225 m	13	12	86	3	7	88	569	14.36	0.380	0.536	13.27	16.44
225 m	15	11	88	27	3	91	863	14.96	0.990	0.610	12.52	18.17
250 m	13	12	86	27	3	91	1566	13.50	0.302	0.569	11.68	15.97
275 m	20	1	86	2	7	86	164	13.04	0.132	-0.518	11.97	13.86
300 m	13	12	86	15	10	87	307	11.89	0.151	0.152	10.82	13.03
300 m	21	5	88	27	3	91	1041	12.05	0.124	0.336	11.14	13.28
400 m	20	1	86	2	7	86	164	9.88	0.072	-0.296	9.18	10.66
400 m	13	12	86	21	7	87	221	9.45	0.032	0.562	9.02	10.10
400 m	19	10	87	17	5	88	212	9.87	0.049	0.127	9.25	10.52
400 m	21	5	89	27	6	90	403	9.36	0.094	0.074	8.67	10.06
500 m	20	1	86	2	7	86	164	8.26	0.048	0.310	7.87	8.80
500 m	13	12	86	21	7	87	221	8.04	0.021	-0.130	7.69	8.42
500 m	19	10	87	17	5	88	212	8.50	0.055	0.384	7.93	9.22
500 m	21	5	89	27	3	91	676	7.96	0.062	1.168	7.44	8.96

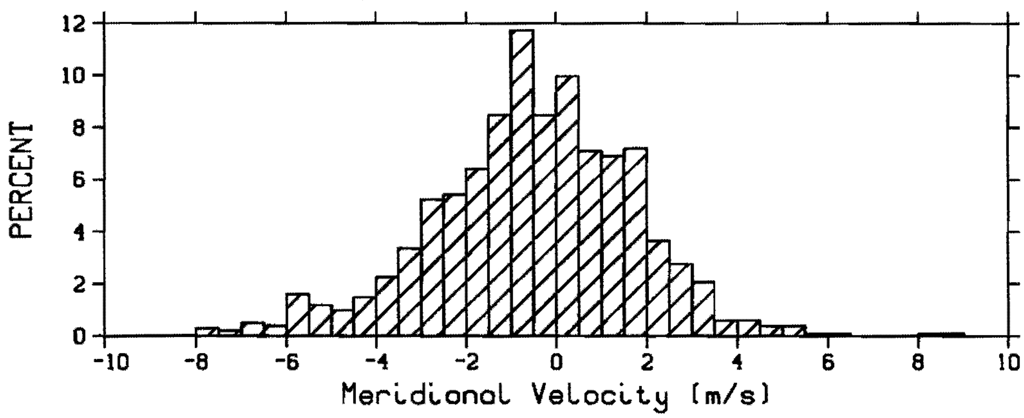
Section II.D: HISTOGRAMS

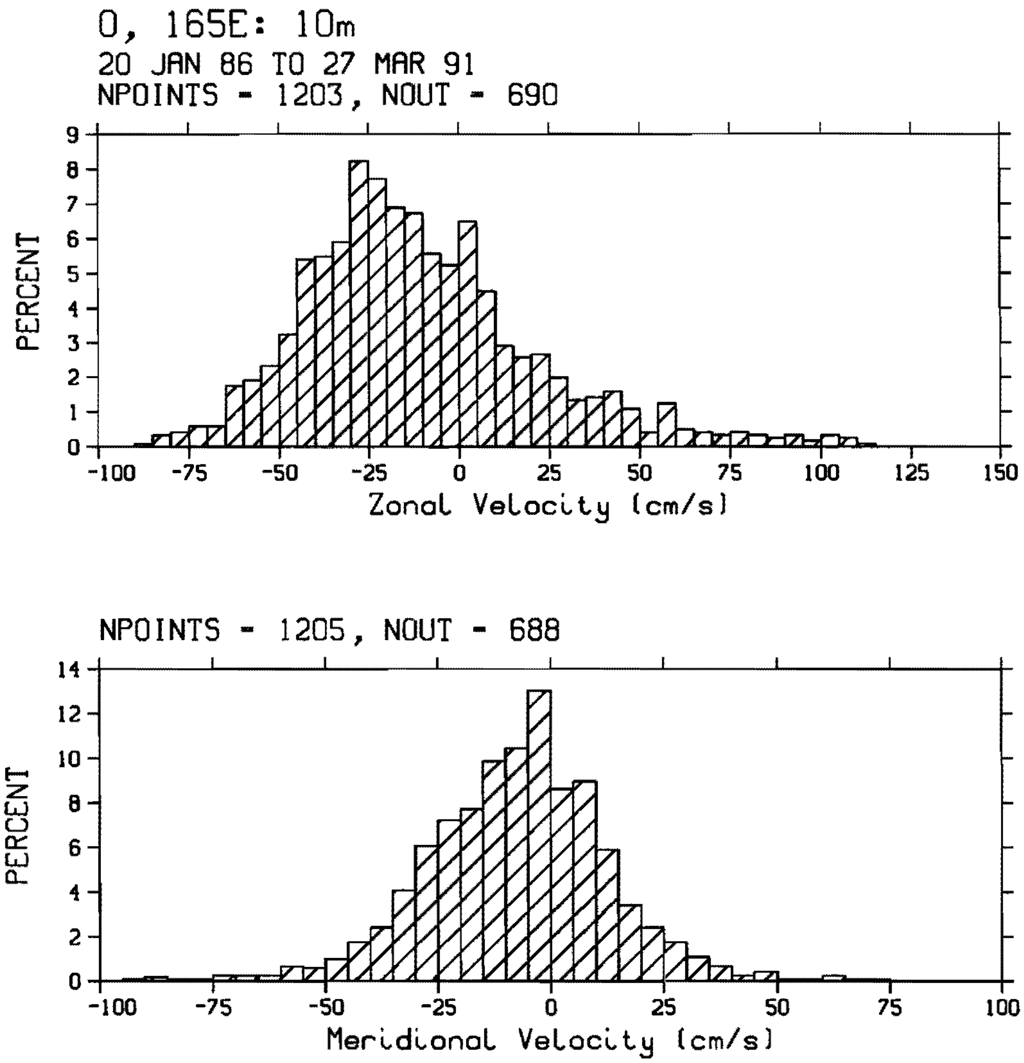
0, 165E: -4m
21 APR 86 TO 16 SEP 90

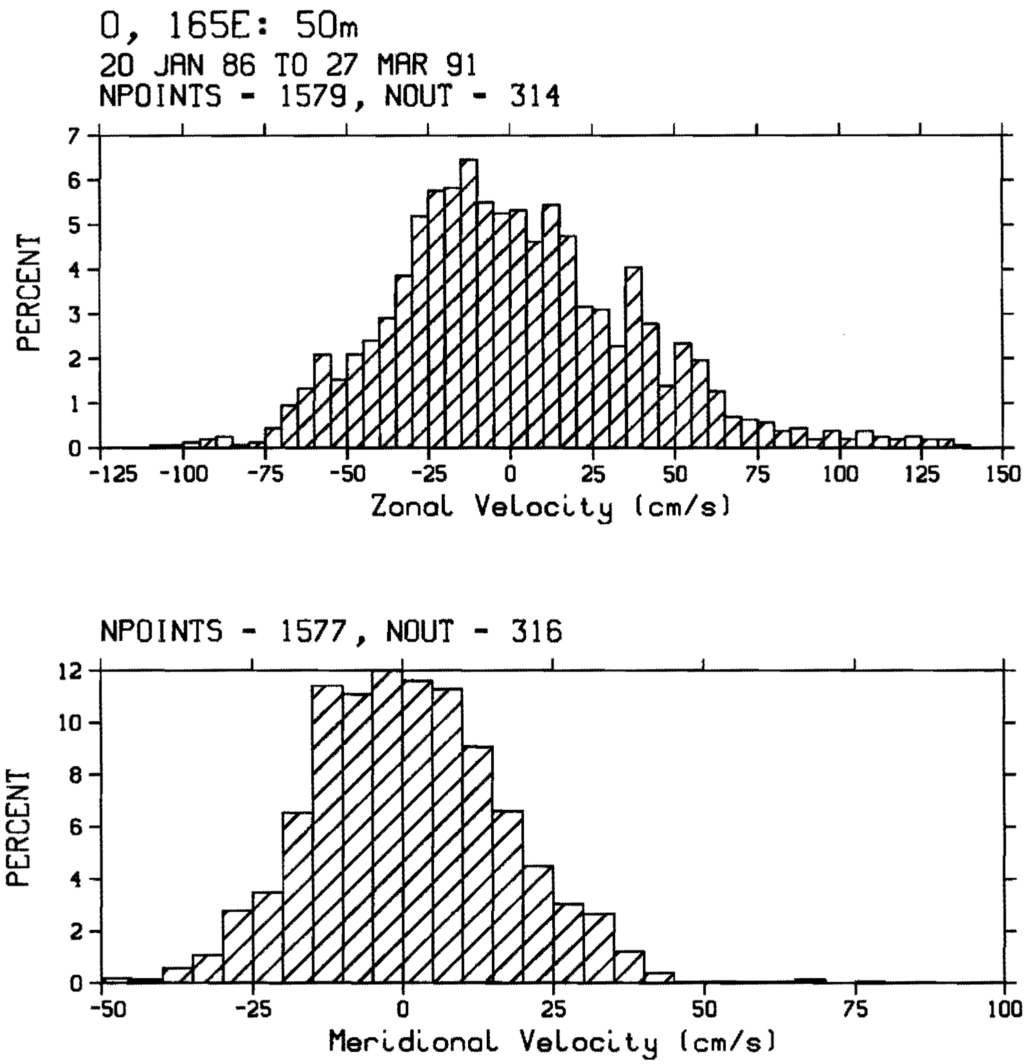
NPOINTS - 1013, NOUT - 597

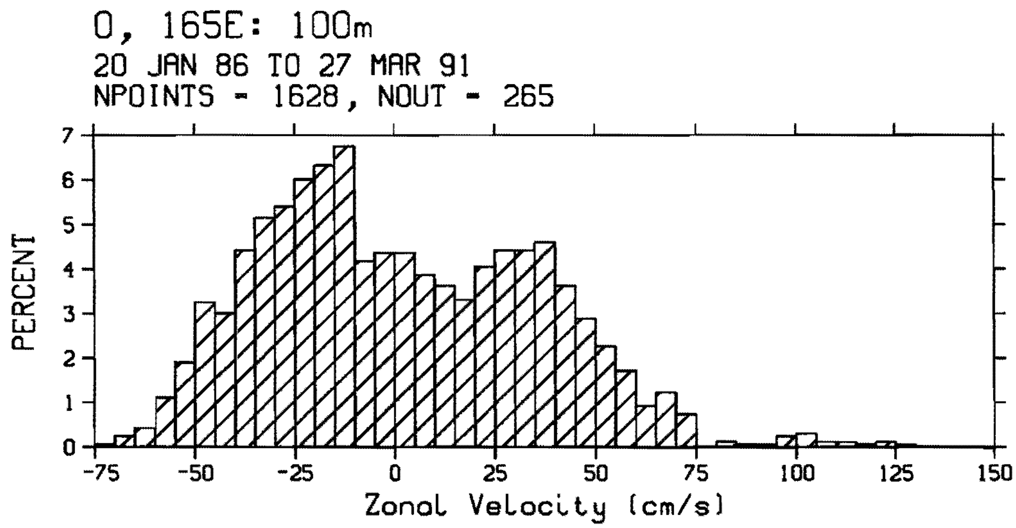


NPOINTS - 1014, NOUT - 596

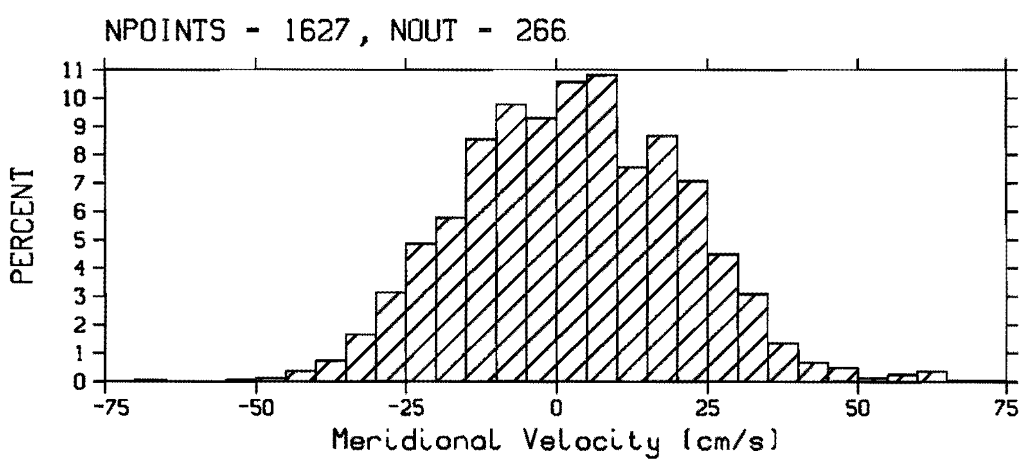



0, 165E: 10m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1203, NOUT - 690
PERCENT
0
1
2
3
4
5
6
7
8
9
-100
-75
-50
-25
0
25
50
75
100
125
150
Zonal Velocity (cm/s)
NPOINTS - 1205, NOUT - 688
PERCENT
0
2
4
6
8
10
12
14
-100
-75
-50
-25
0
25
50
75
100
Meridional Velocity (cm/s)

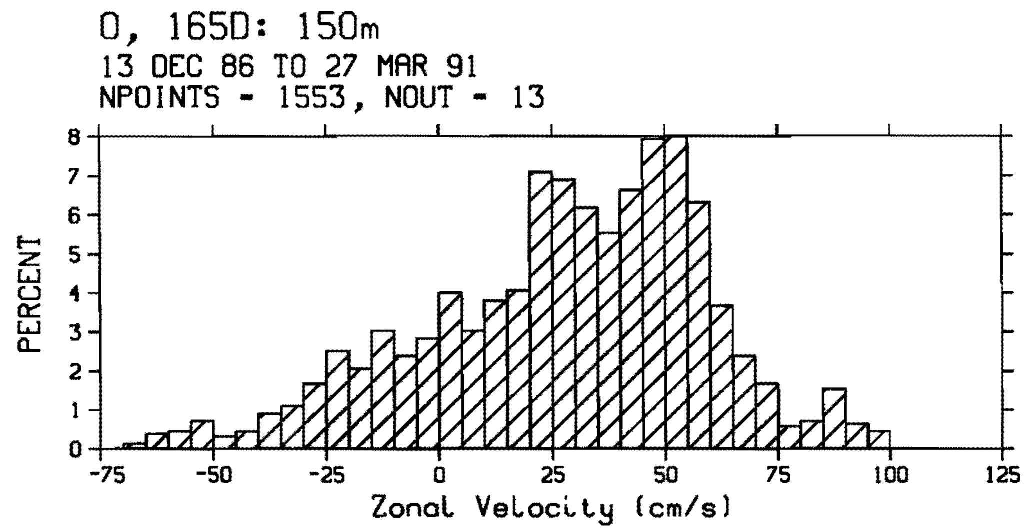

0, 165E: 50m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1579, NOUT - 314
PERCENT
0
1
2
3
4
5
6
7
-125
-100
-75
-50
-25
0
25
50
75
100
125
150
Zonal Velocity (cm/s)
NPOINTS - 1577, NOUT - 316
PERCENT
0
2
4
6
8
10
12
-50
-25
0
25
50
75
100
Meridional Velocity (cm/s)



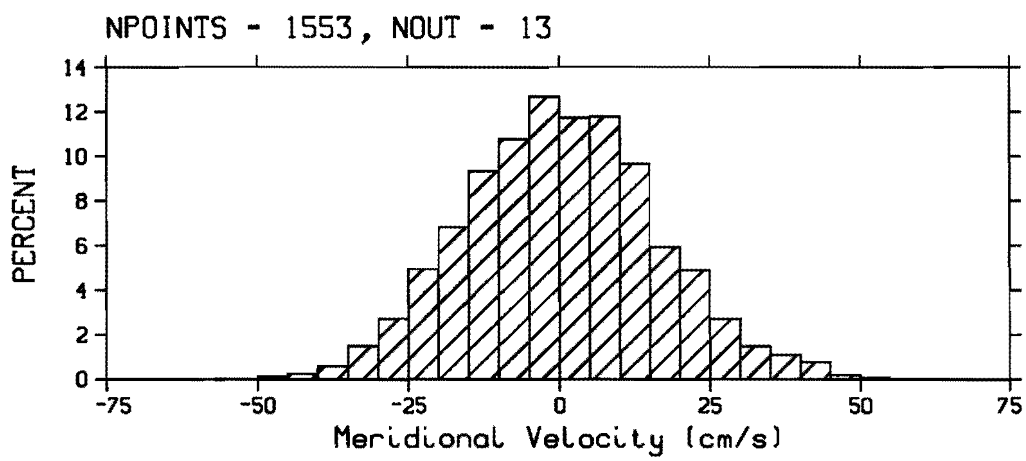
0, 165E: 100m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1628, NOUT - 265
PERCENT
Zonal Velocity (cm/s)



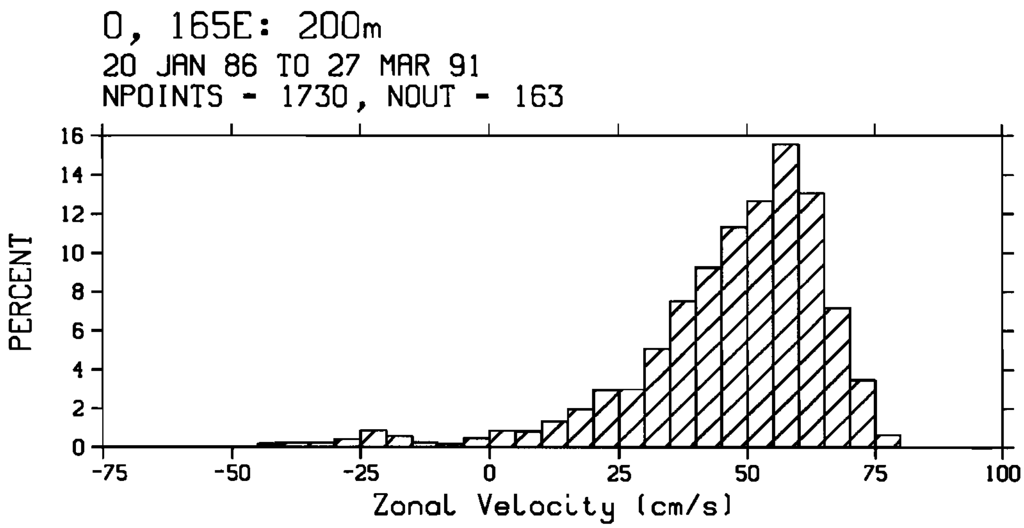
NPOINTS - 1627, NOUT - 266
PERCENT
Meridional Velocity (cm/s)

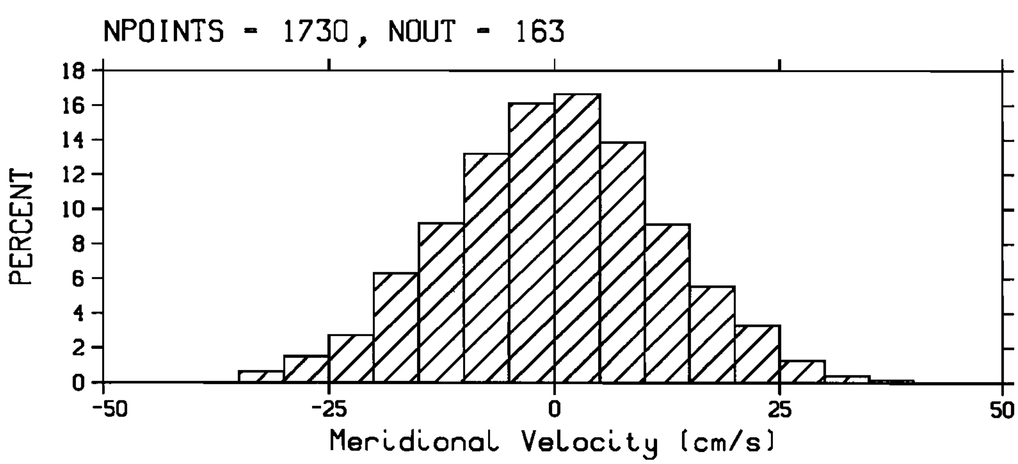


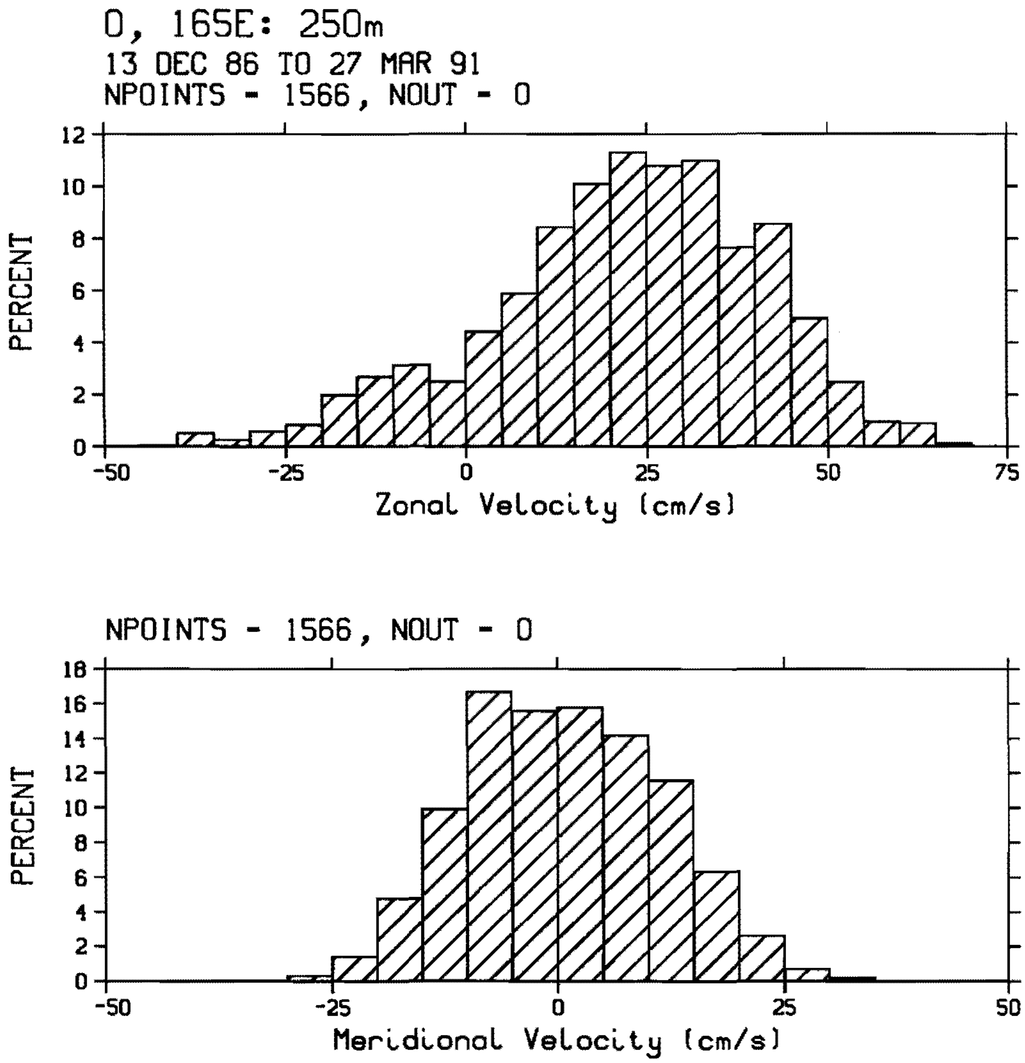
0, 165D: 150m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1553, NOUT - 13
PERCENT
Zonal Velocity (cm/s)



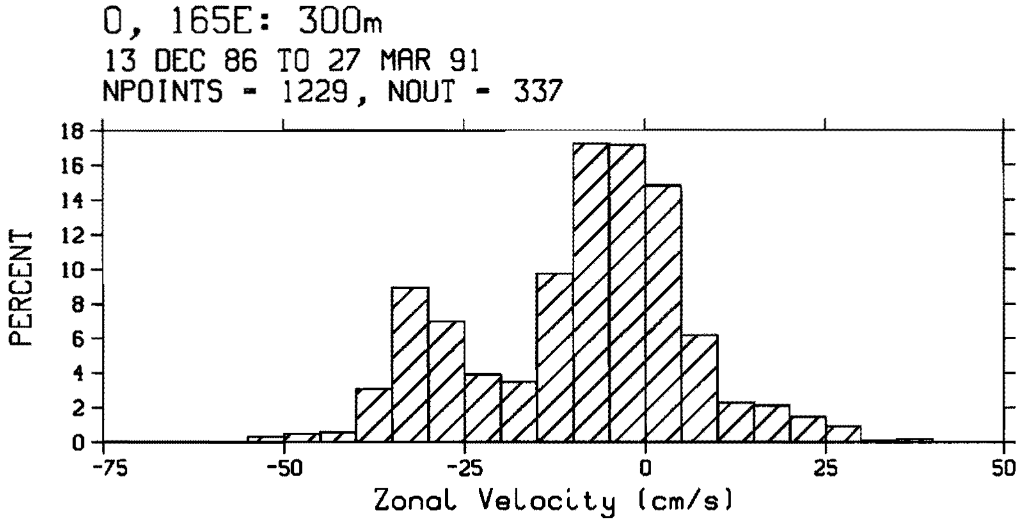
NPOINTS - 1553, NOUT - 13
PERCENT
Meridional Velocity (cm/s)

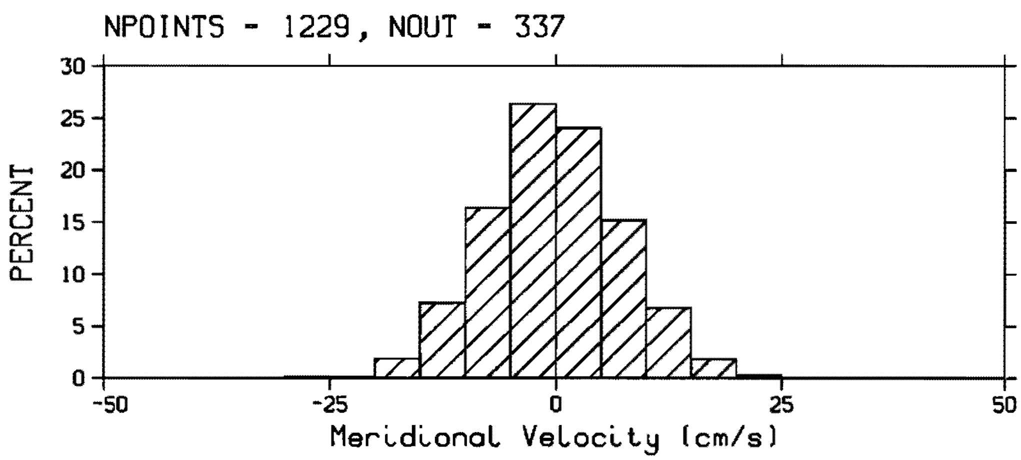

0, 165E: 200m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1730, NOUT - 163
PERCENT
16
14
12
10
8
6
4
2
0
-75
-50
-25
0
25
50
75
100
Zonal Velocity (cm/s)

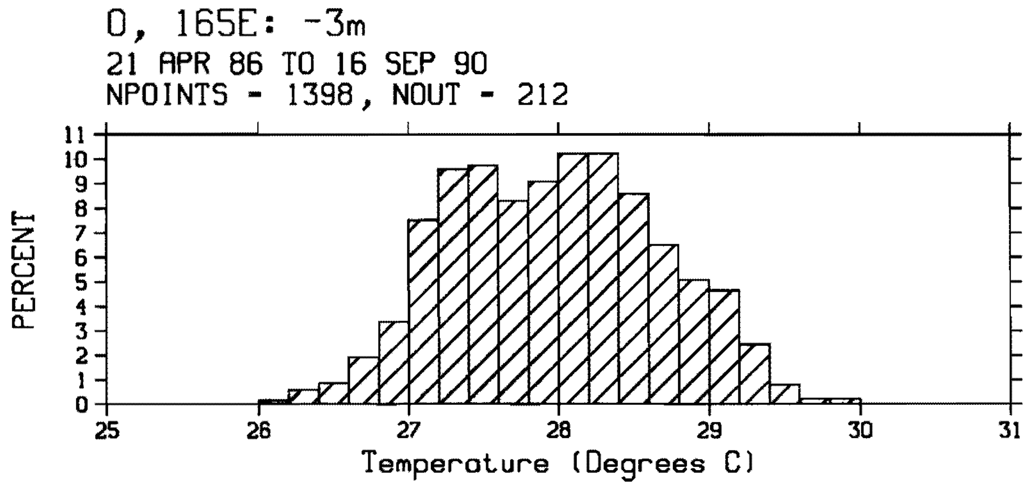

NPOINTS - 1730, NOUT - 163
PERCENT
18
16
14
12
10
8
6
4
2
0
-50
-25
0
25
50
Meridional Velocity (cm/s)

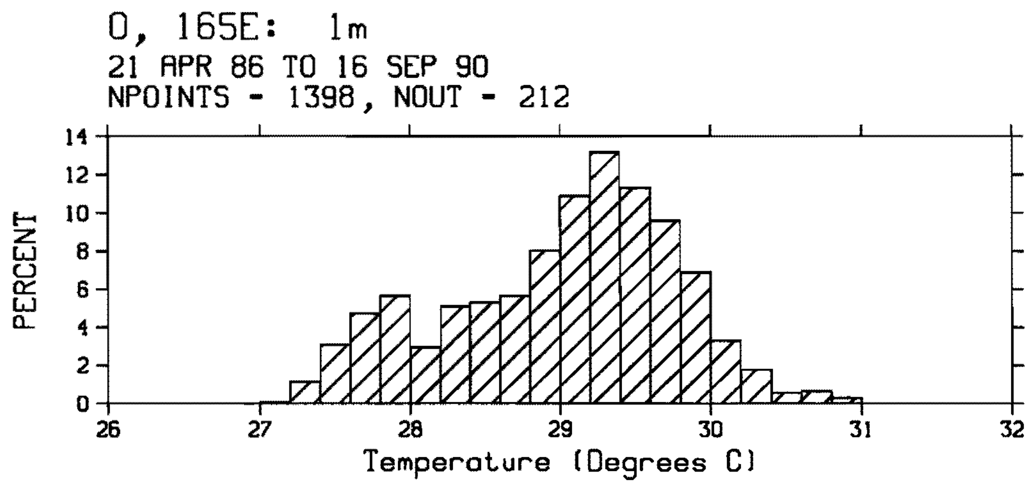


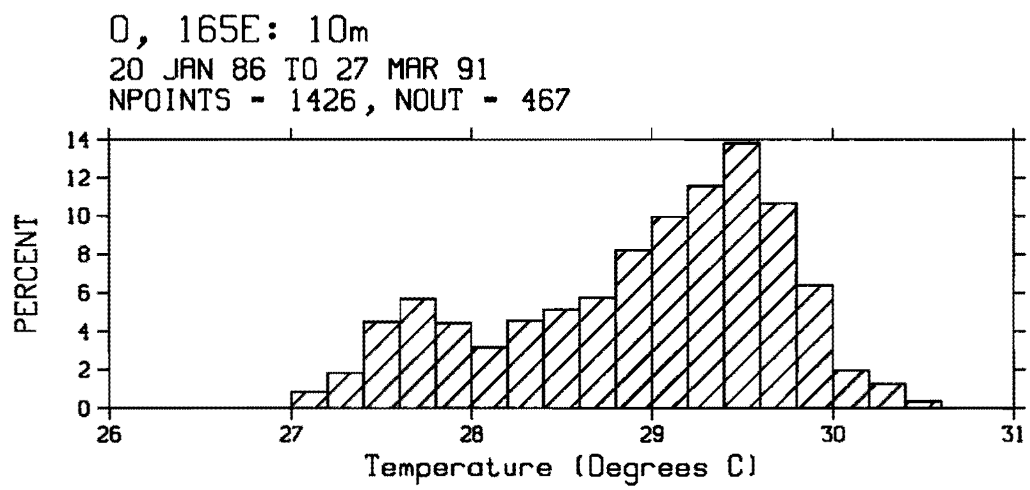
0, 165E: 250m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1566, NOUT - 0
PERCENT
Zonal Velocity (cm/s)
NPOINTS - 1566, NOUT - 0
PERCENT
Meridional Velocity (cm/s)

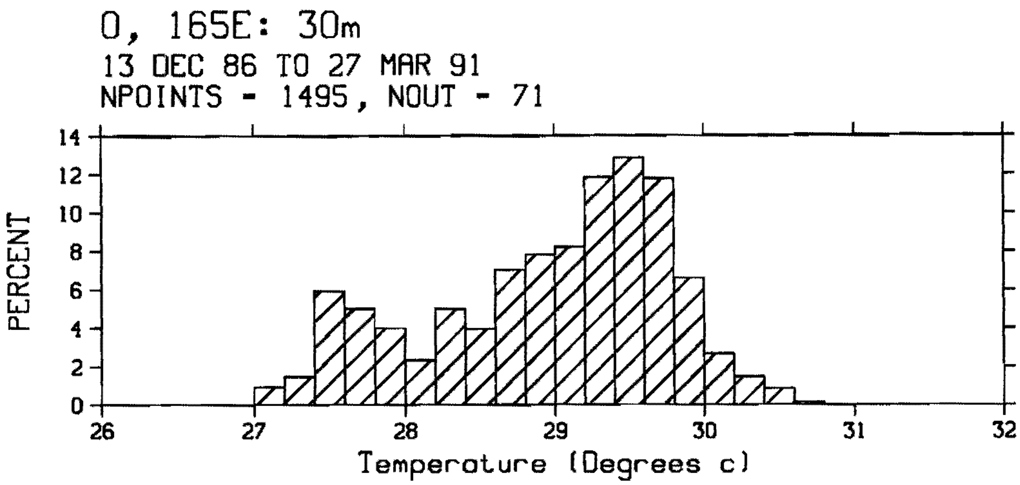

0, 165E: 300m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1229, NOUT - 337
PERCENT
18
16
14
12
10
8
6
4
2
0
-75
-50
-25
0
25
50
Zonal Velocity (cm/s)

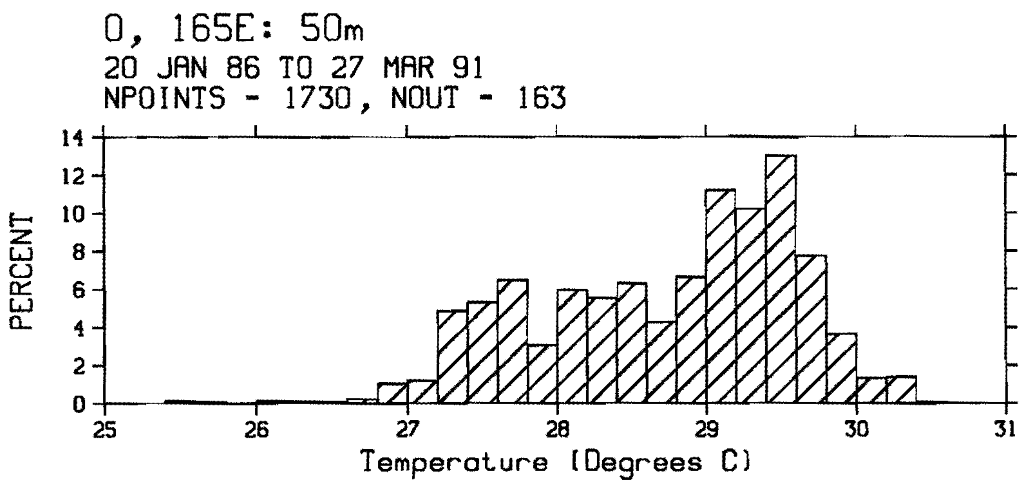

NPOINTS - 1229, NOUT - 337
PERCENT
30
25
20
15
10
5
0
-50
-25
0
25
50
Meridional Velocity (cm/s)

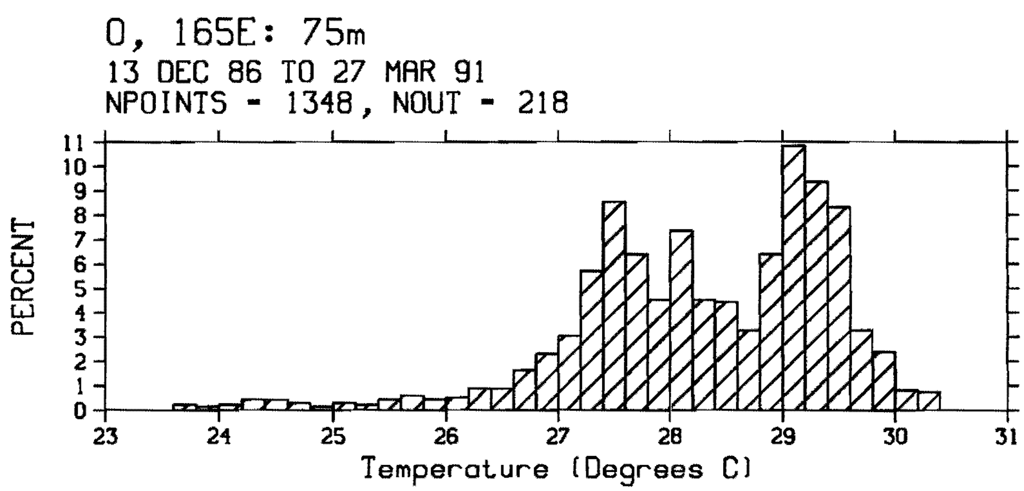

0, 165E: -3m
21 APR 86 TO 16 SEP 90
NPOINTS - 1398, NOUT - 212
PERCENT
Temperature (Degrees C)

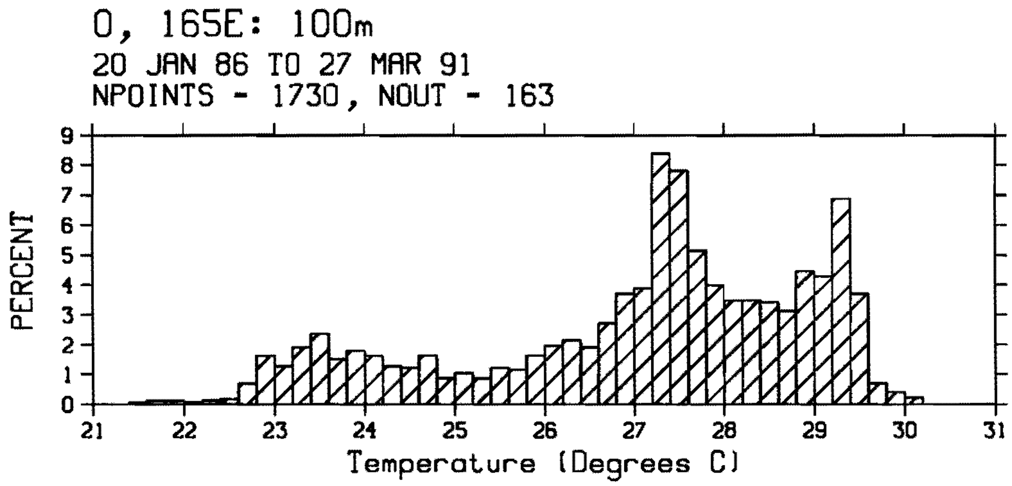

0, 165E: 1m
21 APR 86 TO 16 SEP 90
NPOINTS - 1398, NOUT - 212
PERCENT
Temperature (Degrees C)

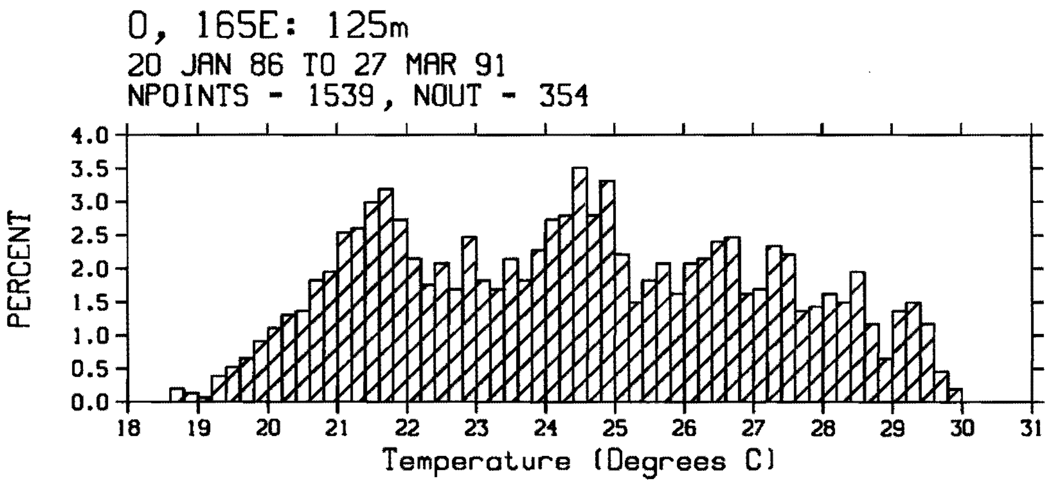

0, 165E: 10m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1426, NOUT - 467
PERCENT
Temperature (Degrees C)

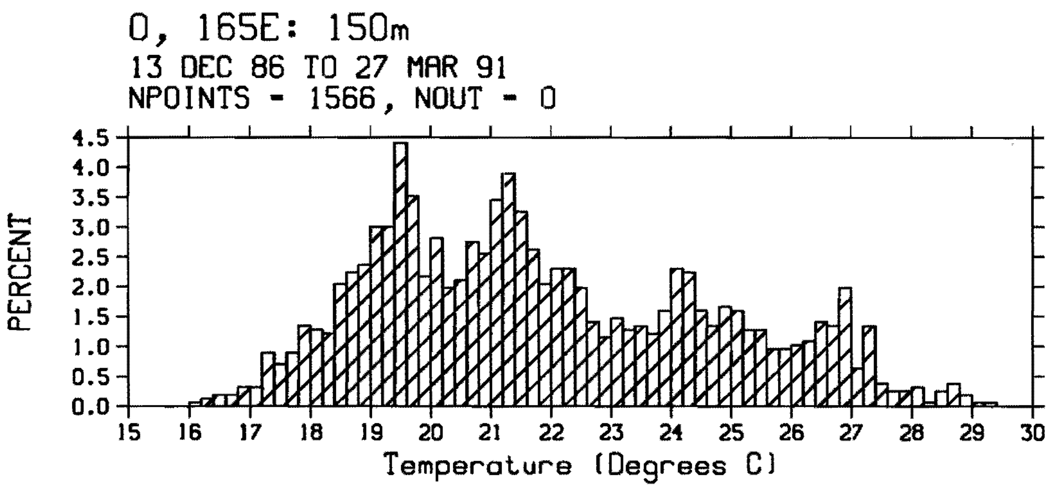

0, 165E: 30m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1495, NOUT - 71
PERCENT
Temperature (Degrees c)

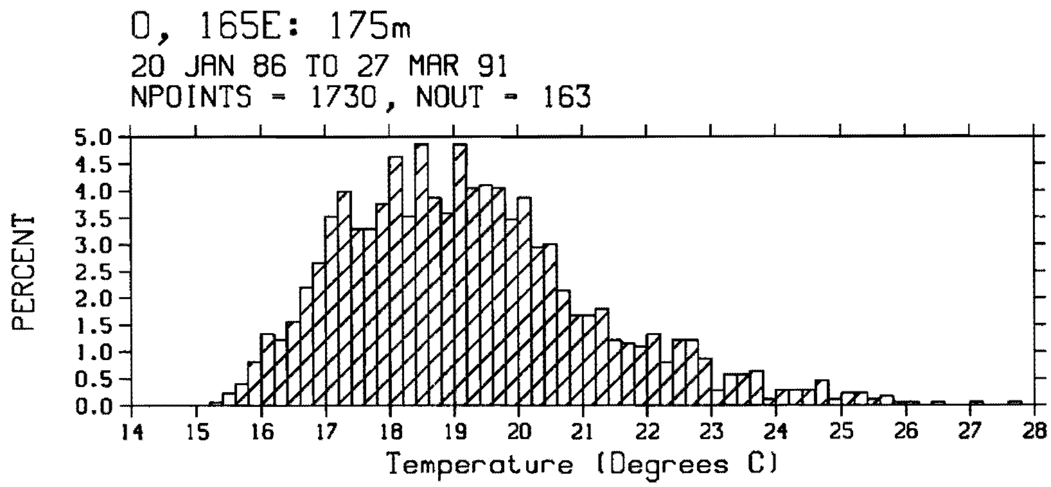

0, 165E: 50m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1730, NOUT - 163
PERCENT
Temperature (Degrees C)

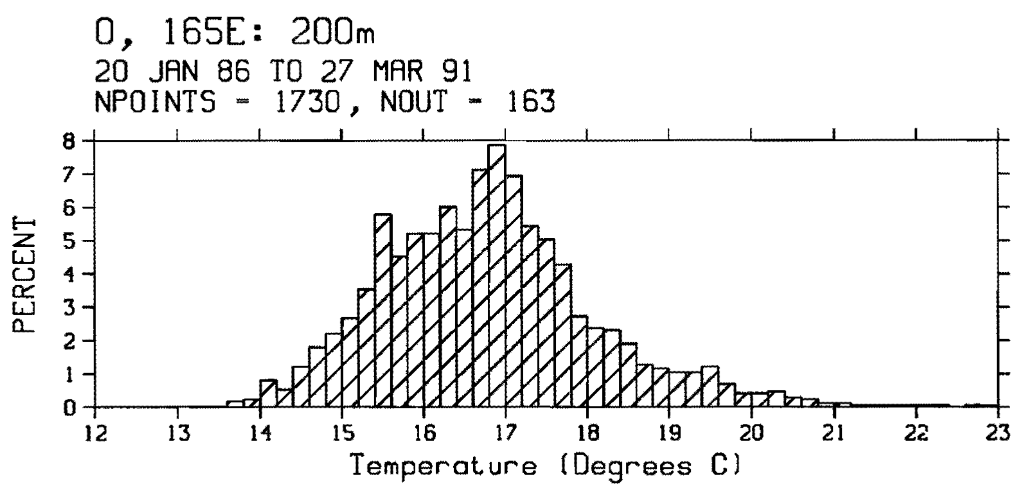

0, 165E: 75m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1348, NOUT - 218
PERCENT
Temperature (Degrees C)

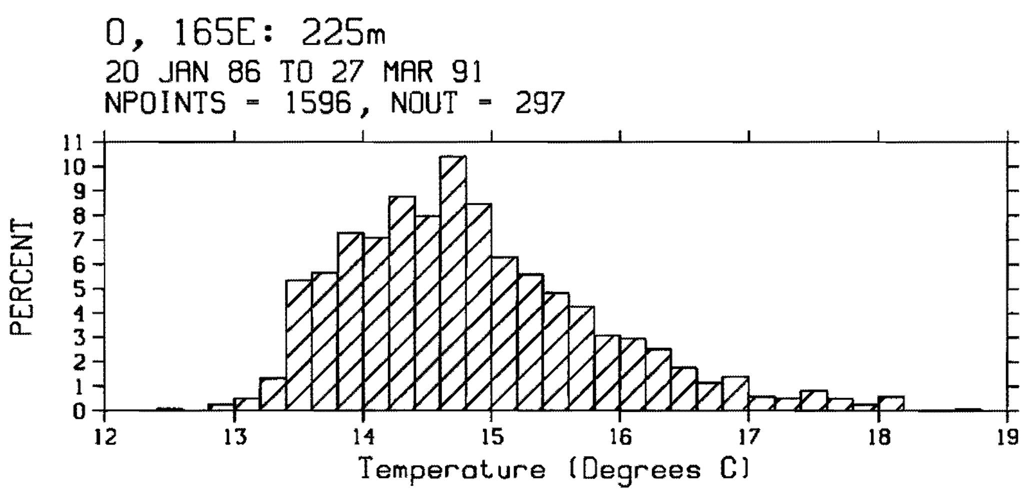

0, 165E: 100m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1730, NOUT - 163
PERCENT
Temperature (Degrees C)

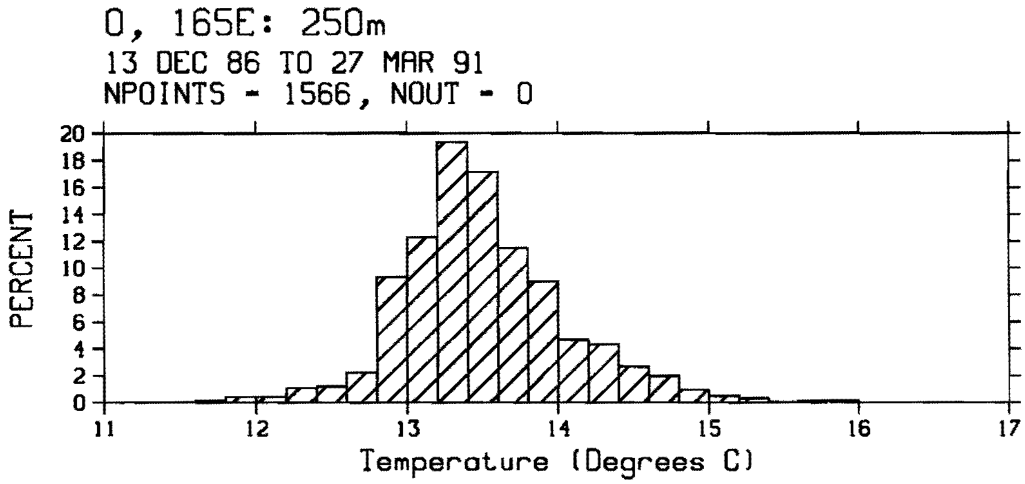

0, 165E: 125m
20 JAN 86 TO 27 MAR 91
NPOINTS - 1539, NOUT - 354
PERCENT
Temperature (Degrees C)

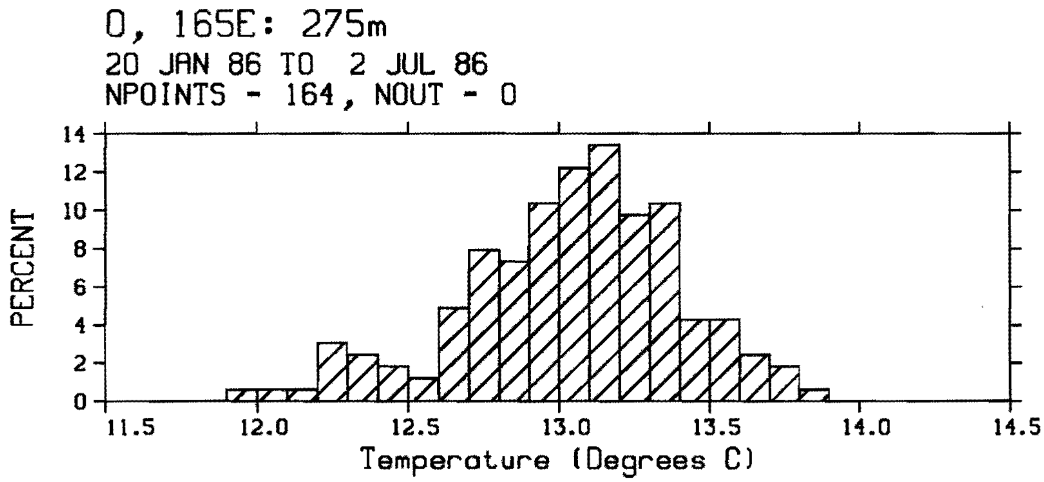

0, 165E: 150m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1566, NOUT - 0
PERCENT
Temperature (Degrees C)

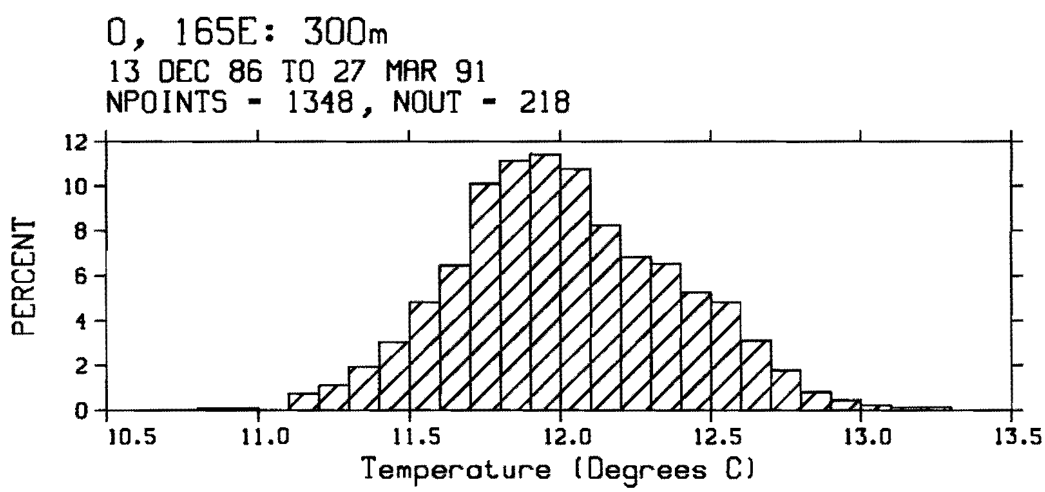

0, 165E: 175m
20 JAN 86 TO 27 MAR 91
NPOINTS = 1730, NOUT = 163
PERCENT
Temperature (Degrees C)


0, 165E: 200m
20 JAN 86 TO 27 MAR 91
NPOINTS = 1730, NOUT = 163
PERCENT
Temperature (Degrees C)

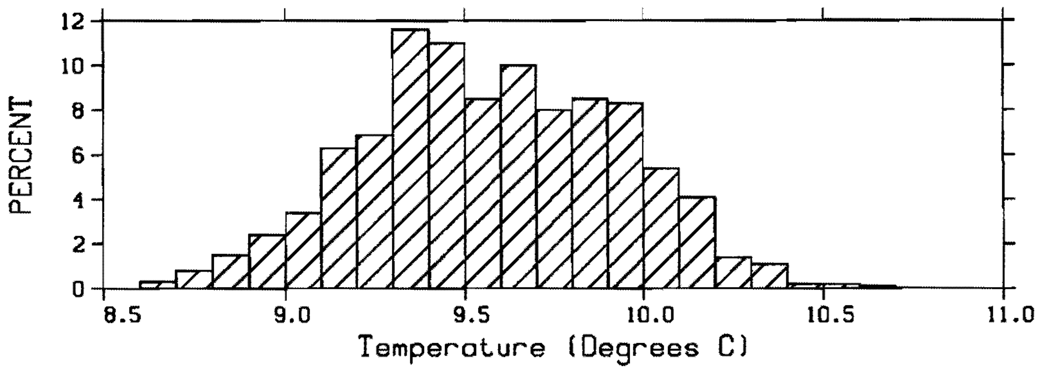

0, 165E: 225m
20 JAN 86 TO 27 MAR 91
NPOINTS = 1596, NOUT = 297
PERCENT
Temperature (Degrees C)


0, 165E: 250m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1566, NOUT - 0
PERCENT
Temperature (Degrees C)

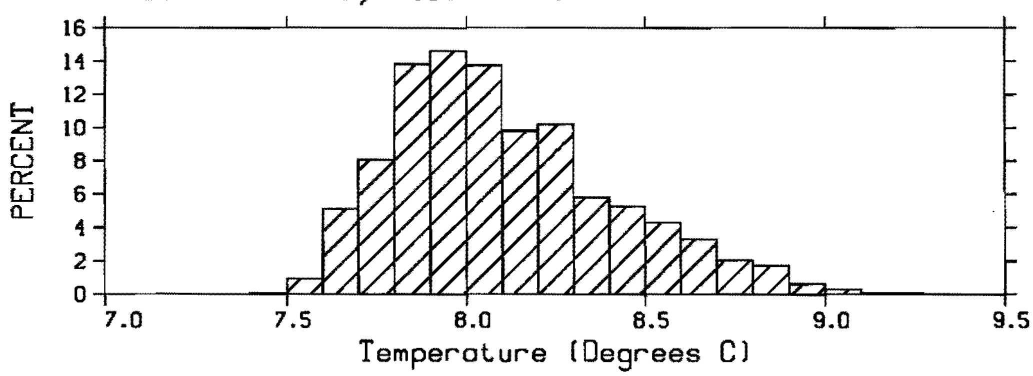

0, 165E: 275m
20 JAN 86 TO 2 JUL 86
NPOINTS - 164, NOUT - 0
PERCENT
Temperature (Degrees C)


0, 165E: 300m
13 DEC 86 TO 27 MAR 91
NPOINTS - 1348, NOUT - 218
PERCENT
Temperature (Degrees C)

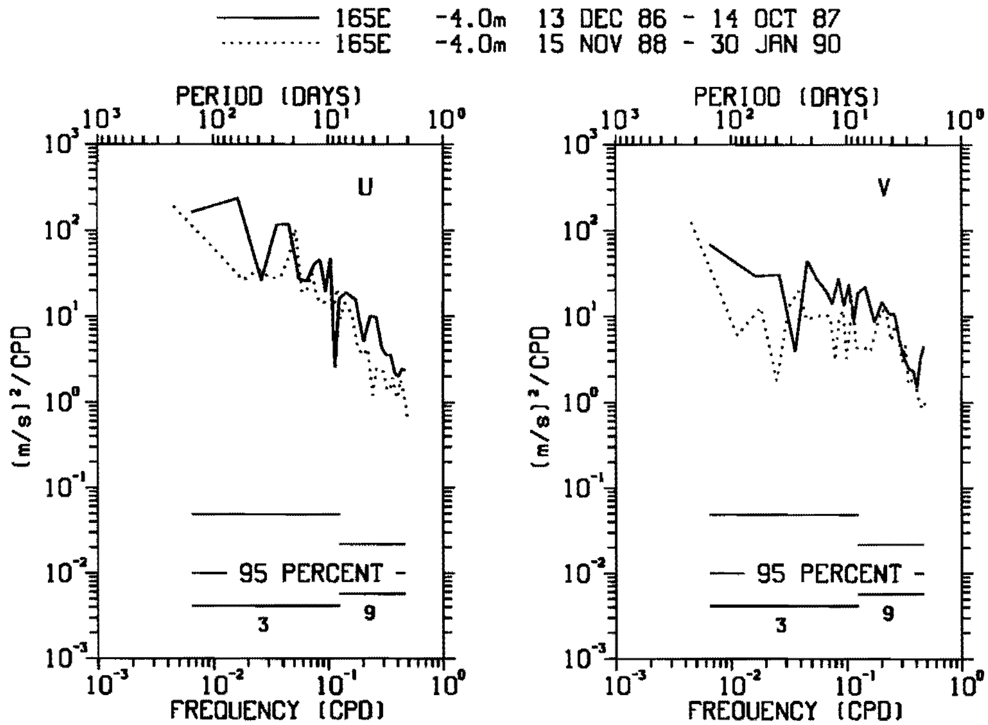
0, 165E: 400m
20 JAN 86 TO 27 JUN 90
NPOINTS = 1000, NOUT = 620

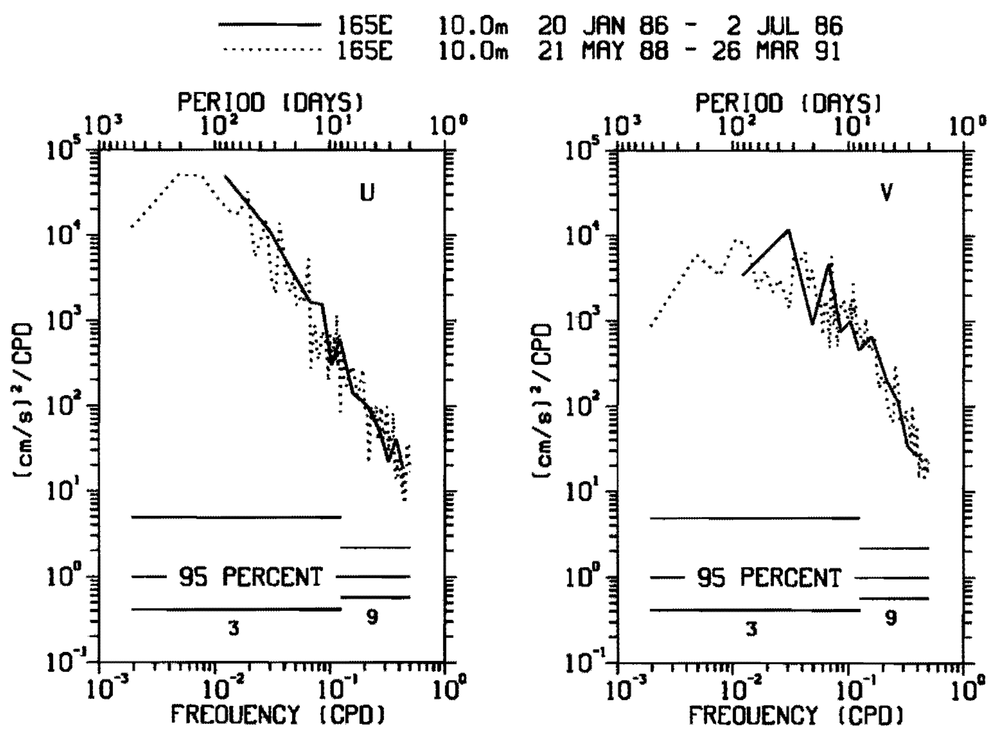


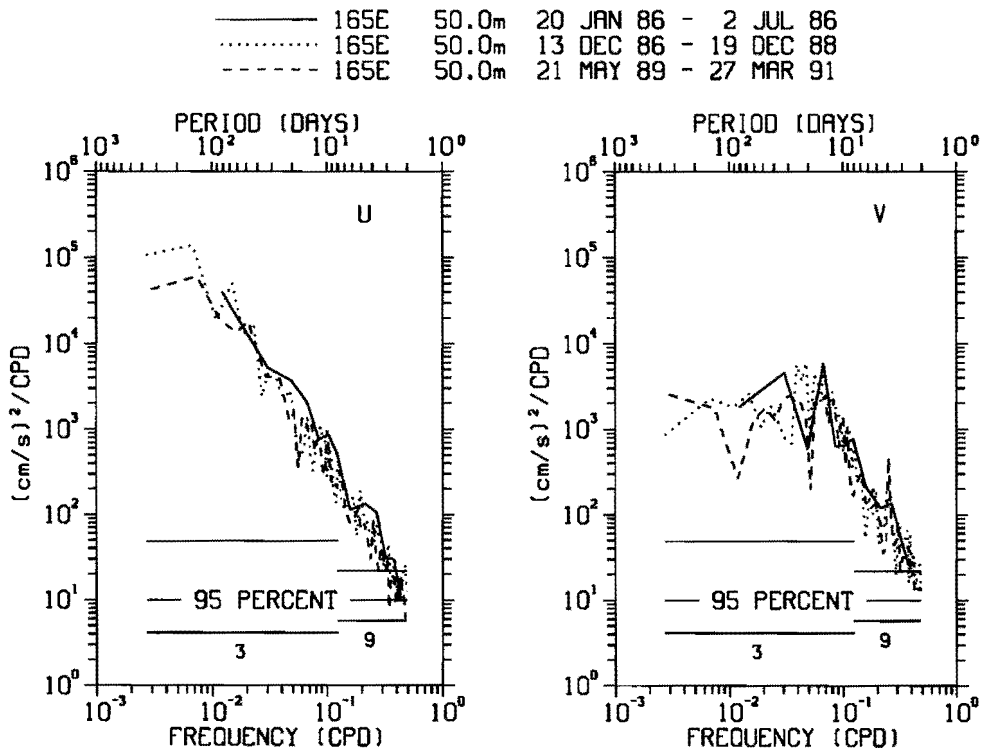
0, 165E: 500m
20 JAN 86 TO 27 MAR 91
NPOINTS = 1273, NOUT = 620

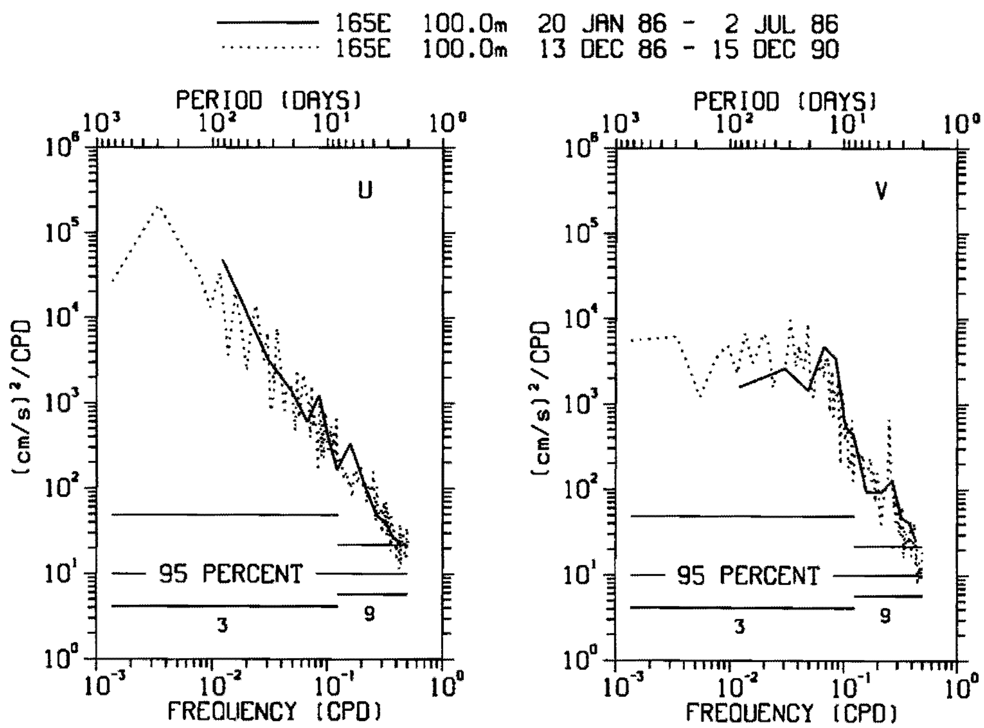


Section II.E: SPECTRA

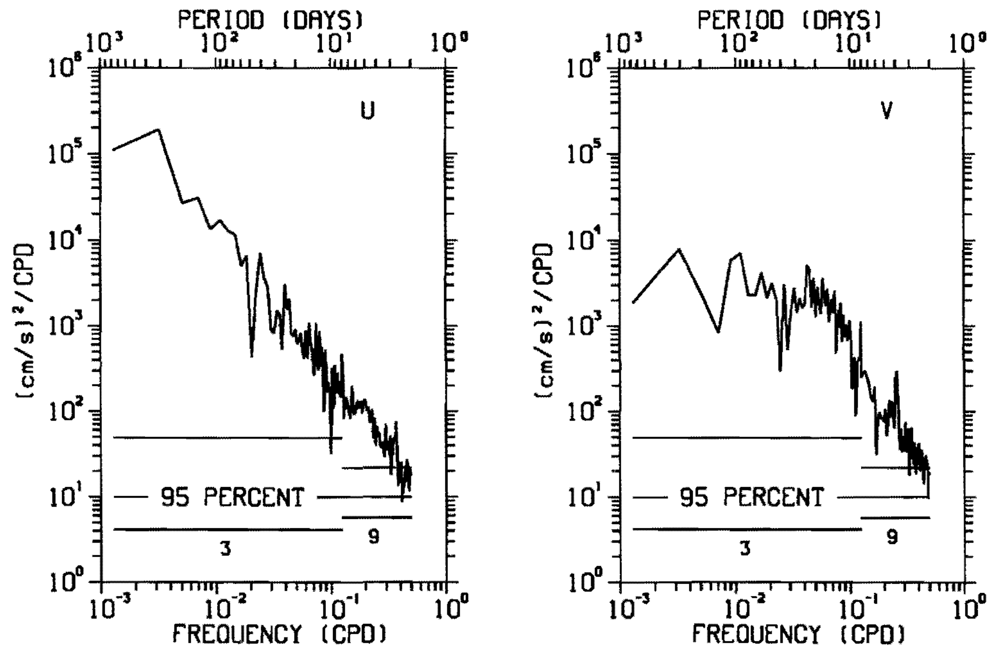

165E -4.0m 13 DEC 86 - 14 OCT 87
165E -4.0m 15 NOV 88 - 30 JAN 90
PERIOD (DAYS)
FREQUENCY (CPD)
(m/s)²/CPD
U
V
95 PERCENT
3
9

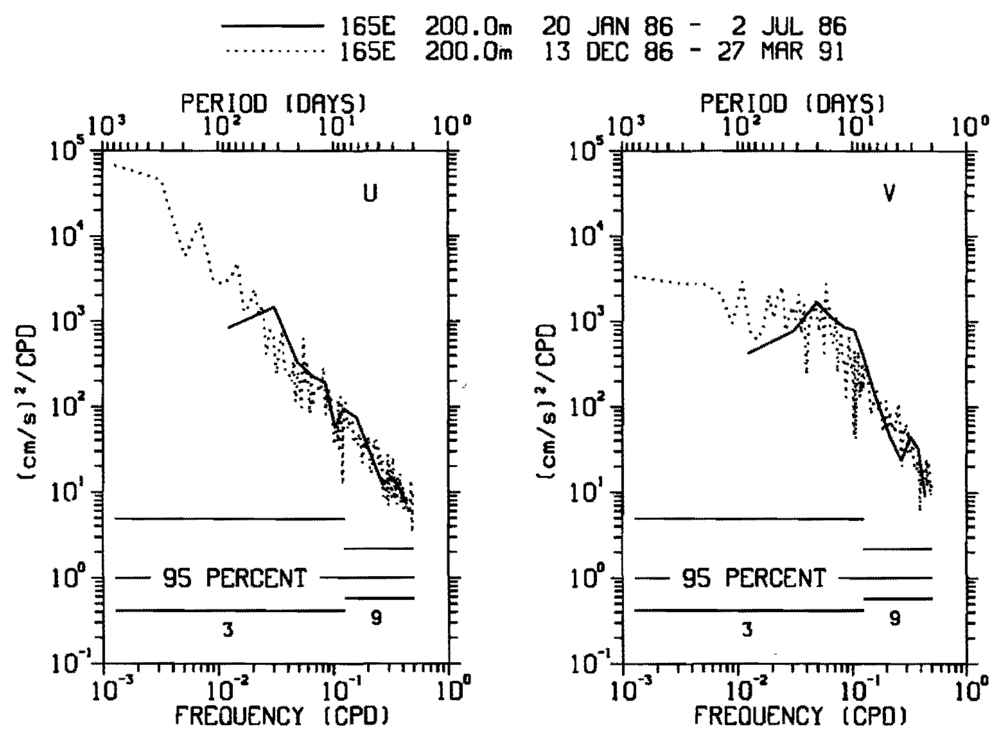

165E 10.0m 20 JAN 86 - 2 JUL 86
165E 10.0m 21 MAY 88 - 26 MAR 91
PERIOD (DAYS)
FREQUENCY (CPD)
(cm/s)²/CPD
U
V
95 PERCENT
3
9


165E 50.0m 20 JAN 86 - 2 JUL 86
165E 50.0m 13 DEC 86 - 19 DEC 88
165E 50.0m 21 MAY 89 - 27 MAR 91
PERIOD (DAYS)
(cm/s)²/CPD
U
V
95 PERCENT
3
9
FREQUENCY (CPD)

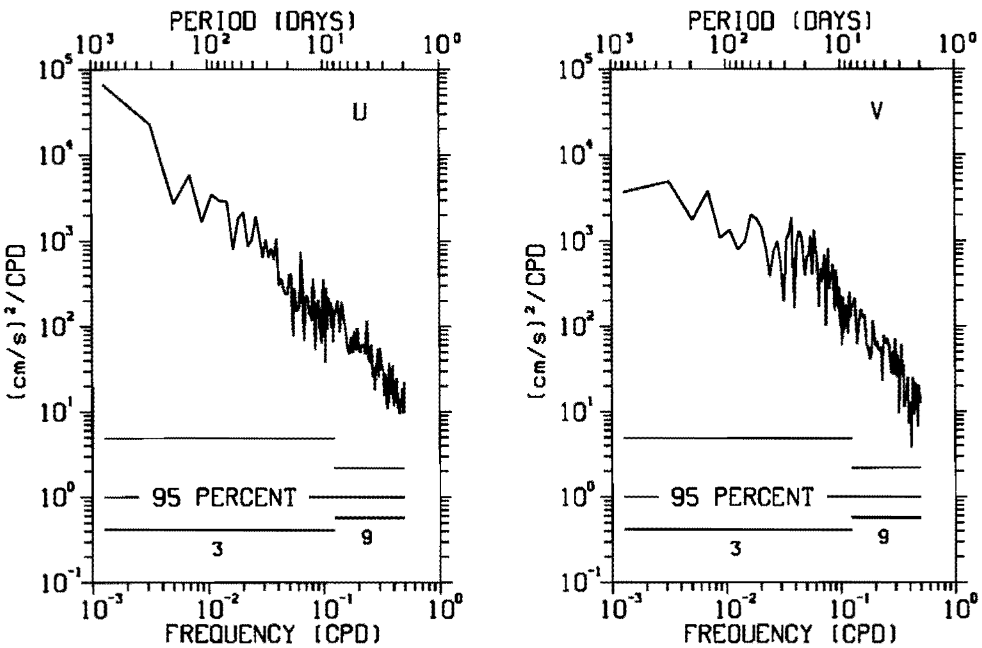

165E 100.0m 20 JAN 86 - 2 JUL 86
165E 100.0m 13 DEC 86 - 15 DEC 90
PERIOD (DAYS)
(cm/s)²/CPD
U
V
95 PERCENT
3
9
FREQUENCY (CPD)

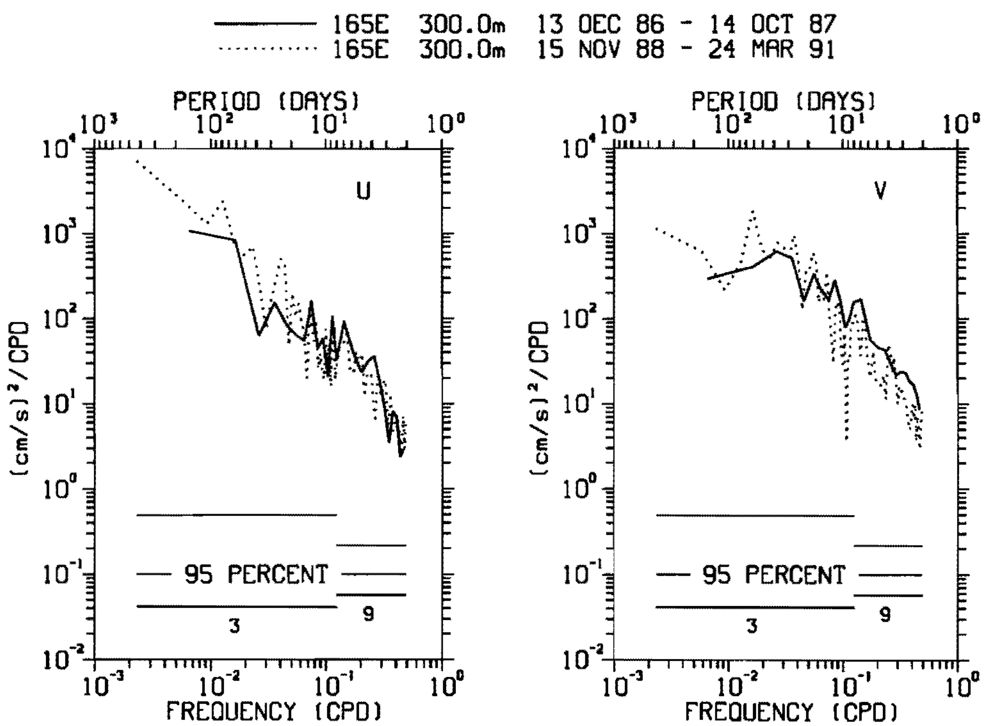
165E 150.0m 13 DEC 86 - 13 MAR 91

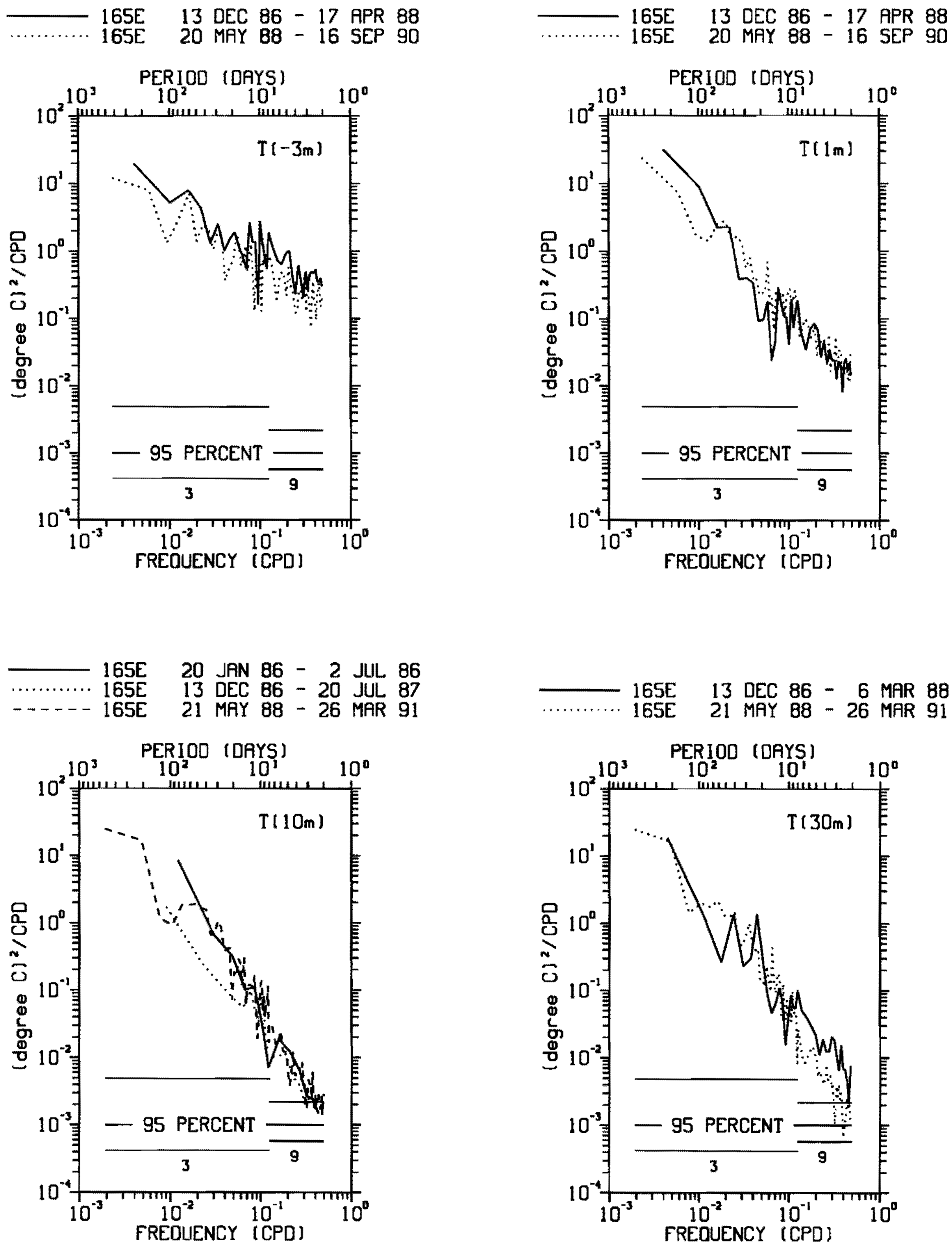




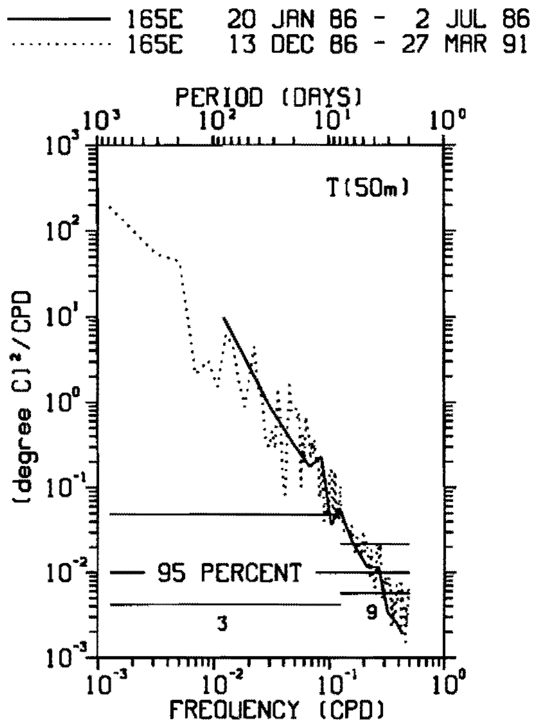
165E 250.0m 13 DEC 86 - 27 MAR 91

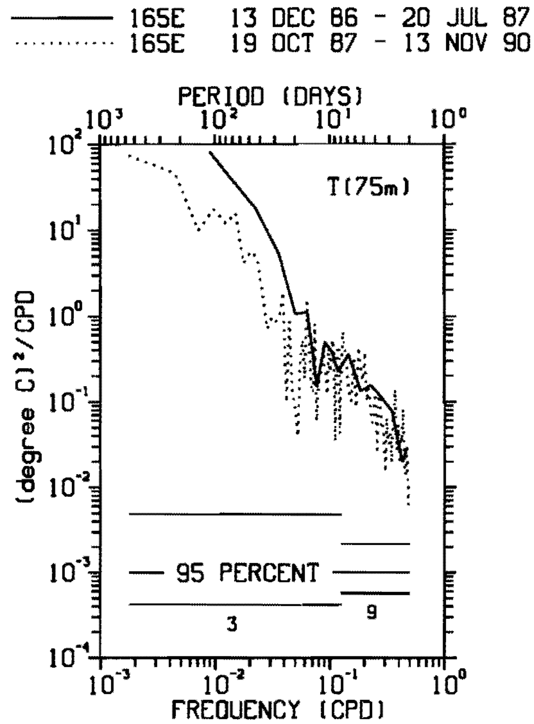


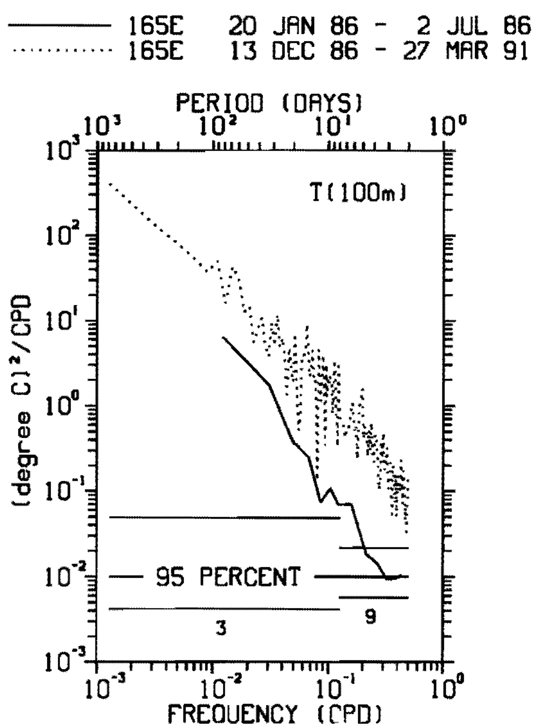


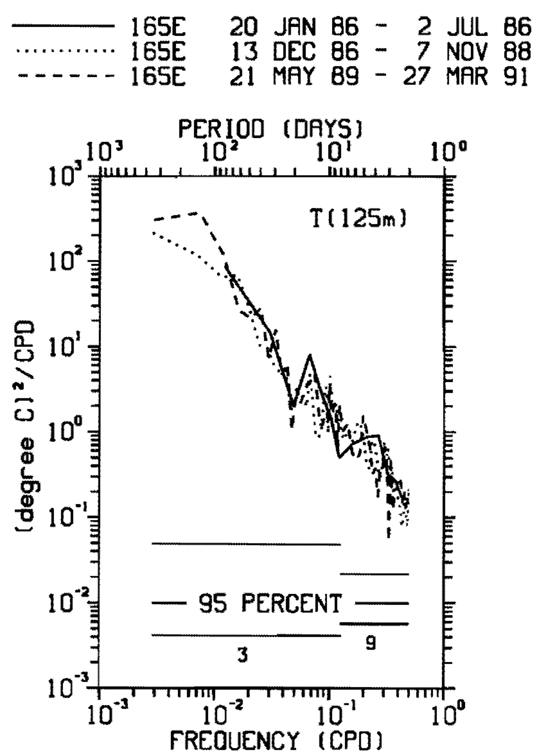


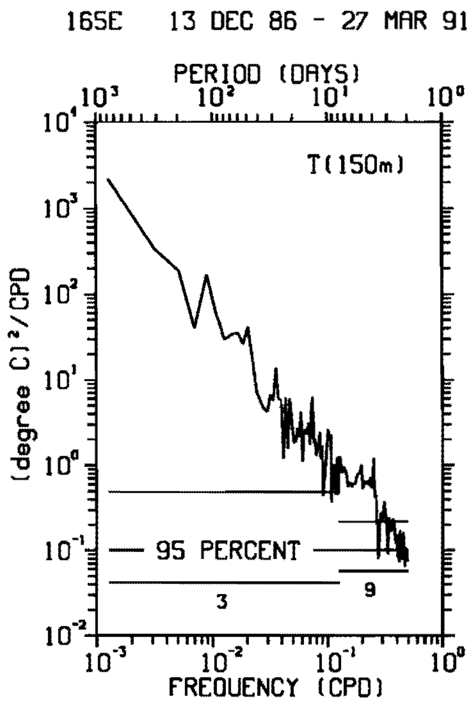
165E 13 DEC 86 - 17 APR 88
165E 20 MAY 88 - 16 SEP 90
PERIOD (DAYS)
T(-3m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)
T(1m)
165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 20 JUL 87
165E 21 MAY 88 - 26 MAR 91
T(10m)
165E 13 DEC 86 - 6 MAR 88
165E 21 MAY 88 - 26 MAR 91
T(30m)

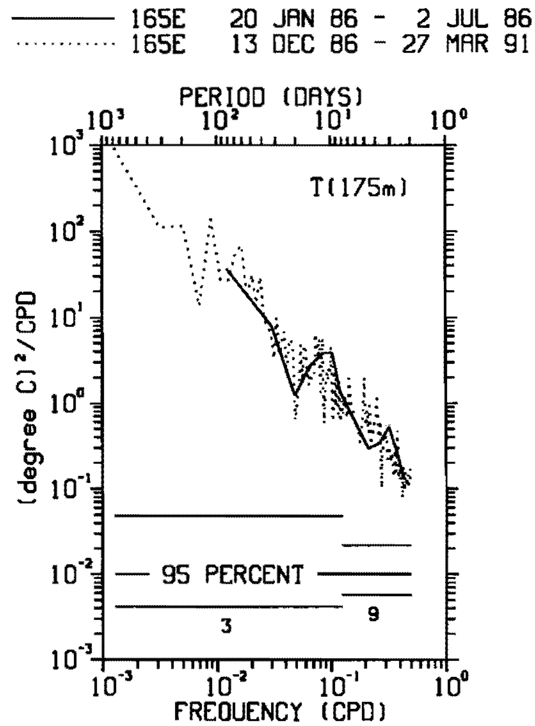

165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 27 MAR 91
PERIOD (DAYS)
T(50m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)

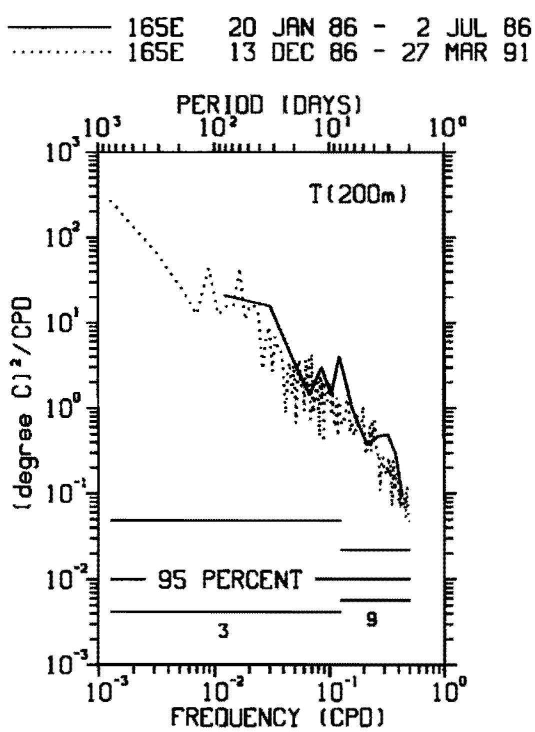

165E 13 DEC 86 - 20 JUL 87
165E 19 OCT 87 - 13 NOV 90
PERIOD (DAYS)
T(75m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)

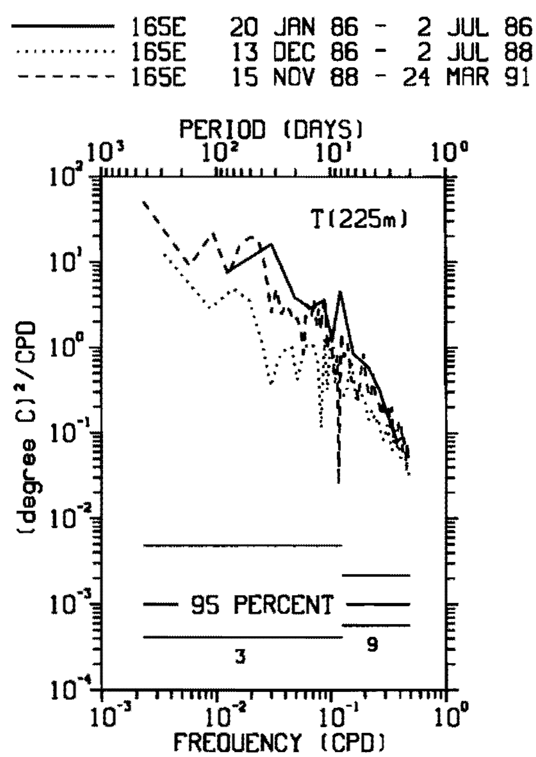

165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 27 MAR 91
PERIOD (DAYS)
T(100m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)


165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 7 NOV 88
165E 21 MAY 89 - 27 MAR 91
PERIOD (DAYS)
T(125m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)

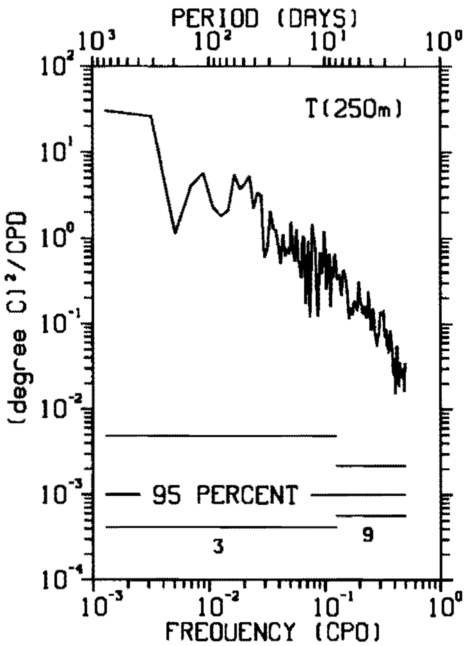

165E 13 DEC 86 - 27 MAR 91
PERIOD (DAYS)
T(150m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)


165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 27 MAR 91
PERIOD (DAYS)
T(175m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)

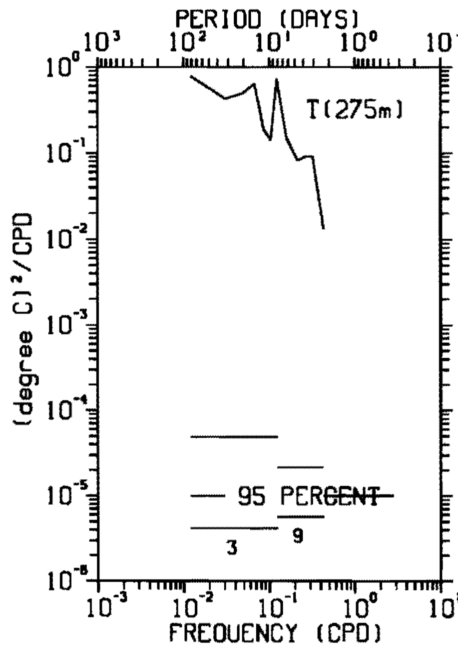

165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 27 MAR 91
PERIOD (DAYS)
T(200m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)


165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 2 JUL 88
165E 15 NOV 88 - 24 MAR 91
PERIOD (DAYS)
T(225m)
(degree C)²/CPD
95 PERCENT
3
9
FREQUENCY (CPD)

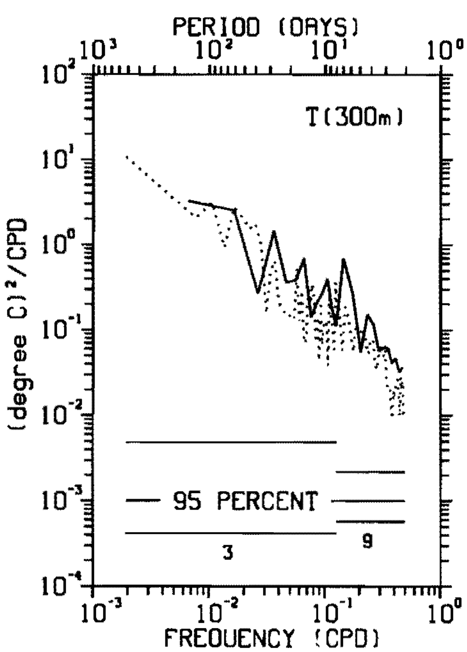
165E 13 DEC 86 - 27 MAR 91



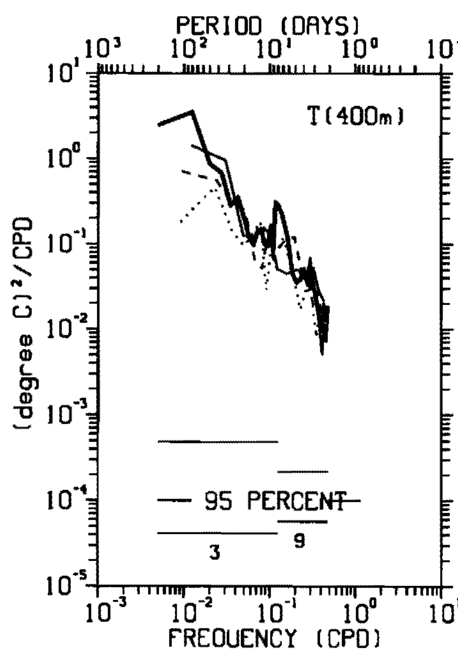
165E 20 JAN 86 - 2 JUL 86

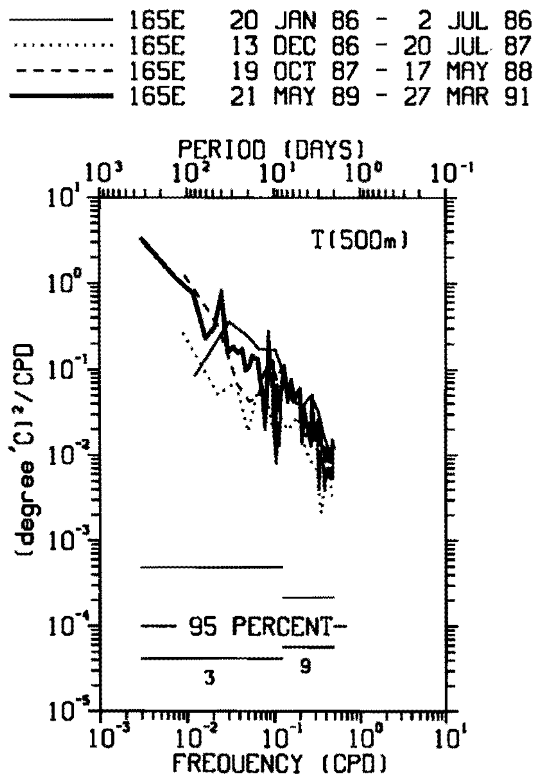


165E 13 DEC 86 - 14 OCT 87
165E 21 MAY 88 - 26 MAR 91



165E 20 JAN 86 - 2 JUL 86
165E 13 DEC 86 - 20 JUL 87
165E 19 OCT 87 - 17 MAY 88
165E 21 MAY 89 - 26 JUN 90





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