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Moored Current and Hydrographic Measurements on the Southeast Shoal of the Grand Bank 1986 and 1987

C.K. Ross, J.W. Loder and M.J. Graca

Physical and Chemical Sciences Branch
Scotia-Fundy Region
Department of Fisheries and Oceans

Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia
Canada B2Y 4A2

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Canadian Data Report of Hydrography and Ocean Sciences No. 71

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Canadian Data Report Of Hydrography and Ocean Sciences

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Regional and headquarters establishments of Ocean Science and Surveys ceased publication of their various report series as of December 1981. A complete listing of these publications is published in the *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 39: Index to Publications 1982. The current series, which begins with report number 1, was initiated in January 1982.

Rapport statistique canadien sur l'hydrographie et les sciences océaniques

Les rapports statistiques servent de véhicule pour la compilation et la diffusion des données sous une forme directement utilisable par les scientifiques et les techniciens. En général, les rapports contiennent des données brutes ou analysées, mais ne fournissent pas d'interprétation des données. Ces compilations sont préparées le plus souvent à l'appui de travaux liés aux programmes et intérêts du service des Sciences et levés océaniques (SLO) du ministère des Pêches et des Océans.

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Les rapports statistiques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés sont fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports en décembre 1981. Une liste complète de ces publications figure dans le volume 39, Index des publications 1982, du *Journal canadien des sciences halieutiques et aquatiques*. La série actuelle a commencé avec la publication du rapport numéro 1 en janvier 1982.

Canadian Data Report of
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MOORED CURRENT AND HYDROGRAPHIC MEASUREMENTS ON THE SOUTHEAST SHOAL OF THE GRAND BANK, 1986 AND 1987

by

C.K. Ross, J.W. Loder and M.J. Graça

Physical and Chemical Sciences
Scotia-Fundy Region
Department of Fisheries and Oceans

Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia
Canada B2Y 4A2

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ABSTRACT

Ross, C.K., J.W. Loder and M.J. Graça. 1988. Moored current and hydrographic measurements on the Southeast Shoal of the Grand Bank, 1986 and 1987. Can. Data Rep. Hydrogr. Ocean Sci. No. 71: vi + 132 pp.

This report presents a statistical and graphical description of the moored data collected during the summers of 1986 and 1987 on the Southeast Shoal of the Grand Bank. The data were collected from moored current meters, thermistor chains, thermographs,and satellite communicating surface pressure/temperature buoys. Geostrophic winds computed by the Atmospheric Environment Service are also presented.

The presentation takes the form of record and monthly means, total and low frequency standard deviations, time series of the raw data and low pass filtered data, progressive vector diagrams and tidal analyses for current records, and spectra of all time series.

RÉSUMÉ

Ross, C.K., J.W. Loder and M.J. Graça. 1988. Moored current and hydrographic measurements on the Southeast Shoal of the Grand Bank, 1986 and 1987. Can. Data Rep. Hydrogr. Ocean Sci. No. 71: vi + 132 pp.

Les auteurs décrivent du point de vue statistique et géographique les données recueillies à l'amarrage pendant l'été, en 1986 et en 1987, sur le haut-fond sud-est du Grand Bank. Les données ont été recueillies au moyen de courantomètres amarrés, de chaînes de thermistances, de thermographes et de bouées de température/pression de surface reliées par satellite. Les auteurs décrivent aussi les vents géostrophiques calculés par le Service de l'environnement atmosphérique.

Le document contient les moyennnes mensuelles et extrêmes, les écarts-types totaux et de faible fréquence, les séries temporelles des données brutes et les données après filtrage passe-bas, les diagrammes vectoriels évolutifs et les analyses de la marée pour les dossiers de courant, ainsi que les spectres de toutes les séries temporelles.

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Introduction

The climatological temperature distribution (fig. 1) shows that, during summer, the warmest bottom water on the entire Grand Bank occurs over the Southeast Shoal. In 1986, the Physical and Chemical Sciences Branch of the Department of Fisheries and Oceans initiated a physical oceanographic field study to describe the seasonal evolution of the bottom temperature feature, identify its origin, and infer the horizontal and vertical exchange rates over the Shoal from a heat budget for the feature's evolution.

In 1986 a pilot program (fig. 2) was conducted consisting of a current meter and thermistor chain mooring and surface temperature buoy near the centre of the Shoal, and Ryan thermograph moorings to the west and east. The mooring program was expanded in 1987 (fig. 2) to include current meter moorings to the west and east, Ryan thermograph moorings to the north and south, as well as the current meter and thermistor chain mooring and surface temperature buoy near the Shoal's centre.

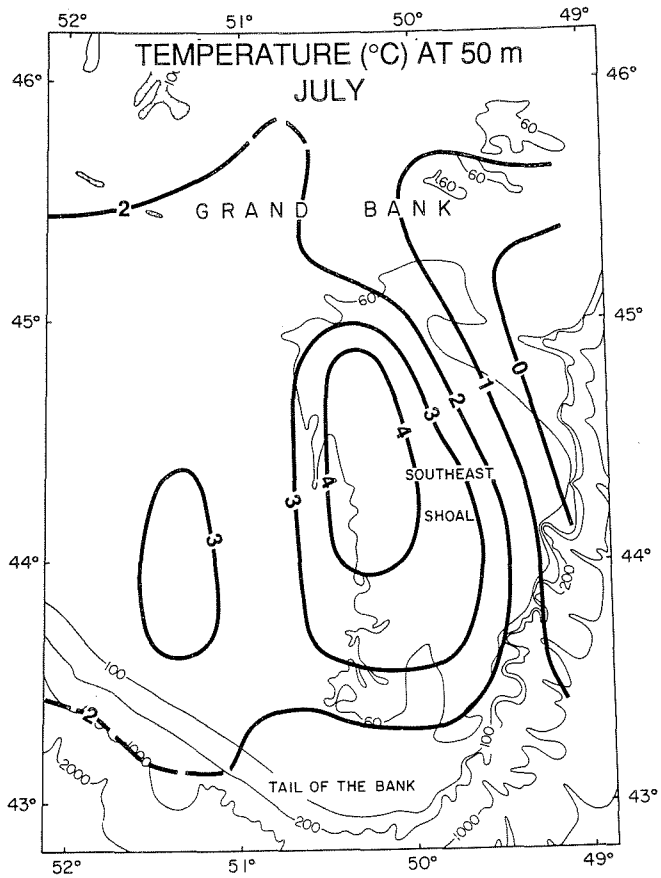


Figure 1. Climatological temperature distribution on the southern Grand Bank in July. Contours are based on the MEDS long-term monthly means for 1/2 x 1/2 degree areas.

TABLE 1

Summary of mooring positions, depths and data return periods for all moored measurements made as part of the Southeast Shoal Exchange Study in 1986 and 1987. The instruments used were: Aanderaa current meters (CM), Aanderaa thermistor chains (TC), Hermes/ARGOS surface buoy (AR), and Ryan thermographs (RT). The periods of good data return for some parameters are less than those indicated for the instrument.

MOORING NUMBER	LATITUDE (N)	LONGITUDE (W)	WATER DEPTH	INSTRUMENT TYPE	INSTRUMENT DEPTH	DATA RETURN PERIOD (dd.mm)
1986:						
774	44 14.4	50 04.2	55	AR	0	18.04-17.10
				CM	20	18.04-03.08
				CM	45	18.04-17.10
				TC	22-52	18.04-17.10
775	44 14.4	50 45.6	65	RT	14	18.04-12.05
				RT	40	18.04-06.09
				RT	65	18.04-16.10
776	44 14.4	49 30.0	49	RT	13	18.04-21.08
				RT	39	18.04-20.08
				RT	49	18.04-13.10
1987:						
830	44 16.0	50 05.3	54	AR	0	03.05-18.10
				CM	11	03.05-02.10
				CM	44	03.05-18.10
				TC	12-42	03.05-18.10
				RT	54	04.05-18.10
831	44 14.9	50 58.8	72	CM	14	03.05-19.10
				CM	47	03.05-19.10
				RT	72	05.05-04.10
832	44 13.3	49 19.5	55	CM	12	04.05-18.10
				CM	45	04.05-18.10
				RT	55	05.05-21.08
833	45 00.0	50 03.9	59	RT	12	Nil
				RT	59	05.05-18.10
834	43 30.3	50 05.7	55	RT	12	Nil
				RT	55	Nil

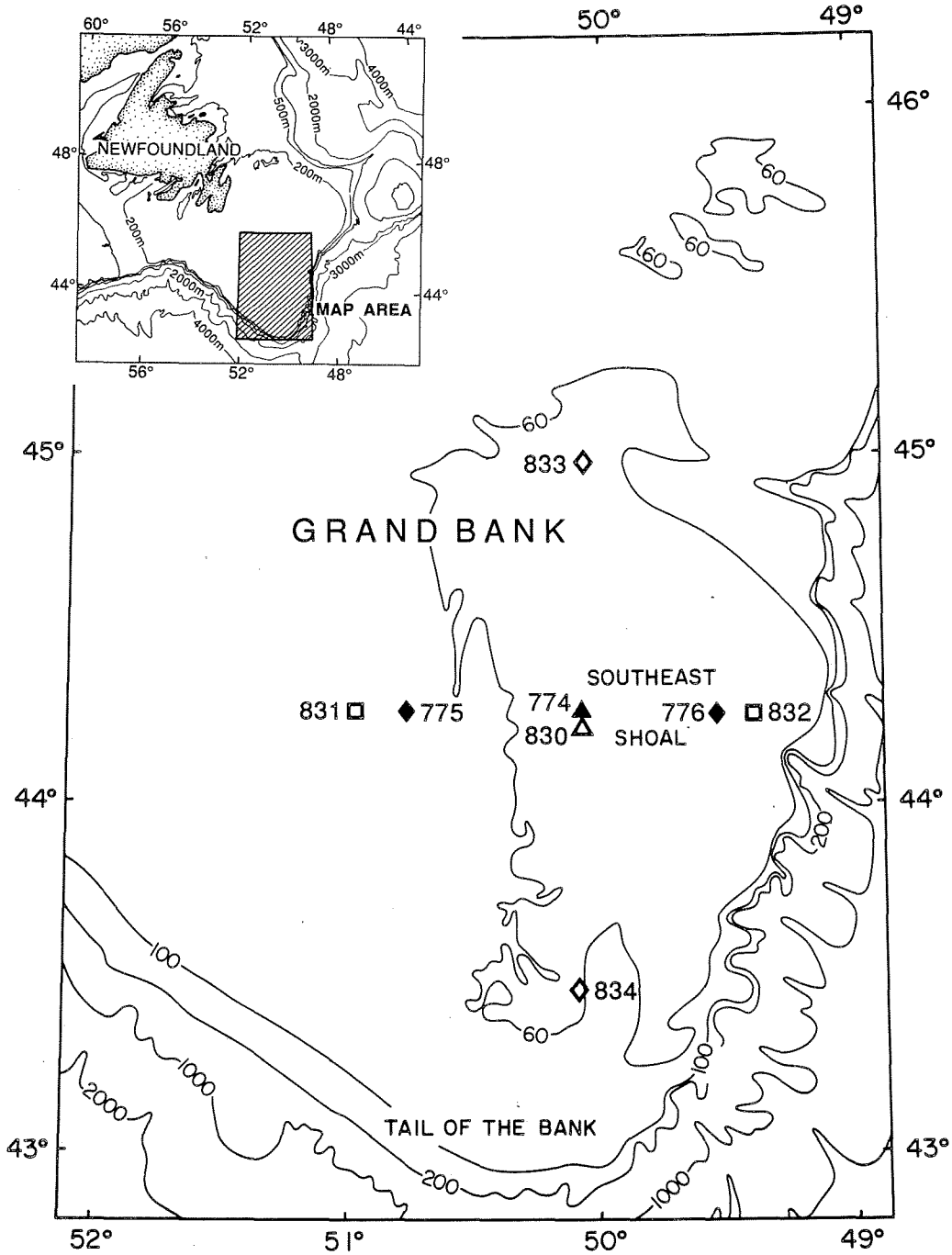


Figure 2. Map showing mooring sites on the Southeast Shoal of the Grand Bank. Closed symbols denote 1986 sites and open symbols 1987 sites.

Mooring Locations

The moorings for the Southeast Shoal experiments were laid out as shown in Table 1 and Figure 2. Each current meter mooring location was protected by a triangular array of surface guard buoys. Single guard buoys were used as the carrier for the Ryan thermographs.

Instrumentation

Current meters: all current meters used were Aanderaa RCM5's fitted with paddle wheel rotors. The instruments recorded pressure (not presented in this data report) temperature, current speed, current direction and conductivity, i.e. salinity at 30-minute intervals. The manufacturer quotes accuracies for this instrument as: time within ±2 s/d; temperature ±0.15°C with a response time of 12 s; current speed ±1 cm/s with a threshold of 1.5 cm/s; current direction ±5° for speeds above 5 cm/s and tilt less than 12° from horizontal; and conductivity ±0.025 mmho/cm. Each of the instruments had their compasses calibrated prior to deployment and CTD stations were occupied near the moorings to provide a check on temperature and give a calibration for salinity.

Thermistor chains: both thermistor chains were Aanderaa TR2 chains with a quoted accuracy of ±0.15°C with a time response of 3.5 min.

Thermographs: Ryan Thermographs Model J were used to acquire additional temperature time series. These instruments record internally on a strip chart. The instruments are calibrated in-house and the data are accurate to ±0.5°C.

ARGOS buoys: These data platforms are manufactured by Hermes Electronics and are a modification of the FGGE drifting buoys. They are equipped with a Paroscientific barometer and a temperature sensor inside the hull of the buoy. Data are relayed via satellite and the ARGOS data centre. The barometric pressure is believed to be accurate to ±1 mbar and the temperature sensor is more accurate than a knowledge of exactly what it is measuring. During daytime periods the instrument is warmed above sea surface temperature and it is possible that cold air temperatures could

lower the buoy temperature below sea surface temperature.

Geostrophic winds: are computed by the Atmospheric Environment Service (pressures from FNOC) and presented for the grid point 44 06N, 50 30W which is taken to be representative of Southeast Shoal. The time series has a sampling interval of 6 hours.

Data Processing

Current meters: the data recorded by the Aanderaa instruments were translated to computer readable files. The direction data are corrected by applying the calibration data from the compass swing and also corrected for the local magnetic variation as given on navigational charts for the area. The current speed is computed by applying a linear relationship to the encoder value according to the data supplied by the manufacturer. The current velocity is determined by taking the direction as the arithmetic mean of the direction data at the beginning and end of the speed integration period. The average speed/direction is then time-stamped at the mid-point of the cycle. Temperature is computed by applying a cubic polynomial fitted to the in-house calibration. The pressure and conductivity use linear relationships. Salinity according to the Practical Salinity Scale of 1978 was computed using temperature, pressure and conductivity with no allowance made for time constant mis-matches. Adjustments indicated by CTD calibration stations were applied as an added constant. The density anomaly (σ_t) refers to the anomaly of the 1980 Equation of State from 1000 kg/m^3.

Time series of north (v) and east (u) components of velocity were computed. Editing involved range specification, median filtering, spike removal and manual inspection. There was serious data degradation due to encoder problems in most of the 1987 data. This is very noticeable in both records at mooring 831 and the shallow instrument on 832. Portions of some of the time series were deleted when it was felt that no useful information could be recovered. The deepest instruments at the central mooring site (45 m on mooring 774 and 44 m on 830) were subject to excessive

biological fouling. Tidal analysis on 5-day blocks of the current data was used to identify the onset of significant degradation of the speed sensor. Both these records were truncated on this basis.

Thermistor chains: a cubic polynomial was fitted to the manufacturer's calibration for the temperature sensors. Editing similar to that for the current meters was performed but the signals were much better and required little interference.

Thermographs: The strip chart records were translated, using a digitizing tablet, to 4-hourly values in computer readable format. Constant offsets determined from comparison with CTD and XBT profiles were applied as appropriate.

ARGOS buoy: these data were received from Service Argos for the 1986 records and until the end of August 1987. After that time the data were received from a 'local user terminal' operated by AES, Downsview. For this reason there are fewer data points and occasional data gaps after day 244 of 1987. The data received were used to recover an original time series of 6-hourly data. Because the satellite recovered data is not equi-spaced the data received was interpolated to an equi-spaced time series by linear interpolation from the data point before and after. Gaps greater than 24 h were not interpolated across.

Data Presentation

Each time series is treated in two modes; a) the original time series at its nominal sampling interval (30 min for current meters, 60 min for thermistor chains, 4 h for thermographs, 6 h for ARGOS buoy and geostrophic winds) and, b) a low pass filtered time series. The low pass filter is a Cartwright filter that passes more than 95% of the input power for periods longer than 40 h, 50% at 31 h and less than 1% for periods less than 24 h. All the resulting time series are subsampled every 6 h.

A table of statistics is given for each record. In this table are the number of points, mean, standard deviation of the original time series (Σ_1) and the standard deviation of the low pass filtered

time series (Σ_2). For the current meter records the density anomaly (σ_t) is computed only for the low pass filtered time series. The same statistics are also given on a monthly basis for each month and each record having a significant number of points.

Time series plots are shown for each record, for the original and then the low pass filtered time series. Current meter data are also shown as progressive vector diagrams, using the unfiltered time series with symbols every 5 days and labelled with year day numbers every 20 days. A stick diagram of velocity vectors is plotted from the low pass filtered time series. A table of the major tidal constituents (K_1, O_1, M_2, S_2, N_2, M_f, M_4, and MS_4) is given for each current record. These constituents are determined from the maximum possible length of record.

Spectra are presented for each time series in two forms: log-log presentation of spectral power against frequency and log-linear presentation of frequency times spectral power against frequency (i.e. energy preserving display). The spectra are computed by using a fast Fourier transform on blocks of data that have had their mean and trends removed, averaging over variable frequency space to give nearly logarithmic spacing and averaging the estimates from each block. The standard error associated with the block to block variability of each spectral estimate is used to give the error estimate shown on each spectral estimate.

Throughout, an attempt has been made to minimize the number of scales used for each presentation so that comparison from record to record may be made.

ACKNOWLEGEMENTS

We would like to thank the many people who helped to collect and present these data; in particular the officers and crew of CSS DAWSON, the technical support within PCS for equipment preparation and operation, the computer systems personnel for writing the software and the data shop for using it, the illustrations section for preparation of some figures and R. Lively for assistance with some of his more esoteric data presentation programs.

ARGOS BUOY

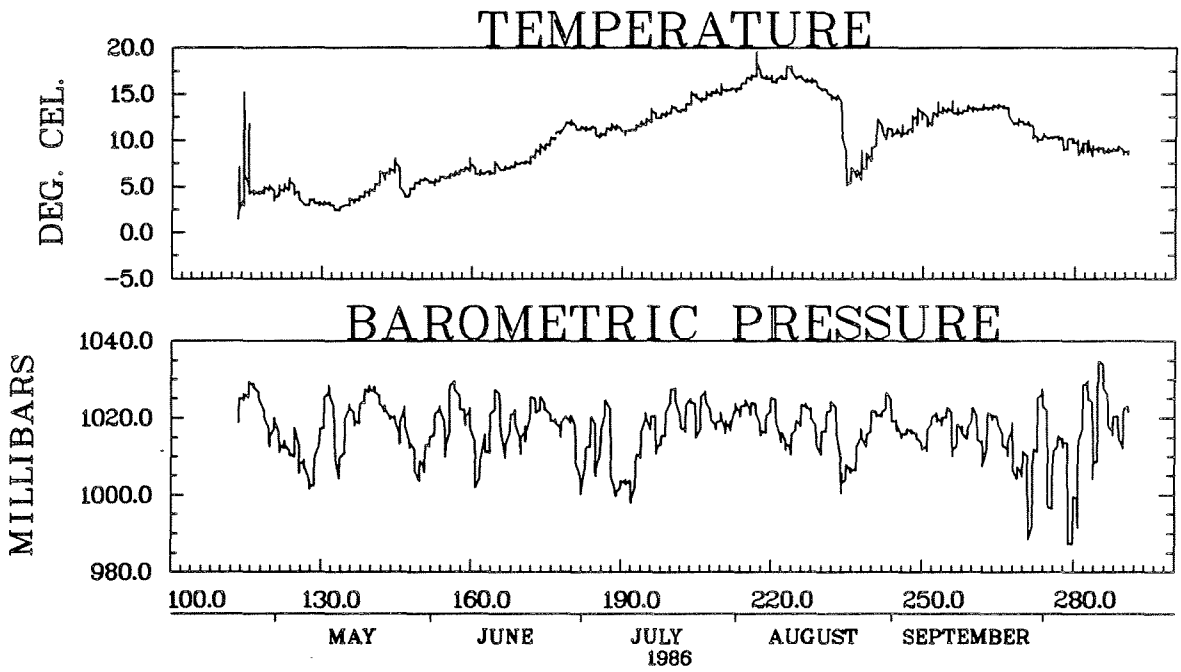
Mooring 774 at surface

(sampling interval irregular and averaged over 6 hours)

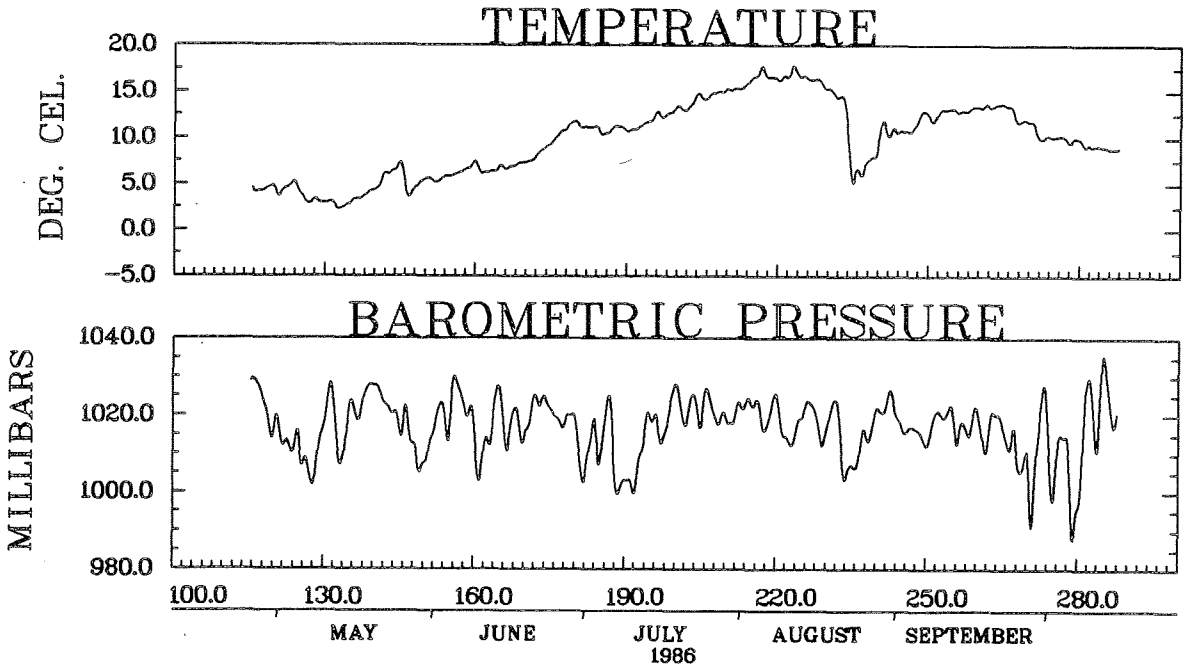
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Sea Surface Temperature (°C)								
(N)	710	32	124	120	124	124	120	66
($\bar{X}$)	9.83	4.66	4.23	7.80	12.74	13.66	12.33	9.35
(Σ_1)	4.12	2.09	1.30	1.95	1.70	3.86	1.14	0.56
(Σ_2)	4.12	0.32	1.28	1.94	1.69	3.85	1.12	0.52
Barometric Pressure (mbar)								
(N)	710	32	124	120	124	124	120	66
($\bar{X}$)	1017.	1023.	1016.	1019.	1016.	1018.	1016.	1015.
(Σ_1)	7.5	4.8	7.3	6.2	7.8	5.8	6.2	11.9
(Σ_2)	7.4	5.4	7.2	6.1	7.7	5.7	6.1	12.5

N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



ARGOS BUOY
SOUTHEAST SHOAL 1986



ARGOS BUOY
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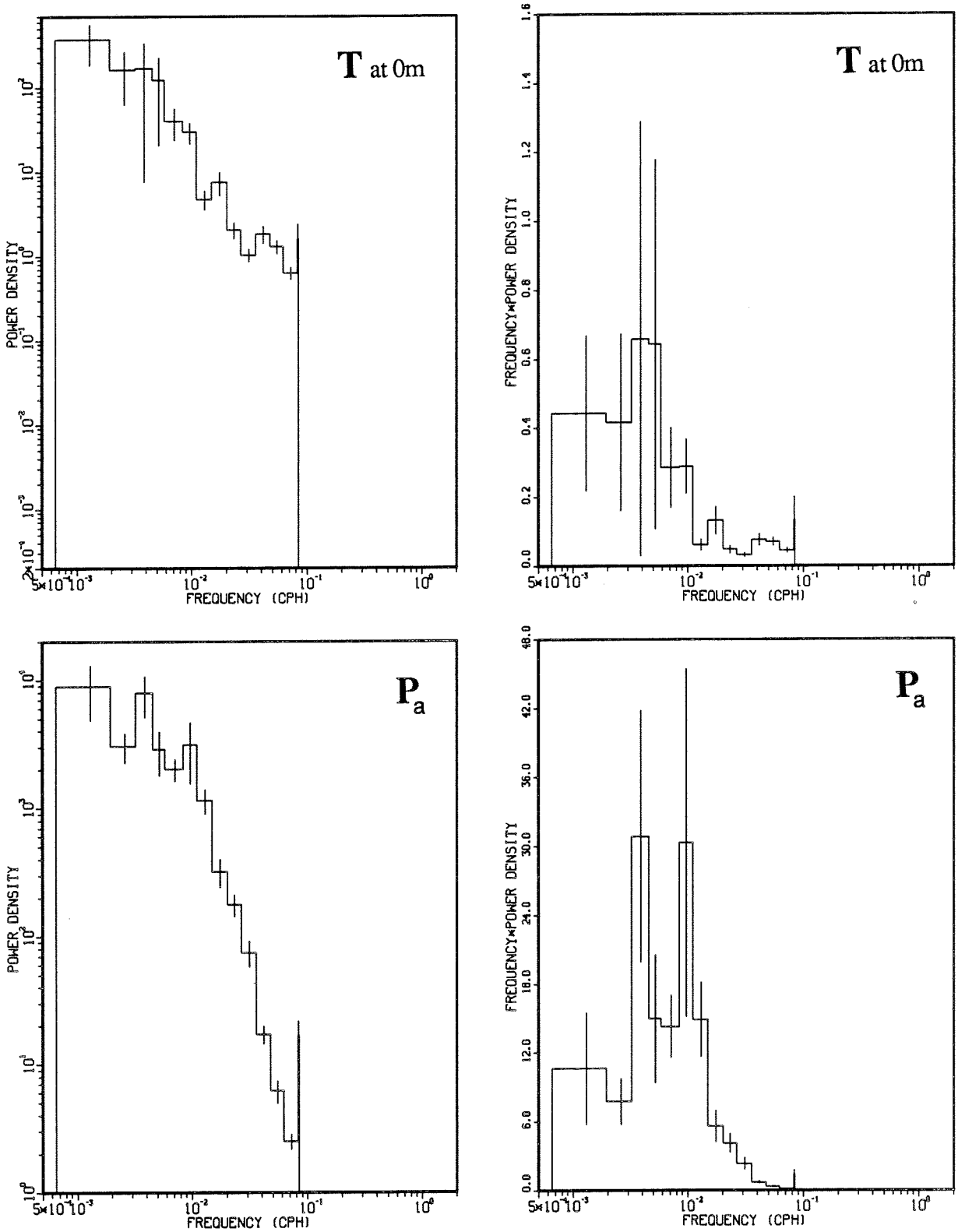


ARGOS BUOY
SOUTHEAST SHOAL 1986

CURRENT METER

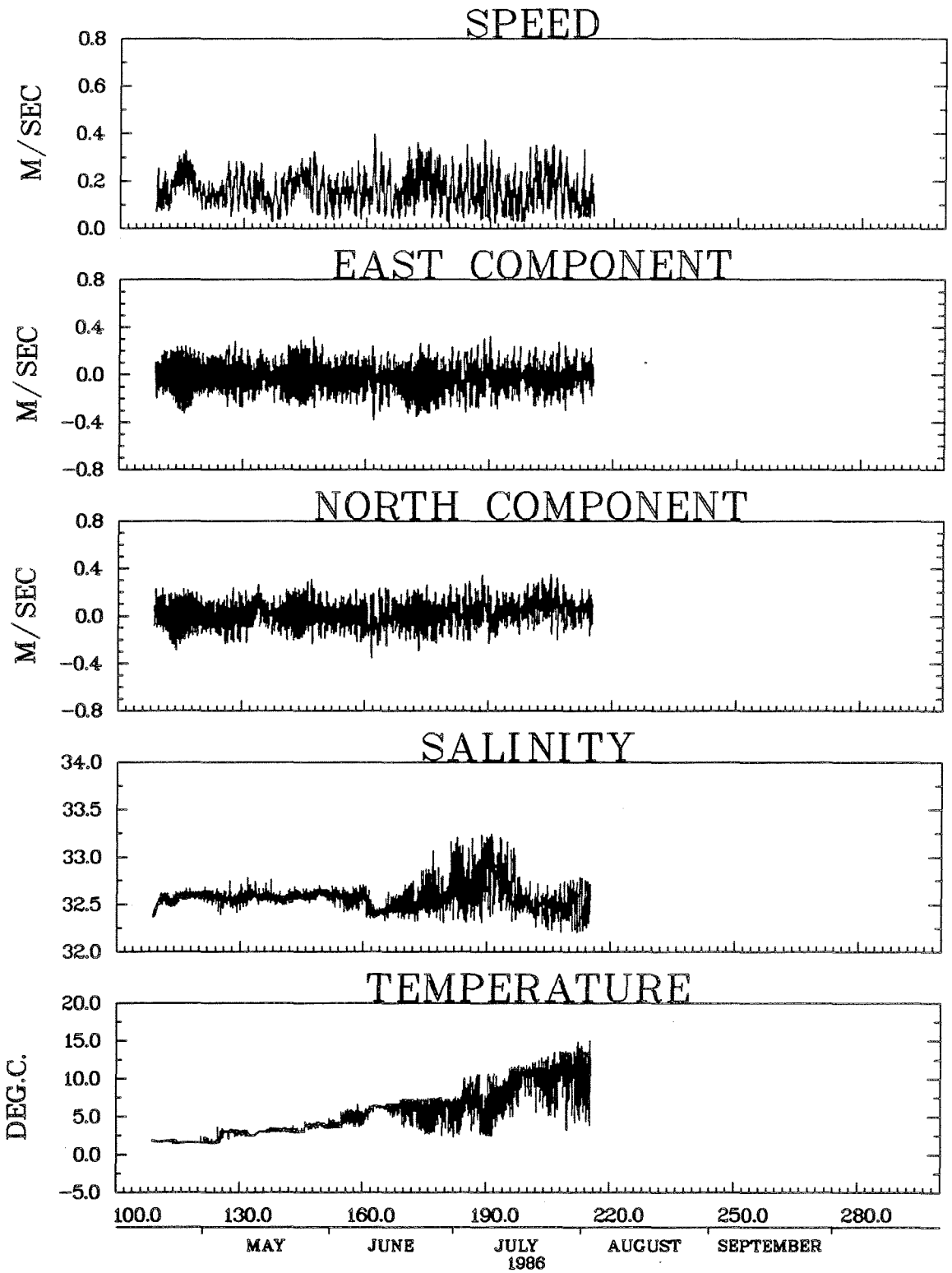
Mooring 774 at 20m

(sampling interval 30 min)

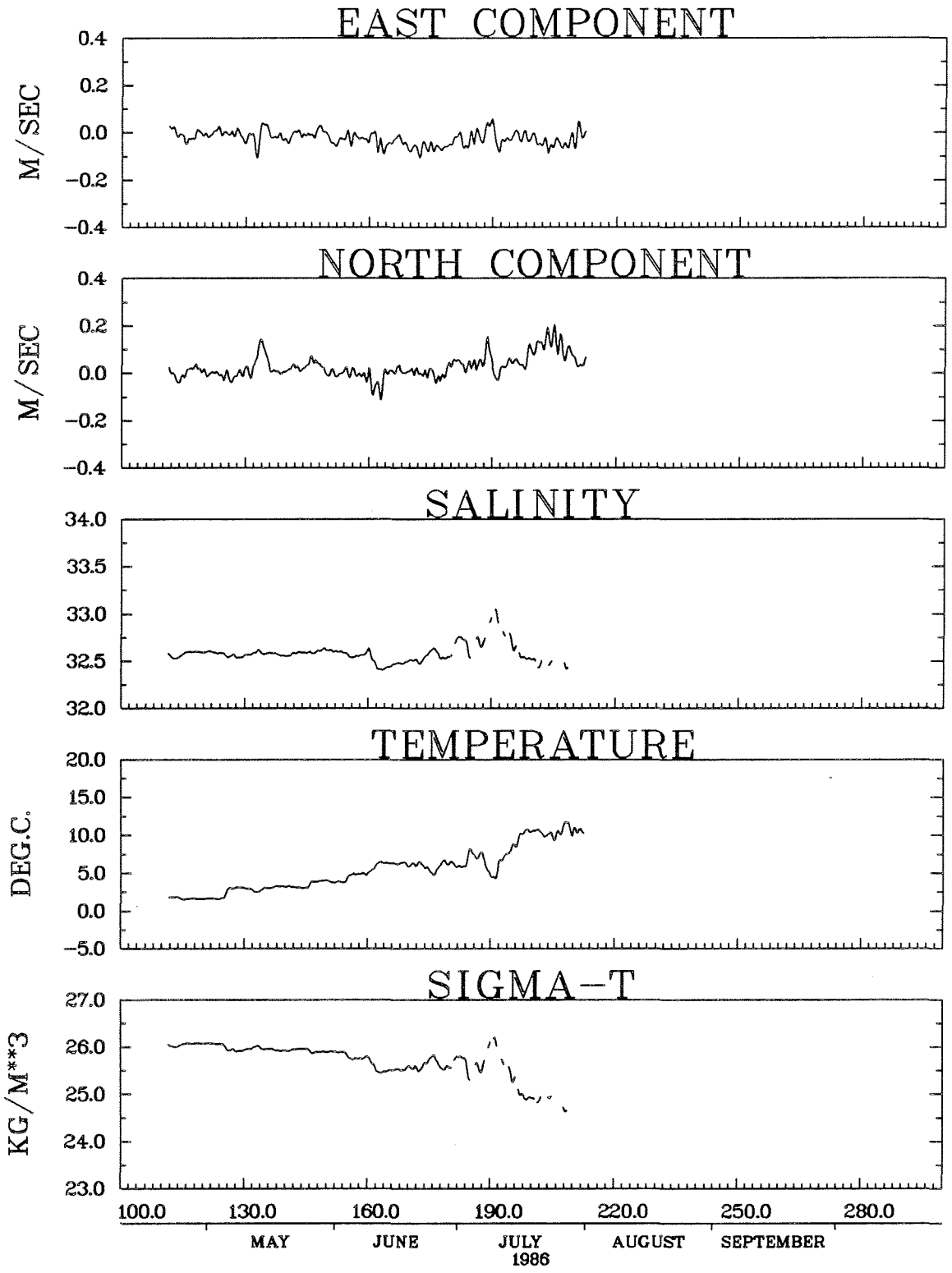
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
East Velocity Component ($m.s^{-1}$)								
(N)	4718	587	1488	1440	1125	78		
($\bar{X}$)	-0.022	-0.009	-0.011	-0.043	-0.022			
(Σ_1)	0.131	0.141	0.130	0.131	0.124			
(Σ_2)	0.030	0.019	0.025	0.025	0.031			
North Velocity Component ($m.s^{-1}$)								
(N)	4718	587	1488	1440	1125	78		
($\bar{X}$)	0.022	0.013	0.019	-0.002	0.059			
(Σ_1)	0.113	0.121	0.109	0.113	0.107			
(Σ_2)	0.048	0.020	0.035	0.031	0.050			
Salinity (PSS78)								
(N)	4331	583	1488	1426	789	45		
($\bar{X}$)	32.57	32.56	32.58	32.53	32.65			
(Σ_1)	0.13	0.06	0.04	0.10	0.23			
(Σ_2)	0.09	0.03	0.02	0.07	0.16			
Temperature (^{o}C)								
(N)	5094	587	1488	1440	1484	95		
($\bar{X}$)	5.38	1.68	2.99	5.62	8.71			
(Σ_1)	3.09	0.12	0.69	1.19	2.63			
(Σ_2)	2.85	0.10	0.66	0.83	2.09			
Sigma-t ($kg.m^3$)								
(N)	349	39	124	118	68			
($\bar{X}$)	25.74	26.05	25.95	25.65	25.33			
(Σ_1)								
(Σ_2)	0.33	0.03	0.06	0.14	0.44			

N: *number of samples in statistics* $\bar{X}$: *mean value*

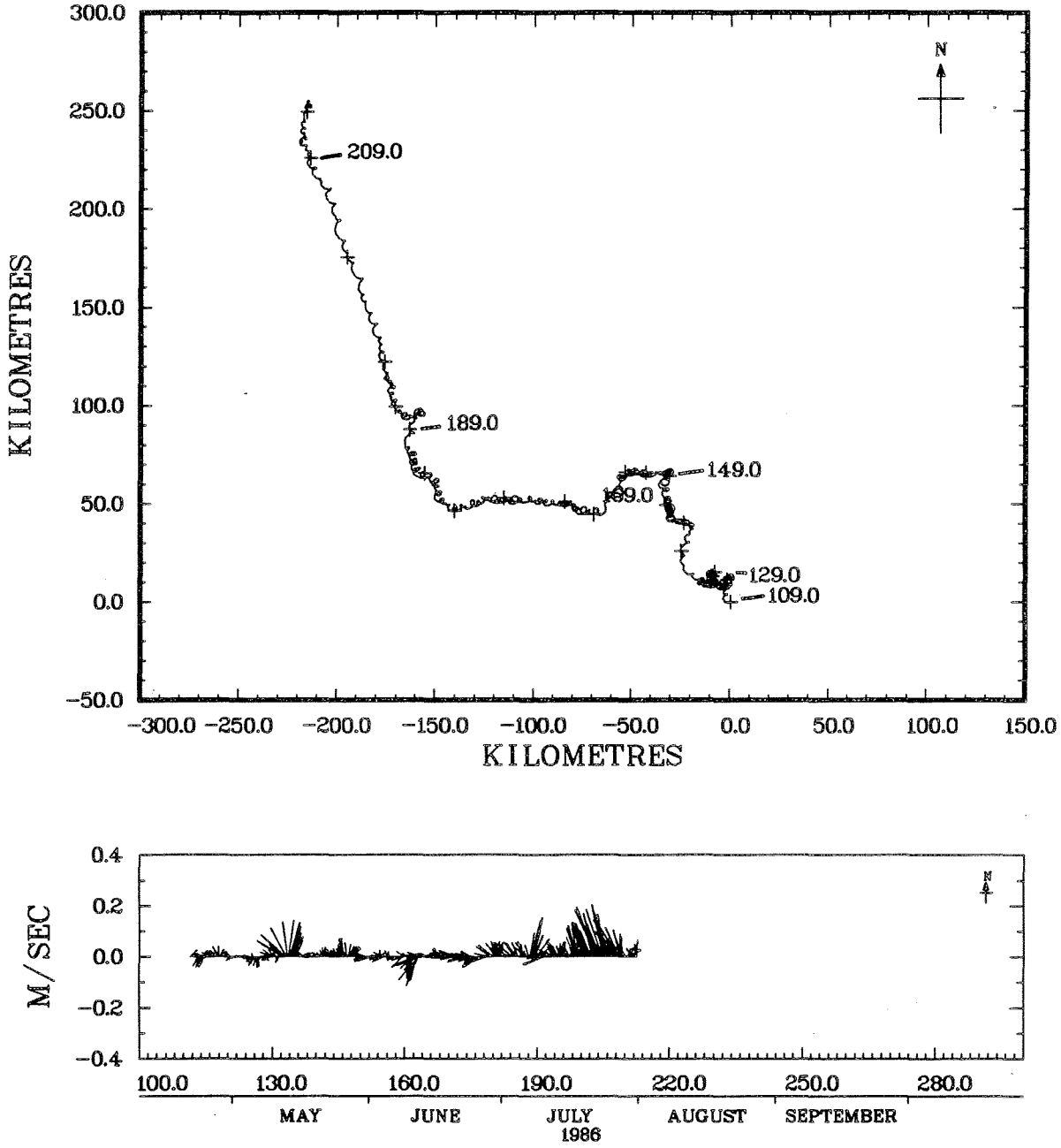
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 774 AT 20M.
SOUTHEAST SHOAL 1986



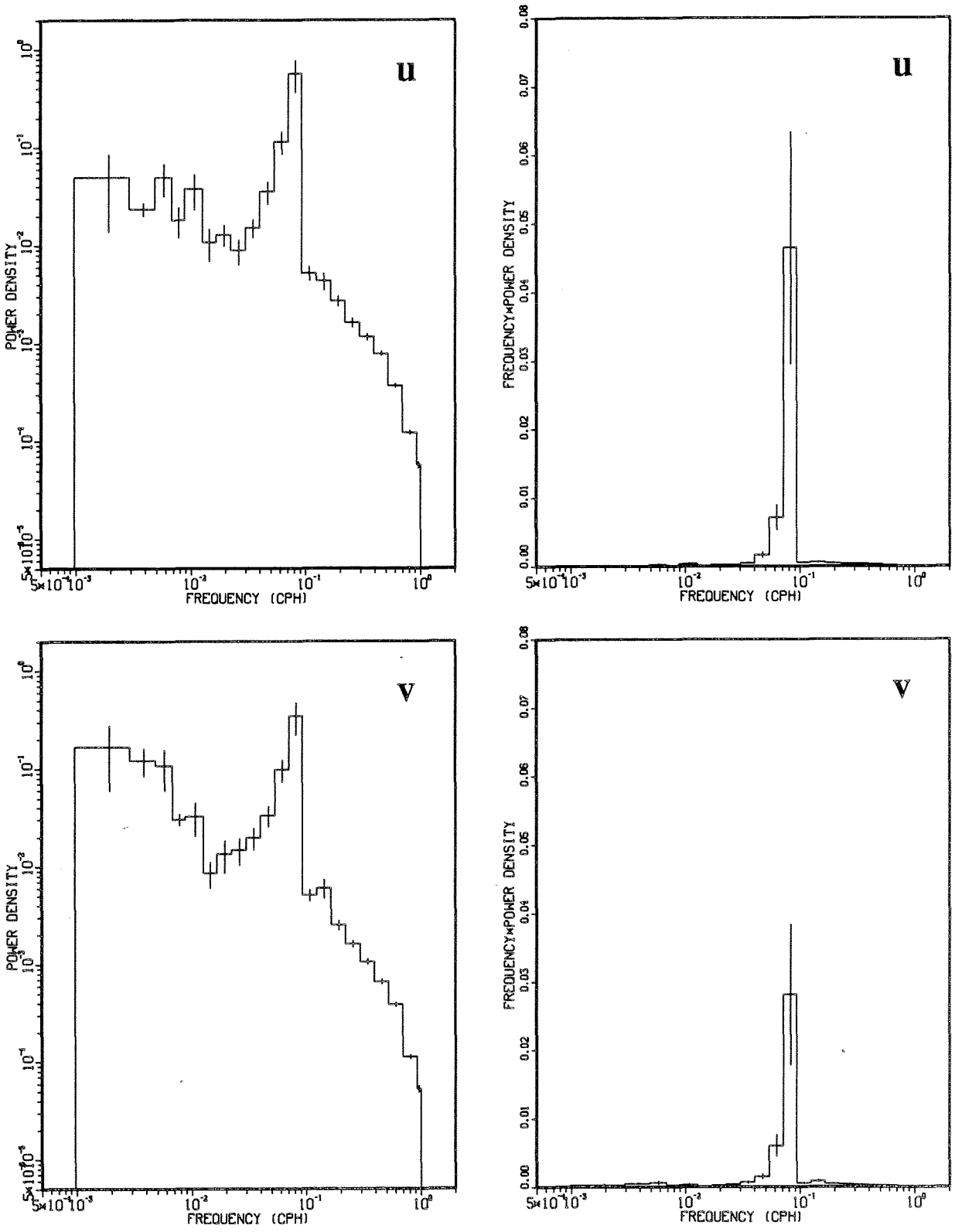
MOORING 774 AT 20M.
SOUTHEAST SHOAL 1986 - LOW PASS



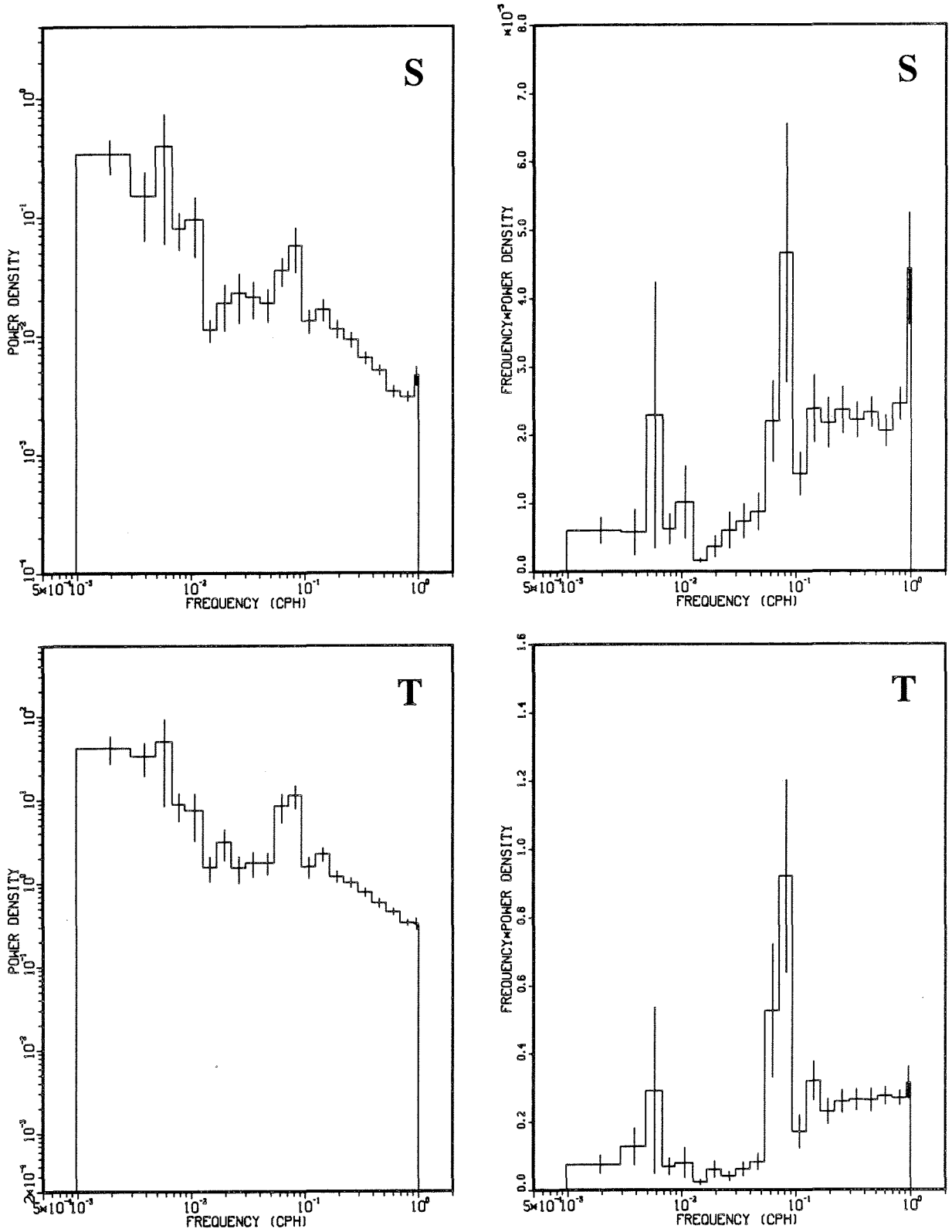
MOORING 774 AT 20M.
SOUTHEAST SHOAL 1986

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	106.5 DAYS CENTERED AT DAY 162, 1986							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(774,020M)	K1	.008	.005	15	122/C	.005	187	.008	113
	O1	.009	.007	10	112/C	.007	190	.009	104
	M2	.150	.115	87	53/C	.150	56	.115	327
	S2	.043	.035	87	73/C	.043	76	.035	347
	N2	.039	.027	75	22/C	.038	32	.028	313
	MF	.007	.003	4	217/A	.003	135	.007	219
	M4	.007	.004	27	156/C	.005	201	.007	141
	MS4	.004	.000	352	155/C	.001	299	.004	155



MOORING 774 AT 20M.
SOUTHEAST SHOAL 1986



MOORING 774 AT 20M.
SOUTHEAST SHOAL 1986

CURRENT METER

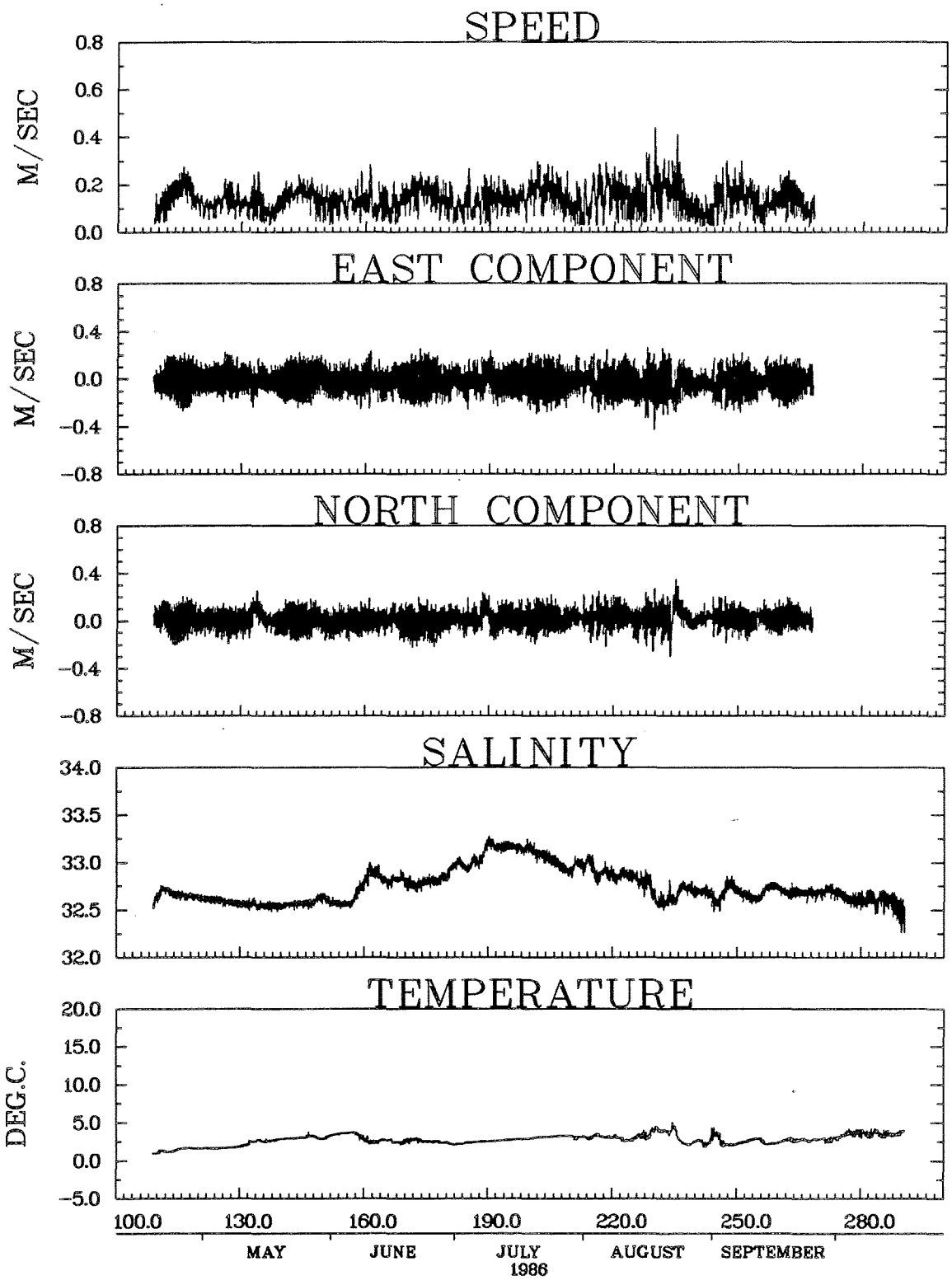
Mooring 774 at 45m

(sampling interval 30 min)

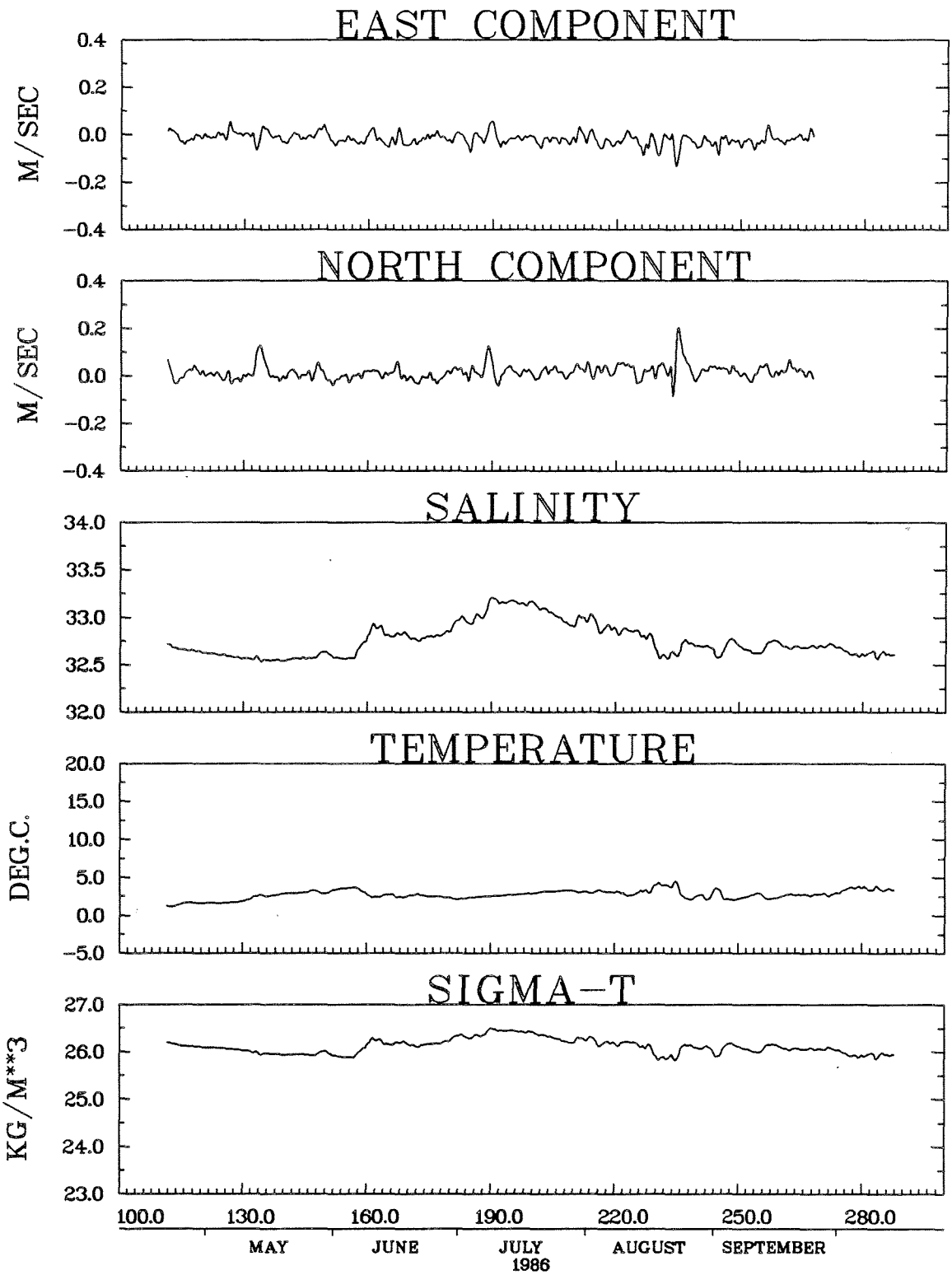
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
East Velocity Component ($m.s^{-1}$)								
(N)	7649	587	1488	1440	1488	1488	1158	
($\bar{X}$)	-0.017	-0.011	-0.003	-0.018	-0.015	-0.031	-0.022	
(Σ_1)	0.116	0.120	0.107	0.111	0.119	0.122	0.115	
(Σ_2)	0.024	0.018	0.021	0.019	0.023	0.029	0.021	
North Velocity Component ($m.s^{-1}$)								
(N)	7649	587	1488	1440	1488	1488	1158	
($\bar{X}$)	0.017	0.017	0.010	0.003	0.021	0.031	0.019	
(Σ_1)	0.090	0.096	0.087	0.086	0.089	0.098	0.079	
(Σ_2)	0.031	0.024	0.032	0.019	0.028	0.042	0.018	
Salinity (PSS78)								
(N)	8722	582	1488	1440	1488	1488	1440	796
($\bar{X}$)	32.75	32.66	32.58	32 77	33 06	32.78	32.69	32.60
(Σ_1)	0.18	0.04	0.03	0.11	0.09	0.13	0.05	0.08
(Σ_2)	0.18	0.03	0.03	0.11	0.09	0.12	0.05	0.03
Temperature (^{o}C)								
(N)	8727	587	1488	1440	1488	1488	1440	796
($\bar{X}$)	2.73	1.40	2.47	2.77	2.81	3.09	2.61	3.50
(Σ_1)	0.65	0.25	0.58	0.47	0.34	0.61	0.37	0.32
(Σ_2)	0.61	0.19	0.58	0.46	0.33	0.59	0.34	0.23
Sigma-t ($kg.m^3$)								
(N)	706	39	124	120	124	124	120	55
($\bar{X}$)	26.11	26.20	25.99	26.13	26.36	26.10	26.07	25.94
(Σ_1)								
(Σ_2)	0.15	0.03	0.06	0.13	0.08	0.13	0.06	0.04

N: *number of samples in statistics* $\bar{X}$: *mean value*

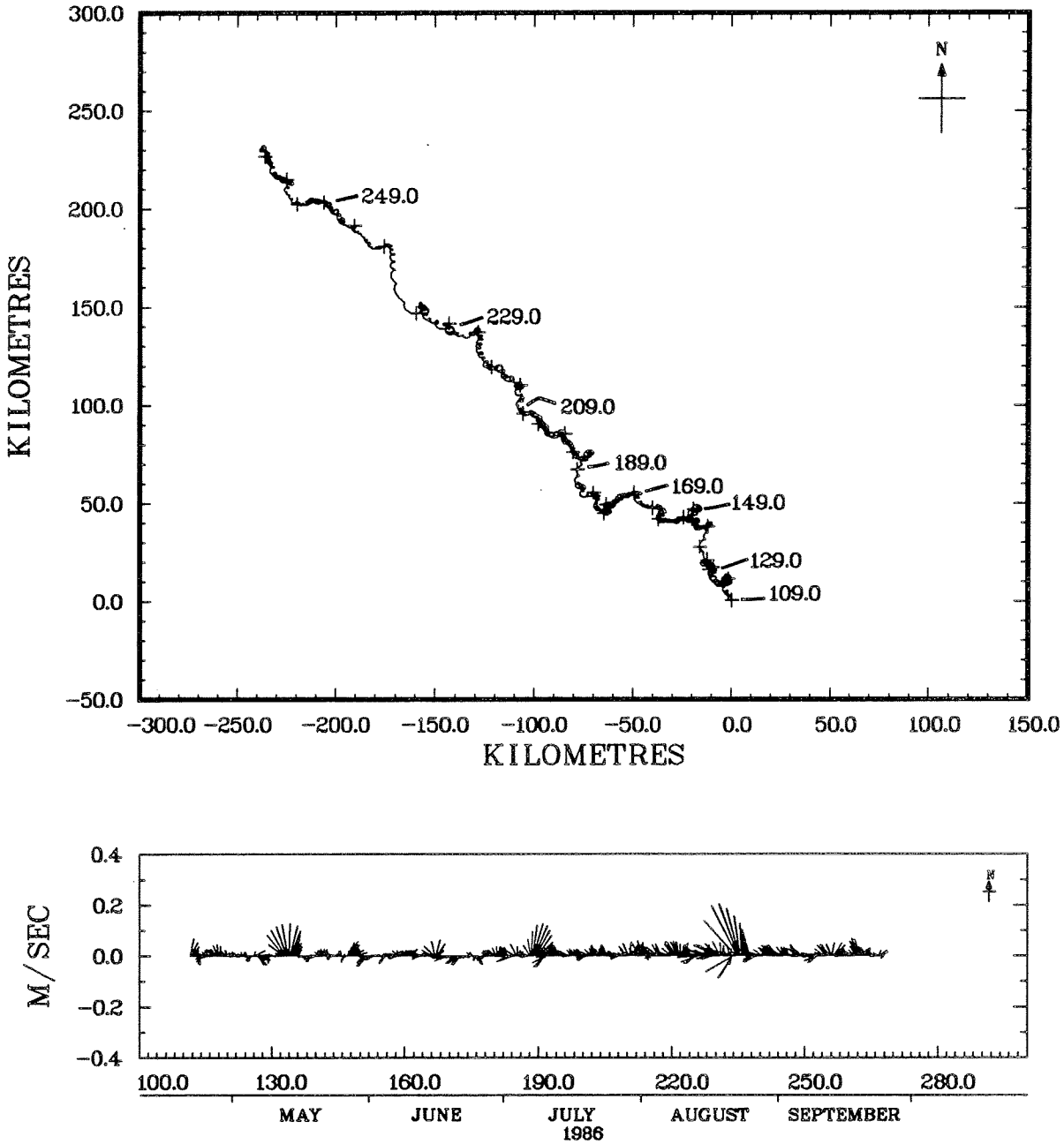
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 774 AT 45M.
SOUTHEAST SHOAL 1986



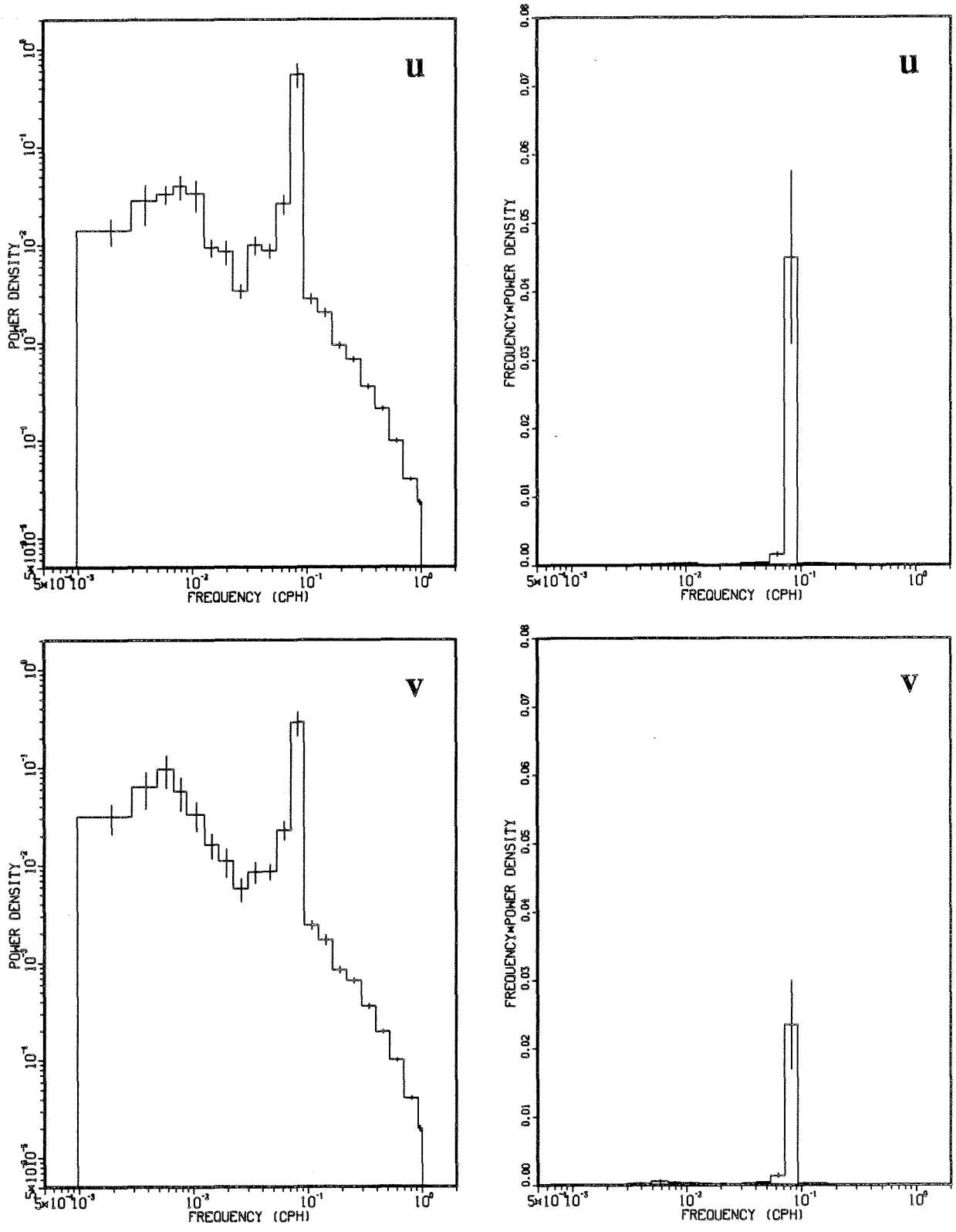
MOORING 774 AT 45M.
SOUTHEAST SHOAL 1986 - LOW PASS



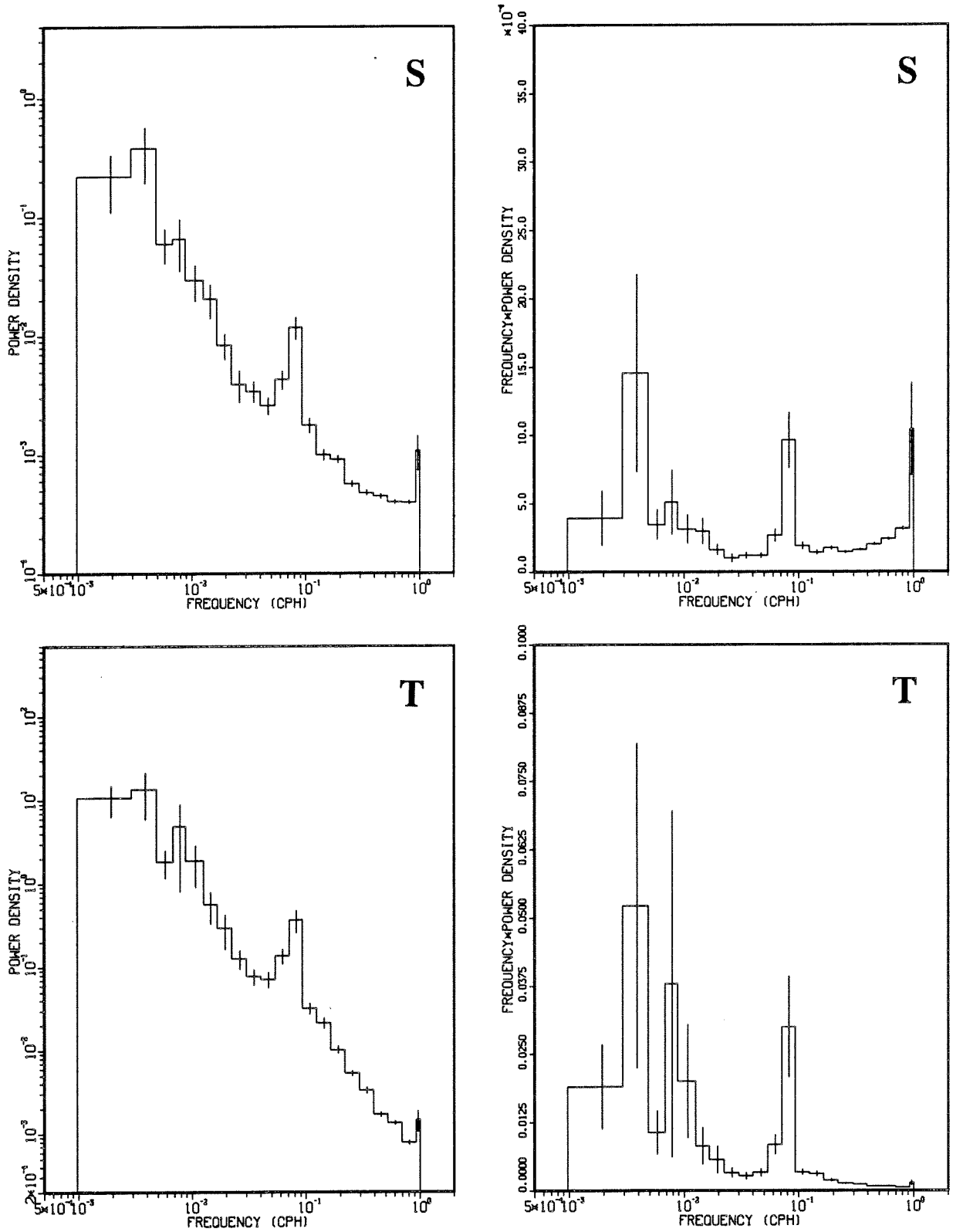
MOORING 774 AT 45M.
SOUTHEAST SHOAL 1986

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	159.3 DAYS CENTERED AT DAY 188, 1986							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
	K1	.008	.006	318	92/C	.007	231	.007	128
(774,045M)	O1	.010	.008	107	234/C	.010	221	.008	122
	M2	.148	.104	99	49/C	.147	43	.105	306
	S2	.051	.035	116	60/C	.048	41	.039	295
	N2	.035	.024	95	28/C	.035	25	.025	291
	MF	.005	.001	7	269/A	.001	210	.005	270
	M4	.004	.001	134	255/C	.003	241	.003	90
	MS4	.001	.001	79	351/A	.001	346	.001	60



MOORING 774 AT 45M.
SOUTHEAST SHOAL 1986



MOORING 774 AT 45M.
SOUTHEAST SHOAL 1986

THERMISTOR CHAIN

Mooring 774

(sampling interval 60 min)

	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature at 22m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	4.99	1.71	2.97	4.59	5.16	6.09	5.39	8.82
(Σ_1)	2.48	0.11	0.67	1.29	2.34	2.42	2.08	1.15
(Σ_2)	2.17	0.09	0.65	0.92	1.52	1.72	1.84	0.80
Temperature at 25m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	4.00	1.70	2.86	3.80	3.16	4.44	4.19	8.58
(Σ_1)	2.03	0.10	0.65	1.13	0.69	1.42	1.92	1.31
(Σ_2)	1.92	0.07	0.62	0.99	0.53	0.97	1.81	0.87
Temperature at 28m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	3.57	1.64	2.74	3.43	2.89	3.80	3.47	7.79
(Σ_1)	1.75	0.13	0.63	0.88	0.38	0.97	1.57	1.48
(Σ_2)	1.67	0.05	0.60	0.83	0.37	0.83	1.50	0.76
Temperature at 31m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	3.18	1.57	2.62	3.18	2.84	3.51	3.01	5.75
(Σ_1)	1.23	0.17	0.62	0.67	0.35	0.81	0.99	1.47
(Σ_2)	1.10	0.07	0.60	0.63	0.35	0.72	0.86	0.78

N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

THERMISTOR CHAIN (con't)

Mooring 774

(sampling interval 60 min)

	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature at 34m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.90	1.48	2.53	2.96	2.81	3.30	2.76	4.18
(Σ_1)	0.82	0.20	0.61	0.50	0.34	0.72	0.56	0.84
(Σ_2)	0.73	0.13	0.59	0.45	0.34	0.67	0.52	0.37
Temperature at 37m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.80	1.44	2.50	2.87	2.81	3.19	2.69	3.66
(Σ_1)	0.69	0.22	0.60	0.46	0.34	0.67	0.47	0.37
(Σ_2)	0.65	0.18	0.59	0.44	0.33	0.65	0.44	0.22
Temperature at 40m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.75	1.42	2.48	2.81	2.82	3.12	2.64	3.54
(Σ_1)	0.66	0.24	0.59	0.47	0.34	0.64	0.41	0.34
(Σ_2)	0.62	0.19	0.59	0.45	0.33	0.62	0.37	0.23
Temperature at 43m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.72	1.41	2.47	2.76	2.82	3.07	2.59	3.46
(Σ_1)	0.64	0.25	0.58	0.48	0.33	0.62	0.35	0.32
(Σ_2)	0.60	0.19	0.58	0.47	0.33	0.60	0.33	0.22

N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

THERMISTOR CHAIN (con't)

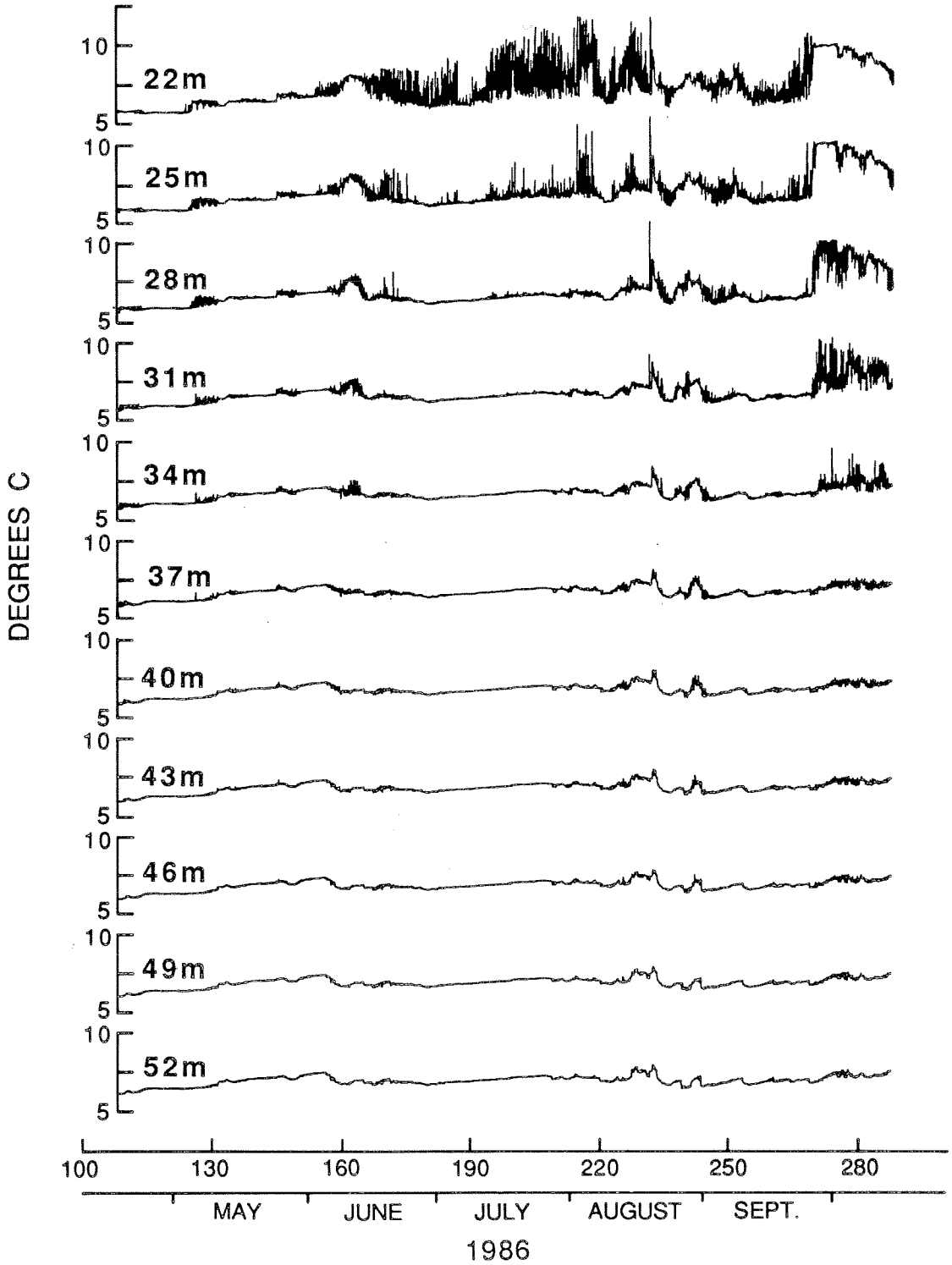
Mooring 774

(sampling interval 60 min)

	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature at 46m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.70	1.43	2.47	2.74	2.82	3.02	2.56	3.41
(Σ_1)	0.63	0.26	0.57	0.48	0.33	0.61	0.32	0.31
(Σ_2)	0.59	0.20	0.57	0.48	0.33	0.60	0.30	0.23
Temperature at 49m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.69	1.43	2.48	2.73	2.83	2.98	2.54	3.39
(Σ_1)	0.62	0.26	0.57	0.49	0.33	0.61	0.29	0.29
(Σ_2)	0.58	0.20	0.57	0.48	0.33	0.60	0.28	0.23
Temperature at 52m (°C)								
(N)	4364	294	744	720	744	744	720	398
($\bar{X}$)	2.64	1.40	2.45	2.68	2.79	2.91	2.50	3.33
(Σ_1)	0.61	0.25	0.57	0.49	0.32	0.62	0.28	0.28
(Σ_2)	0.58	0.20	0.57	0.48	0.32	0.61	0.27	0.22

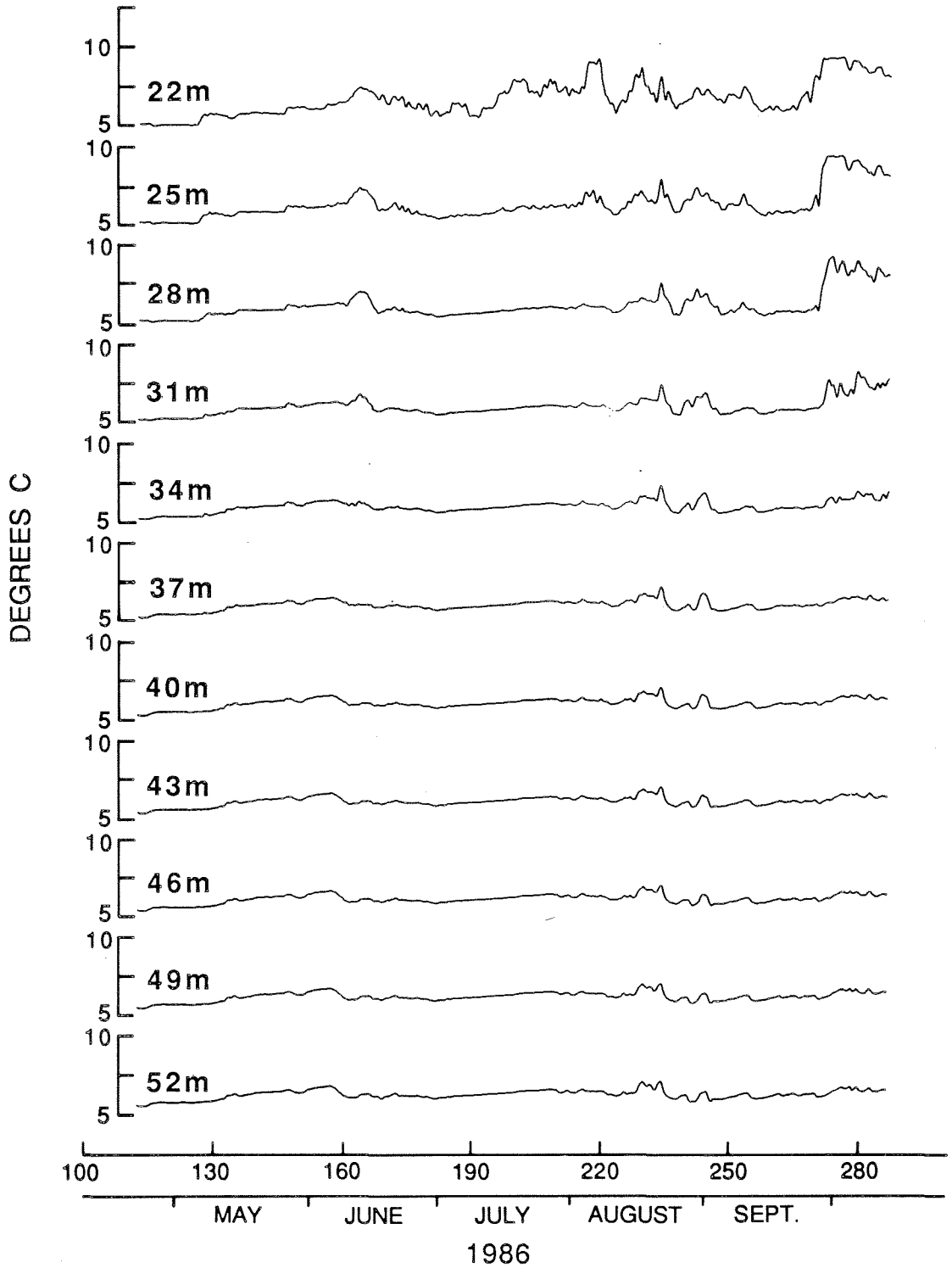
N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



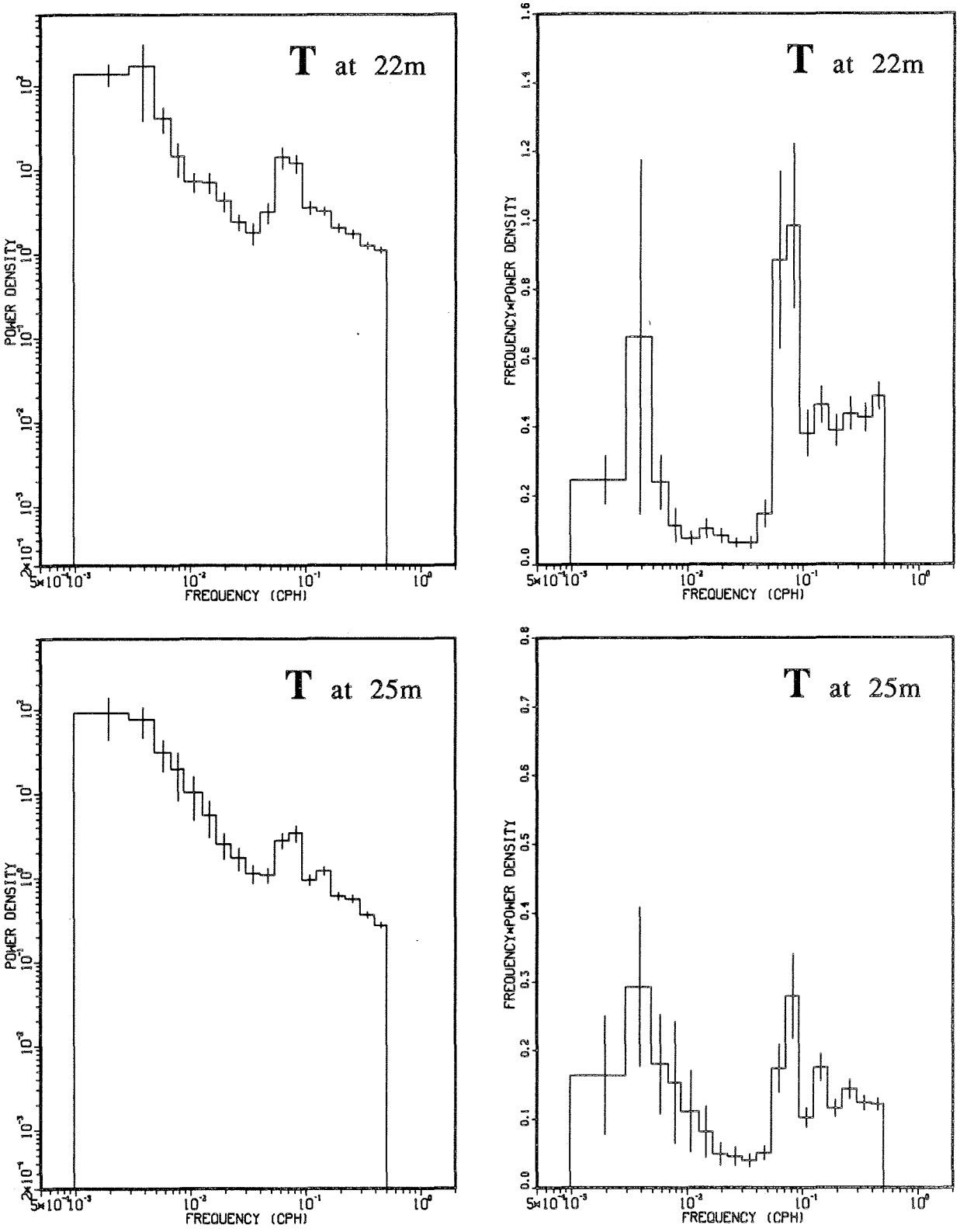
TEMPERATURE

MOORING 774; THERMISTOR - CHAIN
SOUTHEAST SHOAL 1986

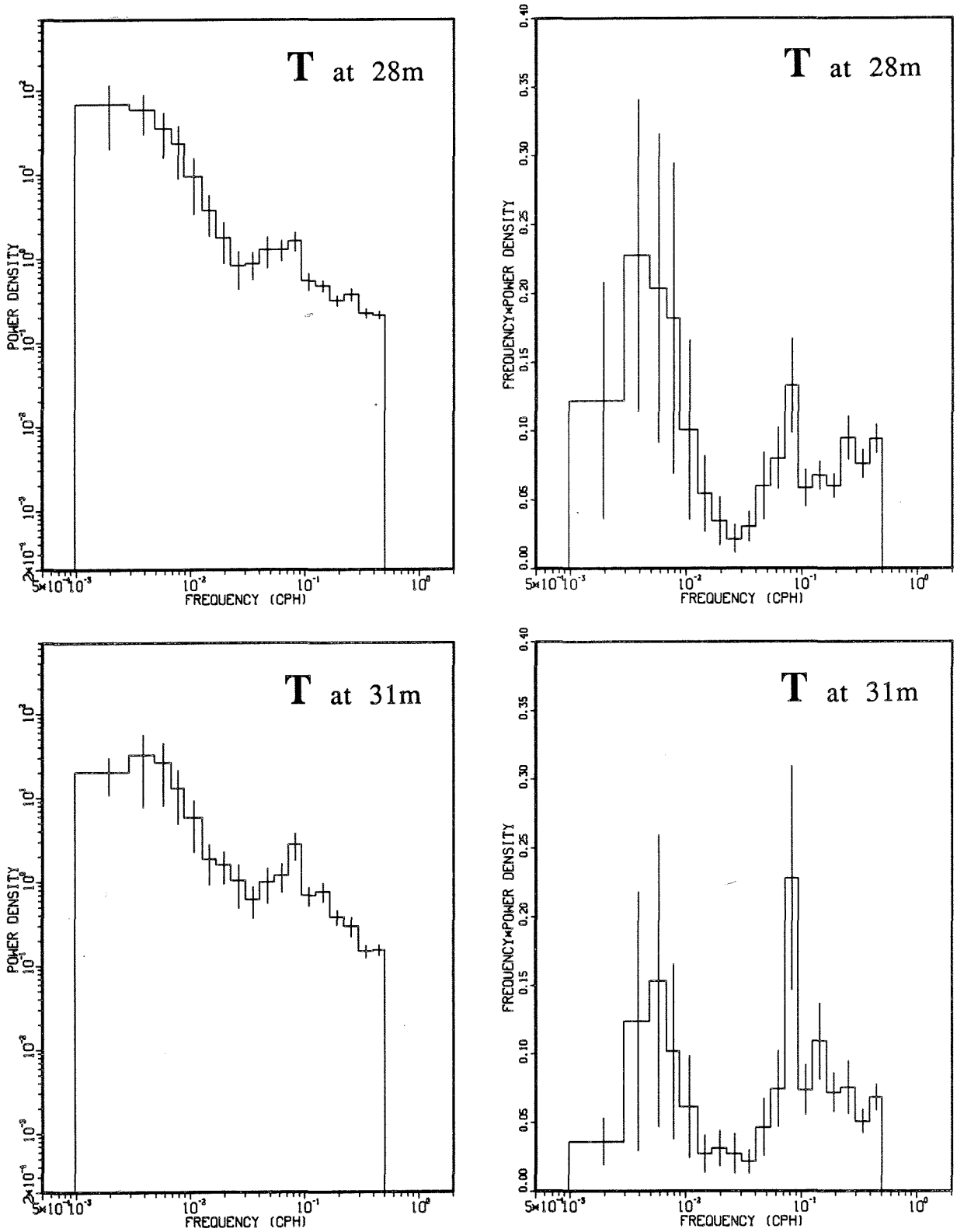


TEMPERATURE

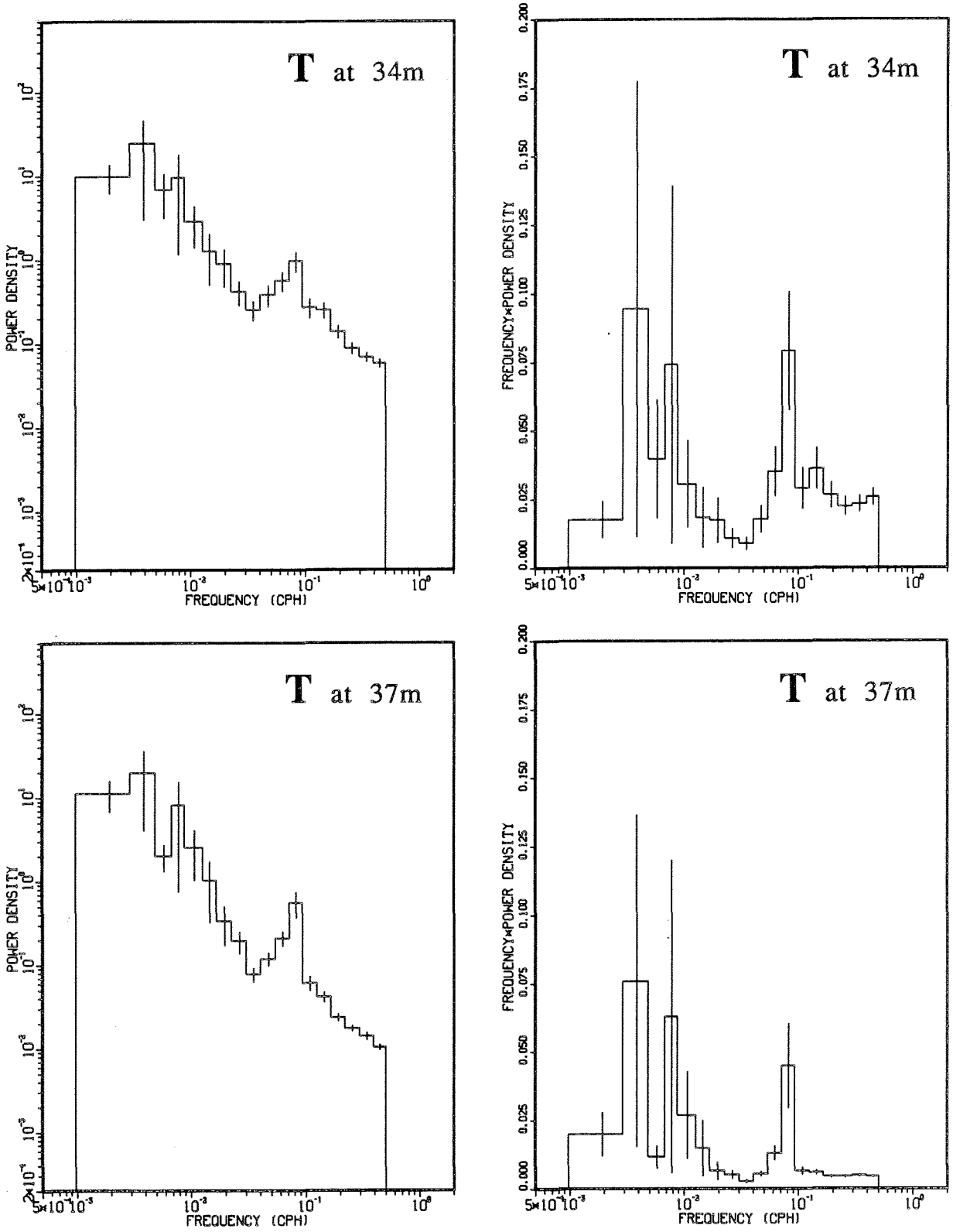
MOORING 774; THERMISTOR - CHAIN
SOUTHEAST SHOAL 1986 - LOW PASS



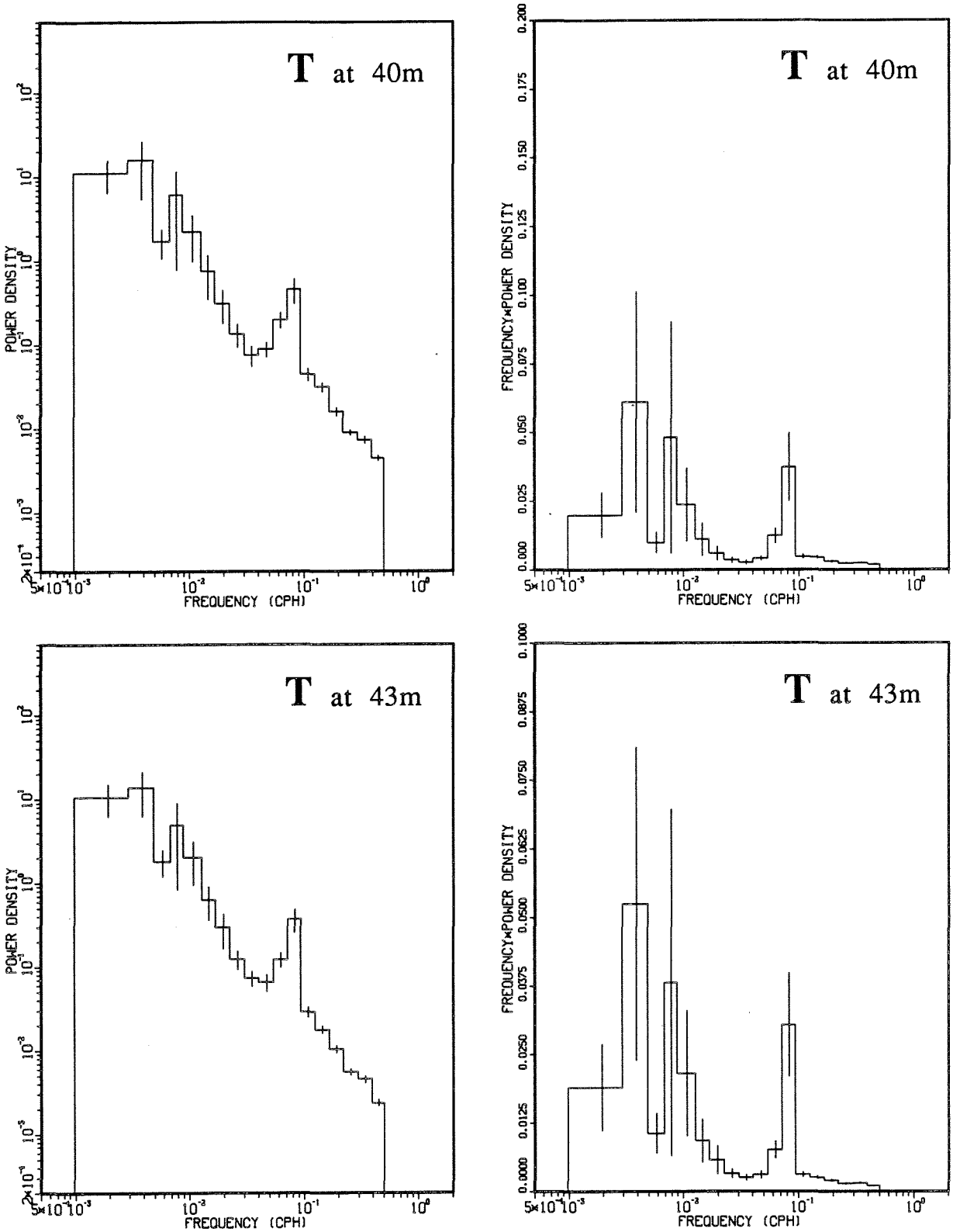
MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986



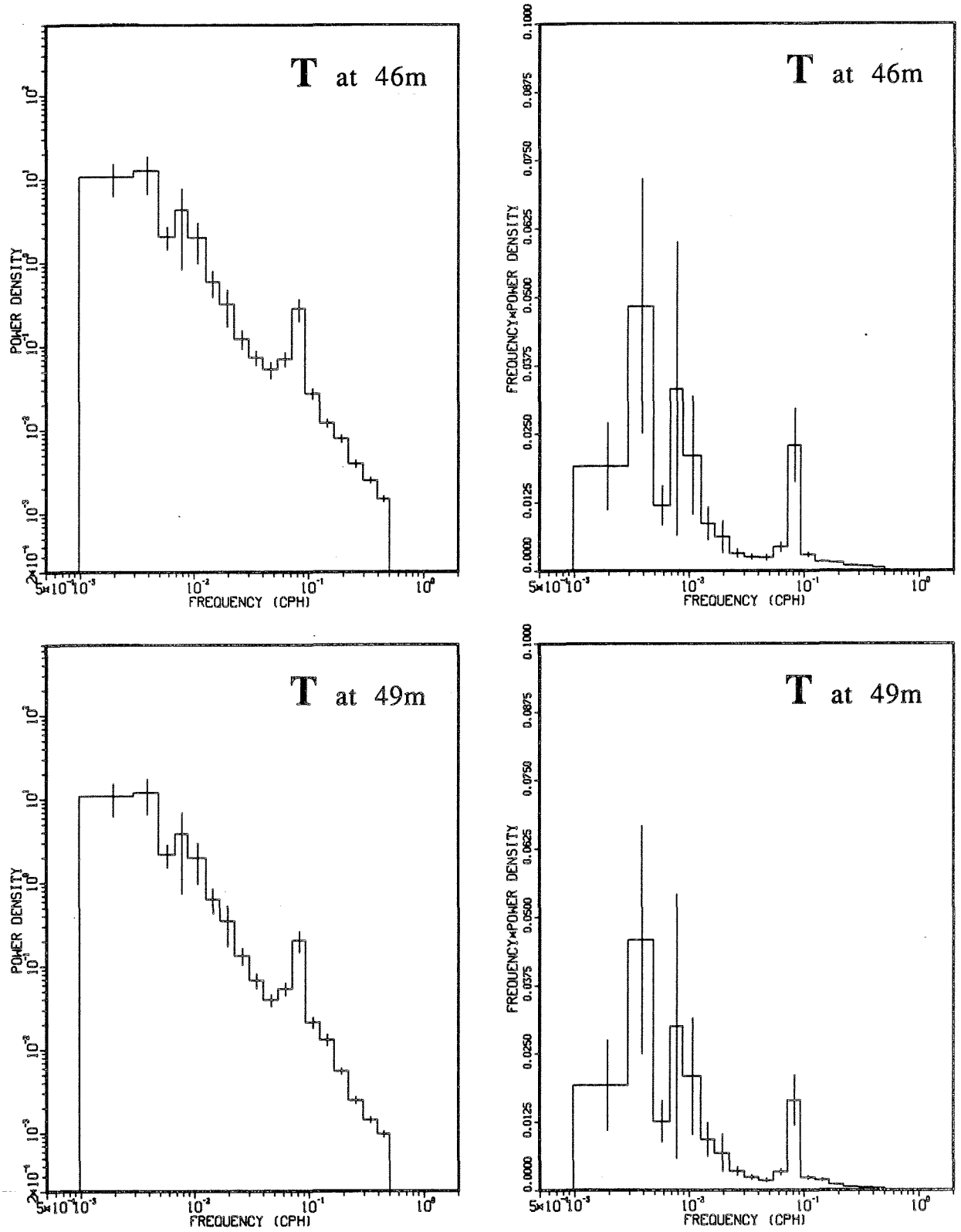
MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986



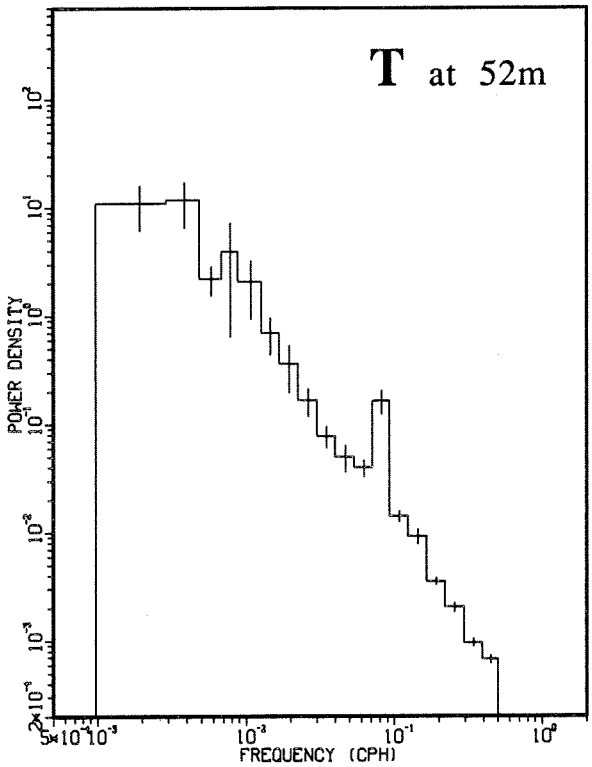
MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986

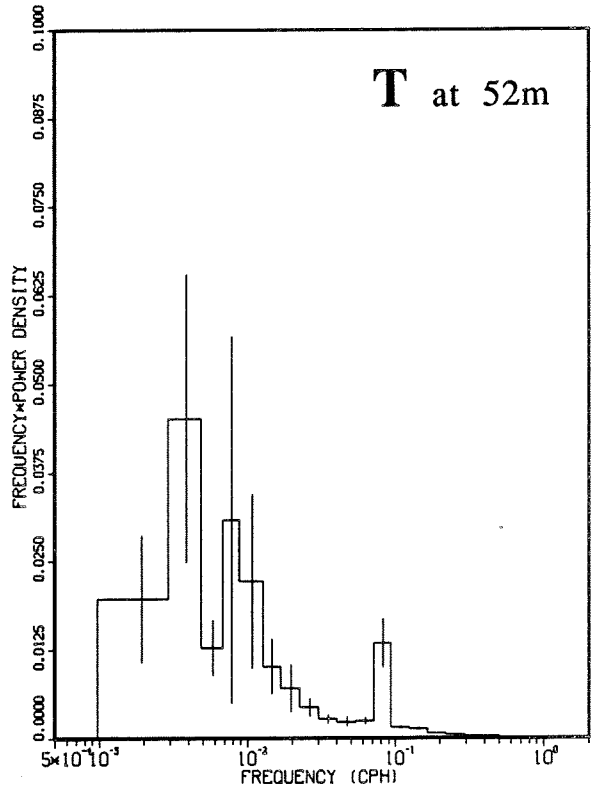


MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986



MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986





MOORING 774; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

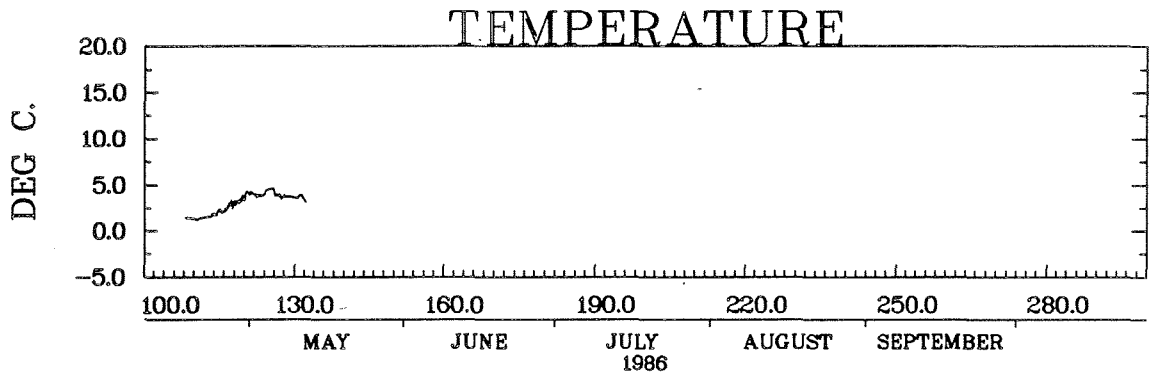
Mooring 775 at 14m

(sampling interval 4 hours)

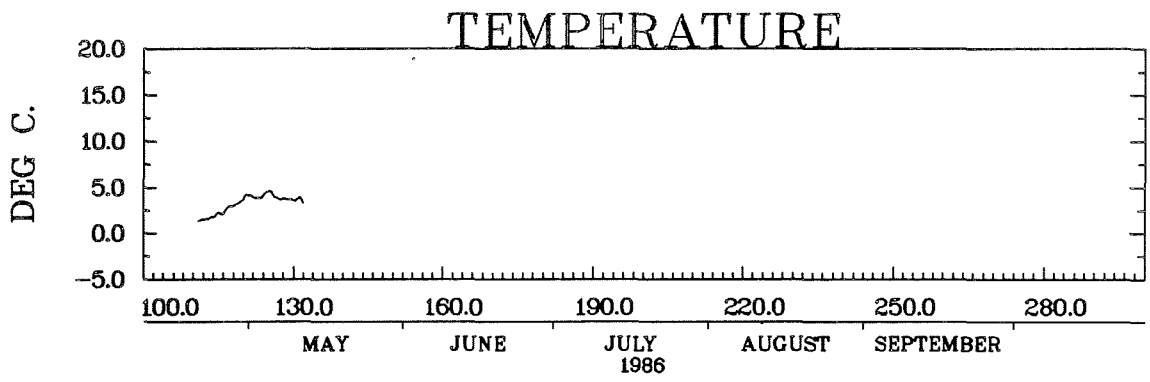
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	145	76	69					
($\bar{X}$)	3.0	2.2	3.9					
(Σ_1)	1.1	0.9	0.3					
(Σ_2)	1.0	0.9	0.3					

N: *number of samples in statistics* $\bar{X}$: *mean value*

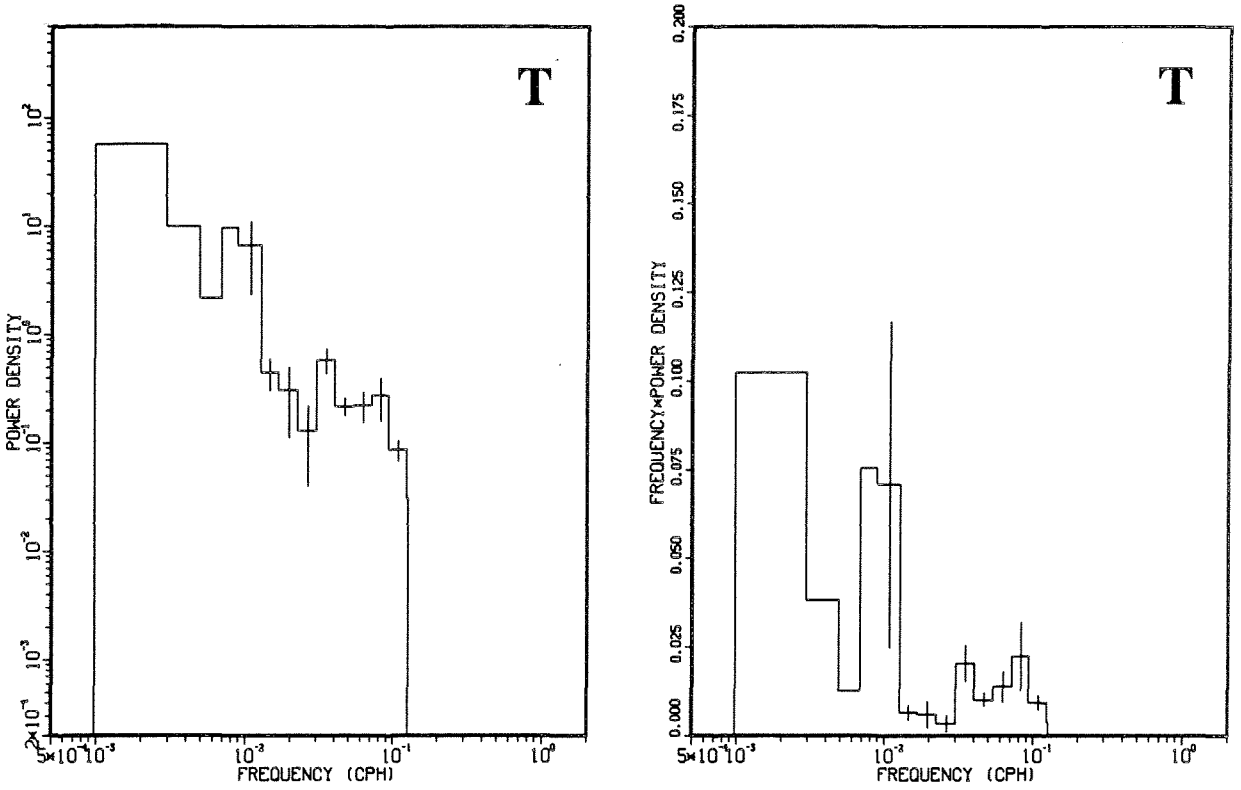
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 775 AT 14M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 775 AT 14M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 775 AT 14M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

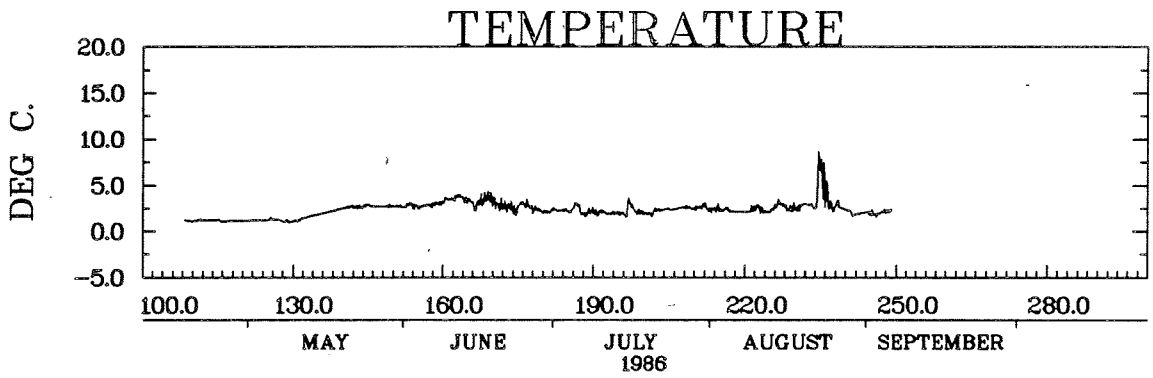
Mooring 775 at 40m

(sampling interval 4 hours)

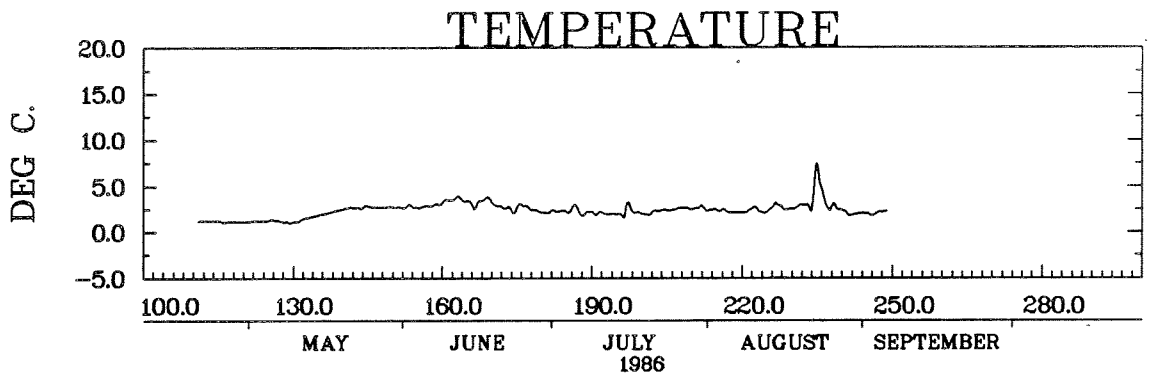
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	845	76	186	180	186	186	31	
($\bar{X}$)	2.3	1.2	2.0	2.9	2.3	2.7	2.1	
(Σ_1)	0.8	0.1	0.7	0.5	0.3	1.0	0.2	
(Σ_2)	0.8	0.1	0.7	0.5	0.3	0.9	0.2	

N: *number of samples in statistics* $\bar{X}$: *mean value*

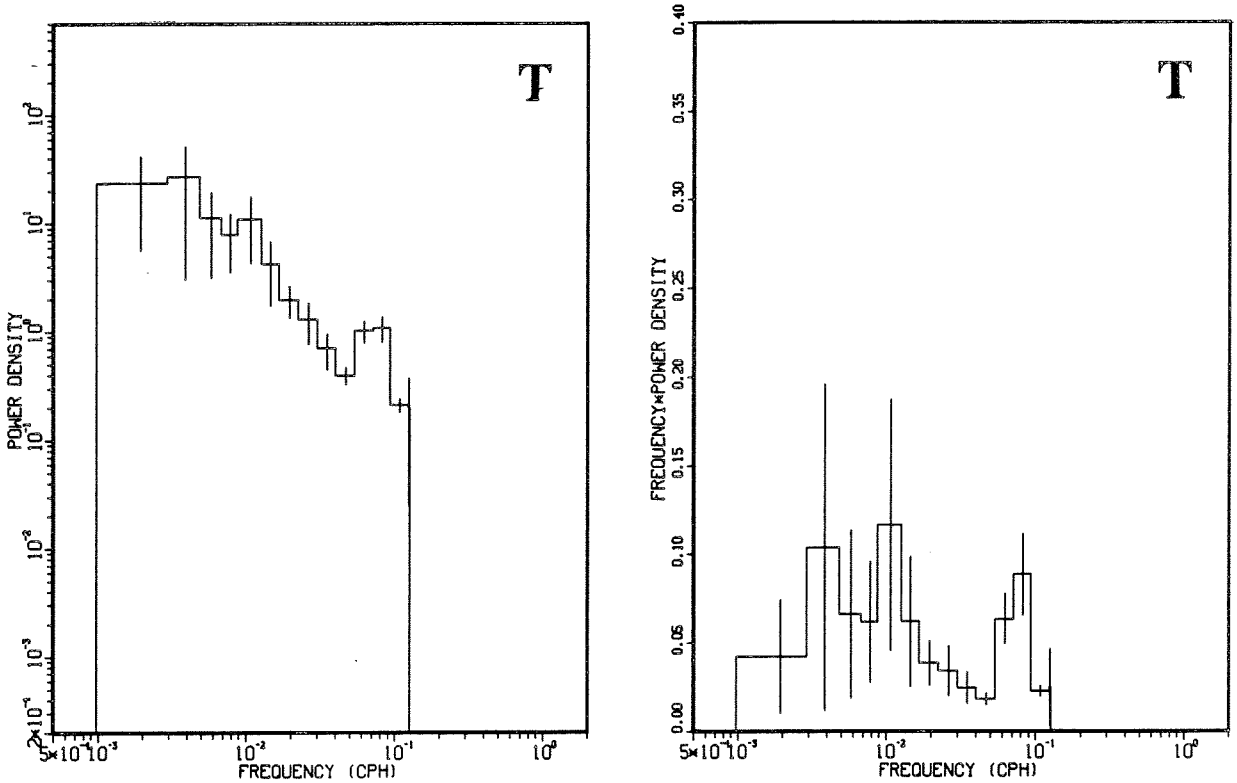
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 775 AT 40M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 775 AT 40M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 775 AT 40M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

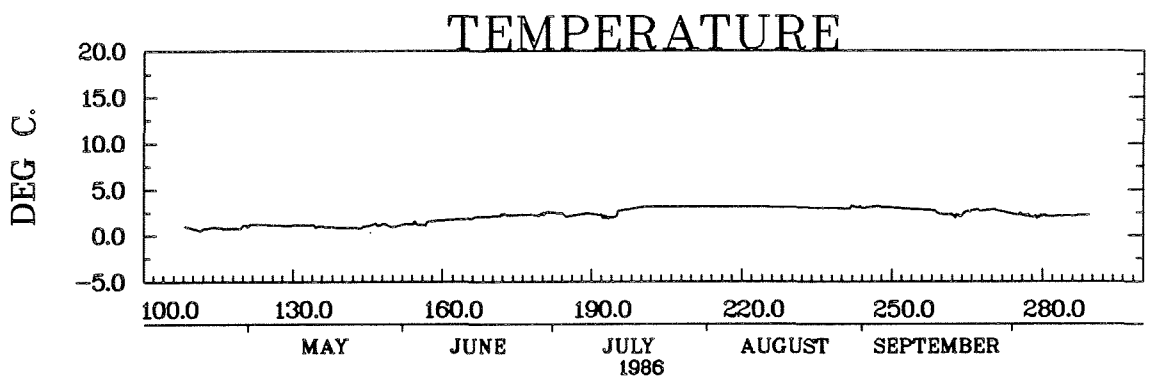
Mooring 775 at 65m

(sampling interval 4 hours)

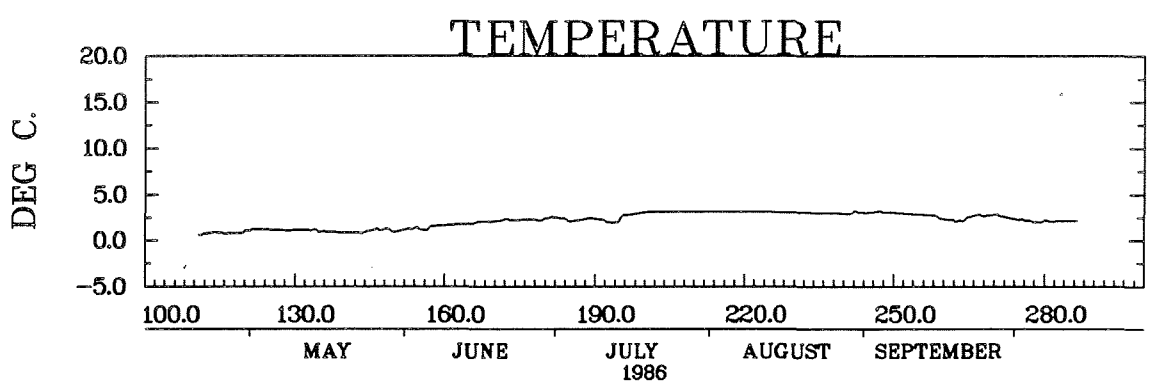
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	1088	77	186	180	186	186	180	93
($\bar{X}$)	2.2	0.8	1.1	1.9	2.7	3.1	2.7	2.2
(Σ_1)	0.8	0.1	0.1	0.4	0.4	0.1	0.3	0.1
(Σ_2)	0.8	0.1	0.1	0.4	0.4	0.1	0.3	0.1

N: *number of samples in statistics* $\bar{X}$: *mean value*

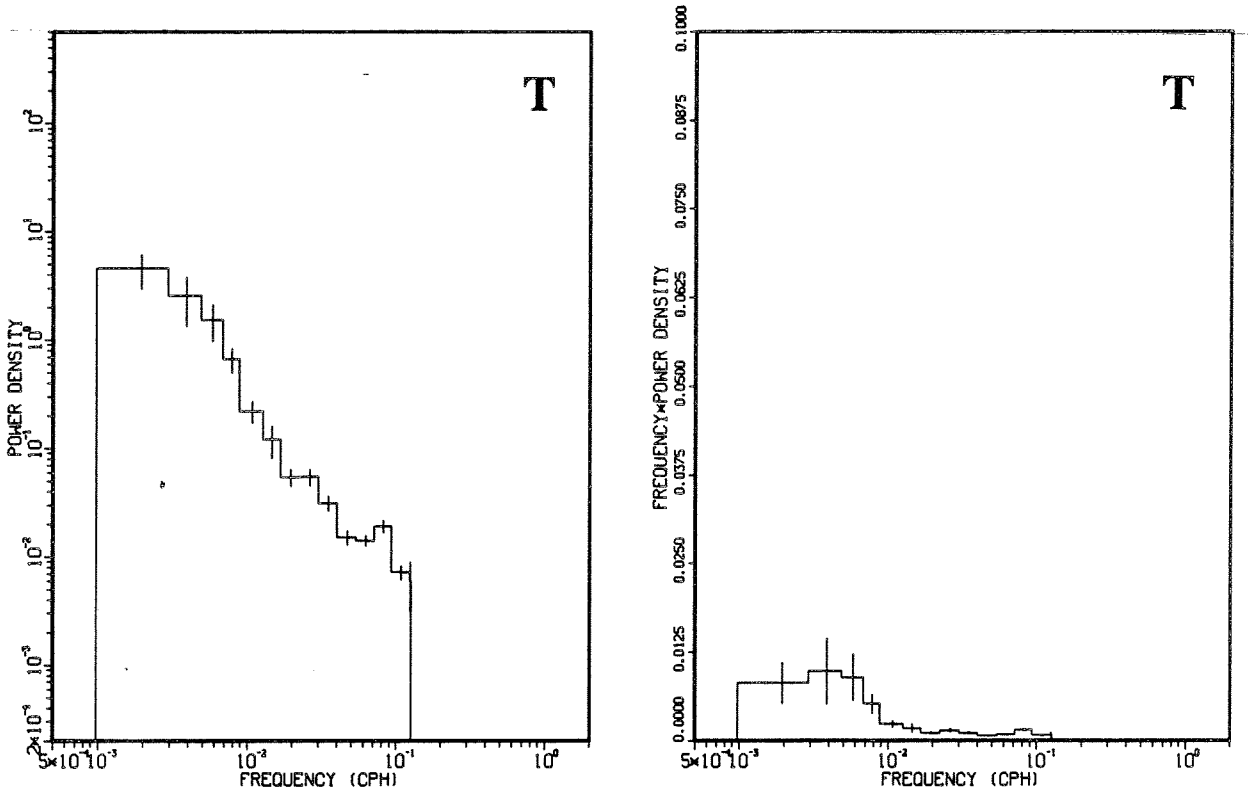
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 775 AT 65M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 775 AT 65M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 775 AT 65M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

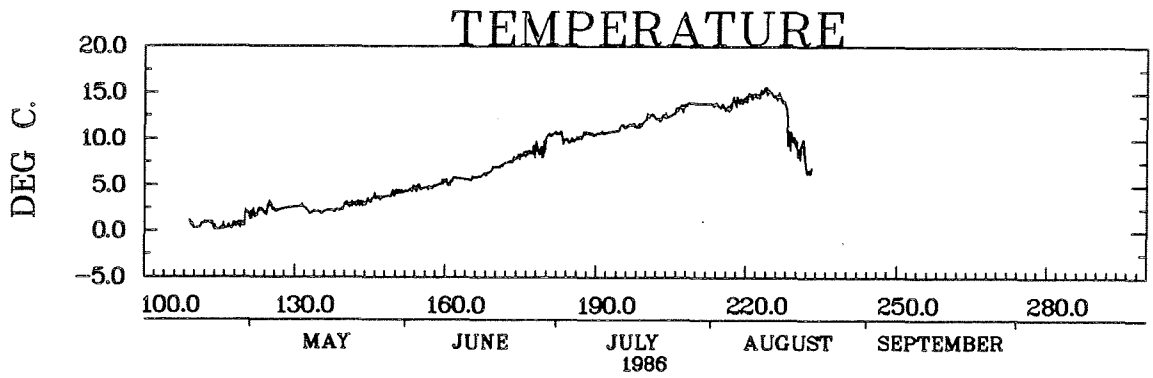
Mooring 776 at 13m

(sampling interval 4 hours)

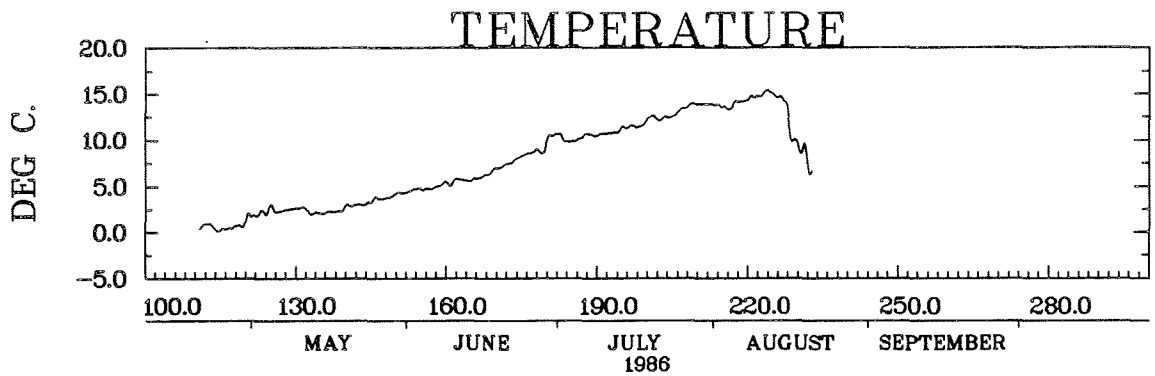
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	747	74	186	180	186	121		
($\bar{X}$)	7.4	0.7	2.8	6.6	11.8	13.0		
(Σ_1)	4.7	0.5	0.7	1.8	1.3	2.6		
(Σ_2)	4.7	0.5	0.7	1.8	1.3	2.5		

N: *number of samples in statistics* $\bar{X}$: *mean value*

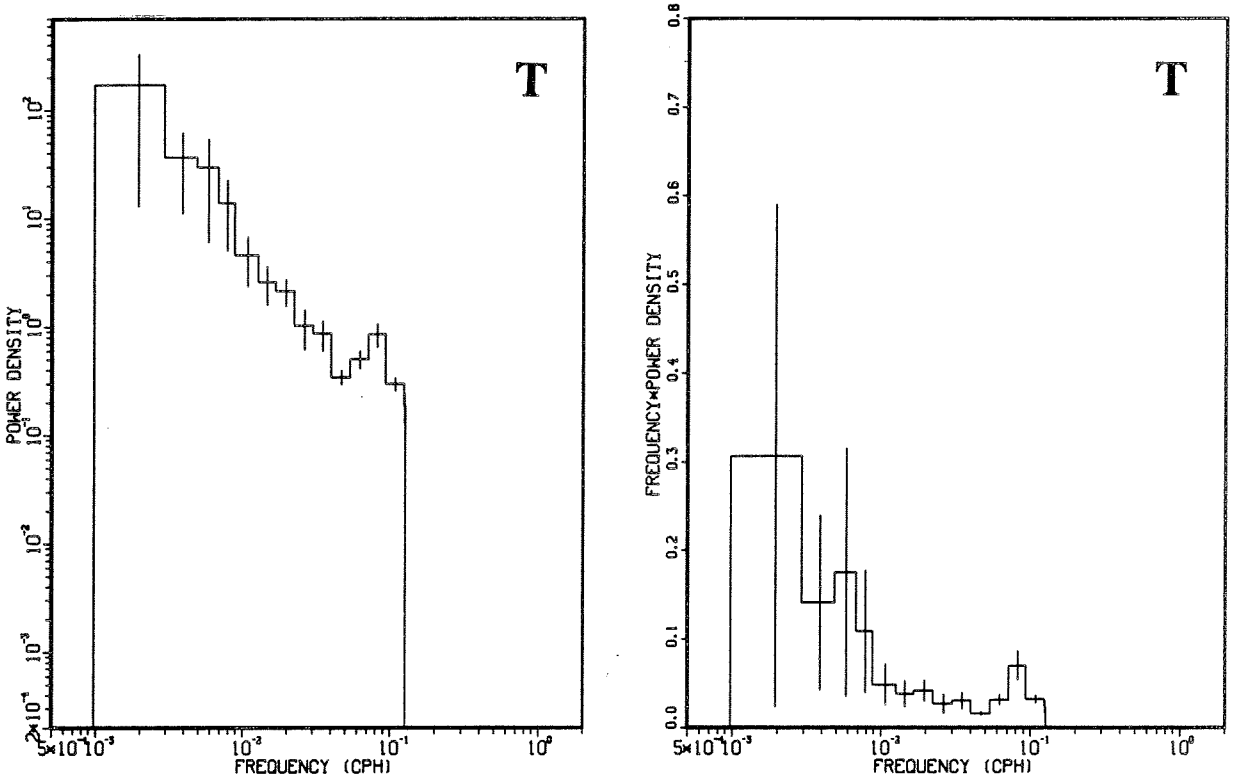
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 776 AT 13M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 776 AT 13M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 776 AT 13M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

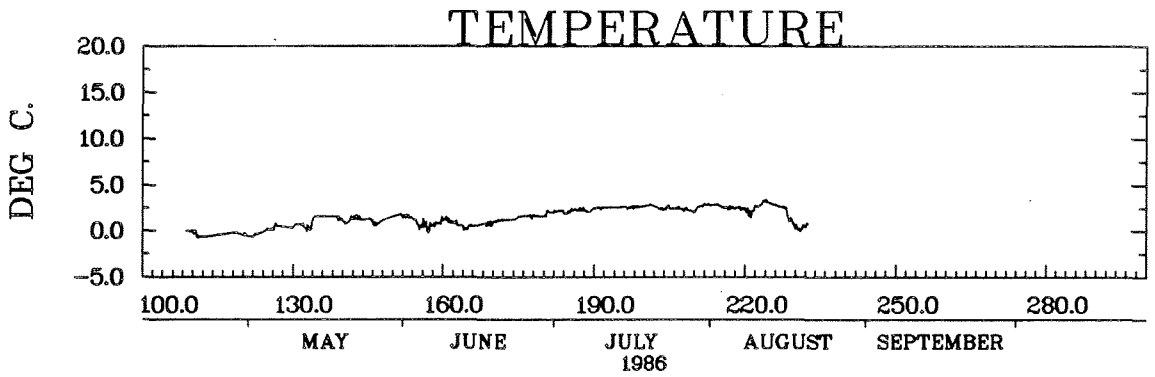
Mooring 776 at 39m

(sampling interval 4 hours)

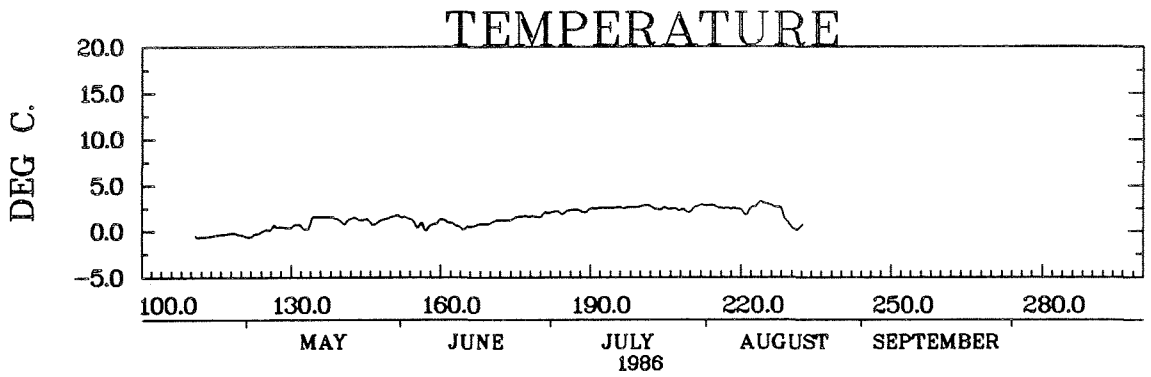
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	745	75	186	180	186	118		
($\bar{X}$)	1.4	-0.4	0.9	1.1	2.5	2.2		
(Σ_1)	1.0	0.2	0.6	0.5	0.2	0.9		
(Σ_2)	1.0	0.2	0.7	0.5	0.2	0.9		

N: *number of samples in statistics* $\bar{X}$: *mean value*

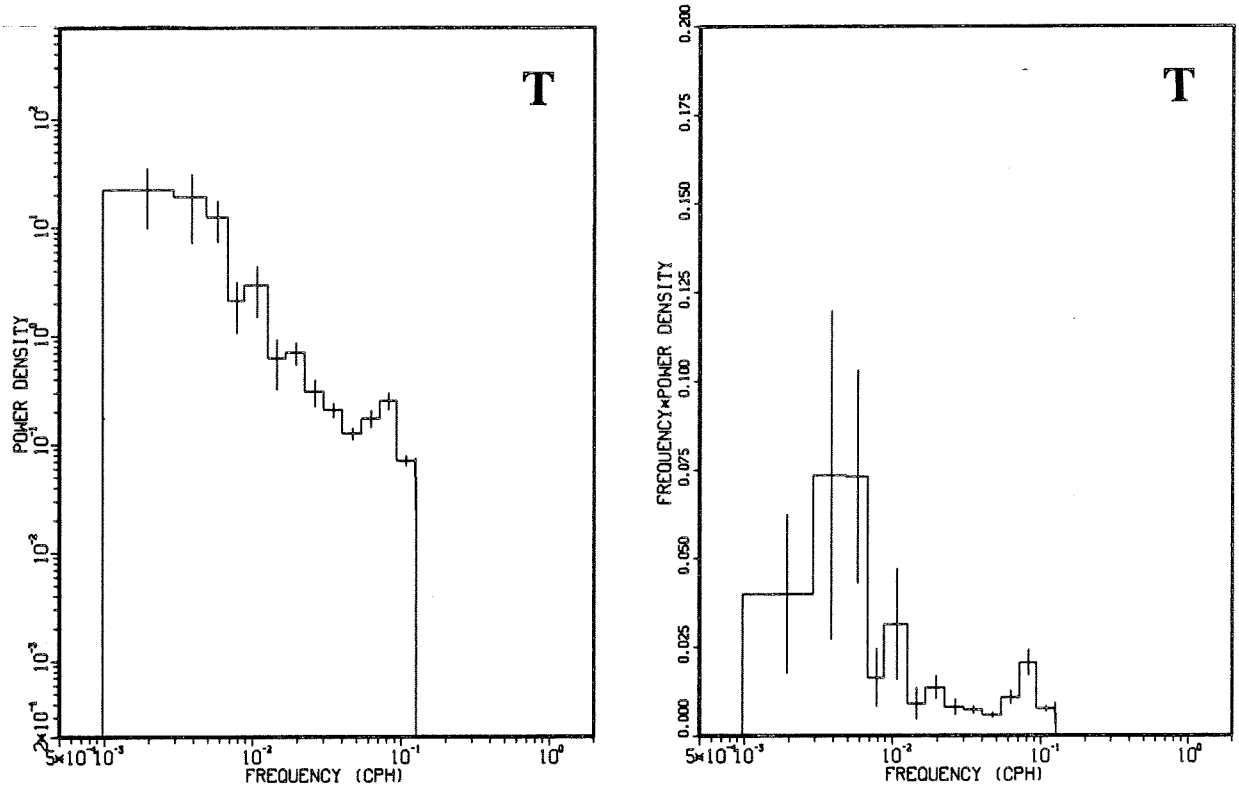
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 776 AT 39M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 776 AT 39M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 776 AT 39M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

RYAN THERMOGRAPH

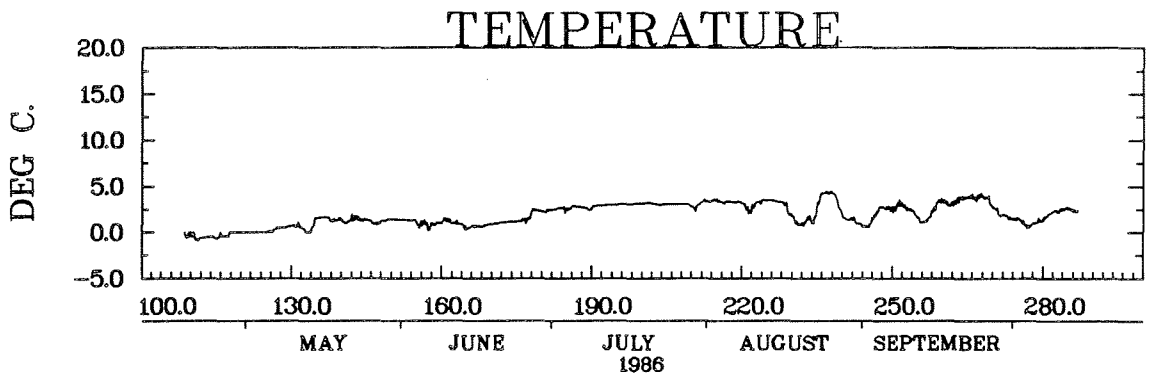
Mooring 776 at 49m

(sampling interval 4 hours)

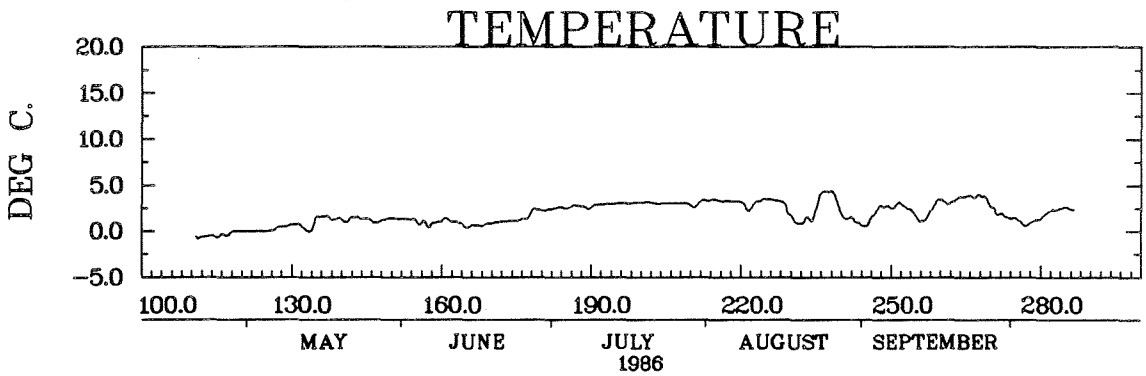
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
Temperature (°C)								
(N)	1071	74	186	180	186	186	180	79
($\bar{X}$)	1.9	-0.4	0.9	1.2	2.9	2.7	2.6	1.7
(Σ_1)	1.2	0.3	0.6	0.5	0.2	1.0	0.9	0.7
(Σ_2)	1.2	0.3	0.6	0.5	0.2	1.0	0.9	0.7

N: *number of samples in statistics* $\bar{X}$: *mean value*

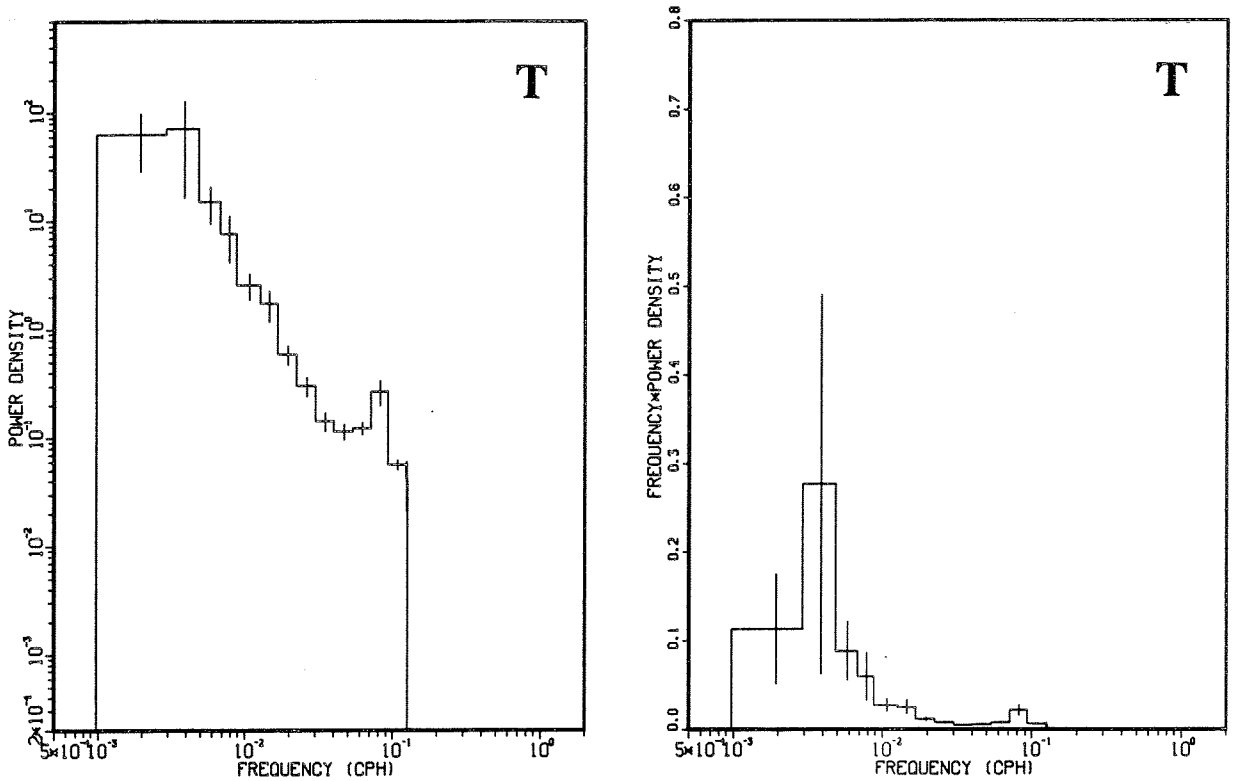
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 776 AT 49M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986



MOORING 776 AT 49M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986 – LOW PASS



MOORING 776 AT 49M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1986

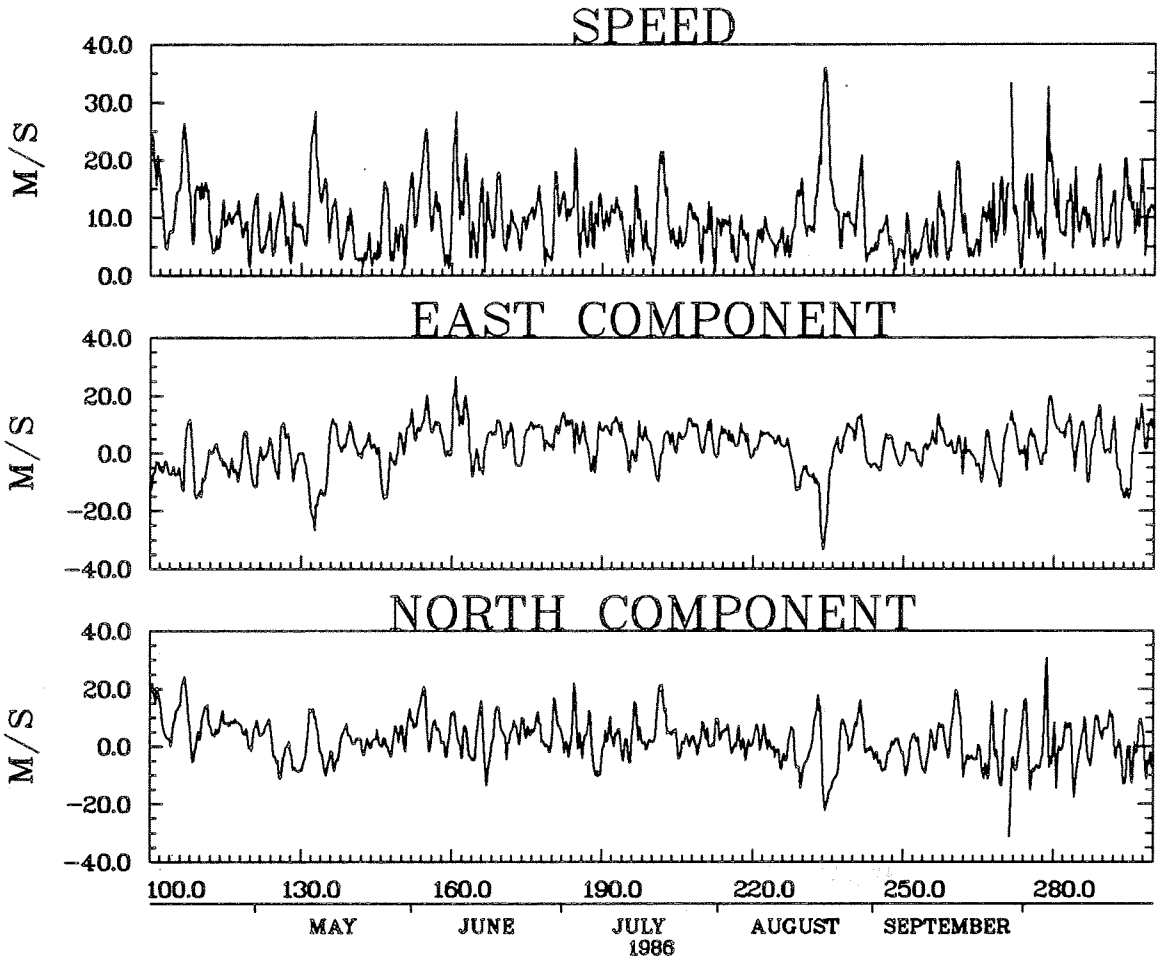
GEOSTROPHIC WINDS

(sampling interval 6 hours)

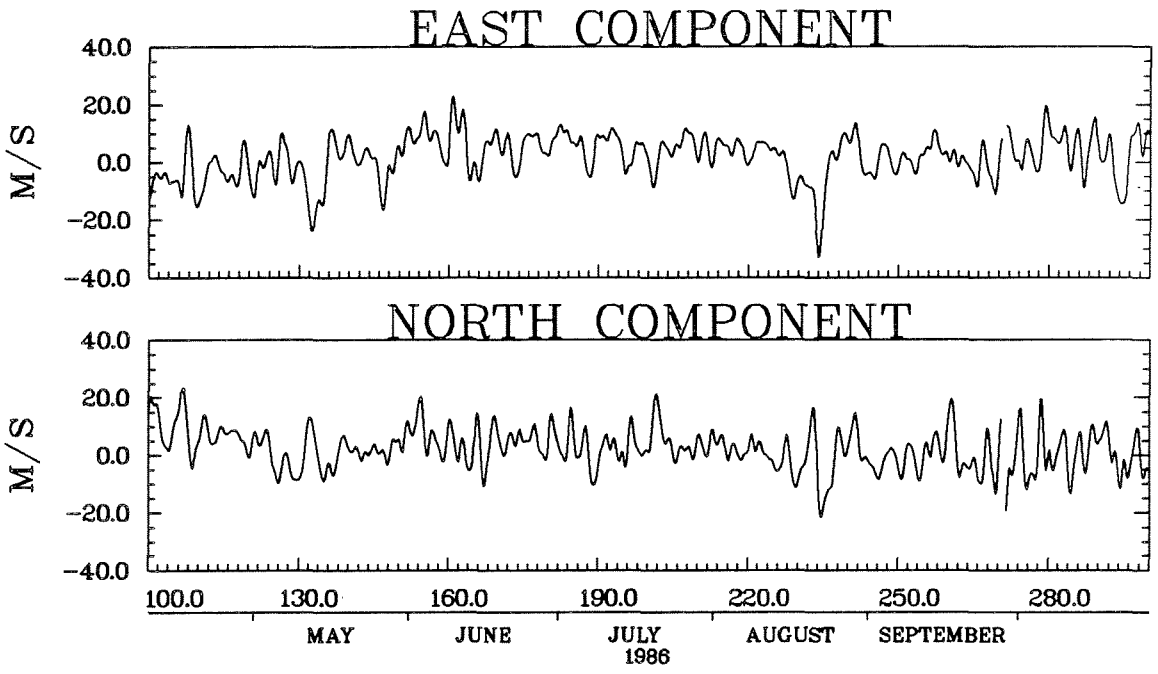
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1986)
East Velocity Component ($m.s^{-1}$)								
(N)	799	84	124	120	124	124	119	104
($\bar{X}$)	1.8	-4.3	-1.3	6.5	5.0	0.2	1.1	3.9
(Σ_1)	7.9	6.2	8.3	6.4	5.4	9.2	5.3	8.2
(Σ_2)	7.7	6.0	8.2	6.2	5.1	9.1	4.9	7.9
North Velocity Component ($m.s^{-1}$)								
(N)	799	84	124	120	124	124	119	104
($\bar{X}$)	2.2	8.5	0.8	5.1	3.2	0.2	-1.3	0.5
(Σ_1)	7.5	6.6	5.7	6.2	6.2	7.6	7.5	8.3
(Σ_2)	7.1	6.4	5.6	5.9	5.8	7.4	6.7	7.5

N: *number of samples in statistics* $\bar{X}$: *mean value*

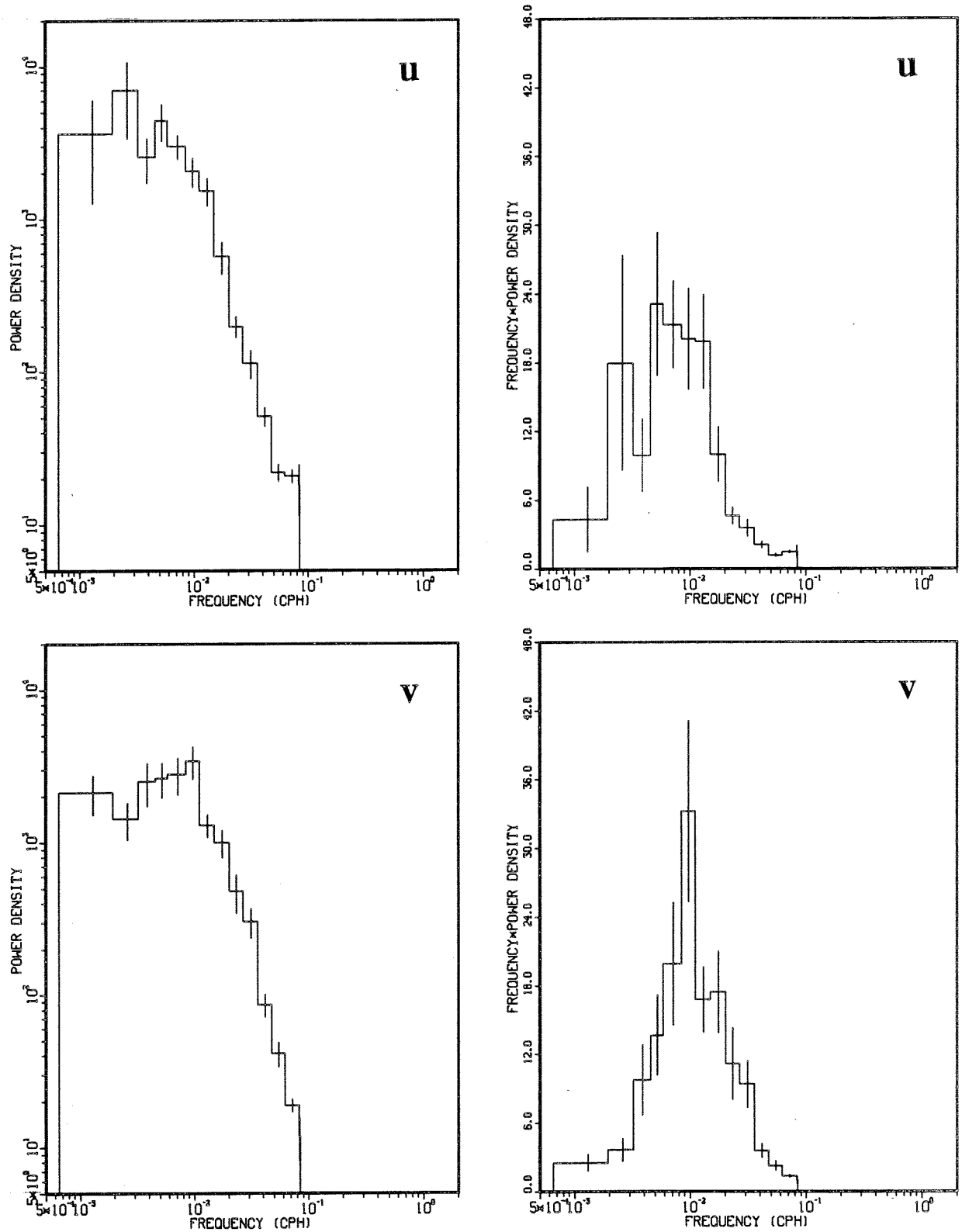
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1986



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1986 – LOW PASS



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1986

ARGOS BUOY

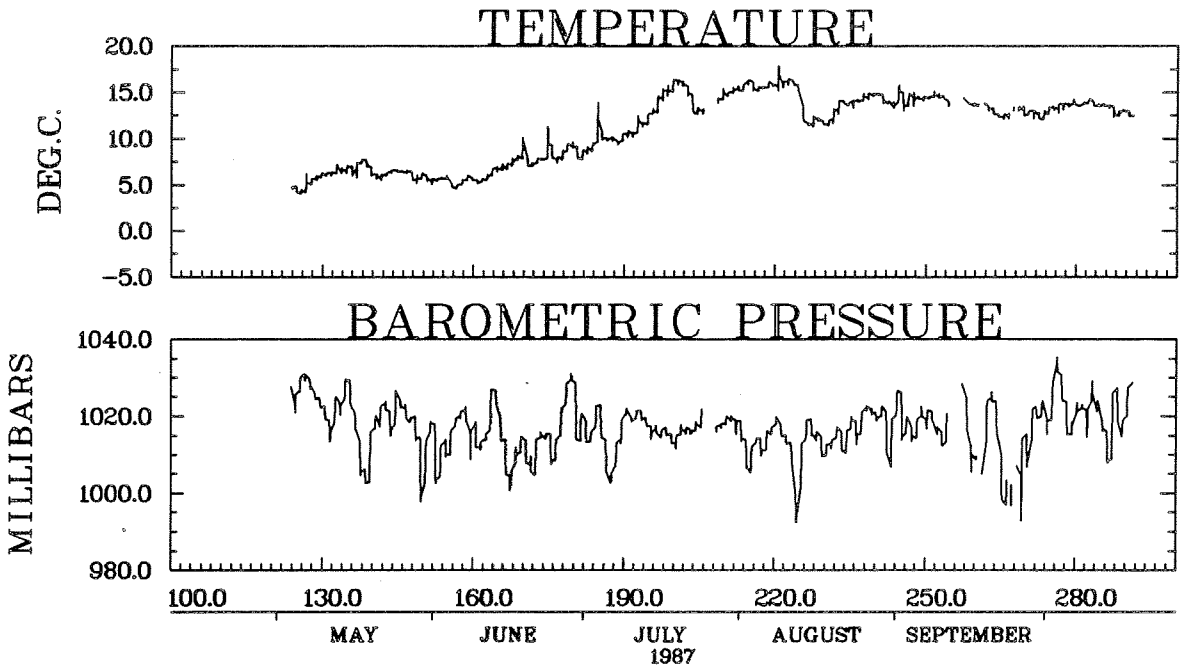
Mooring 830 at surface

(sampling interval irregular and averaged over 6 hours)

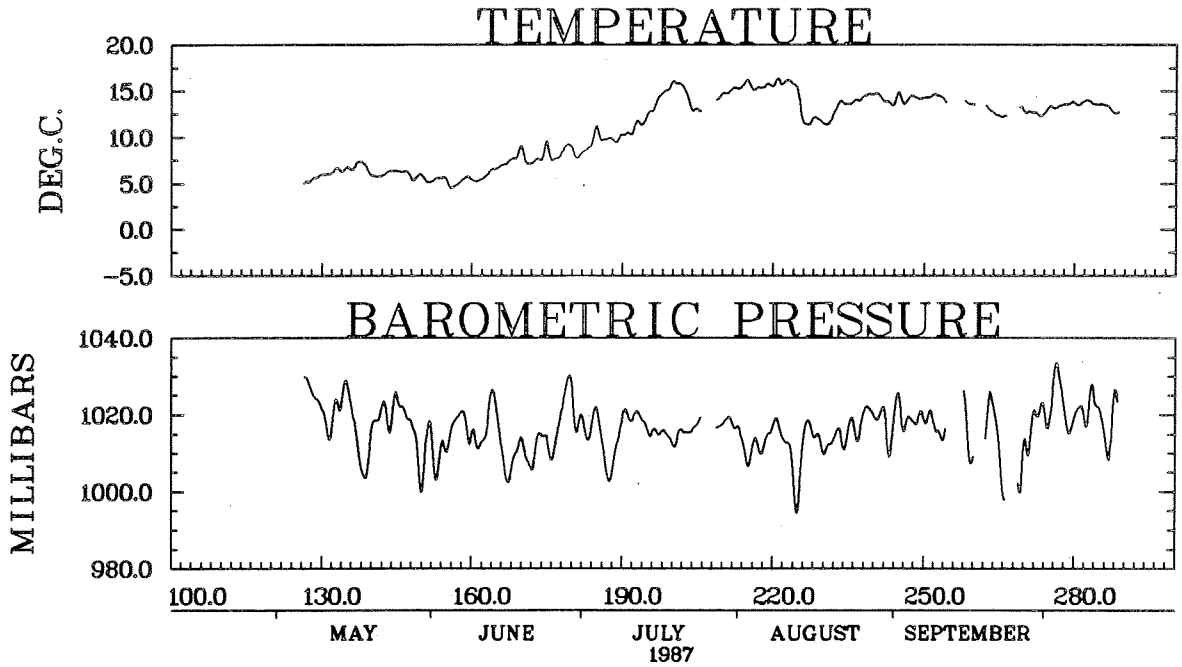
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Sea Surface Temperature (°C)								
(N)	638		113	120	116	124	96	69
($\bar{X}$)	10.85		5.94	6.87	12.54	14.18	13.53	13.31
(Σ_1)	3.70		0.75	1.39	2.36	1.53	0.83	0.45
(Σ_2)	3.67		5.62	1.36	2.36	1.52	0.83	0.37
Barometric Pressure (mbar)								
(N)	638		113	120	116	124	96	69
($\bar{X}$)	1016.		1019.	1015.	1016.	1014.	1016.	1021.
(Σ_1)	6.4		7.2	6.4	3.9	5.2	7.3	5.6
(Σ_2)	6.2		7.1	6.4	3.9	5.2	6.7	5.6

N: *number of samples in statistics* $\bar{X}$: *mean value*

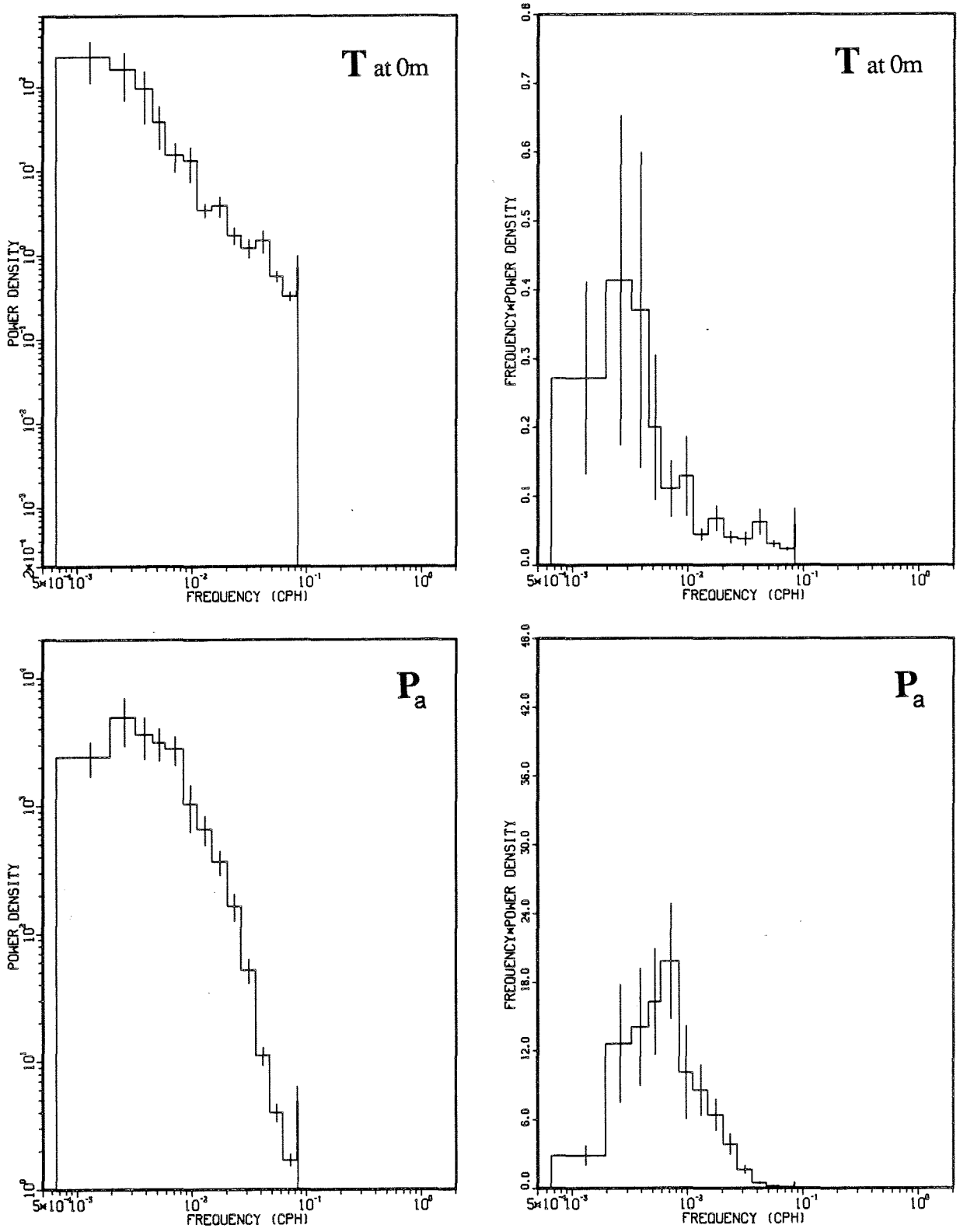
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



ARGOS BUOY
SOUTHEAST SHOAL 1987



ARGOS BUOY
SOUTHEAST SHOAL 1987 – LOW PASS



ARGOS BUOY
SOUTHEAST SHOAL 1987

CURRENT METER

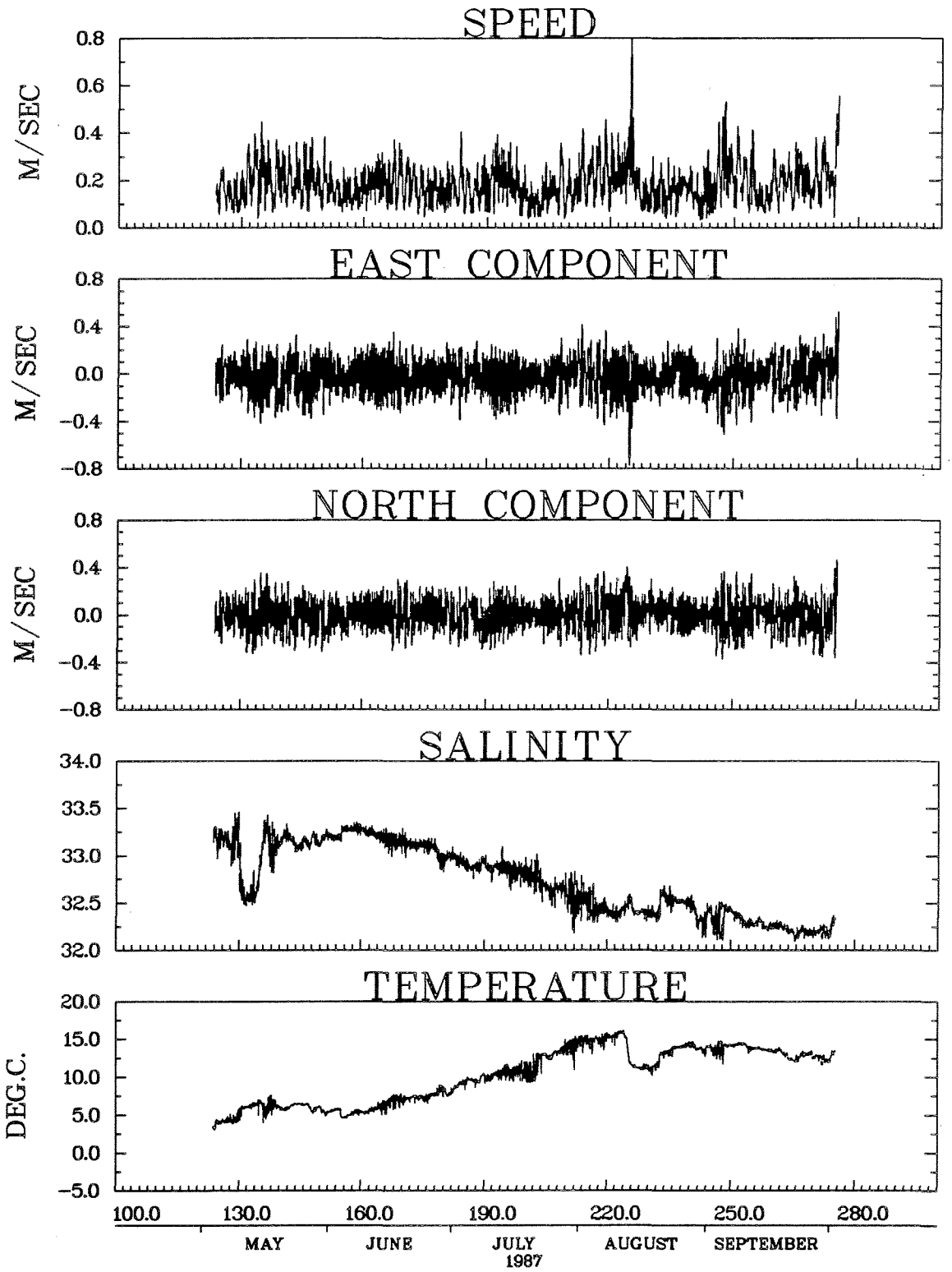
Mooring 830 at 11m

(sampling interval 30 min)

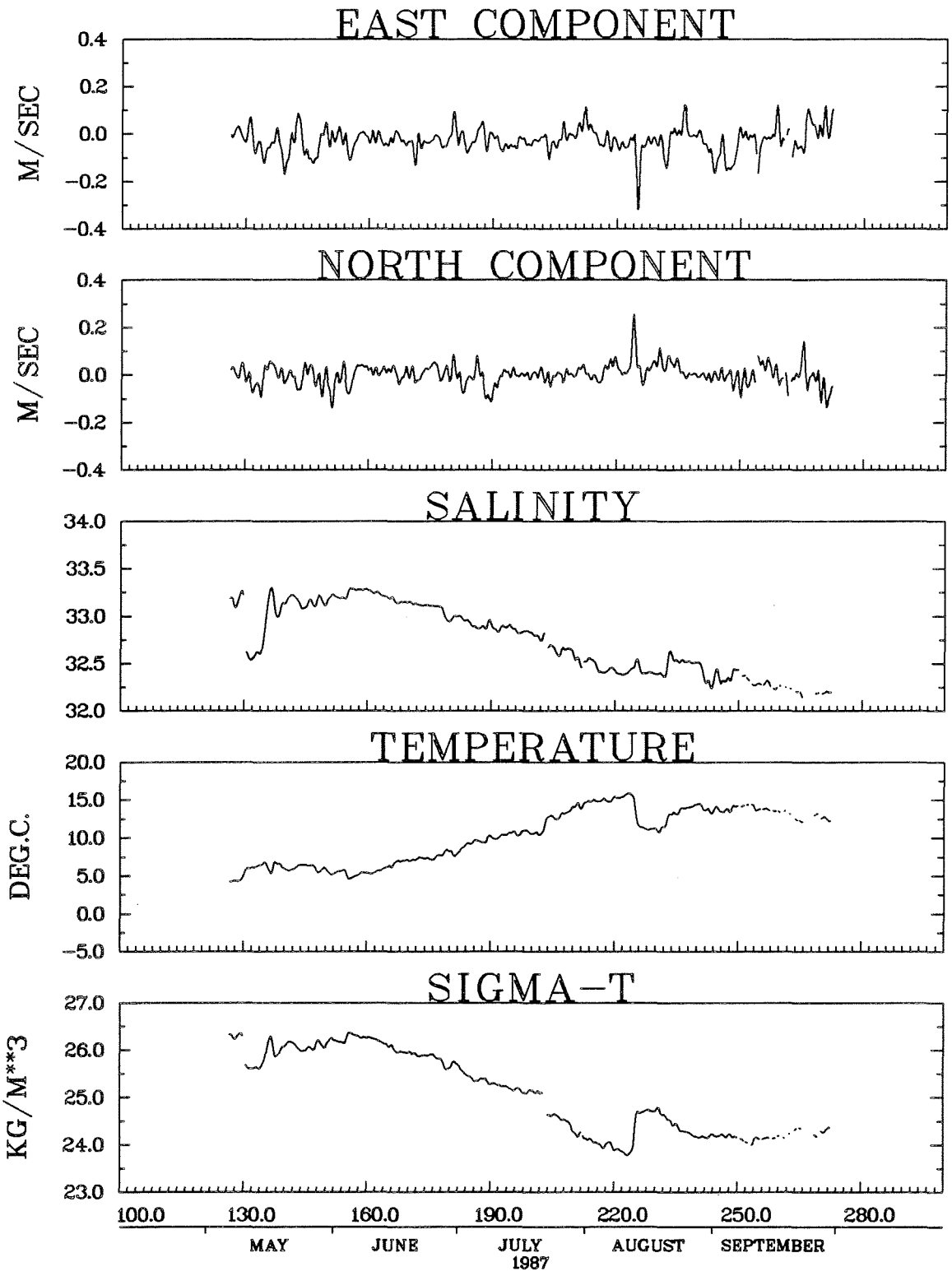
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	7228		1354	1440	1488	1488	1395	63
($\bar{X}$)	-0.026		-0.034	-0.025	-0.022	-0.034	-0.020	
(Σ_1)	0.151		0.151	0.139	0.133	0.160	0.164	
(Σ_2)	0.052		0.056	0.034	0.038	0.062	0.066	
North Velocity Component ($m.s^{-1}$)								
(N)	7228		1354	1440	1488	1488	1395	63
($\bar{X}$)	0.003		-0.011	0.011	-0.008	0.027	-0.009	
(Σ_1)	0.132		0.137	0.116	0.116	0.133	0.147	
(Σ_2)	0.044		0.044	0.031	0.035	0.046	0.049	
Salinity (PSS78)								
(N)	6961		1327	1413	1455	1461	1257	48
($\bar{X}$)	32.75		33.07	33.16	32.79	32.45	32.27	
(Σ_1)	0.37		0.22	0.10	0.14	0.09	0.09	
(Σ_2)	0.35		0.22	0.09	0.13	0.08	0.08	
Temperature ($^{\circ}C$)								
(N)	7087		1354	1440	1488	1479	1277	49
($\bar{X}$)	10.11		5.65	6.49	11.14	13.72	13.40	
(Σ_1)	3.61		0.92	1.10	1.76	1.55	0.72	
(Σ_2)	3.56		0.72	0.01	1.71	1.53	0.65	
Sigma-t ($kg.m^3$)								
(N)	546		99	120	120	124	83	
($\bar{X}$)	25.13		26.03	26.03	25.03	24.26	24.19	
(Σ_1)								
(Σ_2)	0.84		0.22	0.21	0.41	0.30	0.08	

N: *number of samples in statistics* $\bar{X}$: *mean value*

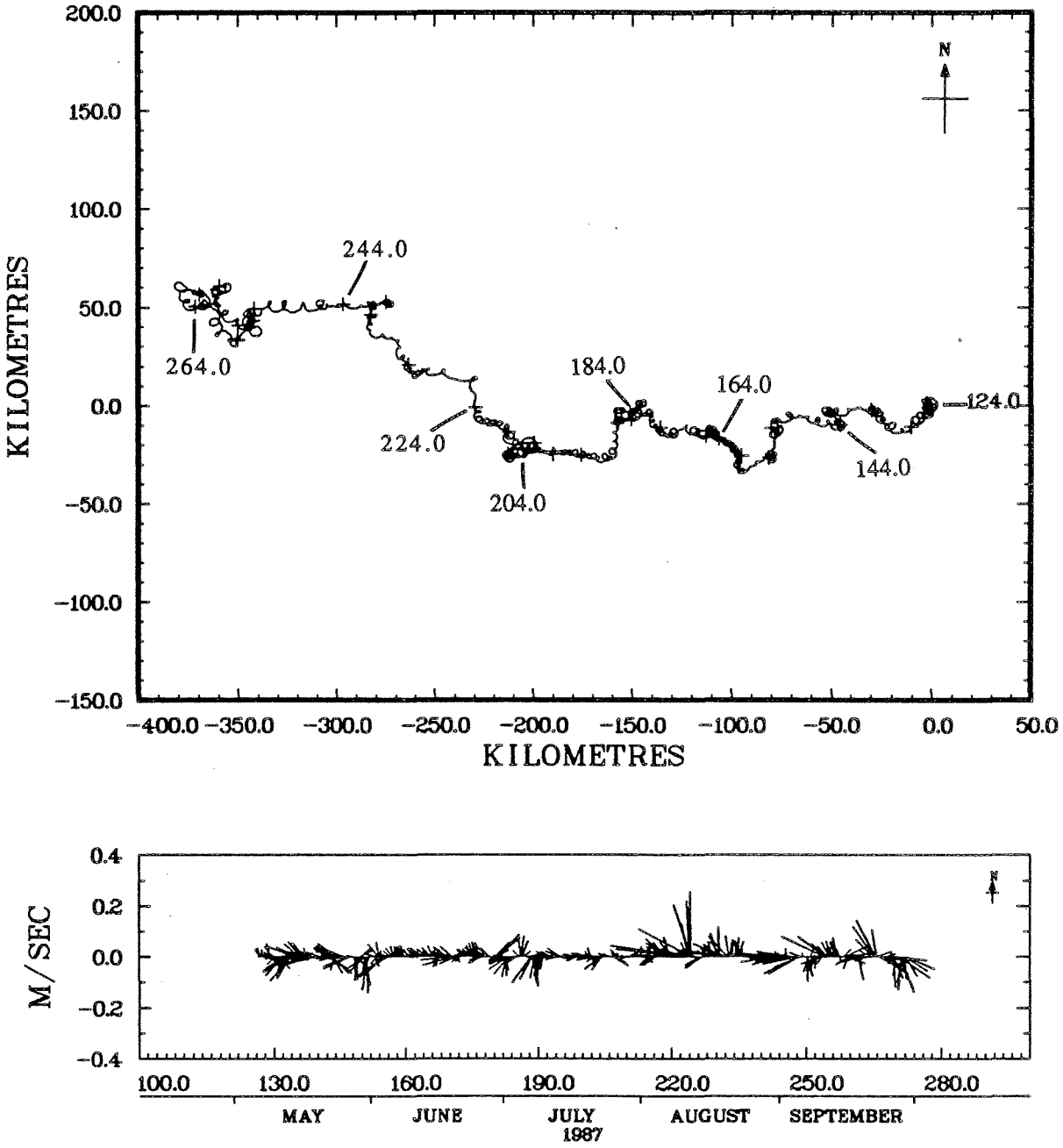
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 830 AT 11M.
SOUTHEAST SHOAL 1987



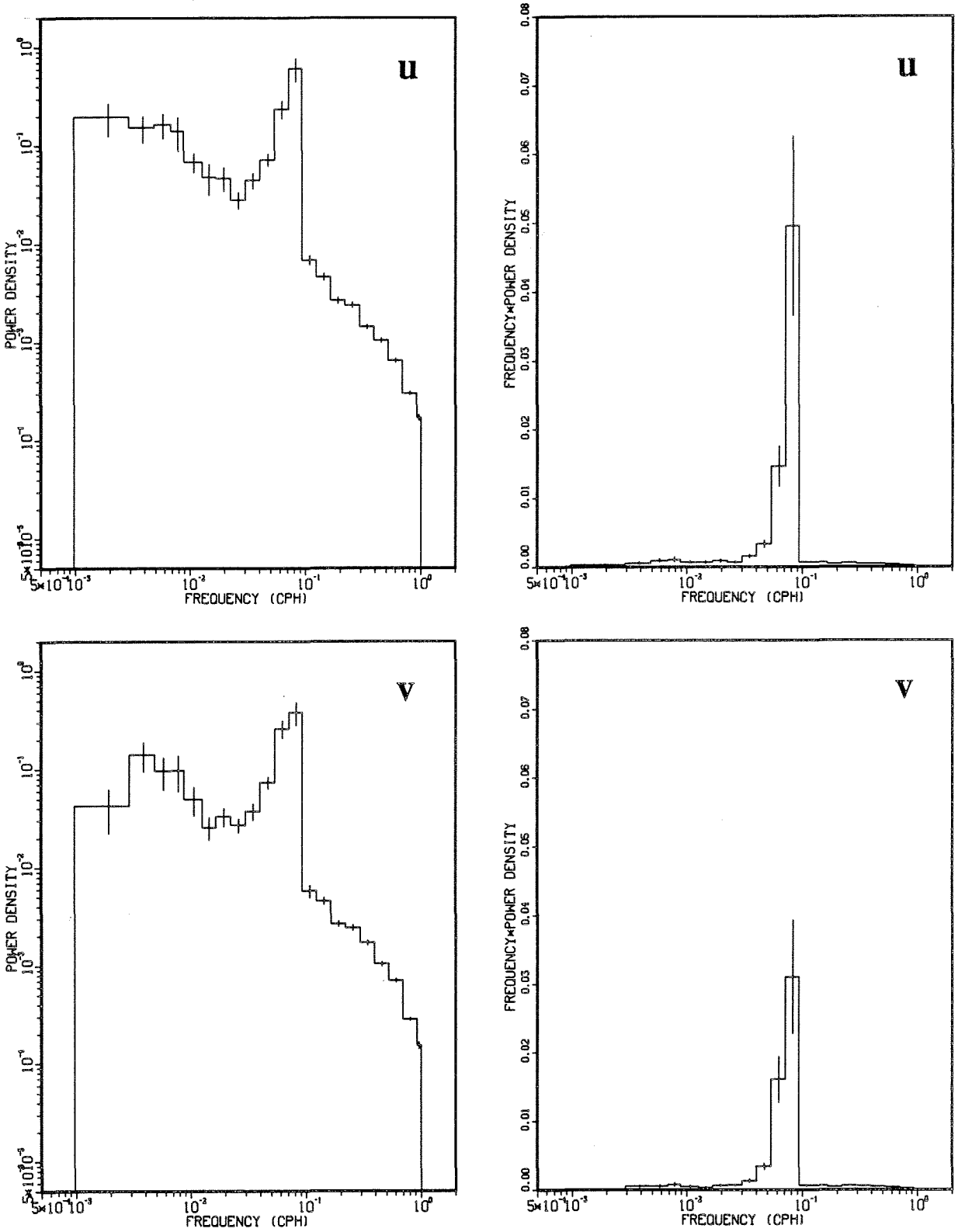
MOORING 830 AT 11M.
SOUTHEAST SHOAL 1987 – LOW PASS



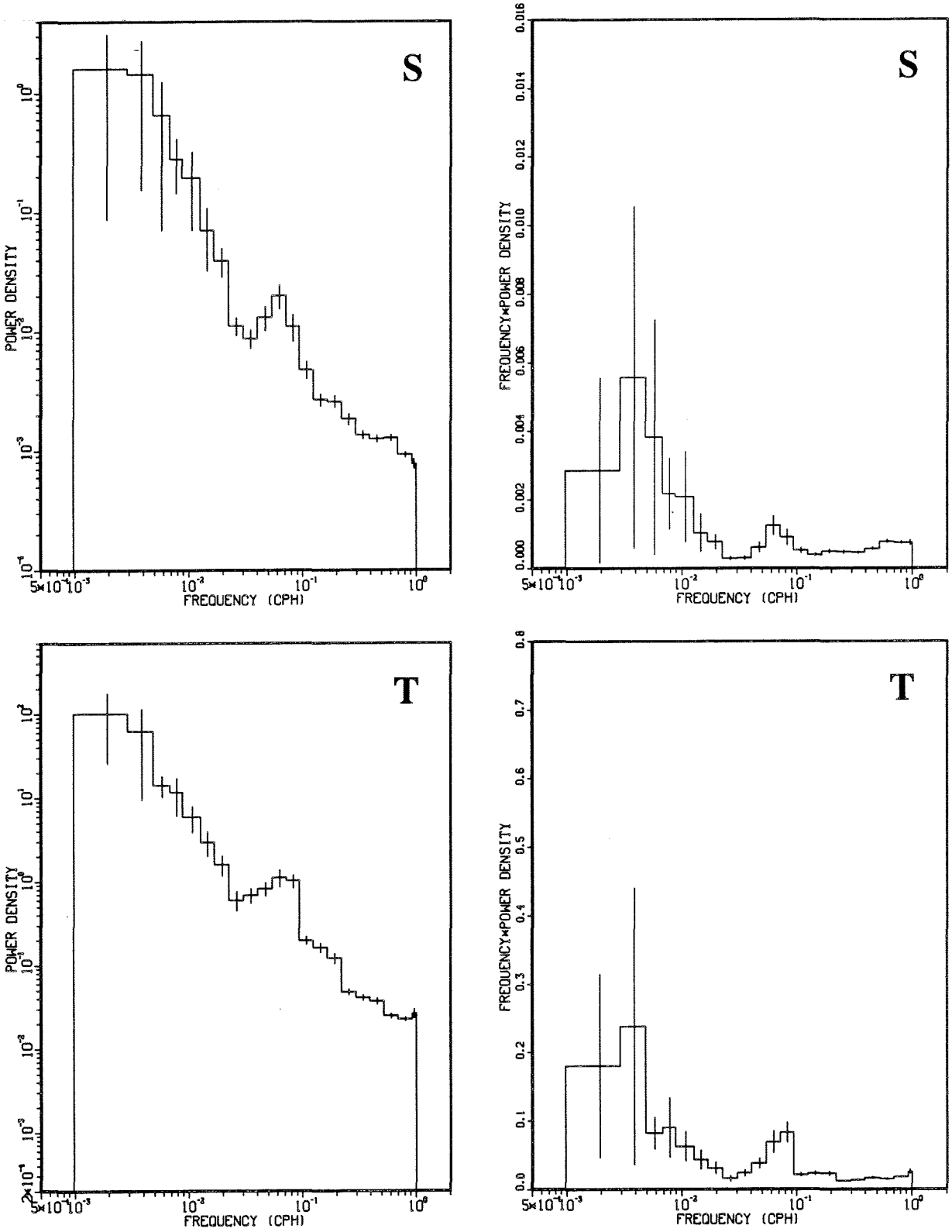
MOORING 830 AT 11M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	151.6 DAYS CENTERED AT DAY 199, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(830,011M)	K1	.013	.006	15	98/C	.007	161	.012	90
	O1	.016	.011	333	54/C	.012	180	.015	74
	M2	.155	.123	87	50/C	.155	53	.123	324
	S2	.051	.039	104	58/C	.050	46	.040	309
	N2	.033	.026	92	39/C	.033	37	.026	306
	MF	.005	.000	49	333/C	.003	335	.003	331
	M4	.003	.000	97	238/A	.003	239	.000	10
	MS4	.003	.001	66	306/C	.003	316	.002	265



MOORING 830 AT 11M.
SOUTHEAST SHOAL 1987



MOORING 830 AT 11M.
SOUTHEAST SHOAL 1987

CURRENT METER

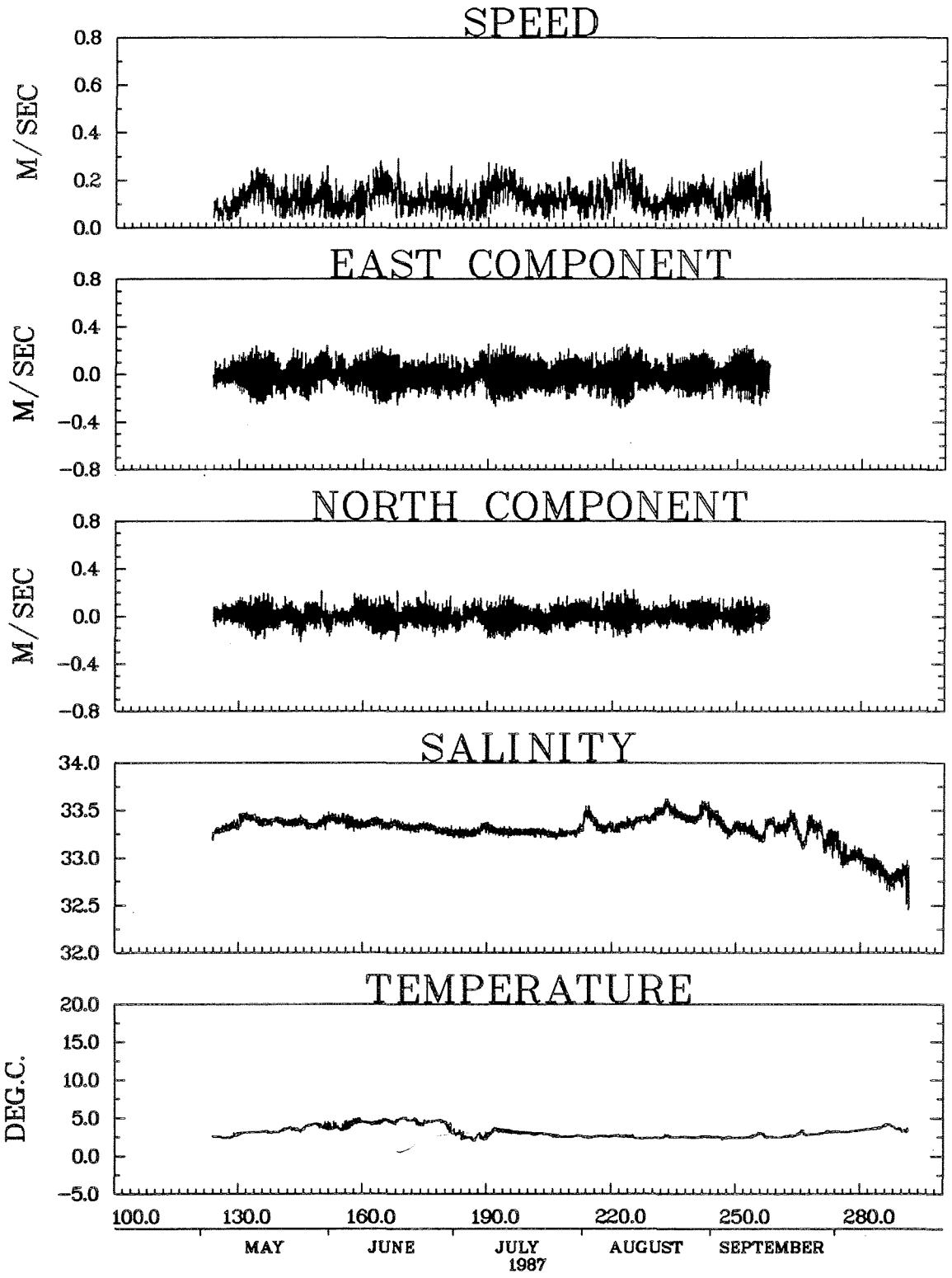
Mooring 830 at 44m

(sampling interval 30 min)

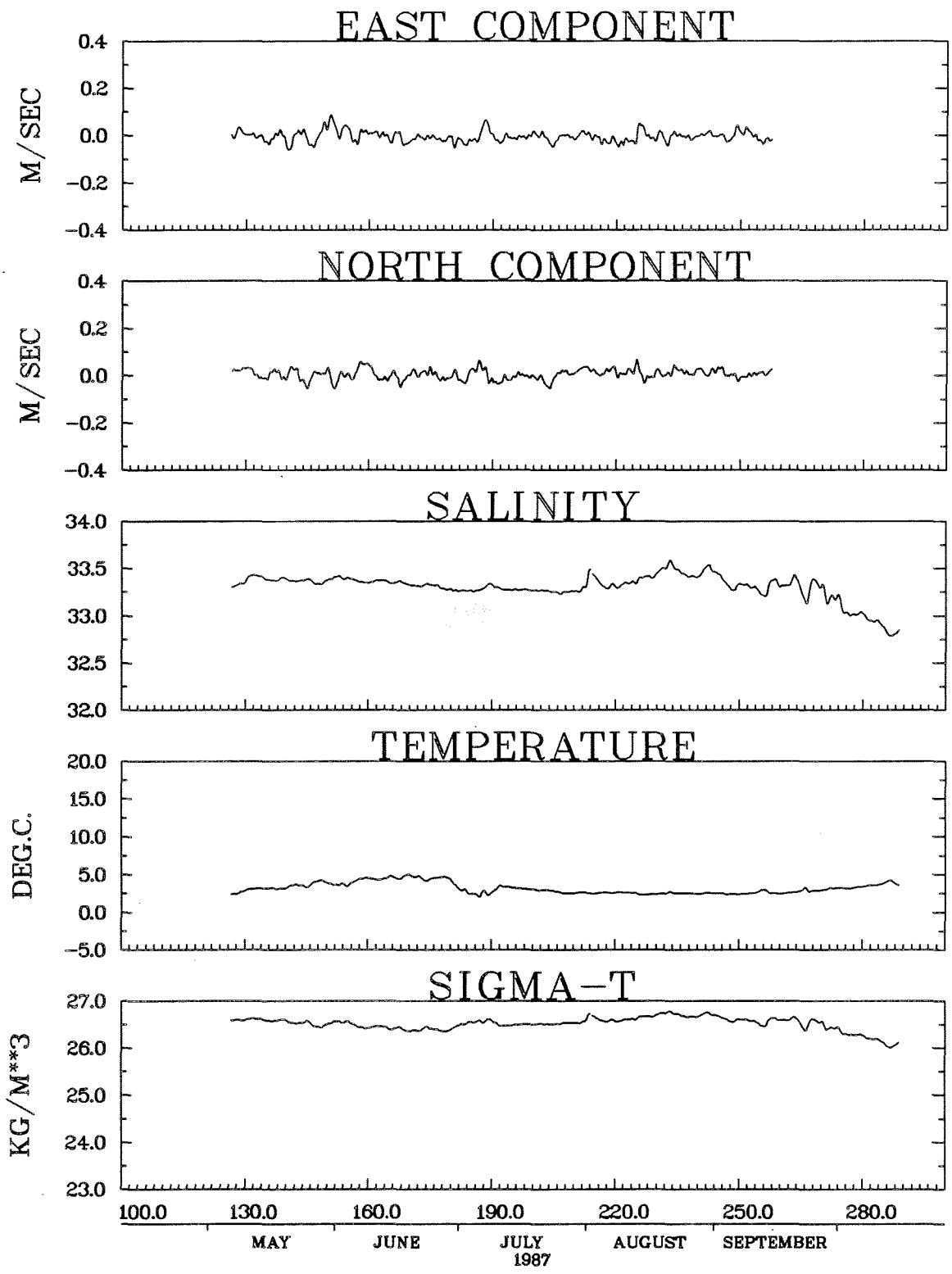
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	6435		1354	1440	1488	1488	665	
($\bar{X}$)	-0.004		0.001	-0.005	-0.005	-0.007	-0.003	
(Σ_1)	0.111		0.108	0.106	0.115	0.115	0.114	
(Σ_2)	0.023		0.030	0.020	0.021	0.020	0.020	
North Velocity Component ($m.s^{-1}$)								
(N)	6435		1354	1440	1488	1488	665	
($\bar{X}$)	0.006		0.006	0.004	-0.001	0.014	0.008	
(Σ_1)	0.079		0.078	0.080	0.079	0.081	0.073	
(Σ_2)	0.021		0.023	0.022	0.024	0.016	0.014	
Salinity (PSS78)								
(N)	7945		1340	1418	1471	1462	1424	830
($\bar{X}$)	33.30		33.37	33.34	33.27	33.42	33.30	32.93
(Σ_1)	0.15		0.05	0.04	0.03	0.08	0.09	0.12
(Σ_2)	0.14		0.03	0.04	0.02	0.07	0.08	0.10
Temperature (^{o}C)								
(N)	8053		1354	1440	1488	1488	1440	843
($\bar{X}$)	3.16		3.25	4.35	2.84	2.51	2.68	3.52
(Σ_1)	0.73		0.51	0.45	0.35	0.11	0.27	0.30
(Σ_2)	0.73		0.47	0.40	0.33	0.10	0.26	0.31
Sigma-t ($kg.m^3$)								
(N)	649		102	120	124	123	120	60
($\bar{X}$)	26.51		26.56	26.43	26.52	26.66	26.56	26.20
(Σ_1)								
(Σ_2)	0.14		0.05	0.06	0.03	0.06	0.08	0.11

N: *number of samples in statistics* $\bar{X}$: *mean value*

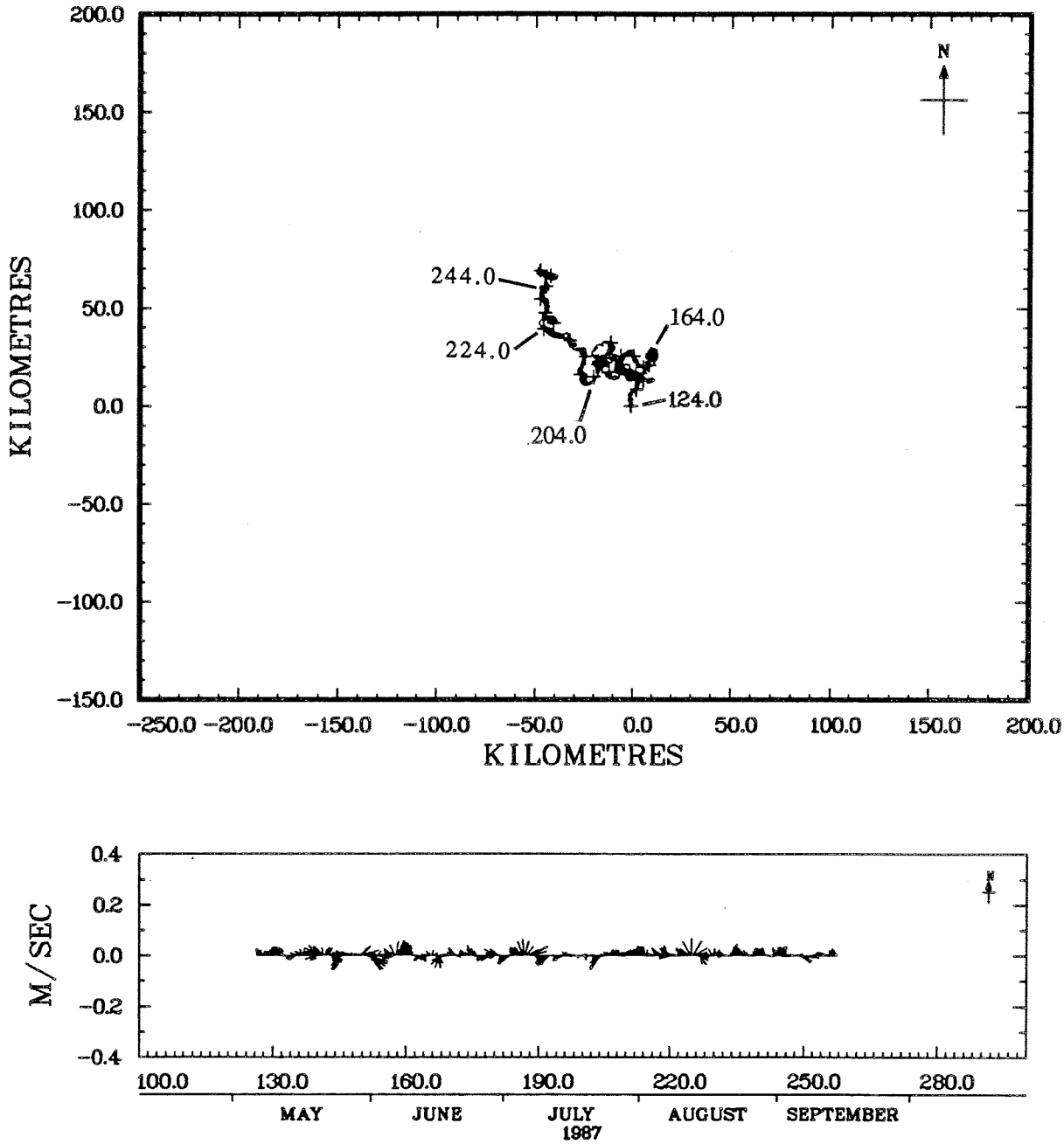
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 830 AT 44M.
SOUTHEAST SHOAL 1987



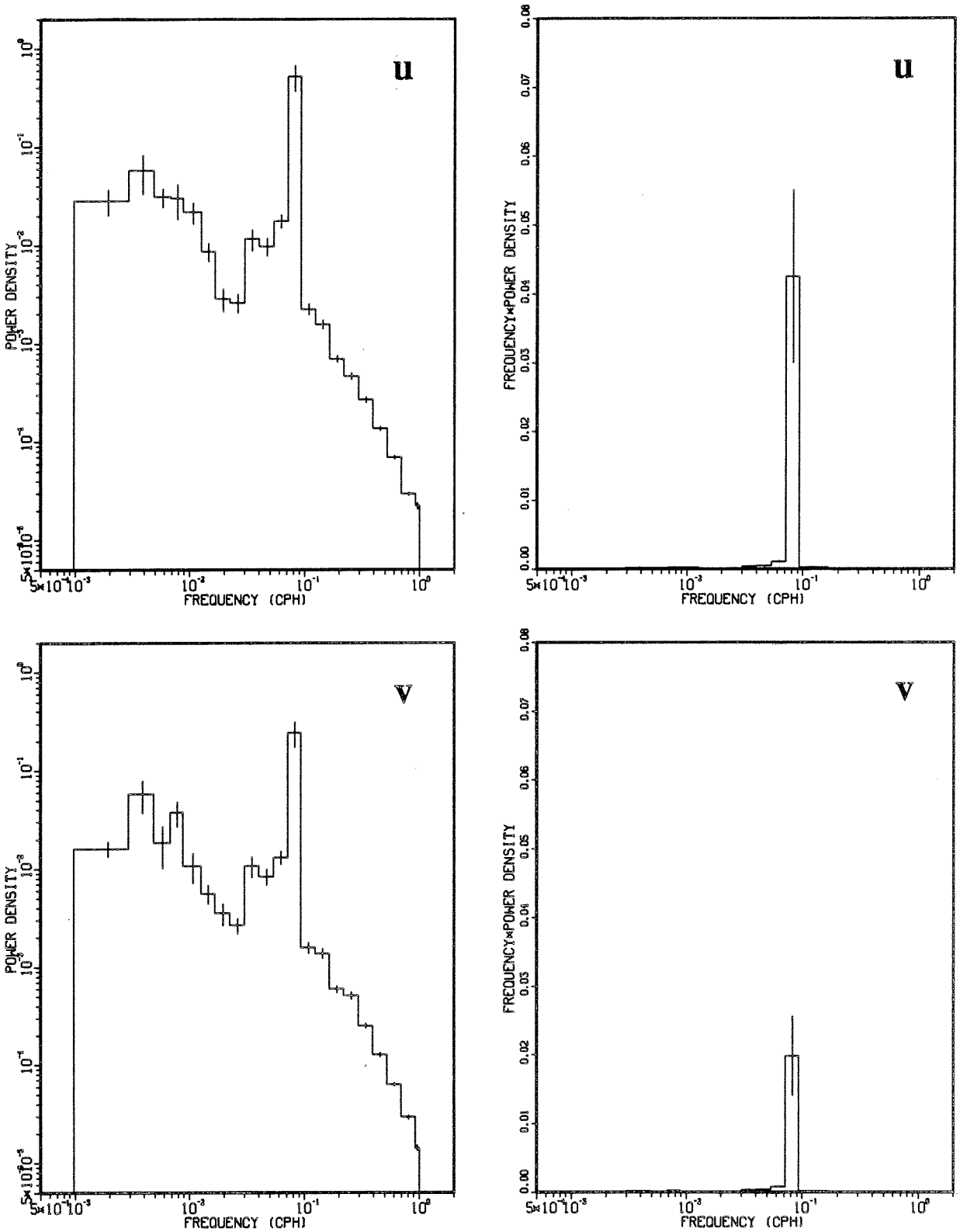
MOORING 830 AT 44M.
SOUTHEAST SHOAL 1987 - LOW PASS



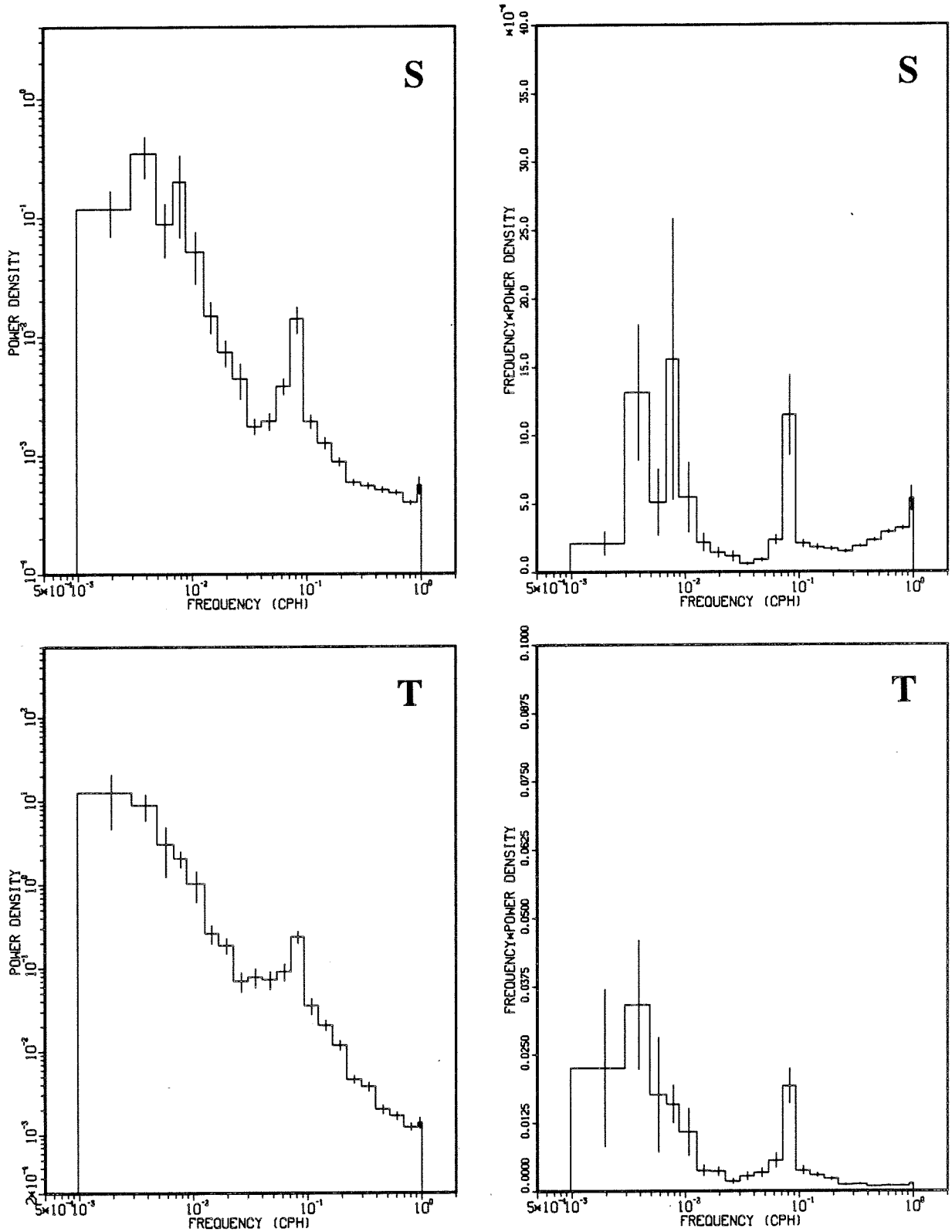
MOORING 830 AT 44M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	134.0 DAYS CENTERED AT DAY 190, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(830,044M)	K1	.009	.007	323	100/C	.008	232	.008	132
	O1	.012	.009	133	255/C	.010	220	.010	114
	M2	.146	.093	104	51/C	.144	42	.097	300
	S2	.044	.028	115	68/C	.042	51	.032	301
	N2	.038	.024	105	37/C	.037	27	.025	284
	MF	.005	.001	20	35/C	.002	64	.005	31
	M4	.003	.002	32	148/C	.002	197	.003	124
	MS4	.002	.001	43	207/A	.002	189	.002	222



MOORING 830 AT 44M.
SOUTHEAST SHOAL 1987



MOORING 830 AT 44M.
SOUTHEAST SHOAL 1987

THERMISTOR CHAIN

Mooring 830

(sampling interval 60 min)

	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature at 12m (°C)								
(N)	4024		675	720	744	744	720	421
($\bar{X}$)	10.37		5.56	6.42	10.82	13.51	13.40	13.31
(Σ_1)	3.53		0.94	1.06	1.61	1.49	0.73	0.48
(Σ_2)	3.46		0.75	1.03	1.53	1.42	0.66	0.40
Temperature at 15m (°C)								
(N)	4023		674	720	744	744	720	421
($\bar{X}$)	9.75		5.16	6.14	9.71	12.24	13.06	13.24
(Σ_1)	3.41		1.01	0.98	1.30	1.67	1.03	0.48
(Σ_2)	3.28		0.81	0.93	1.00	1.24	0.80	0.40
Temperature at 18m (°C)								
(N)	4025		676	720	744	744	720	421
($\bar{X}$)	8.67		4.76	5.84	7.94	9.71	12.18	13.24
(Σ_1)	3.48		1.19	0.86	1.71	3.11	1.96	0.48
(Σ_2)	3.23		1.04	0.78	0.81	2.59	1.62	0.41
Temperature at 21m (°C)								
(N)	4024		675	720	744	744	720	421
($\bar{X}$)	7.26		4.44	5.50	5.17	7.47	10.14	13.16
(Σ_1)	3.58		1.30	0.68	1.97	3.40	3.15	0.52
(Σ_2)	3.31		1.19	0.55	1.06	3.17	2.60	0.45

N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

THERMISTOR CHAIN (con't)

Mooring 830

(sampling interval 60 min)

	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature at 24m (°C)								
(N)	4025		676	720	744	744	720	421
($\bar{X}$)	5.82		4.18	5.18	3.69	5.07	6.86	12.84
(Σ_1)	3.28		1.30	0.49	1.14	2.49	3.45	1.00
(Σ_2)	2.99		1.21	0.33	0.93	2.02	2.90	0.75
Temperature at 27m (°C)								
(N)	4025		676	720	744	744	720	421
($\bar{X}$)	4.56		3.94	4.96	3.28	3.20	3.92	10.63
(Σ_1)	2.54		1.19	0.35	0.67	1.05	1.87	2.47
(Σ_2)	2.23		1.12	0.24	0.59	0.63	1.38	1.36
Temperature at 30m (°C)								
(N)	4026		677	720	744	744	720	421
($\bar{X}$)	3.66		3.72	4.82	3.12	2.66	2.90	5.63
(Σ_1)	1.33		1.02	0.30	0.49	0.32	0.43	2.16
(Σ_2)	1.09		0.94	0.24	0.43	0.18	0.32	0.76
Temperature at 33m (°C)								
(N)	4026		677	720	744	744	720	421
($\bar{X}$)	3.34		3.51	4.70	3.01	2.53	2.75	3.72
(Σ_1)	0.88		0.83	0.30	0.42	0.15	0.28	0.52
(Σ_2)	0.85		0.75	0.22	0.36	0.11	0.26	0.35

N: *number of samples in statistics* $\bar{X}$: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

THERMISTOR CHAIN (con't)

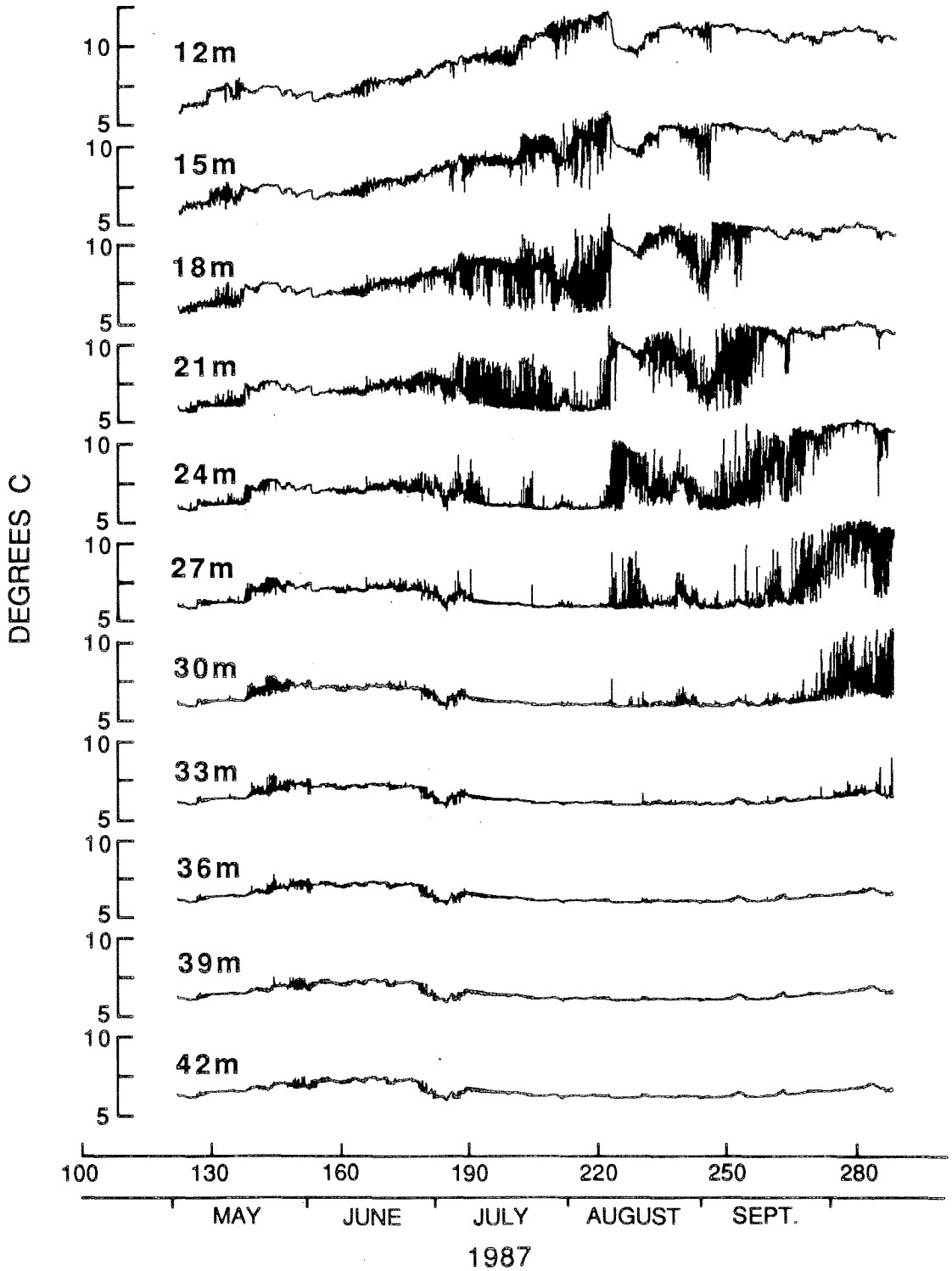
Mooring 830

(sampling interval 60 min)

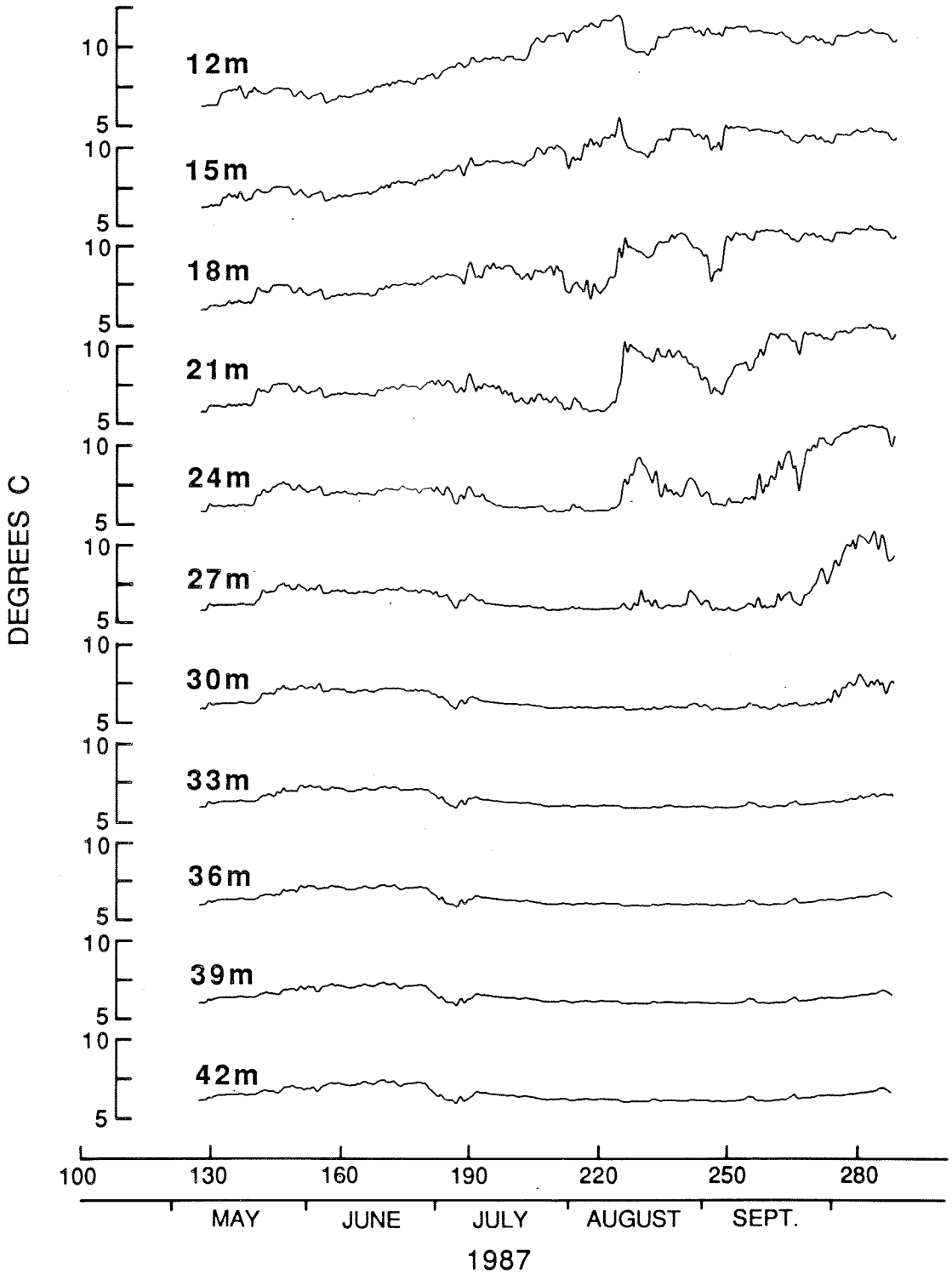
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature at 36m (°C)								
(N)	4026		677	720	744	744	720	421
($\bar{X}$)	3.27		3.39	4.62	2.94	2.52	2.73	3.57
(Σ_1)	0.82		0.68	0.32	0.38	0.13	0.27	0.31
(Σ_2)	0.81		0.63	0.24	0.33	0.11	0.26	0.31
Temperature at 39m (°C)								
(N)	4026		677	720	744	744	720	421
($\bar{X}$)	3.20		3.30	4.51	2.87	2.48	2.68	3.51
(Σ_1)	0.78		0.59	0.36	0.36	0.12	0.27	0.30
(Σ_2)	0.78		0.55	0.28	0.32	0.10	0.26	0.31
Temperature at 42m (°C)								
(N)	4026		677	720	744	744	720	421
($\bar{X}$)	3.18		3.27	4.43	2.86	2.50	2.68	3.51
(Σ_1)	0.75		0.53	0.40	0.36	0.11	0.27	0.30
(Σ_2)	0.75		0.49	0.35	0.32	0.10	0.26	0.31

N: *number of samples in statistics* X: *mean value*

Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

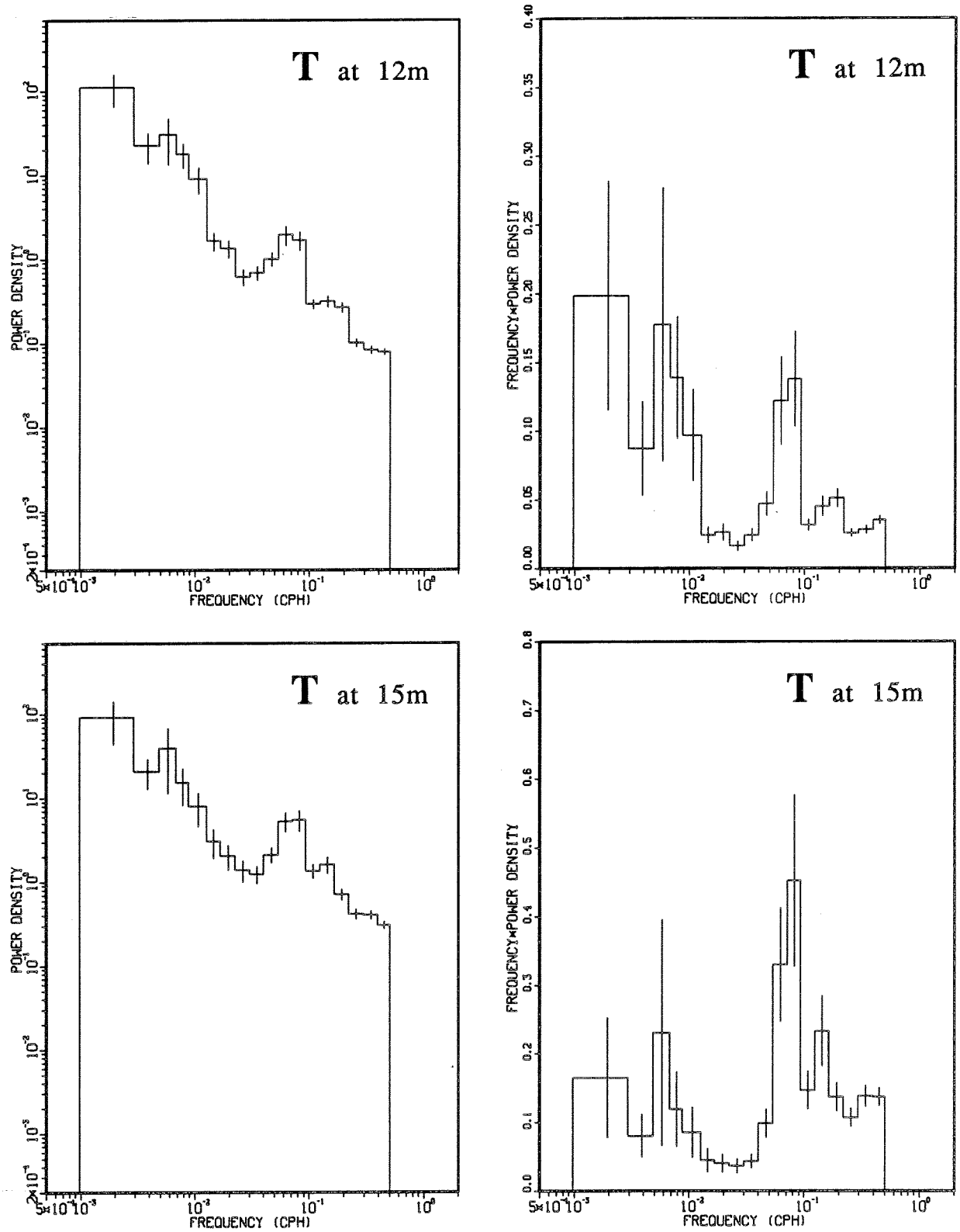


TEMPERATURE
MOORING 830; THERMISTOR - CHAIN
SOUTHEAST SHOAL 1987

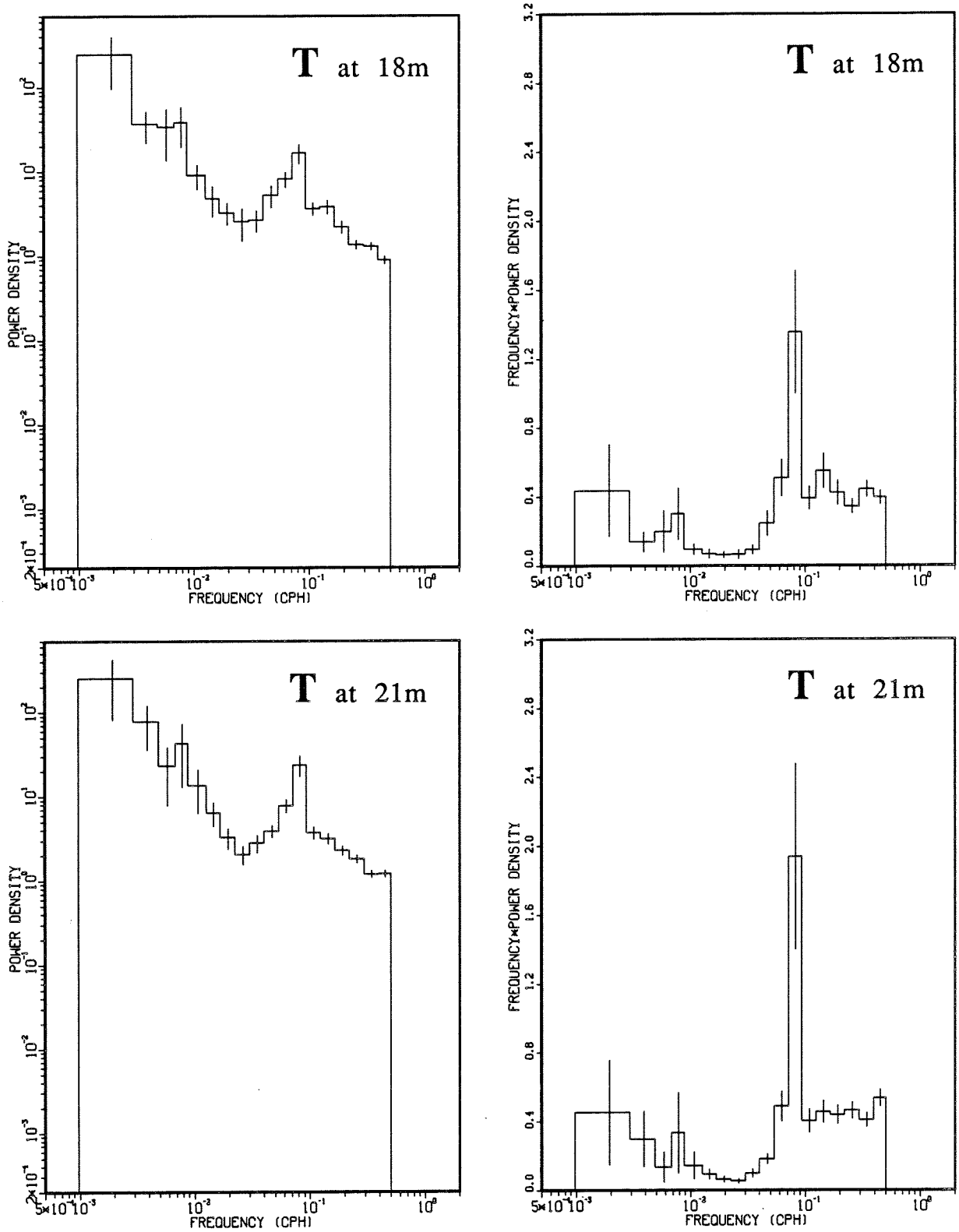


TEMPERATURE

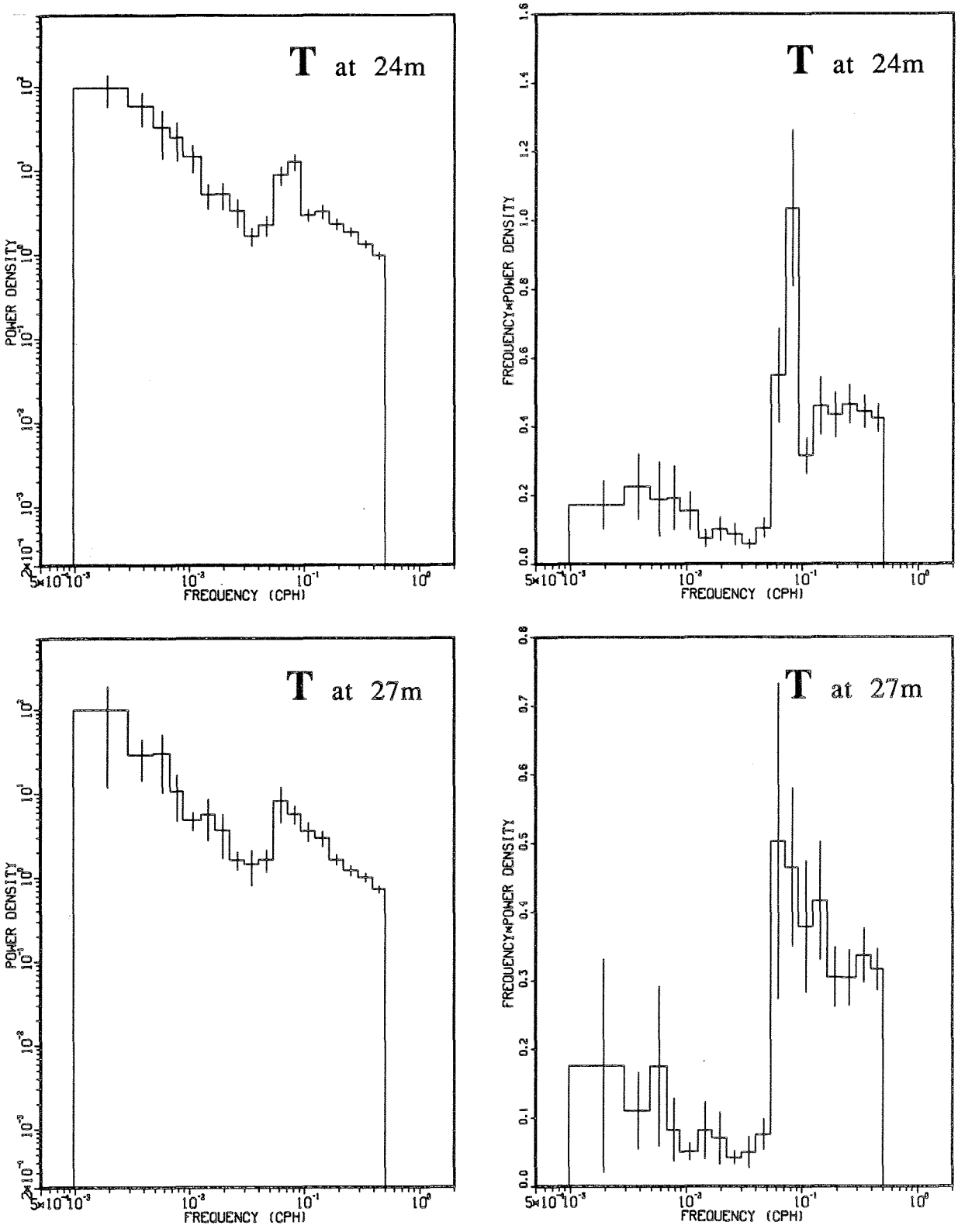
MOORING 830; THERMISTOR - CHAIN
SOUTHEAST SHOAL 1987 - LOW PASS



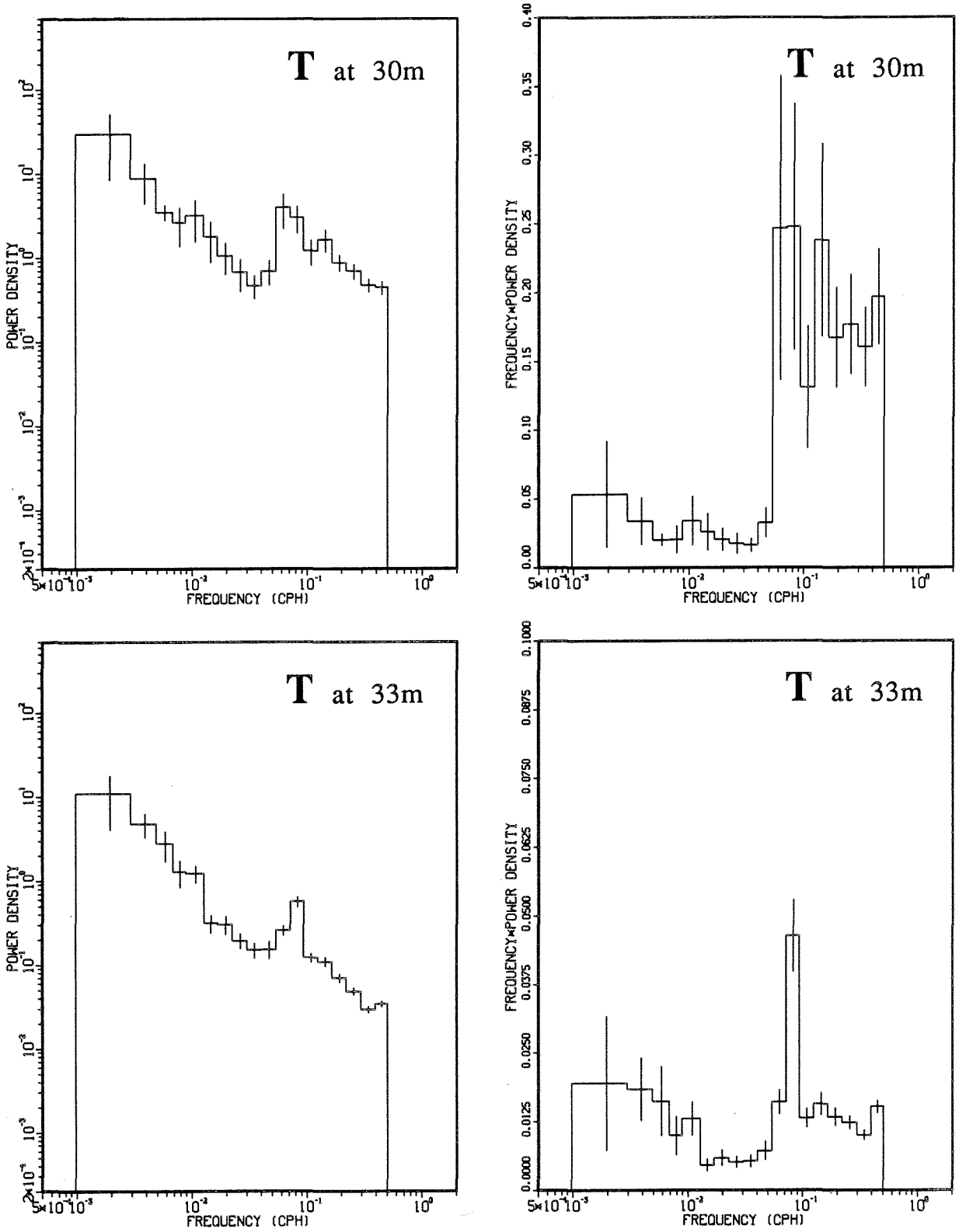
MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



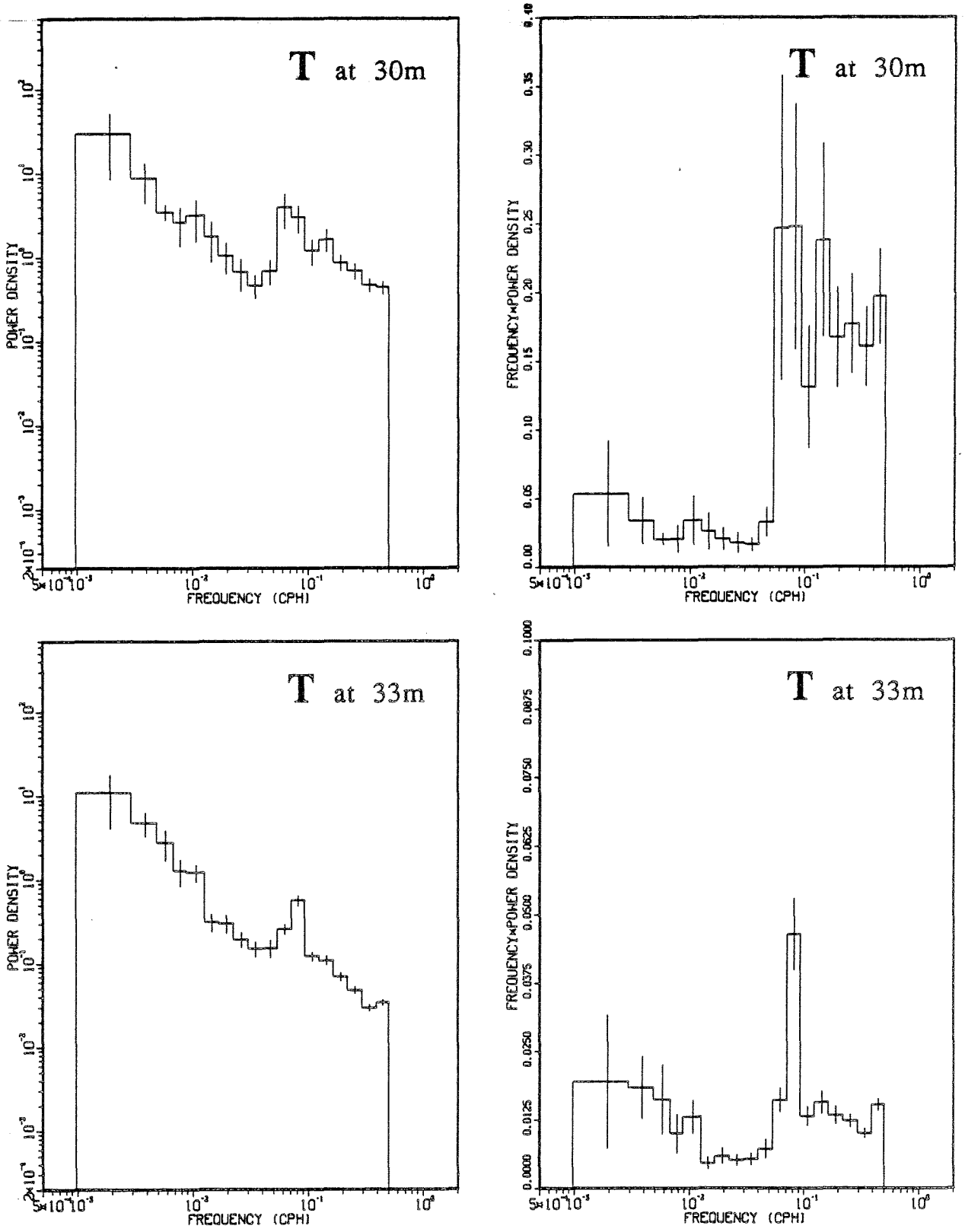
MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



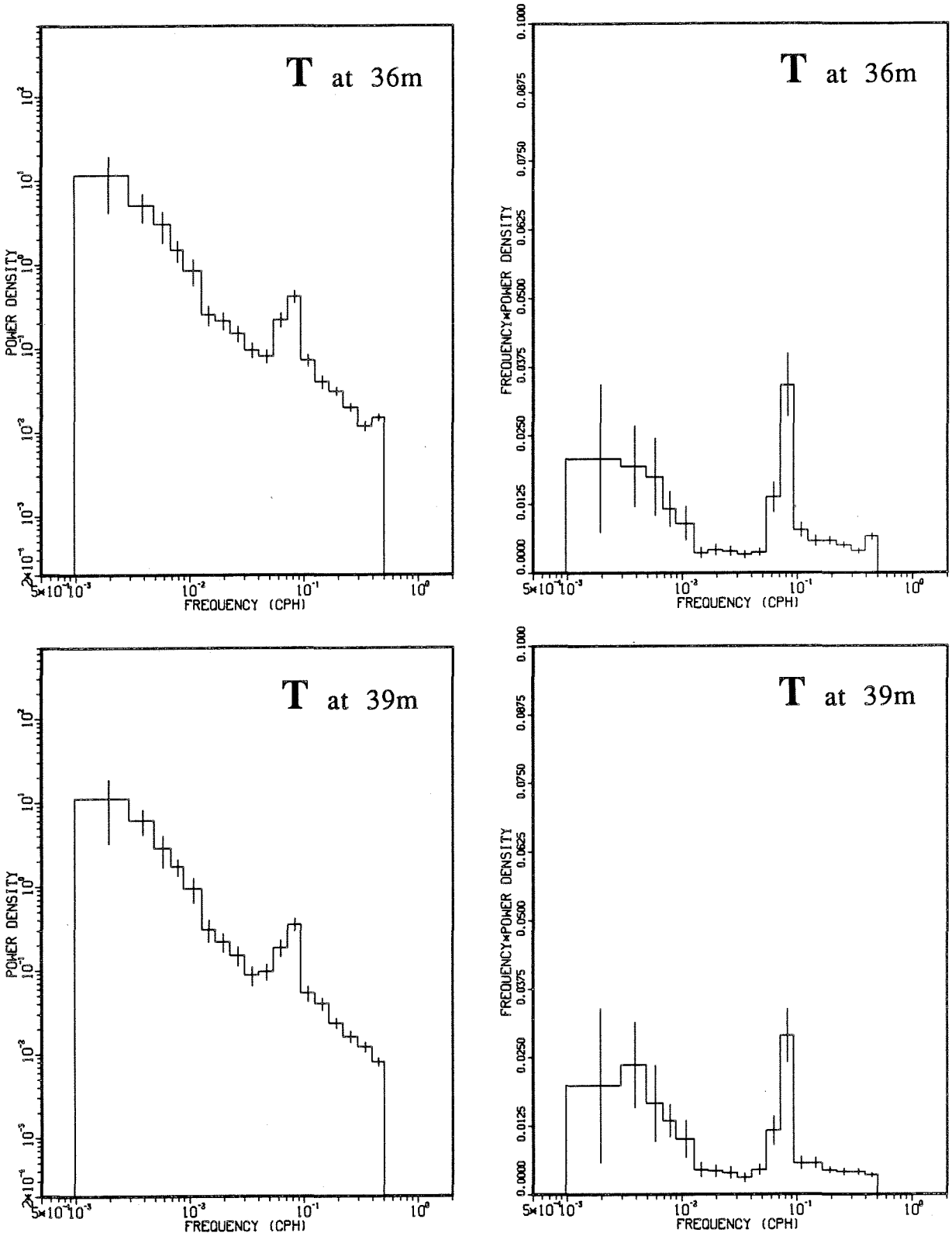
MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



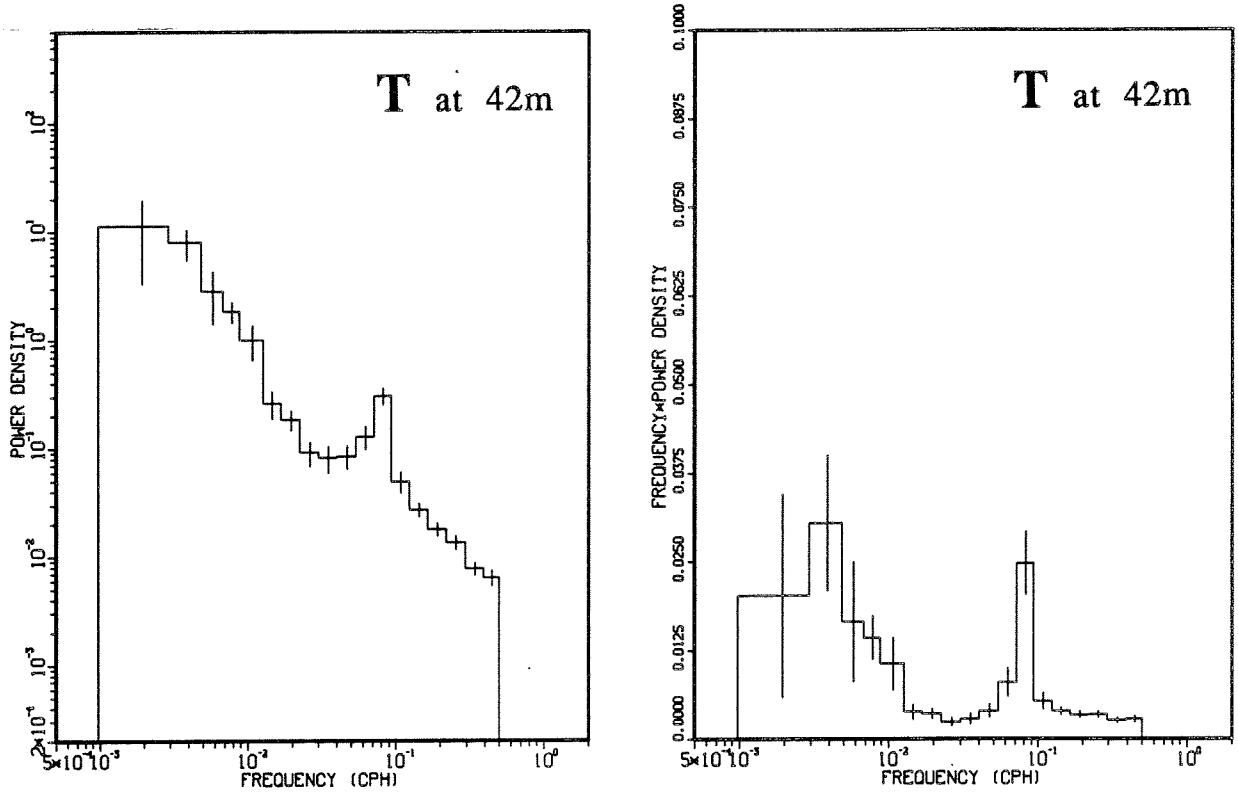
MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987



MOORING 830; THERMISTOR-CHAIN
SOUTHEAST SHOAL 1987

RYAN THERMOGRAPH

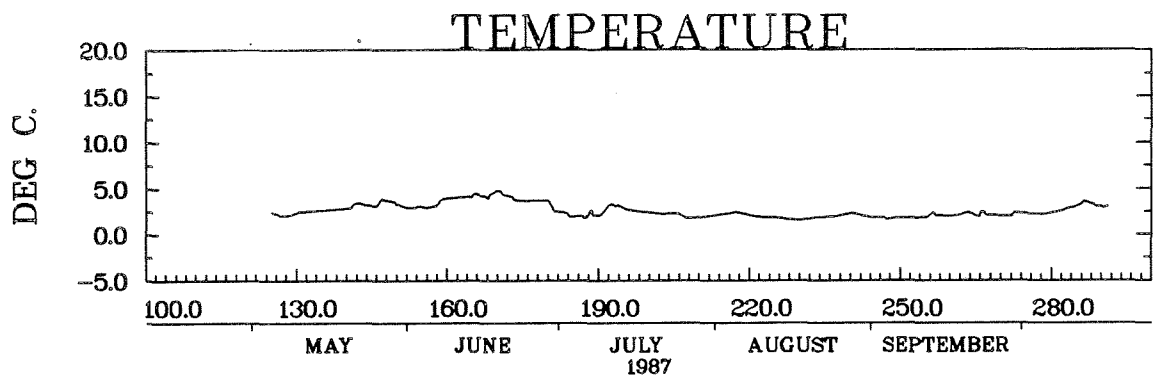
Mooring 830 at 54m

(sampling interval 4 hours)

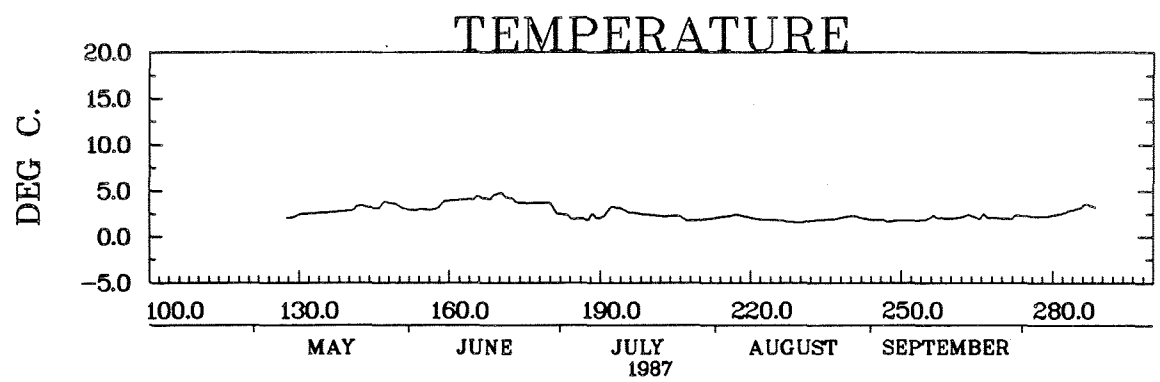
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature (°C)								
(N)	1000		163	180	186	186	180	105
($\bar{X}$)	2.6		2.9	3.7	2.3	2.0	2.0	2.7
(Σ_1)	0.7		0.5	0.5	0.4	0.2	0.2	0.4
(Σ_2)	0.8		0.5	0.5	0.4	0.2	0.2	0.5

N: *number of samples in statistics* $\bar{X}$: *mean value*

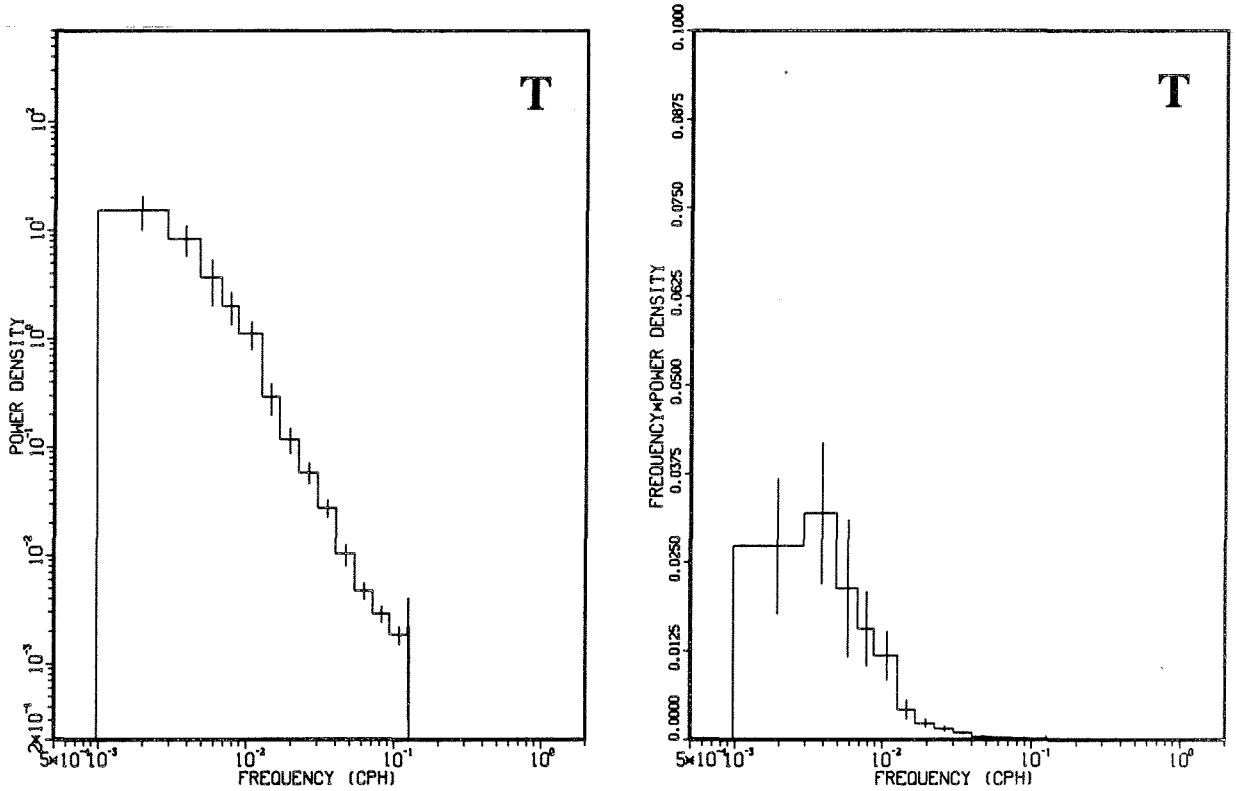
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 830 AT 54M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987



MOORING 830 AT 54M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987 - LOW PASS



MOORING 830 AT 54M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987

CURRENT METER

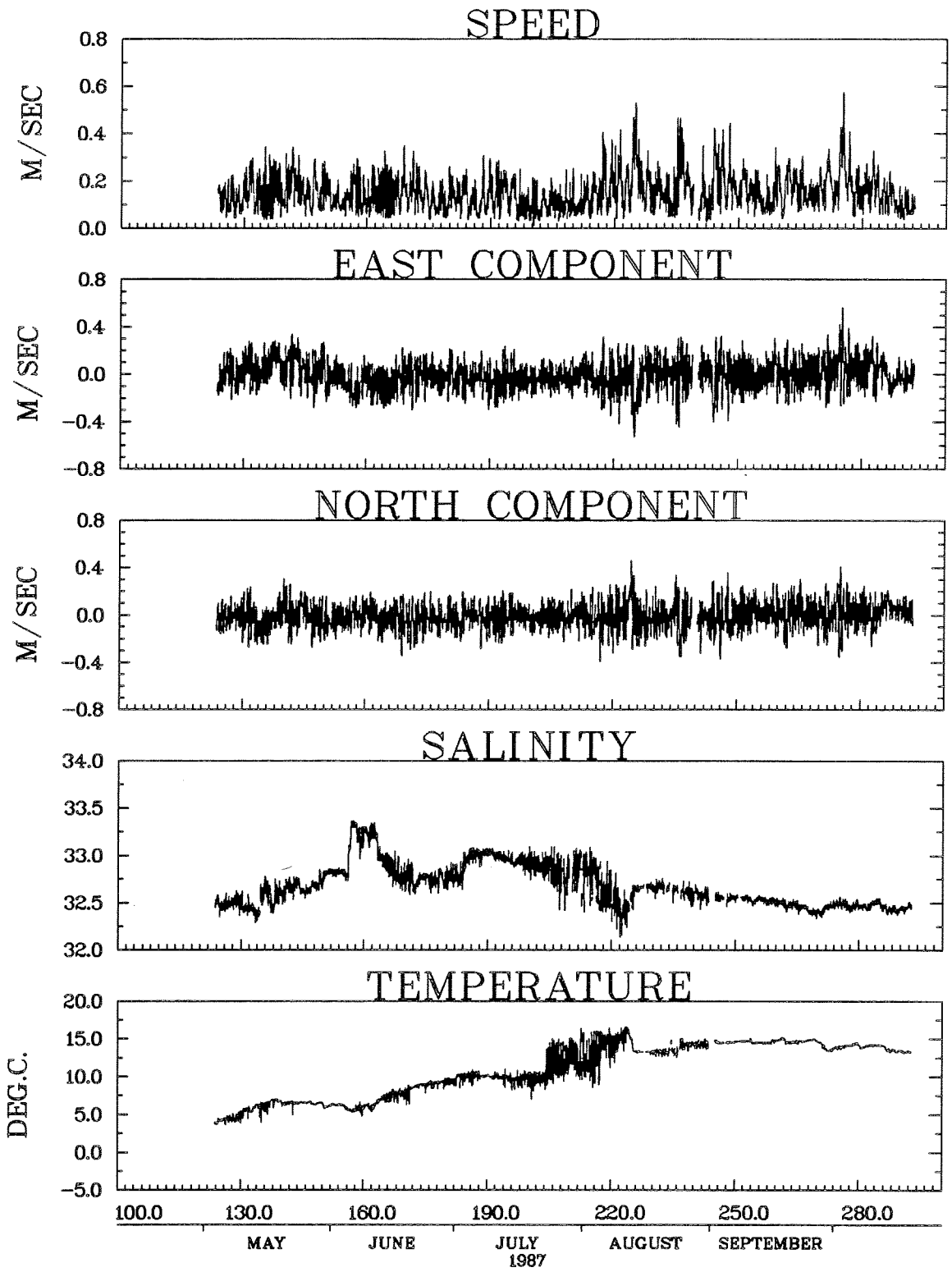
Mooring 831 at 14m

(sampling interval 30 min)

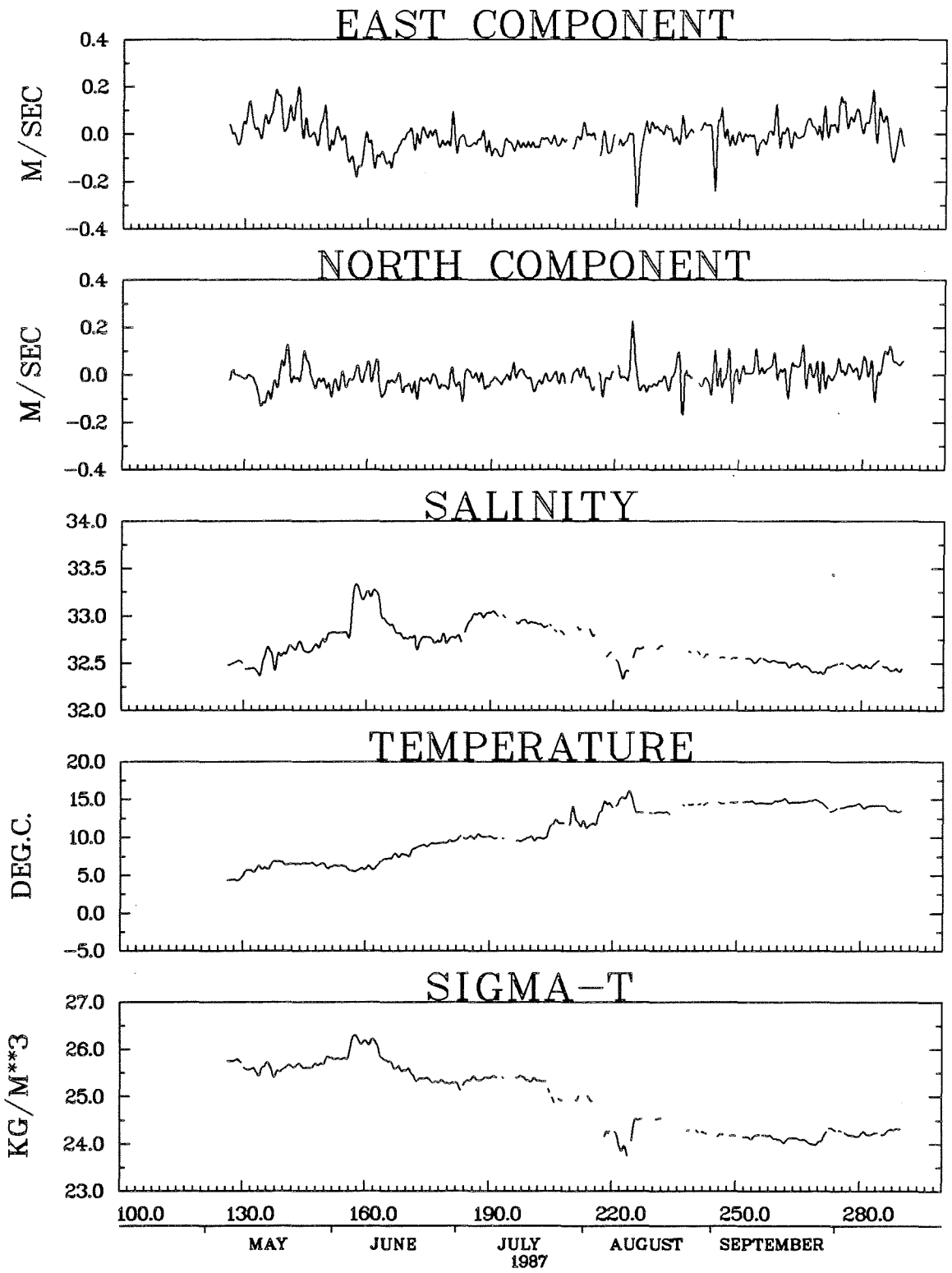
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	8001		1366	1439	1468	1397	1440	891
($\bar{X}$)	-0.007		0.039	-0.048	-0.037	-0.017	0.003	0.033
(Σ_1)	0.127		0.121	0.111	0.091	0.143	0.135	0.136
(Σ_2)	0.065		0.065	0.056	0.026	0.064	0.049	0.071
North Velocity Component ($m.s^{-1}$)								
(N)	8001		1366	1439	1468	1397	1440	891
($\bar{X}$)	-0.007		-0.019	-0.024	-0.014	-0.016	0.014	0.035
(Σ_1)	0.111		0.107	0.095	0.087	0.127	0.123	0.114
(Σ_2)	0.048		0.053	0.035	0.028	0.056	0.046	0.044
Salinity (PSS78)								
(N)	7098		1342	1408	1191	1062	1249	846
($\bar{X}$)	32.68		32.58	32.90	32.93	32.62	32.50	32.47
(Σ_1)	0.22		0.12	0.20	0.10	0.13	0.06	0.04
(Σ_2)	0.23		0.12	0.20	0.08	0.12	0.05	0.03
Temperature (^{o}C)								
(N)	7619		1366	1436	1354	1252	1334	877
($\bar{X}$)	10.73		5.82	7.49	10.54	13.73	14.56	13.87
(Σ_1)	3.56		0.94	1.41	1.33	1.35	0.34	0.37
(Σ_2)	3.50		0.77	1.38	1.06	1.13	0.33	0.30
Sigma-t ($kg.m^3$)								
(N)	520		101	120	85	56	101	57
($\bar{X}$)	25.01		25.65	25.69	25.30	24.33	24.13	24.24
(Σ_1)								
(Σ_2)	0.71		0.10	0.33	0.16	0.29	0.08	0.05

N: *number of samples in statistics* $\bar{X}$: *mean value*

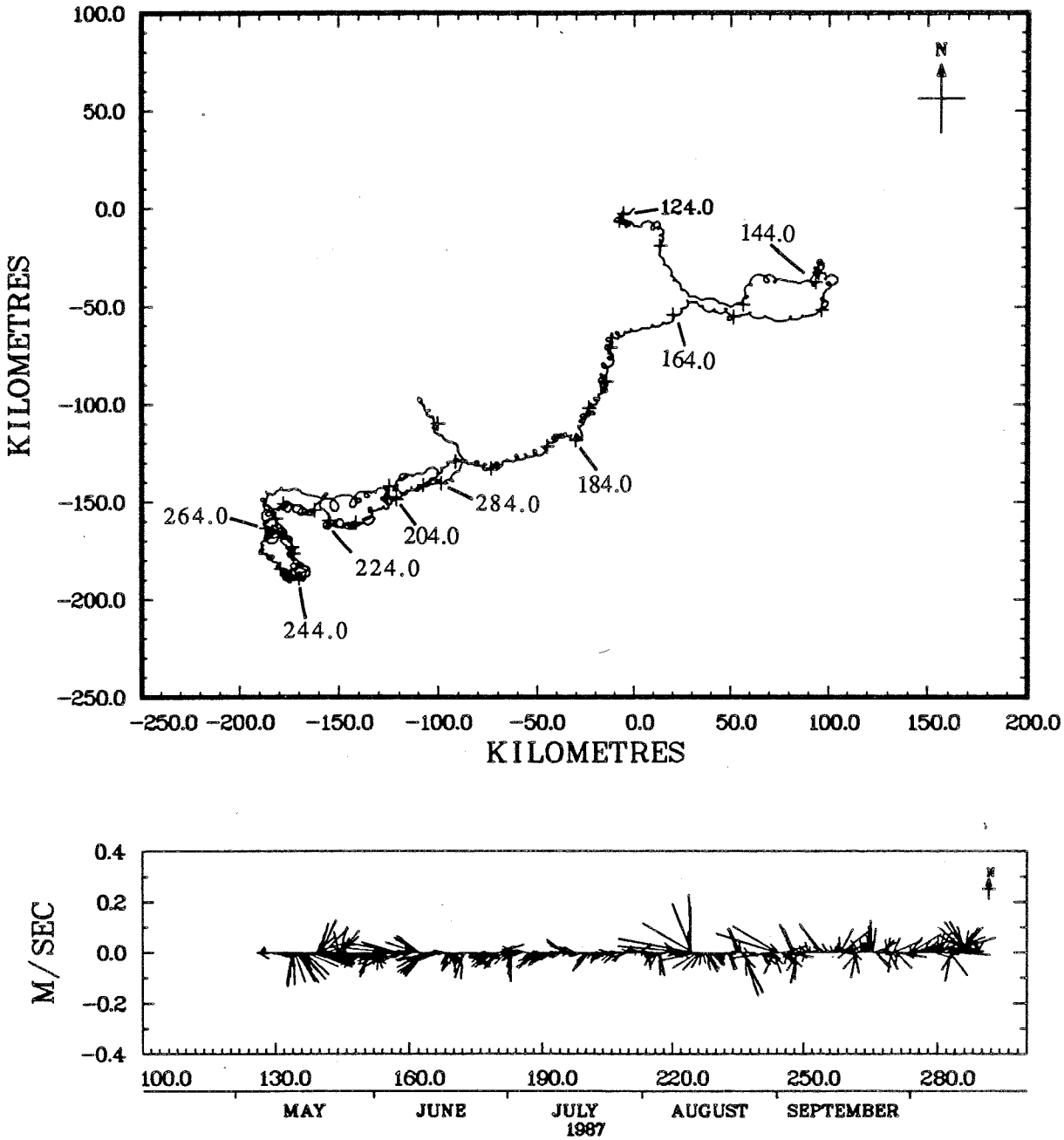
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 831 AT 14M.
SOUTHEAST SHOAL 1987



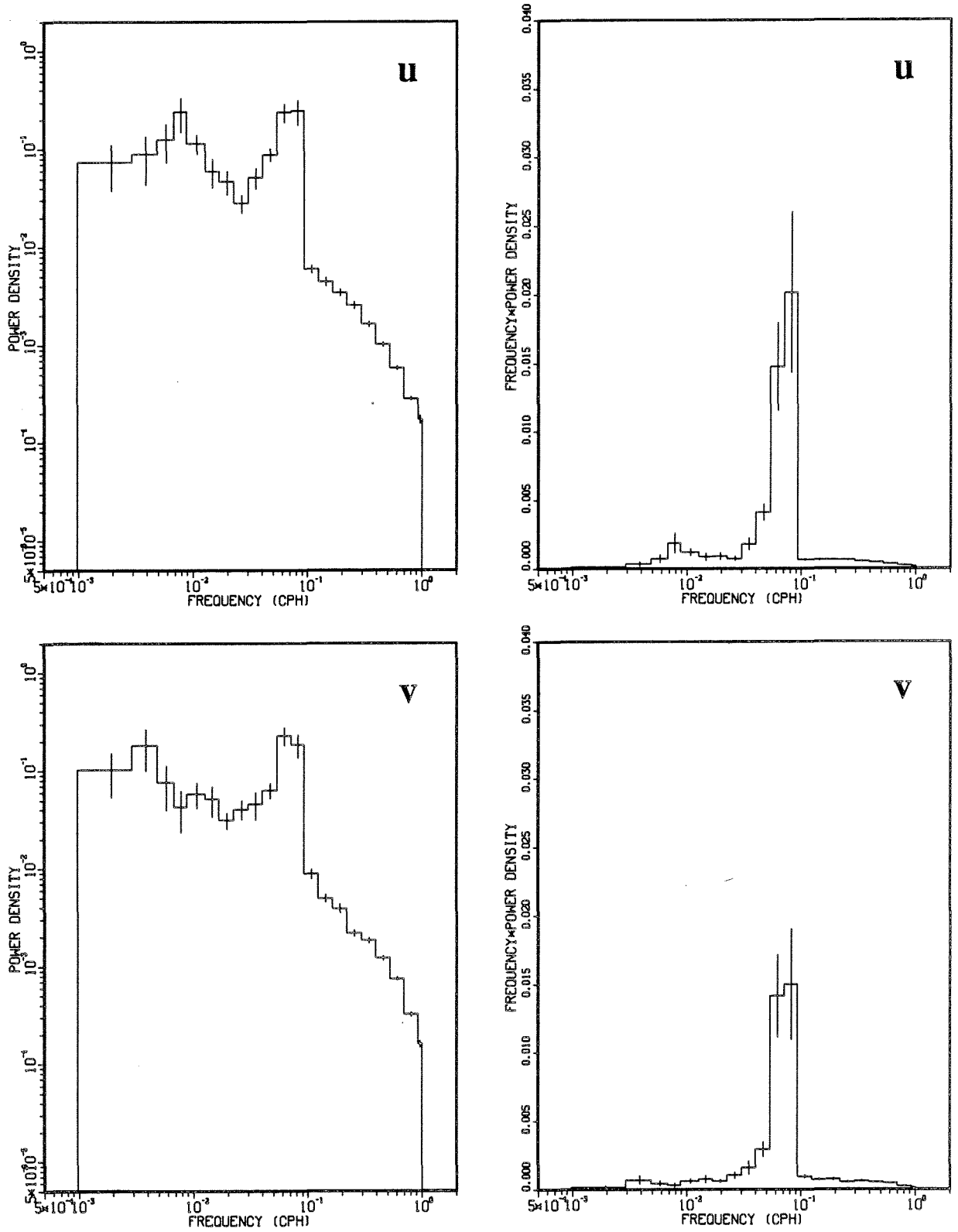
MOORING 831 AT 14M.
SOUTHEAST SHOAL 1987 - LOW PASS



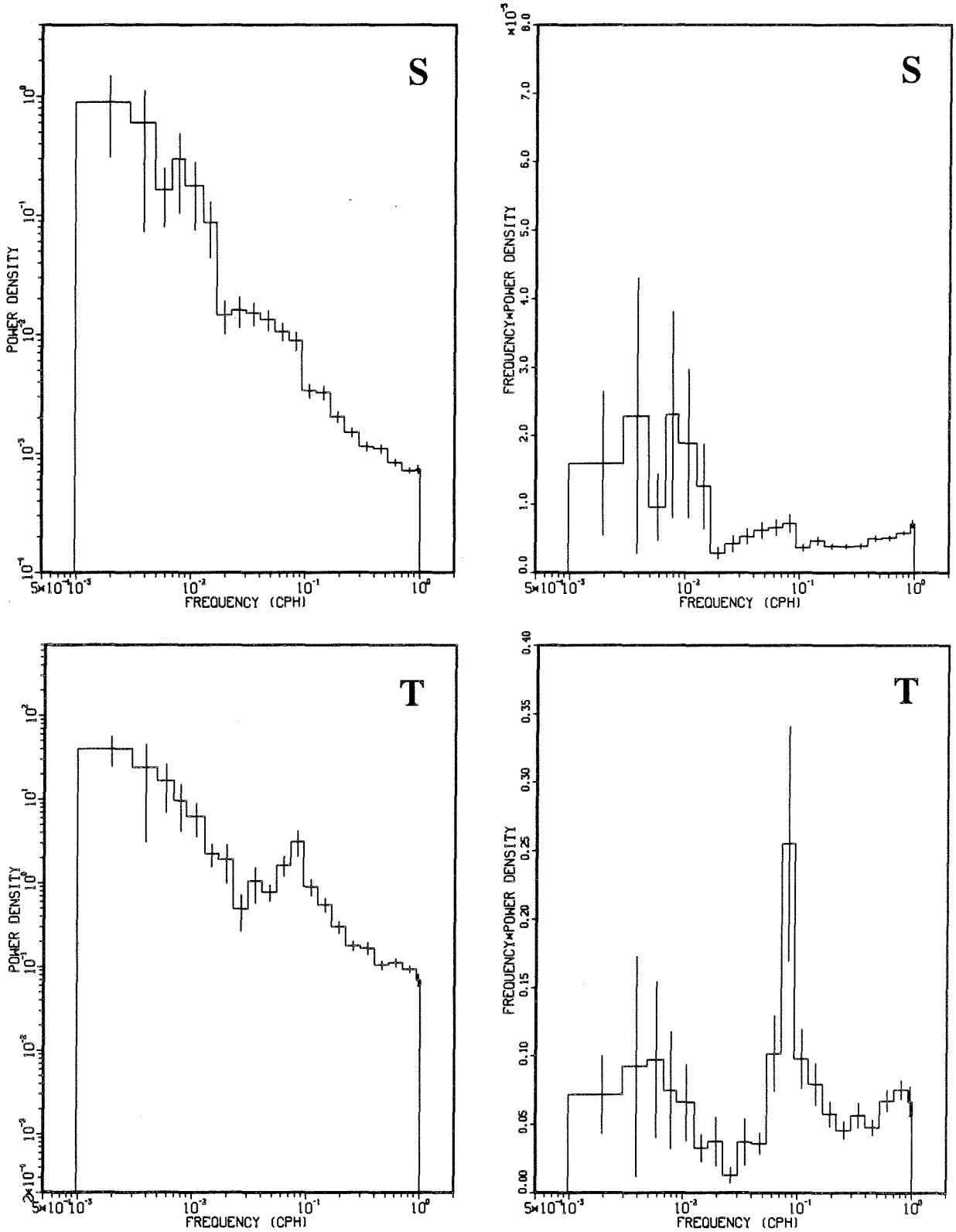
MOORING 831 AT 14M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	169.0 DAYS CENTERED AT DAY 208, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(831,013M)	K1	.007	.003	46	99/C	.005	119	.005	76
	O1	.013	.010	132	227/C	.012	193	.011	87
	M2	.091	.072	93	54/C	.091	51	.072	320
	S2	.027	.024	22	306/C	.025	12	.027	286
	N2	.028	.023	92	38/C	.028	37	.023	306
	MF	.009	.004	359	337/C	.004	70	.009	338
	M4	.002	.001	127	34/C	.002	24	.001	231
	MS4	.002	.001	61	357/C	.002	16	.002	310



MOORING 831 AT 14M.
SOUTHEAST SHOAL 1987



MOORING 831 AT 14M.
SOUTHEAST SHOAL 1987

CURRENT METER

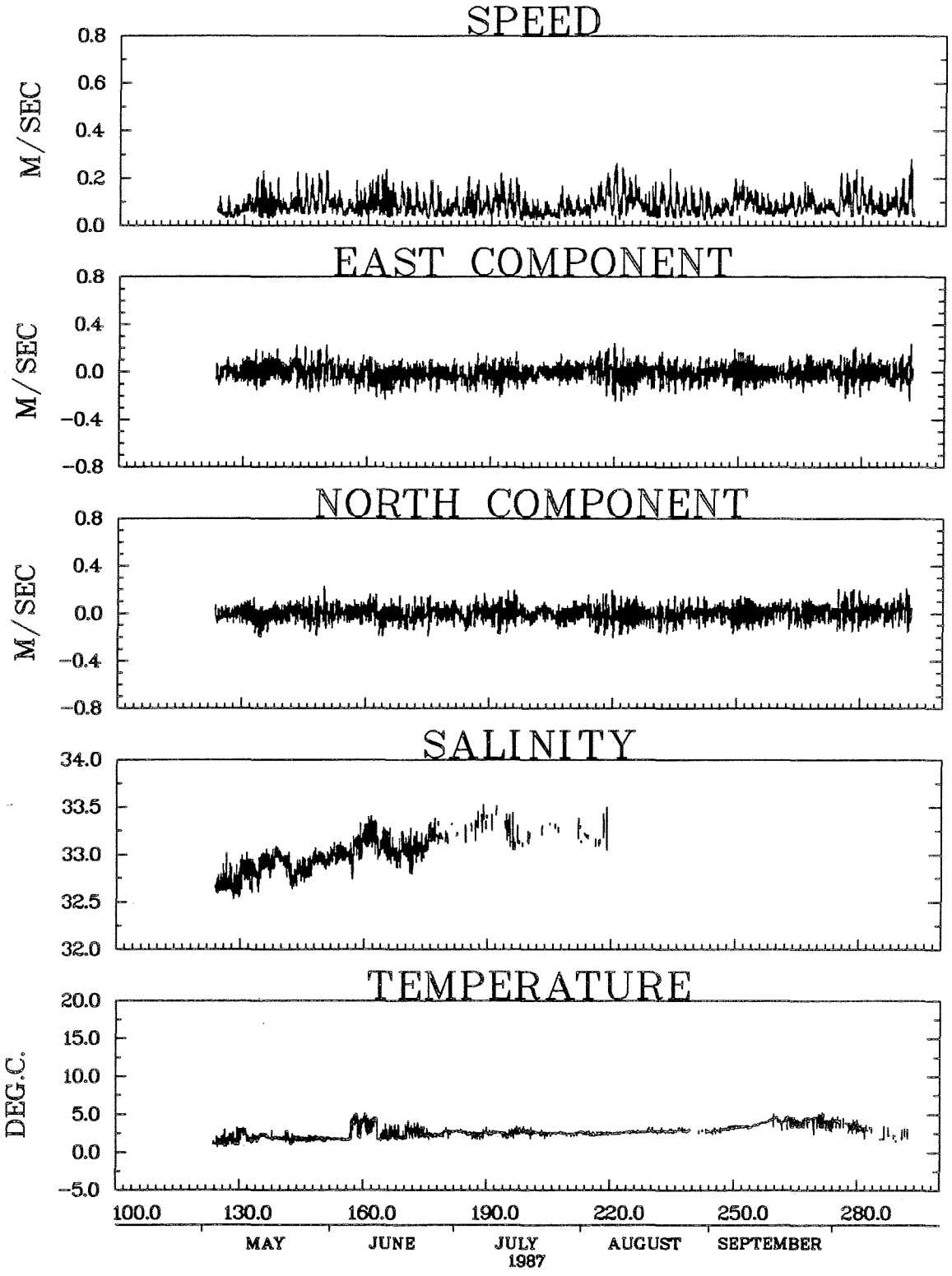
Mooring 831 at 47m

(sampling interval 30 min)

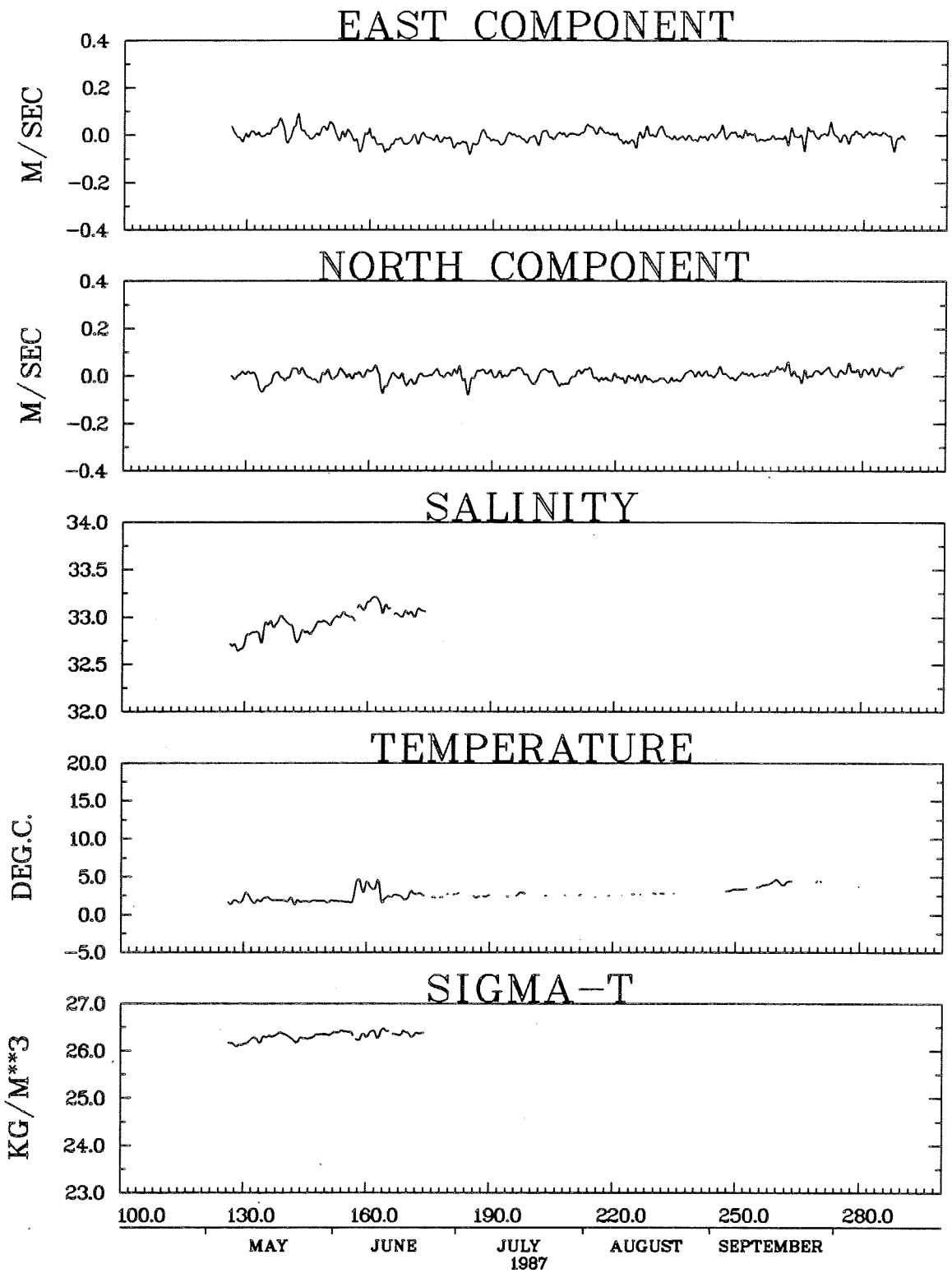
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	8105		1366	1440	1488	1488	1440	883
($\bar{X}$)	-0.005		0.014	-0.021	-0.010	-0.003	-0.002	-0.005
(Σ_1)	0.072		0.072	0.068	0.064	0.079	0.067	0.079
(Σ_2)	0.024		0.025	0.022	0.022	0.020	0.019	0.018
North Velocity Component ($m.s^{-1}$)								
(N)	8105		1366	1440	1488	1488	1440	883
($\bar{X}$)	0.004		-0.004	0.002	0.002	-0.005	0.012	0.023
(Σ_1)	0.065		0.063	0.062	0.059	0.070	0.061	0.073
(Σ_2)	0.021		0.023	0.022	0.024	0.015	0.016	0.013
Salinity (PSS78)								
(N)	2464		1301	941	186	36		
($\bar{X}$)	32.97		32.84	33.08	33.28			
(Σ_1)	0.19		0.12	0.10	0.12			
(Σ_2)	0.14		0.10	0.07				
Temperature ($^{\circ}C$)								
(N)	4552		1335	1036	698	584	668	231
($\bar{X}$)	2.60		1.83	2.71	2.56	2.67	3.80	3.15
(Σ_1)	0.88		0.44	0.97	0.25	0.19	0.59	0.84
(Σ_2)	0.86		0.28	0.83	0.19	0.16	0.48	0.00
Sigma-t ($kg.m^3$)								
(N)	187		103	84				
($\bar{X}$)	26.31		26.26	26.37				
(Σ_1)								
(Σ_2)	0.09		0.08	0.06				

N: *number of samples in statistics* $\bar{X}$: *mean value*

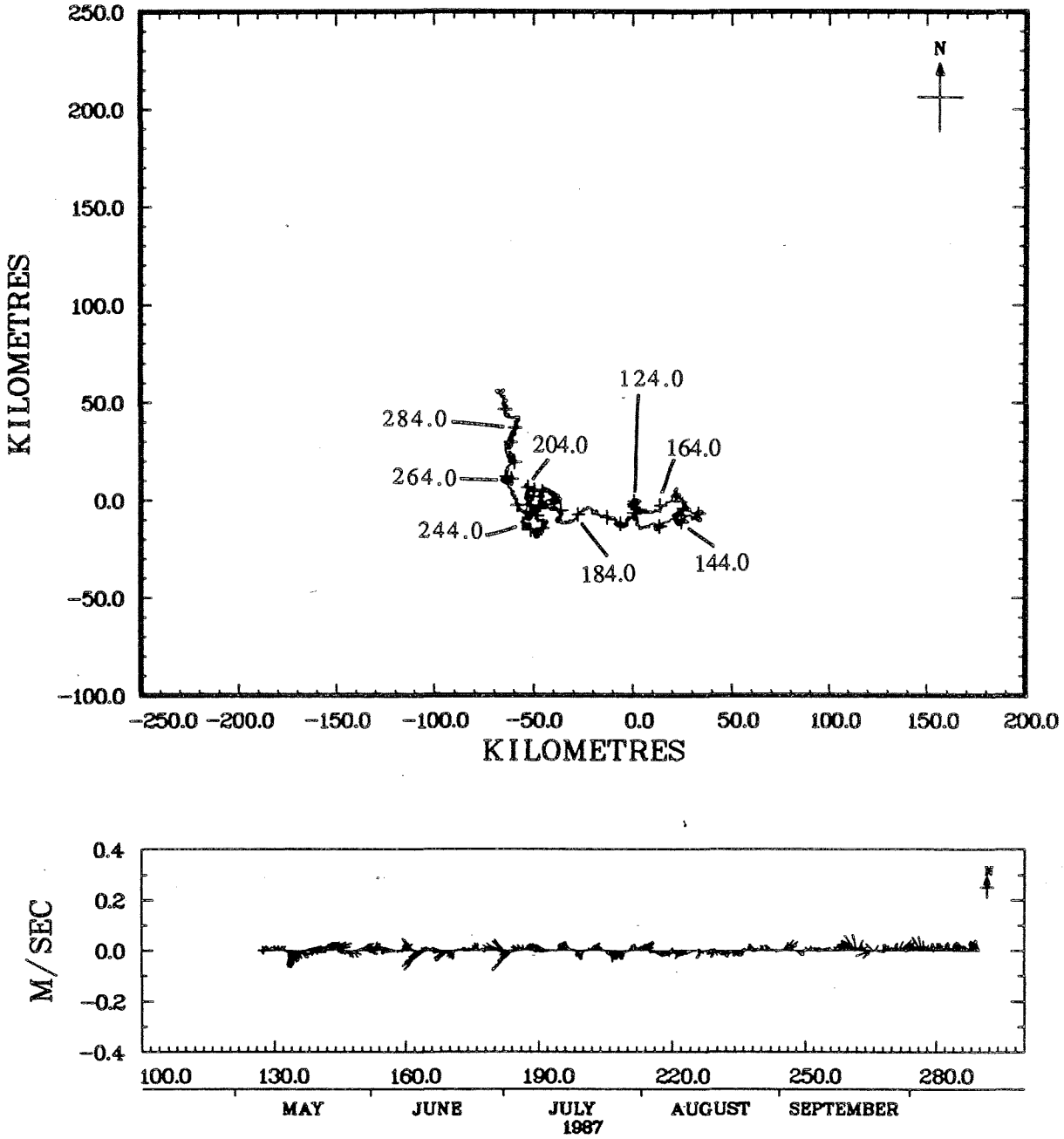
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 831 AT 47M.
SOUTHEAST SHOAL 1987



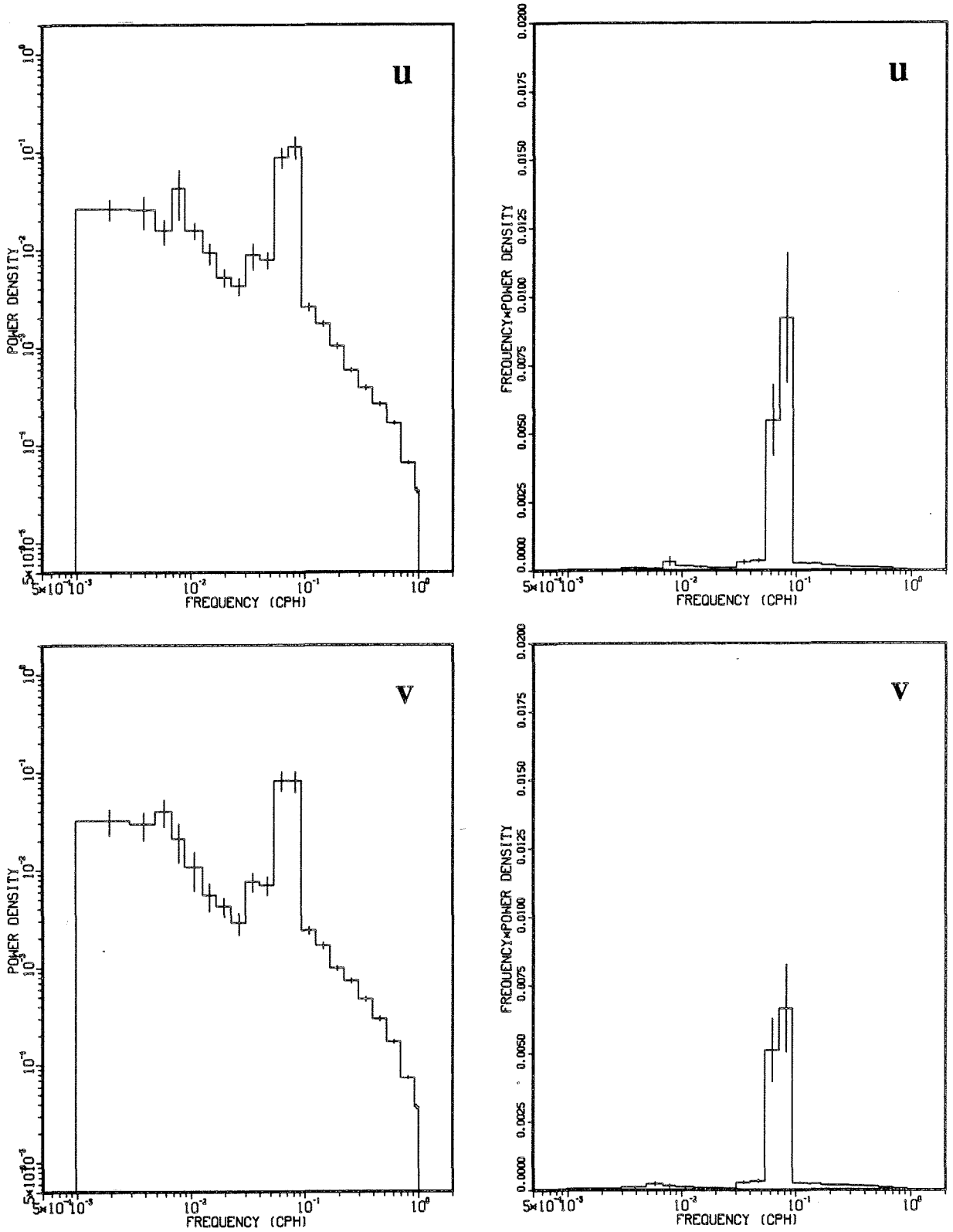
MOORING 831 AT 47M.
SOUTHEAST SHOAL 1987 - LOW PASS



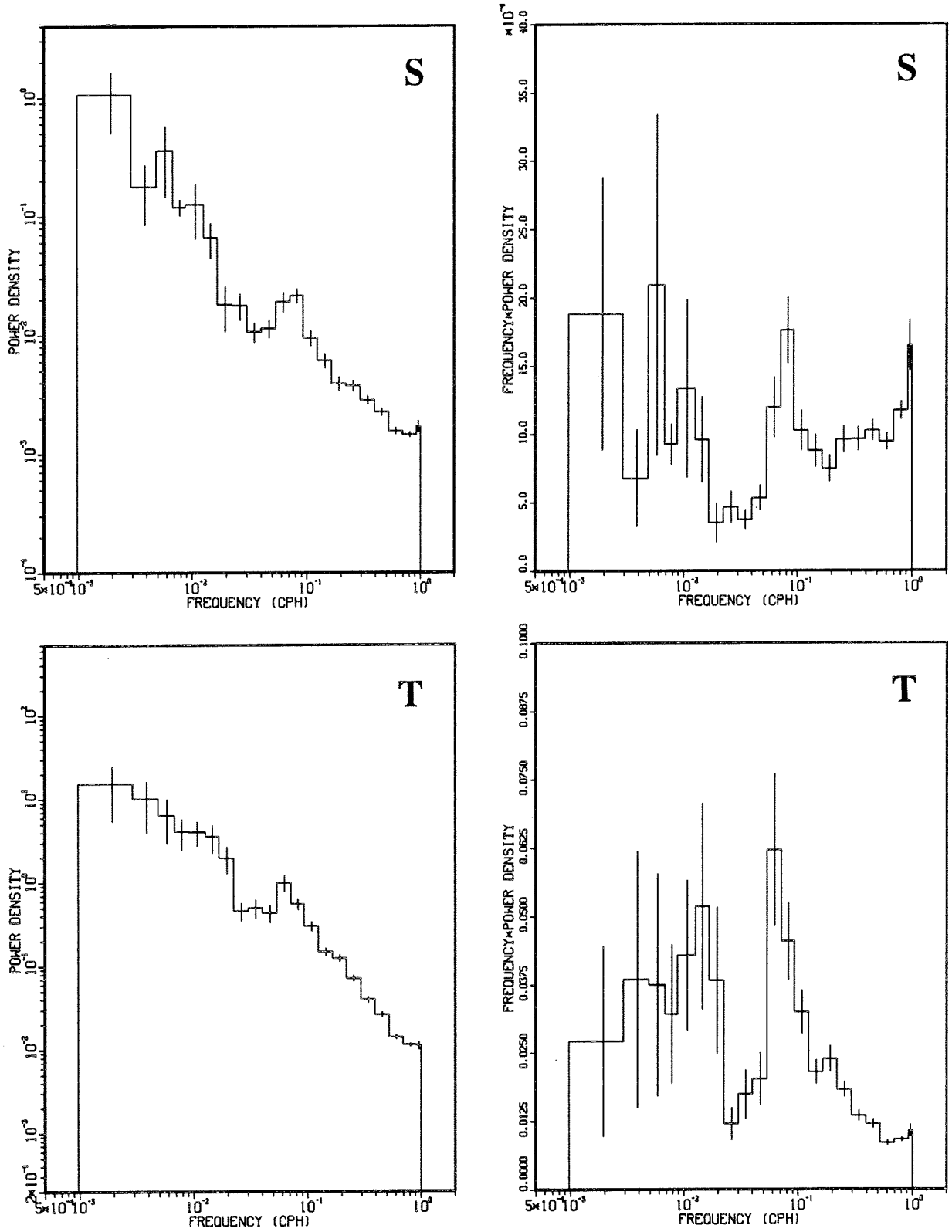
MOORING 831 AT 47M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	169.0 DAYS CENTERED AT DAY 208, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(831,046M)	K1	.004	.003	15	99/C	.003	170	.004	88
	O1	.008	.007	115	215/C	.008	194	.007	95
	M2	.067	.054	100	55/C	.067	47	.054	313
	S2	.020	.019	131	73/C	.020	33	.020	301
	N2	.017	.014	97	29/C	.017	23	.014	290
	MF	.003	.001	106	135/C	.003	130	.001	5
	M4	.002	.000	40	102/C	.001	111	.002	96
	MS4	.002	.001	70	235/C	.002	250	.001	173



MOORING 831 AT 47M.
SOUTHEAST SHOAL 1987



MOORING 831 AT 47M.
SOUTHEAST SHOAL 1987

RYAN THERMOGRAPH

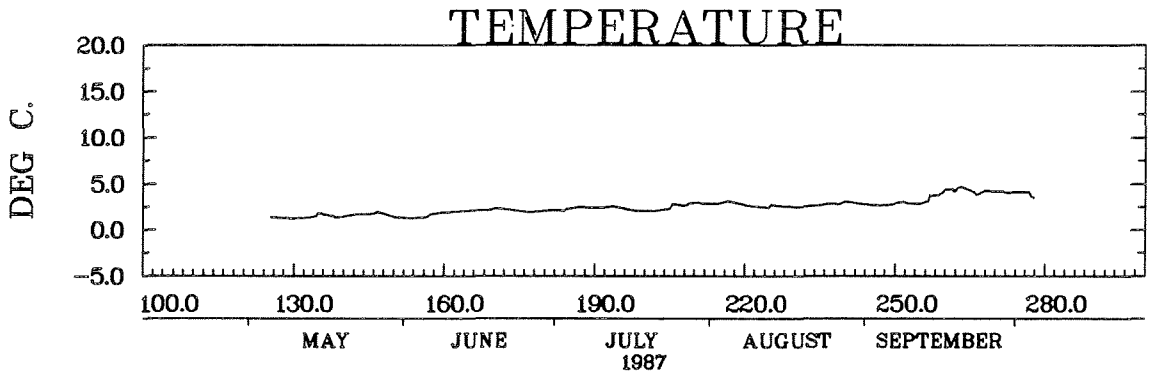
Mooring 831 at 72m

(sampling interval 4 hours)

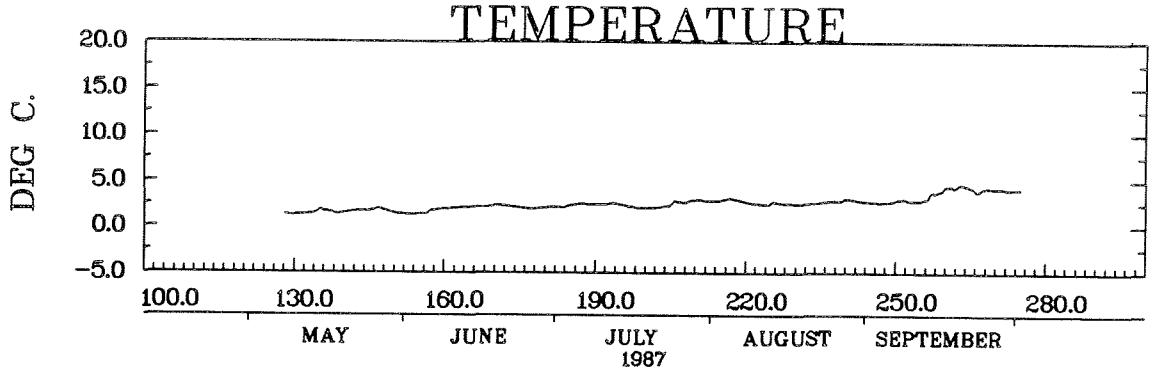
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature (°C)								
(N)	916		160	180	186	186	180	24
($\bar{X}$)	2.5		1.5	1.9	2.4	2.7	3.6	4.0
(Σ_1)	0.8		0.2	0.3	0.3	0.2	0.7	0.2
(Σ_2)	0.8		0.2	0.3	0.3	0.2	0.7	0.0

N: *number of samples in statistics* $\bar{X}$: *mean value*

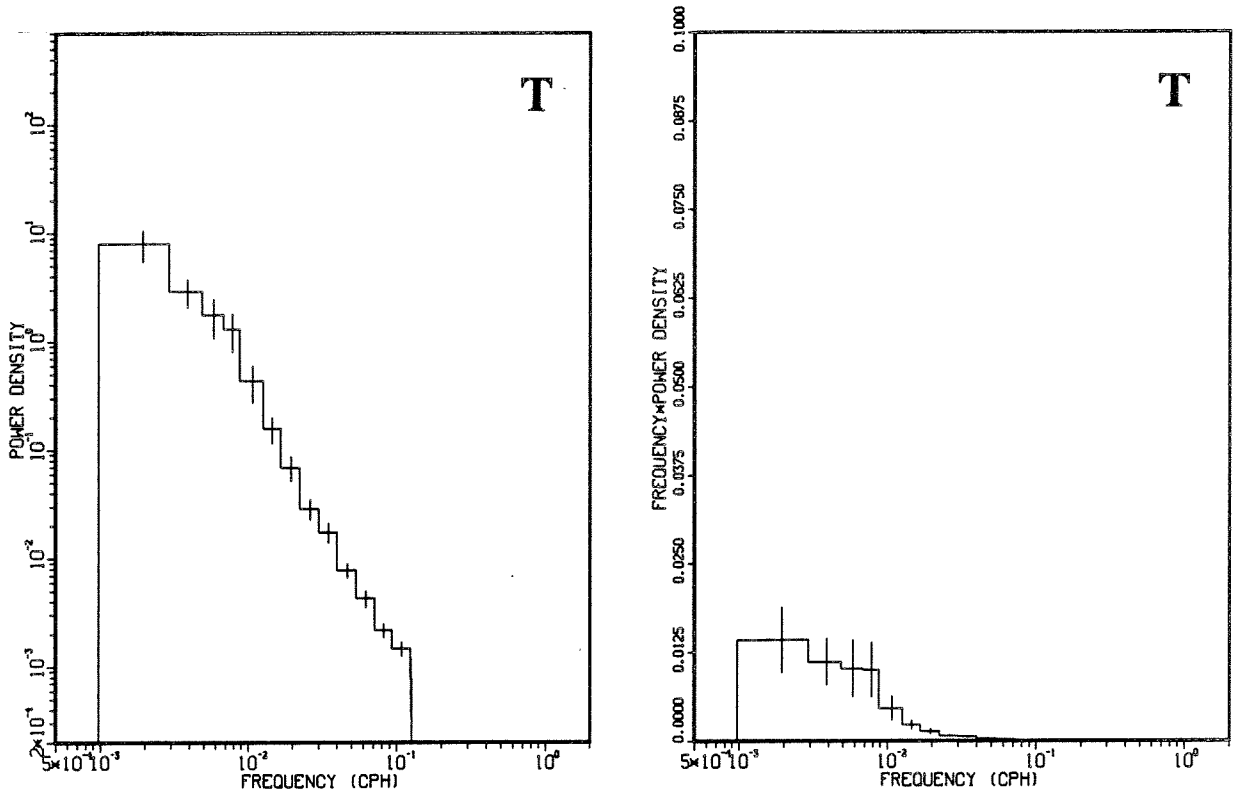
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 831 AT 72M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987



MOORING 831 AT 72M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987 – LOW PASS



MOORING 831 AT 72M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987

CURRENT METER

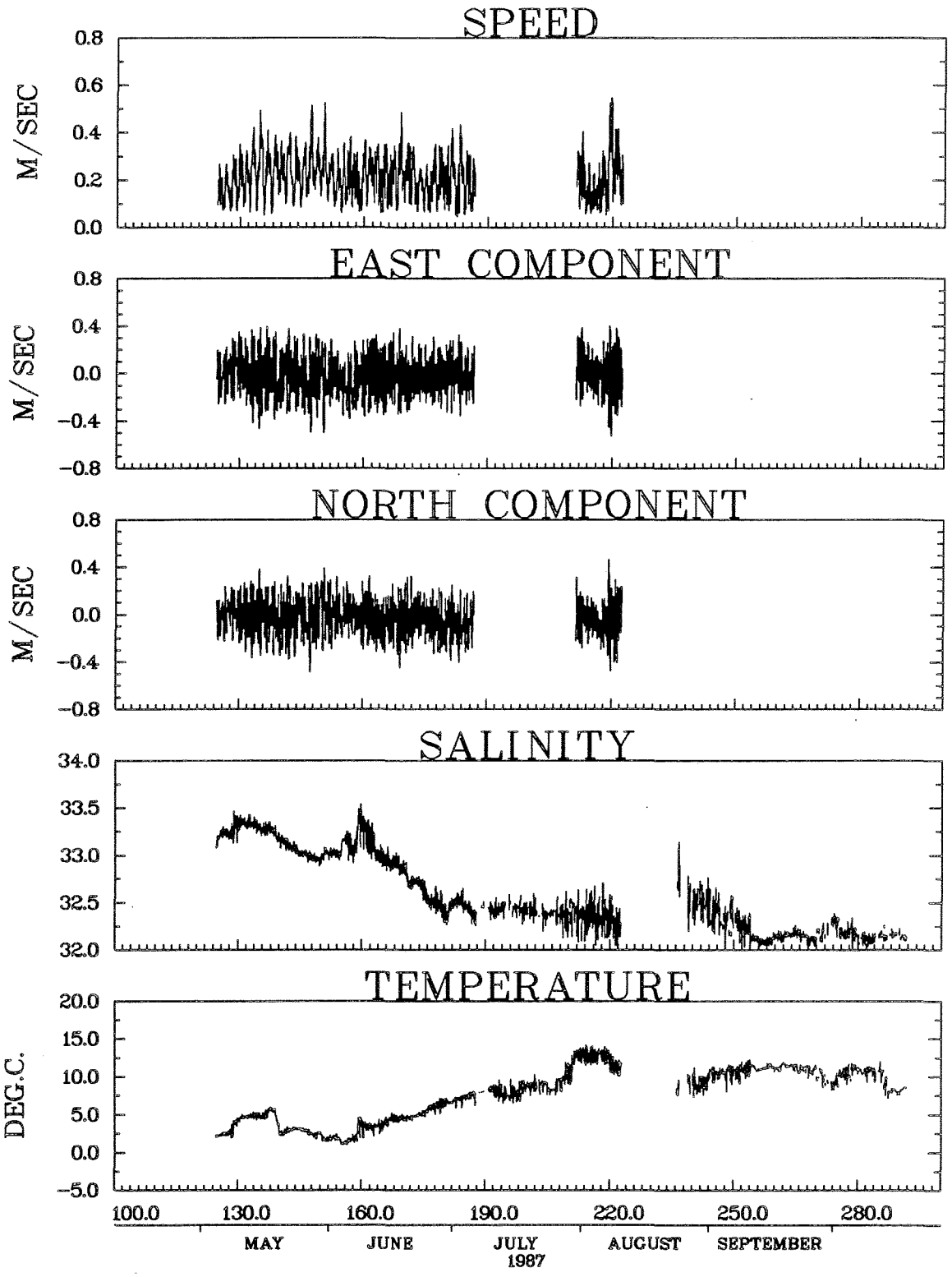
Mooring 832 at 12m

(sampling interval 30 min)

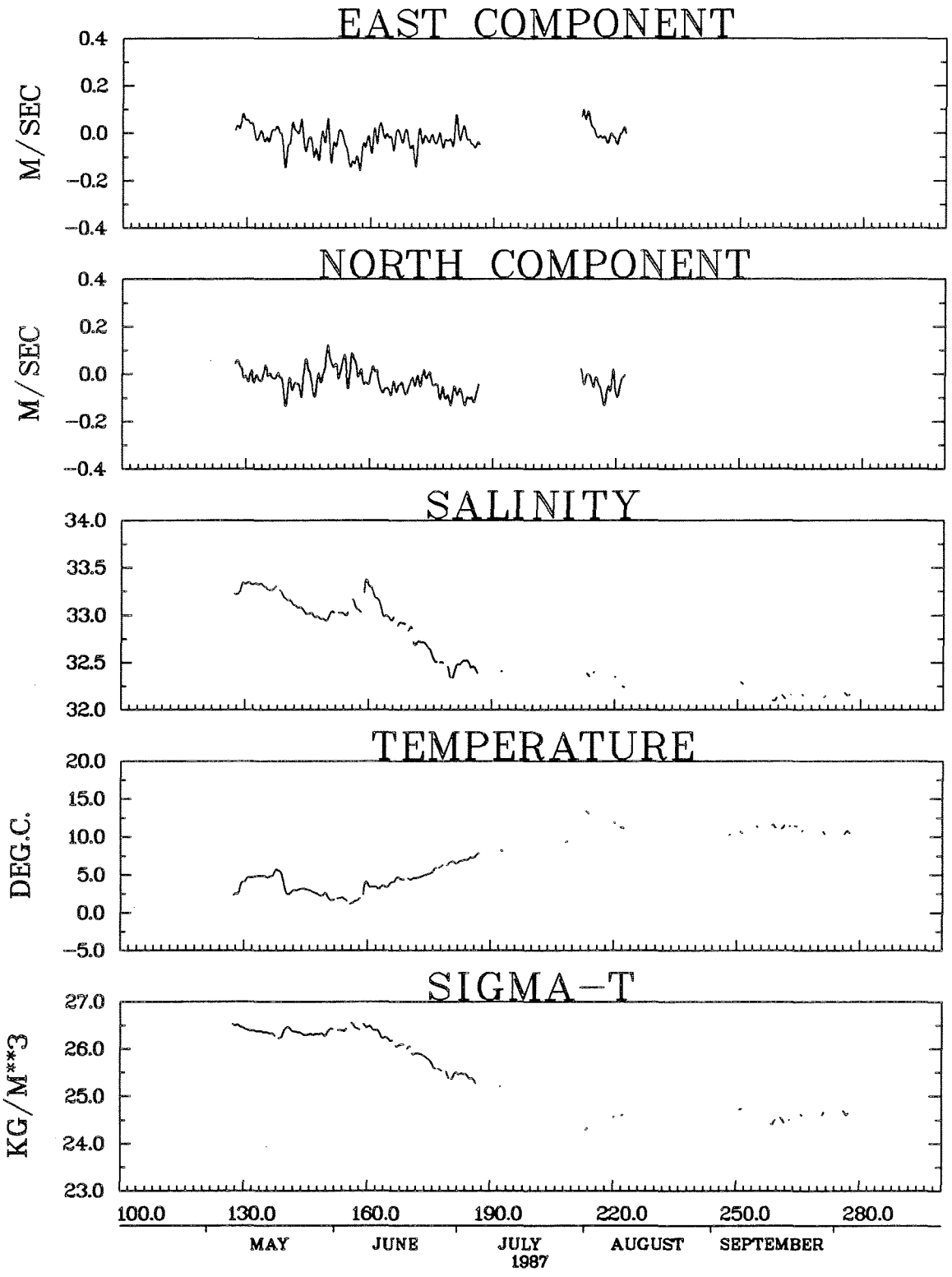
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	3527		1315	1440	315	457		
($\bar{X}$)	-0.020		-0.013	-0.035	-0.003	-0.007		
(Σ_1)	0.173		0.185	0.164	0.163	0.166		
(Σ_2)	0.049		0.051	0.046	0.052	0.030		
North Velocity Component ($m.s^{-1}$)								
(N)	3527		1315	1440	315	457		
($\bar{X}$)	-0.029		-0.009	-0.033	-0.073	-0.043		
(Σ_1)	0.153		0.162	0.144	0.142	0.152		
(Σ_2)	0.050		0.048	0.047	0.042	0.039		
Salinity (PSS78)								
(N)	4927		1254	1335	725	417	814	382
($\bar{X}$)	32.67		33.17	32.87	32.42	32.39	32.19	32.17
(Σ_1)	0.42		0.14	0.27	0.07	0.18	0.10	0.06
(Σ_2)	0.39		0.14	0.27	0.05	0.06	0.06	0.01
Temperature ($^{\circ}C$)								
(N)	5358		1298	1389	859	463	913	436
($\bar{X}$)	6.89		3.43	4.02	8.41	11.46	10.93	10.02
(Σ_1)	3.56		1.19	1.63	1.55	1.81	0.68	1.18
(Σ_2)	3.07		1.17	1.55	0.79	0.92	0.43	0.32
Sigma-t ($kg.m^3$)								
(N)	256		96	102	22	9	21	6
($\bar{X}$)	25.91		26.36	26.07	25.38	24.48	24.54	24.64
(Σ_1)								
(Σ_2)	0.66		0.07	0.35	0.12	0.13	0.10	0.04

N: *number of samples in statistics* $\bar{X}$: *mean value*

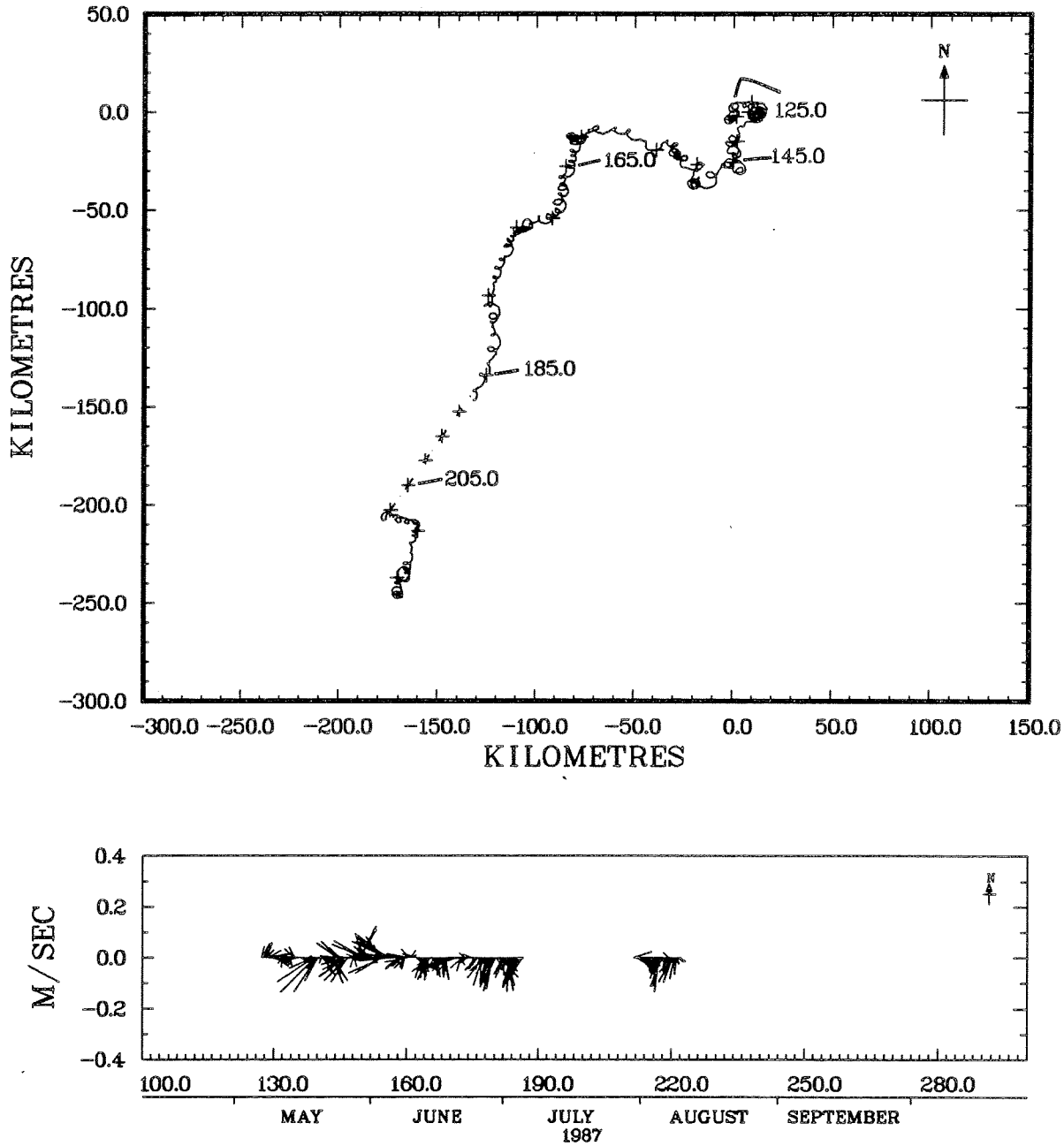
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 832 AT 12M.
SOUTHEAST SHOAL 1987



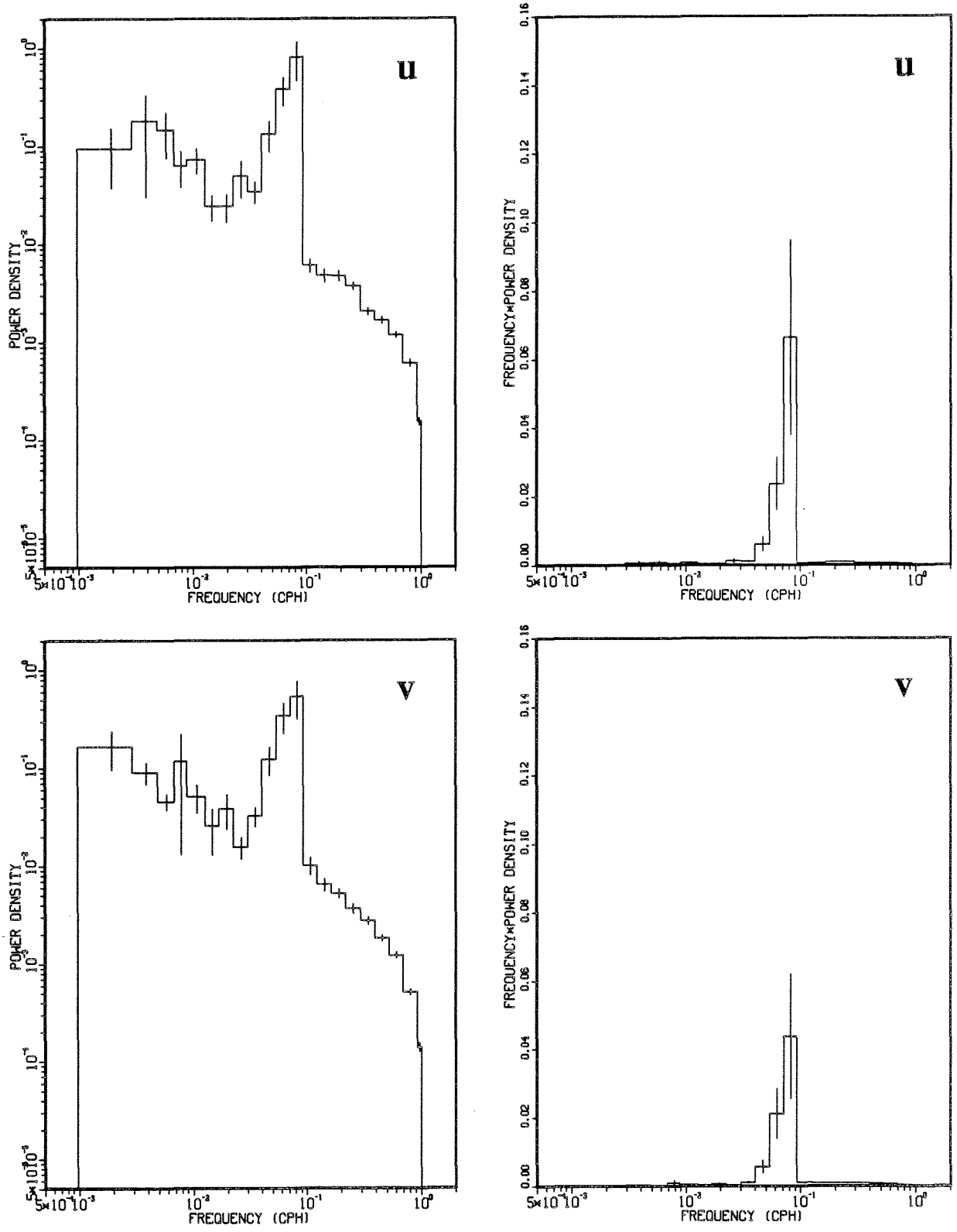
MOORING 832 AT 12M.
SOUTHEAST SHOAL 1987 - LOW PASS



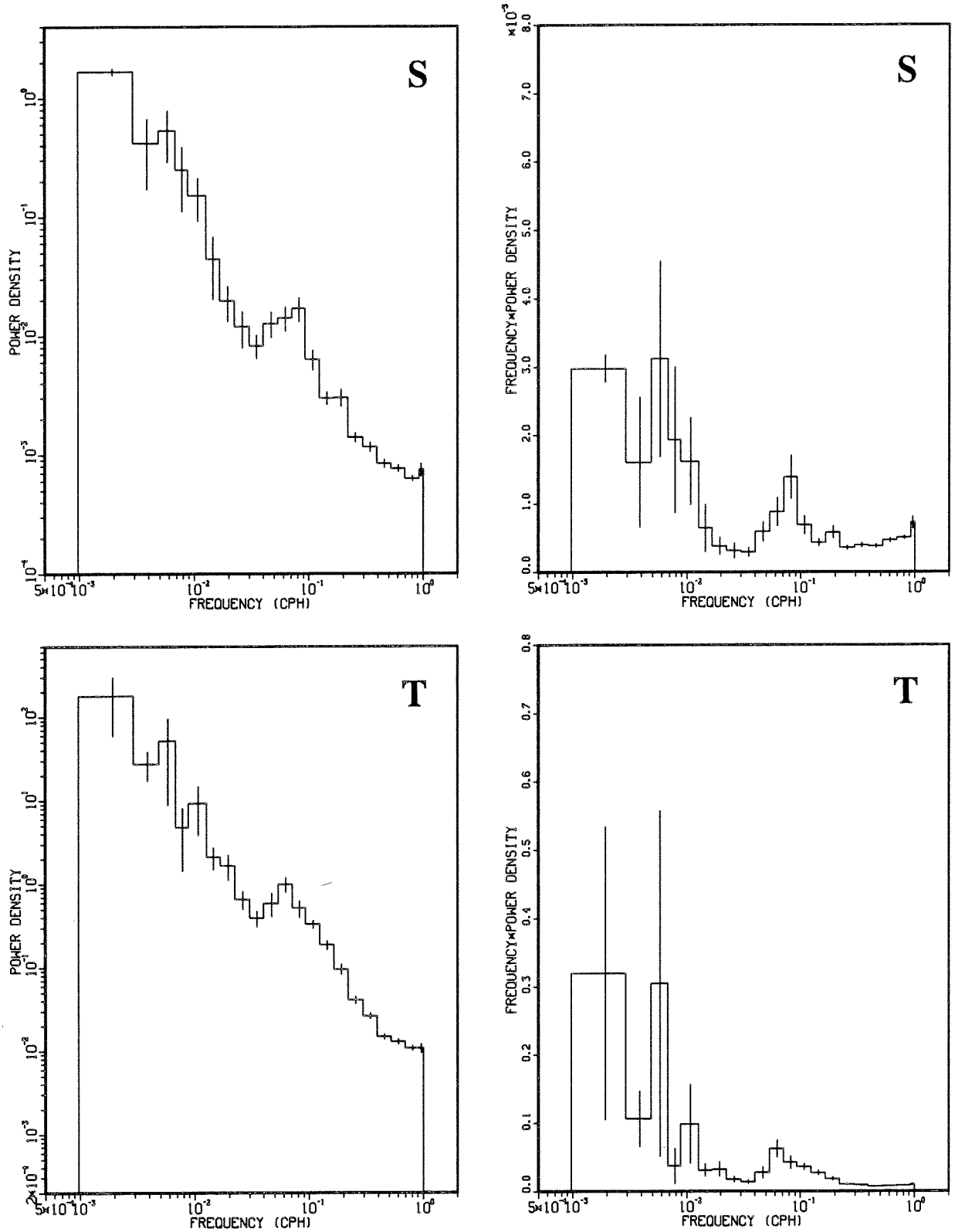
MOORING 832 AT 12M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	62.3 DAYS CENTERED AT DAY 155, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(832,011M)	K1	.019	.013	50	142/C	.017	172	.015	103
	O1	.011	.007	7	63/C	.007	143	.011	59
	M2	.187	.148	97	68/C	.187	62	.148	329
	S2	.046	.035	106	95/C	.045	83	.036	345
	N2	.045	.036	107	76/C	.044	62	.037	325
	MF	.007	.003	342	99/C	.004	225	.007	108
	M4	.007	.000	348	43/C	.001	213	.006	44
	MS4	.002	.000	126	218/C	.002	209	.001	54



MOORING 832 AT 12M.
SOUTHEAST SHOAL 1987



MOORING 832 AT 12M.
SOUTHEAST SHOAL 1987

CURRENT METER

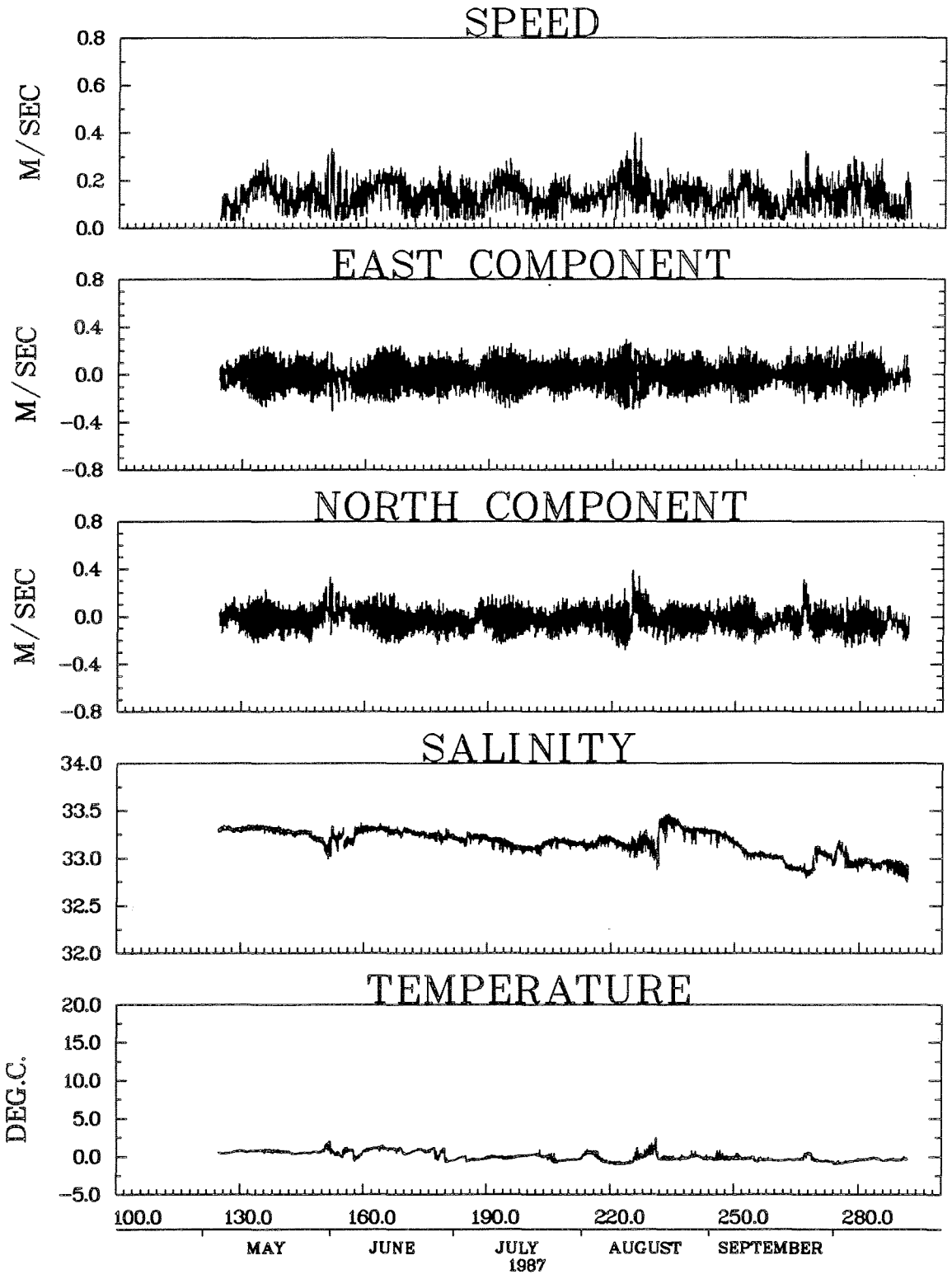
Mooring 832 at 45m

(sampling interval 30 min)

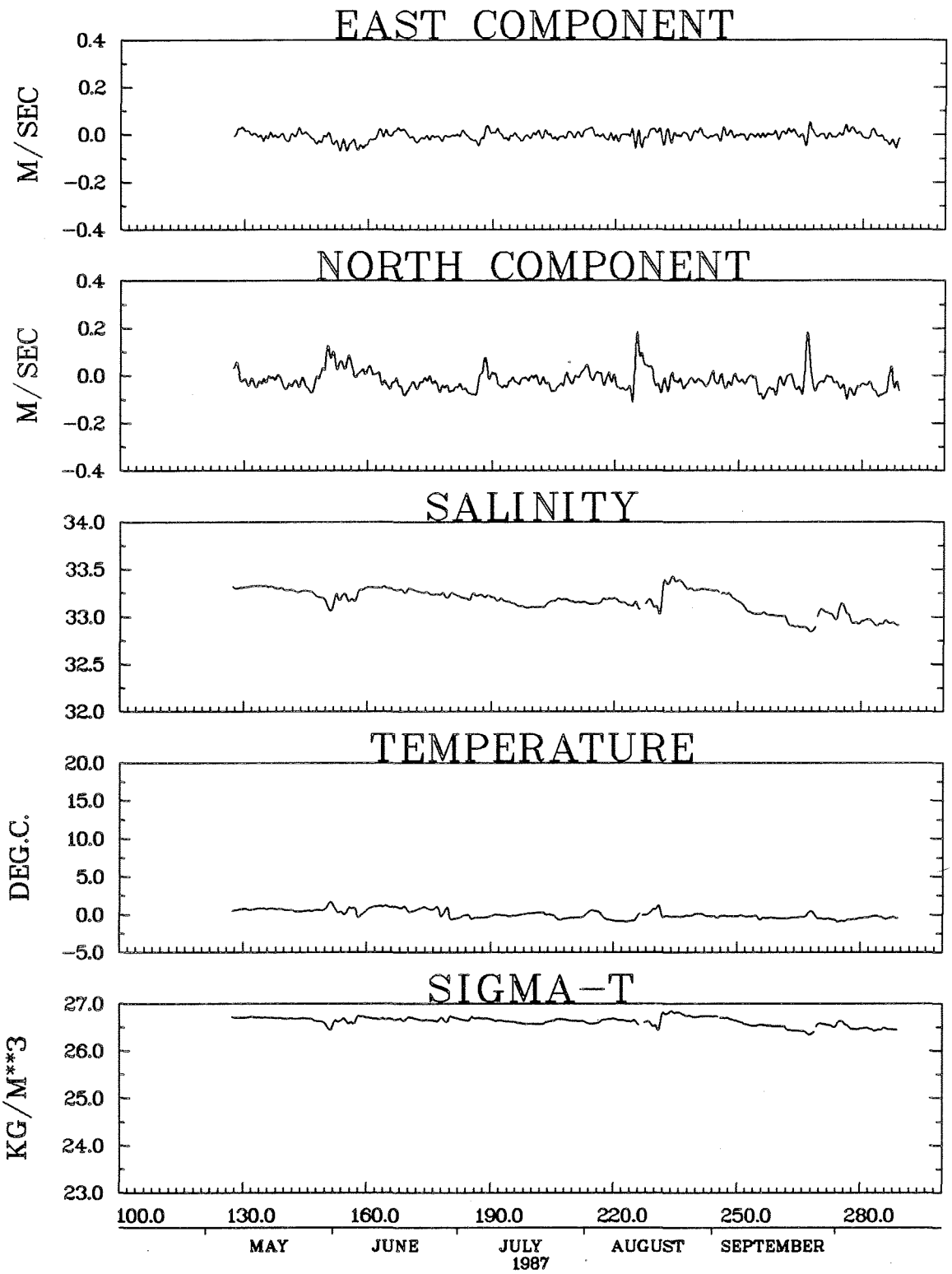
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	8016		1313	1438	1485	1486	1440	854
($\bar{X}$)	-0.005		-0.005	-0.014	-0.003	-0.002	0.001	-0.005
(Σ_1)	0.114		0.115	0.117	0.114	0.124	0.101	0.106
(Σ_2)	0.019		0.017	0.023	0.016	0.019	0.014	0.023
North Velocity Component ($m.s^{-1}$)								
(N)	8016		1313	1438	1485	1486	1440	854
($\bar{X}$)	-0.020		-0.010	-0.014	-0.022	-0.011	-0.024	-0.056
(Σ_1)	0.097		0.099	0.098	0.091	0.106	0.090	0.087
(Σ_2)	0.041		0.042	0.039	0.031	0.046	0.043	0.028
Salinity (PSS78)								
(N)	6871		1304	1425	1428	1190	781	743
($\bar{X}$)	33.18		33.28	33.26	33.17	33.21	33.04	32.95
(Σ_1)	0.13		0.06	0.05	0.05	0.10	0.12	0.06
(Σ_2)	0.13		0.06	0.04	0.04	0.10	0.12	0.06
Temperature (^{o}C)								
(N)	8018		1315	1440	1485	1484	1440	854
($\bar{X}$)	0.04		0.67	0.60	-0.19	-0.15	-0.34	-0.49
(Σ_1)	0.58		0.26	0.51	0.26	0.54	0.26	0.21
(Σ_2)	0.57		0.24	0.49	0.25	0.50	0.23	0.21
Sigma-t ($kg.m^3$)								
(N)	642		99	120	124	120	118	61
($\bar{X}$)	26.62		26.67	26.67	26.63	26.68	26.54	26.49
(Σ_1)								
(Σ_2)	0.09		0.06	0.04	0.04	0.09	0.10	0.06

N: *number of samples in statistics* $\bar{X}$: *mean value*

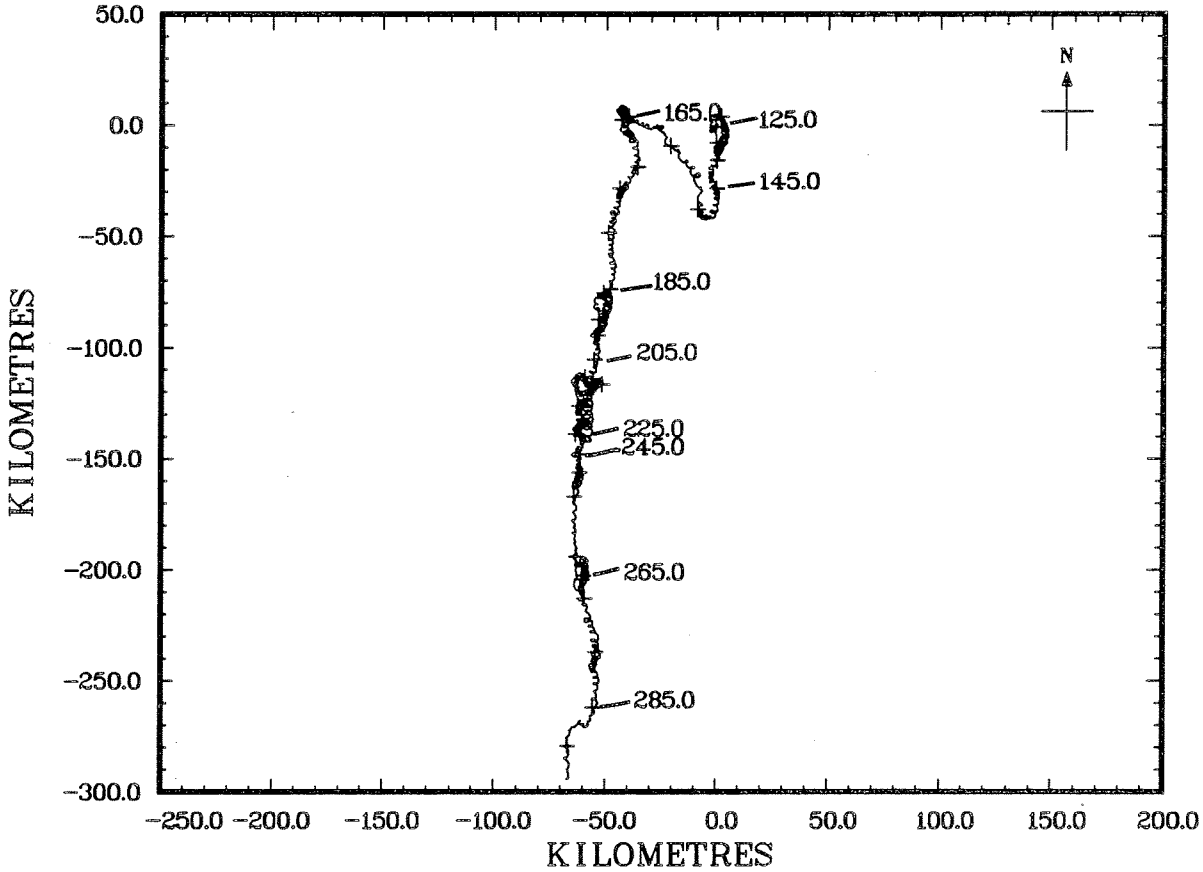
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*

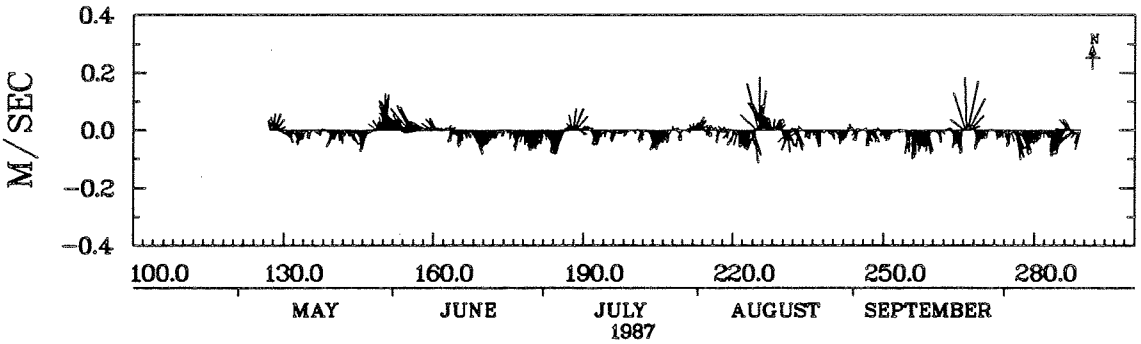


MOORING 832 AT 45M.
SOUTHEAST SHOAL 1987



MOORING 832 AT 45M.
SOUTHEAST SHOAL 1987 - LOW PASS

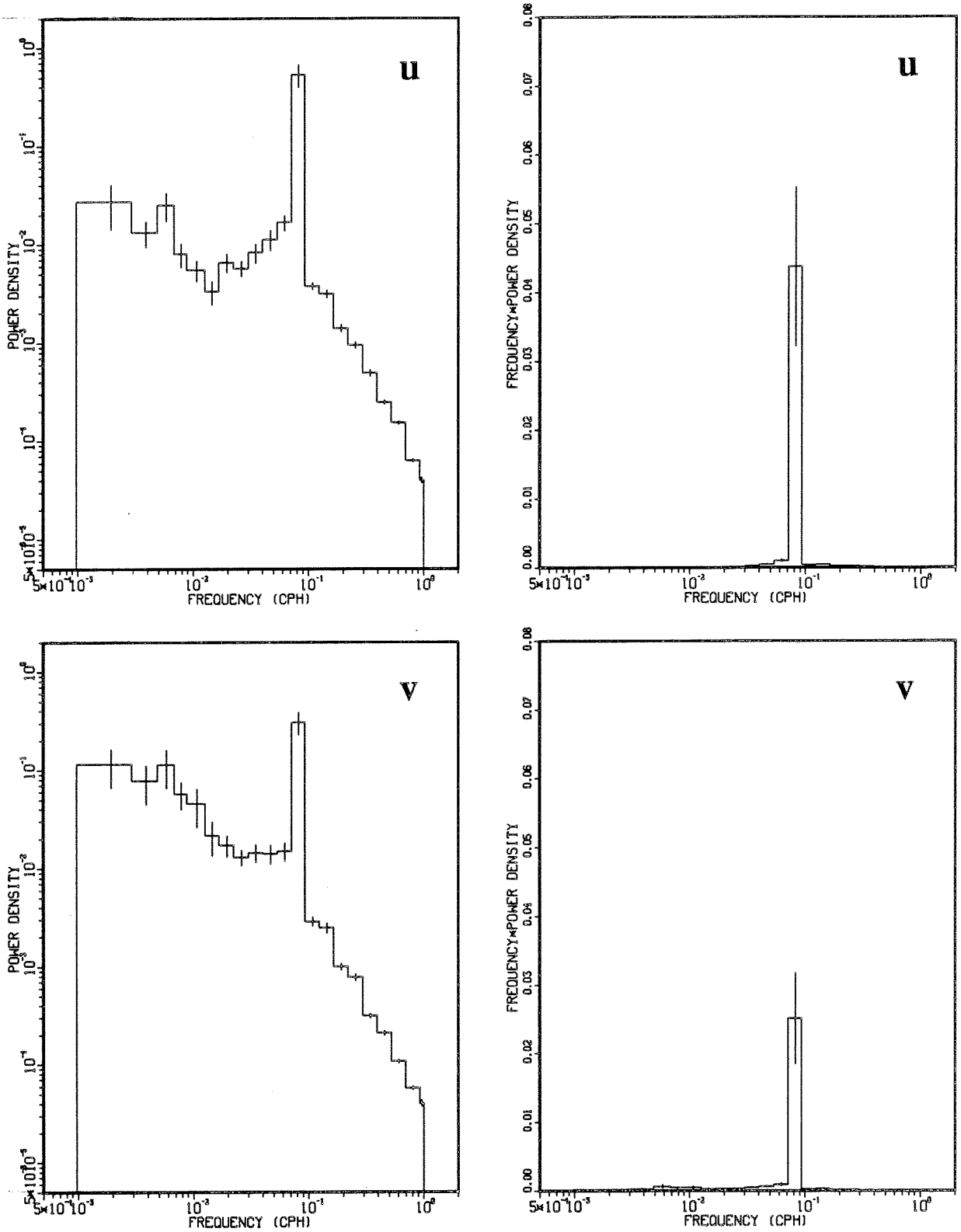




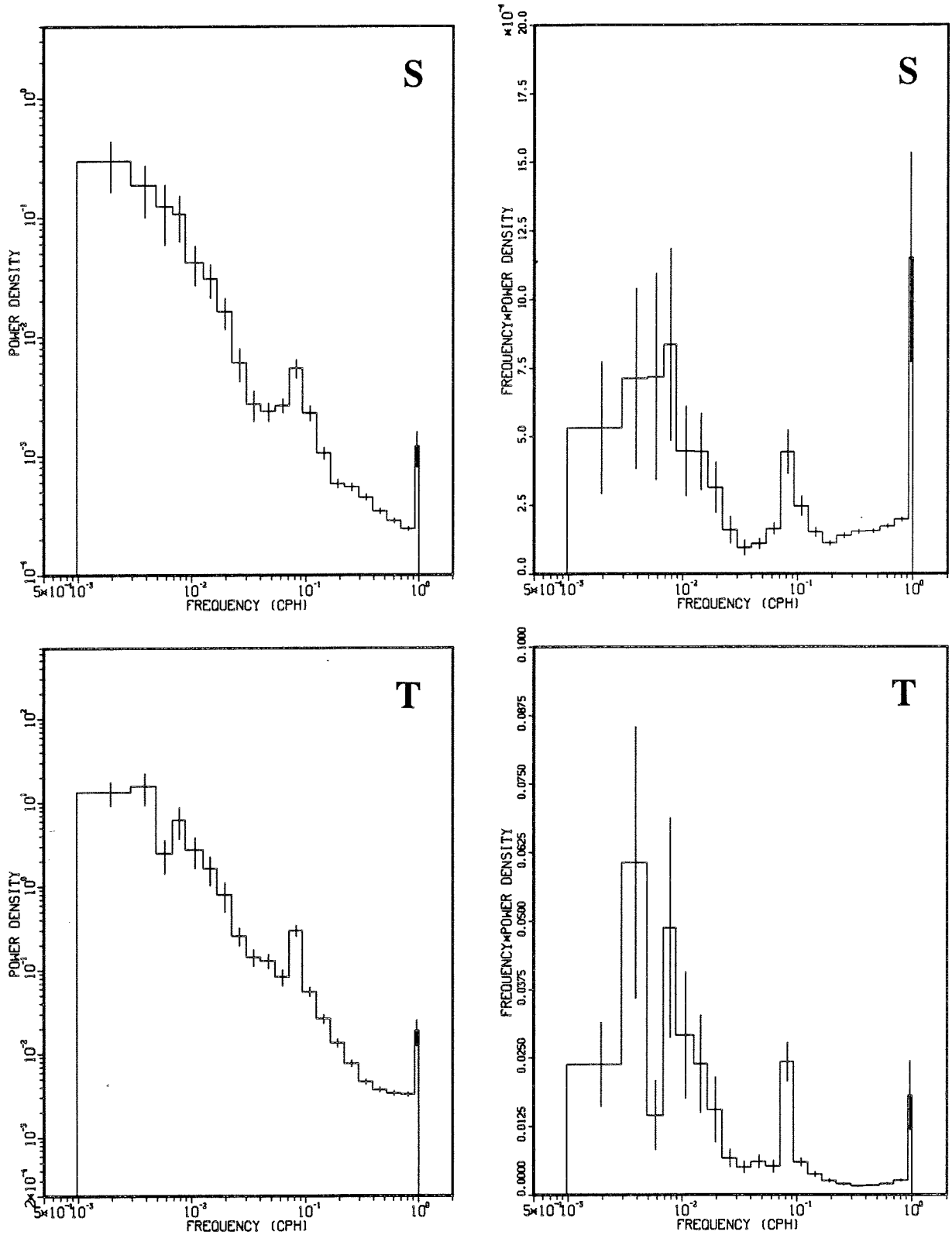
MOORING 832 AT 45M.
SOUTHEAST SHOAL 1987

GENERAL TIDAL ANALYSIS FOR CURRENTS, U COMP VEL, V COMP VEL

SITE (MOORING) (DEPTH)	CONSTITUENT	167.2 DAYS CENTERED AT DAY 208, 1987							
		CURRENT ELLIPSE				U COMP VEL		V COMP VEL	
		MAJ. (M/S)	MIN. (M/S)	ORIEN. (DEG.T)	PHASE SENSE	AMP. (M/SEC)	PHASE (GMT)	AMP. (M/SEC)	PHASE (GMT)
(832,044M)	K1	.009	.007	325	115/C	.008	247	.008	143
	O1	.010	.006	346	102/C	.006	214	.009	112
	M2	.147	.110	100	46/C	.146	38	.111	303
	S2	.041	.029	101	49/C	.040	42	.030	305
	N2	.035	.027	95	24/C	.035	20	.027	287
	MF	.004	.001	2	68/A	.001	347	.004	68
	M4	.006	.001	125	258/C	.005	252	.004	89
	MS4	.001	.001	9	87/A	.001	14	.001	92



MOORING 832 AT 45M.
SOUTHEAST SHOAL 1987



MOORING 832 AT 45M.
SOUTHEAST SHOAL 1987

RYAN THERMOGRAPH

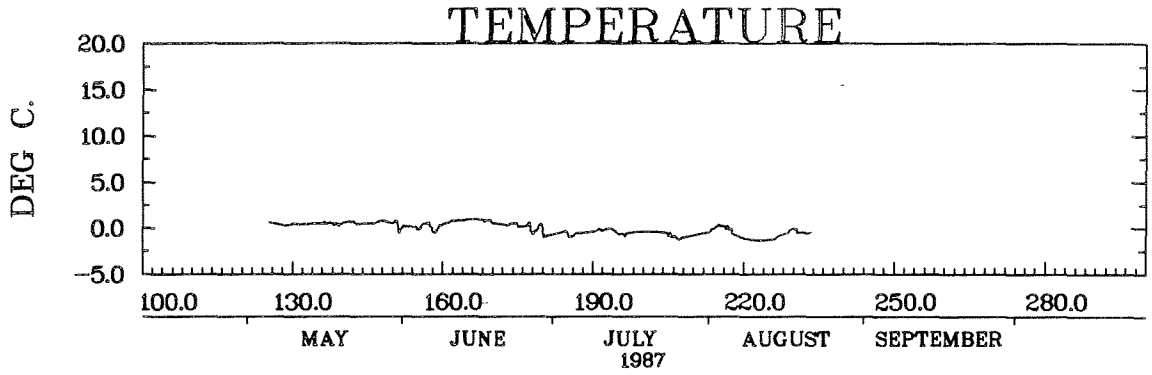
Mooring 832 at 55m

(sampling interval 4 hours)

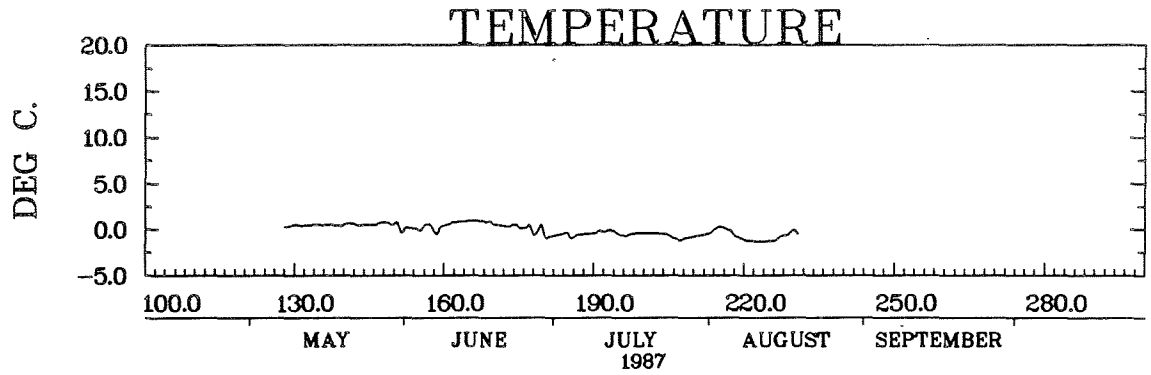
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature (°C)								
(N)	651		161	180	186	124		
($\bar{X}$)	-0.7		0.5	0.4	-0.6	-0.7		
(Σ_1)	0.6		0.2	0.5	0.2	0.5		
(Σ_2)	0.6		0.2	0.5	0.2	0.6		

N: *number of samples in statistics* $\bar{X}$: *mean value*

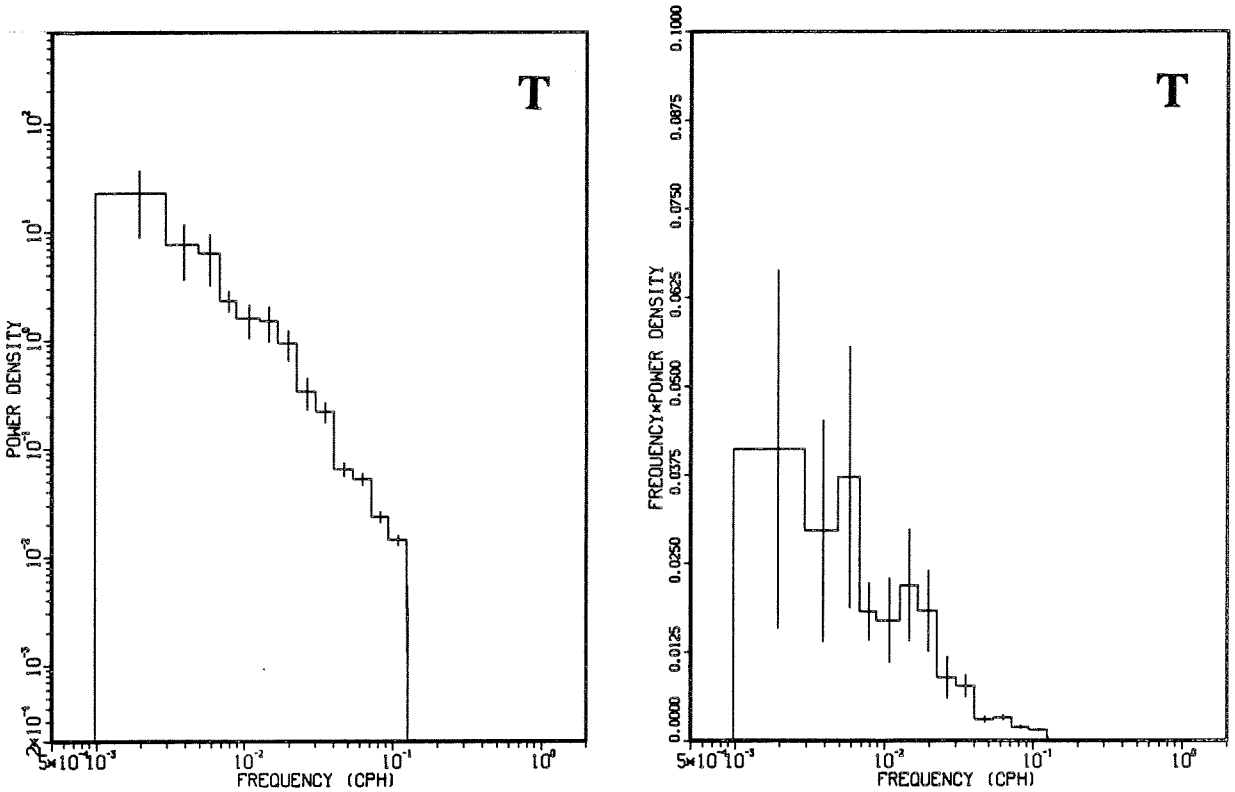
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 832 AT 55M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987



MOORING 832 AT 55M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987 - LOW PASS



MOORING 832 AT 55M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987

RYAN THERMOGRAPH

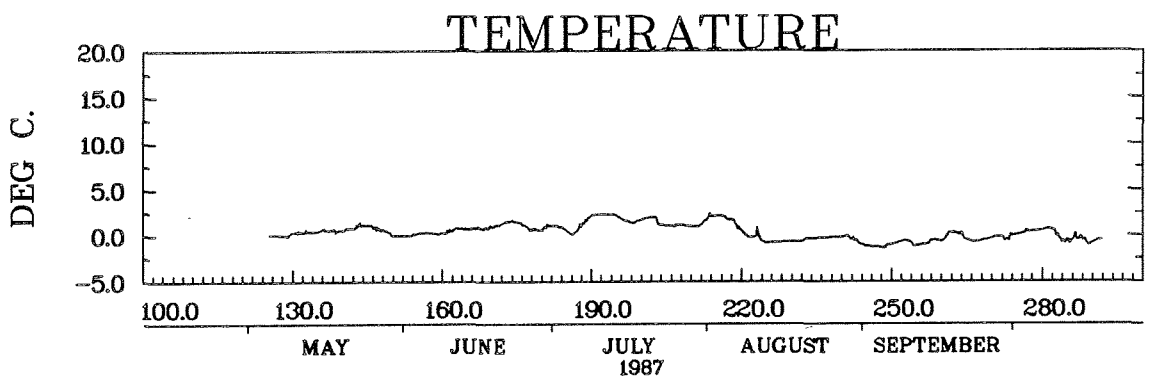
Mooring 833 at 59m

(sampling interval 4 hours)

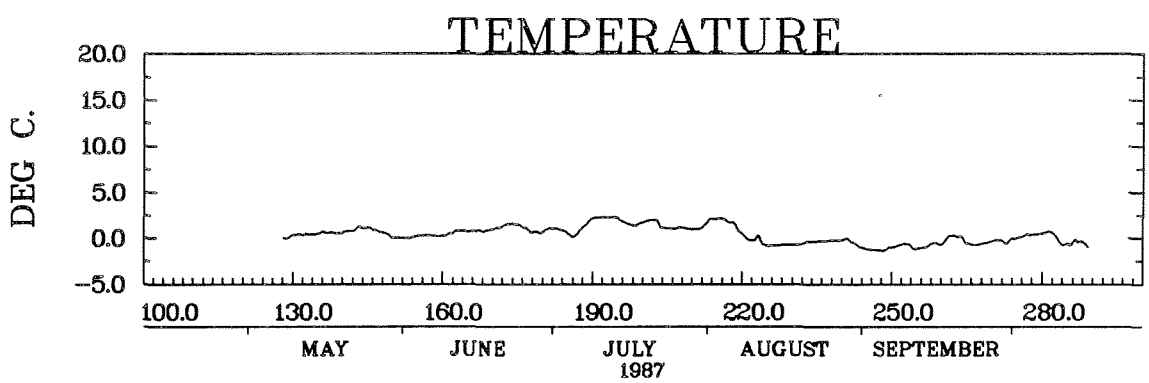
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
Temperature (°C)								
(N)	1000		160	180	186	186	180	108
($\overline{X}$)	0.4		0.5	0.7	1.4	0.1	-0.6	-0.1
(Σ_1)	0.9		0.4	0.4	0.6	1.0	0.4	0.5
(Σ_2)	0.9		0.3	0.4	0.6	1.0	0.4	0.5

N: *number of samples in statistics* $\overline{X}$: *mean value*

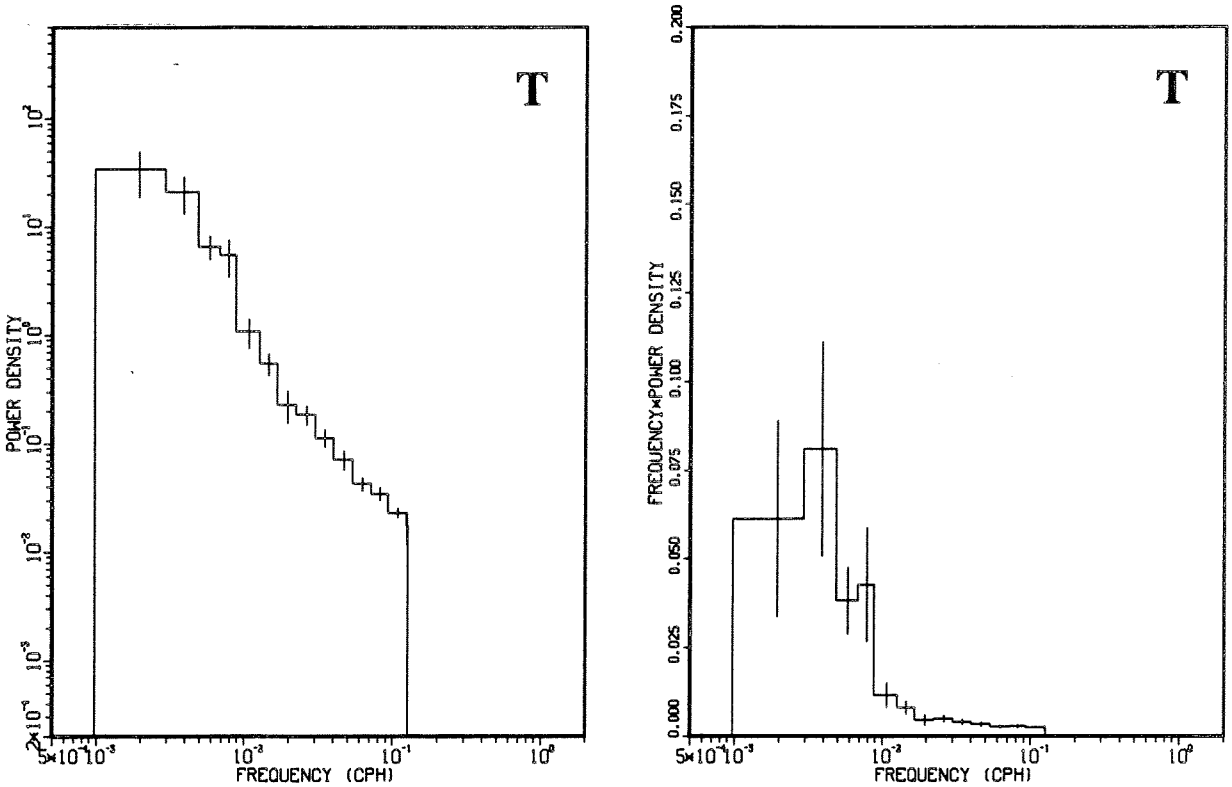
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



MOORING 833 AT 59M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987



MOORING 833 AT 59M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987 – LOW PASS



MOORING 833 AT 59M. (RYAN THERMOGRAPH)
SOUTHEAST SHOAL 1987

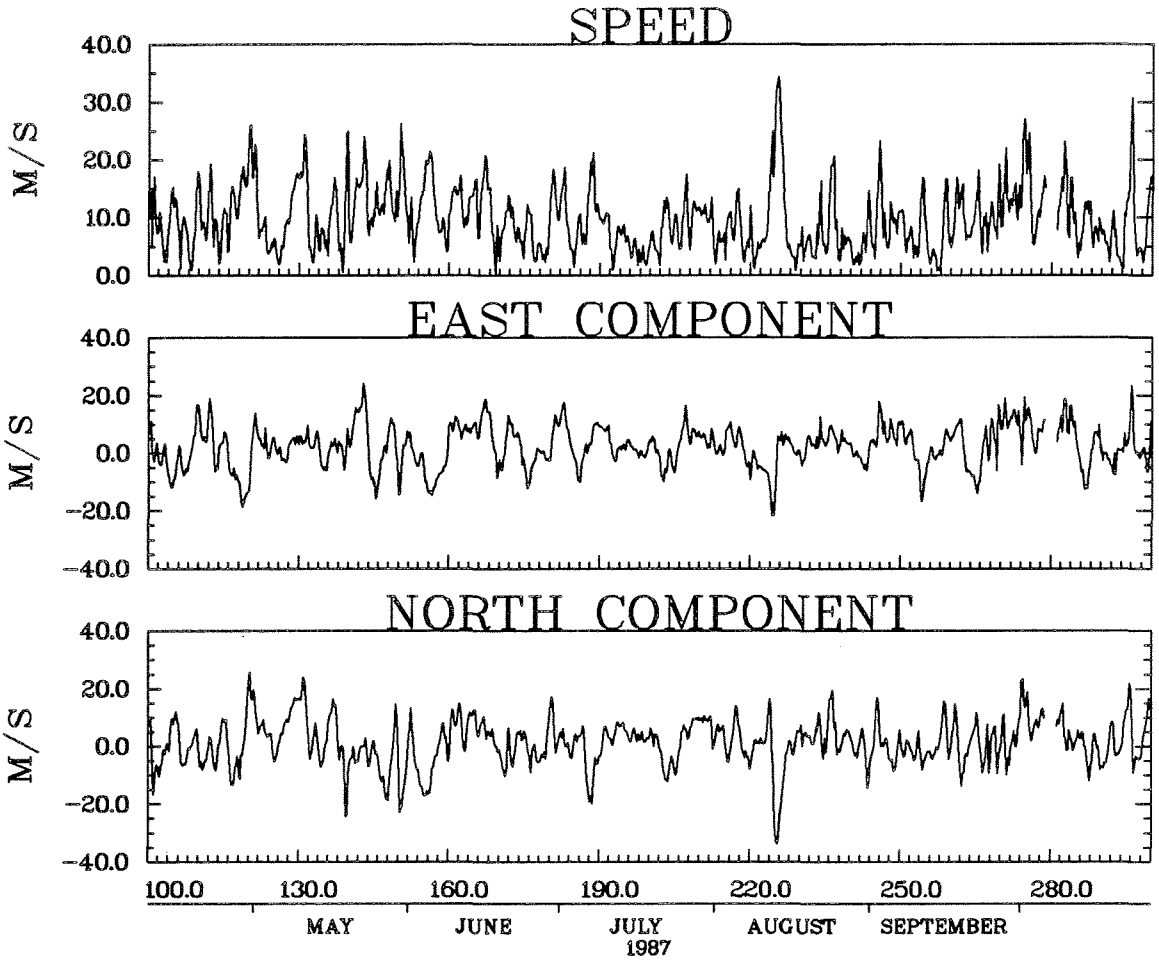
GEOSTROPHIC WINDS

(sampling interval 6 hours)

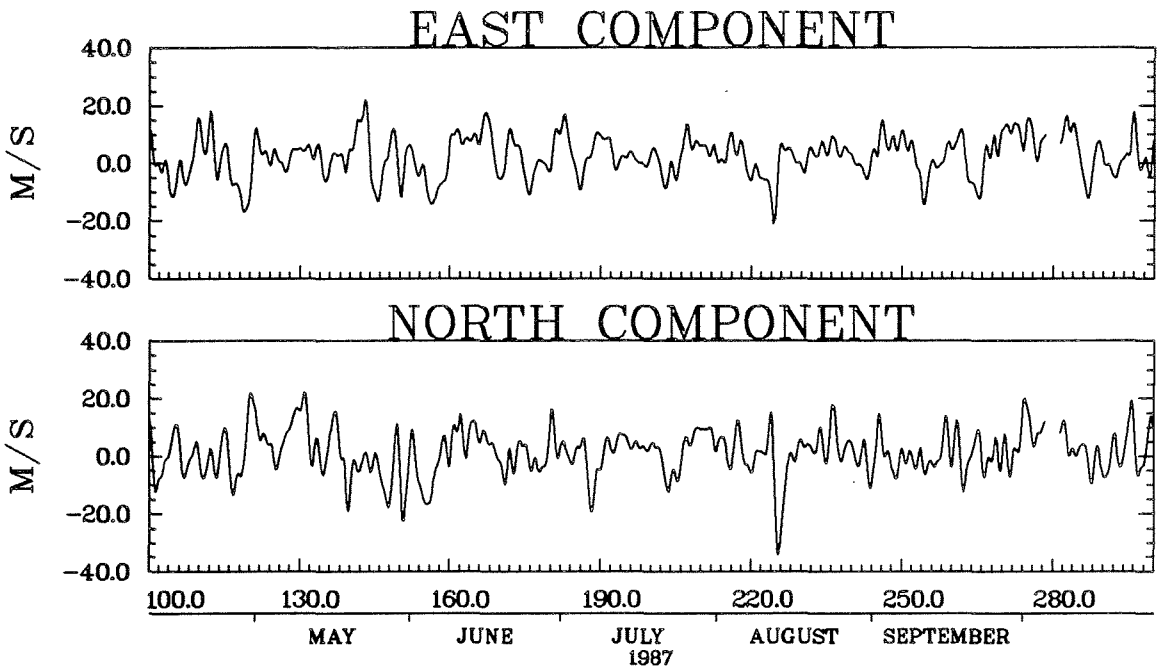
	RECORD	APR	MAY	JUNE	JULY	AUG	SEPT	OCT (1987)
East Velocity Component ($m.s^{-1}$)								
(N)	791	84	124	120	124	124	120	95
($\bar{X}$)	2.3	-0.9	2.7	2.0	3.1	0.8	3.7	3.8
(Σ_1)	7.3	8.6	7.1	8.0	5.7	6.0	7.6	7.7
(Σ_2)	7.1	8.4	6.9	7.9	5.5	5.8	7.2	7.1
North Velocity Component ($m.s^{-1}$)								
(N)	791	84	124	120	124	124	120	95
($\bar{X}$)	1.2	0.0	1.1	0.9	1.5	0.7	0.3	4.1
(Σ_1)	8.2	8.3	10.3	7.9	6.6	8.9	6.1	7.8
(Σ_2)	7.9	8.1	9.9	7.6	6.5	8.7	5.6	7.4

N: *number of samples in statistics* $\bar{X}$: *mean value*

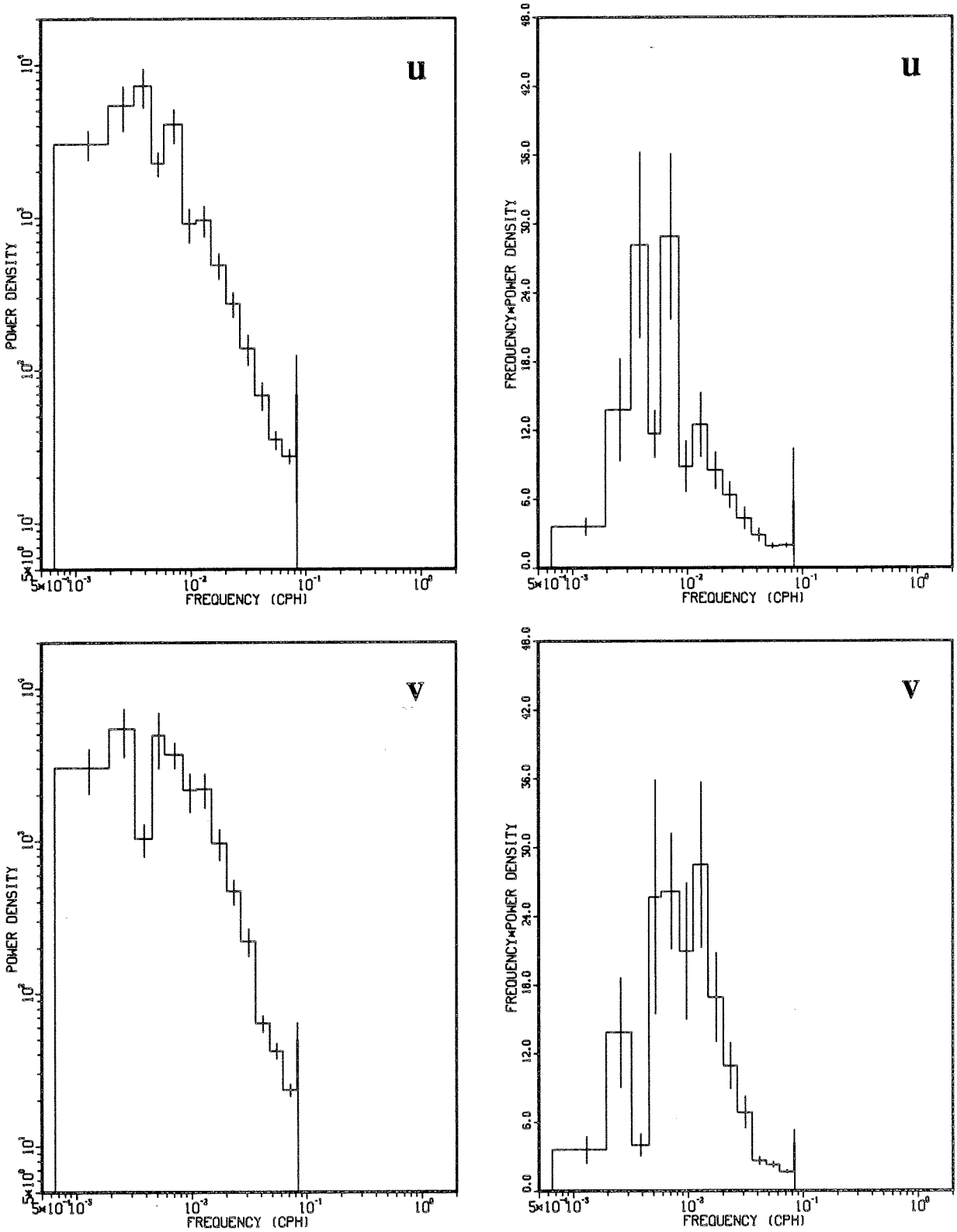
Σ_1: *standard deviation raw time series* Σ_2: *standard deviation low passed*



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1987



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1987 - LOW PASS



GEOSTROPHIC WINDS
SOUTHEAST SHOAL 1987