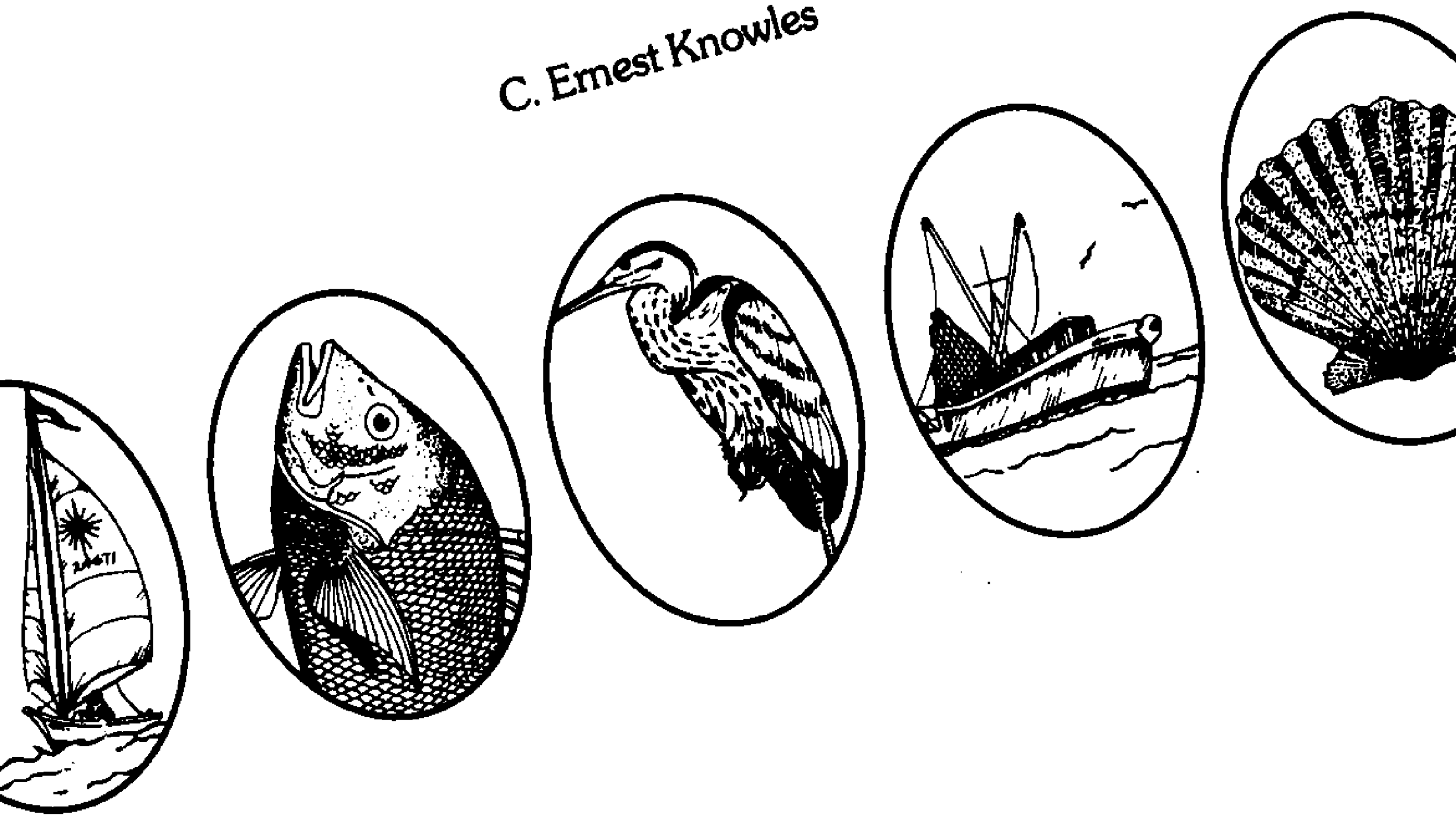
Working Paper 81-8

Wind-Wave Climatology And Wind Tides
For Fort Raleigh Wave-Gauge Site, 1979

C. Ernest Knowles



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WIND-WAVE CLIMATOLOGY AND WIND-TIDES FOR FORT RALEIGH WAVE-GAUGE SITE, 1979

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INTRODUCTION

The wave data presented and discussed in this report were recorded almost continuously from January 26 to December 31, 1979 by a pressure transducer mounted 30 cm above the bottom (in water with a mean depth of about 100 cm) and about 60 m offshore immediately adjacent to the Fort Raleigh National Historic Site (Figures 1 and 2). The data were collected as part of a shoreline stabilization project funded by the U.N.C. Sea Grant Program and conducted through and with the close cooperation of the Superintendent of the Fort Raleigh National Historic Site and his staff. Correlation of wave energy data with the success in using marine grasses to stabilize shorelines will be the subject of a separate report.

Specific results from the wave portion of this study have been published as a referred working paper (Knowles, 1981a), presented at scientific meetings (Knowles, 1979, 1980a, 1980b, 1981b, 1981c, 1981d), and submitted for journal publication (Knowles, 1981e, 1981f).

This technical, summary report will deal specifically with the monthly wave climatologies and wind tides at the Fort Raleigh site for 1979; other data reports for Fort Raleigh (1980) and for Bogue Sound and Neuse River, N.C. sites (1979) are in preparation.

THE EXPERIMENT

Data Collection and Analysis

Data were recorded digitally by file number on a cassette tape at a rate of five samples/sec every three hours with a sample length of 1024 using the data logger shown in Figure 3 (see Appendix A for details of wave recording system, and Table 1 for a summary of the dates, times and numbers of files of collected data). Power spectral densities, $F_p(f)$, were obtained for each file from the pressure-data time series using a FFT algorithm and convolution averaging with 34 degrees of freedom for $f<fc$ (where $f_c = f_m + 16\Delta f$, f_m was the spectral peak frequency, and Δf was the frequency interval) and 50 degrees of freedom for $f>f_c$; the 90 percent confidence interval factors were (1.57, 0.70) and (1.44, 0.74), respectively.

Surface-wave spectral densities, F(f), were estimated from the subsurface-pressure densities using the small-

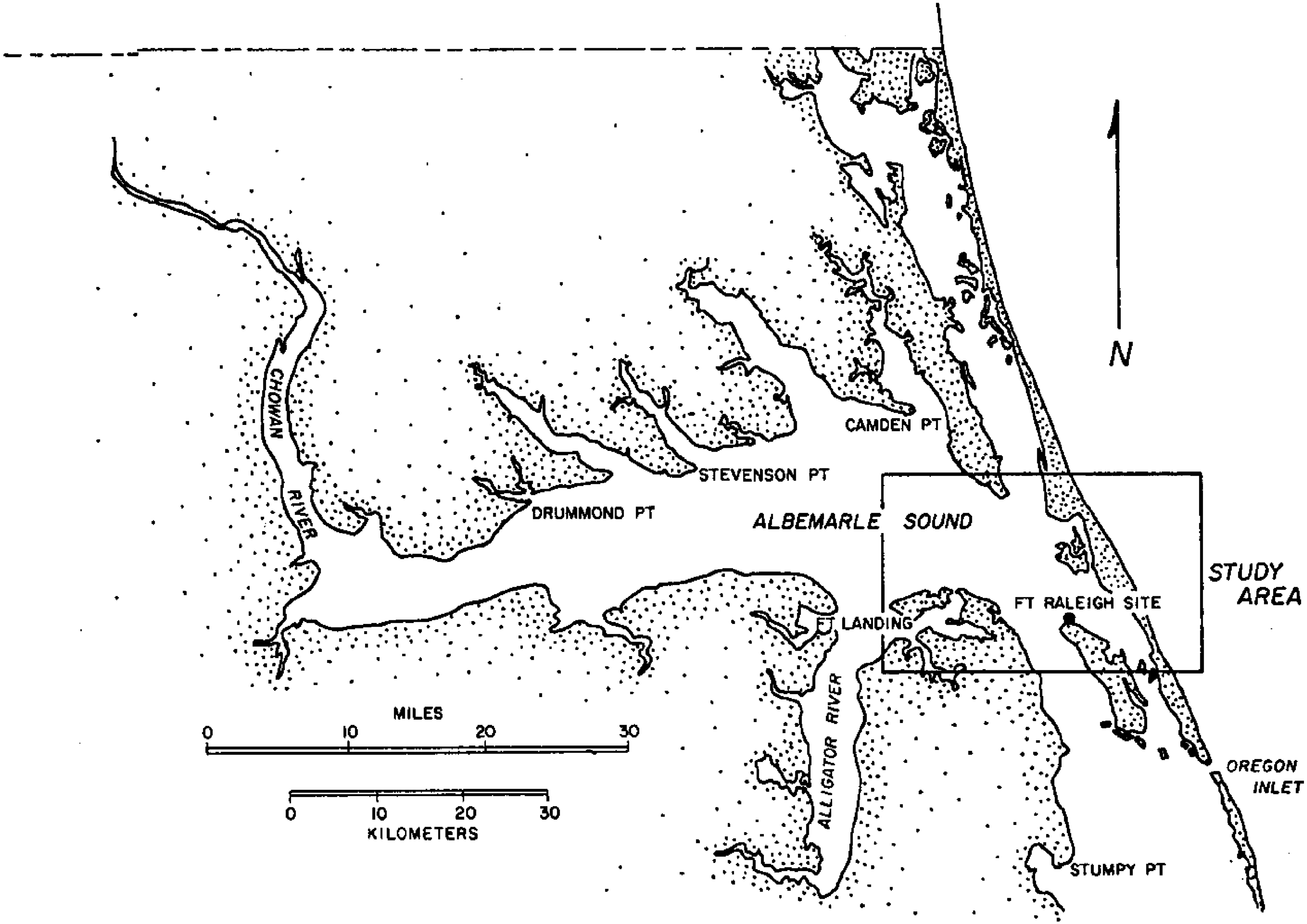

Figure 1. Albermarle Sound showing restricted fetch basin and Fort Raleigh wave-gauge site.

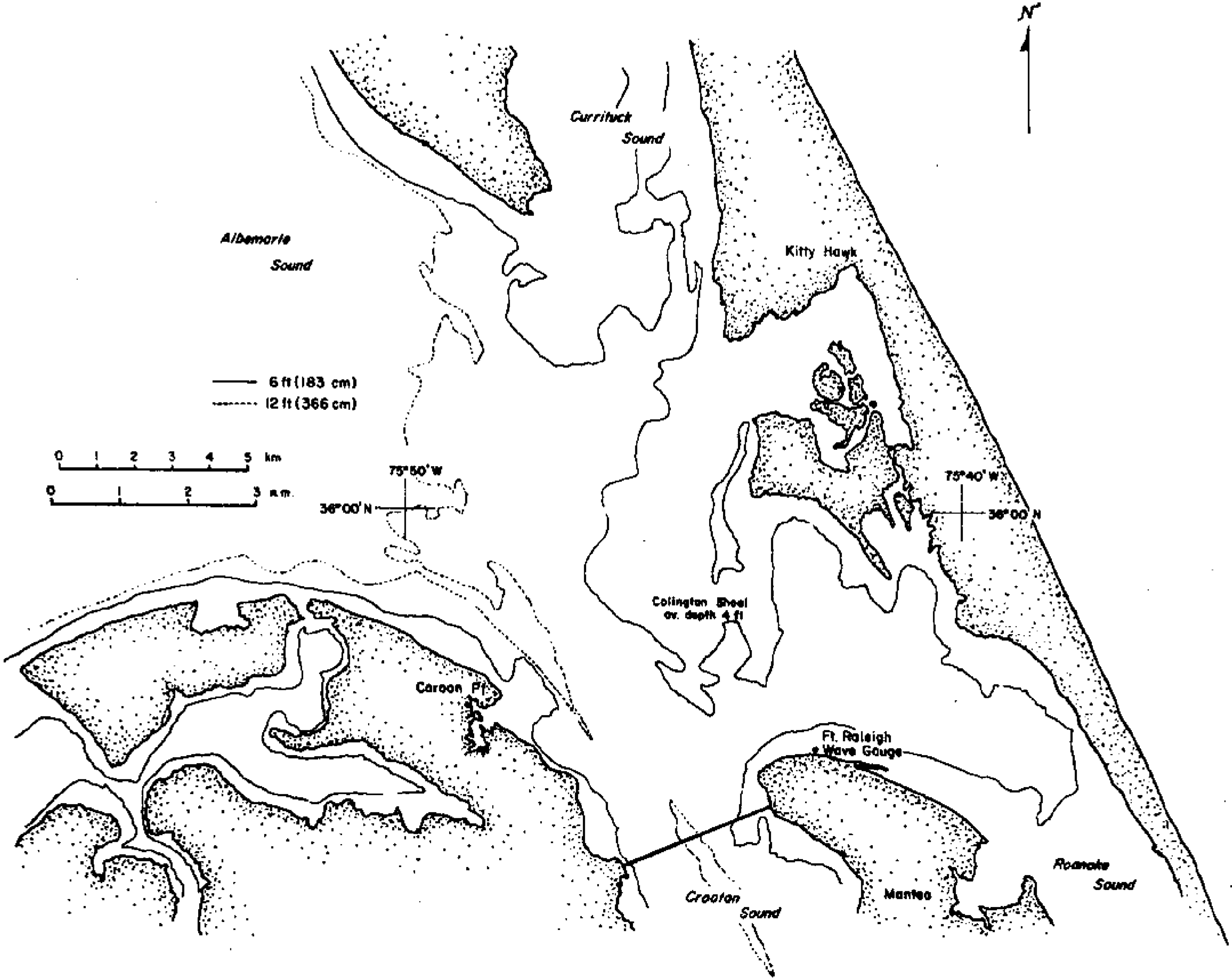

Figure 2 Topographic and bathymetric chart of SE Albemarle basin adjacent to Fort Raleigh wave-gauge site.

amplitude wave theory attenuation compensation-coefficient, cosh kh/cosh kd, modified by Grace's (1978) empirical correction factor, n(f); i.e.

$$F(f) = \left[n(f) \frac{\cosh kh}{\cosh kd} \right]^2 F_p(f), \qquad (1)$$

where k(=2π/L) is the local wave number, L the local wavelength, h the local depth and d the pressure transducer height above the bottom. The empirical correction factor, n(f), was determined by Grace (1978) from wavetank measurements, but Knowles (1980b, 1981a) showed that Grace's equation agrees rather satisfactorily with other data as well (e.g. Hom-ma, et al, 1966 -wavetank data; Esteva and Harris, 1970 -lower gauge field data; and Tubman and Suhayda's, 1976 -field data). The parameter kh was estimated from f by using an iteration scheme (cf. Knowles, 1981a) to find the root of the modified linear-theory dispersion relation

$$\frac{(2\pi f)^2 h}{g} = kh \tanh kh. \qquad (2)$$

Wave climatology has been presented as a joint-probability distribution of significant wave height (in cm) derived as an integral quantity from the corrected wave spectrum, i.e.

$$H_s = 4E^{1/2}, \qquad (3)$$

where,

$$E = \int F(f)df \qquad (4)$$

is the wave height variance, and F(f) is estimated from (1); and significant wave period (in secs) defined by Goda (1974) as

$$T_s = \frac{0.937}{f_m} \quad . \qquad (5)$$

Hourly wind data for use in the wind-tide study were obtained from the Cape Hatteras Weather Facility. Though this station is nearly 70 km from the Fort Raleigh site, its data

Figure 3. Datalogger and test oscilloscope mounted in watertight enclosure.

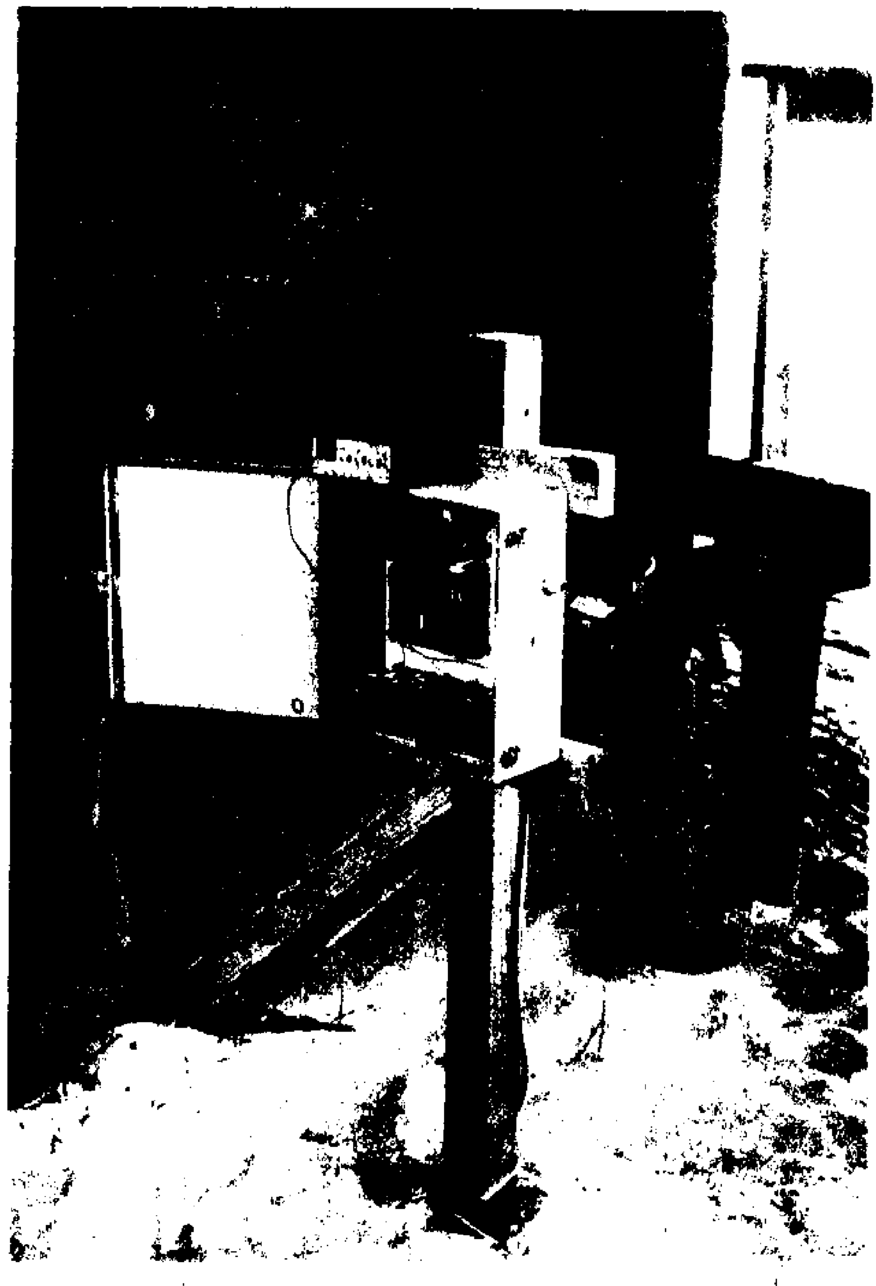

Table 1. Summary of 1979 wave data for Fort Raleigh wave site. Label TP is the data tape number, TI is the EST of the first file and TO the EST of the last file recorded, and NF the number of files on each tape. The sampling interval is three hours and the number of samples/file is 1024 for all data. ND means no data were recorded.

TP	Date	TI	Date	TO	NF	TP	Date	TI	Date	TO	NF
01	01/26	1625	02/09	1325	112	14	07/22	ND	-	-	-
02	02/09	1625	02/23	1025	111	15	08/15	ND	-	-	-
03	02/23	1430	03/09	1430	113	16	09/05	1740	09/08	1140	23
04	03/16	1730	03/25	1730	72	17	09/14	1840	09/28	1240	111
05	03/25	1840	04/06	1240	95	18	09/28	1540	10/10	1840	98
06	04/06	1840	04/20	1240	111	19	10/15	1440	10/26	1440	89
07	04/20	1840	04/28	1840	65	20	10/26	1740	11/09	1140	111
08	04/28	1855	05/12	2155	114	21	11/09	1900	11/23	1300	111
09	05/16	1134	05/30	1434	114	22	11/23	2200	12/01	1000	61
10	06/01	1434	06/14	1434	105	23	12/01	1600	12/15	1600	113
11	06/15	ND	-	-	-	24	12/17	1900	12/28	1000	86
12	06/23	1405	07/06	0805	103	25	12/28	1600	12/31	2200	27
13	07/06	1516	07/20	1516	113						

compares very well with data from the U.S. Coast Guard Station at Oregon Inlet (after winds are scaled from the 19 m height there to the 10 m height recorded at Cape Hatteras). Singer and Knowles (1975) demonstrated also that Cape Hatteras wind data agreed very well with data from a weather station set up near Stumpy Point (Figure 1). It is recognized that with the passage of a slow moving front, for instance, there may be a several hour lag or a lead time between these stations; this may result in some uncertainty in the interpretation, but should not affect the trend of the wave and wind-tide data. Water levels at the site ranged from 60 cm to 150 cm and were estimated for each data file by taking the mean of the sensor time series and adding it to the transducer height d (see appendix A for sensor calibration details that relate total pressure directly to water depth).

Wave-Gauge Site Characteristics

The basin adjacent to the wave gauge is highly restricted (radial distances from site to shoreline are unique). The longest fetch (≈40 km) is to the NW, but the waves generated there will not be as large as they could be, given the fetch length, because as can be seen in Figure 2, Colington Shoal (with a nearly constant 1.2 m depth) partially shields the site from the deeper basin (mean of 4.5 m with max depth of 5.5 m) to the NW. The smaller basin N and E of the site has only a five to seven kilometer fetch and no comparable shoal shielding it; the waves generated at this fetch generally will not be as large as those from the NW. The smaller basin has a nearly constant depth of 2.75-3.0 m with a rather steep (1/20) slope from that depth to the shelf break at the 1.83 m contour line; the slope from the break to the site is about 1/950. Southerly winds (from the lee side of Roanoke Island) usually generate very low energy waves and do affect significantly the water level at the site, as will be seen later.

The presence of currents at the sensor depth and location can affect the determination of kh (cf. Knowles, 1981f, for details) by introducing an advective frequency component (Doppler shift) on the left side of (2). No current measurements were made during this study, but for the same months in 1975, Singer and Knowles (1975) found that currents, when present near the shelf break adjacent to the site, were very slow (< five cm/sec), generally parallel to the shelf contour (which is nearly one kilometer from the site) but otherwise erratic in direction; they therefore would not likely influence the waves recorded at the site. The only location where Singer and Knowles (1975) measured currents that might have altered the waves before they reached the site was in the deep channel between Colington Shoal and Caroon Point (Figure

2). In response to sustained NW winds, currents of nearly one m/sec were recorded with a general direc tion toward the SE. Since these same winds also would generate waves near that axis, the waves could be lengthened slightly and reduced in amplitude before reaching the site, but certainly could not affect the estimation of kh.

According to Riggs and O'Connor (1974), the sediment near the site consists of sand that is about three meters thick and graded from coarse (0.5 -1.0 mm) near shore to medium (0.25 -0.5 mm) at midshelf (about 400 m from the site) and fine (< 0.25 mm) beyond the shelf break in the deeper interior basin and on Colington Shoal. Shemdin et al (1980) demonstrated that for finite depths, wave energy could be dissipated in course sand by percolation with a damping coefficient of $0 \sim 10^{-3}$/sec, or by bottom friction when the mean sand diameter is in the range 0.1 -0.4 mm and percolation is inhibited. So, it is likely that these two mechanisms had an active role in wave dissipation in this study.

RESULTS

The joint-distribution tables of H_s and T_s are included in Appendix B for an eleven-month period (no data were collected in August) of 1979; Table 2 has been included in this section to summarize those results.

The monthly wave climatologies and wind-tide results were obtained by combining the files shown in Table 1 into calendar months for analysis and plotting. In some instances there were time gaps between files during the month; while this would not affect the joint-probability distributions, it could complicate the intrepretation of the wind-tide plots. When the gap was greater than a few hours, a vertical line was included on the wind-tide plots to emphasize the time break and the time axis was adjusted accordingly.

Wave Climatologies

Table 2 is a summary of the monthly wave climatologies of H_s versus T_s included in Appendix B, and contains the number of non-calm and calm observations (when the wave energy was so low that no spectral peak could be detected), the monthly mean and standard deviation of H_s and T_s, and the modal (largest number of occurrences for the month) and maximum (may be only one observation) H_s and T_s joint-ranges.

The small number of observations obviously biased upward the January data, because the winds during the six days mostly

Table 2. Summary from Appendix B of monthly mean H_s and T_s values (and their standard deviations) for 1979 at the Fort Raleigh wave site. Label NC represents the number of non-calm and C the number of calm observations (file numbers) included in the means. Also included are the modal and maximum ranges of H_s and T_s. Dimensions are H_s (cms) and T_s (secs).

Observations			Means/s.d.				Modal		Maximum	
Month	NC	C	H_s	s'd.	T_s	s.d.	H_s	T_s	H_s	T_s
Jan	43	0	26.8	10.5	2.1	0.4	35-40	2.25-2.49	40-45	2.50-274
Feb	208	16	20.0	10.8	1.8	0.5	05-10	1.20-1.49	45+*	3.00-3.44
Mar	187	4	17.8	7.1	1.7	0.4	15-20	1.50-1.74	35-40*	2.75-2.99
Apr	218	3	16.2	9.0	1.8	0.4	10-15	1.50-1.74	45+*	2.75-2.99
May	209	1	14.6	7.6	1.8	0.4	05-10	1.20-1.49	35-40*	2.50-2.74
Jun	163	1	16.5	8.5	1.8	0.4	10-15	1.50-1.74	45+*	2.75-2.99
Jul	156	1	13.4	6.6	1.6	0.4	05-10	1.20-1.49	40-45*	2.25-2.49
Aug		--------------------NO DATA--------------------------								
Sept	152	1	20.0	8.3	1.8	0.4	20-25	1.75-1.99	40-45*	2.50-2.74
Oct	208	2	15.5	8.8	1.8	0.4	05-10	1.20-1.49	45+*	2.75-2.99
Nov	233	8	18.3	11.5	1.8	0.4	05-10	1.20-1.49	45+*	2.75-2.99
Dec	213	13	15.5	9.2	1.8	0.4	05-10	1.20-1.49	40-45	2.50-2.74

*single observations

were from the NW with speeds greater than five m/sec (i.e. the aver ages of H_s and T_s were not reduced greatly -there were only a few instances where southerly winds generated very low energy lee-side waves). The January data will be disregarded in most of the discussion that follows.

One remarkable result evident from the monthly wave climatologies is that the mean T_s is a nearly constant 1.8 sec, and the standard deviation is an almost constant ±0.4 sec (about 20 percent of the mean). The modal and maximum ranges (and a close examination of the Tables in Appendix B) suggest, however, that this finding does not describe fully the monthly changes in T_s. The modal range is less than the mean in every month except September, and the maximum ranges of T_s are, except for July no smaller than $2.50 < T_s < 2.74$; the greatest maximum range ($3.00 < T_s < 3.44$) occurs only once (in February).

The mean H_s show a more expected seasonal variation, and the larger standard deviations (≈50 percent of the mean H_s) are, in part, the result of the greater variability of the integral properties of the spectrum; i.e., in general, f_m (and therefore, T_s) is easier than E to estimate. According to U.S. Naval Weather Service Command (1970) data, the more energetic northerly winds are usually predominant during the late fall, winter and early spring, so the more energtic waves (i.e. those having a larger wave-height variance E) should be present then also. The data in Table 2 tends to support this, with September, November and February having the largest mean H_s and May and July the smallest. The same seasonal trends are evident for the standard deviations of H_s, which suggests that for 1979 at least, the summer months have longer periods of southerly winds (and their associated lower-energy, lee-side waves) and that the northerly winds not only have less speed but also less directional variability than the fall-winter winds. These trends are evident in the stick-plots contained in Appendix C; the May and July northerly winds were primarily from the shorter fetch NE direction, while November and February had winds that included the longest-fetch NW and the shortest fetch NE directions.

Finally, the distribution of H_s and T_s in the joint-probability intervals may be affected directly when the water depth at the site drops below about 78 cm under strong NE winds; this is evident in the wind-tide plot for February in Appendix C, where H_s and T_s go to zero as the water depth steadily drops to a low of about 55 cm. Knowles (1981f) demonstrated that this virtual elimination of waves at these depths was the result of a rapid increase in non-linear interactions as depth decreased. More will be said about the reasons for the depth decrease in the next section.

Wind Tides

The wind-tide plots are included in Appendix C; this section will summarize the effects that the winds have on the water level at the Fort Raleigh site.

As can be seen in Figures 1 and 2, Fort Raleigh is situated on the northern end of Roanoke Island, with the large Albemarle and Pamlico Sounds immediately north and south, respectively, with the very shallow Roanoke Sound to the east and the relatively deep (≈ four meter) Croatan Sound to the west.

In general, winds from the north to east cause the water level to drop (water exits Albemarle Sound via Croatan Sound) with a rate dependent on wind speed and with a lag time of three to nine hours he wind onset to a significant drop in depth. This effect is seen clearly in the wind-tide plots for almost every month; e.g., some of the larger drops are on February 6-7 and 17-18, March 21 and 27-28, May 5, June 24-26, July 4-5, September 17 and November 3-4. The major drop (discussed in the last section) on February 17-18 is a dramatic example of the importance of NE winds in decreasing the water level. The winds shifted from westerly to just a few degrees east of north during the late morning on February 16 and the water depth began to decrease almost immediately (within three hours), leveled off slightly for nine hours, then continued its decline as the winds increased slightly until early morning on February 18, when an increase in speed and a shift to NE caused a dramatic drop in depth six hours later; i.e. even though the water level already had been reduced from about 110 to 75 cm by northerly winds the depth was further reduced by 20 cm when the winds shifted to NE.

Winds from the NW sometimes cause a gradual rise in water level; but then, if winds persist for > 24 hours with wind speeds > eight m/sec, the water level will eventually drop (see January 28-29 plot and after a slight relaxation in the winds, the February 1-3 plot) probably existing via the narrow dredged channel in Roanoke Sound. If NW winds, however, follow directly after southerly winds (with speeds > five m/sec) the water level usually will drop rather than rise, because southerly winds will have already caused the water level at the site to rise above normal (water will have returned to Albermarle Sound via Croatan Sound), causing a slight pressure head to be established in Albemarle Sound.

The increase in water level can be dramatic upon passage of a front when southerly winds follow immediately after NE winds (see February 18-19 plot); the increase is the result of the changing wind direction, but just as importantly it is also the result of the rebound of water held in Croatan and Pamlico Sounds by the NE winds.

SUMMARY AND CONCLUSIONS

That significant erosian occurs on the sandy banks of northern Roanoke Island is self-evident; a sea-wall has been constructed to protect the important outdoor theater and historic site at Fort Raleigh. Marine grasses have been unsuccessful in stabilizing the shoreline, at least in part because the wave energy there is too great. It is evident from this study, however, that wind-tides are just as important as wave heights in causing the erosion. Most shoreline damage will occur when northerly winds with speeds greater than eight m/sec follow an extended period of southerly winds; the high wind-tide will allow the higher energy waves to attack the shoreline at a greater elevation (see the plots of H_s in Appendix C for May 3-5, June 11, July 4-5, September 15-18, October 8-11, November 1-4, and November 30 -December 3). Before the new seawall was built, the waves riding on these high wind-tides would pass over the seawall and erode the shoreline behind it. The same "drowning" of the marine grasses reduced their effectiveness and made the establishment of a dense protective cover impossible.

An examination of the stick-plots in Appendix C show that for 1979 the northerly winds were primarily from the N to NE. It was shown earlier that winds generating waves from the NE also cause the water level to decrease, a "self-correcting factor" that mitigates the waves erosive capability by reducing the wave elevation on the shoreline and dissipating more of the wave energy by shoaling. It seems likely that the most destructive waves are those generated by N winds that arrive in conjunction with high wind-tides; because the water level drops more slowly than when winds are from the NE, and the waves have more time at the higher elevations of the shore-front to do their damage.

ACKNOWLEDGEMENTS

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data tapes between the monthly battery-servicing trips and in helping me relocate and calibrate the pressure sensor; the success of this data collection effort was, to a very large extent, the result of his help.

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DISSEMINATION OF RESEARCH RESULTS

a. Papers Presented At Scientific Meetings

1979 Knowles, C.E. Wind wave analysis and prediction in large estuaries. Trans. AGU, 60(46), p. 847.

1980a Knowles, C.E. Equilibrium-range slope for shallow water gravity-wave spectra. Trans. AGU, 61(17), p 262.

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1981b Knowles, C.E. Wind-wave spectra and the effects of finite-depth. IUCRM Symposium on Wave Dynamics and Radio Probing of Ocean Surface, Miami Beach, FL, May, 1981.

1981c Knowles, C.E. Wind-wave growth and atmospheric stability in a large, shallow-water estuary. Trans. AGU, 62(17), p. 313.

1981d Knowles, C.E. Transducer height selection to avoid a maximum compensation factor cut-off in estimating surface gravity-waves from subsurface fluctuations. Trans. AGU, 62(45), p. 930.

b. Manuscripts Submitted

1981e Knowles, C.E. On the effects of finite-depth on wind-wave spectra: 1. A comparison with deep-water equilibrium range slope and other spectral parameters. Submitted to Jour. Phys. Ocean.

1981f Knowles, C.E. On the effects of finite-depth on wind-wave spectra: 2. Energy overshoot and the role of $k_p h$ in wave growth. Submitted to O.M. Phillips for inclusion in IUCRM Symposium proceedings.

Appendix A. Wave recording system.

The wave recording system consisted of a bottom-mounted, highly sensitive, Gulton pressure-transducer that converted the subsurface pressure-fluctuations to a frequency-modulated signal that was transmitted to the datalogger by a three-conductor cable.

The datalogger contained a clock (to regulate the sampling interval, turn on the tape recorder and determine the sample length), a Memodyne incremental digital tape recorder, and an electronic package that digitized the signal at a rate of five samples/sec and wrote it serially onto the tape.

The datalogger and four 12 Vdc batteries were housed in a watertight NEMA-type enclosure and mounted on a post buried in the ground on the shoreline adjacent to the anchored transducer; this system and a portable oscilliscope used for adjusting the datalogger are shown in Figure 3. The system was calibrated with water depth from the surface to a depth of 1.52m by lowering the transducer through a graduated tube and recording 32 samples of the frequency output on a cassette tape. These frequency samples were averaged for each depth increment of 15.2 cm (6 inches), plotted versus depth and a linear calibration line established. Atmospheric pressure at the time of calibration was recorded and an equation for the slope of the line derived. This method of calibration gives the frequency output from the transducer as a direct function of depth without having to calculate the total pressure.

Appendix B. Monthly joint-probability distributions tables.

Wave climatologies for all months of 1979 (except August) at the Fort Raleigh site are included in this appendix, in the form of eleven joint-probability distribution tables. The significant heights H_s and periods T_s were calculated from the empirically-compensated surface spectrum using (1), (3), (4) and (5) and then sorted into the intervals shown in the tables. The calm observations (i.e. those where wave energy was so low that a spectral-peak frequency could not be determined) were not included in the determination of the means or standard deviations. All numbers shown in the intervals are in parts/thousand.

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 26 - 31 JAN 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 43 CALM CONDITION OBSERVATIONS NOT INCLUDED: 0

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 12.2 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM)												
	02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	0.0	0.0	46.5	23.3	0.0	0.0	0.0	0.0	0.0	0.0	69.8	69.8	1.34
1.50-1.74	0.0	0.0	46.5	93.0	23.3	0.0	0.0	0.0	0.0	0.0	162.8	232.6	1.65
1.75-1.99	0.0	0.0	0.0	93.0	69.8	23.3	0.0	0.0	0.0	0.0	186.0	418.6	1.90
2.00-2.24	0.0	23.3	0.0	0.0	93.0	46.5	23.3	0.0	0.0	0.0	186.0	604.7	2.14
2.25-2.49	0.0	0.0	0.0	0.0	23.3	23.3	0.0	116.3	23.3	0.0	186.0	790.7	2.37
2.50-2.74	0.0	0.0	0.0	0.0	0.0	23.3	23.3	69.8	93.0	0.0	209.3	1000.0	2.60
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	0.0	23.3	93.0	209.3	209.3	116.3	46.5	186.0	116.3	0.0			
CUM.TOTAL	0.0	23.3	116.3	325.6	534.9	651.2	697.7	883.7	1000.0	1000.0			
HT.AVG	0.0	7.4	12.7	17.2	22.8	29.5	34.1	38.3	42.4	0.0			

AVERAGE WAVE HEIGHT: 26.80 CM
VARIANCE OF WAVE HEIGHT: 109.92 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 10.48 CM

AVERAGE WAVE PERIOD: 2.10 SEC
VARIANCE OF WAVE PERIOD: 0.15 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.39 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 28 FEB 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 208 CALM CONDITION OBSERVATIONS NOT INCLUDED: 16

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 63.7 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	9.6	115.4	91.3	43.3	19.2	0.0	0.0	0.0	0.0	0.0	278.8	278.8	1.31
1.50-1.74	0.0	33.7	76.9	48.1	24.0	4.8	0.0	0.0	0.0	0.0	187.5	466.3	1.62
1.75-1.99	0.0	4.8	33.7	91.3	91.3	19.2	0.0	0.0	0.0	0.0	240.4	706.7	1.88
2.00-2.24	0.0	4.8	9.6	4.8	28.8	48.1	4.8	0.0	0.0	0.0	101.0	807.7	2.09
2.25-2.49	0.0	0.0	0.0	0.0	14.4	14.4	33.7	4.8	0.0	0.0	67.3	875.0	2.34
2.50-2.74	0.0	0.0	0.0	0.0	4.8	4.8	4.8	24.0	28.8	9.6	76.9	951.9	2.63
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	4.8	9.6	14.4	14.4	43.3	995.2	2.84
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8	1000.0	3.00
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	9.6	158.7	211.5	187.5	182.7	91.3	48.1	38.5	43.3	28.8			
CUM.TOTAL	9.6	168.3	379.8	567.3	750.0	841.3	889.4	927.9	971.2	1000.0			
HT.AVG	4.6	7.4	12.2	17.5	22.8	26.9	31.8	37.8	42.7	49.3			

AVERAGE WAVE HEIGHT: 19.96 CM
VARIANCE OF WAVE HEIGHT: 115.94 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 10.77 CM

AVERAGE WAVE PERIOD: 1.83 SEC
VARIANCE OF WAVE PERIOD: 0.22 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.47 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 31 MAR 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 187 CALM CONDITION OBSERVATIONS NOT INCLUDED: 4

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 54.3 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	0.0	85.6	101.6	42.8	37.4	10.7	0.0	0.0	0.0	0.0	278.1	278.1	1.27
1.50-1.74	0.0	16.0	80.2	128.3	16.0	10.7	0.0	0.0	0.0	0.0	251.3	529.4	1.64
1.75-1.99	0.0	16.0	21.4	74.9	64.2	48.1	0.0	0.0	0.0	0.0	224.6	754.0	1.86
2.00-2.24	0.0	5.3	32.1	42.8	21.4	58.8	21.4	0.0	5.3	0.0	187.2	941.2	2.09
2.25-2.49	0.0	5.3	16.0	5.3	0.0	10.7	5.3	0.0	0.0	0.0	42.8	984.0	2.30
2.50-2.74	0.0	0.0	5.3	0.0	0.0	0.0	0.0	5.3	0.0	0.0	10.7	994.7	2.54
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	0.0	5.3	1000.0	2.82
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	0.0	128.3	256.7	294.1	139.0	139.0	26.7	10.7	5.3	0.0			
CUM.TOTAL	0.0	128.3	385.0	679.1	818.2	957.2	984.0	994.7	1000.0	1000.0			
HT.AVG	0.0	7.8	12.7	17.3	21.9	27.5	33.3	37.0	41.1	0.0			

AVERAGE WAVE HEIGHT: 17.73 CM
VARIANCE OF WAVE HEIGHT: 50.61 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 7.11 CM

AVERAGE WAVE PERIOD: 1.72 SEC
VARIANCE OF WAVE PERIOD: 0.12 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.35 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 30 APR 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 218 CALM CONDITION OBSERVATIONS NOT INCLUDED: 3

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 62.9 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	13.8	119.3	105.5	13.8	0.0	0.0	0.0	0.0	0.0	0.0	252.3	252.3	1.31
1.50-1.74	0.0	68.8	146.8	64.2	18.3	4.6	0.0	0.0	0.0	0.0	302.8	555.0	1.64
1.75-1.99	0.0	18.3	64.2	27.5	13.8	18.3	13.8	0.0	0.0	0.0	156.0	711.0	1.86
2.00-2.24	0.0	4.6	36.7	27.5	18.3	41.3	18.3	9.2	0.0	0.0	156.0	867.0	2.13
2.25-2.49	0.0	18.3	13.8	13.8	4.6	13.8	18.3	18.3	4.6	4.6	110.1	977.1	2.34
2.50-2.74	0.0	0.0	4.6	0.0	4.6	0.0	4.6	0.0	0.0	4.6	18.3	995.4	2.63
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.6	1000.0	2.91
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	13.8	229.4	371.6	146.8	59.6	78.0	55.0	27.5	4.6	13.8			
CUM.TOTAL	13.8	243.1	614.7	761.5	821.1	899.1	954.1	981.6	986.2	1000.0			
HT.AVG	4.7	7.8	12.5	17.5	22.4	28.0	32.4	37.0	41.8	45.6			

AVERAGE WAVE HEIGHT: 16.23 CM
VARIANCE OF WAVE HEIGHT: 80.00 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 8.94 CM

AVERAGE WAVE PERIOD: 1.77 SEC
VARIANCE OF WAVE PERIOD: 0.14 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.38 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLCGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 31 MAY 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 209 CALM CONDITION OBSERVATIONS NOT INCLUDED: 1

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 59.7 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	9.6	134.0	43.1	33.5	0.0	0.0	0.0	0.0	0.0	0.0	220.1	220.1	1.32
1.50-1.74	0.0	110.0	124.4	62.2	9.6	0.0	0.0	0.0	0.0	0.0	306.2	526.3	1.63
1.75-1.99	0.0	19.1	28.7	47.8	19.1	4.8	4.8	4.8	0.0	0.0	129.2	655.5	1.85
2.00-2.24	0.0	33.5	47.8	23.9	28.7	38.3	14.4	4.8	0.0	0.0	191.4	846.9	2.13
2.25-2.49	0.0	19.1	52.6	14.4	4.8	14.4	9.6	0.0	0.0	4.8	119.6	966.5	2.35
2.50-2.74	0.0	4.8	9.6	0.0	4.8	9.6	0.0	4.8	0.0	0.0	33.5	1000.0	2.58
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	9.6	320.6	306.2	181.8	67.0	67.0	28.7	14.4	0.0	4.8			
CUM.TOTAL	9.6	330.1	636.4	818.2	885.2	952.2	980.9	995.2	995.2	1000.0			
HT.AVG	4.5	8.1	12.6	16.9	22.7	27.9	32.8	36.3	0.0	50.6			

AVERAGE WAVE HEIGHT: 14.64 CM
VARIANCE OF WAVE HEIGHT: 57.33 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 7.57 CM

AVERAGE WAVE PERIOD: 1.80 SEC
VARIANCE OF WAVE PERIOD: 0.15 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.38 SEC

(CALMS NOT INCLUDED IN AVE.. VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 30 JUN 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 163 CALM CONDITION OBSERVATIONS NOT INCLUDED: 1

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 46.6 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	0.0	98.2	116.6	42.9	0.0	0.0	0.0	0.0	0.0	0.0	257.7	257.7	1.34
1.50-1.74	0.0	42.9	135.0	36.8	12.3	0.0	0.0	0.0	0.0	0.0	227.0	484.7	1.61
1.75-1.99	0.0	30.7	24.5	42.9	85.9	30.7	6.1	0.0	0.0	0.0	220.9	705.5	1.88
2.00-2.24	0.0	42.9	36.8	6.1	55.2	36.8	36.8	6.1	0.0	0.0	220.9	926.4	2.12
2.25-2.49	6.1	6.1	6.1	0.0	6.1	12.3	6.1	6.1	6.1	0.0	55.2	981.6	2.39
2.50-2.74	0.0	6.1	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	12.3	993.9	2.66
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	1000.0	2.78
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	6.1	227.0	319.0	128.8	159.5	79.8	55.2	12.3	6.1	6.1			
CUM.TOTAL	6.1	233.1	552.1	681.0	840.5	920.2	975.5	987.7	993.9	1000.0			
HT.AVG	4.4	7.8	12.4	17.1	22.2	27.1	31.9	38.4	43.0	55.4			

AVERAGE WAVE HEIGHT: 16.49 CM
VARIANCE OF WAVE HEIGHT: 72.69 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 8.53 CM

AVERAGE WAVE PERIOD: 1.78 SEC
VARIANCE OF WAVE PERIOD: 0.13 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.36 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 01 - 20 JUL 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 156 CALM CONDITION OBSERVATIONS NOT INCLUDED: 1

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 44.7 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	32.1	217.9	89.7	51.3	6.4	0.0	0.0	0.0	0.0	0.0	397.4	397.4	1.28
1.50-1.74	6.4	44.9	33.3	102.6	32.1	6.4	0.0	0.0	0.0	0.0	275.6	673.1	1.63
1.75-1.99	0.0	38.5	25.6	25.6	12.8	19.2	6.4	0.0	0.0	0.0	128.2	801.3	1.88
2.00-2.24	0.0	38.5	32.1	12.8	25.6	19.2	0.0	6.4	0.0	0.0	134.6	935.9	2.11
2.25-2.49	0.0	19.2	12.8	6.4	6.4	6.4	0.0	0.0	6.4	0.0	57.7	993.6	2.37
2.50-2.74	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	1000.0	2.52
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	38.5	359.0	250.0	198.7	83.3	51.3	6.4	6.4	6.4	0.0			
CUM.TOTAL	38.5	397.4	647.4	846.2	929.5	980.8	987.2	993.6	1000.0	1000.0			
HT.AVG	4.2	7.9	12.6	16.8	22.1	26.7	31.5	35.5	40.5	0.0			

AVERAGE WAVE HEIGHT: 13.39 CM
VARIANCE OF WAVE HEIGHT: 44.00 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 6.63 CM

AVERAGE WAVE PERIOD: 1.64 SEC
VARIANCE OF WAVE PERIOD: 0.13 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.36 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 05 - 30 SEP 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 152 CALM CONDITION OBSERVATIONS NOT INCLUDED: 1

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 43.5 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	19.7	105.3	59.2	26.3	0.0	13.2	0.0	0.0	0.0	0.0	223.7	223.7	1.27
1.50-1.74	0.0	6.6	59.2	85.5	46.1	0.0	0.0	0.0	0.0	0.0	197.4	421.1	1.65
1.75-1.99	0.0	0.0	19.7	19.7	144.7	65.8	6.6	0.0	0.0	0.0	256.6	677.6	1.85
2.00-2.24	0.0	6.6	6.6	6.6	26.3	78.9	39.5	19.7	0.0	0.0	184.2	861.8	2.09
2.25-2.49	0.0	0.0	26.3	13.2	6.6	0.0	26.3	13.2	0.0	0.0	85.5	947.4	2.34
2.50-2.74	0.0	0.0	0.0	13.2	13.2	6.6	0.0	6.6	6.6	0.0	46.1	993.4	2.63
2.75-2.99	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	6.6	1000.0	2.91
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	19.7	118.4	171.1	171.1	236.8	164.5	72.4	39.5	6.6	0.0			
CUM.TOTAL	19.7	138.2	309.2	480.3	717.1	881.6	953.9	993.4	1000.0	1000.0			
HT.AVG	4.4	7.9	12.8	17.5	22.3	27.4	31.8	36.9	41.1	0.0			

AVERAGE WAVE HEIGHT: 20.02 CM
VARIANCE OF WAVE HEIGHT: 68.72 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 8.29 CM

AVERAGE WAVE PERIOD: 1.81 SEC
VARIANCE OF WAVE PERIOD: 0.15 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.39 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 31 OCT 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 208 CALM CONDITION OBSERVATIONS NOT INCLUDED: 2

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 59.7 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	28.8	187.5	62.5	9.6	0.0	4.8	0.0	4.8	0.0	0.0	298.1	298.1	1.28
1.50-1.74	0.0	14.4	57.7	62.5	9.6	0.0	0.0	0.0	0.0	0.0	144.2	442.3	1.61
1.75-1.99	0.0	24.0	52.9	48.1	38.5	4.8	0.0	0.0	0.0	0.0	168.3	610.6	1.89
2.00-2.24	0.0	28.8	43.3	19.2	38.5	57.7	38.5	0.0	0.0	0.0	226.0	836.5	2.11
2.25-2.49	0.0	24.0	48.1	4.8	4.8	4.8	9.6	24.0	0.0	0.0	120.2	956.7	2.35
2.50-2.74	0.0	4.8	0.0	14.4	0.0	4.8	0.0	4.8	0.0	0.0	28.8	985.6	2.60
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8	990.4	2.78
3.00-3.44	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	995.2	3.00
3.25-3.49	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	1000.0	3.37
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	28.8	293.3	264.4	158.7	91.3	76.9	48.1	33.7	0.0	4.8			
CUM.TOTAL	28.8	322.1	586.5	745.2	836.5	913.5	961.5	995.2	995.2	1000.0			
HT.AVG	4.3	7.4	12.5	16.9	22.8	27.5	32.6	36.6	0.0	48.2			

AVERAGE WAVE HEIGHT: 15.51 CM
VARIANCE OF WAVE HEIGHT: 77.86 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 8.82 CM

AVERAGE WAVE PERIOD: 1.81 SEC
VARIANCE OF WAVE PERIOD: 0.19 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.44 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 30 NOV 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 233 CALM CONDITION OBSERVATIONS NOT INCLUDED: 8

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 68.6 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	90.1	150.2	77.3	4.3	0.0	0.0	0.0	0.0	0.0	0.0	321.9	321.9	1.27
1.50-1.74	0.0	17.2	94.4	38.6	8.6	0.0	0.0	0.0	0.0	0.0	158.8	480.7	1.62
1.75-1.99	4.3	21.5	30.0	17.2	60.1	21.5	0.0	0.0	0.0	0.0	154.5	635.2	1.88
2.00-2.24	4.3	21.5	21.5	8.6	25.8	60.1	51.5	17.2	4.3	0.0	214.6	849.8	2.12
2.25-2.49	0.0	0.0	4.3	0.0	0.0	8.6	38.6	51.5	8.6	0.0	111.6	961.4	2.33
2.50-2.74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	4.3	8.6	30.0	991.4	2.54
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.3	8.6	1000.0	2.88
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	98.7	210.3	227.5	68.7	94.4	90.1	90.1	85.8	21.5	12.9			
CUM.TOTAL	98.7	309.0	536.5	605.1	699.6	789.7	879.8	965.7	987.1	1000.0			
HT.AVG	4.4	7.6	12.5	17.7	22.8	27.5	32.1	36.5	41.3	49.1			

AVERAGE WAVE HEIGHT: 18.27 CM
VARIANCE OF WAVE HEIGHT: 132.10 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 11.49 CM

AVERAGE WAVE PERIOD: 1.77 SEC
VARIANCE OF WAVE PERIOD: 0.18 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.43 SEC

(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

WAVE CLIMATOLOGY FOR FT RALEIGH N C FOR PERIOD FROM 1 - 31 DEC 79

DISTRIBUTION OF SIG. HEIGHT(IN OBSERVATIONS PER 1000 OBSERVATIONS) AS A FUNCTION OF SIG. PERIOD

NON-CALM CONDITION OBSERVATIONS: 213 CALM CCNDITION OBSERVATIONS NOT INCLUDEC: 13

DATA OBTAINED FROM SET OF DIGITAL BOTTOM-MOUNTED PRESSURE TRANSDUCER RECORDS TOTALING 64.3 HOURS THAT HAS BEEN CORRECTED FOR PRESSURE ATTENUATION BEFORE ANALYSIS

PERIOD (SECS)	HEIGHT(CM) 02-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45+	TOTAL	CUM. TOTAL	PRD AVG
1.20-1.49	61.0	117.4	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	206.6	206.6	1.28
1.50-1.74	9.4	79.8	65.7	32.9	0.0	0.0	0.0	0.0	0.0	0.0	187.8	394.4	1.64
1.75-1.99	4.7	51.6	37.6	75.1	61.0	4.7	0.0	0.0	0.0	0.0	234.7	629.1	1.88
2.00-2.24	0.0	46.9	9.4	28.2	42.3	84.5	28.2	0.0	0.0	0.0	239.4	868.5	2.12
2.25-2.49	4.7	9.4	9.4	9.4	0.0	32.9	23.5	4.7	0.0	0.0	93.9	962.4	2.34
2.50-2.74	0.0	4.7	4.7	0.0	4.7	4.7	4.7	4.7	9.4	0.0	37.6	1000.0	2.58
2.75-2.99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.00-3.44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
3.25-3.49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	C.0
3.50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1000.0	0.0
TOTAL	79.8	309.9	154.9	145.5	108.0	126.8	56.3	9.4	9.4	0.0			
CUM.TOTAL	79.8	389.7	544.6	690.1	798.1	924.9	981.2	990.6	1000.0	1000.0			
HT.AVG	4.4	7.3	12.2	17.6	22.5	27.2	31.8	39.4	40.4	0.0			

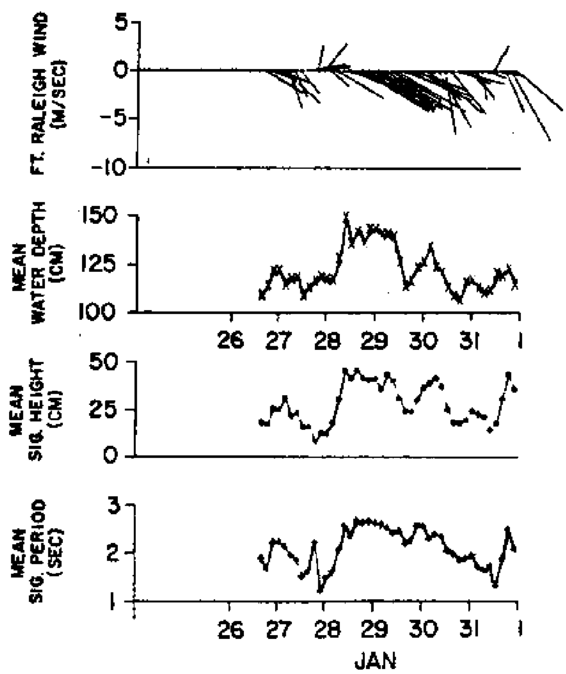
AVERAGE WAVE HEIGHT: 15.49 CM
VARIANCE OF WAVE HEIGHT: 84.48 CM SQ
STANDARD DEVIATION OF WAVE HEIGHT: 9.19 CM

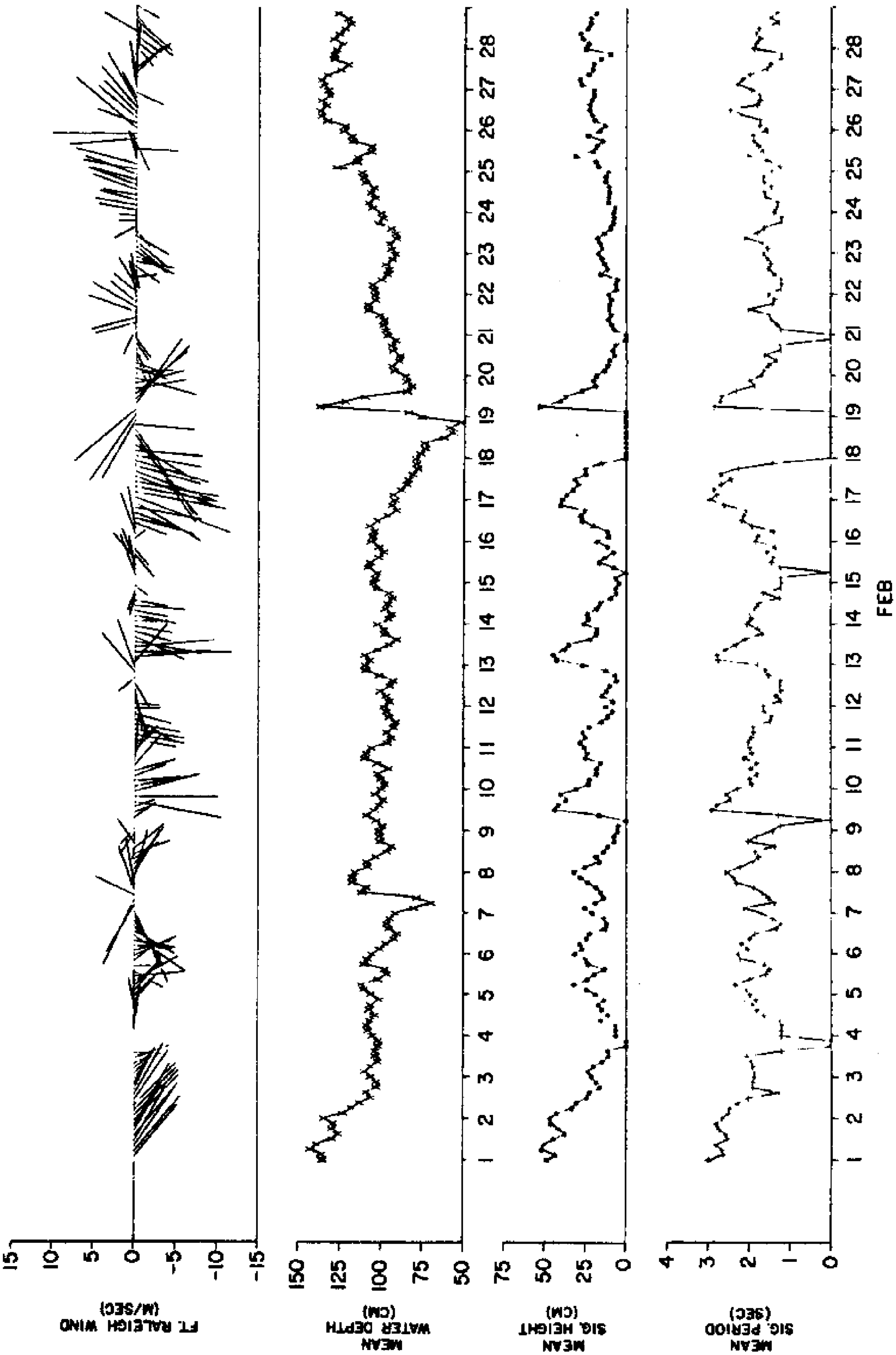
AVERAGE WAVE PERIOD: 1.84 SEC
VARIANCE OF WAVE PERIOD: 0.14 SEC SQ
STANDARD DEVIATION OF WAVE PERIOD: 0.38 SEC

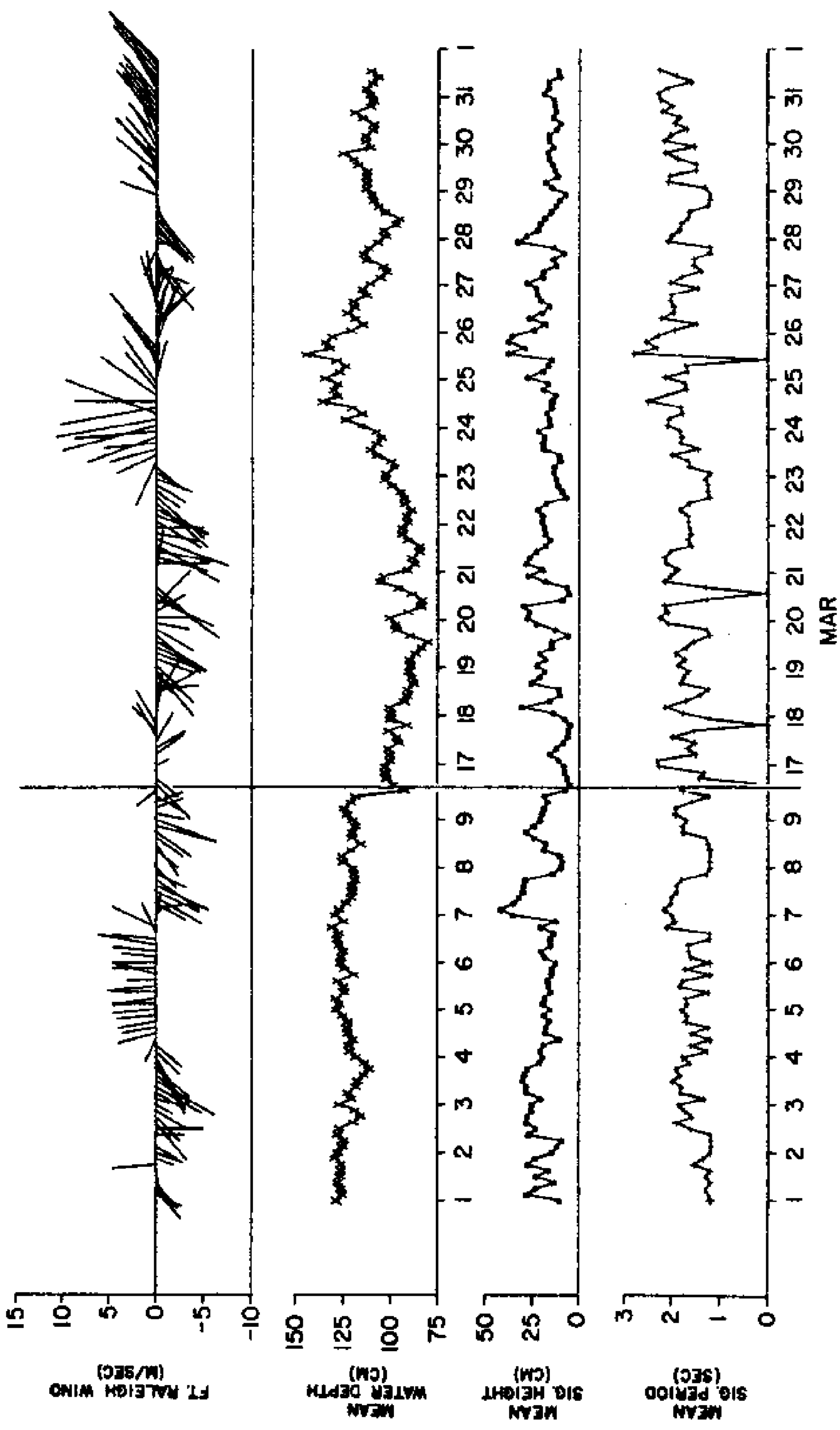
(CALMS NOT INCLUDED IN AVE., VAR. OR ST.DEV.)

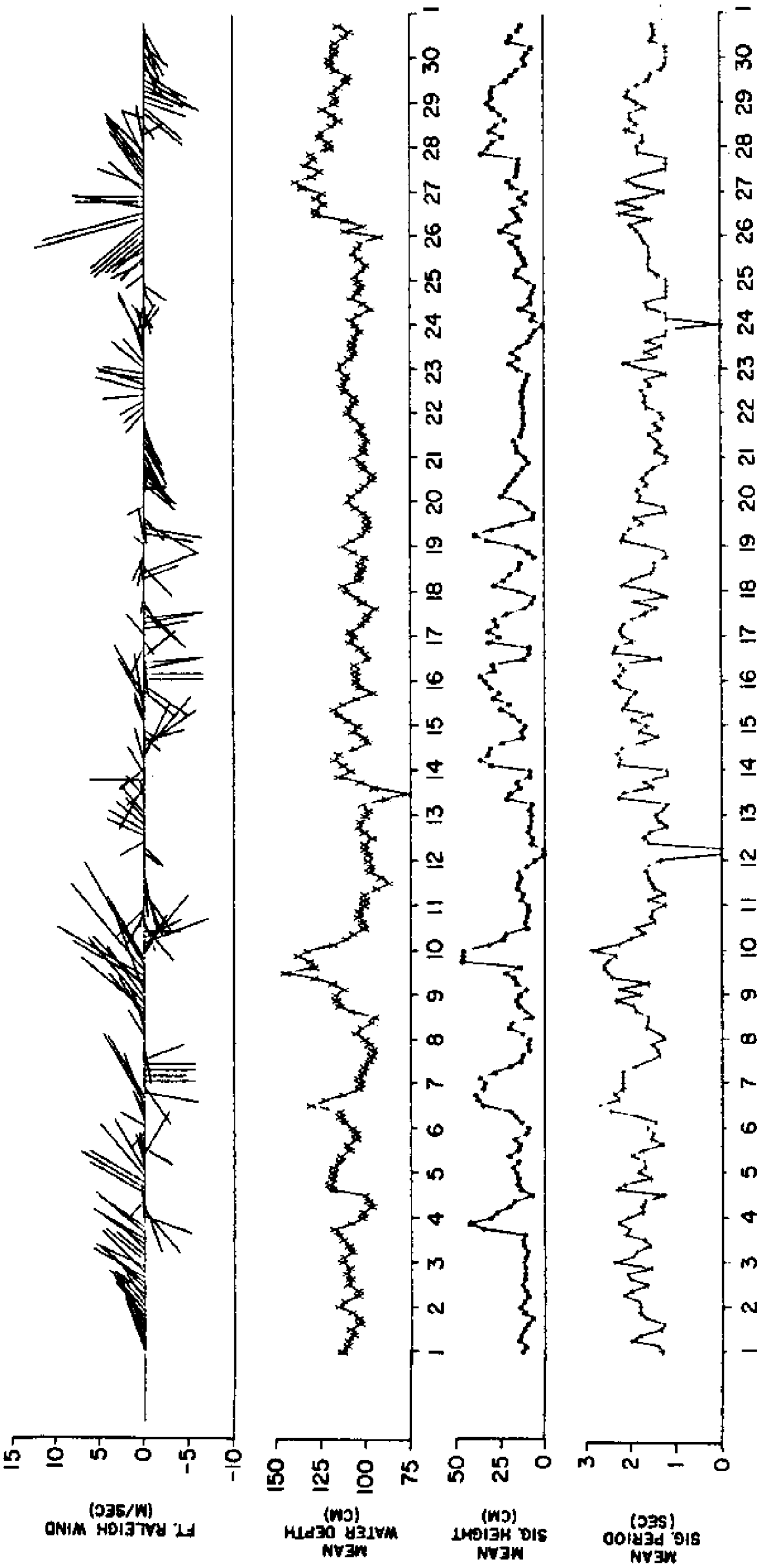
Appendix C. Monthly wind stick-plots, wind-tides and time histories of H_s and T_s.

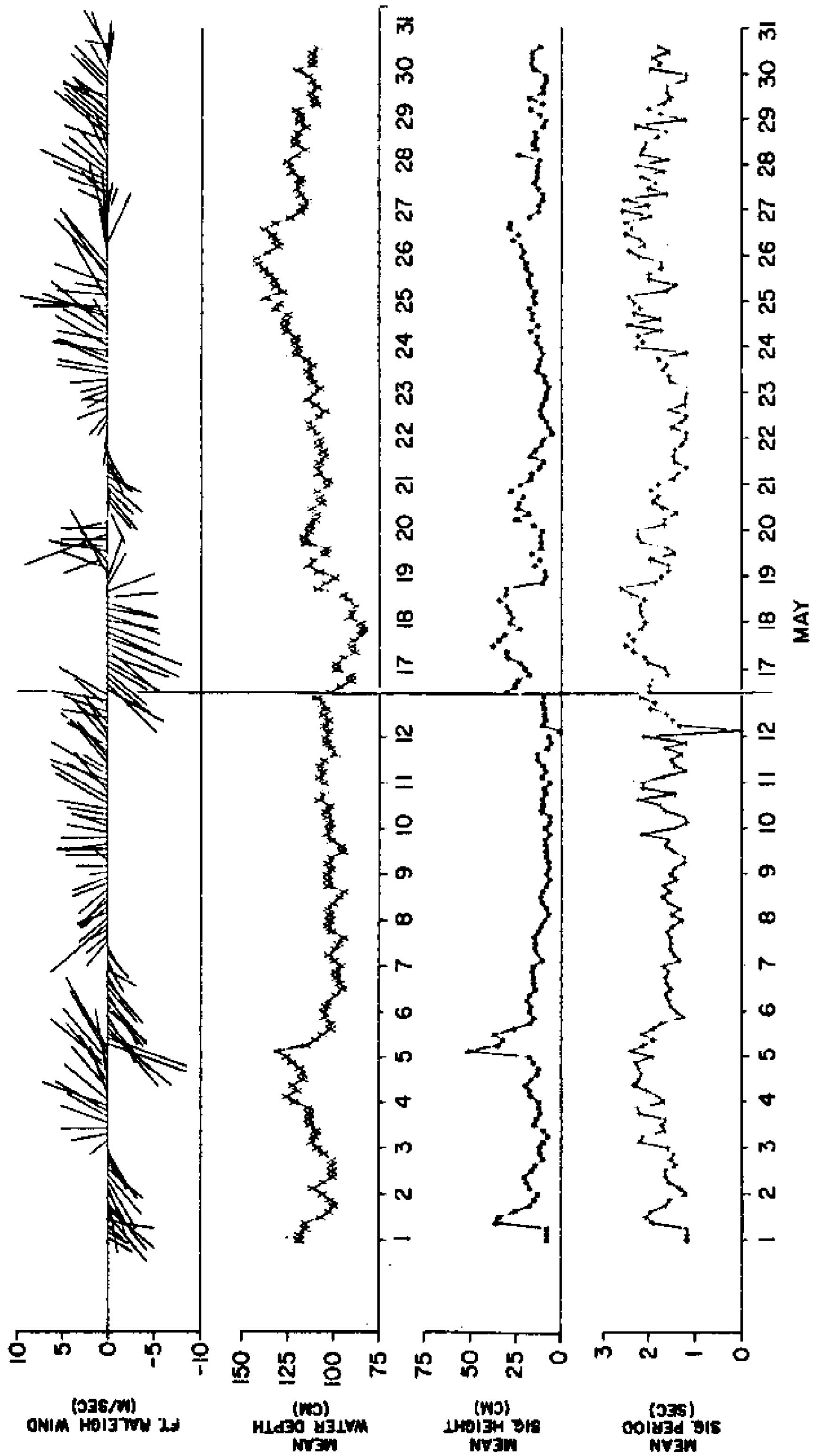
Time-series plots for all months of 1979 (except August) of Cape Hatteras winds, Fort Raleigh wave-site water levels (wind-tides), and H_s and T_s are included in this appendix as the next eleven figures. Vertical lines shown on some plots have been included to emphasize gaps in the time series where data were not collected; the time axis has been adjusted accordingly. The stick-plot vectors represent the direction that the wind is coming from; i.e. the tail of the vector would lie on the horizontal time line.

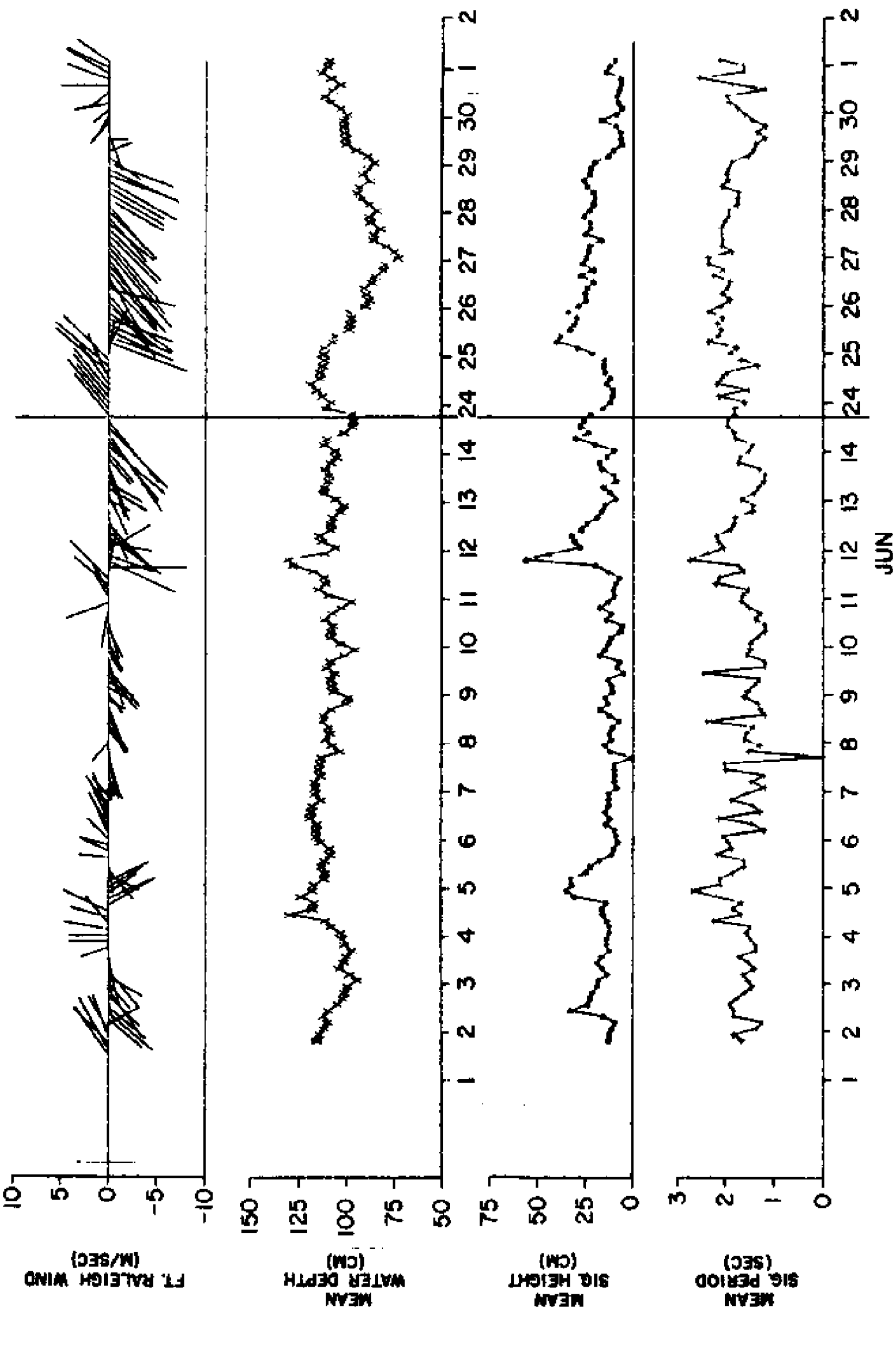

FT. RALEIGH WIND (M/SEC)
5
0
-5
-10
MEAN WATER DEPTH (CM)
150
125
100
26
27
28
29
30
31
1
MEAN SIG. HEIGHT (CM)
50
25
0
MEAN SIG. PERIOD (SEC)
3
2
1
26
27
28
29
30
31
1
JAN

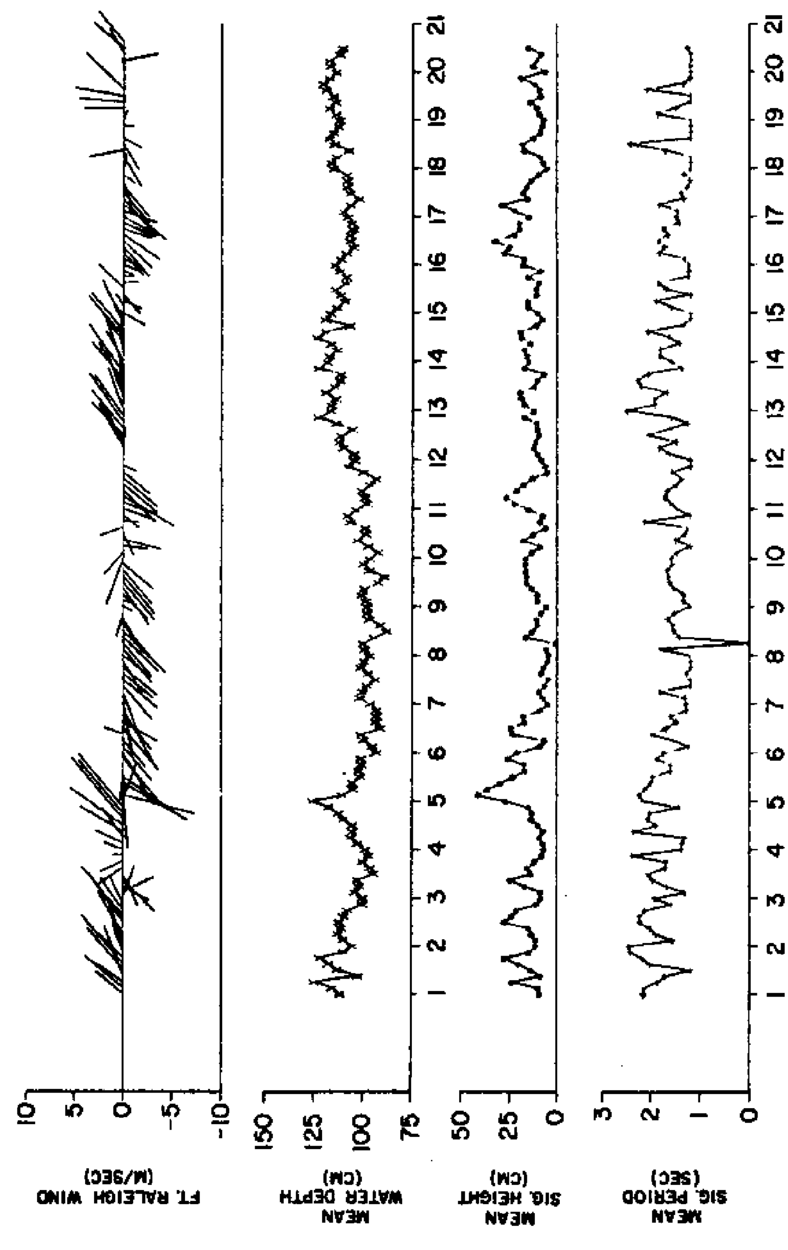

FT. RALEIGH WIND (M/SEC)
15 10 5 0 -5 -10 -15
MEAN WATER DEPTH (CM)
150 125 100 75 50
MEAN SIG. HEIGHT (CM)
75 50 25 0
MEAN SIG. PERIOD (SEC)
4 3 2 1 0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
FEB

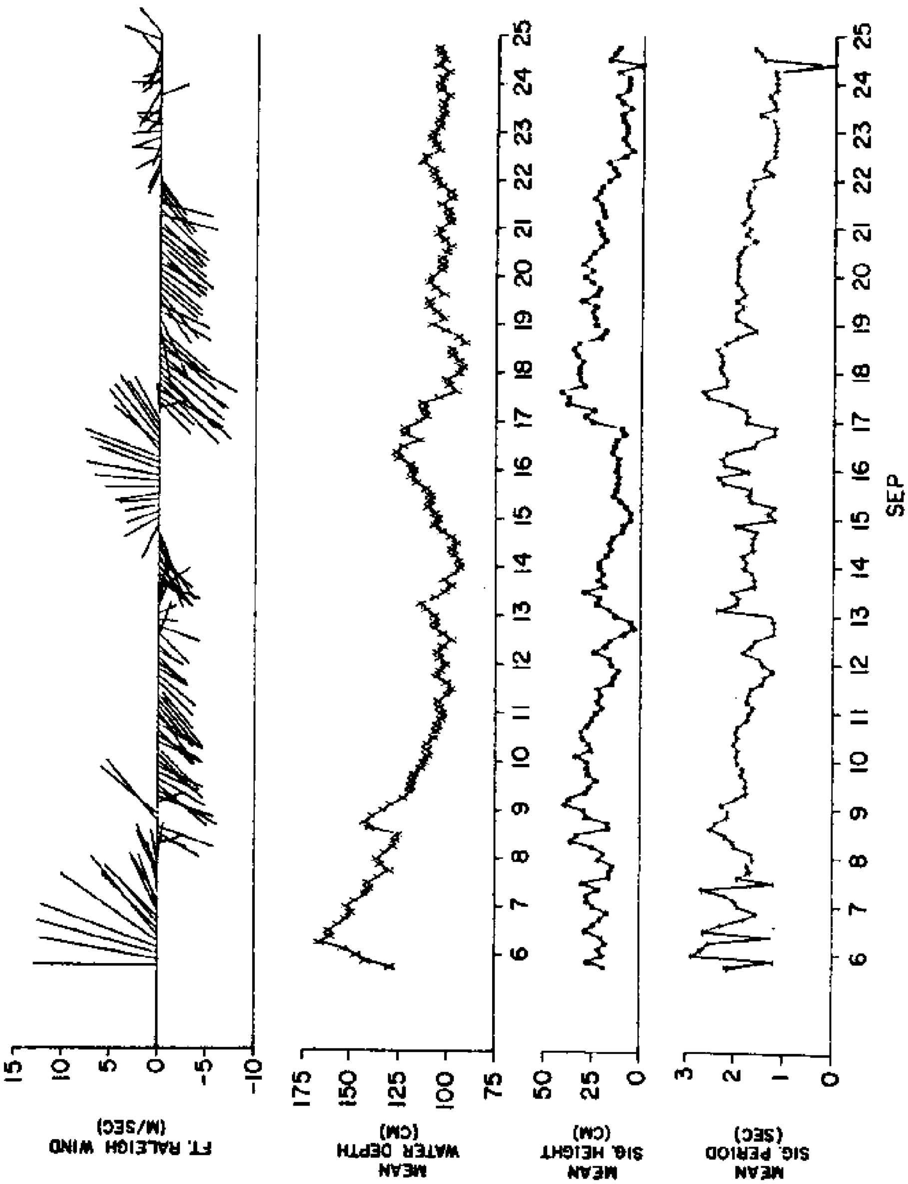

FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
MAR

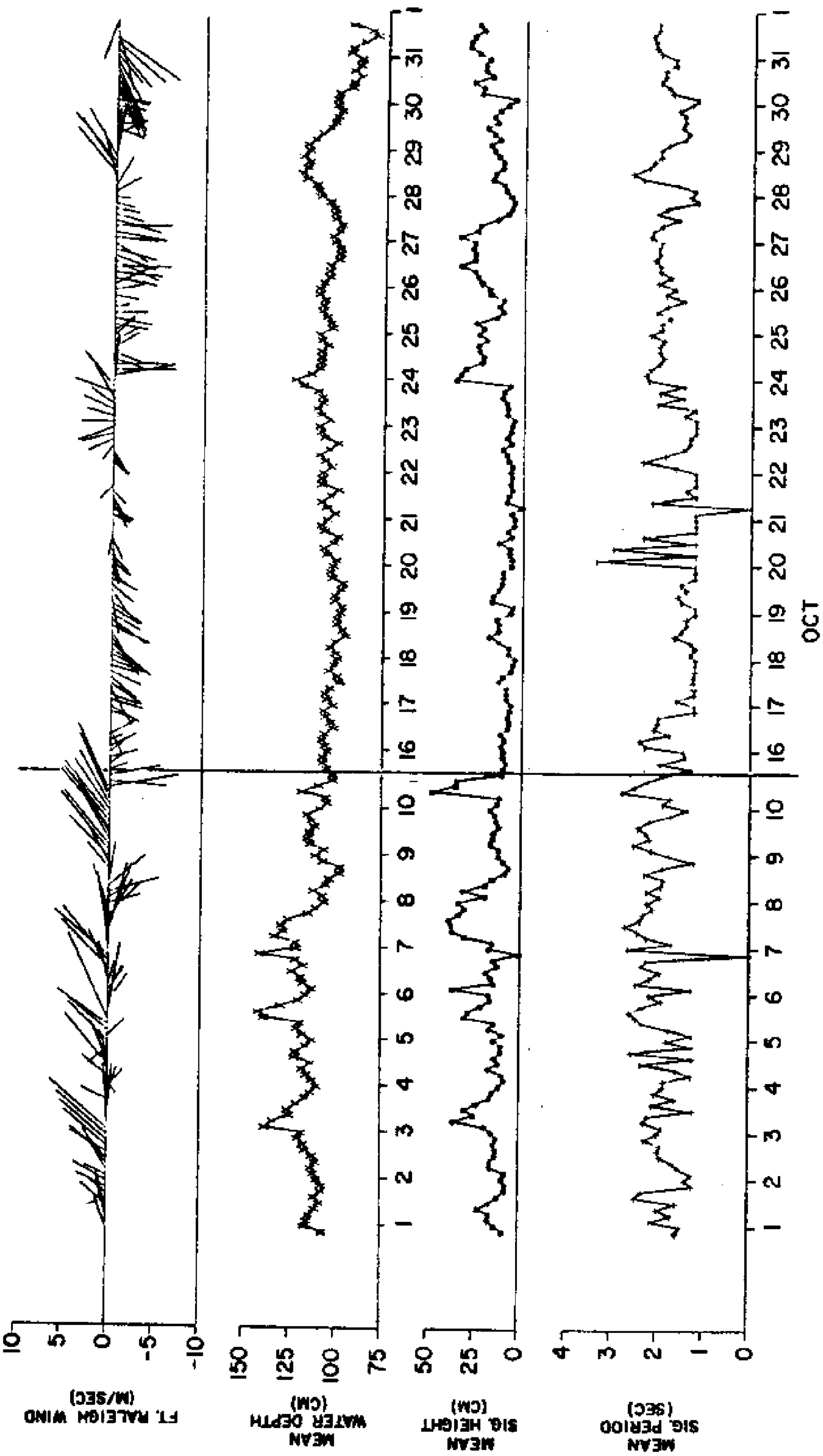

FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
APR

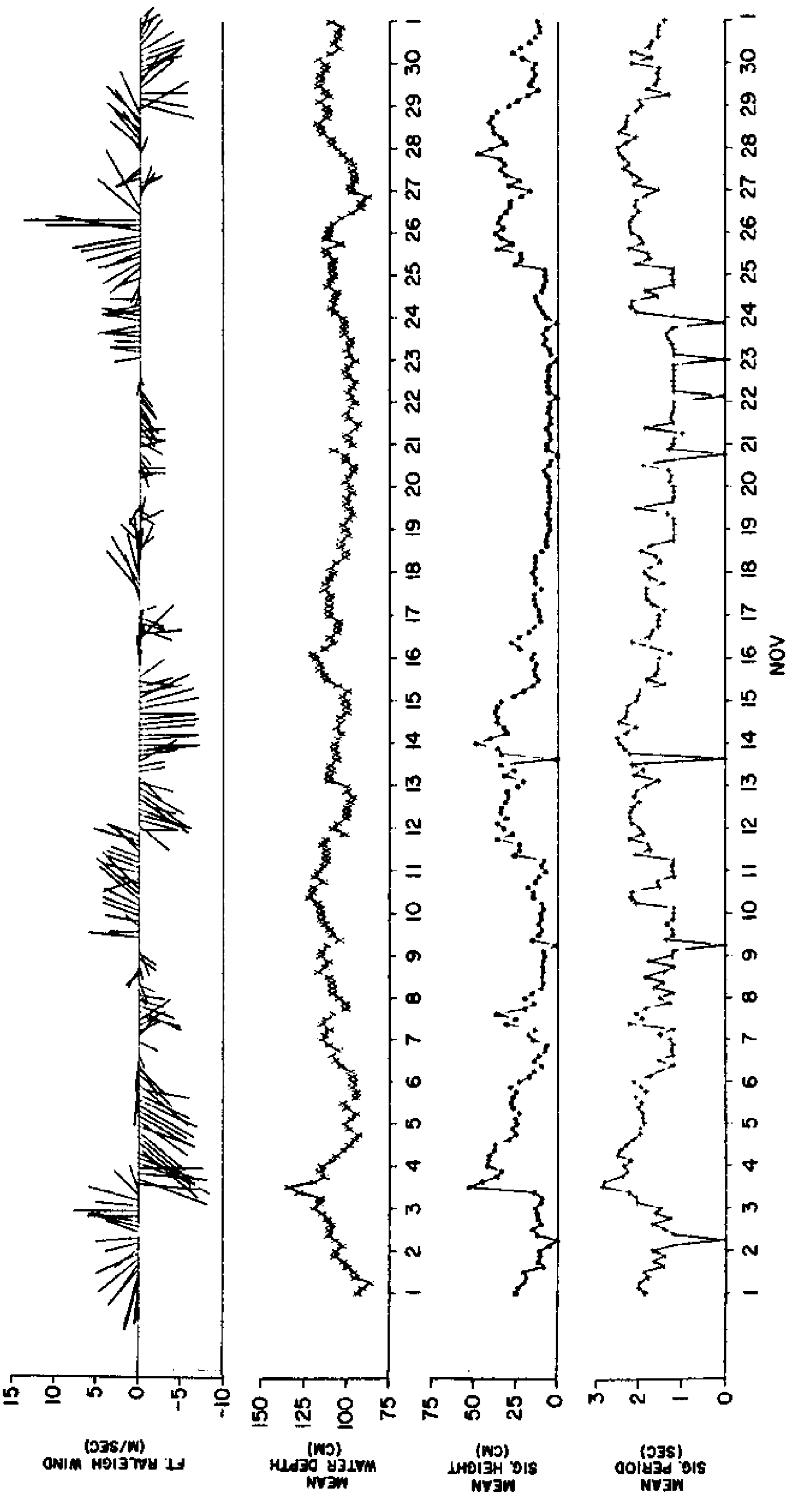

FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
MAY


FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
JUN

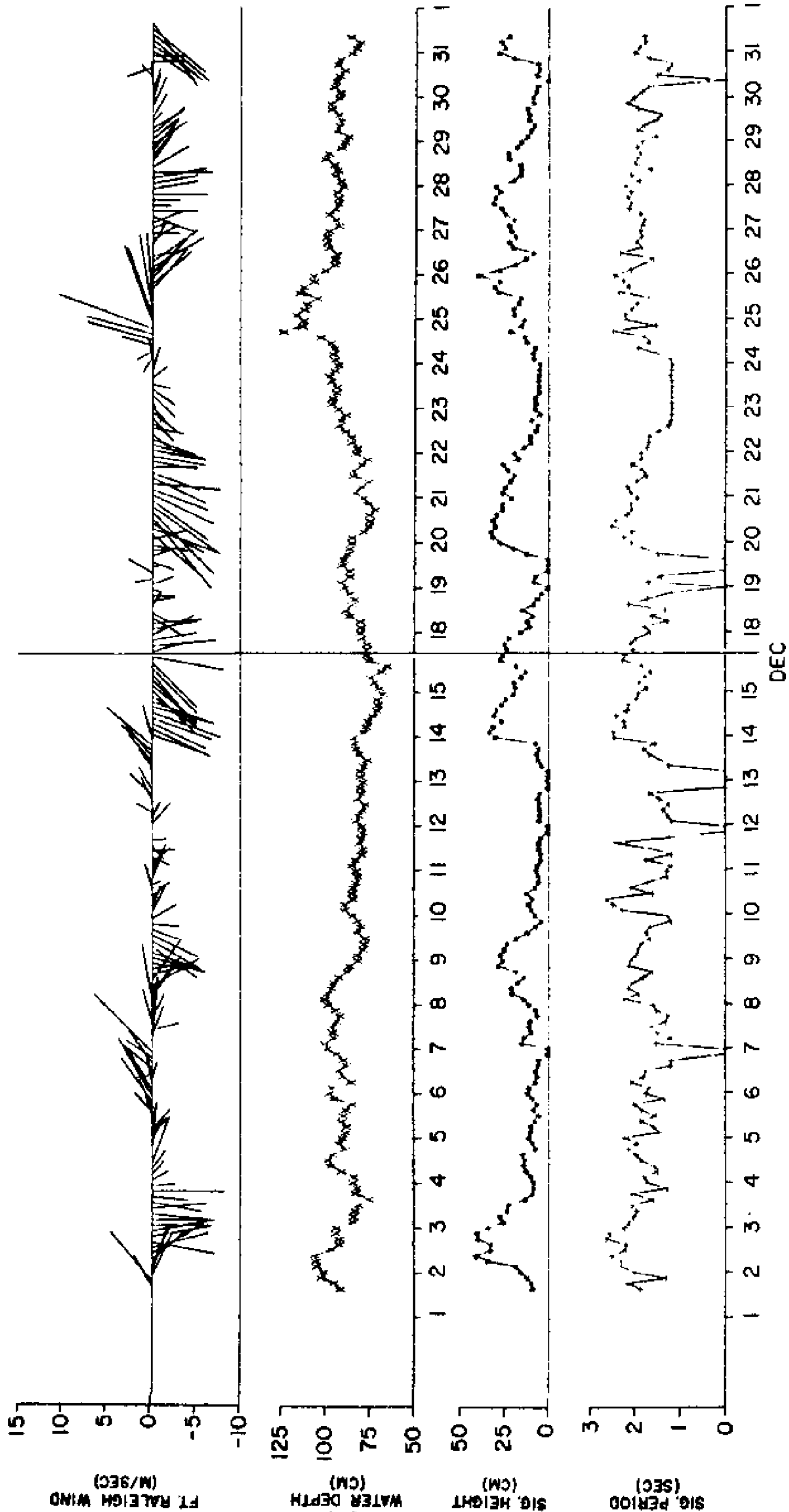

FT. RALEIGH WIND
(M/SEC)
MEAN
WATER DEPTH
(CM)
MEAN
SIG. HEIGHT
(CM)
MEAN
SIG. PERIOD
(SEC)
JULY


FT. RALEIGH WIND (M/SEC)
15
10
5
0
-5
-10
MEAN WATER DEPTH (CM)
175
150
125
100
75
MEAN SIG. HEIGHT (CM)
50
25
0
MEAN SIG. PERIOD (SEC)
3
2
1
0
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
SEP


FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
OCT



FT. RALEIGH WIND (M/SEC)
MEAN WATER DEPTH (CM)
MEAN SIG. HEIGHT (CM)
MEAN SIG. PERIOD (SEC)
NOV


FT. RALEIGH WIND
(M/SEC)
MEAN
WATER DEPTH
(CM)
MEAN
SIG. HEIGHT
(CM)
MEAN
SIG. PERIOD
(SEC)
DEC