AD-A169 579 PRELIMINARY DATA SUMMARY SEPTEMBER 1985(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION KITTY HAWK NC FIELD RESEARCH FACILITY SEP 85 1/1

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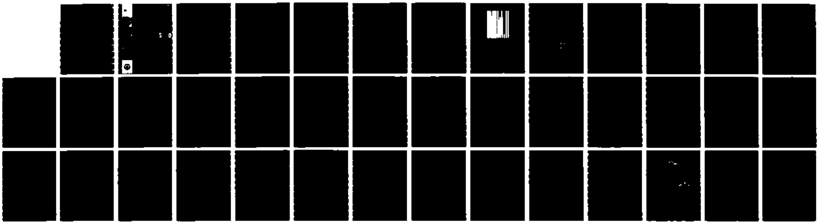

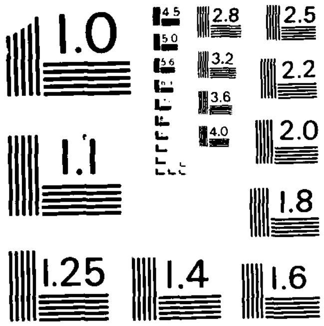

MICROCOPY RESOLUTION TEST CHART
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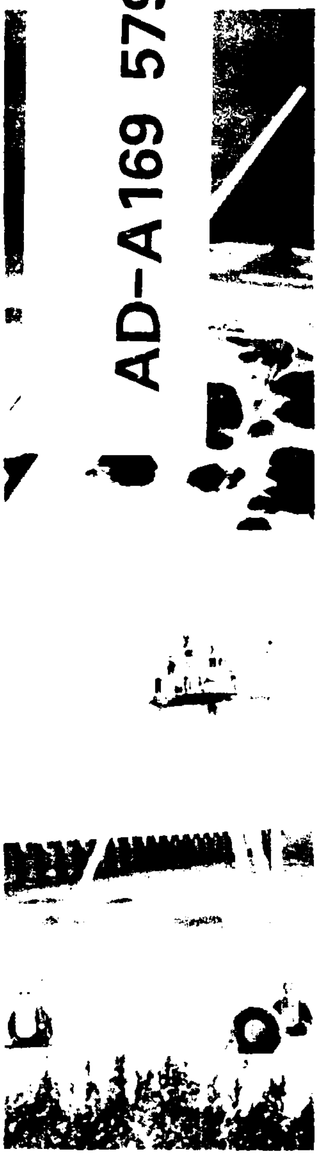

PRELIMINARY DATA SUMMARY

SEPTEMBER 1985

by

Field Research Facility
Coastal Engineering Research Center
U. S. Army Engineer Waterways Experiment Station
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US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

PRELIMINARY DATA SUMMARY

September 1985

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

PRELIMINARY DATA SUMMARY

CERC Field Research Facility
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

CONTENTS

FIGURES

TABLES

I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. H. Carl Miller at (919) 261-3511.

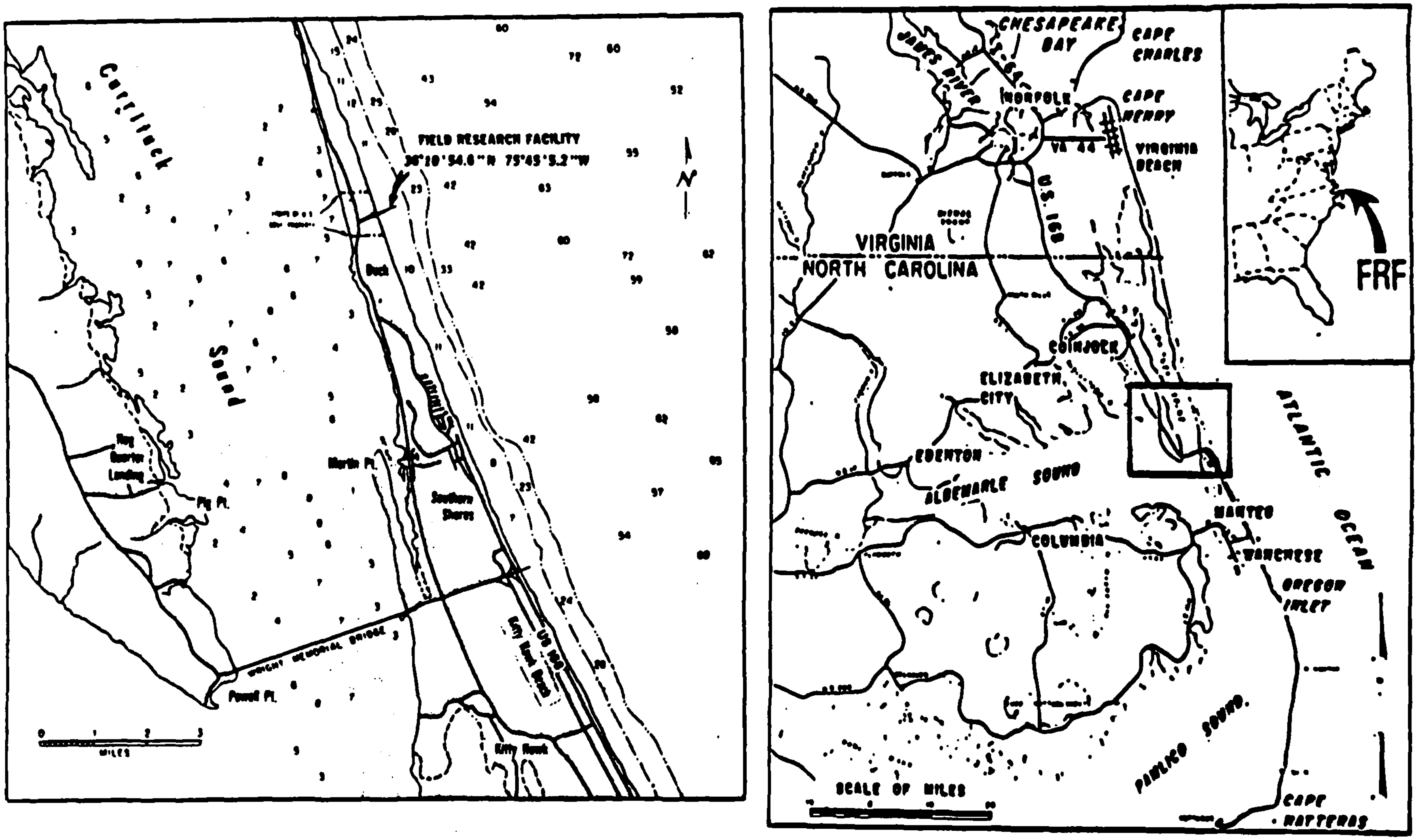

Figure 1. FRF Location Map

TABLE 1
INSTRUMENT STATUS/DATA AVAILABILITY
September 1985

GAGE NUMBER	DESCRIPTION/REMARKS	DEPTH AT SENSOR		DAY OF THE MONTH 1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30
	Barometric Press.		Instrument Status	
			Data Collected	
			Analog Record	
	Precipitation		Instrument Status	
			Data Collected	
			Analog Record	
	Air Temperature		Instrument Status	
			Data Collected	
			Maximum/Minimum	
	Anemometer on Lab Bldg - Elevation 19m (MSL)		Instrument Status	
			Data Collected	
			Analog Record	
645	Baylor staff located at station 7+80 on FRF pier	See profile data	Instrument Status	
			Data Collected	
625	Baylor staff located at station 19+00 on FRF pier	See profile data	Instrument Status	
			Data Collected	
640	Waverider buoy located 1.0 km from shore	Approx. 8.5 m MSL	Instrument Status	
			Data Collected	
630	Waverider buoy located 6.0km from shore	Approx. 18 m. MSL	Instrument Status	
			Data Collected	
639	Current meter at station 14+20 on FRF pier	See profile data	Instrument Status	Gage Inoperative
			Data Collected	
679	Current meter 500M south (0.5km offshore)	Approx. 6 m MSL	Instrument Status	
			Data Collected	
865-1370	NOAA primary tide station located at seaward end of FRF pier		Instrument Status	
			Data Collected	

Instrument Status: Operational ■ - Daily Observation: YES ■

Data Collected: ALL ■, SOME ◩

Analog Record: ALL ■, PARTIAL ◩

Preliminary Analysis: ALL ■, SOME ◩

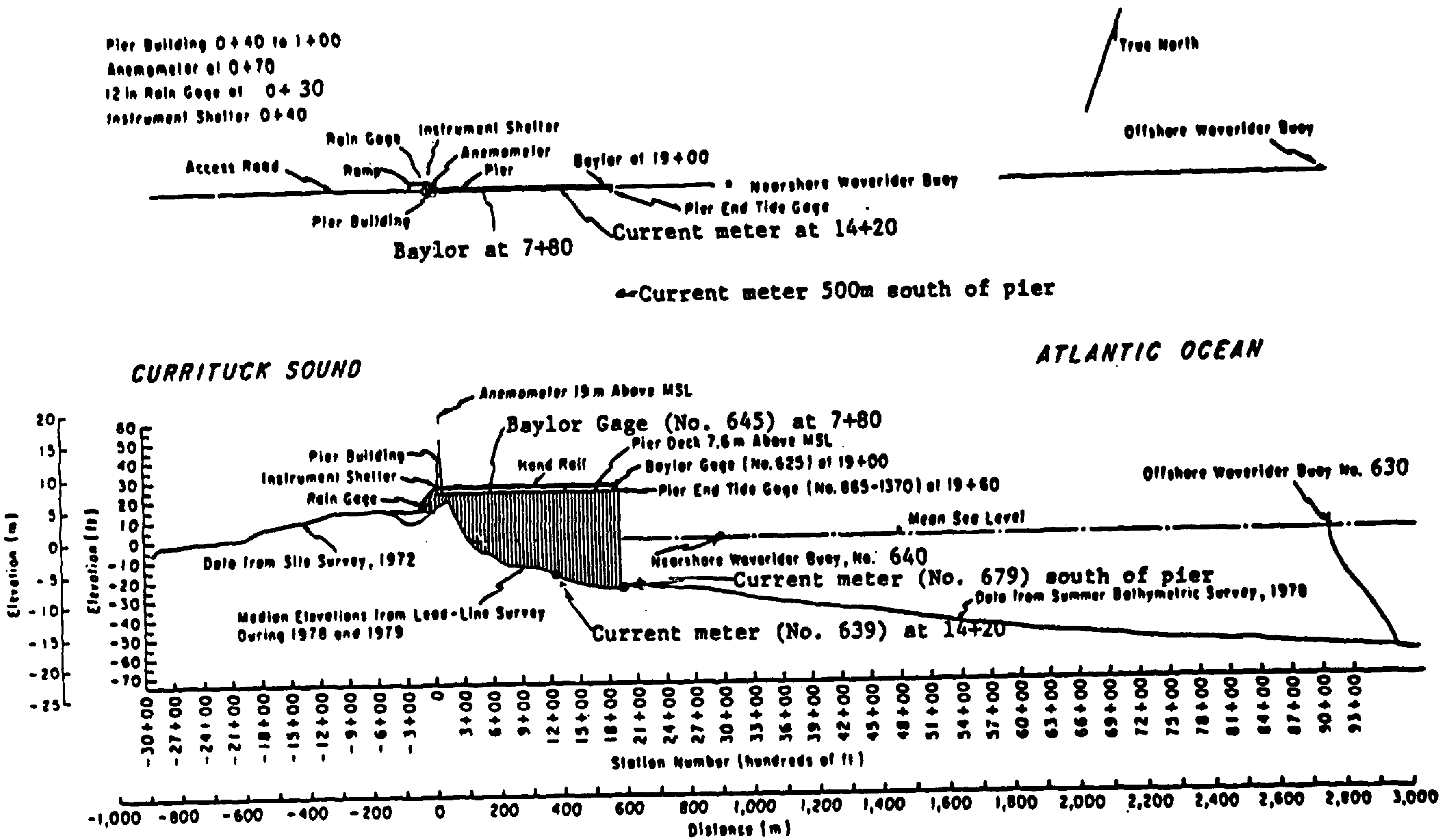

Figure 2. Instrument locations at FRF.

II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Data General NOVA-4 computer. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS *maximum and minimum thermometers* and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -
   mm x .03937 = in

2. Millibars (mb) to inches of mercury (in Hg) -
   mb x 0.02953 = in Hg

3. Degrees Celcius (C) to degrees Fahrenheit (F) -
   (C x 9/5) + 32 = F

4. Meters per second (m/s) to knots (kn) -
   m/s x 1.943 = kn

TABLE 2: METEOROLOGICAL DATA

PART 1

SEPTEMBER 1985

DAY	HOUR	WIND SPEED (M/S)	WIND DIRECTION (DEG TN)	TEMPERATURE (DEG C)	ATM PRESSURE (MB)	PRECIPITATION (MM)
1	100	7	75	22.5	1018.3	0
	700	7	46	23.2	1021.7	0
	1300	4	56	25.8	1023.7	0
	1900	4	100	23.1	1023.6	0
2	100	3	110	23.2	1024.2	0
	700	1	174	24.5	1024.4	0
	1300	4	193	28.7	1022.9	0
	1900	5	195	25.1	1021.3	0
3	100	6	233	24.1	1020.9	0
	700	4	241	25.5	1019.2	0
	1300	3	209	29.7	1019.2	0
	1900	3	173	26.1	1019.2	0
4	100	5	235	25.1	1019.2	0
	700	4	242	25.8	1019.2	0
	1300	6	231	31.8	1019.2	0
	1900	3	195	28.4	1015.8	0
5	100	6	235	25.7	1015.8	0
	700	6	250	26.4	1019.2	0
	1300	6	238	32.1	1015.8	0
	1900	4	200	28.8	1015.8	0
6	100	7	233	25.4	1015.8	0
	700	7	246	26.2	1019.2	0
	1300	7	243	31.8	1015.8	0
	1900	3	214	28.8	1015.8	0
7	100	6	243	26.3	1015.8	0
	700	4	267	26.2	1019.2	0
	1300	3	26	29.3	1019.2	0
	1900	1	113	26.2	1019.2	0
8	100	0		24.3	1019.2	0
	700	2	249	25.9	1019.2	0
	1300	4	117	31.2	1019.2	0
	1900	4	192	27.7	1015.8	0
9	100	5	241	26.2	1015.8	0
	700	4	237	26.6	1015.8	0
	1300	5	230	31.8	1015.8	0
	1900	5	189	27.3	1014.1	0
10	100	7	227	25.8	1013.1	0
	700	5	234	26.3	1013.4	0
	1300	4	208	32.1	1015.8	0
	1900	5	193	27.6	1012.4	0
11	100	6	237	26.2	1012.4	0
	700	7	11	24.9	1012.4	0
	1300	12	18	24.2	1015.8	0
	1900	10	38	22.7	1015.8	0
12	100	10	49	22.0	1019.2	0
	700	10	39	21.4	1019.2	0
	1300	8	10	22.4	1019.2	0
	1900	9	29	20.5	1019.2	0
13	100	10	25	21.0	1022.6	0
	700	15	8	19.4	1022.6	0
	1300	13	358	18.5	1026.0	0
	1900	13	358	16.6	1026.0	0
14	100	14	13	17.1	1026.0	0
	700	13	23	18.3	1029.3	0
	1300	11	24	19.7	1029.3	0
	1900	10	31	17.6	1029.3	0
15	100	10	46	17.9	1029.3	0
	700	8	41	19.2	1026.0	0
	1300	7	34	20.8	1026.0	0
	1900	7	43	19.3	1026.0	0
16	100	6	44	19.4	1026.0	0
	700	8	38	20.1	1022.6	0
	1300	8	40	21.2	1022.6	0
	1900	7	40	19.4	1022.6	0

TABLE 2: METEOROLOGICAL DATA

PART 2

SEPTEMBER 1985

DAY	HOUR	WIND SPEED (M/S)	WIND DIRECTION (DEG TN)	TEMPERATURE (DEG C)	ATM PRESSURE (MB)	PRECIPITATION (MM)
17	100	7	41	20.0	1022.6	0
	700	7	38	21.1	1022.6	0
	1300	8	37	22.0	1022.6	0
	1900	5	27	20.6	1022.6	0
18	100	5	23	20.5	1022.6	0
	700	8	9	20.7	1026.0	0
	1300	6	27	22.6	1026.0	0
	1900	*		21.1	1026.0	0
19	100			21.4	1026.0	0
	700	3	36	22.2	1026.0	0
	1300	7	49	23.6	1026.0	0
	1900	5	58	21.7	1022.6	0
20	100	3	25	21.3	1022.6	0
	700	5	24	22.2	1022.6	0
	1300	4	64	24.4	1022.6	0
	1900	5	94	22.3	1022.6	0
21	100	3	120	21.6	1022.6	0
	700	4	69	22.4	1022.6	0
	1300	5	64	24.5	1020.2	0
	1900	3	76	22.6	1019.5	0
22	100	4	66	22.8	1017.8	0
	700	7	12	21.0	1017.5	0
	1300	4	80	23.6	1015.8	0
	1900	6	4	22.3	1015.8	28
23	100	8	45	21.4	1015.8	13
	700	6	326	21.2	1015.5	0
	1300	18	240	1.9	1002.9	9
	1900	4	291	23.0	1014.1	0
24	100	5	263	20.5	1015.5	0
	700	4	270	20.0	1016.1	0
	1300	0		*	1015.5	0
	1900	2	160	23.1	1015.5	0
25	100	3	229	22.6	1016.7	0
	700	12	24	21.1	1018.3	0
	1300	10	28	21.0	1018.3	0
	1900	8	29		1017.6	0
26	100	8	49		1015.8	3
	700	5	351		1013.8	27
	1300	8	71		1009.7	0
	1900	13	57	Gage	1001.9	0
27	100	21	67	Inoperative	973.1	0
	700	15	250		999.9	0
	1300	6	232		1005.4	0
	1900	4	191		1011.4	0
28	100	8	293		1015.8	0
	700	4	317		1021.6	0
	1300	8	6		1024.3	0
	1900	4	19		1025.6	0
29	100	5	30		1026.2	0
	700	6	58		1027.2	0
	1300	5	45		1026.6	0
	1900	4	66		1024.5	0
30	100	4	63		1024.1	0
	700	4	43		1023.3	0
	1300	4	57		1022.2	0
	1900	6	88		1020.3	0

*=Electronic problems

III. WAVE DATA

Wave data were collected from two Baylor staff gages (CERC gage Nos. 625 and 645) and Waverider buoys (CERC gage Nos. 630 and 640, Table 1 and Figure 2). The data were collected, analyzed, and stored on magnetic tape using a Data General NOVA-4 computer.

The NOVA-4 is programmed to sample the wave gages every 6 hours near 0100, 0700, 1300, and 1900 EST at a sampling rate of four times per second, collecting data in 20- minute records.

Wave height (Hmo) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. The wave period is identified from the computation of a variance (energy) spectrum using a Fast Fourier Transform of 4096 data points (1024 sec). The period (Tp) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape and entered into the CERC data base.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means shown in Table 3 are an average of the values computed for all data records collected. The monthly standard deviations are standard deviations from the monthly mean of values for each record.

Figure 3 is a *time* history of the Hmo and Tp values for the Waverider 6 km from shore (630) and the Baylor gage at pier station 19+00 (625).

Differences in wave periods between wave gages (Table 4 and Figure 3) may be due to wave breaking or reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA PART 1

SEPTEMBER 1985

GAGE		645		625		640		630	
		Baylor at 7+80		Baylor at 19+00		Nearshr Wvrdr		Farshr Wvrdr	
DAY	TIME	Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)
1	1	.68	3.95	.42	5.02	*		.94	5.02
	7	.69	5.99	.52	6.40	1.11	5.99	1.06	5.99
	13	.56	5.63	.77	8.06	.84	5.99	.92	8.06
	19	.43	7.42	.62	7.42			.40	3.95
2	1	.52	6.87	.54	8.83	*		.33	12.34
	7	.48	9.75	.42	9.75	.88	9.75	.99	9.75
	13	.34	9.75	.71	9.75	.77	9.75	.82	8.83
	19	.39	9.75	.70	8.83	.73	8.83	.76	8.83
3	1	.29	12.34	.56	10.89	.67	12.34	.70	10.89
	7	.34	11.25	.66	11.98	.77	11.25	.78	11.98
	13	.30	12.80	.58	12.80	.62	12.80	.65	11.98
	19	.30	11.98	.62	11.98	.69	11.98	.64	11.25
4	1	.27	11.98	.62	11.25	.75	11.98	.69	11.98
	7	.26	11.98	.68	11.98	.78	11.25	.66	11.25
	13	.23	11.25	.52	10.04	.60	10.04	.60	11.25
	19	.24	11.25	.15	11.25	.49	11.25	.61	10.04
5	1	.23	11.25	.16	11.25	.41	11.98	.53	11.25
	7	.19	11.25	.30	11.25	.43	10.61	.43	11.25
	13	.24	10.04	.37	11.25	.47	10.04	.45	11.25
	19	.26	9.53	.41	8.64	.45	10.04	.47	9.06
6	1	.28	8.64	.34	11.98	.42	10.04	.50	9.06
	7	.25	9.06	.34	11.25	.38	9.06	.45	9.06
	13	.26	9.53	.30	11.98	.35	11.98	.43	11.98
	19	.26	9.06	.20	11.25	.45	11.25	.47	11.25
7	1	.27	11.98	.21	11.98	.39	11.25	.46	11.98
	7	.22	11.25	.20	11.25	.37	11.98	.47	11.98
	13	.30	11.98	.18	11.25	.42	11.98	.47	11.98
	19	.24	11.98	.80	11.98	.48	11.98	.45	11.98
8	1	.28	11.98	.30	11.98	.51	11.98	.49	11.25
	7	.22	11.25	.41	10.04	.50	10.61	.49	10.04
	13	.31	11.98	.43	11.25	.46	11.25	.43	9.53
	19	.21	9.53	.42	9.53	.49	10.61	.45	10.04
9	1	.26	10.61	.47	10.61	.53	10.61	.56	11.25
	7	.19	11.98	.42	10.04	.47	10.04	.51	10.61
	13	.26	11.25	.49	11.25	.52	11.25	.51	10.61
	19	.29	10.61	.53	10.61	.59	11.98	.61	9.53
10	1	.21	11.25	.37	10.61	.42	10.61	.49	10.04
	7	.16	10.04	.34	11.25	.34	11.25	.39	10.61
	13	.22	14.84	.26	13.74	.36	9.53	.38	10.04
	19	.29	13.74	.24	11.25	.38	11.25	.47	11.25
11	1	.18	12.80	.20	12.80	.28	11.98	.37	11.98
	7	.30	17.66	.25	17.66	.36	10.61	.40	9.53
	13	1.19	4.96	.87	5.24	1.33	5.39	1.45	5.39
	19	1.29	6.52	1.47	7.01	1.55	7.01	1.93	6.76
12	1	.97	5.24	1.44	7.01	1.43	7.01	1.63	7.29
	7	.97	4.96	.86	5.72	1.30	7.29	1.70	6.76
	13	.81	4.71	1.23	7.91	1.28	7.29	1.48	5.55
	19	.81	5.72	1.21	8.64	1.29	8.64	1.47	8.64
13	1	.89	5.09	1.40	5.09	1.42	6.10	1.61	4.96
	7	1.33	5.72	1.64	6.10	1.75	5.55	2.17	5.39
	13	1.41	6.52	1.91	6.30	1.94	6.30	2.32	7.01
	19	1.46	7.01	1.84	7.01	1.84	7.59	2.13	5.39
14	1	1.48	6.30	1.91	6.52	2.01	6.76	2.31	6.10
	7	1.61	6.76	1.80	6.30	1.79	7.01	2.15	6.76
	13	1.36	7.01	1.80	7.91	1.81	7.29	2.02	6.30
	19	1.12	4.83	1.59	10.04	1.58	10.04	1.71	6.52
15	1	1.00	4.96	1.49	9.53	1.47	9.53	1.64	6.10
	7	.89	4.59	1.37	10.61	1.41	9.53	1.52	8.26
	13	.72	11.25	1.11	9.53	1.12	10.04	1.18	9.06
	19	.70	4.38	1.03	10.61	1.00	9.53	1.12	10.61
16	1	.63	10.04	.92	10.04	.93	9.06	1.01	10.61
	7	.77	3.61	1.05	10.04	1.04	10.04	1.13	6.10
	13	.73	4.59	1.08	4.71	1.13	10.04	1.20	4.83
	19	.75	5.39	1.00	4.71	1.05	8.64	1.13	9.53

*=Electronic Problems

TABLE 3: WAVE DATA PART 2

SEPTEMBER 1985

GAGE		645 Baylor at 7+80		625 Baylor at 19+00		640 Nearshr Wvrdr		630 Farshr Wvrdr	
DAY	TIME	Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)
17	1	.65	8.64	.92	9.53	.96	9.06	1.05	9.53
	7	.71	7.91	.92	9.53	.91	9.06	1.05	7.29
	13	.75	8.26	1.05	4.09	1.15	9.53	1.18	9.53
	19	.75	8.64	.97	4.48	1.04	7.91	1.17	8.26
18	1	.64	7.91	.90	7.59	.99	9.06	1.02	8.64
	7	.82	6.10	1.17	9.53	1.25	9.06	1.37	8.64
	13	.64	10.04	1.04	10.04	1.19	9.06	1.30	8.64
	19	.83	12.80	1.17	12.80	1.31	12.80	1.28	12.80
19	1	.98	11.98	1.28	11.98	1.39	11.98	1.38	11.98
	7	.98	11.25	1.21	11.98	1.29	11.98	1.38	9.06
	13	.81	12.80	1.21	11.98	1.27	11.98	1.36	11.25
	19	1.03	11.98	1.17	11.98	1.25	11.98	1.37	11.25
20	1	.68	8.26	.98	10.04	1.03	11.25	1.05	10.61
	7	.63	9.53	.87	9.53	.91	10.04	1.03	11.25
	13	.63	8.64	.80	10.61	.88	9.06	.98	8.26
	19	.67	9.06	.87	9.53	.92	10.04	1.05	11.25
21	1	.63	8.64	.81	11.25	.83	14.84	.99	9.06
	7	.55	13.74	.78	10.61	.84	10.61	.88	10.61
	13	.69	8.06	.89	10.89	.98	12.34	.96	10.89
	19	.70	14.22	.82	10.89	.88	10.89	1.02	9.75
22	1	.74	14.22	.87	14.22	.90	14.22	1.00	8.83
	7	.85	7.42	1.07	6.87	1.15	6.40	1.30	8.06
	13	1.24	8.64	1.31	8.26	1.41	8.26	1.63	7.29
	19	1.23	9.06	1.30	7.29	1.47	7.59	1.72	8.64
23	1	1.45	7.59	1.53	7.29	1.64	8.64	1.96	8.64
	7	1.47	10.89	1.23	10.89	1.73	9.75	1.89	9.75
	13	1.02	8.83	.89	9.75	1.38	8.83	1.65	9.75
	19	.98	14.22	1.32	8.83	1.52	7.42	1.71	8.83
24	1	.90	12.34	1.13	12.34	1.23	12.34	1.37	8.06
	7	.69	8.06	.81	8.06	.91	12.34	1.01	7.42
	13					*		*	
	19	*		*		1.03	10.89	.98	10.89
25	1							1.05	10.89
	7	1.10	4.53	1.34	10.89			1.44	4.13
	13	.87	6.40	1.51	5.63			1.65	5.99
	19	1.05	12.34	1.24	12.34			1.62	12.34
26	1	.93	14.22	.93	10.89	Gage Inoperative		1.57	12.34
	7	.92	14.22	.82	14.22			*	
	13	1.54	12.80	1.09	12.80			2.07	14.84
	19	2.09	16.13	1.91	13.74			3.66	14.84
27	1	2.10	12.80	2.42	16.13			6.12	14.84
	7	2.06	14.84	1.59	14.84			3.11	14.84
	13	1.26	13.74					1.45	12.80
	19	1.19	9.53					1.46	10.04
28	1	.95	8.64	*				1.17	8.64
	7	.75	9.75					1.06	8.83
	13	.91	5.63					1.39	6.40
	19	.66	8.83					1.04	5.63
29	1	.64	6.40					.86	6.87
	7	.58	7.42	.35	8.06			.83	5.99
	13	.54	2.69	.28	14.22			.70	8.06
	19	.56	6.87	.32	6.87			.81	6.87
30	1	.61	6.87	.28	14.22			.76	6.40
	7	.50	14.22	.27	14.22			.67	4.32
	13	.48	14.22	.26	14.22			.61	7.42
	19	.59	5.99	.25	7.42	.25	5.99	.65	6.40
	MEAN	.72	9.47	.86	10.04	.95	9.89	1.14	9.24
	STD	.43	3.15	.49	2.67	.45	2.04	.75	2.46

*=Electronic Problems

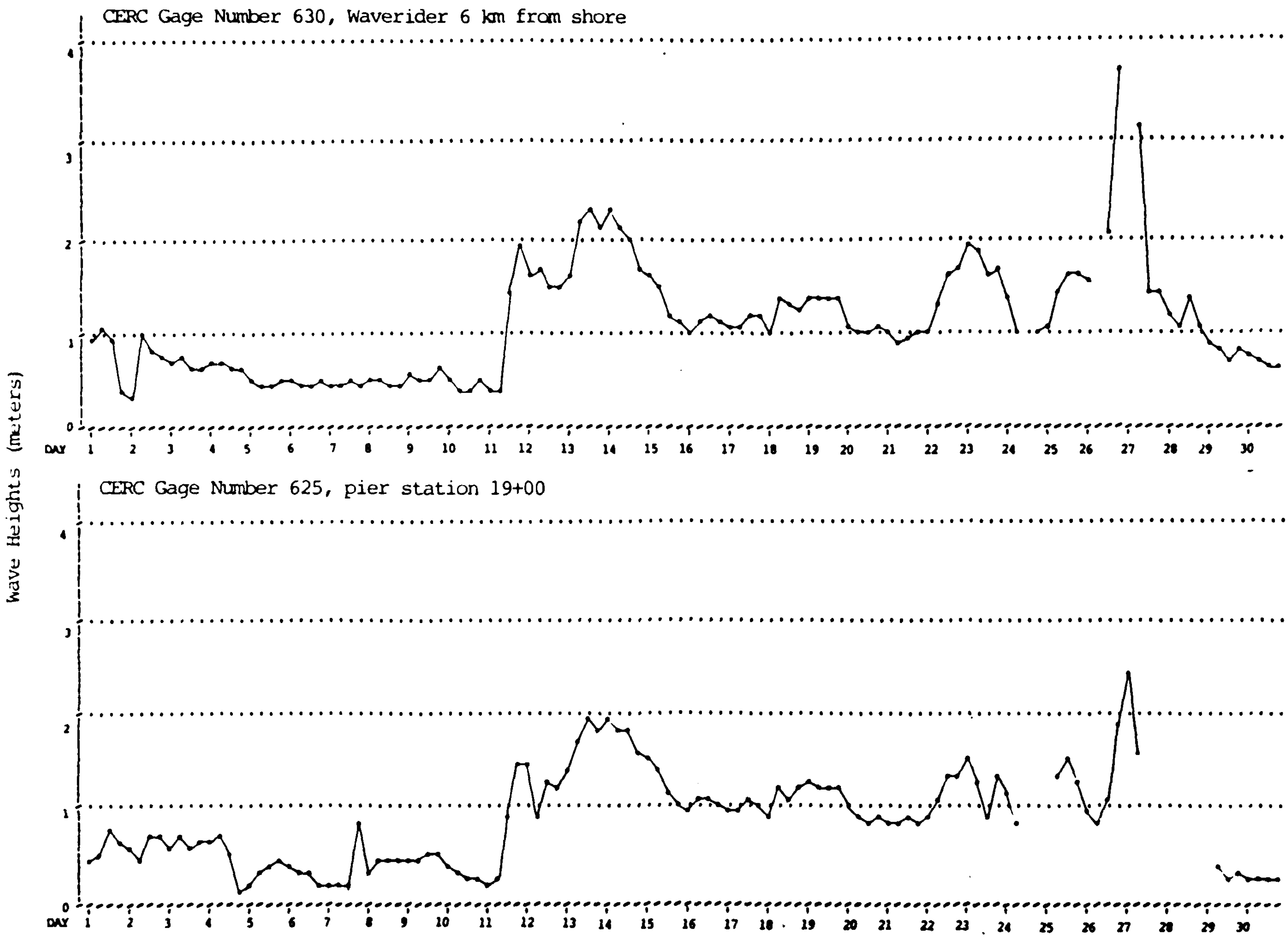

FIGURE 3. Time History of Wave Heights and Periods - September 1985 Part I: Heights

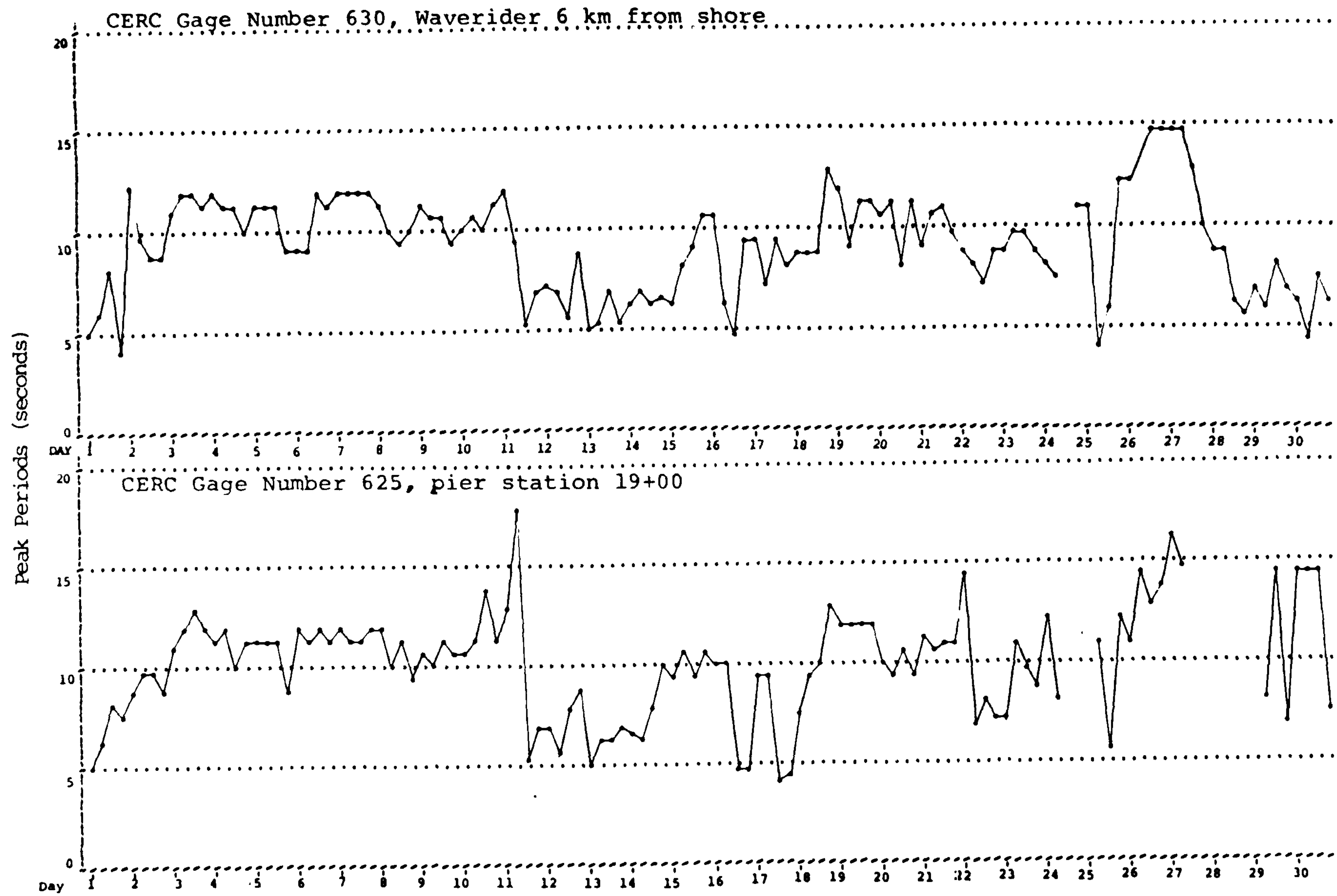

FIGURE 3. Time History of Wave Heights and Periods - September 1985 Part II: Periods

IV. CURRENT DATA

Current data (Table 4) are collected from two Marsh-McBirney electromagnetic biaxial current meters (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: CURRENT DATA
(SPEEDS IN CM/SEC)

September 1985

DAY	TIME		DYE AT 1940C (579m) (SURFACE) SPEED	DIR	CURRENT METER AT 14420 (432m) I.D.#639 DEPTH -4.2m MSL SPEED	DIR	PIER MEASUREMENTS: DYE AT MID SURF ZONE (SURFACE) DIST. FROM BASELINE (M)	SPEED	DIR	BEACH MEASUREMENTS (500 UPDRIFT): DYE 12M OFFSHORE (SURFACE) LOCATION	SPEED	DIR	CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL) I.D.#679 SPEED	DIR
1	0100	Alongshore			1	S							3	N
		Cross-shore			1	ON							0	
		Resultant			1	208							3	340
1	0700	Alongshore	0	0	1	S		61	S		30	S	3	N
		Cross-shore	0	0	2	ON	126	0	0	North			3	OF
		Resultant	0	0	2	222		61	152				4	21
1	1300	Alongshore			1	S							2	S
		Cross-shore			1	ON							1	OF
		Resultant			1	215							2	143
1	1900	Alongshore			3	S							3	N
		Cross-shore			1	ON							1	ON
		Resultant			3	182							3	318
2	0100	Alongshore			1	S							6	S
		Cross-shore			1	ON							4	ON
		Resultant			1	219							8	193
2	0700	Alongshore	29	S	1	S		55	N		0	0	4	S
		Cross-shore	3	Off	2	ON	126	0	0	South			5	ON
		Resultant	29	166	2	223		55	340				7	208
2	1300	Alongshore			1	S							6	S
		Cross-shore			[illegible]	ON							7	ON
		Resultant			2	222							9	208
2	1900	Alongshore			1	S							3	N
		Cross-shore			1	ON							3	ON
		Resultant			2	214							4	300
3	0100	Alongshore			1	S							5	N
		Cross-shore			1	ON							0	
		Resultant			2	213							5	340
3	0700	Alongshore	122	N	1	[illegible]		68	S		10	S	2[illegible]	N
		Cross-shore	0	0	1	ON	126	0	0	North			[illegible]	OF
		Resultant	122	340	1	201		68	152				2[illegible]	345
3	1300	Alongshore			1	N							1	S
		Cross-shore			0								1	OF
		Resultant			1	340							1	115
3	1900	Alongshore			1	[illegible]							1	N
		Cross-shore			[illegible]	[illegible]								OF
		Resultant			2	5							7	62
4	0100	Alongshore			1	S							[illegible]	N
		Cross-shore			1	ON							2	OF
		Resultant			1	205							6	358
4	0700	Alongshore	18	N	2	S		3[illegible]	N		[illegible]	[illegible]	11	N
		Cross-shore	9	On	2	OF	14[illegible]	16	On	South			4	OF
		Resultant	20	7	3	115		[illegible]	[illegible]				12	360
4	1300	Alongshore			1	S							8	N
		Cross-shore			0								4	OF
		Resultant			1	160							9	7
4	1900	Alongshore			1	S							9	N
		Cross-shore			[illegible]	[illegible]							4	OF
		Resultant			3	[illegible]							1[illegible]	4
5	0100	Alongshore			1								[illegible]	N
		Cross-shore			[illegible]								0	
		Resultant			1	16[illegible]							[illegible]	340
5	0700	Alongshore	[illegible]	N	1	[illegible]		[illegible]	N		[illegible]	N	9	N
		Cross-shore	[illegible]	On	1		[illegible]34			South			3	OF
		Resultant	8	[illegible]	1	[illegible]		2[illegible]	34[illegible]				9	358
5	1300	Alongshore			0								4	N
		Cross-shore											0	
		Resultant			0								4	340
5	1900	Alongshore			1								7	N
		Cross-shore											0	OF
		Resultant			1	16[illegible]							11	29
6	0100	Alongshore			1								3	N
		Cross-shore			[illegible]								1	ON
		Resultant			1	[illegible]							3	32[illegible]
6	0700	Alongshore	7	N				5[illegible]	N		18	N	5	N
		Cross-shore	8	On			1[illegible]			South			1	ON
		Resultant	10	3[illegible]	1	2[illegible]		5[illegible]	34[illegible]				5	329
6	1300	Alongshore			1								7	N
		Cross-shore			5								10	OF
		Resultant			[illegible]	[illegible]							12	35
6	1900	Alongshore											8	N
		Cross-shore											[illegible]	OF
		Resultant											8	354

KEY: ALL SPEEDS IN CM/SEC
[illegible], SHORE PARALLEL
[illegible], SHORE PARALLEL
[illegible]
[illegible]

TABLE 4: CURRENT DATA
(SPEEDS IN CM/SEC)

			PIER MEASUREMENTS							BEACH MEASUREMENTS (500 UPDRIFT)				
			DYE AT 19400 (579m) (SURFACE)		CURRENT METER AT 14420(433m) I.D.0639 (DEPTH -4.2m MSL)		DYE AT MID-SURF ZONE (SURFACE) DIST. FROM			DYE 12M OFFSHORE (SURFACE)			CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL) I.D.0679	
DAY	TIME		SPEED	DIR	SPEED	DIR	BASELINE(M)	SPEED	DIR	LOCATION	SPEED	DIR	SPEED	DIR
7	0100	Alongshore											0	
		Cross-shore											0	
		Resultant											0	0
7	0700	Alongshore	11	N				61	N		23	N	1	S
		Cross-shore	1	On			140	18	On	South			7	OF
		Resultant	10	346				64	357				7	78
7	1300	Alongshore											5	N
		Cross-shore											6	OF
		Resultant											8	30
7	1900	Alongshore											0	
		Cross-shore											0	
		Resultant											0	0
8	0100	Alongshore											7	N
		Cross-shore											8	ON
		Resultant											11	291
8	0700	Alongshore	44	S				47	N		40	S	1	N
		Cross-shore	0	0			140	0	0	North			3	ON
		Resultant	44	157				47	340				3	268
8	1300	Alongshore											4	S
		Cross-shore											[illegible]	ON
		Resultant											6	211
8	1900	Alongshore											1	S
		Cross-shore											2	ON
		Resultant											2	223
9	0100	Alongshore											1	N
		Cross-shore											3	ON
		Resultant											3	268
9	0700	Alongshore	5	N				55	N		26	S	3	N
		Cross-shore	8	On			150	0	0	South			1	ON
		Resultant	9	36				55	343				3	322
9	1300	Alongshore											8	N
		Cross-shore											4	OF
		Resultant											9	7
9	1900	Alongshore											15	N
		Cross-shore											7	OF
		Resultant											17	5
10	0100	Alongshore											23	N
		Cross-shore											1	ON
		Resultant											23	338
10	0700	Alongshore	10	N				20	N		10	N	8	N
		Cross-shore	7	On			148	13	On	South			3	ON
		Resultant	12	17				24	13				9	319
10	1300	Alongshore											5	S
		Cross-shore											15	ON
		Resultant											16	232
10	1900	Alongshore											5	N
		Cross-shore											1	ON
		Resultant											5	329
11	0100	Alongshore											17	N
		Cross-shore											2	ON
		Resultant											17	333
11	0700	Alongshore	44	S				51	S		31	S	1	N
		Cross-shore	11	Off			150	5	Off	North			4	ON
		Resultant	45	174				51	165				4	264
11	1300	Alongshore											2	S
		Cross-shore			Gage Inoperative								12	ON
		Resultant											12	241
11	1900	Alongshore											18	S
		Cross-shore											8	ON
		Resultant											20	184
12	0100	Alongshore											14	S
		Cross-shore											6	ON
		Resultant											15	183
12	0700	Alongshore	47	S				87	S		34	S	15	S
		Cross-shore	16	Off			140	26	Off	North			7	ON
		Resultant	50	179				90	177				17	185
12	1300	Alongshore											2	S
		Cross-shore											7	ON
		Resultant											7	234
12	1900	Alongshore											15	S
		Cross-shore											6	ON
		Resultant											16	182

KEY = ALL SPEEDS IN CM/SEC
N =NORTHWARD, SHORE PARALLEL
S =SOUTHWARD, SHORE PARALLEL
ON=ONSHORE
OF=OFFSHORE

TABLE 4: CURRENT DATA
(SPEEDS IN CM/SEC)

			PIER MEASUREMENTS							BEACH MEASUREMENTS (500 UPDRIFT)				
			DYE AT 19400 (579m) (SURFACE)		CURRENT METER AT 14420(433m) I.D.0639 (DEPTH -4.2m MSL)		DYE AT MID-SURF ZONE (SURFACE) DIST. FROM			DYE 12M OFFSHORE (SURFACE)			CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL) I.D.0679	
DAY	TIME		SPEED	DIR	SPEED	DIR	BASELINE(M)	SPEED	DIR	LOCATION	SPEED	DIR	SPEED	DIR
13	0100	Alongshore											12	S
		Cross-shore											6	ON
		Resultant											13	187
13	0700	Alongshore	55	S				122	S		99	S	25	S
		Cross-shore	0	0			175	24	Off	North			13	ON
		Resultant	55	160				124	171				28	187
13	1300	Alongshore											29	S
		Cross-shore											16	ON
		Resultant											33	189
13	1900	Alongshore											27	S
		Cross-shore											15	ON
		Resultant											31	189
14	0100	Alongshore											25	S
		Cross-shore											13	ON
		Resultant											28	187
14	0700	Alongshore	61	S				122	S		39	S	24	S
		Cross-shore	6	On			152	12	On	North			14	ON
		Resultant	61	166				122	154				28	190
14	1300	Alongshore											24	S
		Cross-shore											9	ON
		Resultant											26	181
14	1900	Alongshore											18	S
		Cross-shore											8	ON
		Resultant											20	184
15	0100	Alongshore											11	S
		Cross-shore											7	ON
		Resultant											13	192
15	0700	Alongshore	44	S				51	1		38	S	6	S
		Cross-shore	0	0			152	0	0	North			3	ON
		Resultant	44	160				51	157				7	187
15	1300	Alongshore											12	S
		Cross-shore											7	ON
		Resultant											14	190
15	1900	Alongshore											10	S
		Cross-shore											6	ON
		Resultant											12	191
16	0100	Alongshore											11	S
		Cross-shore											6	ON
		Resultant											13	189
16	0700	Alongshore	30	S				21	S		17	N	1	S
		Cross-shore	9	On			135	0	0	North			4	ON
		Resultant	32	143				21	160				4	236
16	1300	Alongshore											13	S
		Cross-shore											7	ON
		Resultant											15	188
16	1900	Alongshore											8	S
		Cross-shore											6	ON
		Resultant											10	197
17	0100	Alongshore											10	S
		Cross-shore											5	ON
		Resultant											11	187
17	0700	Alongshore	5	S	Gage Inoperative			10	N		10	N	0	
		Cross-shore	2	Off			136	5	On	North			0	
		Resultant	5	17				11	8				0	0
17	1300	Alongshore											13	S
		Cross-shore											6	ON
		Resultant											14	185
17	1900	Alongshore											1	S
		Cross-shore											5	ON
		Resultant											5	239
18	0100	Alongshore											9	S
		Cross-shore											4	ON
		Resultant											10	184
18	0700	Alongshore	11	S				23	N		2	N	3	S
		Cross-shore	3	Off			142	15	On	South			3	ON
		Resultant	11	174				27	11				4	205
18	1300	Alongshore											11	S
		Cross-shore											6	ON
		Resultant											13	189
18	1900	Alongshore											11	S
		Cross-shore											7	ON
		Resultant											13	192

KEY = ALL SPEEDS IN CM/SEC
N =NORTHWARD, SHORE PARALLEL
S =SOUTHWARD, SHORE PARALLEL
ON=ONSHORE
OF=OFFSHORE

TABLE 4: CURRENT DATA
(SPEEDS IN CM/SEC)

DAY	TIME		PIER MEASUREMENTS: DYE AT 19+00 (579m) (SURFACE) SPEED	DIR	PIER MEASUREMENTS: CURRENT METER AT 14+20 (433m) I.D.#639 (DEPTH -4.2m MSL) SPEED	DIR	PIER MEASUREMENTS: DYE AT MID-SURF ZONE (SURFACE) DIST. FROM BASELINE(M)	SPEED	DIR	BEACH MEASUREMENTS (500 UPDRIFT) DYE 12M OFFSHORE (SURFACE) LOCATION	SPEED	DIR	CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL) I.D.#679 SPEED	DIR
19	0100	Alongshore											10	S
		Cross-shore											6	ON
		Resultant											12	191
19	0700	Alongshore	90	N				8	S		19	N	6	S
		Cross-shore	0	0			189	18	On	North			4	ON
		Resultant	10	340				19	94				7	194
19	1300	Alongshore											13	S
		Cross-shore											7	ON
		Resultant											15	188
19	1900	Alongshore											21	N
		Cross-shore											3	ON
		Resultant											21	332
20	0100	Alongshore											21	N
		Cross-shore											1	ON
		Resultant											21	337
20	0700	Alongshore	6	N				29	N		13	N	6	N
		Cross-shore	1	On			160	37	Off	South			3	OF
		Resultant	6	346				47	287				7	7
20	1300	Alongshore											1	N
		Cross-shore											3	OF
		Resultant											3	52
20	1900	Alongshore											20	N
		Cross-shore											2	OF
		Resultant											20	346
21	0100	Alongshore											33	N
		Cross-shore											3	OF
		Resultant											33	345
21	0700	Alongshore	23	N				68	N		23	N	10	N
		Cross-shore	7	On			152	16	Off	South			6	OF
		Resultant	23	357				70	326				12	11
21	1300	Alongshore											34	N
		Cross-shore											11	OF
		Resultant											36	358
21	1900	Alongshore											23	N
		Cross-shore											7	OF
		Resultant											24	357
22	0100	Alongshore											16	N
		Cross-shore											5	OF
		Resultant											17	357
22	0700	Alongshore	16	S				102	N				1	N
		Cross-shore	0	0			140	0	0				1	ON
		Resultant	16	160				102	340				1	295
22	1300	Alongshore											14	N
		Cross-shore											3	ON
		Resultant											14	328
22	1900	Alongshore											7	N
		Cross-shore											1	ON
		Resultant											7	332
23	0100	Alongshore											5	S
		Cross-shore											9	ON
		Resultant											10	221
23	0700	Alongshore	38	S	Gage Inoperative			30	N		22	N	4	S
		Cross-shore	6	On			202	27	Off	South			10	ON
		Resultant	39	151				41	298				11	228
23	1300	Alongshore											4	S
		Cross shore											-10	OF
		Resultant											11	230
23	1900	Alongshore											5	S
		Cross-shore											9	ON
		Resultant											10	221
24	0100	Alongshore											3	N
		Cross-shore											5	ON
		Resultant											6	281
24	0700	Alongshore	12	S				51	S		17	N	13	N
		Cross-shore	2	Off			144	28	Off	South			6	ON
		Resultant	12	171				58	311				14	315
24	1300	Alongshore											2	S
		Cross-shore											35	OF
		Resultant											35	74
24	1900	Alongshore											85	N
		Cross-shore											2	ON
		Resultant											85	338

KEY = ALL SPEEDS IN CM/SEC
N =NORTHWARD, SHORE PARALLEL
S =SOUTHWARD, SHORE PARALLEL
ON=ONSHORE
OF =OFFSHORE

TABLE 4: CURRENT DATA
(SPEEDS IN CM/SEC)

DAY	TIME	PIER MEASUREMENTS: DYE AT 19400 (579m) (SURFACE) SPEED	DIR	PIER MEASUREMENTS: CURRENT METER AT 14120 (433m) I.D.#639 (DEPTH -4.2m MSL) SPEED	DIR	PIER MEASUREMENTS: DYE AT MID-SURF ZONE (SURFACE) DIST. FROM BASELINE(M)	SPEED	DIR	BEACH MEASUREMENTS (500 UPDRIFT): DYE 12M OFFSHORE (SURFACE) LOCATION	SPEED	DIR	CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL) I.D.#679 SPEED	DIR
25	0100-Alongshore											78	N
	Cross-shore											1	ON
	Resultant											78	339
25	0700-Alongshore	47	S				38	S		15	S	78	N
	Cross-shore	5	Off			152	8	Off	North			7	ON
	Resultant	47	166				39	171				78	335
25	1300-Alongshore											160	N
	Cross-shore											2	ON
	Resultant											160	339
25	1900-Alongshore											76	N
	Cross-shore											4	ON
	Resultant											77	337
26	0100-Alongshore											80	N
	Cross-shore											5	ON
	Resultant											80	336
26	0700-Alongshore	27	S				51	N		35	N	81	N
	Cross-shore	1	Off			150	76	Off	South			4	ON
	Resultant	27	163				92	284				81	337
26	1300-Alongshore											66	N
	Cross-shore											3	ON
	Resultant											66	337
26	1900-Alongshore											70	N
	Cross-shore											1	OF
	Resultant											70	341
27	0100-Alongshore											156	N
	Cross-shore											70	OF
	Resultant											171	4
27	0700-Alongshore	27	N				122	N				77	N
	Cross-shore	7	Off			152	12	On				3	OF
	Resultant	27	326				123	346				77	342
27	1300-Alongshore											95	N
	Cross-shore											2	ON
	Resultant											95	339
27	1900-Alongshore											88	N
	Cross-shore											4	OF
	Resultant											88	343
28	0100-Alongshore											74	N
	Cross-shore											4	OF
	Resultant											74	343
28	0700-Alongshore	22	S				36	S		54	S	61	N
	Cross-shore	2	On			128	7	On	North			2	OF
	Resultant	22	154				37	149				61	342
28	1300-Alongshore											82	N
	Cross-shore											7	ON
	Resultant											82	335
28	1900-Alongshore											74	N
	Cross-shore											2	ON
	Resultant											74	338
29	0100-Alongshore											80	N
	Cross-shore											2	ON
	Resultant											80	339
29	0700-Alongshore	12	S				13	N		13	N	5	S
	Cross-shore	6	Off	Gage Inoperative		137	0	0	South			9	OF
	Resultant	14	187				13	340				10	99
29	1300-Alongshore											6	S
	Cross-shore											10	OF
	Resultant											12	102
29	1900-Alongshore											5	S
	Cross-shore											9	OF
	Resultant											10	100
30	0100-Alongshore											5	S
	Cross-shore											9	OF
	Resultant											10	99
30	0700-Alongshore	30	S				5	N		21	N	5	S
	Cross-shore	3	Off			116	0	0	South			9	OF
	Resultant	30	166				5	340				10	99
30	1300-Alongshore											8	S
	Cross-shore											9	OF
	Resultant											12	111
30	1900-Alongshore											5	S
	Cross-shore											9	OF
	Resultant											11	98

KEY = ALL SPEEDS IN CM/SEC
N =NORTHWARD, SHORE PARALLEL
S =SOUTHWARD, SHORE PARALLEL
ON=ONSHORE
OF=OFFSHORE

V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

SUPPLEMENTAL OBSERVATIONS
September 1985

DAY	TIME	WAVE APPROACH ANGLE AT PIER END (° from True N) PRIMARY	SECONDARY	RADAR WAVE ANGLE (° from True N)	WIDTH OF SURF ZONE (M)	WATER CHARACTERISTICS AT PIER END TEMP (°C)	DENSITY (g/cc)	SECCI VIS (M)
1	0720	45		60	22	23.8	1.0227	3.0
2	0720	60	140	60	29	24.0	1.0216	4.3
3	0755	60		50	23	23.4	1.0223	2.4
4	0710			50	29	24.0	1.0222	4.6
5	0750	60		60	12	23.4	1.0224	4.3
6	0700	75		55	17	22.5	1.0231	4.0
7	0750	80			30	25.4	1.0220	6.4
8	0720	120	155		18	26.8	1.0202	4.9
9	0705	95	145	60	23	28.1	1.0216	6.1
10	0820	130		60	13	22.8	1.0227	3.0
11	0710	20		20	4	22.0	1.0232	2.4
12	0710	35		30	49	24.2	1.0219	2.4
13	0735	45		15	114	23.5	1.0214	1.2
14	0655	50			116	20.6	1.0206	2.1
15	0920	55	40	40	43	21.0	1.0210	2.4
16	0730	85	25	40	54	21.4	1.0200	1.8
17	0705	75	50	75	69	22.2	1.0200	2.1
18	0715	95	30	55	72	21.8	1.0202	2.1
19	0710	95	15	60	179	22.4	1.0201	2.1
20	0705	95	30	80	89	22.5	1.0203	4.9
21	0840				67	23.2	1.0205	1.8
22	0540	90	15	80	105	23.1		2.1
23	0725	80	20	90	229	23.1	1.0203	1.8
24	0725	100	10	70	80	23.0	1.0201	1.5
25	0710			60	99	22.8	1.0206	1.8
26	0720	80	30	90	85	22.5	1.0214	1.5
27	1030	110			103	23.0		.6
28	0730	40		70	67	22.2	1.0218	.9
29	0600	50		70	58	22.0	1.0219	1.5
30	0710	70		70	14	22.4	1.0207	2.4

VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865- 1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the range of each cycle while Figure 5 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

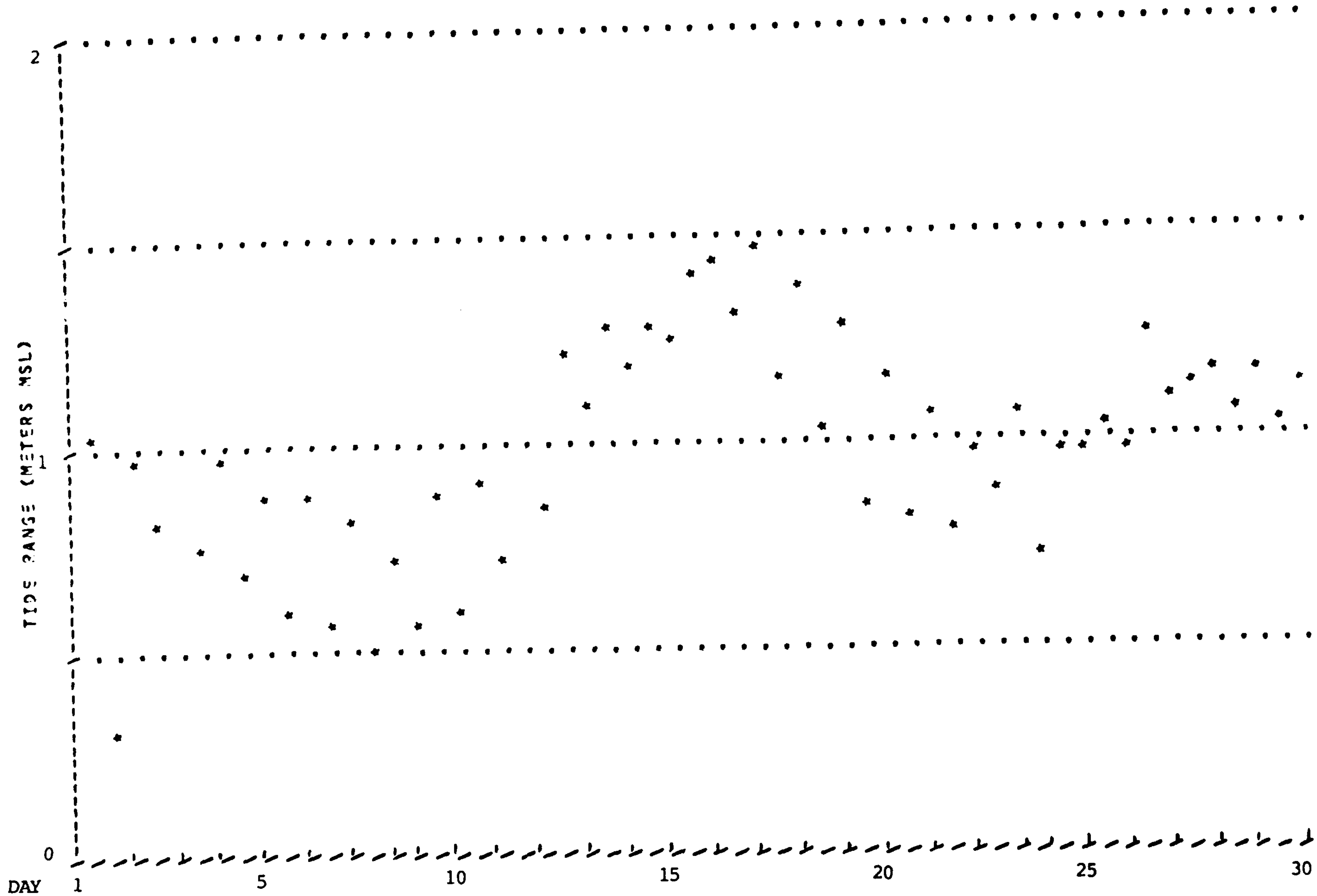

FIGURE 4. Time History of Tide Range, September 1985 (Gage No. 865-1370)

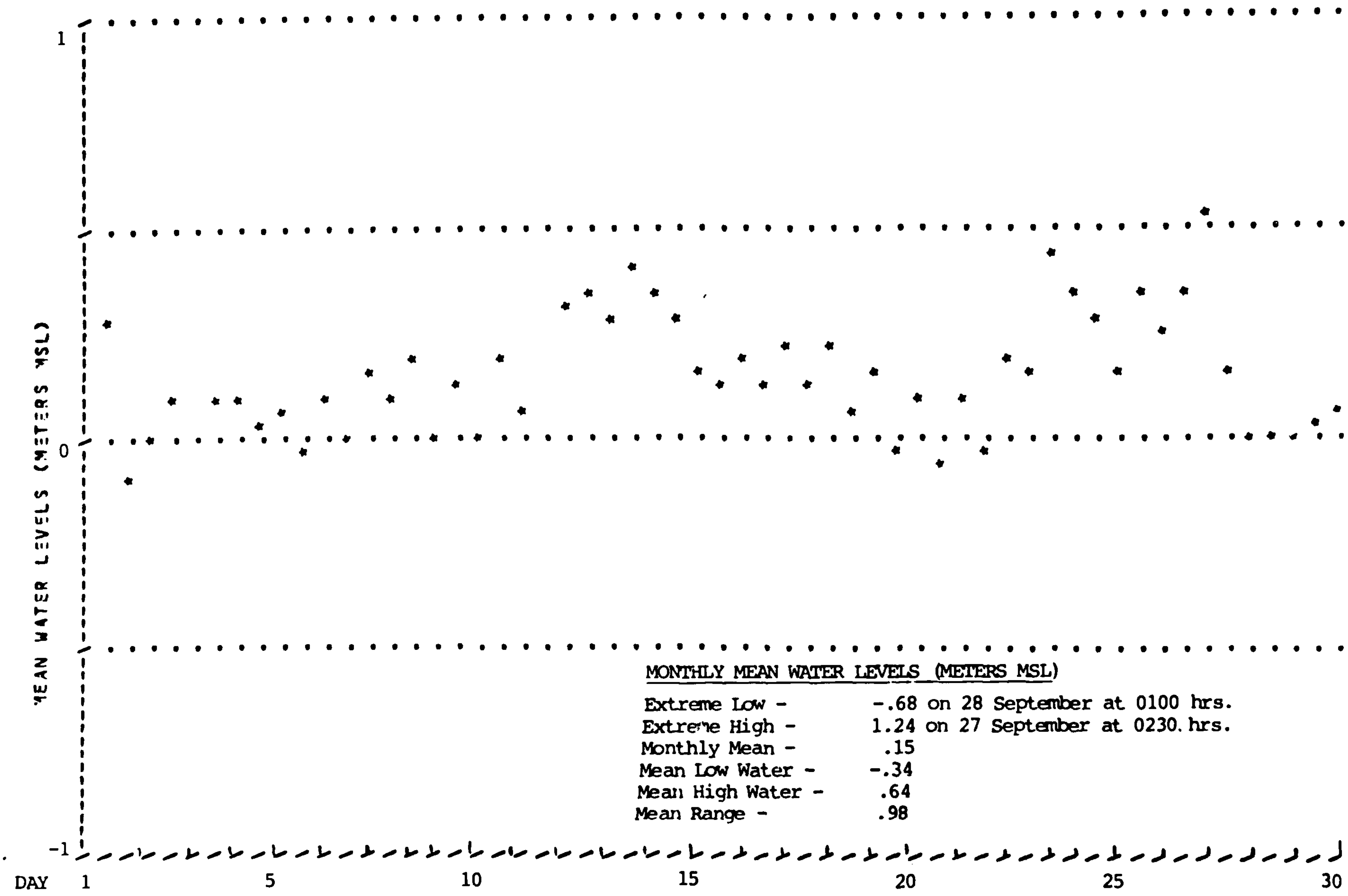

FIGURE 5. Time History of Mean Water Levels, September 1985 (Gage No. 865-1370)

TABLE 6

WATER LEVELS (METERS MSL)
Tidal Characteristics
September 1985

MID-CYCLE DAY	TIME	LOW	HIGH	MEAN	RANGE
1	612	-.21	.81	.29	1.02
1	1837	-.25			
2	702		.67		
2	1928	-.30	.52	.09	.82
3	753				
3	2018	-.23	.51	.11	.74
4	843	-.39	.58	.10	.96
4	2108	-.29	.40	.04	.69
5	934	-.37	.51	.05	.88
5	2159	-.29	.31	-.02	.60
6	1024	-.37	.50	.08	.87
6	2249	-.26	.29	-.00	.55
7	1114	-.28	.54	.17	.82
7	2340	-.16	.32	.08	.48
8	1205	-.20	.53	.19	.73
9	30	-.30	.26	.01	.57
9	1255	-.32	.55	.11	.87
10	120	-.30	.29	-.01	.59
10	1346	-.30	.62	.19	.92
11	211	-.29	.42	.06	.71
11	1436				
12	301	-.12	.72	.30	.84
12	1526	-.25	.98	.35	1.23
13	352	-.27	.83	.27	1.10
13	1617	-.25	1.03	.39	1.29
14	442	-.24	.95	.33	1.19
14	1707	-.35	.93	.29	1.28
15	532	-.46	.78	.16	1.24
15	1758	-.59	.82	.12	1.41
16	623	-.55	.90	.18	1.45
16	1848	-.52	.79	.13	1.31
17	713	-.52	.95	.23	1.47
17	1938	-.44	.72	.13	1.16
18	804	-.52	.87	.21	1.39
18	2029	-.41	.62	.06	1.03
19	854	-.51	.77	.15	1.29
19	2119	-.45	.38	-.04	.84
20	944	-.52	.63	.08	1.15
20	2210	-.45	.36	-.06	.81
21	1035	-.47	.59	.08	1.06
21	2300	-.43	.36	-.02	.79
22	1125	-.32	.66	.18	.98
22	2350	-.30	.58	.16	.89
23	1216	-.08	.98	.45	1.06
24	41	-.02	.69	.34	.71
24	1306	-.20	.79	.29	.98
25	131	-.33	.64	.17	.97
25	1356	-.16	.87	.34	1.04
26	222	-.24	.72	.24	.96
26	1447	-.26	.99	.34	1.25
27	312	.16	1.24	.53	1.08
27	1537	-.37	.75	.16	1.12
28	402	-.68	.48	-.01	1.15
28	1628	-.53	.52	.01	1.05
29	453	-.59	.55	-.00	1.14
29	1718	-.47	.55	.03	1.02
30	543	-.51	.60	.07	1.11

VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 6 shows the last survey in August and the five surveys taken during September on profile line 188, located 517 m south of the pier. The most dramatic changes occurred in the nearshore (120 to 240 m). The last survey in August and the first September survey show the presence of only a small rudimentary nearshore bar (130 m). However, the bar (160 m) reformed following a small storm on the 13th and 14th. The survey obtained on the 25th in anticipation of Hurricane Gloria showed a smaller bar which had migrated 20 m offshore (180 m). The last survey in September immediately following the passage of Hurricane Gloria showed the redevelopment of a well defined nearshore bar (200 m) with a deep inner trough. The bar crest had shifted an additional 20 m offshore. The outer bar also reformed (320 m).

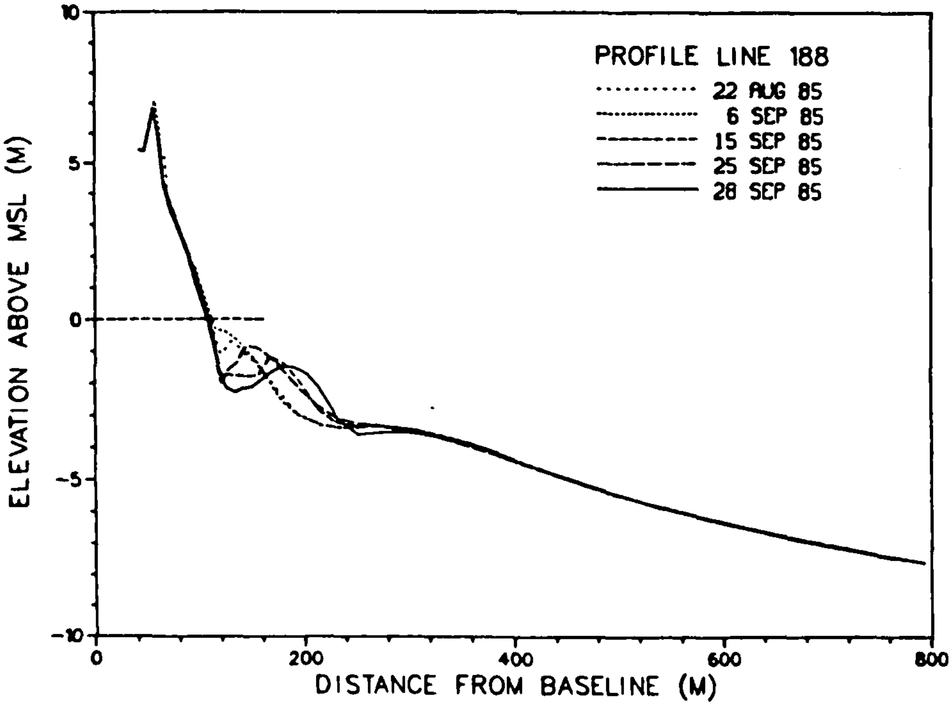

Figure 6. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 7) reflects the maximum changes which occurred on the profile between January and September. Hurricane Gloria was responsible for the changes visible on the lower envelope profile (130 m) as well as the seawardmost changes on the upper envelope profile (180 m). The remaining changes to the upper profile reflect the seaward migration of the nearshore bar prior to Hurricane Gloria (27 September).

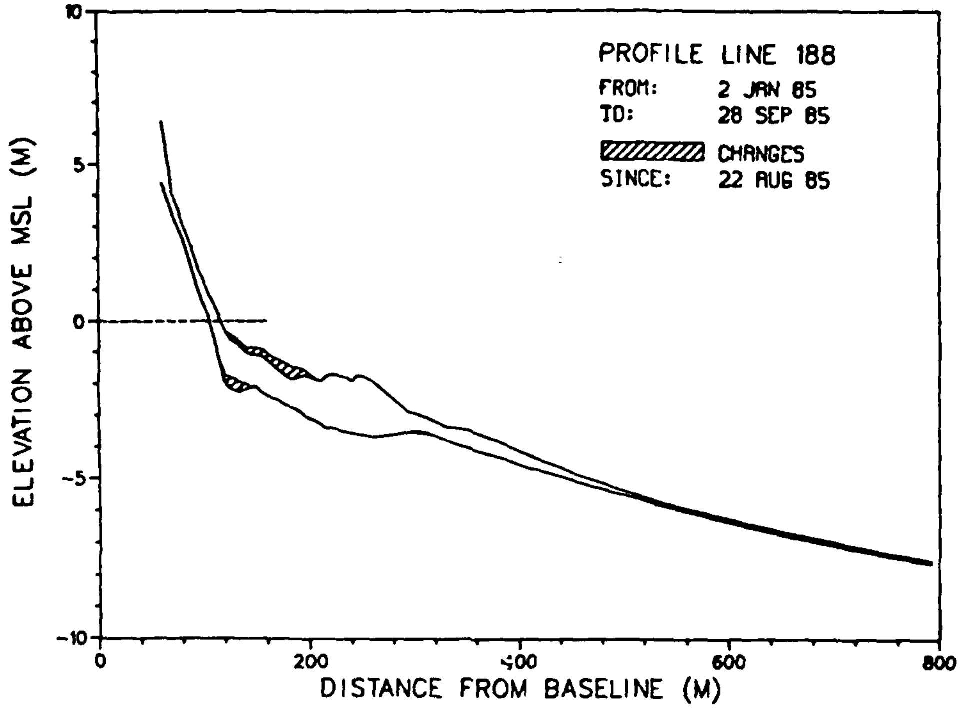

Figure 7. CRAB profile envelope - profile 188.

B. Bathymetry. This month's survey was completed on 28 September following the passage of Hurricane Gloria which caused significant bottom changes. Because of this, the data are presented and discussed in Section VIII, Special Events.

VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor gage #625 at pier station 19+00) exceeded 2 m and wave records were obtained every hour:

Start	End
26 Sep (1900)	27 Sep (0600)

B. Hurricane Gloria. On the morning of 27 September, Hurricane Gloria passed over the Field Research Facility. The following discussion of her passage is excerpted from a more-comprehensive report which will be published by CERC. Although predicted to affect the area with 130+ mph winds, the actual path was slightly seaward of the coast resulting in less than hurricane force winds at the FRF. In addition, Gloria's rapid passage coincided with low tide which minimized her impact.

Storm Track. Approaching Wilmington, NC from the southeast, the hurricane veered to the north late on 26 September. Picking up speed, the storm's eye passed over Cape Hatteras, NC at approximately 0130 on 27 September with the western edge of the eye passing over the FRF at approximately 0230. Continuing to gain speed, Gloria made landfall at Long Island, NY early that afternoon.

Meteorological Conditions. Figure 8 shows the time histories of mean wind speed and direction on the land based tower at the FRF. Beginning on 26 September, ENE winds began to steadily increase reaching their NE peak of 21 m/s at 0200 on the 27th. At that time, the wind direction shifted rapidly to the NW and the mean speed dropped dramatically then began to rapidly increase again reaching the storm's peak wind speed of 22 m/s at 0400. These changes occurred only slightly after the time of minimum barometric pressure (966 mb), see Figure 9. These observations indicate that the western edge of the hurricane's eye passed over the FRF at about 0230 on the 27th. Surprisingly, only 30 mm of rainfall was measured during the storm.

Tides. The ocean tide hydrograph (Figure 10), was measured by the National Ocean Service primary tide station at the seaward end of the FRF pier. Predicted values are provided for comparison and indicate that approximately 5 ft of storm surge was produced during Gloria's passage. Note the rapid increase beginning at about midnight, reaching a maximum of 1.2 m (4 ft) above NGVD at 0230 or about 1.5 m (5 ft) above the predicted value at 0230 on the 27th. This was followed by a rapid decrease in water levels between 0230 and 0330. By the next high tide, predicted levels had again been reached. It is fortuitous that the storm passed during low tide, for elevations of more than 8 ft above NGVD would have occurred during high astronomical tides.

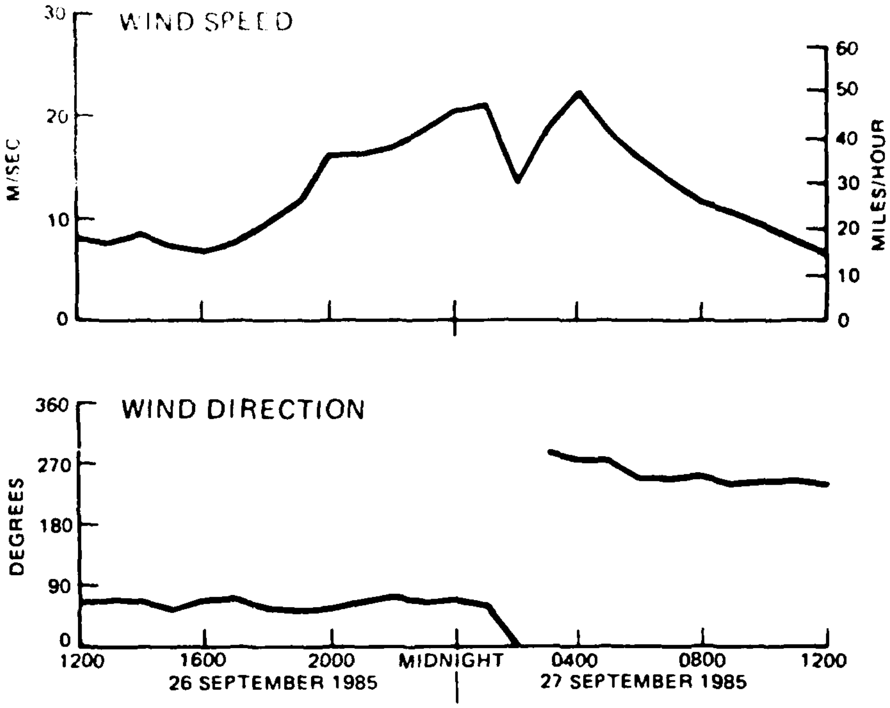

Figure 8. Wind Speed and Direction Time History

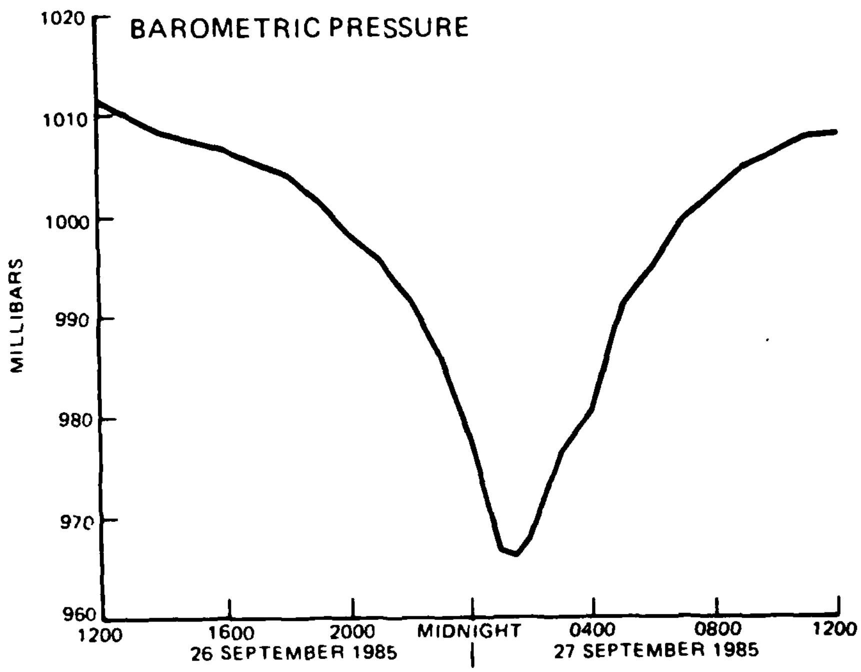

Figure 9. Barometric Pressure Time History

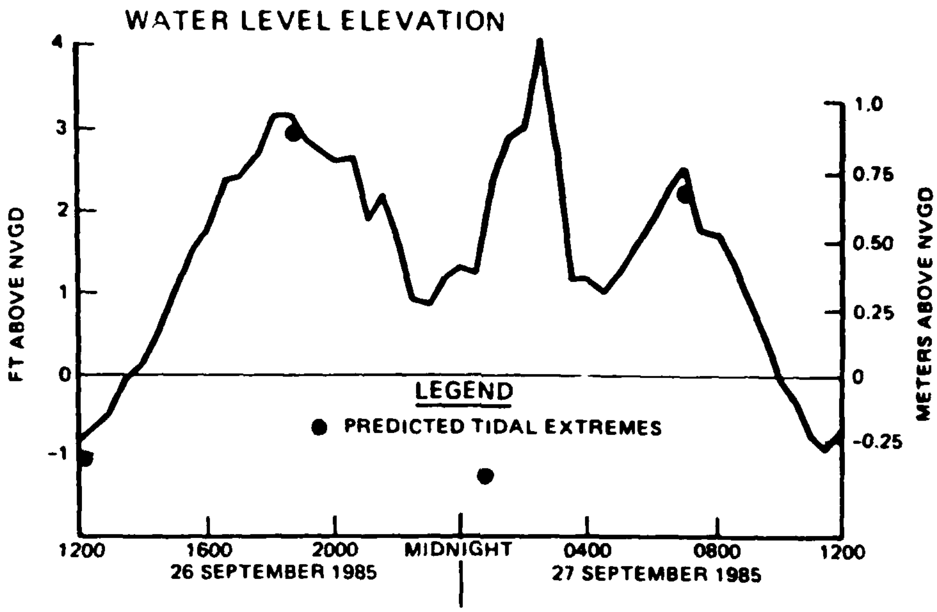

Figure 10. Ocean Tide Hydrograph

Waves. Wave heights measured at pier station 14+20 (Baylor gage) and about 6 km (3.7 miles) from shore (Waverider) show similar time histories (Figure 11). Slow but steadily increasing values during the afternoon rose much more rapidly between 2000 and midnight on the 26th. By 0200, maximum wave heights of almost 7 m were recorded at the offshore location. The Baylor gage, being in much shallower water, showed considerably smaller values, indicating that the upper limit on the energy possible at this shallow water depth was reached about midnight, with maximum values over 3 m occurring concurrently with the offshore maxima, slightly after 0200 on the 27th. Wave heights at all locations rapidly diminished with passage of the storm's center and arrival of strong westerly winds. Peak wave periods at the offshore Waverider increased slightly as the storm approached, reaching about 11 seconds, but then diminished to pre-storm values of about 8 seconds (Figure 11). At the Baylor gage, however, maximum values reached about 17 seconds during the eye's passage over the site before diminishing to 8 second values. Wave directional measurements computed from the Sxy directional array indicated that waves approached the pier from slightly south of shore-normal throughout the storm, even though local winds were from the east-northeast during the early stages.

Longshore Currents. Examination of data from the current meters indicates that longshore components of flow were northward throughout the storm, but that their strength varied with time and distance from shore. Figure 12 shows representative time histories of the longshore components of currents from 3 gages; one located near the north property

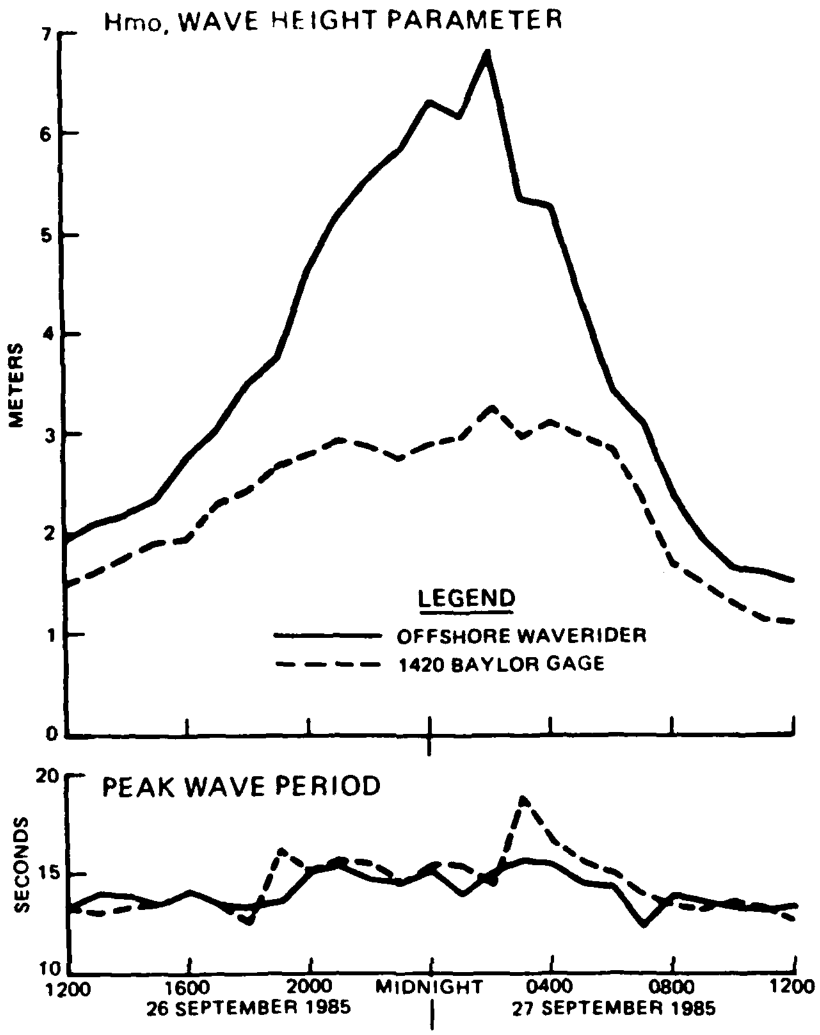

Figure 11. Wave heights and peak periods

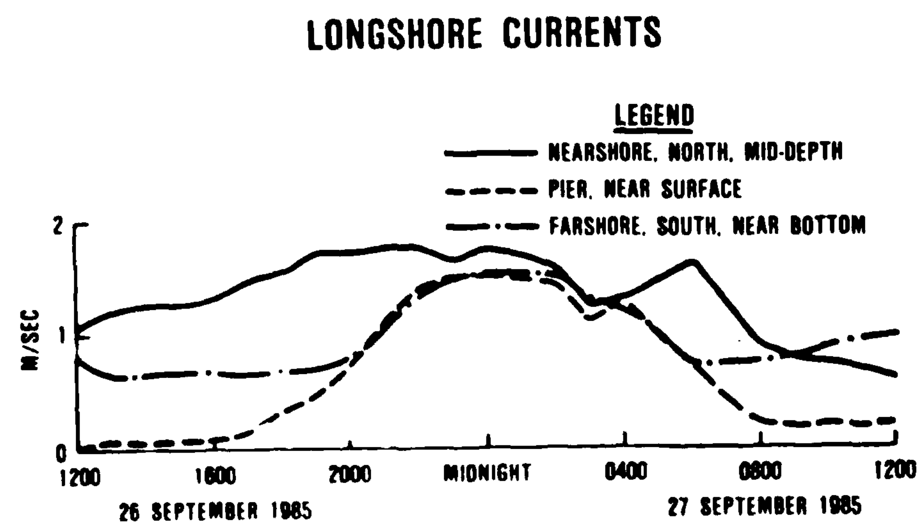

Figure 12. Time Histories of Longshore Currents

line about 114 m (375 ft) from shore, another under the pier about 300 m (1100 ft) from shore, and a third on a bottom-mounted tripod about 500 m (1650 ft) south of the pier end. Near shore currents were high throughout the period (up to 1.8 m/second). However, offshore current speeds increased proportionately with wave heights, reaching values equal to those nearshore at about 0400 on the 27th. The longshore components approximate the actual current speeds, since the flow was within 30 degrees of shore parallel. Thus, during these times of rapid longshore flow far from shore, the surf zone apparently extended much farther seaward than normal (probably well beyond the end of the pier), for all the current meters recorded northward flows of over 1.5 m/sec at that time.

Nearshore Profiles and Bathymetric Changes. In order to document the response of the nearshore bottom to Hurricane Gloria, pre and post-storm surveys of two areas were made. One survey area included 25 cross-shore profiles from the toe of the dune to the 9 m water depth, covering a longshore distance of 580 m either side of the pier. This area was surveyed on 21 August (Figure 13) and 28 September (Figure 14). A smaller, more frequently-surveyed area (the mini-grid) covered an area north of the pier extending 400 m longshore and 800 m offshore. A pre-storm survey of this area and two profiles south of the pier were completed on 25 September, with post-storm profiles obtained on 27 and 28 September. Analyses of these data indicate that changes on either side of the pier differed significantly.

On the south side, changes to the nearshore bottom were quite linear (i.e. uniform in the longshore direction). The nearshore bar moved offshore about 40 m, and an offshore bar developed about 200 m from shore. Changes to the shoreline were minimal, with slight landward movement of the mean sea level intercept throughout the area.

On the north side in contrast, changes were much more three-dimensional (Figure 15). The pre-storm crescentic bar configuration was greatly modified, with general offshore movement of the bar and elimination of small rip channels. The post-storm bathymetry was characterized by a relatively large depression and a slightly more-pronounced offshore bar. In this area, a well-developed berm on the upper foreshore was completely eliminated, although shoreline changes showed some accretion.

Near the research pier, the scour trough under the pier enlarged greatly to the north. Just north of this trough extensive deposition occurred (compare the 3 and 4 m contours in Figures 13 and 14).

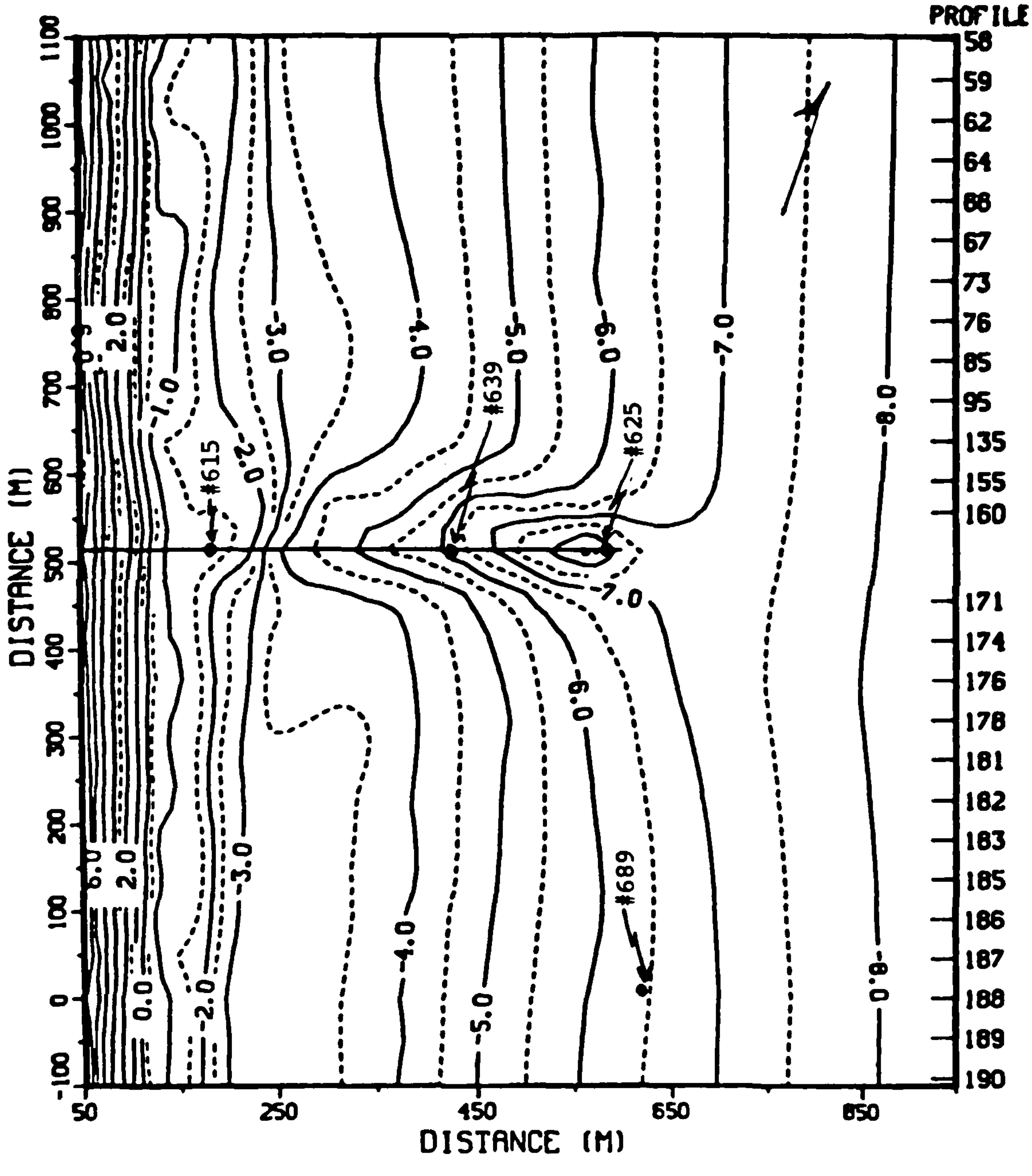

FIGURE 13. **FRF BATHYMETRY 21 AUG 85**
CONTOURS IN METERS

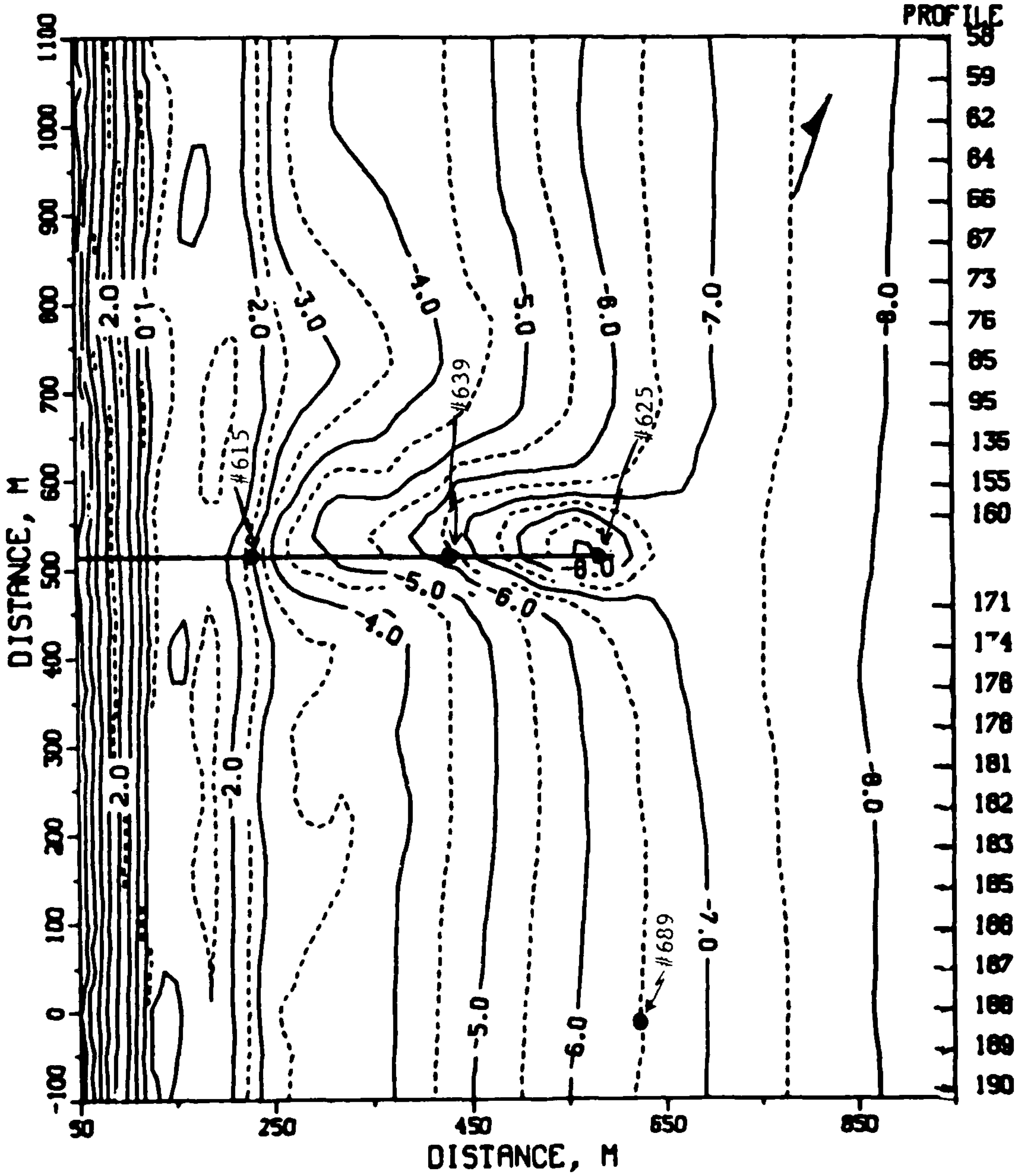

FIGURE 14. FRF BATHYMETRY 28 SEP 85
CONTOURS IN METERS

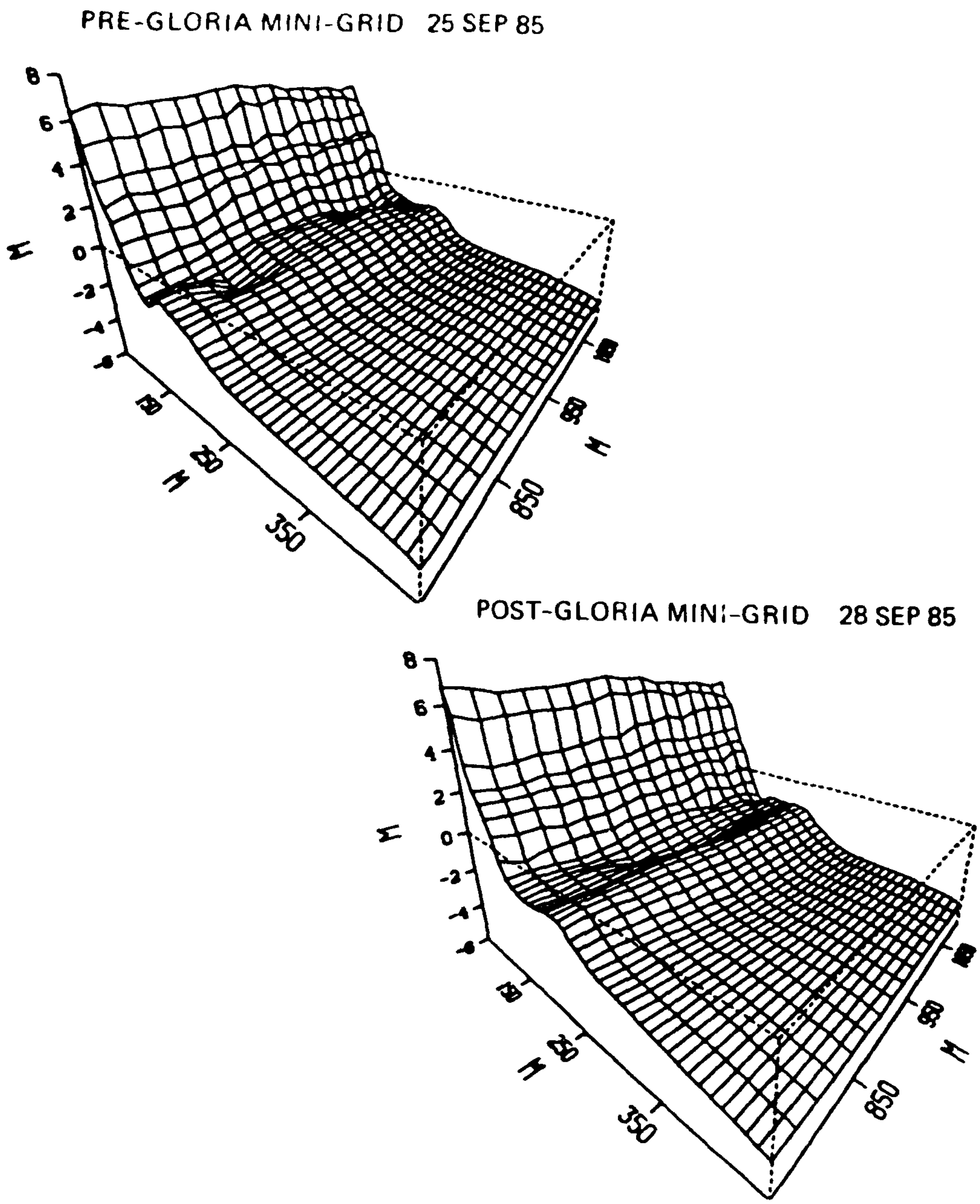

Figure 15. Mini-grid surveys

Summary. Within the vicinity of the Field Research Facility, wave heights and wind speeds during Hurricane Gloria approximated those typical of intense northeasters, although offshore wave heights were considerably greater. Changes to the nearshore bathymetry were essentially mirror-images of those observed during northeasters, apparently due to the fact that Gloria's waves approached from the south. Changes to the beach and dune were minimized by the hurricane's rapid passage, and the timing of maximum surge near the astronomical low water.

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