Hydrodynamic Climate for Navarre Beach State Park

Prepared for

Division of Recreation and Parks
Florida Department of Environmental Protection

By

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under contract to

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ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

This report provides hydrodynamic climate for use in selecting design conditions for a planned Underwater Marine Sanctuary as part of the Navarre Beach State Park. The hydrodynamic parameters are water levels, wind waves, winds, water currents, and depth of closure. Each parameter was treated separately for normal conditions, that can be expected to occur during any year, and extremal conditions associated with tropical storms and hurricanes. Statistics were compiled from observed data at appropriate measurement sites and numerical models operated by federal and state agencies. Predictions from two or more models were compared, validated with data when possible, and weighted to provide the best solution for this particular site. The following table summarizes the results of the extremal analysis for the five hydrodynamic parameters.

Parameter	10 Year	25 Year	50 year	100 Year	500 Year
Surge (ft)	4	7	9	11	13
Waves (ft)	10	13	16	18	
Winds (kn)	80	100	110	120	
Currents (kn)	3, max				
Depth of Closure (ft)	20, max				

Performance criteria are provided, with quantifiable limits from climatic analysis where appropriate, as guidelines for any proposed design. Criteria include:

- **Functional**
  - · Use Capacity
  - · Aerial Coverage
  - · Habitat Creation
  - · Depth and Distance

- **Safe**
  - · For Users
  - · For Non-users

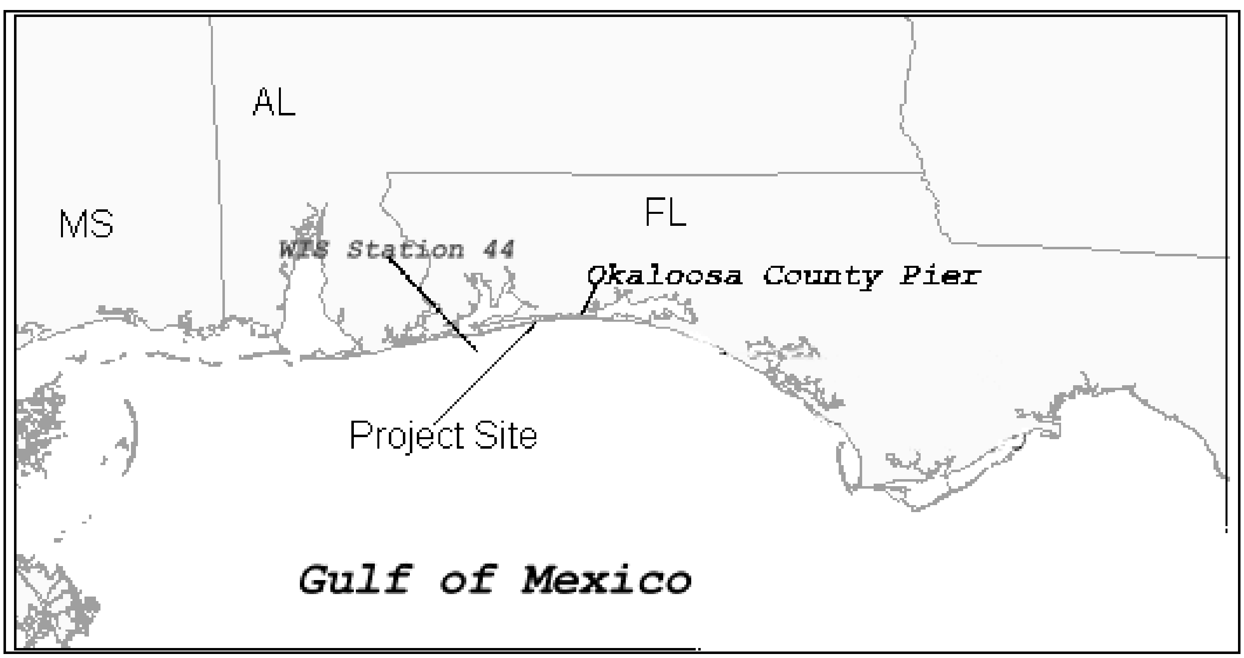
- **Acceptable Cost/Risk**
  - · Constructable
  - · Expandable
  - · Survivable
  - · Benign
  - · Removable

INTRODUCTION

The purpose of this report is to establish a hydrodynamic climate for use in selecting design conditions for a planned Underwater Marine Sanctuary as part of the Navarre Beach State Park. The hydrodynamic parameters are water levels, wind waves, winds, water currents, and depth of closure.

The project site is located at 30° 22.6' N, 86° 51.5' W at Navarre Beach, FL on the open coast of Santa Rosa Island. Santa Rosa Island is a low, sandy barrier island less than 1 nautical mile (nm) wide in the north central Gulf of Mexico. It extends about 30 nm from East Pass, the inlet for Choctawhatchee Bay, westward to Pensacola Pass. Navarre Beach is approximately centered between these inlets (Figure 1). The offshore slope is approximately 0.01 between the 60 ft contour to the shoreline, and steepens to about 0.02 from a depth of 30 ft to the shoreline .

Figure 1



METHODOLOGY

Generally, the methods recommended by the US Army Corps of Engineers Shore Protection Manual (SPM) will be used in analysis and modeling. When appropriate, other sources will be used to supplement or modify the SPM methods.

Each parameter will be treated separately for normal conditions, that can be expected to occur during any year, and extremal conditions associated with tropical storms and hurricanes. Statistics for normal conditions will be derived from frequency distribution analysis of long records, and will be presented as annual and/or seasonal means, maxima , etc. Hurricane statistics will be derived from extremal analysis and presented as predicted values for varying return periods. The return period of an event is the inverse of the probability of that event occurring in any one year; i.e., a 50-year event has a one in 50 chance of occurring in any year. A second statistic associated with the return period is the prediction limit for a given confidence level. It describes the probability that an event with a severity less than or equal to the N-year event will occur within the N-year period. For example, if a surge level has a prediction limit of 10 ft for a 25-year return period at 90 % confidence level, then there is a 90% chance that the surge will not exceed 10ft in a 25-year interval.

Statistics will be compiled from observed data at appropriate measurement sites and numerical models operated by federal and state agencies. Predictions from two or more models will be compared, validated with data when possible, and weighted to provide the best solution for this particular site. Measured wave, water level and current information is available from observations from a directional wave gage operated between February 1987 and May 1990 at 30° 23.5' N, 86° 35.6' W, approximately 13 nm east of the project site. The gage was located in ~ 30 ft of water just offshore of the Okaloosa County Pier (OCP) (see Figure 1). For climatic purposes, conditions at this measurement site can be assumed identical to the project site. Tidal statistics will be obtained from the11-year record of water level measurements from a National Ocean Service (NOS) tide gage that was located on the Navarre Beach fishing pier (see Figure 2). Storm surge levels will be derived from numerical models, supplemented with historical measurements at or near the project site. Typical and extreme wind wave statistics will be derived from numerical hindcast models for locations in deeper water offshore, transformed to the project site, and from a stochastic hurricane model nearshore. Water current conditions under non-storm conditions will be obtained from the Okaloosa County Pier measurements. Wind statistics used in the current analysis will be derived from long-term observations from nearby regional airports and weather stations. Currents associated with hurricanes will be calculated from analytical formulas for the design wave/surge conditions.

WATER LEVELS

Normal Tides

The tides in the northern Gulf of Mexico are low amplitude, mixed diurnal and semidiurnal - that is sometimes there are two highs and two lows in a day and other times only one of each. A NOS tide station was operated at the fishing pier adjacent to project from 1978 through 1988. The recorded mean tide range was 1.4 ft. The highest recorded water level was 3.2 ft above Mean Lower low Water (MLLW) during the approach of Hurricane Kate on November 21, 11985. The lowest was - 1.8 ft MLLW on February 29, 1983.

Breaking waves change the near shore water levels in the cross shore direction. As wave approach shallow water, water level decreases, reaching a minimum at the breaker point (set down). From the break point to shore, water level increases (set up). The effect for normal storm condition is on the order of the tidal range, and will not be a significant design factor.

Storm Surge

Storm surge is the change in elevation of the normal water level during a storm due to the combination of atmospheric pressure, wind stress, and wave setup. The change can be positive when winds blow onshore and negative when the wind stress is offshore, but only positive surge values will have a significant engineering impact on the project. Four government sources have products that were utilized to estimate the return period for storm surges elevations: the Federal Emergency Management Agency (FEMA), the Florida Department of Environmental Protection (DEP), the Beaches and Shores Resource Center (BSRC) at the University of Florida, and the Florida Department of Community Affairs (DCA).

The transect or boundary of each model's application is shown in Figure 2; the four regions can be considered co-located for statistical purposes. However, the cross shore position associated with the surge predictions vary. In addition, the models use different initial assumptions, hydrodynamic algorithms, even definitions of storm surge, so identical results should not be expected. In the discussion that follows, each agency's product will be reduced to a
common datum, NGVD[1], and will be recalculated, if necessary, to include the surge component only, i.e., the still water level with wind waves filtered out.

[1] Though NGVD is assumed identical to Mean Sea Level (MSL) in some of these reports, there is a difference of several tenths of a foot in this region. See www.emeraldoe.com for details.

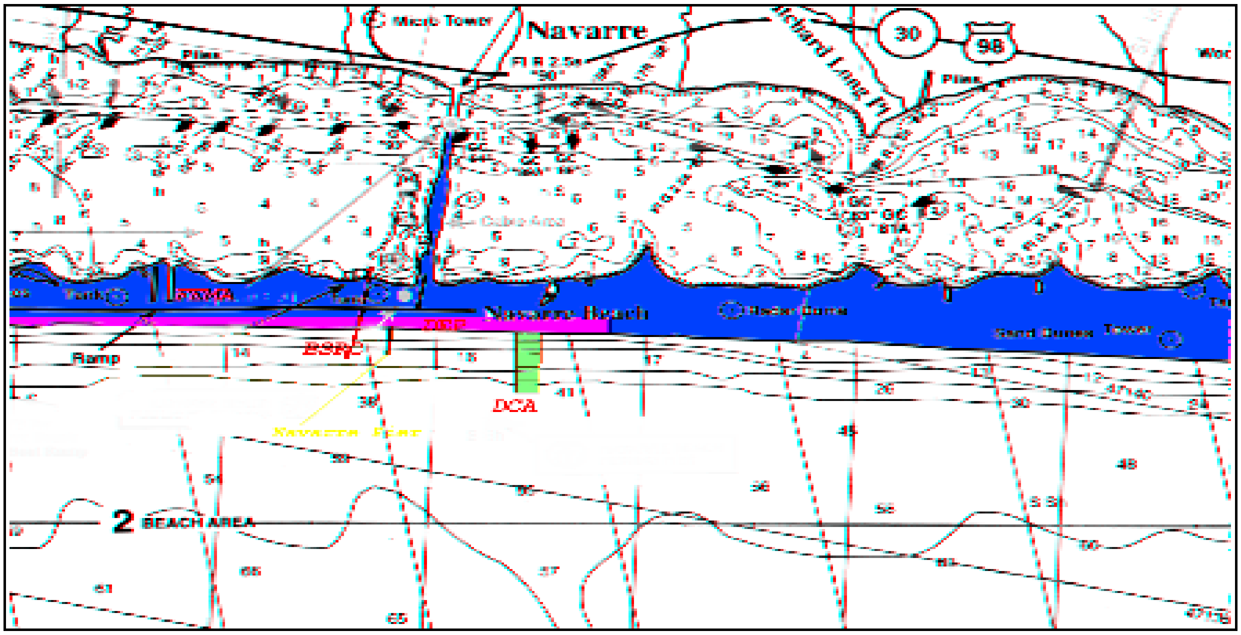


Figure 2

FEMA’s report (FEMA, 2000) provides values of storm surge for the 10, 50, 100, and 500 year events that are constants for the entire shoreline of Santa Rosa Island, so the exact location of the transect is immaterial. The surge level is also assumed constant in the cross shore direction from offshore to the point where this elevation intersects the existing grade elevation. Tide stages are included statistically in the elevations for all events, but only the 100-year storm includes the effect of wave setup on the still water level.

DEP published a report by BSRC with for a 100-year return period storm surge and design grade elevations for discrete segments of shoreline for each coastal county (BSRC, 1999). The DEP model calculates an eroded profile resulting from the predicted surge and wave action. The cross shore location of the predicted surge elevation is defined as the breaking point for the predicted wave on the eroded profile. This location could be seaward or landward of the existing shoreline, depending upon the predicted surge elevation, wave height and the shape of the initial and eroded profile. At Navarre Beach, the cross shore position is near the primary dune line.

An earlier report from BSRC   provides plots of “storm tide elevation” as a function of return period out to 500 years for discrete transects along the state’s coastline (Dean and Chiu, 86). There are four transects modeled for Santa Rosa Island, and the easternmost is near the project site (Figure 2). The cross shore location of the predicted storm tide is described as approximately the existing shoreline, and does not change in the onshore direction[2].

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[2] Telephone conversation with Dr. Robert Wang, BSRC, on 03/13/91

DCA conducted a statewide hazard assessment from hurricanes using The Arbiter of Storms, Version "R" (TAOS/R) model - a " modular, scalable, multi-hazard meteorological simulation system" (Watson and Johnson, 19__). TAOS provides a wide variety of spatially referenced risk assessment and damage predictions for an entire county.

When run stochastically for a wide range of input storm characteristics (intensity, forward speed, and approach angle), TAOS predicts the maximum envelope (ME) for winds, storm surge and wave heights, and other risk factors at each grid point for tropical storm and category 1 through 5 (Safford-Simpson scale) hurricanes. The ME product is the true maxima associated with a large number of model runs for a wide variety of possible storm tracks of a particular size. Figure 3 is an example of color-coded surge levels for the southeast section of Santa Rosa County for a category 2 hurricane. The colors in this sample are not referenced to any particular depths, but serve to illustrate the resolution of the model. At the Gulf shoreline in the vicinity of the project, each grid cell is 600 ft on a side. The surge elevation is expressed in water depth above grade. Over water, the datum is MSL. Tides are included in the predicted surge.

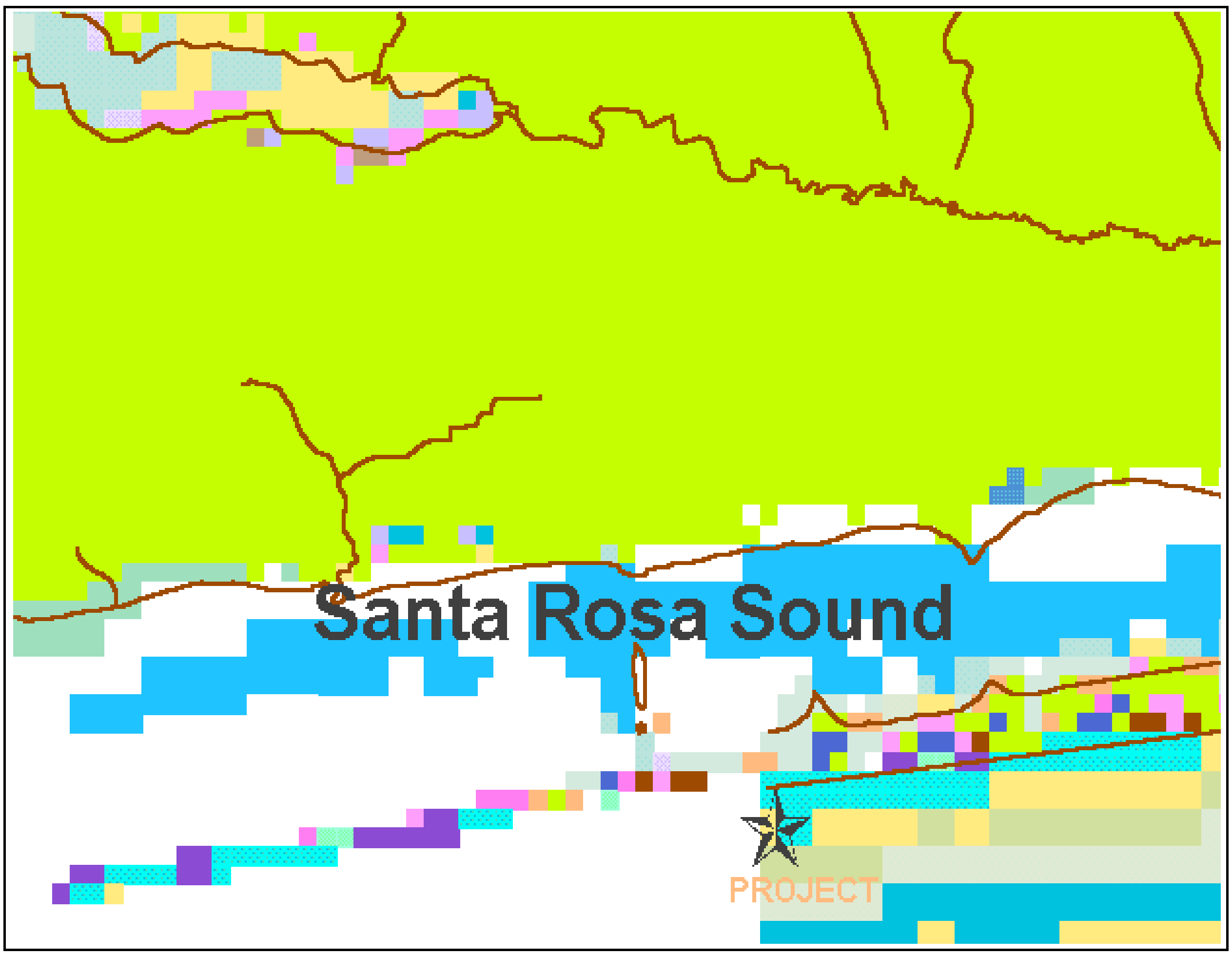


Figure 3

The following table shows the results of TAOS predictions for the first 5 cells extending seaward from the shoreline at the project site for each storm category (Cells 2- 3 and 4-5 were combined in Table 1 since they showed no change in output). The first column lists the offshore extent and the range of water depths applicable to each cell. The first row gives the storm category and the predicted wind velocity at the shoreline (Cell no. 1).

Table 1. TAOS Surge Predictions by Category

Cell No. Offshore Dist. (ft) / Depth Range (ft)	TS 53 kn	Cat. 1 73 kn	Cat. 2 87 kn	Cat. 3 105 kn	Cat. 4 125 kn	Cat.5 150 kn
1 0 - 600 / 0 - 6	2.3	4.6	8.5	11.5	16.7	23.6
2 and 3 600 - 1800 / 6 - 40	2	4.3	7.9	11.2	16.4	23.0
4 and 5 1800 - 3000 / 40 - 60	2	3.9	7.5	10.8	16.1	22.6

TAOS was also run in a hindcast mode to provides extremal statistics - the predicted wind, wave and storm surge associated with the 10, 25, 50, and 100 year return period events. A hindcast model simulates historical conditions at regular temporal and spatial intervals. The basic return period products include maximum likelihood estimates (MLE) of surge for each return period. In addition, TAOS accounts for the uncertainty in the MLE being the *actual extreme for each return period* by assigning prediction limits for increasing confidence levels. Prediction limits are provided for the 95%, 90%, 75%, certainty of not being exceeded. The MLE is approximately equivalent to the 50% confidence prediction limit. The predicted surge elevations from the four sources (Cell No. 1 for TAOS) are found in Table 2 below.

Table 2. Predicted Surge Elevation (ft) above NGVD by each Agency

Source	10 Year	25 Year	50 year	100 Year	500 Year
FEMA	4.0	NA	6.8	10.5 (a)	11.0
DEP	NA	NA	NA	11.5	NA
BSRC	4.1		9.2	10.7	13.8
DCA - MLE	3	5.9	8.2	10.5	
DCA -75%	7.2	10.5	12.8	15.7	
DCA-90%	10.5	13.8	16.7	18.7	
DCA-95%	13.8	16.4	18.7	22.6	

Note (a): includes wave setup of 2.5 ft

Discussion

Fortunately (?) for this analysis, the project site has experienced a category 1 hurricane (Erin) and the maximum winds from a category 3 hurricane (Opal) in recent history for comparison. The nearest functioning interior tide gage during these storms was at Pensacola, 15 nm to the west in Pensacola Bay. Open coast storm surge estimates were obtained from post-storm surveys. The highest recorded tide at Pensacola during Hurricane Erin was + 2.94 ft, MLLW at 0300 CST on 4 August. This occurred about 2 hours before a predicted high tide of 1.44 ft at 0459, giving a maximum bay surge of approximately 1.5 ft above normal. The actual landfall of the storm was occurred between 0900 and 1000 on the 3rd, during a falling tide, corresponding to a maximum water elevation of + 2.3 ft, or about 1.3 ft above the predicted tide. These data are consistent with the National Hurricane Center's statement: "Storm tides averaged 1 to 2 feet along the west- central Florida peninsula." Given that the hurricane occurred during a falling tide, and the storm was a marginal category 1 storm by the time it made landfall, the TAOS prediction of ~ 2- 4 ft for the ME is a reasonable upper limit for the surge.

The highest recorded tide at Pensacola during Hurricane Opal was + 6.13 ft, MLLW at 1600 CST on 4 October, as the storm made landfall. This also occurred on a falling tide, very near a predicted low tide of 0.58 ft at 1800, giving a maximum bay surge of approximately 5.5 ft above normal. Opal had rapidly dwindled from a Category 5 to a marginal category 3 storm as it approached land. Post storm estimates of Opal's maximum open coast surge range from 12 to 14 ft[3]. The TAOS predictions appear to underestimate the surge for a category 3 hurricane. However, when the storm surge is understood as a very long period, long-length water wave with considerable momentum, it would not be expected to respond as rapidly as the wind. In that light, it's reasonable to look to Category3/4 levels, which are more consistent with the observations.

In Table 2, there is fairly close agreement between the different sources, assuming the first three agencies also report the MLE value. In fact, the convergence of the four sources at the 100 year event is notable, and probably indicates some degree of coordination for this statistic due to its economic and statutory importance. For example, FEMA included an additional 2.5 ft of surge from wave setup at the 100-year level, which is a significant contribution to total surge at larger wave heights. FEMA's decision not to include it other return periods is probably responsible for their relatively lower values.

[3]Telephone conversation w/ Mr Mark Leadon, DEP on 3/13/01

WAVES

There have been several other wave gages operated in the general region besides the one at the OCP. However, none have been in operation long enough to develop reliable frequency of occurrence or return period statistics. The measurements at OCP provide a total data set of about 22 months over a four year period, so while accurate, they are statistically unstable, especially for extremal analysis. Another source for establishing typical wave statistics at the project site is the Wave Information Study (WIS), a global hindcast of wind, wave, and water levels that is managed by the US Army Corps of Engineers specifically to provide climatic statistics for coastal engineering applications. The latest version of the hindcast covers the 20-year period from 1976 through 1995.

Normal Wave Conditions

The nearest WIS grid point, or station, is number 42, at 30°15' N, 86° 45' W, in ~ 80 ft of water. Station 44, located at 30°15' N, 87° 15' W is slightly further to the west of the project, but is modeled as being in 17 ft of water[4], and is situated closer to shore, so it is a better representation of conditions at the project. A rigorous, time-domain validation of the WIS model is beyond the scope of this report, but a comparison to the measurements at OCP will reveal some characteristics of the hindcast. Table 3 compares WIS predictions for the highest wave each month to the measured maxima for those months when the gage was operational. Individual peaks are both over and under predicted, and average bias for any one year can exceed one ft, but the average bias for the 23 months of measured data is less than -0.03 ft. This result is typical for the WIS hindcast, and demonstrates that, while it may not predict conditions at any one time with high accuracy, it is a valuable tool for climatic analysis.

Table 4 show the means, H_{av} and maxima H_{max} for wave heights at WIS station 44 by month and annually. The annual mean of 1.8 ft is in close agreement to the 1.6 ft annual mean for Destin from SPM. The distribution of wave heights at the WIS station for all periods and all directions and, for comparison, the measured data at the OCP is given in Table 5. The wave heights in the table are the center value of 1.6 ft range bins. The measured site shows a higher percentage of the lowest waves, but the trends converge for the higher waves. This may be indicative a slightly less energetic climate at the OCP, but more likely reflects the smaller, skewed population of measurements; i.e., the measurements only cover a few years and have nearly twice as many gaps in the winter months versus the summer months. The percentage of time that wave conditions remain below a given threshold is important from an operational standpoint. Table 6 shows what percent of time that wave heights remain below, for example, 1.6 ft for each month and annually at WIS station 44.

Table 3. Comparison of Highest Waves (ft), by Month for WIS and OCP Measurements

[4] The actual water depth at the location of WIS station 44 is closer to 60 ft, but since the model "thinks" it is only 16 ft, it will simulate wave conditions in that depth of water.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	An. Av. BIAS
87WIS44		6.9	8.9	3.3			2.6	2.0	3.3			6.6	
87 OCP		5.9	7.3	7.9			3.0	4.0 (a)	2.6			4.6	
87 44BIAS		1.0	1.7	-4.6			-0.3	-2.0	0.7			2.0	-0.2
88WIS44	7.6	5.0	5.6		3.6	3.3	3.6				8.6	4.3	
88 OCP	6.6	2.3	6.9		5.3	3.6	2.3				5.9	4.3	
88 44BIAS	1.0	2.6	-1.3		-1.7	-0.3	1.3				2.6	0.0	+0.5
89WIS44	3.6				3.3	6.3	4.6	5.0					
89 OCP	4.6				3.6	8.6	6.6 (b)	5.9 (b)					
89 44BIAS	-1.0				-0.3	-2.3	-2.0	-1.0					-1.3
90WIS44			7.3	7.3	5.0								
90 OCP			6.6	4.6	5.0								
90 44BIAS	`		0.7	2.6	0.0								+1.1

(a) Unnamed Tropical Storm, 13 - 15 August 1987
(b) Hurricane Chantral, 31 July - 1 August 1989

Table 4. WIS Station 44; Mean and Maximum Wave Heights (ft) by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
H_{av}	2.2	2.3	2.4	2.0	1.6	1.3	1.1	1.2	1.6	1.8	2.1	2.1	1.8
Hmax	9.6	10.6	10.6	8.9	8.3	10.6	10.6	10.6	10.6	10.6	10.6	9.6	10.6

Table 5. Distribution for Hindcast and Measured Wave Heights

Center Value of 1.6 ft bin	WIS 44 - Percent Occur.	Ok. Co. Pier - Percent Occur.
0.8	48.98%	62.00%
2.5	38.51%	25.00%
4.1	9.47%	10.00%
5.8	2.02%	2.50%
7.4	0.61%	0.40%
9	0.22%	0.10%
10.7	0.18%	

Table 6. Distribution of Wave Heights Less than 1.6 ft, by Month, for WIS 44

Month	Jan	Feb	Mar	Apr	May	Jun	Table
No. Occur.	1549	1326	1578	2011	2563	3170	continued
% Occur.	31%	29%	32%	42%	52%	66%	below

Month	Jul	Aug	Sep	Oct	Nov	Dec	Annual
No. Occur.	3879	3717	2845	2080	1544	1527	27789
% Occur.	78%	75%	59%	42%	32%	31%	48%

Extreme Wave Conditions

Two sources are used to develop extreme wave statistics: WIS and the TAOS model. Both fit the predicted parameters to one of two types of Weibull probability distribution - a mathematical model of a random population. WIS return periods are calculated separately for tropical storms/hurricanes and all other times when no tropical storms influenced the conditions. Only the tropical storm statistics are used below. WIS gives two prediction limits - an upper one with a 68 % confidence level and an unlabeled value, assumedly the MLE or 50 % limit. Table 7 compares the predicted wave heights by return period from both sources. Since the TAOS values vary with position offshore, TAOS data from Cell No. 2 that corresponds to the WIS modeled water depth is presented. Note that WIS provides a 20- year, and the Taos, a 25- year, prediction.

It's apparent from Table 7 that a change in prediction limit, say from 75% to 90% for TAOS, increases the predicted value by about as much as doubling of the return period. This is one indication of the uncertainty inherent in these statistics.

Table 7. Predicted Wave Heights by return Period for WIS and TAOS

Return Period -	5	10	20 (WIS) 25 (TAOS)	50	100
44WIS TS 50%	6.6	7.9	9.9	12.9	
44WIS TS 68%	7.3	9.6	12.2	16.8	
TAOS, MLE	NA	5.6	7.5	9.5	11.2
TAOS, 75%	NA	8.9	11.2	14.4	16.7
TAOS, 90%	NA	11.5	14.1	17.4	19.4
TAOS, 95%	NA	13.8	15.7	19.4	21.6

Discussion

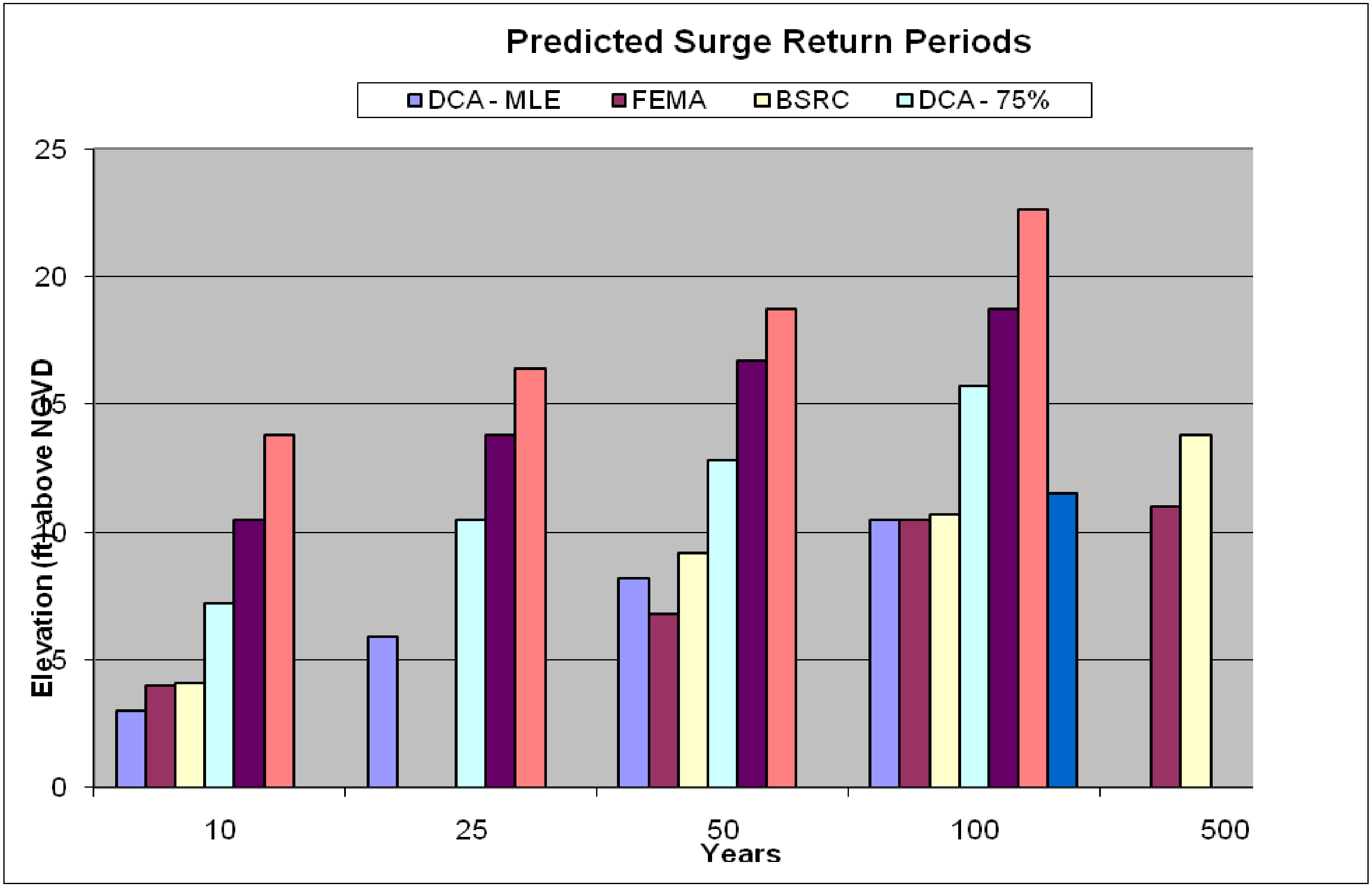
Figure 4 plots the six predictions on a compressed, approximately logarithmic time scale. Also, to simplify the image and provide a clearer comparison of the predictions, the WIS 20-year return period values and the TAOS 25-year return periods were co-located at a pseudo 22-year position on the plot. The slight distortion of the x axis will not cause a significant change in the shape of either the WIS or TAOS curves. At this scale, some of the characteristics of each data set become obvious.

The WIS data set covers 20 years from 1976 through 1995, which produced an average of 9.6 named tropical storms or hurricanes per year in the North Atlantic. The long-term average is 9.8 storms/year, so this is a representative sample in terms of the number of storms. However, there were only 29 systems that came into the Gulf within 300 nm of the project site, a distance close enough to cause reasonable large waves. Of those, only 6 passed within 100 nm of the project as hurricanes, and three of those occurred in one season (1995). This small of a sample would not be expected to produce accurate predictions for the higher wave/longer return period statistics, but should be sufficient for the 5 to 10-year statistics.

The TAOS model utilized 959 tropical cyclones covering 1886-1997 from the HURDAT (Hurricane Data from the National Hurricane Center) data set. TAOS was run for each storm, and the extreme phenomena over the duration of the storm were saved at each cell. A five-fold increase in the number of storms will provide a population that is more likely to fit the model. This fact is one reason the TAOS data are better "behaved"; e.g., have a more linear shape on the logarithmic scale. It does not necessarily mean that the TAOS is more accurate hydrodynamically than WIS. Both models, given reasonable input, could predict the highest waves for any one storm within a foot or so. The uncertainty lies in defining the return periods, and the larger data set of TAOS makes it a more reliable predictor for longer return periods.

For the shorter return periods, the proximity of the WIS 50% and 68% curves illustrate high statistical confidence in the predictions. Extending the TAOS MLE curves to the 5-year event yields a wave height of just 3.5 ft, a value that, according to Table 5, was exceeded about 13 % of the time at OCP. In fact, Table 3 shows the WIS 50 % 5-year height of 6.6 ft was met or exceeded at OCP on 7 different months, in the 23-month data set - and only one of those was due to a hurricane. Even the WIS 68% 5-year prediction limit, 7.7 ft, was exceeded twice in the measurement interval. The TAOS 90 % prediction limit, if extrapolated to a 5-year event, would just exceed the 8.6 ft maximum wave observed at the OCP.

Figure 4


Predicted Surge Return Periods
DCA - MLE
FEMA
BSRC
DCA - 75%
25
20
15
10
5
0
Elevation (ft) above NGVD
10
25
50
100
500
Years

Appendix A - Water Levels

TIDES
From NOS - http://www.co-ops.nos.noaa.gov/benchmarks/8729678.html

FLORIDA 872 9678

NAVARRE BEACH, GULF OF MEXICO

Tidal datums at NAVARRE BEACH, GULF OF MEXICO are based on the following:

LENGTH OF SERIES	= 11 YEARS
TIME PERIOD	= 1978-1988
TIDAL EPOCH	= 1960-1978
CONTROL TIDE STATION	= PENSACOLA (872 9840)

Elevations of tidal datums referred to mean lower low water (MLLW) are as follows:

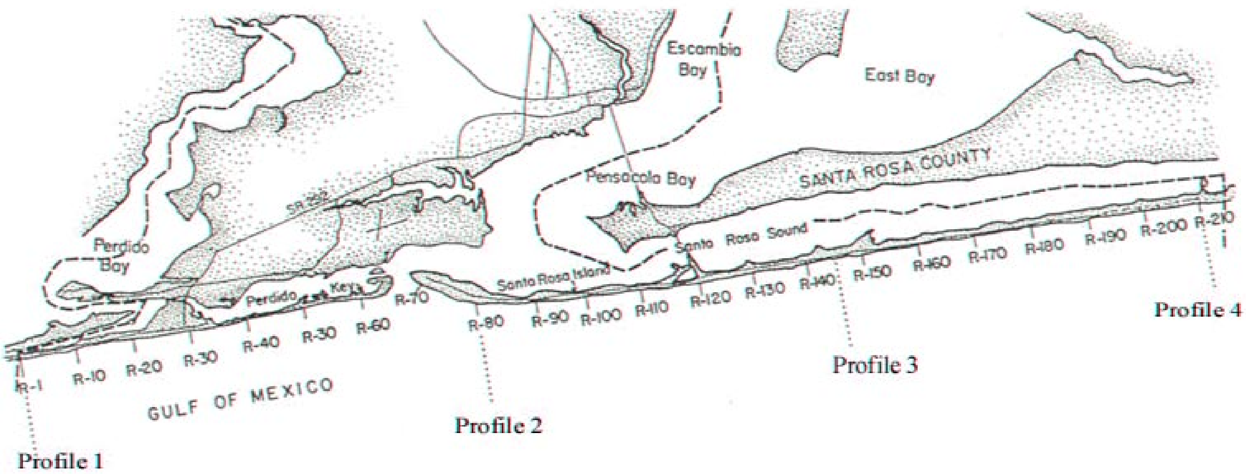
HIGHEST OBSERVED WATER LEVEL (11/21/1985)	= 3.18 FEET
MEAN HIGHER HIGH WATER (MHHW)	= 1.40 FEET
MEAN HIGH WATER (MHW)	= 1.33 FEET
MEAN TIDE LEVEL (MTL)	= 0.70 FEET
MEAN LOW WATER (MLW)	= 0.07 FEET
MEAN LOWER LOW WATER (MLLW)	= 0.00 FEET
LOWEST OBSERVED WATER LEVEL (02/29/1984)	= -1.83 FEET

ESCAMBIA COUNTY

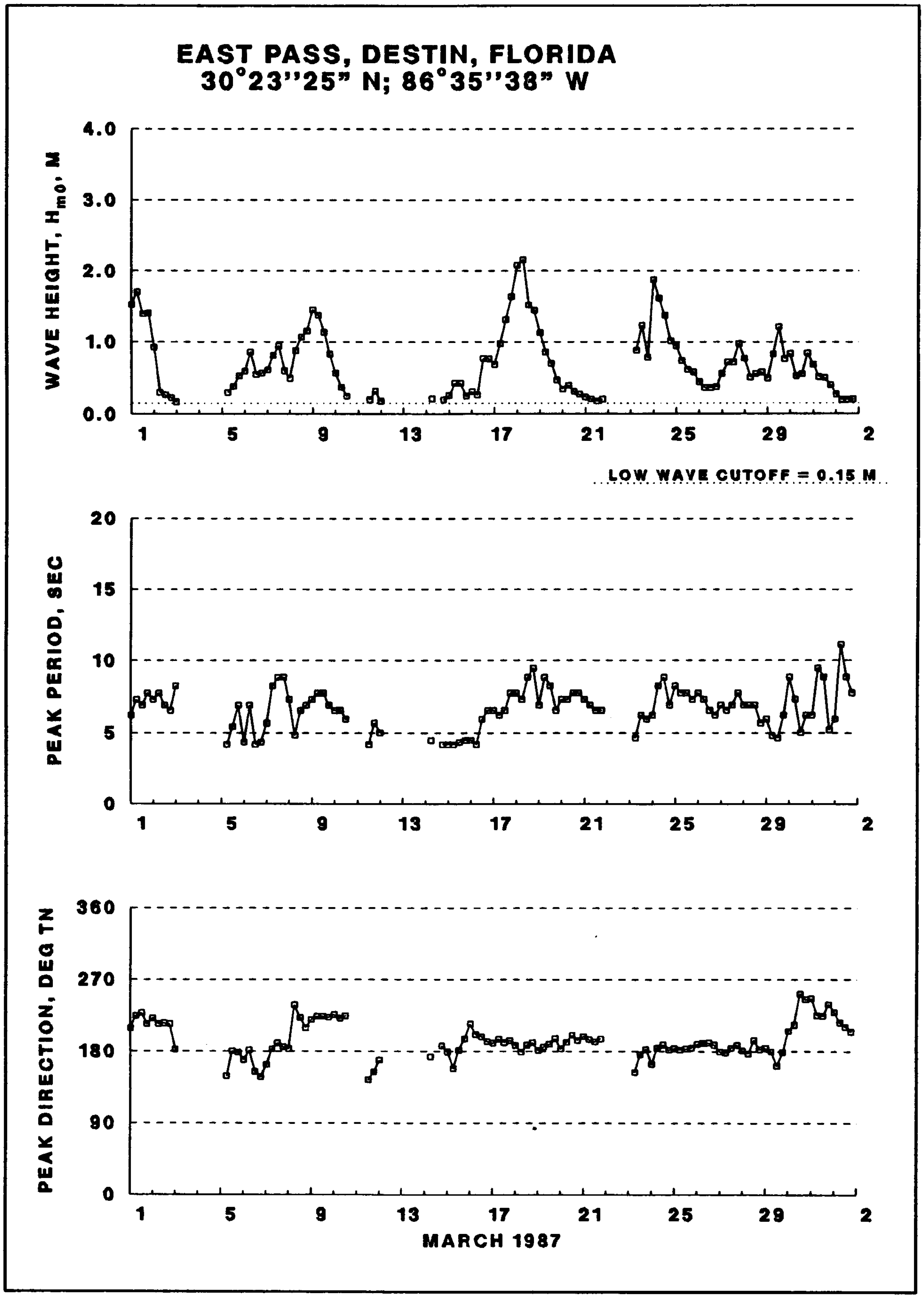
Combined Total Storm Tide Values for Various Return Periods				
Return Period TR (years)	Combined Total Storm Tide Level* above NGVD (ft.)			
	Profile One	Profile Two	Profile Three	Profile Four
500	15.3	14.3	13.9	13.8
200	12.9	12.4	12.2	12.0
100	11.4	11.0	10.8	10.7
50	9.8	9.7	9.4	9.2
20	7.3	7.4	7.1	6.9
10	4.3	4.3	4.2	4.1

*Includes contributions of: wind stress, barometric pressure, dynamic wave set-up and astronomical tide.

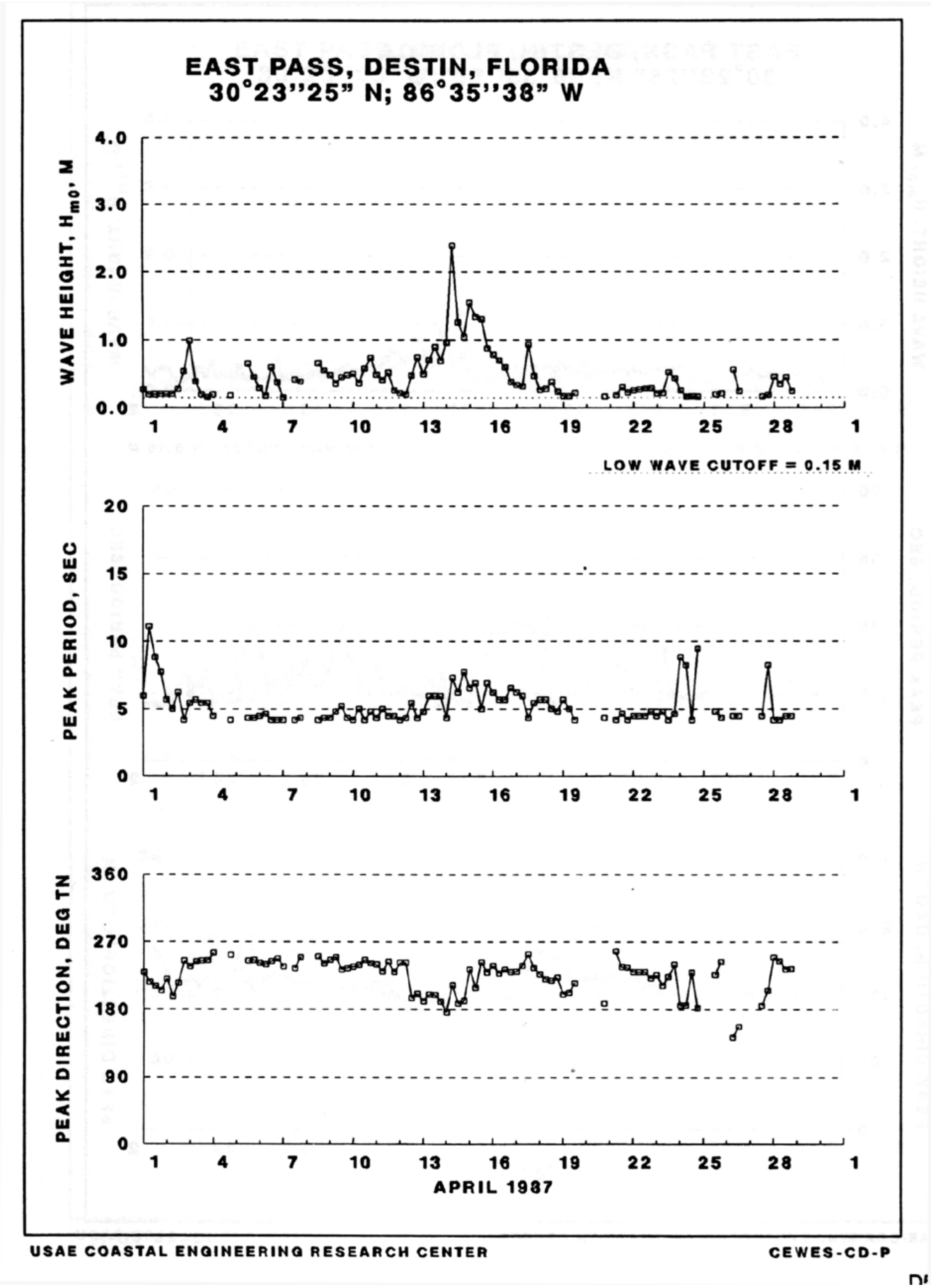
Escambia County Location Profiles



Appendix B

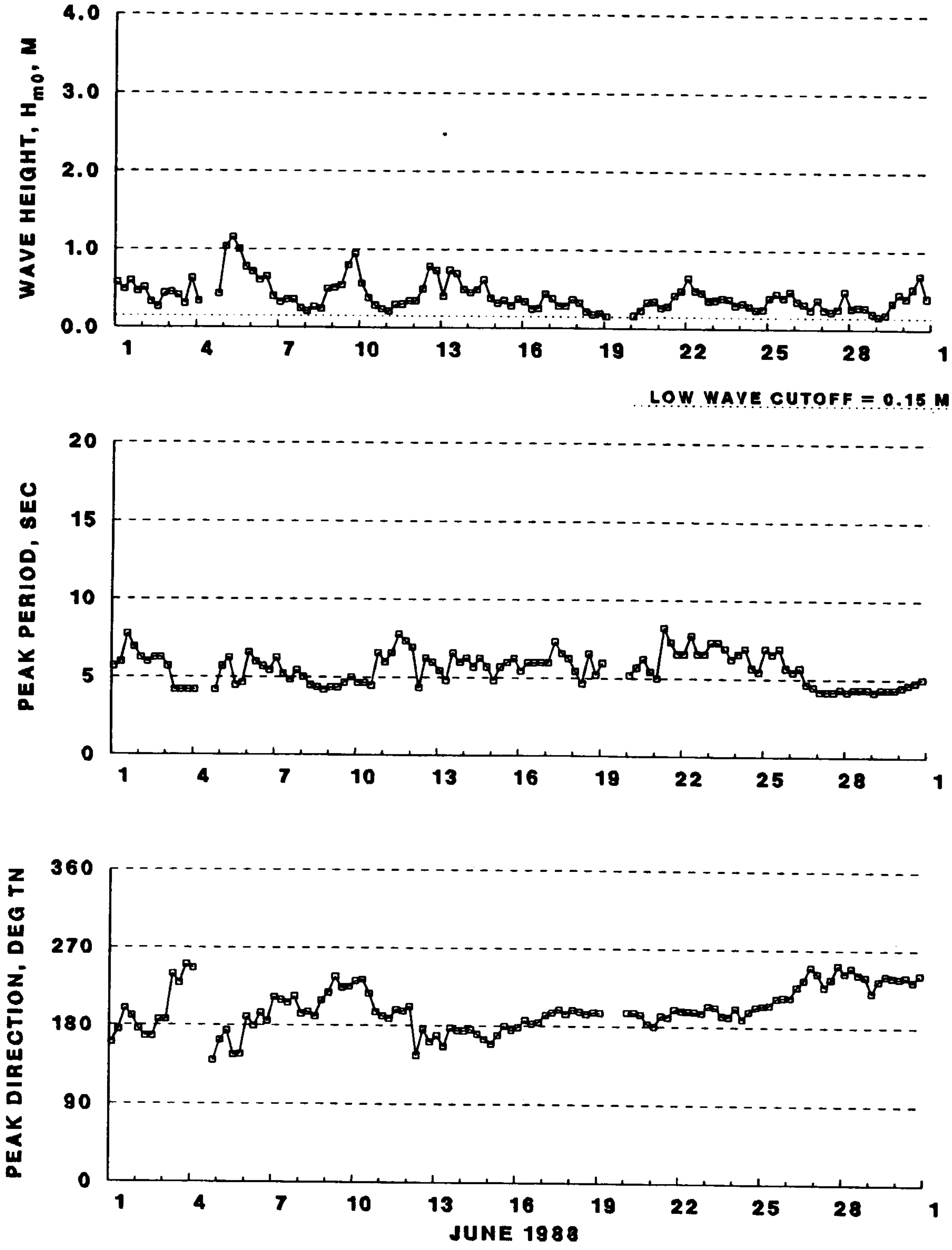


USAE COASTAL ENGINEERING RESEARCH CENTER CEWES-CD-P



EAST PASS, DESTIN, FLORIDA
30°23''25" N; 86°35''38" W
WAVE HEIGHT, Hmo, M
4.0
3.0
2.0
1.0
0.0
1
4
7
10
13
16
19
22
25
28
1
LOW WAVE CUTOFF = 0.15 M
PEAK PERIOD, SEC
20
15
10
5
0
PEAK DIRECTION, DEG TN
360
270
180
90
0
APRIL 1987
USAE COASTAL ENGINEERING RESEARCH CENTER
CEWES-CD-P

EAST PASS, DESTIN, FLORIDA
30°23''25" N; 86°35''38" W



NORMAL STATISTICS
WIS 42

WIS GULF OF MEXICO UPDATE - WITH HURRICANES 1976 - 1995
LAT: 30.25 N, LONG: 86.75 W, DEPTH: 14 M
SUMMARY OF WAVE INFORMATION BY MONTH

STATION: 42

OCCURRENCES OF WAVE HEIGHT BY MONTH FOR ALL YEARS

Hs(m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0.00 - 0.49	1549	1326	1578	2011	2563	3170	3879	3717	2845	2080	1544	1527	27789
0.50 - 0.99	2180	2051	1904	1873	2005	1422	932	993	1352	2383	2315	2298	21708
1.00 - 1.49	946	773	964	729	347	180	91	130	465	375	733	881	6614
1.50 - 1.99	196	289	347	149	32	18	36	54	92	58	159	212	1642
2.00 - 2.49	71	47	137	29	9	8	6	33	12	13	33	38	436
2.50 - 2.99	14	28	25	9	4	2	5	15	10	12	4	4	132
3.00 - 3.49	4	6	5	.	.	.	9	11	3	15	3	.	56
3.50 - 3.99	.	.	.	.	.	.	.	6	8	7	2	.	23
4.00 - 4.49	.	.	.	.	.	.	2	1	3	3	6	.	15
4.50 - 4.99	.	.	.	.	.	.	.	.	3	3	1	.	7
5.00 - 5.49	.	.	.	.	.	.	.	.	2	3	.	.	5
5.50 - 5.99	.	.	.	.	.	.	.	.	1	4	.	.	5
6.00 - 6.49	.	.	.	.	.	.	.	.	1	4	.	.	5
6.50 - 6.99	.	.	.	.	.	.	.	.	.	.	.	.	0
7.00 - 7.49	.	.	.	.	.	.	.	.	2	.	.	.	2
7.50 - 7.99	.	.	.	.	.	.	.	.	1	.	.	.	1
8.00 - 8.49	.	.	.	.	.	.	.	.	.	.	.	.	0
8.50 - 8.99	.	.	.	.	.	.	.	.	.	.	.	.	0
9.00 - 9.49	.	.	.	.	.	.	.	.	.	.	.	.	0
9.50 - 9.99	.	.	.	.	.	.	.	.	.	.	.	.	0
10.00 - GREATER	.	.	.	.	.	.	.	.	.	.	.	.	0
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 42

OCCURRENCES OF PEAK PERIOD BY MONTH FOR ALL YEARS

Tp(sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
3.0 - 3.9	1864	1489	1463	1681	1690	1971	2488	2400	2316	2360	1862	1787	23371
4.0 - 4.9	1576	1383	1209	1017	1352	1360	1604	1499	1472	1823	1613	1788	17696
5.0 - 5.9	706	750	878	860	1163	949	604	653	610	461	667	700	9001
6.0 - 6.9	393	384	599	700	556	374	175	225	186	137	409	377	4515
7.0 - 7.9	240	333	423	402	145	105	53	72	114	48	177	222	2334
8.0 - 8.9	131	133	258	106	37	33	15	28	13	41	32	69	896
9.0 - 9.9	34	35	98	32	17	2	4	25	14	14	7	16	298
10.0 - 10.9	14	13	24	2	.	2	15	21	15	28	5	1	140
11.0 - 11.9	2	.	8	.	.	4	2	14	20	21	7	.	78
12.0 - 12.9	.	.	.	.	.	.	.	7	17	10	10	.	44
13.0 - 13.9	.	.	.	.	.	.	.	6	17	15	5	.	43
14.0 - 14.9	.	.	.	.	.	.	.	6	5	2	2	.	15
15.0 - 15.9	.	.	.	.	.	.	.	4	1	.	4	.	9
16.0 - 16.9	.	.	.	.	.	.	.	.	.	.	.	.	0
17.0 - 17.9	.	.	.	.	.	.	.	.	.	.	.	.	0
18.0 - 18.9	.	.	.	.	.	.	.	.	.	.	.	.	0
19.0 - 19.9	.	.	.	.	.	.	.	.	.	.	.	.	0
20.0 - LONGER	.	.	.	.	.	.	.	.	.	.	.	.	0
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 42

OCCURRENCES OF PEAK DIRECTION BY MONTH FOR ALL YEARS

Dm(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
348.75 - 11.24 (0.0)	597	414	247	179	139	64	11	31	179	479	494	523	3357
11.25 - 33.74 (22.5)	376	317	204	139	100	33	9	42	200	395	446	503	2764
33.75 - 56.24 (45.0)	317	238	157	139	118	81	21	78	297	489	349	356	2640
56.25 - 78.74 (67.5)	215	222	148	152	92	131	76	189	523	674	384	290	3096
78.75 - 101.24 (90.0)	294	285	241	260	256	254	154	444	704	723	439	322	4376
101.25 - 123.74 (112.5)	296	244	275	333	412	243	167	323	461	355	385	331	

3825

123.75 - 146.24 (135.0)	362	325	485	530	696	466	500	595	641	411	508	463	5982
146.25 - 168.74 (157.5)	575	552	843	883	1346	1110	1179	1025	609	452	531	591	9696
168.75 - 191.24 (180.0)	728	800	1258	1103	900	985	833	656	521	304	547	586	9221
191.25 - 213.74 (202.5)	165	210	175	209	275	489	511	566	259	110	144	183	3296
213.75 - 236.24 (225.0)	90	128	189	210	265	607	747	506	175	83	73	104	3177
236.25 - 258.74 (247.5)	59	110	114	105	111	179	286	208	51	76	42	52	1393
258.75 - 281.24 (270.0)	90	99	106	156	57	67	255	130	33	52	46	84	1175
281.25 - 303.74 (292.5)	181	134	128	94	51	47	119	72	23	51	69	96	1065
303.75 - 326.24 (315.0)	296	217	170	128	53	17	66	46	38	104	105	172	1412
326.25 - 348.74 (337.5)	319	225	220	180	89	27	26	49	86	202	238	304	1965
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 42

OCCURRENCES OF WAVE HEIGHT AND PEAK PERIOD FOR ALL DIRECTIONS

Hs(m)	Tp(sec) 3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-11.9	12.0-LONGER	TOTAL
0.00 - 0.99	23371	15764	6589	2640	798	187	52	42	22	32	49497
1.00 - 1.99	.	1932	2406	1778	1458	508	96	20	18	40	8256
2.00 - 2.99	.	.	6	97	75	197	133	43	9	8	568
3.00 - 3.99	.	.	.	.	3	4	15	31	21	5	79
4.00 - 4.99	.	.	.	.	.	.	2	3	3	14	22
5.00 - 5.99	.	.	.	.	.	.	.	1	4	5	10
6.00 - 6.99	.	.	.	.	.	.	.	.	1	4	5
7.00 - 7.99	.	.	.	.	.	.	.	.	.	3	3
8.00 - 8.99	.	.	.	.	.	.	.	.	.	.	0
9.00 - GREATER	.	.	.	.	.	.	.	.	.	.	0
TOTAL	23371	17696	9001	4515	2334	896	298	140	78	111	58440

MAX Hs(m)*10 WITH ASSOCIATED Tp(sec) AND Dm(deg/10) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1976	13 717	17 619	16 526	12 513	18 817	10 4 7	5 319	11 4 4	13 5 9	21 816	13 434	17 528	21

816

1977	22 821	28 917	29 917	26 918	12 510	11 524	6 417	17 5 9	19 6 9	12 510	15 619	19 719	29 917
1978	30 919	19 721	21 817	12 434	22 917	13 619	8 411	9 5 8	7 410	12 5 8	17 818	21 722	30 919
1979	34 921	20 719	21 725	17 817	11 619	10 4 6	34 917	9 425	771218	15 613	15 719	21 819	771218
1980	17 716	14 534	21 818	27 717	14 616	10 423	10 619	25 6 8	13 511	16 618	18 528	14 535	27 717
1981	17 526	321018	29 921	17 817	11 618	12 510	7 521	8 616	8 436	14 618	15 5 8	18 719	321018
1982	26 917	15 512	15 717	16 818	13 619	12 817	4 318	12 510	13 5 8	11 4 4	14 617	21 815	26 917
1983	281016	28 723	341117	21 819	13 616	10 618	11 5 8	11 513	11 717	10 510	20 817	27 917	341117
1984	19 818	26 917	27 919	19 817	27 918	7 425	8 521	12 717	16 510	10 617	20 715	13 616	27 918
1985	21 818	23 627	23 917	23 818	10 430	14 717	10 518	361016	591117	611218	451119	15 718	611218
1986	15 532	17 722	24 917	14 619	10 411	8 4 8	8 427	9 516	8 410	15 718	15 717	24 917	24 917
1987	20 818	21 817	24 916	11 526	8 412	12 619	11 5 8	7 523	11 436	13 5 5	16 716	20 818	24 916
1988	22 817	17 529	17 718	18 525	12 619	11 510	13 5 8	23 817	40 915	11 4 1	24 713	12 616	40 915
1989	14 526	19 719	17 717	15 621	12 621	24 819	13 5 9	11 718	20 6 9	12 432	19 625	16 618	24 819
1990	14 718	22 816	20 817	15 615	15 717	7 425	10 619	7 424	11 4 0	15 532	21 821	16 719	22 816
1991	15 718	19 821	261018	16 818	19 915	13 5 8	7 419	6 424	11 5 8	12 4 0	12 614	17 5 9	261018
1992	25 822	18 819	16 719	16 717	8 435	12 620	14 719	38 916	14 5 8	18 5 8	19 612	17 528	38 916
1993	15 510	20 818	241019	25 917	14 716	14 510	5 328	7 4 8	11 619	23 719	12 615	22 818	25 917
1994	23 817	17 718	24 818	11 615	11 4 3	17 720	411017	11 524	16 717	341118	17 718	14 532	411017
1995	25 918	20 719	16 510	19 714	14 719	251117	18 510	42 919	14 5 9	641218	18 719	19 719	641218

MAX 34 921 321018 341117 27 717 27 918 251117 411017 42 919 771218 641218 451119 27 917

MAX Hs(m): 7.7 MAX Tp(sec): 12. MAX Dm(deg): 176. DATE(gmt): 1979091306
MAX WIND SPEED(m/sec): 44. MAX WIND DIRECTION(deg): 155. DATE(gmt): 1995100421
MEAN Hmo(m): 0.6 MEAN Tp(sec): 4.

	2.1	2.9	3.0	7.7	2.7	3.2	2.6	3.4	2.7	6.1
	2.4	2.4	4.0	2.4	2.2	2.6	3.8	2.5	4.1	6.4

WIS 44

WIS GULF OF MEXICO UPDATE - WITH HURRICANES 1976 - 1995
LAT: 30.25 N, LONG: 87.25 W, DEPTH: 5 M
SUMMARY OF WAVE INFORMATION BY MONTH

STATION: 44

OCCURRENCES OF WAVE HEIGHT BY MONTH FOR ALL YEARS

Hs(m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
0.00 - 0.49	1606	1358	1624	2010	2568	3259	4035	3910	2944	2160	1607	1545	28626
0.50 - 0.99	2403	2251	2010	1902	2034	1394	821	838	1418	2490	2441	2504	22506
1.00 - 1.49	761	666	911	698	315	129	52	115	335	203	602	747	5534
1.50 - 1.99	128	175	267	154	34	14	26	46	64	48	99	126	1181
2.00 - 2.49	51	40	102	28	7	1	14	27	7	13	35	32	357
2.50 - 2.99	11	19	35	8	2	2	6	12	8	15	5	6	129
3.00 - 3.49	.	11	11	.	.	1	6	12	24	31	11	.	107
3.50 - 3.99	.	.	.	.	.	.	.	.	.	.	.	.	0
4.00 - 4.49	.	.	.	.	.	.	.	.	.	.	.	.	0
4.50 - 4.99	.	.	.	.	.	.	.	.	.	.	.	.	0
5.00 - 5.49	.	.	.	.	.	.	.	.	.	.	.	.	0
5.50 - 5.99	.	.	.	.	.	.	.	.	.	.	.	.	0
6.00 - 6.49	.	.	.	.	.	.	.	.	.	.	.	.	0
6.50 - 6.99	.	.	.	.	.	.	.	.	.	.	.	.	0
7.00 - 7.49	.	.	.	.	.	.	.	.	.	.	.	.	0
7.50 - 7.99	.	.	.	.	.	.	.	.	.	.	.	.	0
8.00 - 8.49	.	.	.	.	.	.	.	.	.	.	.	.	0
8.50 - 8.99	.	.	.	.	.	.	.	.	.	.	.	.	0
9.00 - 9.49	.	.	.	.	.	.	.	.	.	.	.	.	0
9.50 - 9.99	.	.	.	.	.	.	.	.	.	.	.	.	0
10.00 - GREATER	.	.	.	.	.	.	.	.	.	.	.	.	0
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 44

OCCURRENCES OF PEAK PERIOD BY MONTH FOR ALL YEARS

Tp(sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
3.0 - 3.9	1976	1606	1548	1747	1719	1983	2511	2425	2342	2485	1967	1904	24213
4.0 - 4.9	1368	1157	909	778	1042	1118	1409	1363	1338	1533	1316	1495	14826
5.0 - 5.9	533	597	690	660	1120	974	666	655	553	534	579	602	8163
6.0 - 6.9	506	484	756	870	759	542	249	279	272	164	524	524	5929
7.0 - 7.9	334	419	546	514	238	132	64	97	149	80	254	304	3131
8.0 - 8.9	157	185	327	183	61	39	37	52	38	52	90	108	1329
9.0 - 9.9	69	45	137	44	19	4	16	27	26	27	21	21	456
10.0 - 10.9	15	22	35	3	2	3	8	15	18	33	12	2	168
11.0 - 11.9	2	5	12	1	.	5	.	20	23	21	9	.	98
12.0 - 12.9	.	.	.	.	.	.	.	12	16	11	18	.	57
13.0 - 13.9	.	.	.	.	.	.	.	4	20	17	4	.	45
14.0 - 14.9	.	.	.	.	.	.	.	5	5	3	2	.	15
15.0 - 15.9	.	.	.	.	.	.	.	6	.	.	4	.	10
16.0 - 16.9	.	.	.	.	.	.	.	.	.	.	.	.	0
17.0 - 17.9	.	.	.	.	.	.	.	.	.	.	.	.	0
18.0 - 18.9	.	.	.	.	.	.	.	.	.	.	.	.	0
19.0 - 19.9	.	.	.	.	.	.	.	.	.	.	.	.	0
20.0 - LONGER	.	.	.	.	.	.	.	.	.	.	.	.	0
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 44

OCCURRENCES OF PEAK DIRECTION BY MONTH FOR ALL YEARS

Dm(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
348.75 - 11.24 (0.0)	543	377	227	185	129	67	24	52	177	477	486	532	3276
11.25 - 33.74 (22.5)	441	352	227	161	97	44	7	42	221	401	426	499	2918
33.75 - 56.24 (45.0)	349	268	179	125	133	85	24	86	320	478	403	411	2861
56.25 - 78.74 (67.5)	226	232	138	177	107	135	79	153	526	686	385	303	3147
78.75 - 101.24 (90.0)	260	259	223	241	213	236	121	378	570	669	391	286	3847
101.25 - 123.74 (112.5)	258	191	216	303	386	231	182	352	496	365	304	282	

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123.75 - 146.24 (135.0)	425	382	518	565	775	568	677	806	773	561	602	502	7154
146.25 - 168.74 (157.5)	1019	1084	1771	1664	1847	1592	1583	1430	918	616	898	938	15360
168.75 - 191.24 (180.0)	543	596	712	634	681	915	859	774	480	228	432	526	7380
191.25 - 213.74 (202.5)	62	89	123	166	230	502	524	361	111	85	64	89	2406
213.75 - 236.24 (225.0)	40	86	86	62	103	187	275	141	52	46	35	59	1172
236.25 - 258.74 (247.5)	25	45	65	62	40	98	158	90	19	28	19	31	680
258.75 - 281.24 (270.0)	70	74	82	122	51	60	221	129	30	45	32	49	965
281.25 - 303.74 (292.5)	139	99	81	85	37	41	128	85	13	42	58	82	890
303.75 - 326.24 (315.0)	221	174	127	108	52	21	60	38	24	67	74	134	1100
326.25 - 348.74 (337.5)	339	212	185	140	79	18	38	43	70	166	191	237	1718
TOTAL	4960	4520	4960	4800	4960	4800	4960	4960	4800	4960	4800	4960	58440

STATION: 44

OCCURRENCES OF WAVE HEIGHT AND PEAK PERIOD FOR ALL DIRECTIONS

Hs(m)	Tp(sec) 3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-11.9	12.0-LONGER	TOTAL
0.00 - 0.99	24213	13771	7472	3969	1141	341	117	49	26	33	51132
1.00 - 1.99	.	1055	691	1956	1975	769	155	34	34	46	6715
2.00 - 2.99	.	.	.	4	15	218	176	51	10	12	486
3.00 - 3.99	.	.	.	.	.	1	8	34	28	36	107
4.00 - 4.99	.	.	.	.	.	.	.	.	.	.	0
5.00 - 5.99	.	.	.	.	.	.	.	.	.	.	0
6.00 - 6.99	.	.	.	.	.	.	.	.	.	.	0
7.00 - 7.99	.	.	.	.	.	.	.	.	.	.	0
8.00 - 8.99	.	.	.	.	.	.	.	.	.	.	0
9.00 - GREATER	.	.	.	.	.	.	.	.	.	.	0
TOTAL	24213	14826	8163	5929	3131	1329	456	168	98	127	58440

STATION: 44

SUMMARY OF MEAN Hs(m) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1976	0.66	0.51	0.69	0.39	0.60	0.35	0.21	0.28	0.35	0.59	0.54	0.61	0.48
1977	0.75	0.75	1.02	0.64	0.32	0.26	0.25	0.49	0.52	0.48	0.65	0.75	0.57
1978	0.74	0.62	0.62	0.50	0.55	0.39	0.31	0.36	0.30	0.43	0.48	0.74	0.50
1979	0.79	0.63	0.72	0.78	0.51	0.32	0.67	0.26	0.85	0.46	0.63	0.57	0.60
1980	0.68	0.63	0.94	0.61	0.52	0.29	0.34	0.47	0.38	0.51	0.71	0.52	0.55
1981	0.49	0.77	0.70	0.52	0.49	0.40	0.27	0.34	0.29	0.47	0.53	0.71	0.50
1982	0.84	0.65	0.59	0.73	0.38	0.46	0.21	0.31	0.44	0.54	0.64	1.02	0.57
1983	0.60	1.00	0.92	0.79	0.62	0.46	0.30	0.34	0.46	0.48	0.77	0.86	0.63
1984	0.59	0.63	0.60	0.81	0.64	0.30	0.29	0.28	0.58	0.49	0.64	0.51	0.53
1985	0.63	0.79	0.69	0.65	0.39	0.38	0.29	0.65	0.73	0.85	0.81	0.56	0.62
1986	0.52	0.68	0.80	0.38	0.47	0.29	0.26	0.30	0.40	0.53	0.60	0.64	0.49
1987	0.69	0.69	0.86	0.42	0.40	0.44	0.32	0.28	0.34	0.53	0.69	0.76	0.53
1988	0.78	0.57	0.68	0.68	0.43	0.35	0.33	0.45	0.81	0.44	0.87	0.54	0.58
1989	0.55	0.65	0.65	0.42	0.46	0.59	0.43	0.33	0.48	0.54	0.54	0.66	0.52
1990	0.51	0.83	0.64	0.56	0.52	0.28	0.35	0.22	0.30	0.52	0.51	0.68	0.49
1991	0.67	0.73	1.02	0.79	0.65	0.35	0.26	0.25	0.40	0.49	0.60	0.55	0.56
1992	0.58	0.57	0.52	0.61	0.32	0.39	0.37	0.46	0.40	0.47	0.77	0.58	0.50
1993	0.62	0.73	0.65	0.81	0.54	0.44	0.22	0.28	0.40	0.50	0.53	0.58	0.52
1994	0.76	0.63	0.66	0.51	0.32	0.49	0.42	0.34	0.47	0.61	0.62	0.53	0.53
1995	0.70	0.66	0.70	0.65	0.58	0.48	0.39	0.44	0.39	0.77	0.58	0.58	0.58
MEAN	0.66	0.69	0.73	0.61	0.49	0.39	0.32	0.36	0.47	0.54	0.64	0.65	

STATION: 44

MAX Hs(m)*10 WITH ASSOCIATED Tp(sec) AND Dm(deg/10) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1976	14 716	14 717	13 717	13 614	18 816	9 5 7	5 517	10 4 5	11 5 8	22 816	13 717	16 716	22 816
1977	19 816	27 917	321016	25 917	11 814	7 619	6 416	14 713	18 616	10 613	14 616	18 716	321016
1978	22 917	17 718	21 817	11 617	21 817	12 617	7 513	8 415	7 514	10 5 8	17 817	14 715	22 917
1979	27 918	17 717	21 816	19 816	10 616	9 4 6	321017	7 513	321217	15 714	14 717	19 817	321217
1980	17 716	12 616	21 817	25 817	14 716	9 423	9 617	24 812	11 612	15 717	181217	11 4 1	25 817
1981	13 714	321017	25 917	18 816	10 617	10 510	7 422	7 617	8 4 1	13 717	13 617	18 717	321017
1982	25 917	15 715	13 717	15 817	12 617	13 816	4 317	11 612	10 4 6	10 4 7	13 716	22 816	25 917
1983	291016	311115	321016	19 718	14 716	9 717	9 5 8	11 716	11 717	9 431	21 816	29 916	321016

1984	20 816	26 916	21 917	21 816	25 917	6 326	8 716	14 716	13 713	10 616	20 816	12 616	26 916
1985	20 817	20 817	281016	21 817	8 431	15 716	9 815	321015	321116	321117	321516	13 618	321516
1986	12 533	18 817	26 916	12 717	9 614	7 818	6 323	9 516	8 515	16 717	14 716	26 916	26 916
1987	20 816	21 816	27 916	10 616	8 514	10 618	8 5 9	6 521	10 436	11 4 4	17 716	20 816	27 916
1988	23 816	15 717	17 817	15 717	11 618	10 510	11 5 8	23 816	321017	9 4 3	261216	13 616	321017
1989	11 4 3	16 718	18 716	12 619	10 619	19 817	14 616	15 717	17 6 9	10 433	13 532	13 717	19 817
1990	13 717	22 816	22 916	15 716	13 717	7 326	7 618	5 329	9 4 1	12 435	18 818	15 717	22 916
1991	15 717	18 816	251017	19 817	191015	11 5 8	6 418	5 413	10 5 7	10 5 9	11 614	17 712	251017
1992	20 820	18 817	15 717	18 816	8 436	10 718	13 717	321016	11 5 8	17 914	17 815	16 716	321016
1993	12 615	21 917	201017	27 916	15 716	12 612	4 335	6 4 7	10 617	20 718	13 615	23 816	27 916
1994	23 916	15 717	23 917	11 716	9 4 4	15 619	32 916	8 5 9	17 717	321116	17 717	11 5 8	321116
1995	24 817	17 718	16 716	19 816	15 717	321116	16 814	271115	12 6 9	321317	16 717	17 717	321317
MAX	291016	321017	321016	27 916	25 917	321116	32 916	321016	321017	321317	321516	29 916	

MAX Hs(m): 3.2 MAX Tp(sec): 13. MAX Dm(deg): 169. DATE(gmt): 1995100503

MAX WIND SPEED(m/sec): 43. MAX WIND DIRECTION(deg): 115. DATE(gmt): 1995100421

MEAN Hmo(m): 0.5 MEAN Tp(sec): 4.

STANDARD DEVIATION Hmo(m): 0.4 STANDARD DEVIATION Tp(sec): 1.5

Table 3 - Deepwater Mean and Maximum Wave Heights (ft) and Periods (s) and Breaking Mean and Maximum Wave Heights (ft) and Depths (ft), by Month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
WIS42 ***H_o*** / T	3.3 6	3.3 6	3.3 6	3.0 5	2.3 5	2.0 5	1.7 5	2.0 5	2.6 5	3.0 5	3.3 6	3.3 6	3.3 6
WIS42 [H_o]/T	7.6 8	8.6 9	8.3 9	8.3 9	6.9 8	6.6 8	5.0 7	6.6 8	8.6 9	6.3 7	7.3 8	8.9 9	8.9 9
WIS42 ***H_b*** /h_b	4.0 5.0	4.0 5.0	4.0 5.0	3.3 4.0	2.6 3.4	2.3 3.0	2.0 2.3	2.3 3.0	3.0 3.8	3.3 4.0	4.0 5.0	4.0 5.0	**4.0** **5.0**
WIS42 [H_b]/ h_b	8.4 10.6	9.7 12.2	9.4 11.9	9.4 11.9	7.9 9.9	7.5 9.6	5.6 7.3	7.5 9.6	9.7 12.2	6.9 8.7	8.1 10.3	10.0 12.7	10.0 12.7
WIS44 ***H_{av}***	2.2	2.3	2.4	2.0	1.6	1.3	1.1	1.2	1.6	1.8	2.1	2.1	1.8
WIS44 ***H_{mx}***	9.6	10.6	10.6	8.9	8.3	10.6	10.6	10.6	10.6	10.6	10.6	9.6	10.6

WIS 44 Distribution

Wave Height	No. Occur.	% Occur.
0.8	27789	47.550%
2.5	21708	37.150%
4.1	6614	11.320%
5.8	1642	2.810%
7.4	436	0.750%
9	132	0.230%
10.7	56	0.100%
12.4	23	0.040%
14	15	0.030%
15.7	7	0.010%
17.3	5	0.010%
19	5	0.010%
20.6	5	0.010%
22.3	0	0.000%
23.9	2	0.000%
25.6	1	0.000%
Total	58440	100%

SOURCE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
87WIS H_b		7.59	7.92	3.96			3.96	2.64	3.63			7.26
87 OCP H_s		5.94	7.26	7.92			2.97	3.96	2.64			4.62

87 BIAS		1.65	0.66	-3.96			0.99	-1.32	0.99			2.64
88WIS H_b	7.92	5.61	5.94		4.29	5.28	4.29				8.25	4.29
88 OCP H_s	6.6	2.31	6.93		5.28	3.63	2.31				5.94	4.29
88 BIAS	1.32	3.3	-0.99		-0.99	1.65	1.98				2.31	0
89WIS H_b	4.62				4.29	8.58	4.29	4.29				
89 OCP H_s	4.62				3.63	8.58	6.6	5.94				
89 BIAS	0				0.66	0	-2.31	-1.65				
90WIS H_b			6.93	5.28	5.61							
90 OCP H_s			6.6	4.62	4.95							
90 BIAS			0.33	0.66	0.66							

EXTREMAL STATISTICS

NOTE: The summary tables for all 122 Gulf of Mexico Update stations /GU1_Tables, are based on 20 years of wave information (1976-1995). The summary tables report NUMBER of occurrences rather than PERCENT occurrence. The Return Period Tables for all 122 stations are in one file, Gulf_Return_Periods. The summary tables are formatted for a line printer (132 characters per line, 8.5 point).

NOTES:
1976-1995 Gulf of Mexico update hindcast includes hurricanes
0.25-deg computational grid

Station number
Latitude (degrees to hundredths)
Longitude (degrees to hundredths)
Water depth (meters)
Return period interval (years)
Significant wave height (meters)
Peak wave period (seconds)

EITHER Fisher-Tippet Type I or Fisher-Tippet Type II provided the "best fit" for the tropical/non-tropical events. The value inside ( ) is the upper limit (68% confidence interval).
An asterisk [*] indicates results are depth-limited.

STATION 40 (30.25N, 86.25W / 28M)

RETURN PERIOD	TROPICAL		NON-TROPICAL	
(YEAR)	Hs(TYPE:II)	Tp	Hs(TYPE: I)	Tp
5	2.1 (2.4)	7.2(7.7)	5.5 (6.1)	11.7(12.5)
10	2.7 (3.4)	8.2(9.2)	6.4 (7.2)	12.8(13.7)
20	3.6 (4.8)	9.5(11.0)	7.3 (8.3)	13.8(14.7)
50	5.1 (7.3)	11.3(13.8)	8.5 (9.7)	14.9(16.0)

STATION 41 (30.25N, 86.50W / 16M)

RETURN PERIOD	TROPICAL		NON-TROPICAL	
(YEAR)	Hs(TYPE:II)	Tp	Hs(TYPE: I)	Tp
5	2.2 (2.6)	7.4(8.1)	5.3 (5.8)	11.8(12.4)
10	2.9 (3.5)	8.5(9.5)	6.2 (7.0)	12.8(13.6)
20	3.6 (4.6)	9.6(11.0)	7.1 (8.1)	13.7(14.7)
50	4.9 (6.7)	11.3(13.3)	8.3 (9.5)	14.9(16.0)

STATION 42 (30.25N, 86.75W / 14M)

RETURN PERIOD	TROPICAL		NON-TROPICAL	
(YEAR)	Hs(TYPE:II)	Tp	Hs(TYPE: I)	Tp
5	2.4 (2.9)	7.7(8.5)	5.3 (5.8)	11.8(12.4)
10	3.2 (3.9)	9.1(10.1)	6.2 (6.9)	12.8(13.6)
20	4.1 (5.3)	10.3(11.8)	7.0 (7.9)	13.7(14.5)
50	5.6 (7.9)	12.2(14.5)	8.2 (9.3*)	14.8(15.8)

STATION 43 (30.25N, 87.00W / 11M)

RETURN PERIOD	TROPICAL		NON-TROPICAL	
(YEAR)	Hs(TYPE:II)	Tp	Hs(TYPE: I)	Tp
5	2.4 (2.8)	7.8(8.5)	5.0 (5.5)	11.5(12.1)
10	3.2 (3.9)	9.1(10.1)	5.8 (6.5)	12.4(13.2)
20	4.1 (5.4)	10.4(12.0)	6.7 (7.5*)	13.4(14.2)
50	5.8 (8.1*)	12.4(14.8)	7.7*(8.8*)	14.4(15.4)

STATION 44 (30.25N, 87.25W / 5M)

RETURN PERIOD	TROPICAL		NON-TROPICAL	
(YEAR)	Hs(TYPE:II)	Tp	Hs(TYPE: I)	Tp
5	2.0 (2.2)	7.3(7.6)	3.3*(3.3*)	9.4(9.4)

10	2.4 (2.9)	8.0(8.8)	3.4*(3.4*)	9.6(9.6)
20	3.0 (3.7*)	9.0(10.0)	3.5*(3.5*)	9.7(9.7)
50	3.9*(5.1*)	10.3(11.7)	3.6*(3.7*)	9.8(10.0)

STATION 45 (30.00N, 87.50W / 28M)

RETURN PERIOD (YEAR)	TROPICAL Hs(TYPE:II)	Tp	NON-TROPICAL Hs(TYPE: I)	Tp
5	3.1 (3.6)	8.8(9.5)	5.6 (6.1)	11.8(12.5)
10	4.0 (4.9)	10.0(11.1)	6.4 (7.0)	12.8(13.5)
20	5.1 (6.6)	11.3(13.0)	7.2 (7.9)	13.7(14.4)
50	7.0 (9.7)	13.5(16.0)	8.2 (9.1)	14.6(15.5)

Monthly Maxima, WIS 42, WIS transformed to Project, and Okaloosa County Pier data- in m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
95WIS	2.5	2.0	1.6	1.9	11.4	2.5	1.8	4.2	1.4	6.4	1.8	1.9	
9542039												4.0	
87 WIS	2.0	2.1	2.4	1.1	.8	1.2	1.1	.7	1.1	1.3	1.6	2.0	
87WISt		2.3	2.4	1.2			1.2	.8	1.1			2.2	
87 OCP		1.8	2.2	2.4			.9	1.2	.8			1.4	
88 WIS	2.2	1.7	1.7	1.8	1.2	1.1	1.3	2.3	4.0	1.1	2.4	1.2	
88Wist	2.4	1.7	1.8		1.3	1.6	1.3				2.5	1.3	
88 OCP	2.0	.7	2.1		1.6	1.1	.7				1.8	1.3	
89 WIS	1.4	1.9	1.7	1.5	1.2	2.4	1.3	1.1	2.0	1.2	1.9	1.6	
89WISt	1.4				1.3	2.6	1.3	1.3					
89 OCP	1.4				1.1	2.6	2.0	1.8					
90 WIS	1.4	2.2	2.0	1.5	1.5	.7	1.0	.7	1.1	1.5	2.1	1.6	
90WISt			2.1	1.6	1.7								
90 OCP			2.0	1.4	1.5								

RETURN PERIODS for H (ft) T, (s) and Db (ft)

	5	10	20	50	100
30WIS (I), Hs	8.3	8.9	9.2	10.2	
30WIS (I),75%	9.2	9.6	9.9	10.6	
30WIS (I), Lower	8.2	8.6	8.9	9.6	
42WIS (II), non TS H 50%(?) and T(s)	17.5 11.8	20.5 12.8	23.1 13.7	27.1 14.8	
42WIS (II) non TS, H 68% and T(s)	19.1 12.4	22.8 13.6	26.0 14.5	30.7 15.8	
42WIS (II), TS Ho 50% Hb T Db	7.9 8.4 7.7 12.7	10.6 11.3 9.1 16.9	13.6 14.5 10.3 21.8	18.5 19.7 12.2 30.3	
42WIS (II), TS Ho 68% Hb T Db	9.6 10.1 8.5 15.3	12.9 13.7 10.1 21.1	17.5 18.6 11.8 28.7	26.1 27.7 14.5 42.7	
44WIS TS 50% H Db	6.6 8.5	7.9 10.1	9.9 12.7	12.9 16.5	
44WIS TS 68%	7.3 9.4	9.6 12.3	12.2 15.6	16.8 21.5	
TAOS, ME	na	5.6	7.5 (25 yr)	9.5	11.2
TAOS, 75%	na	8.9	11.2 (25 yr)	14.4	16.7
TAOS, 90%	na	11.5	14.1 (25 yr)	17.4	19.4
TAOS, 95%	na	13.8	15.7 (25 yr)	19.4	21.6

Table 3. NUMBER AND RETURN PERIOD OF STORM CONDITIONS WITHIN 100 MILES from Muller

City	Trop. Storm (count)	Hurr. 1 - 2 (count)	Hurr. 3 - 5 (count)	T. S. + Hurr (years)	Hurr. 1 - 5 (years)	Hurr. 3 - 5 (years)
Pensacola	13	12	2	4	7	50
½ way				4 2.3 6.5	8.5 8.5 12.9	42 23.6 23
Destin	17	7	3	4	10	33

Breaker limit based on Taos Predicted Surge Elevation (ft) above NGVD

Hb	10 Year	25 Year	50 year	100 Year
DCA -50%	7.0	9.3	11.1	12.9
DCA -75%	11.1	12.9	14.7	16.9
DCA-90%	12.9	15.4	17.7	19.3
DCA-95%	15.4	17.5	19.3	22.3

Note (a): includes wave setup of 2.5 ft

Appendix C

Wind generated current
Date: Fri, 11 Aug 2000 18:38:07 +0200
From: "Stephen Luger" <SLuger@csir.co.za>
To: <aholtzhausen@prdw.co.za>, <coastal_list@UDel.Edu>

Assuming you are working in shallow depths (<50m) adjacent to a straight coastline then the applicable momentum equation in the longshore direction for unstratified conditions is:

```
dv/dt = -g*dz/dy + rhoair*cd*wnd**2/(rhowater*h) - g*v**2/(cz**2*h)
```

where

v = current velocity (m/s)
z = water level above SWL (m)
y = longshore distance (m)
rhoair = density air (approx 1.2 kg/m3)
rhowater = density water (approx 1025 kg/m3)
cd = wind drag coefficient (range 0.001 to 0.0025)
wnd = wind speed component in longshore direction (m/s)
h = water depth (m)
cz = Chezy coefficient (approx 65 m^0.5/s)

Assuming no longshore slope, i.e. a straight coastline with no obstructions, the dz/dy term falls away and inserting approximate values for the constants gives:

```
dv/dt = 1.76E-6*wnd**2/h - 2.32E-3*v**2/h
```

Assuming that the wind has been blowing long enough for steady state we get the following:

```
v = 0.028*wnd
```

Note that it could take a few days to reach steady state. 2D and 3D hydrodynamic models will be required if the problem geometry is more complex than the simple straight coastline considered here, or if stratification is important.

Regards

YY	MM	DD	hh	WD	WSPD	GST	WVHT	DPD	APD	MWD	BAR	ATMP	WTMP	DEWP	VIS
Cape San Blas C-Man															
87	03	16	00	150	01.5	02.1	99.00	99.00	99.00	999	1019.6	15.6	999.0	999.0	99.0
87	03	16	01	150	01.5	02.6	99.00	99.00	99.00	999	1019.7	15.7	999.0	999.0	99.0
87	03	16	02	150	02.1	03.6	99.00	99.00	99.00	999	1020.1	15.6	999.0	999.0	99.0
87	03	16	03	160	02.6	03.6	99.00	99.00	99.00	999	1020.2	15.6	999.0	999.0	99.0
87	03	16	04	150	01.5	02.6	99.00	99.00	99.00	999	1020.0	15.8	999.0	999.0	99.0
87	03	16	05	160	02.6	03.1	99.00	99.00	99.00	999	1020.0	15.9	999.0	999.0	99.0
87	03	16	06	000	00.0	00.5	99.00	99.00	99.00	999	1019.8	15.7	999.0	999.0	99.0
87	03	16	07	000	00.0	00.5	99.00	99.00	99.00	999	1019.3	15.3	999.0	999.0	99.0
87	03	16	08	000	00.0	00.5	99.00	99.00	99.00	999	1018.7	15.3	999.0	999.0	99.0
87	03	16	09	000	00.0	00.5	99.00	99.00	99.00	999	1018.6	15.6	999.0	999.0	99.0
87	03	16	10	110	00.5	01.5	99.00	99.00	99.00	999	1018.5	16.0	999.0	999.0	99.0
87	03	16	11	130	00.5	01.5	99.00	99.00	99.00	999	1019.1	16.0	999.0	999.0	99.0
87	03	16	12	000	00.0	00.5	99.00	99.00	99.00	999	1019.6	16.2	999.0	999.0	99.0
87	03	16	13	060	01.0	01.5	99.00	99.00	99.00	999	1019.8	16.9	999.0	999.0	99.0
87	03	16	14	120	02.1	04.1	99.00	99.00	99.00	999	1020.5	18.8	999.0	999.0	99.0
87	03	16	15	100	03.1	04.1	99.00	99.00	99.00	999	1020.7	18.1	999.0	999.0	99.0
87	03	16	16	100	03.6	04.6	99.00	99.00	99.00	999	1020.8	19.2	999.0	999.0	99.0
87	03	16	17	100	03.6	04.6	99.00	99.00	99.00	999	1020.8	19.1	999.0	999.0	99.0
87	03	16	18	090	02.1	03.6	99.00	99.00	99.00	999	1019.9	19.6	999.0	999.0	99.0
87	03	16	19	110	02.6	04.1	99.00	99.00	99.00	999	1019.1	19.8	999.0	999.0	99.0
87	03	16	20	090	03.1	03.6	99.00	99.00	99.00	999	1018.7	19.4	999.0	999.0	99.0
87	03	16	21	120	03.1	04.6	99.00	99.00	99.00	999	1018.1	18.8	999.0	999.0	99.0
87	03	16	22	100	02.6	04.1	99.00	99.00	99.00	999	1017.9	18.5	999.0	999.0	99.0
87	03	16	23	090	02.1	03.1	99.00	99.00	99.00	999	1018.0	17.6	999.0	999.0	99.0
87	03	17	00	100	01.5	03.1	99.00	99.00	99.00	999	1017.9	17.2	999.0	999.0	99.0
87	03	17	01	110	01.5	02.6	99.00	99.00	99.00	999	1017.9	16.9	999.0	999.0	99.0
87	03	17	02	110	01.0	02.1	99.00	99.00	99.00	999	1018.1	16.7	999.0	999.0	99.0
87	03	17	03	100	02.1	03.1	99.00	99.00	99.00	999	1017.9	16.5	999.0	999.0	99.0
87	03	17	04	090	01.5	02.6	99.00	99.00	99.00	999	1017.3	16.5	999.0	999.0	99.0
87	03	17	05	090	01.5	02.6	99.00	99.00	99.00	999	1017.3	16.4	999.0	999.0	99.0
87	03	17	06	080	01.5	02.6	99.00	99.00	99.00	999	1016.6	16.4	999.0	999.0	99.0
87	03	17	07	080	02.1	03.6	99.00	99.00	99.00	999	1015.9	16.2	999.0	999.0	99.0
87	03	17	08	100	02.1	03.1	99.00	99.00	99.00	999	1015.8	16.1	999.0	999.0	99.0
87	03	17	09	080	02.1	03.1	99.00	99.00	99.00	999	1016.0	16.1	999.0	999.0	99.0
87	03	17	10	070	02.1	03.1	99.00	99.00	99.00	999	1016.5	15.8	999.0	999.0	99.0
87	03	17	11	070	01.5	02.6	99.00	99.00	99.00	999	1017.0	15.2	999.0	999.0	99.0
87	03	17	12	080	02.6	04.1	99.00	99.00	99.00	999	1017.1	15.8	999.0	999.0	99.0
87	03	17	13	090	03.6	06.2	99.00	99.00	99.00	999	1017.6	17.3	999.0	999.0	99.0
87	03	17	14	090	05.1	07.2	99.00	99.00	99.00	999	1017.7	18.1	999.0	999.0	99.0
87	03	17	15	090	06.2	08.8	99.00	99.00	99.00	999	1017.5	18.6	999.0	999.0	99.0
87	03	17	16	090	06.2	09.3	99.00	99.00	99.00	999	1017.4	18.5	999.0	999.0	99.0

87 03 17 17 100 04.6 06.2 99.00 99.00 99.00 999 1017.4 19.4 999.0 999.0 99.0
87 03 17 18 100 05.1 06.7 99.00 99.00 99.00 999 1016.6 19.6 999.0 999.0 99.0
87 03 17 19 100 05.7 08.3 99.00 99.00 99.00 999 1015.8 19.2 999.0 999.0 99.0
87 03 17 20 090 04.6 06.7 99.00 99.00 99.00 999 1015.2 19.0 999.0 999.0 99.0
87 03 17 21 100 04.6 07.7 99.00 99.00 99.00 999 1015.0 18.7 999.0 999.0 99.0
87 03 17 22 100 05.1 06.7 99.00 99.00 99.00 999 1014.9 18.6 999.0 999.0 99.0
87 03 17 23 100 04.1 06.2 99.00 99.00 99.00 999 1014.6 18.0 999.0 999.0 99.0

Dauphin Island C-Man
87 02 15 00 176 03.6 04.1 99.00 99.00 99.00 999 1009.4 16.5 14.4 999.0 99.0
87 02 15 01 147 04.1 04.3 99.00 99.00 99.00 999 1009.2 16.5 14.4 999.0 99.0
87 02 15 02 140 04.0 04.2 99.00 99.00 99.00 999 1008.8 16.3 14.5 999.0 99.0
87 02 15 03 147 04.2 04.5 99.00 99.00 99.00 999 1008.8 16.4 14.7 999.0 99.0
87 02 15 04 158 05.5 06.0 99.00 99.00 99.00 999 1008.8 16.5 15.7 999.0 99.0
87 02 15 05 157 05.4 05.7 99.00 99.00 99.00 999 1008.5 16.5 14.8 999.0 99.0
87 02 15 06 144 04.2 04.3 99.00 99.00 99.00 999 1007.9 16.5 14.9 999.0 99.0
87 02 15 07 126 04.3 04.6 99.00 99.00 99.00 999 1007.6 16.2 15.1 999.0 99.0
87 02 15 08 130 03.3 03.5 99.00 99.00 99.00 999 1008.0 16.1 15.0 999.0 99.0
87 02 15 09 095 03.4 03.5 99.00 99.00 99.00 999 1007.2 16.1 14.7 999.0 99.0
87 02 15 10 063 03.6 03.8 99.00 99.00 99.00 999 1007.3 15.8 14.7 999.0 99.0
87 02 15 11 079 03.3 03.5 99.00 99.00 99.00 999 1007.4 14.7 14.7 999.0 99.0
87 02 15 12 080 05.4 05.6 99.00 99.00 99.00 999 1006.6 15.1 14.5 999.0 99.0
87 02 15 13 110 07.4 07.8 99.00 99.00 99.00 999 1006.4 15.6 14.3 999.0 99.0
87 02 15 14 108 07.4 07.9 99.00 99.00 99.00 999 1005.9 16.1 14.2 999.0 99.0
87 02 15 15 109 08.0 09.5 99.00 99.00 99.00 999 1005.7 16.7 14.4 999.0 99.0
87 02 15 16 137 07.7 08.6 99.00 99.00 99.00 999 1006.2 17.0 15.3 999.0 99.0
87 02 15 17 123 10.1 10.9 99.00 99.00 99.00 999 1004.7 17.5 15.2 999.0 99.0
87 02 15 18 122 11.4 12.6 99.00 99.00 99.00 999 1002.9 17.6 15.3 999.0 99.0
87 02 15 19 131 14.1 15.8 99.00 99.00 99.00 999 1000.4 17.8 15.3 999.0 99.0
87 02 15 20 141 14.8 16.2 99.00 99.00 99.00 999 0999.4 17.8 15.4 999.0 99.0
87 02 15 21 147 13.7 15.5 99.00 99.00 99.00 999 0998.6 18.1 15.4 999.0 99.0
87 02 15 22 161 18.4 21.6 99.00 99.00 99.00 999 0997.2 18.5 15.4 999.0 99.0
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87 02 16 03 217 04.3 05.8 99.00 99.00 99.00 999 1000.6 16.2 15.9 999.0 99.0
87 02 16 04 238 06.3 07.6 99.00 99.00 99.00 999 1000.7 16.6 16.1 999.0 99.0
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87 02 16 07 224 06.2 07.2 99.00 99.00 99.00 999 1000.0 16.4 15.8 999.0 99.0
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87 02 16 11 274 04.1 05.4 99.00 99.00 99.00 999 1002.0 14.7 15.3 999.0 99.0
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87 02 16 17 296 05.5 06.5 99.00 99.00 99.00 999 1005.1 15.5 15.1 999.0 99.0
87 02 16 18 239 07.6 09.1 99.00 99.00 99.00 999 1004.9 15.5 15.5 999.0 99.0
87 02 16 19 247 06.7 08.8 99.00 99.00 99.00 999 1004.5 15.5 15.6 999.0 99.0
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87 03 17 00 110 08.1 08.8 99.00 99.00 99.00 999 1015.3 17.4 15.3 999.0 99.0
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87 03 17 10 099 10.1 10.7 99.00 99.00 99.00 999 1012.5 17.4 15.2 999.0 99.0
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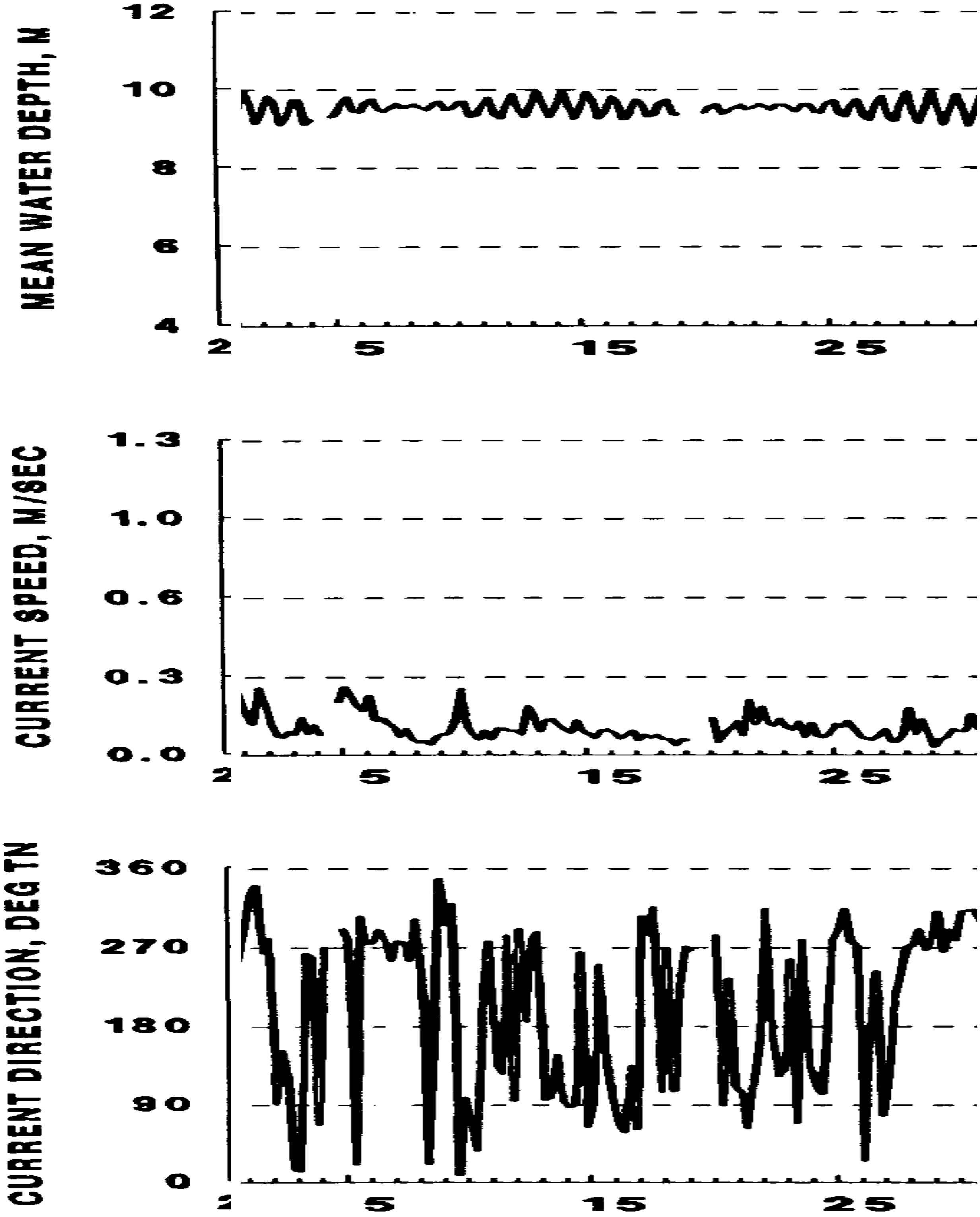
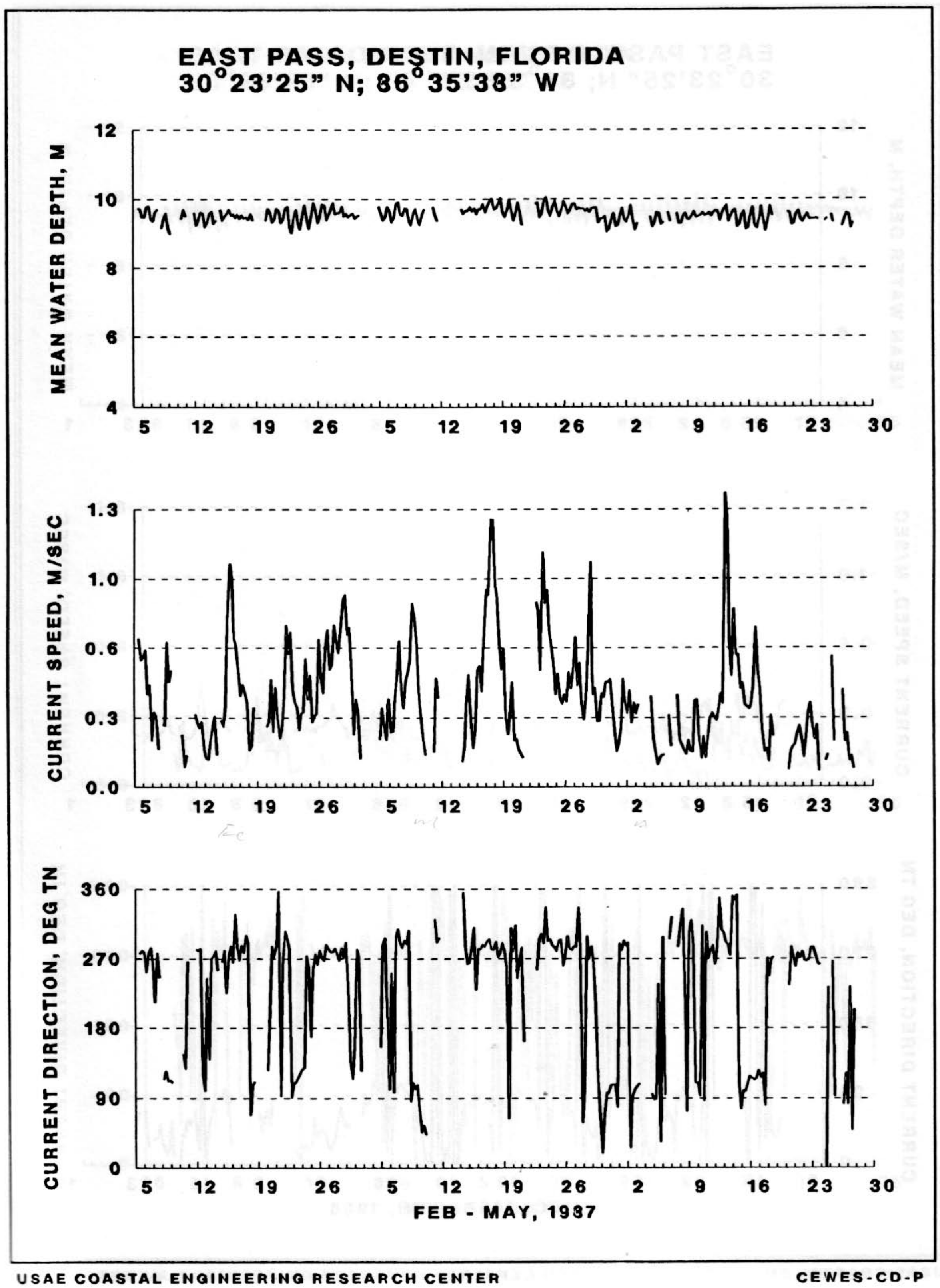
87 03 18 03 125 14.0 15.1 99.00 99.00 99.00 999 1007.7 18.4 16.3 999.0 99.0
87 03 18 04 126 13.5 15.1 99.00 99.00 99.00 999 1008.1 18.3 16.7 999.0 99.0
87 03 18 05 131 15.4 16.4 99.00 99.00 99.00 999 1006.8 17.6 16.7 999.0 99.0

87	03	18	06	129	17.5	19.4	99.00	99.00	99.00	999	1005.3	18.8	16.8	999.0	99.0
87	03	18	07	133	17.8	20.3	99.00	99.00	99.00	999	1003.6	18.4	17.2	999.0	99.0
87	03	18	08	141	14.7	17.2	99.00	99.00	99.00	999	1004.2	19.0	17.3	999.0	99.0
87	03	18	09	235	00.9	02.4	99.00	99.00	99.00	999	1006.3	17.2	17.2	999.0	99.0

87	04	13	20	171	04.1	04.4	99.00	99.00	99.00	999	1014.9	19.7	19.7	999.0	99.0
87	04	13	21	133	03.8	04.2	99.00	99.00	99.00	999	1013.8	19.9	19.6	999.0	99.0
87	04	13	22	106	04.0	04.4	99.00	99.00	99.00	999	1013.7	19.6	19.5	999.0	99.0
87	04	13	23	089	06.3	06.9	99.00	99.00	99.00	999	1012.9	19.8	19.4	999.0	99.0
87	04	14	00	089	06.9	07.6	99.00	99.00	99.00	999	1012.8	19.7	19.3	999.0	99.0
87	04	14	01	098	04.9	05.5	99.00	99.00	99.00	999	1013.4	19.9	19.2	999.0	99.0
87	04	14	02	125	07.3	07.8	99.00	99.00	99.00	999	1013.7	19.8	19.2	999.0	99.0
87	04	14	03	136	06.7	07.4	99.00	99.00	99.00	999	1013.9	19.9	19.4	999.0	99.0
87	04	14	04	143	08.9	10.0	99.00	99.00	99.00	999	1013.2	20.2	19.4	999.0	99.0
87	04	14	05	160	09.9	11.5	99.00	99.00	99.00	999	1013.6	20.8	19.4	999.0	99.0
87	04	14	06	158	14.9	16.6	99.00	99.00	99.00	999	1012.0	20.9	19.4	999.0	99.0
87	04	14	07	158	15.8	17.4	99.00	99.00	99.00	999	1009.8	21.3	19.4	999.0	99.0
87	04	14	08	174	10.0	12.0	99.00	99.00	99.00	999	1010.5	21.2	19.6	999.0	99.0
87	04	14	09	177	09.3	10.7	99.00	99.00	99.00	999	1010.8	20.9	19.6	999.0	99.0
87	04	14	10	160	09.6	11.0	99.00	99.00	99.00	999	1010.4	20.8	19.7	999.0	99.0


MEAN WATER DEPTH, M
12
10
8
6
4
2
5
15
25
CURRENT SPEED, M/SEC
1.3
1.0
0.6
0.3
0.0
2
5
15
25
CURRENT DIRECTION, DEG TN
360
270
180
90
0
5
15
25


EAST PASS, DESTIN, FLORIDA
30°23'25" N; 86°35'38" W
MEAN WATER DEPTH, M
12
10
8
6
4
5 12 19 26 5 12 19 26 2 9 16 23 30
CURRENT SPEED, M/SEC
1.3
1.0
0.6
0.3
0.0
5 12 19 26 5 12 19 26 2 9 16 23 30
CURRENT DIRECTION, DEG TN
360
270
180
90
0
5 12 19 26 5 12 19 26 2 9 16 23 30
FEB - MAY, 1937
USAE COASTAL ENGINEERING RESEARCH CENTER
CEWES-CD-P