



**COASTAL PROCESSES ALONG NORTH KAKINADA COAST,  
ANDHRA PRADESH BASED ON SHORT- TERM STUDY**

**N. S. N. RAJU<sup>\*</sup>, K. ASHOK KUMAR, R. GOWTHAMAN  
V. SANIL KUMAR & S. JAYA KUMAR**

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DONA PAULA, GOA – 403 004.**

**\* NIO, R.C, VISAKHAPATNAM**



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## 1.0 INTRODUCTION

Oceans bring joy and inspiration to people everywhere. Seventy percent of the total population in the world are living along the coastal region. Tourism is an important potential to increase the economy of the country. In olden days it was an entertainment / relaxing to the tourists. But in the present scenario it is an important tool for the Government to increase the country's economy and create more employment opportunities for the public.

Construction of structures for the development of harbours, jetties, laying of pipelines for effluent disposal, seawater intake, etc., have increased the activities in the coastal zone along with recreation and a proper plan is required to meet these needs. Understanding the coastal processes help in preparation of suitable management plan for the nearshore activities. It is also essential to know the distribution of the sand transport across the surfzone to demarcate the zones of active sediment movement regions.

Kakinada is situated in the central part of the Andhra Pradesh State on the east coast of India. To cater to recreational activities of the people in this coastal town, the State Andhra Pradesh State Government has taken up an interactive to develop the beaches between Fishing Harbour and the Uppada village for the recreation and coastal development activities. Kakinada is one of the intermediate ports in Andhra Pradesh. The State Government is interest o develop the port in order to increase its export / import capability round the year. For the purpose, construction of deep-water port, establishment of Fishing Harbour and construction of breakwater are some of the events that have taken place in the recent years. Nagarjuna Fertilisers Ltd., Godavari Fertilizers, Bharat Petroleum Corporation Ltd., Southern Power Generation Ltd., etc., are some of the other major industries established in this region.



Waves, winds and currents mould the shorelines and their interaction with the land and its run off determines the configuration of the coastlines and the adjacent bathymetry. Coastal processes covering at least an annual cycle is required to know the behavior of the shoreline changes.

Significant changes in the beaches on the East coast of India are expected. The fully developed berm parts of the beaches will start eroding and the breaking wave heights increases the intensity. An attempt has been made to study this area during 15<sup>th</sup> May to 15<sup>th</sup> June 2001 by taking up daily littoral environmental observations and weekly beach profiles.

The beach profiles were carried out on the spring and neap tidal days. Instrumentally measured values are of great importance to estimate the volume of sediment transport. However, in the absence of those instruments, a well trained person obtaining the visual observations on surfzone parameters are also universally adopted for the estimation of longshore sediment transport.

## **2.0 . DESCRIPTION OF THE STUDY AREA**

The coast line between Kakinada and Uppada village is about 15 km long (Fig.1). The continental shelf of the study region is relatively narrow. It is about 20 km north of Godavari delta. The 10 m depth contour is 0.2 to 1.2 km away from the shore. The 20 m contour is about 6 to 8 km, 30m contour is about 15 km from shore. 50, 100 and 200 m depth contours are 22, 32 and 45 km from the shore.

River Godvari transports considerable quantity of sediments to the sea which nourish the sandy beaches in the vicinity.



The area near Kakinada-Uppada coast is a plain and even. During high tide the sea water enters the costal plain and thereby the salinity level increases on the adjacent agriculture fields. The hinterland is protected with the recently laid tar road from the waves during monsoon. Some tidal creeks are also present. Casurina plantations are present for certain stretch of this coastline.

The Kakinada Bay is about 11 km wide and shallow. During the spring tidal days at low tide time the bay is exposed. The Coringa and the Gaderu estuaries join in the south of the study area, originate from Godavari River, drain huge quantity of fresh water during July and October. Kakinada town is situated on the western side of this bay. An irrigation canal joins the bay in the western side of Kakinada town.

To the north of this study area, i.e. nearer to Uppada, a river called Pedda river and a Upputeru join the Bay of Bengal. The present study has been taken up in between the Pedda River in the north-east and the Kakinada canal in the south west.

The continental shelf off Kakinada is dominantly silt till 1.8 m depth of 9.4 m. The Seafloor upto a distance of 3km sand, from 3-20 km it is covered with clay and upto 20-30 km it is covered with shells the outer most zone consists of clay, fine sand and shell fragments (Reddy and Mohan Rao, 1996).

The sediment entering the shelf off Godavari delta, the third largest among Indian deltas is mainly silt-enriched sediment brought by the distributaries of the Godavari river. The length of the Godavari river from its origin till joining Bay of Bengal is 1450 km. The River Godavari drains a mean annual discharge of  $1.05 \times 10^{14}$  litres at Dowleswaram.



The annual sediment load by Godavari River at terminal points in 1984 is  $38.839 \times 10^9$  kg / year (  $38.839 \times 10^{12}$  m<sup>3</sup>) (Rama Sarma and Ganapathi, P.N., 1968).

The formation of a 15 km long sand bar north of Godavari river mouth is a distinct feature in this region giving protective shelter for the Kakinada port. A 15 km long natural barrier is unique and a rare wonder of nature with the eastern tip called Godavari point of the HOPE Island separating the bay from the sea. This sand bar gradually broadens and bends in a northwest direction forming the eastern boundary for the Kakinada bay. The HOPE Island's width ranges from 200 to 1200 m. The change in coastline from 1846 to 1956 is shown in Fig. 2. The development of the Godavari spit from 1851 to 1929 is shown in Fig.3. Oceanography of this region is dominated by South west (June-Sept.) and North-east (Oct.-Jan.) monsoons and fair weather period (Feb to May).

Based on the ship observed data for 19 years ( 1968-1986) published through Indian Daily Weather Report by India Meteorological Department, Pune, the wave characteristics during May and June for latitude 15<sup>0</sup> to 20<sup>0</sup> N, longitude 80<sup>0</sup> to 85<sup>0</sup> E covering the study region shows that the wave heights range between 1.0 and 2.5 m and the wave periods predominantly vary between 5 and 9 sec. (Chandramohan, et. al., 1989).

Based on the time series data collected instrumentally using Datawell wave rider buoy during May 1983 to August 1984 at 90 m water depth deployed off Kakinada, the maximum wave height ( $H_{max}$ ) varied between 0.45 m to 4.40 m and the significant wave height ( $H_s$ ) varied between 0.3 to 2.8 m. During the months of June, July and August '83 the  $H_{max}$  exceeded 4 m and  $H_s$  exceeded 2.5 m (NIO/SSP/ONGC/October 1985).





The directional distribution of waves in the form of wave power based on the ship observations during 1968-86 is relatively high during June, July and August months and is predominantly contributed from the sector between South South West (SSW) and West South West (WSW). The seasonal wave power distribution for Kakinada area is 18.4 kw/m crest length for the SW monsoon (June– Sept.) and NE monsoon [Oct.-Jan.] and 6.9 kw/m for non-monsoon [Feb.- May] (Chandramohan et. al., 1987). The annual average wave power per metre crest length is 11.4 kw/m (Chandramohan, P and Nayak, B.U., 1987). As per the Kakinada port authorities, during the North-East monsoon (Oct.-Dec.) the wave height exceeds 2 m for 32% of the time and 58% of the waves approach from North-Northwest direction.

The results of the measured wave parameters off Kakinada by using directional wave rider buoy at 33 m water depth during the study period (May – June 2001) is shown in Table 1

The results of the measured wave parameters off Kakinada at 33m depth with directional wave rider buoy, carried out during the study period are shown in Table 1. The daily variations of the measured wave characteristics during the study period are shown in Figs. 4 to 6.

The tides in this region are characterized as predominantly semi-diurnal. Based on the Kakinada port tidal data for the year 2000 the spring tidal range is about 1.34 m and the neap tidal range is about 0.53 m.



The study area is prone to frequent severe cyclonic storms, which originate in the Bay of Bengal as low pressure zones. In 1996, during 5-7 November one of such cyclone occurred with a maximum wind speed of 140-150 kmph and crossed the coast at 50km south of Kakinada and severe erosion has been taken place at Uppada village, 15km north of Kakinada Town (plate. 1).

The tracks of the tropical storms and cyclones during 50 years from 1921-1970 is shown in Fig. 7 (Bay of Bengal Pilot, 1978)

Based on the Kakinada port information, most of the time, an average wind speed for this region does not exceed 19 km/hr. The average wind speed during the summer is 5 to 10 km/hr and in winter it is greater than 15 km/hr. Based on climatic table compiled for 30 years observations (1931 to 1960), 8 m above MSL at Kakinada, the wind speed is 9.125 kmph in May in the SE-W, during June and it is 10 kmph in SE-W direction. The wind distribution during SW monsoon month (July) in Bay of Bengal is shown in Fig. 8.

The results obtained from the measured wind parameters 20 m above MSL at Kakinada port with Aanderaa Weather Station during the study period is shown in Table. 2

The annual rainfall of this region is 117 cm. The mean current pattern during May is shown in Fig. 9 (Bay of Bengal pilot, 1978).



### **3.0 SCOPE OF THE STUDY**

- i. 4 Base stations were established covering the shoreline from Uppada to Kakinada, Fishing Harbour, (Fig. 1). The details of each station and their morphological features are given in Appendix 1.
- ii. Weekly changes in beach levels were measured on each station during 18 May to 15 June, 2001.
- iii. Daily littoral environmental observations on breaking wave characteristics and longshore current velocities were made during 18 May to 15 June 2001 at stns. 1 to 4.
- iv. Longshore sediment transport rates at stns. 1 to 4 were theoretically estimated using the collected data.

### **4.0 METHODS OF STUDY**

#### **4.1 Beach levels:**

Weekly beach levels were measured with reference to a local bench mark, at every 5 m interval along the transect from backshore dune, seaward till 1m water depth in the surface zone. Automatic level and a graduated staff were measured during the low tide conditions.

#### **4.2 Breaking wave characteristics:**

Breaking wavelength, wave period and direction were observed during the study period. Heights of 10 consecutive breakers were visually measured, the average of them was notified as the corresponding breaking wave height. The total time required for 11 consecutive breaks were noted using a stop-watch and the average was considered as breaking wave period. The breaking wave angle with respect to the coastline was measured using a magnetic compass.



### 4.3 Littoral Environmental Observations (LEO)

Longshore current velocity, surfzone width, wind speed and direction are the parameters observed in this study. Neutrally buoyant floats were released in the surfzone and the distance travelled by them in two minutes and the direction of the travel were noted. The speed and direction of these floats were noted as the longshore current speed and direction. Surfzone width was visually estimated. Wind speed was observed based on the occurrence of the intensity and classified as calm, mild, moderate, medium, strong or very strong, for a speed of 0, 5, 10, 20, 40 or 60 kmph respectively. The direction was measured using a magnetic compass.

### 4.4 Beach Sediments:

Beach surface sediment samples were collected from the inter-tidal region, close to the water line at each station every week during the study period and the sieve analysis was carried out to study the grain size distribution.

### 4.5 Longshore sediment transport rate:

The longshore sediment transport rates were estimated as per Shore Protection Manual, 1984, (Walton's and Bruno, 1989).

$$Q = \frac{(1290 \rho g H_b W v C_f)}{(0.78 (5 \Pi/2) (v/v_0))} \text{-----( 1)}$$



where

$Q$  = annual longshore sediment transport rate in  $\text{m}^3 / \text{year}$

$\rho = 1025 \text{ kg} / \text{m}^3$

$g = 9.81 \text{ m} / \text{s}^2$

$C_f = 0.01$

$H_b$  = breaking wave height in m

$W$  = surf zone width in m

$V$  = longshore current velocity in m/s

$v/v_0$  = theoretical dimension-less longshore current velocity,

(Longuet – Higgins, 1970)

Since the observations were made daily for a period of one month, the daily longshore sediment transport rates is estimated by dividing  $Q$  with 365 to obtain the LST rate in  $\text{m}^3 / \text{day}$ . Then the weekly LST rate has been calculated while taking into consideration of all the daily LST rates.

## **RESULTS AND DISCUSSION:**

The results based on the various data collected on the coastal processes from 15 May to 15 June 2001 are presented.

### **5.1 Beach studies**

The weekly variations in beach levels at each station in a month are shown in Figs. 11 to 14 and the data is given in Appendix-2. The changes occurred in a month is also compared with the earlier profile. Variations in beach levels obtained represent the periodical changes occurred during end of fair weather period, onset of Southwest monsoon and beginning of Southwest monsoon. To understand the beach level variation quantitatively, the relative



changes in the weekly volume of the sediment per metre length of the beach at each station are presented in Fig. 15. These changes in volume were computed for each beach section upto the waterline per unit length (one metre) measured along the beach. Lowest beach level over a month cycle was observed in the first week at stns. 1, 2, 3 and 4. The maximum beach level was observed at stn. 1 during 1<sup>st</sup> week, 2<sup>nd</sup> week and on 15 June . (4<sup>th</sup> week), during 2<sup>nd</sup> week at stn. 2, during 3<sup>rd</sup> week on 7 June at stn. 3, during 4<sup>th</sup> week on 15 June, 2001 at stn. 4 respectively. The week details are given in Appendix-3.

It is seen that the stretch of the beach undergo monthly changes at all the stations during the study period. The weekly changes in the net volume of sediment per metre length of the beach over a month tidal cycle were 19, 8, 20 and 8 m<sup>3</sup> at stns. 1, 2, 3 & 4 respectively. Based on the variation in weekly beach levels from 18 May to 15 June 2001 it is seen that the stretch of the long beach lost their profiles at stns 1 and 3 and gained at stns 2 and 4 in a month, thereby indicating that this beach is not stable during the study period. The onset of SW monsoon, thereby the increase in wave energy on the foreshore slopes of the beach resulting in strong longshore currents persisted on the spring tidal days of the study period also effected the profile.

## **5.2 Breaking wave characteristics**

Daily variation of breaking wave height, wave period, breaker angle, longshore current and wind characteristics at stns.1 to 4 are presented in Figs. 16 to 23 and the data are presented in Appendix-4

During the study period, the breaking wave heights varied between 0.6 and 1.7m at stn.1, 0.5 and 1.8m at stn.2, 0.4 and 1.7m at stn.3 and between 0.4 and 1.5m at stn.4.



The breaker periods mostly ranged between 9 and 14 s. at all the stations during the study. The breakers were mostly plunging and spilling with occasional spilling type. The wave breaker angles observed are predominantly within  $-2^{\circ}$  and  $+2^{\circ}$  to the coastline during the study period.

The surfzone width varied between 18 and 40 m at stn.1; 15 and 40 m at stn.2; 8 and 45 m at stn.3 and 15 and 38m at stn.4 respectively during the study period.

### **5.3 Longshore currents:**

The daily variation of longshore current speed and direction are shown in Figs.17, 19, 21, 23 for stations 1, 2, 3 & 4 respectively. At stn.1 near Uppada, the longshore current was towards north-east during the entire period of observation.

The study shows that the distribution of longshore current is not similar throughout the region. The longshore current speed was about 0.2m/s at stn.1 and 2, 0.15m/s at stn.3 and 0.11m/s at stn.4 during the study period.



## 5.4 Longshore Sediment Transport

The daily field measurements made on longshore current velocity and surfzone width at stns.1, 2, 3, and 4 were used in equation 1 and the longshore sediment transport rate was estimated. The values and direction of weekly sediment transport rate at stns.1, 2, 3 and 4 are shown in Table 3 and Fig. 25.

The weekly sediment transport was relatively low at stns.2 and 4 compared at stns.1 and 3. The transport was mostly towards north-east except in 3<sup>rd</sup> week during which it was towards south-west at stn.2. At stn.4, the transport was mostly towards south-west except in 4<sup>th</sup> week.

At stn.1, the sediment transport was towards north-east during the study period and it was relatively high about  $1.2 \times 10^3 \text{ m}^3 / \text{week}$  during the last week and low  $0.646 \times 10^3 \text{ m}^3 / \text{week}$  during 4<sup>th</sup> week.

At stn.2, the sediment transport was mostly towards north-east except during 3<sup>rd</sup> week. The transport was relatively low due to weak longshore currents.

Stn.3 experienced low sediment transport rates during 2<sup>nd</sup> and 4<sup>th</sup> weeks and were in north-east direction during the study period.

Stn.4 experienced low sediment transport rate during 1<sup>st</sup> and 4<sup>th</sup> weeks and high sediment rates during the 2<sup>nd</sup> and 3<sup>rd</sup> weeks of the study period.





The monthly net transport was towards north-east about  $3.534 \times 10^3$  m<sup>3</sup>/month at stn.1,  $0.830 \times 10^3$  m<sup>3</sup>/month at stn.2 and it was in opposite direction for about  $1.052 \times 10^3$ /month and  $0.968 \times 10^3$ /month towards south-west at stns. 3 and 4 respectively.

The monthly gross transport was relatively high about  $3.534 \times 10^3$ /month at stn.1 and relatively low about  $1.418 \times 10^3$  m<sup>3</sup>/month,  $1.402 \times 10^3$  m<sup>3</sup>/month and  $1.056 \times 10^3$  m<sup>3</sup>/month at stns 2,3 and 4 respectively during the study period.

The estimated longshore sediment transport rates shows that the sediment transport was towards north-east at stn.1 and 2 near Uppada and Subbampeta and towards south-west at stns 3 and 4. i.e. at Komaragiri and Suryaraopeta respectively.

The transport is high at Uppada when compared to Fishing Harbour side of Kakinada because the existence of HOPE Island protects from high waves breaking and acts as a barrier for sediment transport movement at Fishing Harbour. Also circulatory currents are generating due to the obstruction of this HOPE Island, the longshore sediment transport is moving towards south-westerly direction i.e., at stn.4 (Fishing Harbour side) and it is observed that the long stretch of this beach at this station is under accretion.



## 5.5 Sediment size distribution

Beach sediments were collected weekly and the variation of particle median size ( $D_{50}$ ) at each station during the study period are shown in Fig.24 and the data are presented in Table 4. In general, the study region consists of fine to medium sand.

## 6.0 CONCLUSIONS

The study shows that the distribution of longshore current is not similar throughout the region.

The monthly net sediment transport observed at stn. 1 was of the order of  $3.534 \times 10^3 \text{ m}^3/\text{month}$  towards north-east, about  $0.830 \times 10^3 \text{ m}^3/\text{month}$  at stn.2 towards north-east, about  $1.052 \times 10^3/\text{month}$  and  $0.968 \times 10^3/\text{month}$  towards south-west at stns. 3 and 4 respectively.

The monthly gross transport was relatively high about  $3.534 \times 10^3/\text{month}$  at stn.1 and relatively low about  $1.418 \times 10^3 \text{ m}^3/\text{month}$ ,  $1.402 \times 10^3 \text{ m}^3/\text{month}$  and  $1.056 \times 10^3 \text{ m}^3/\text{month}$  at stns 2,3 and 4 respectively during the study period.

The estimated longshore sediment transport rates shows that the sediment transport is towards north-easterly at stn.1 and 2 near Uppada and Subbampeta and towards south-westely at stns. 3 and 4. i.e. at Komaragiri and Suryaraopeta respectively.

The sediment transport is high at Uppada when compared to Fishing Harbour side of Kakinada because of the existence of HOPE Island. In general, sea flore in the study region consists of fine to medium sand.



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Table 1. Measured wave parameters off Kakinada during the 15<sup>th</sup> May - 15<sup>th</sup> June 2001.

Parameter	Minimum	Maximum
Significant wave height $H_s$ , (m)	0.66	1.23
Maximum wave height, $H_{max}$ ,(m)	1.03	2.20
Zero crossing wave period, $T_z$ , (s)	3.60	8.10
Maximum spectral energy, $E_{max}$ , ( $m^2$ /Hz)	0.24	1.62
Predominant wave direction, $\theta$ (deg)	140 <sup>0</sup>	170 <sup>0</sup>

Table 2. Measured wind parameters at Kakinada during the 15<sup>th</sup> May - 15<sup>th</sup> June 2001

Parameter	VALUE
Average mean wind speed	4 m/s
Average wind gust	7.1 m/s
Maximum mean wind speed	13.8 m/s
Predominant wind direction	240 <sup>0</sup> - 280 <sup>0</sup> N

Table 3. Weekly longshore sediment transport rate at different station during study period

Week	Station Numbers			
	1	2	3	4
	* Sediment Transport rate ( $m^3$ /week)			
First	-1222	-210	687	84
Second	-934	-537	-62	384
Third	-732	294	540	549
Fourth	-646	-377	-113	-49
Net ( $m^3$ /month)	-3534	-830	1052	968
Gross ( $m^3$ /month)	3534	1418	1402	1066

- \* (-) Transport towards north-easterly  
 (+) Transport towards south-westerly



Table 4. Median size ( $d_{50}$ ) of beach sediments during the study period in mm.

Date	Stn 1	Stn 2	Stn 3	Stn.4
18 May 2001	0.24	0.21	0.25	0.17
24 May 2001	0.22	0.18	0.25	0.15
31 May 2001	0.23	0.26	0.23	0.15
07 June 2001	0.15	0.23	0.20	0.22
15 June 2001	0.20	0.17	0.20	0.23



Table 5. Changes in beach volume sediment at different station  
Station 1

Date	Volume(m <sup>3</sup> )	Difference w.r.t previous volume(m <sup>3</sup> )
18 May 2001	275.000000	0
24 May 2001	286.859985	-11.859985
31 May 2001	303.537476	-16.677490
7 June 2001	288.062469	15.475006
15 June 2001	294.397491	-6.335022
Net volume (m <sup>3</sup> /month)		-19.397491

Station 2

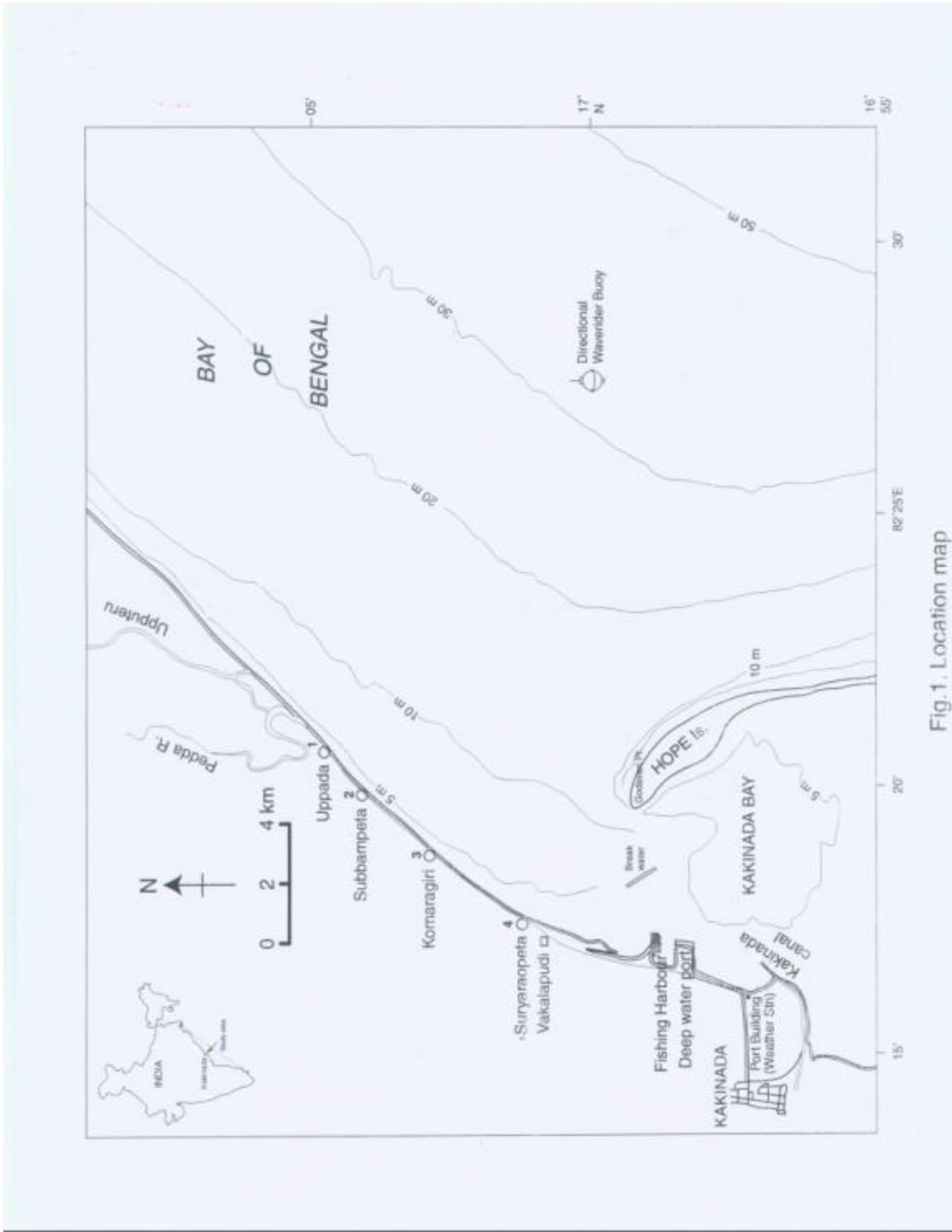
Date	Volume(m <sup>3</sup> )	Difference w.r.t previous volume(m <sup>3</sup> )
18 May 2001	519.756226	0
24 May 2001	519.337463	0.418762
31 May 2001	507.199982	12.137482
7 June 2001	498.812469	8.387512
15 June 2001	511.218781	-12.406311
Net volume (m <sup>3</sup> /month)		8.537445

Station 3

Date	Volume(m <sup>3</sup> )	Difference w.r.t previous volume(m <sup>3</sup> )
18 May 2001	553.831238	0
24 May 2001	583.274963	-29.443726
31 May 2001	540.149963	43.125000
7 June 2001	562.962463	-22.812500
15 June 2001	574.693787	-11.731323
Net volume (m <sup>3</sup> /month)		-20.862549

Station 4

Date	Volume(m <sup>3</sup> )	Difference w.r.t previous volume(m <sup>3</sup> )
18 May 2001	709.037476	0
24 May 2001	714.856262	-5.818787
31 May 2001	714.307556	0.548706
7 June 2001	709.552429	4.755127
15 June 2001	700.987488	8.564941
Net volume (m <sup>3</sup> /month)		8.049987





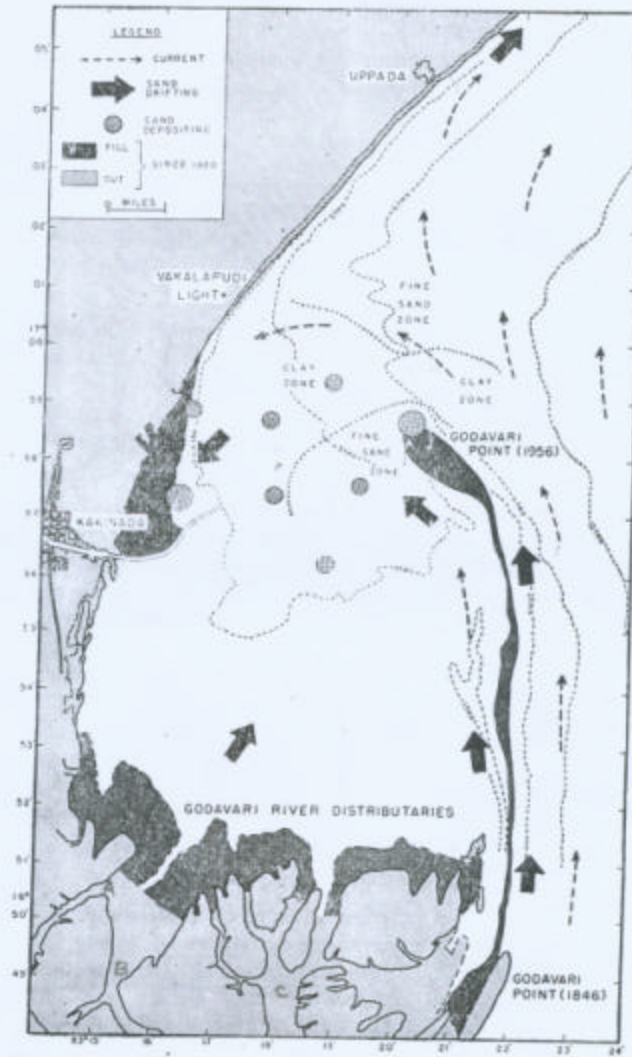


FIG. 2 Composite chart of the northern distributaries of the Godavari River, Kakinada, and Uppada Beaches (from Admiralty Chart No. 81, published in 1846 and 1860, and U.S. Hydrographic Chart No. 1711, published in 1951). Shown are the cut and fill over a century, currents, sand drift and sand depositing.

NOTE : 1 mile = 1.6 km  
1 fathom = 1.8 m  
A - Matlapalem  
B - Corangi river  
C - Gadevu river

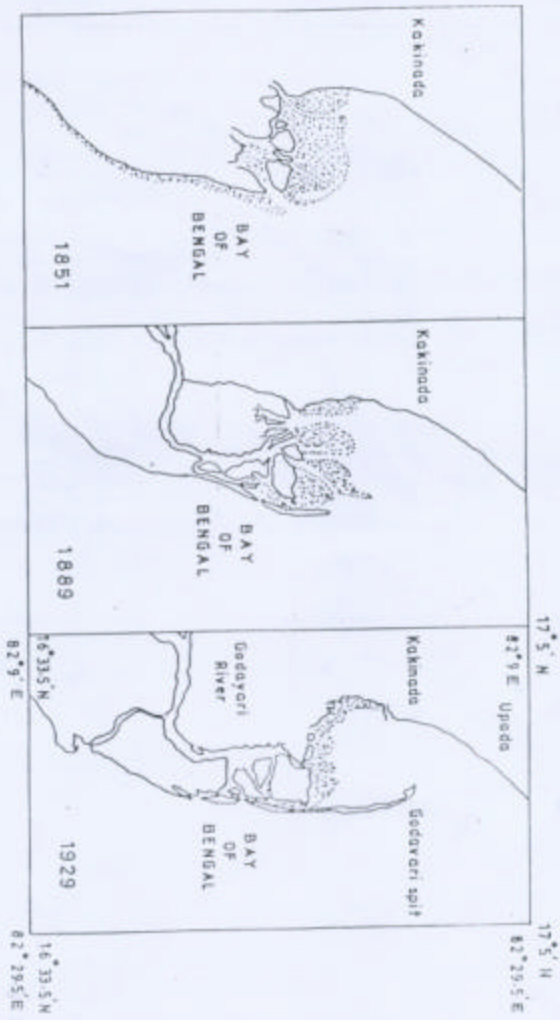


Fig. 3 Development of the Godavari Spit on the East Coast of India (After Mahadevan and Prasada Rao, 1958)

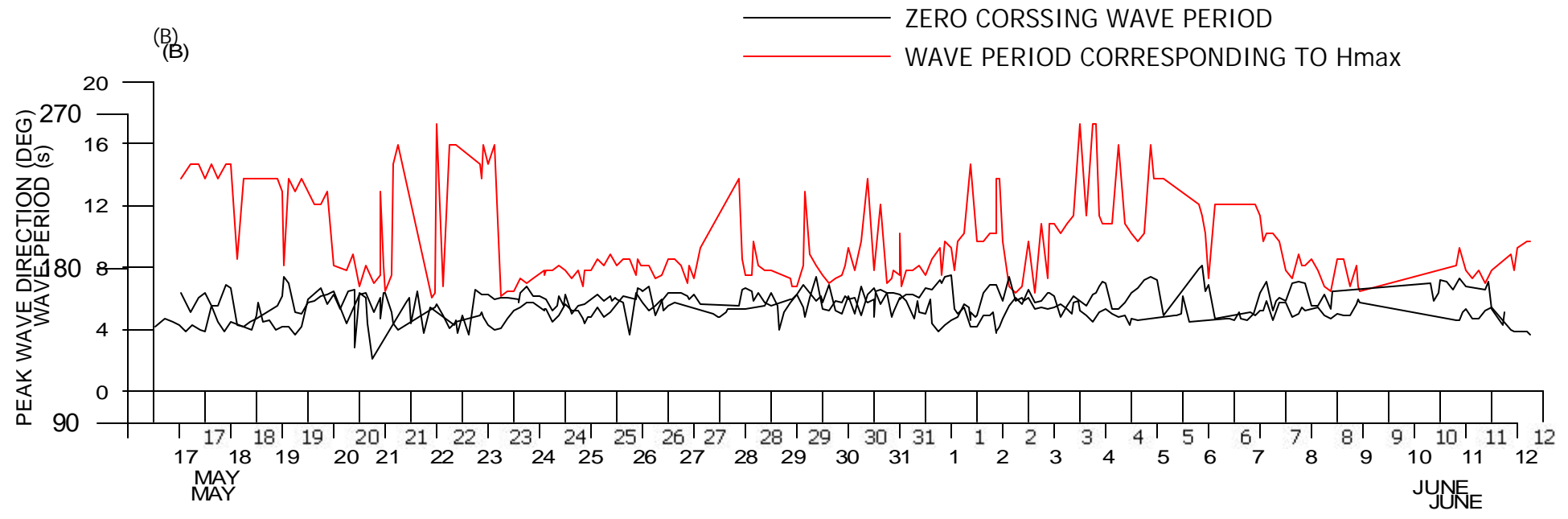
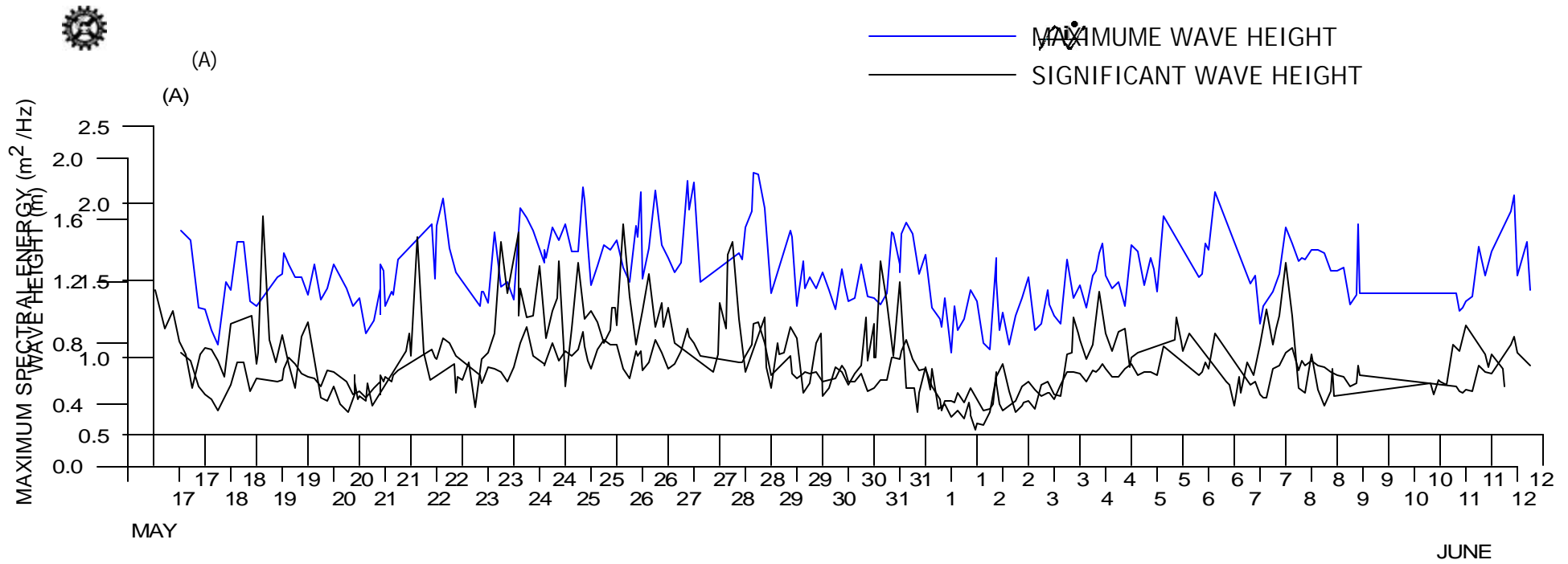


FIG. 4 VARIATION OF (A) WAVE HEIGHT AND (B) WAVE PERIOD DURING MAY - JUNE 2001

FIG. 5 VARIATION OF (A) MAXIMUM SPECTRAL ENERGY AND (B) PEAK WAVE DIRECTION DURING MAY - JUNE 2001

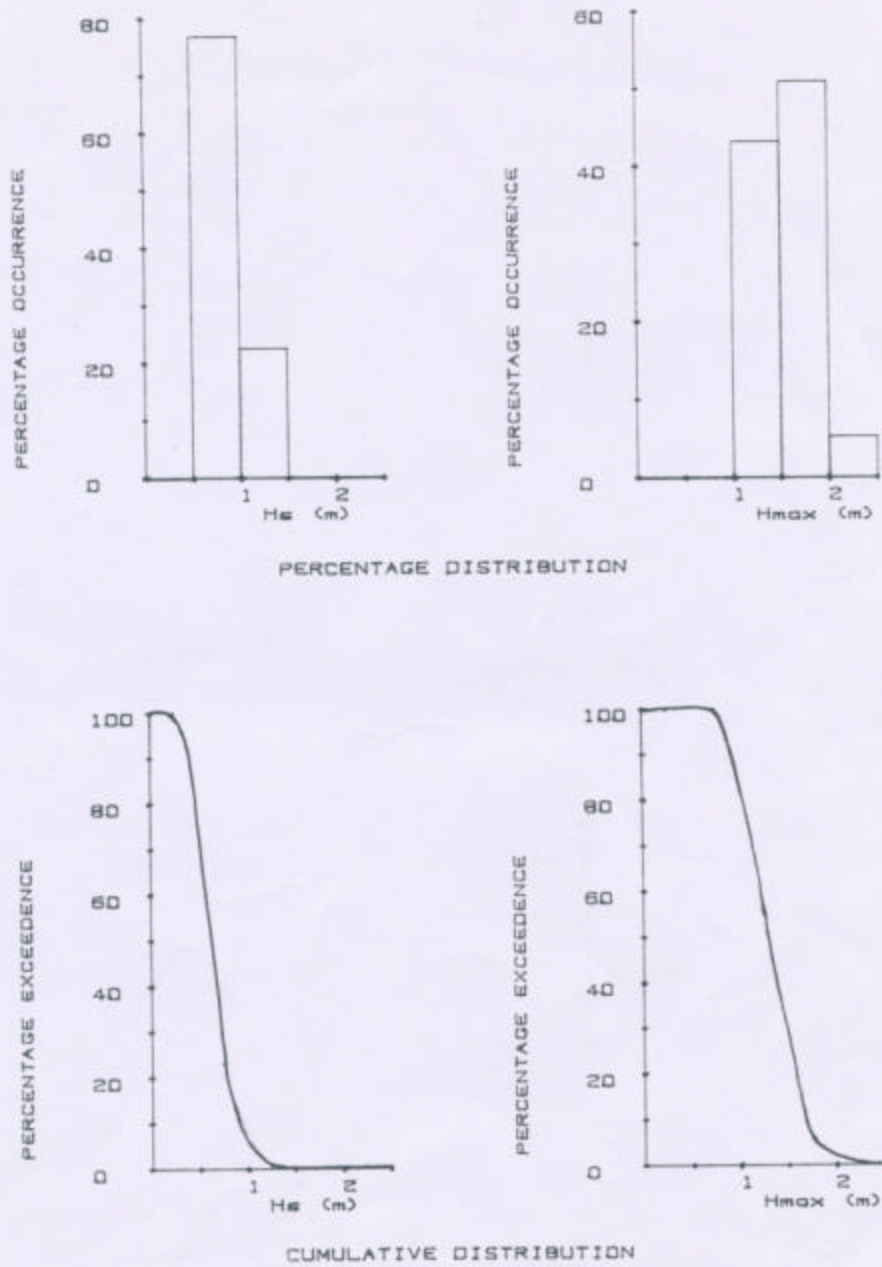


FIG.6 DISTRIBUTION OF SIGNIFICANT WAVE HEIGHT AND MAXIMUM WAVE HEIGHT (MAY - JUNE 2001)



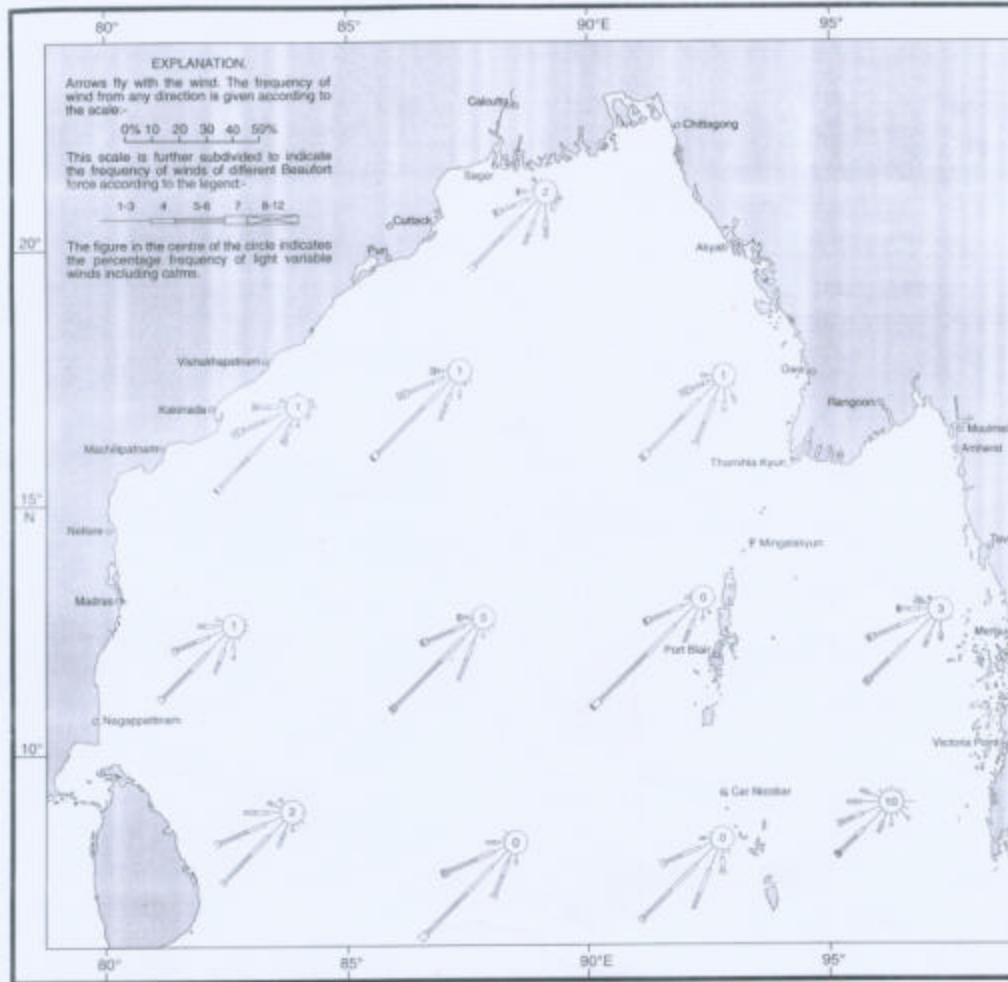


FIG. 8. WIND DISTRIBUTION DURING SW MONSOONAL MONTH JULY IN BAY OF BENGAL

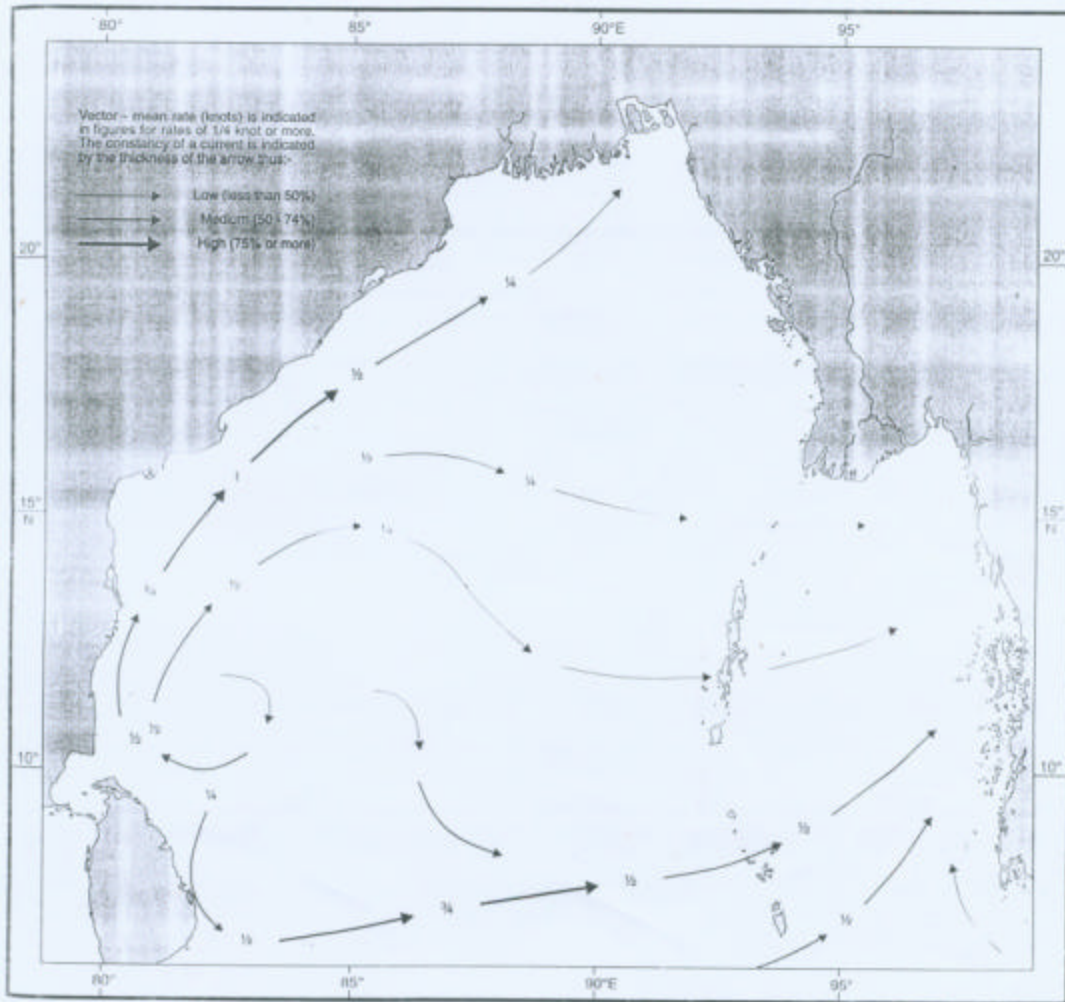


FIG. 9 MEAN CURRENT PATTERN IN BAY OF BENGAL DURING MAY

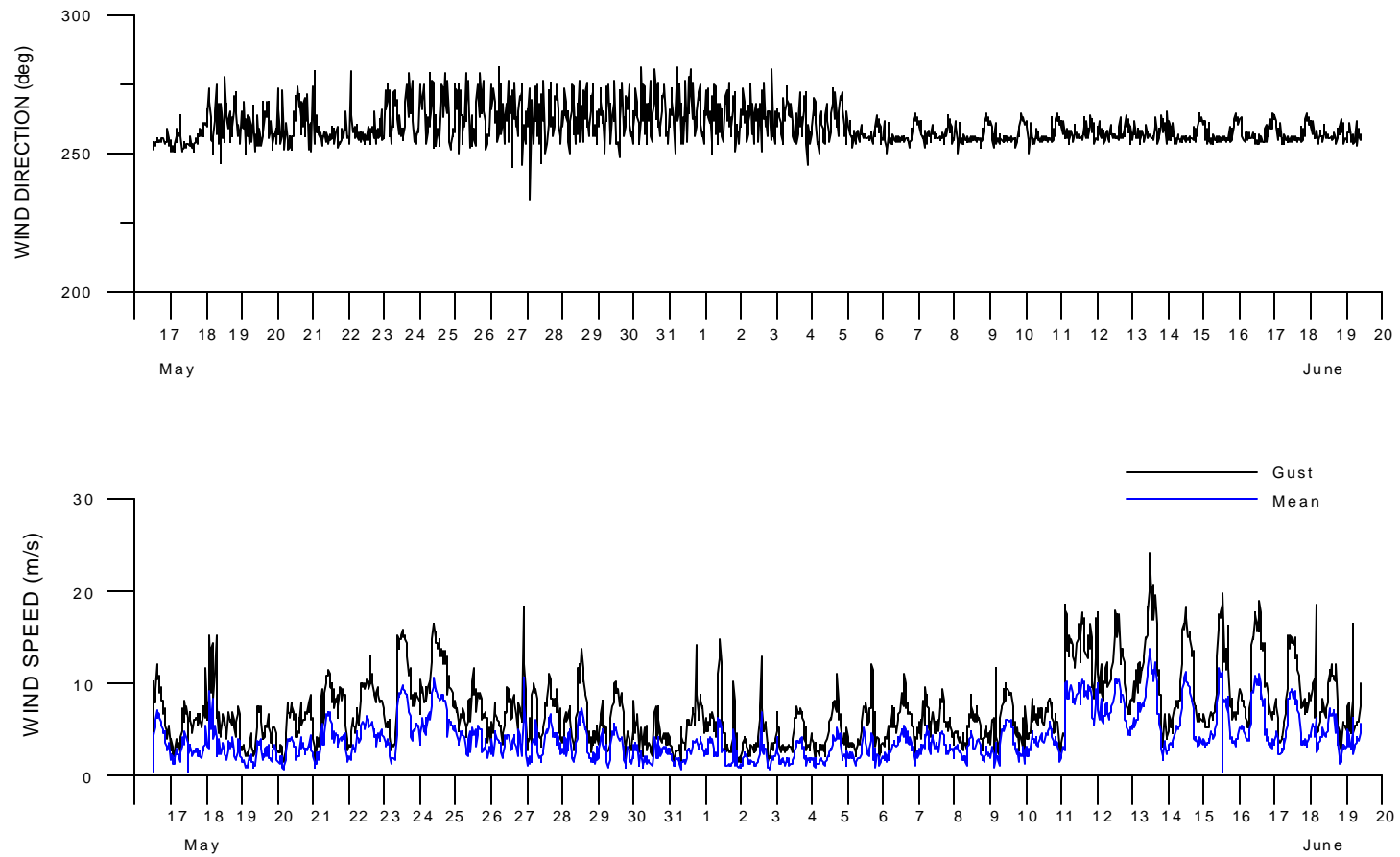


FIG. 10 VARIATION OF (A) WIND DIRECTION AND (B) WIND SPEED DURING MAY - JUNE 2001



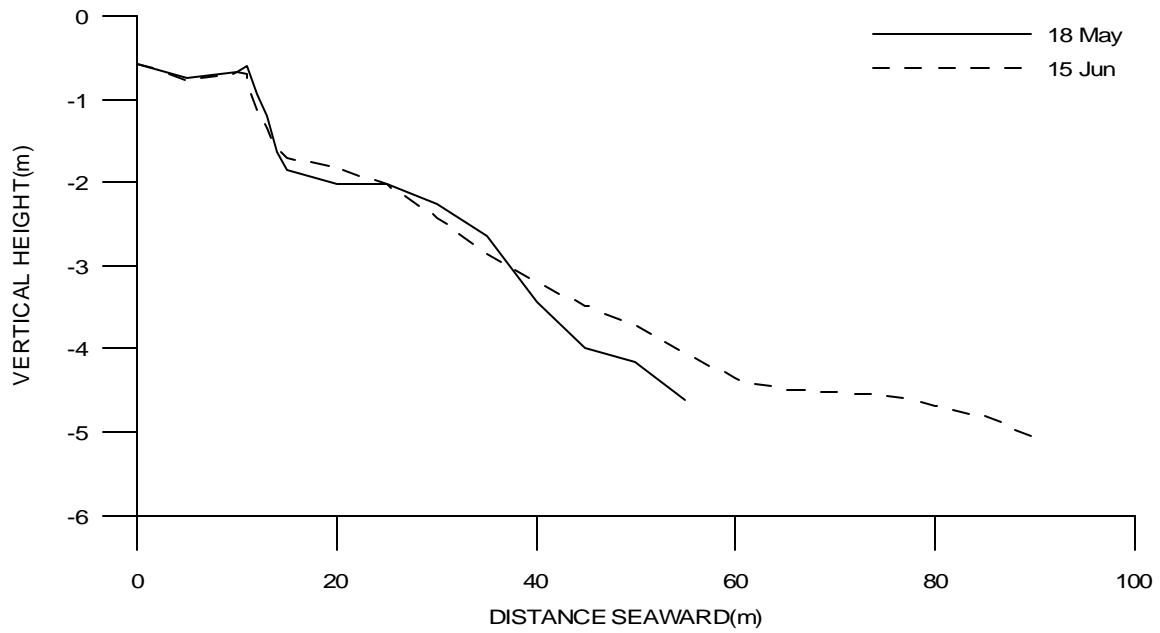
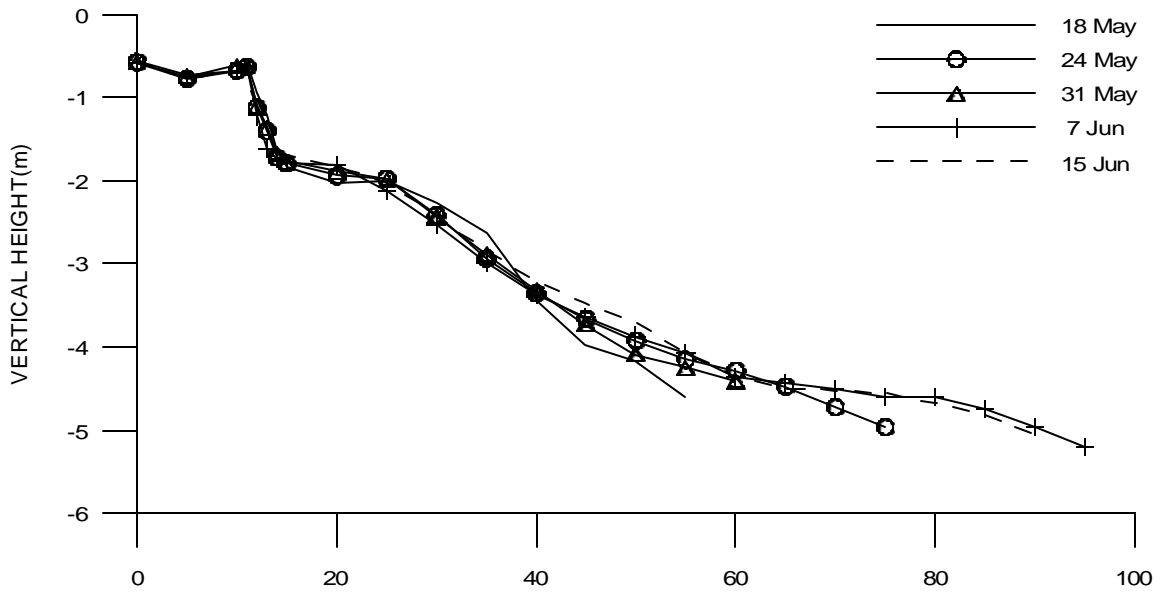


FIG. 11 VARIATION IN BEACH PROFILES AT STATION 1

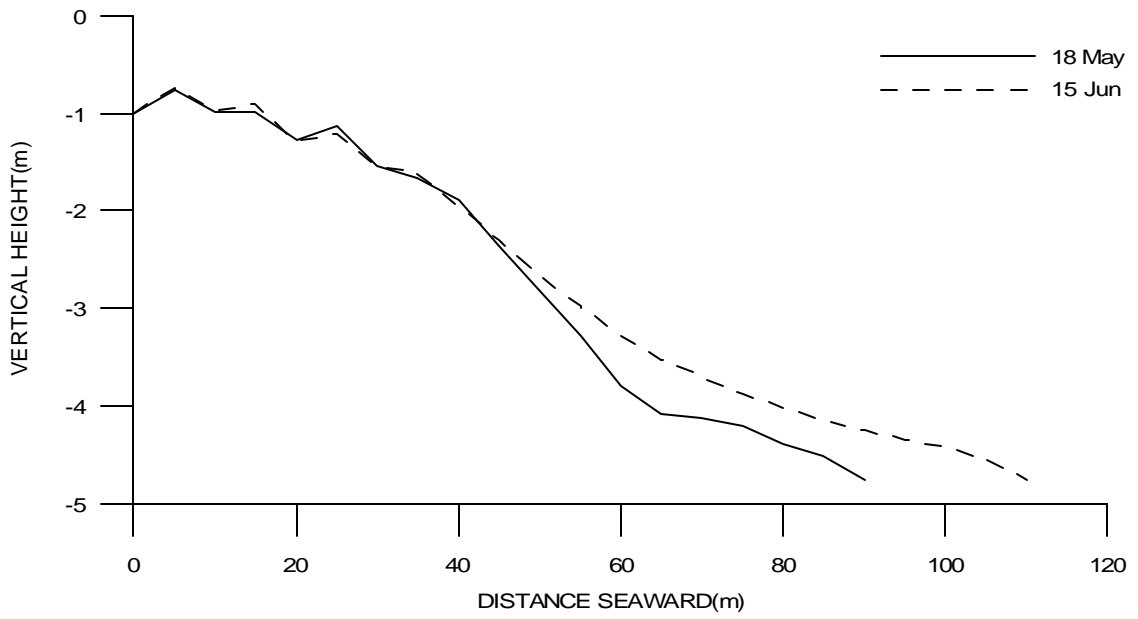
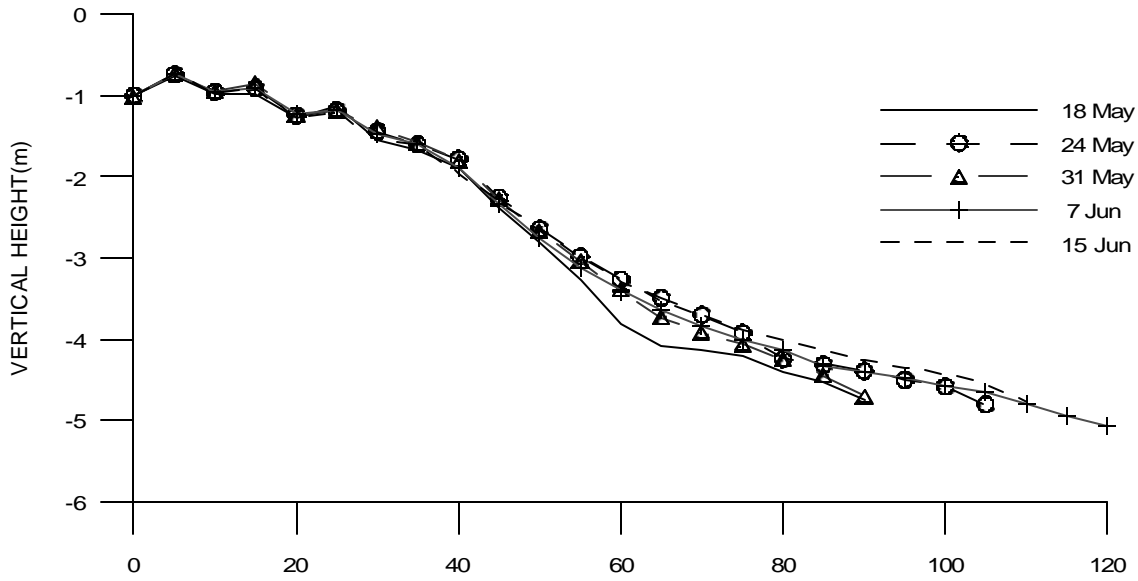


FIG. 12 VARIATION IN BEACH PROFILES AT STATION 2

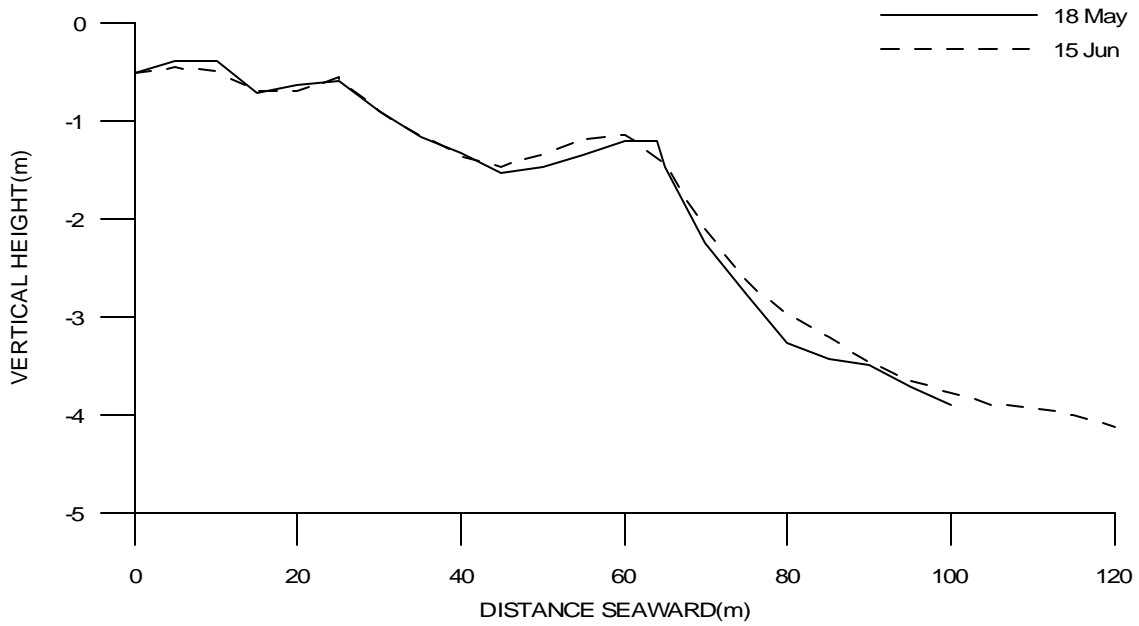
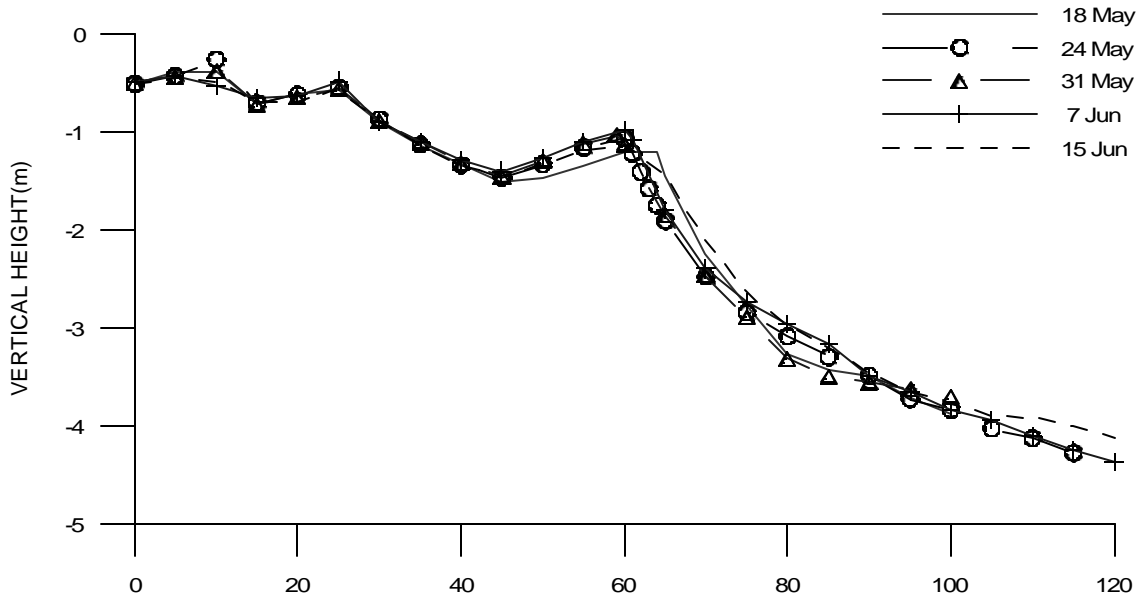


FIG. 13 VARIATION IN BEACH PROFILES AT STATION 3

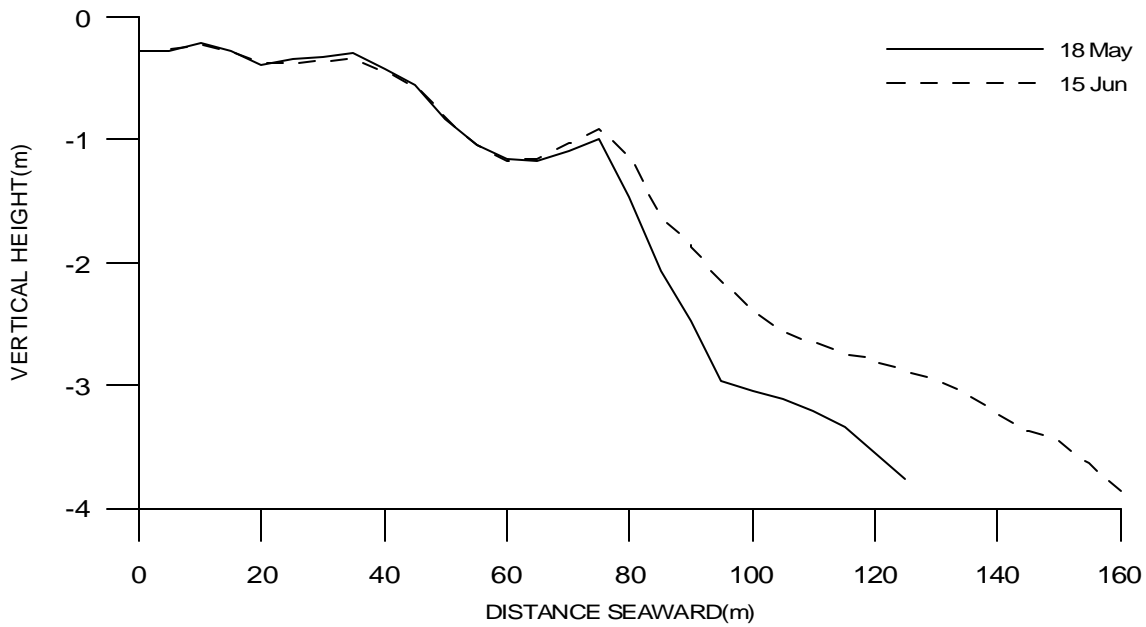
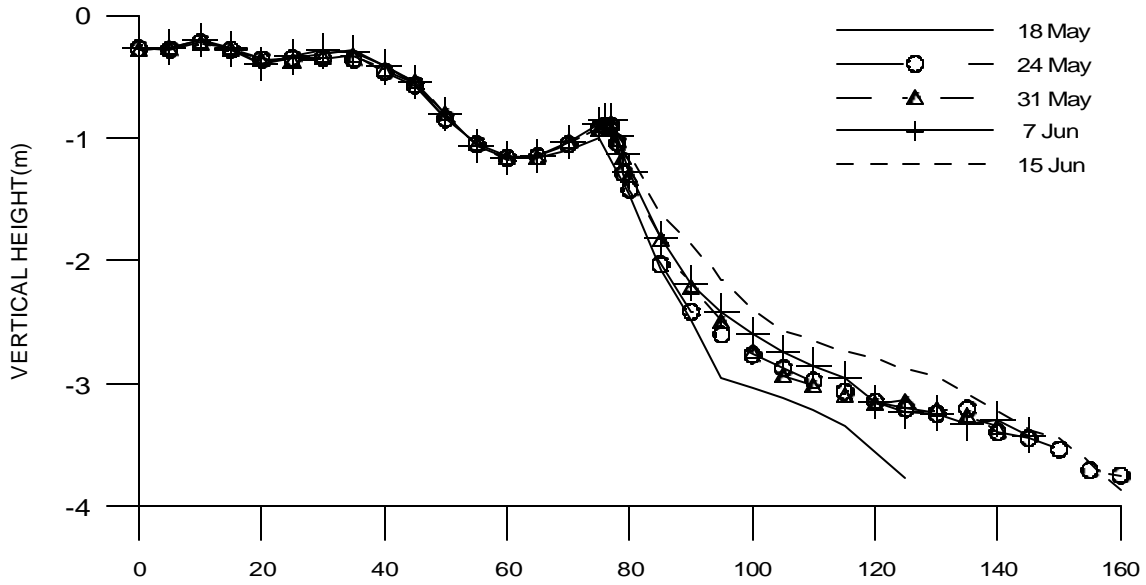


FIG. 14 VARIATION IN BEACH PROFILES AT STATION 4

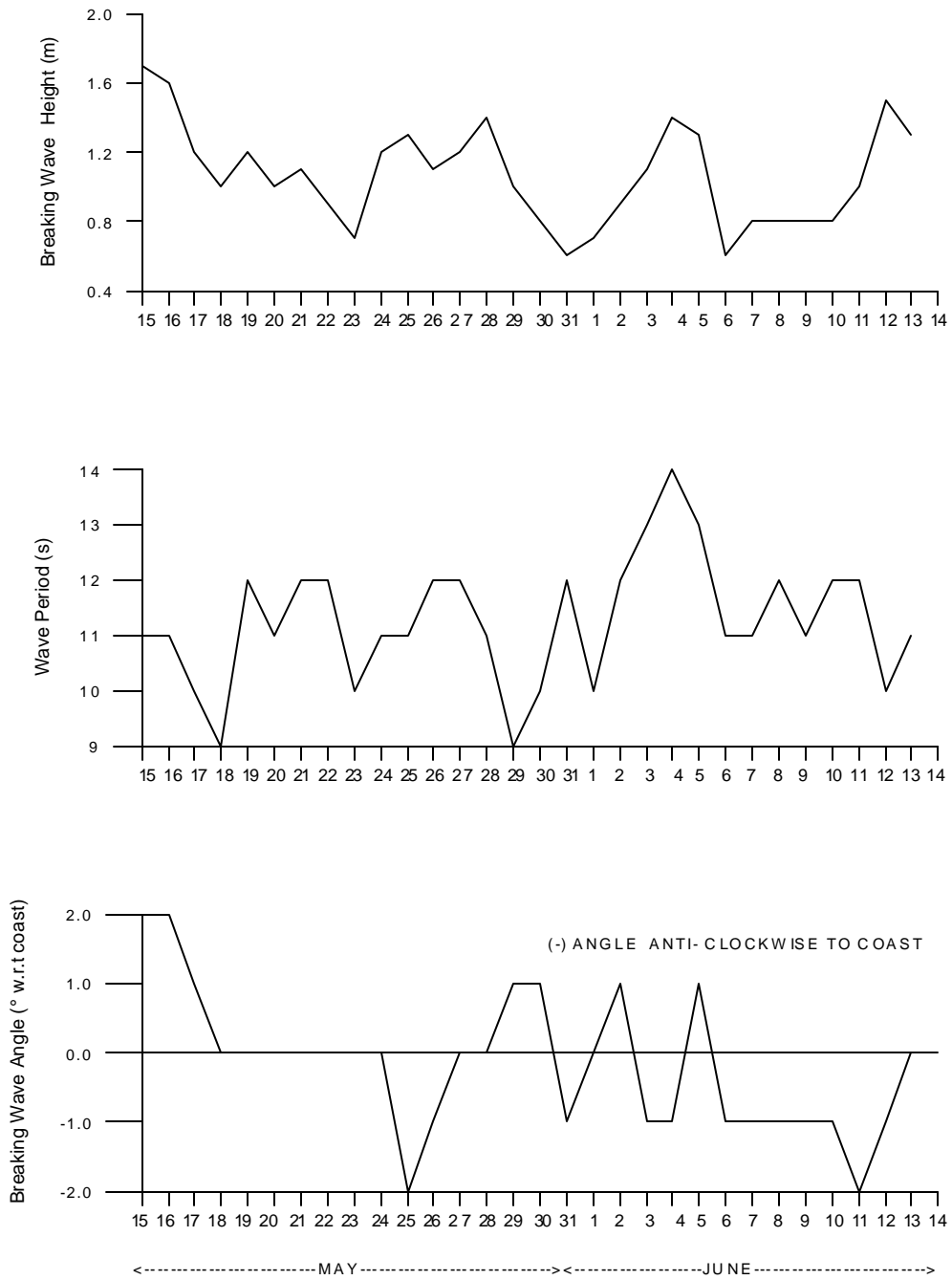


FIG. 16 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 1

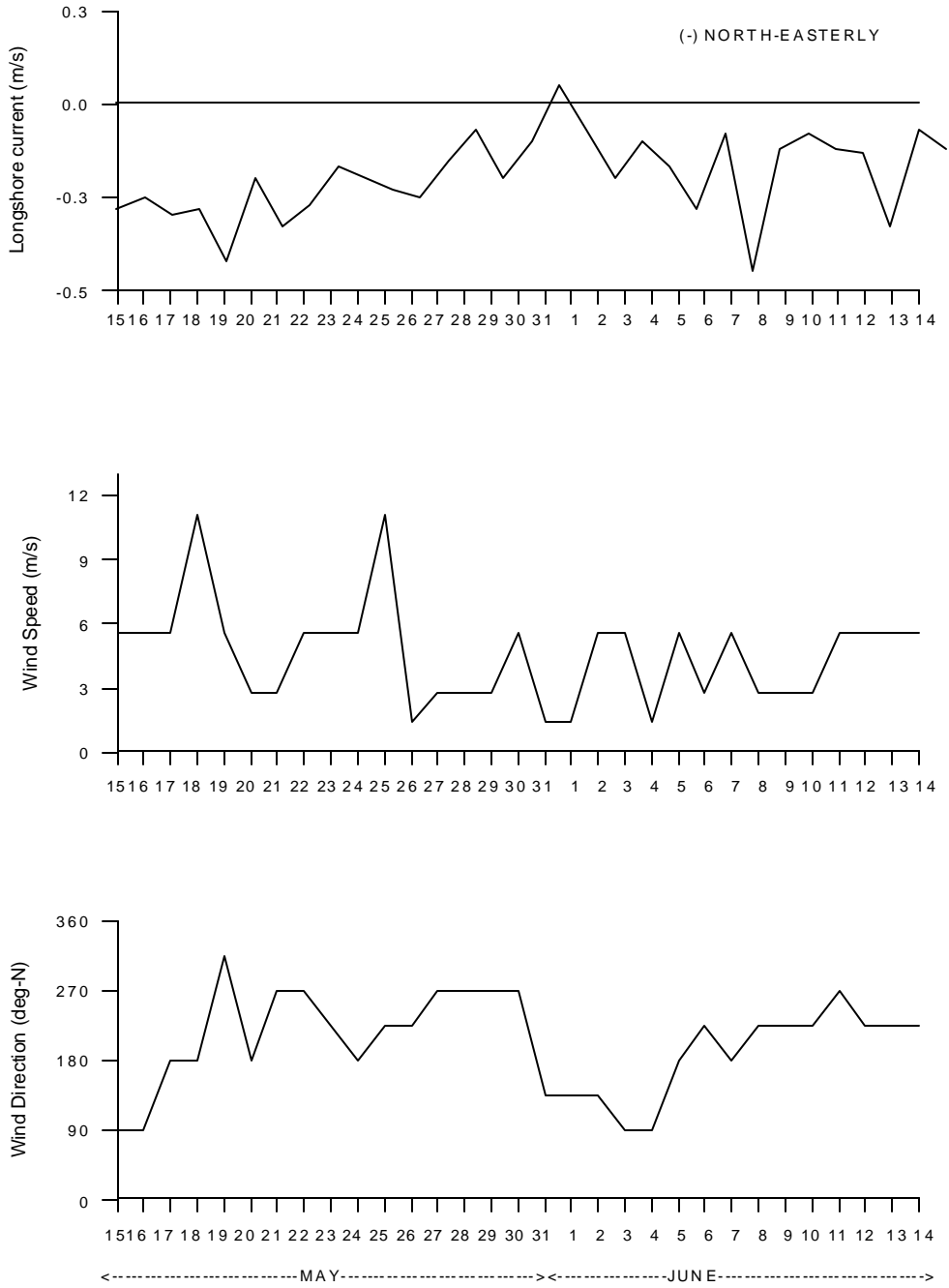


FIG.17 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 1

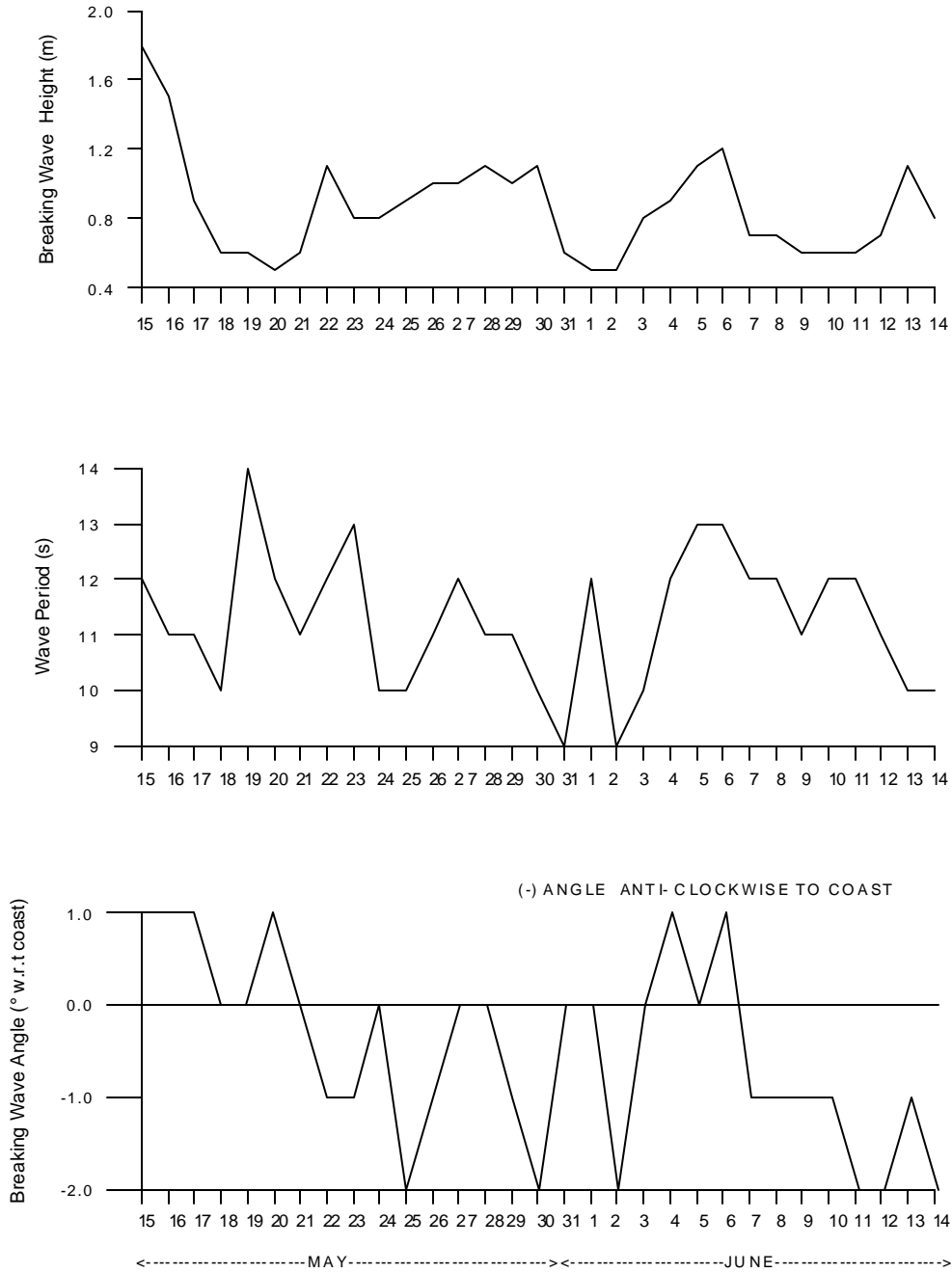


FIG.18 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 2

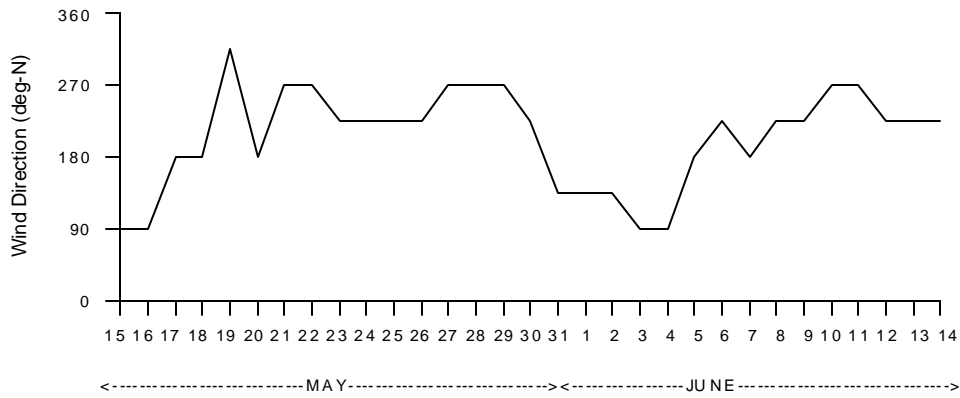
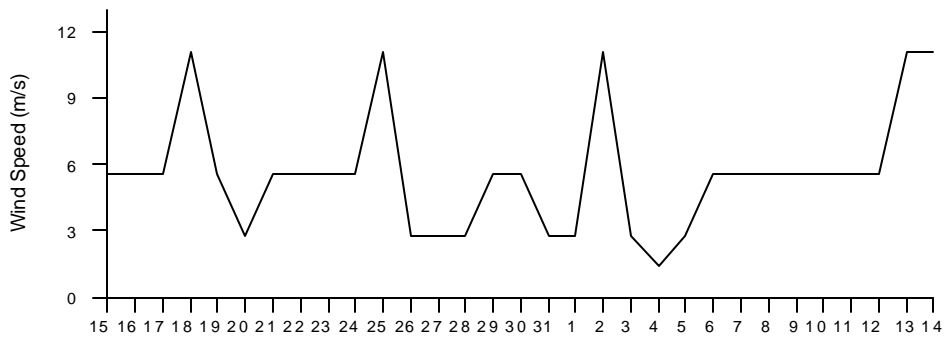
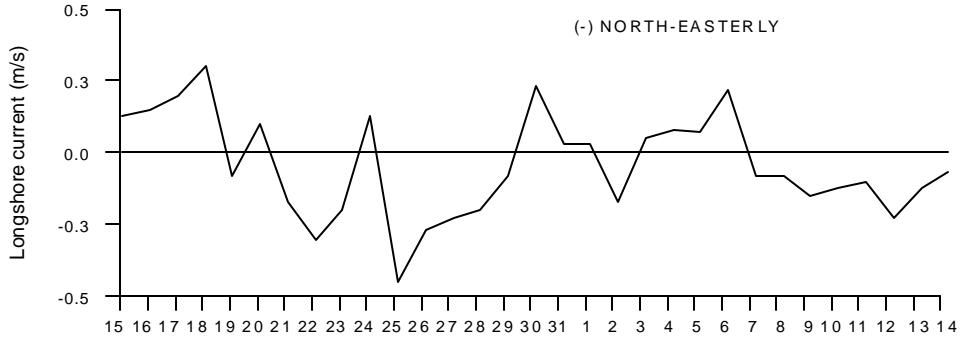


FIG.19 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 2



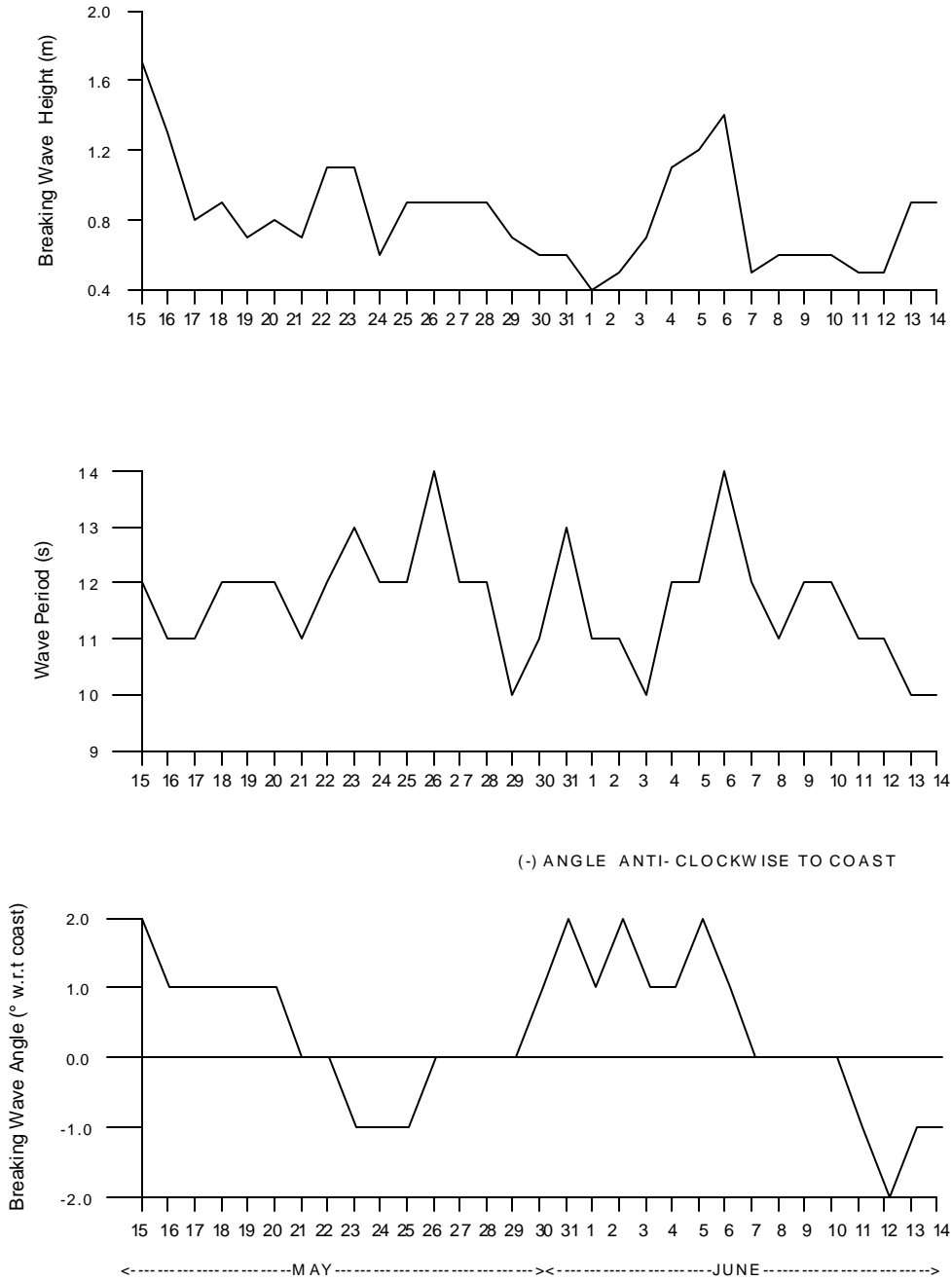


FIG. 20 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 3

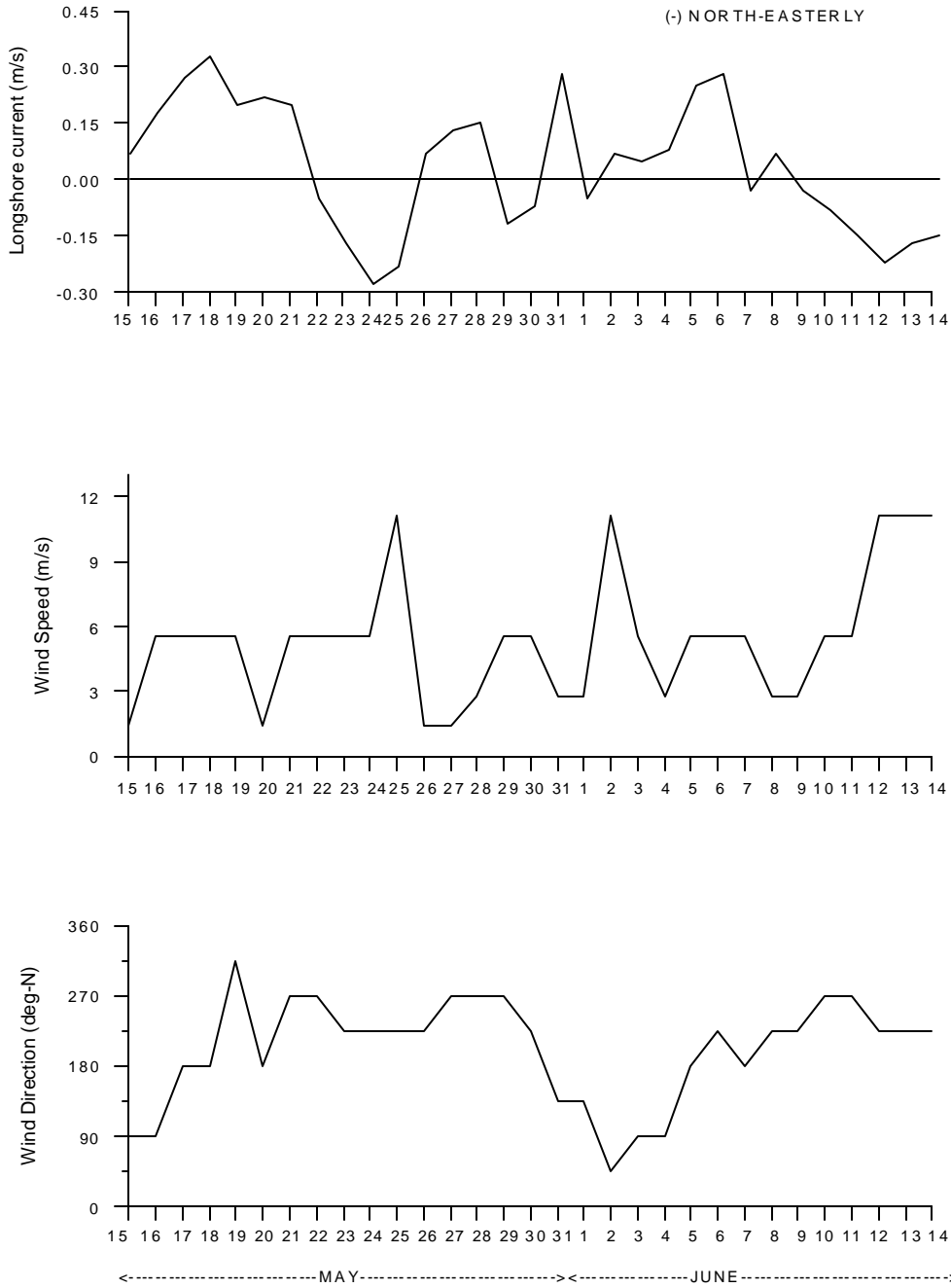


FIG. 21 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 3

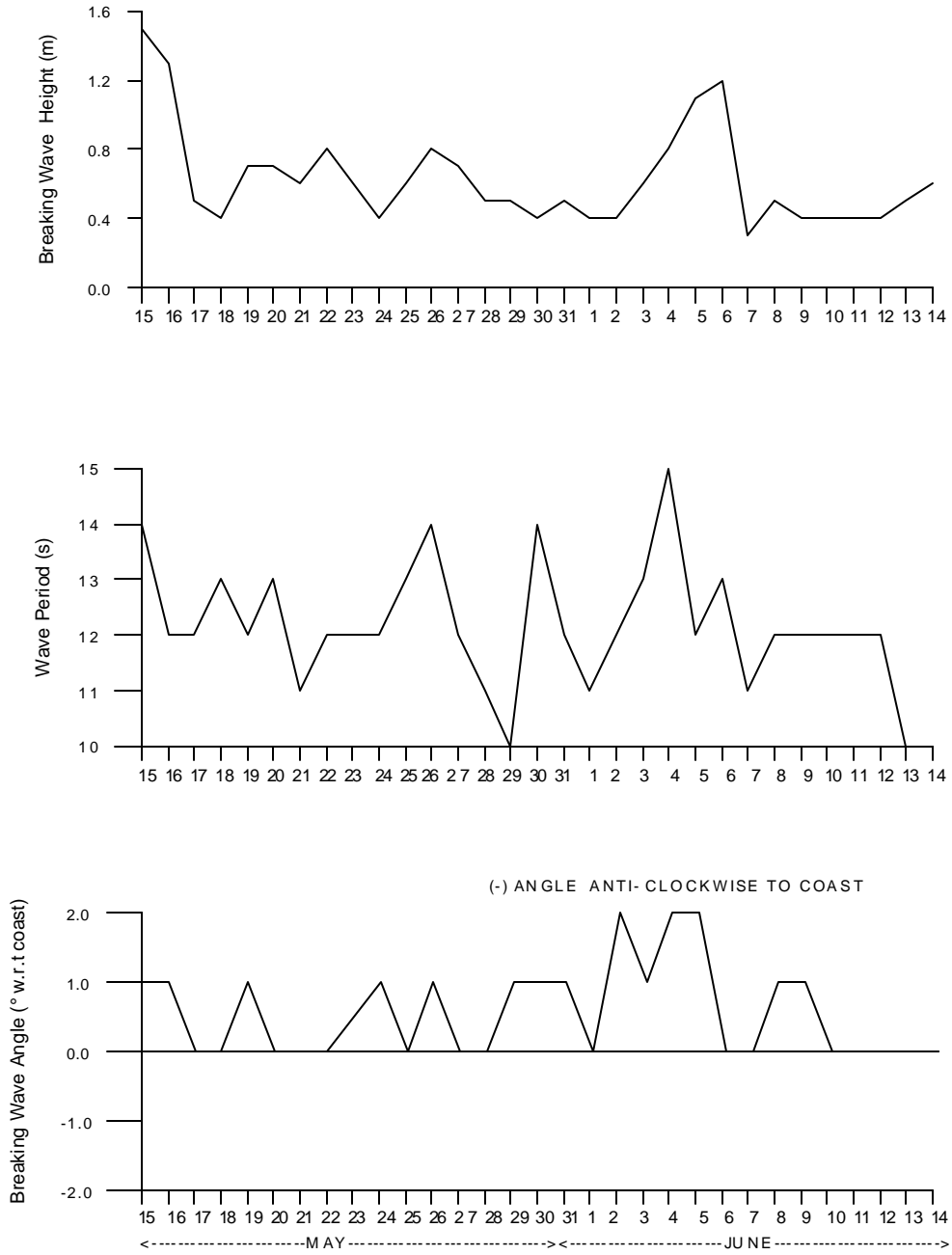


FIG. 22 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 4

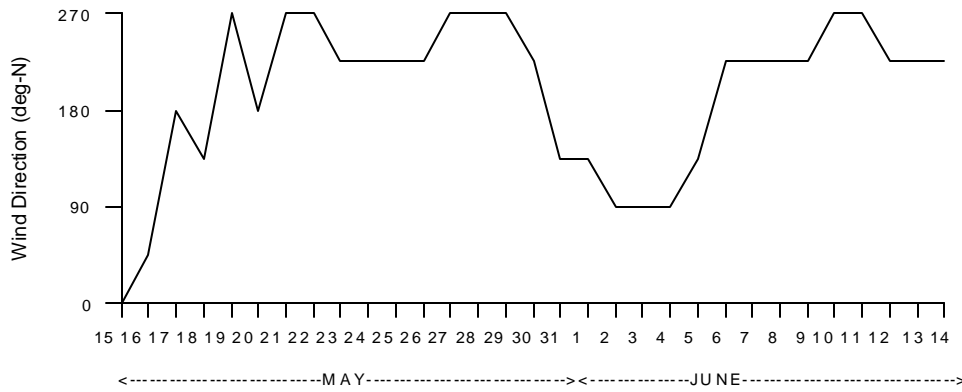
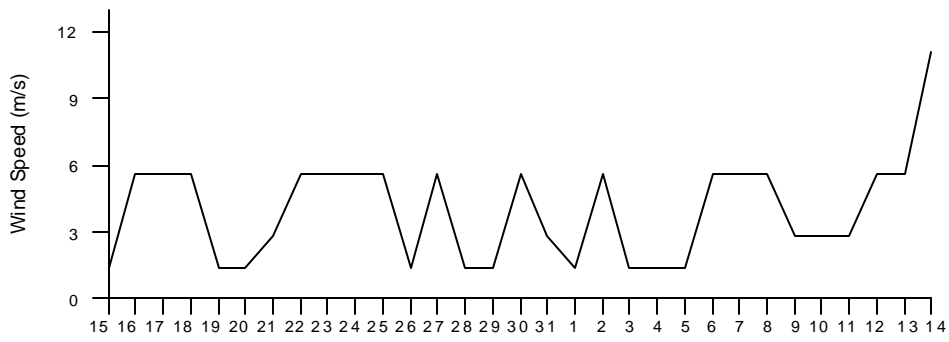
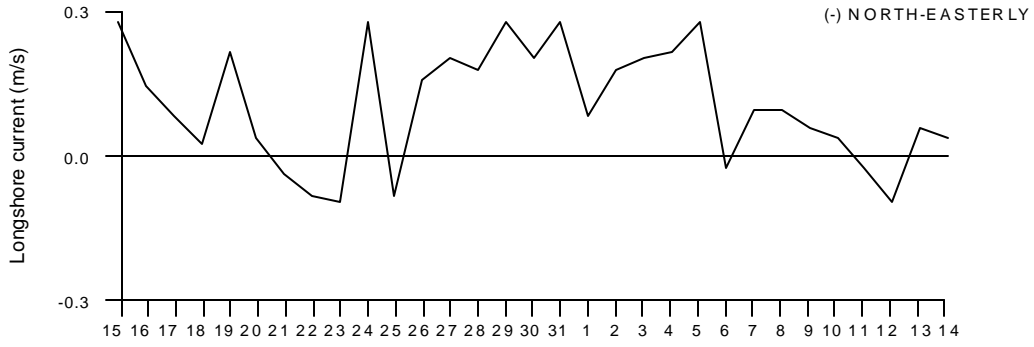


FIG. 23 DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 4

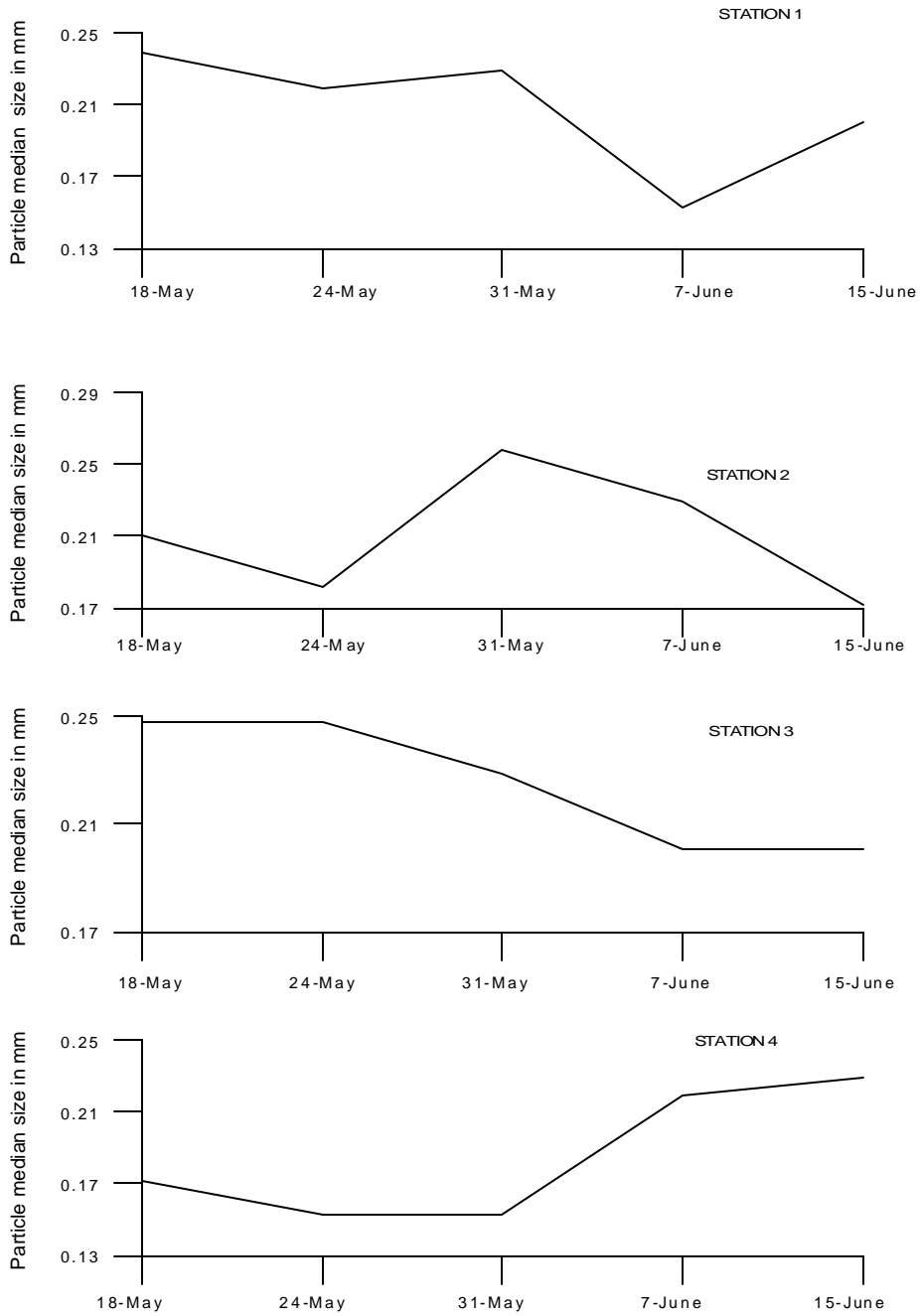
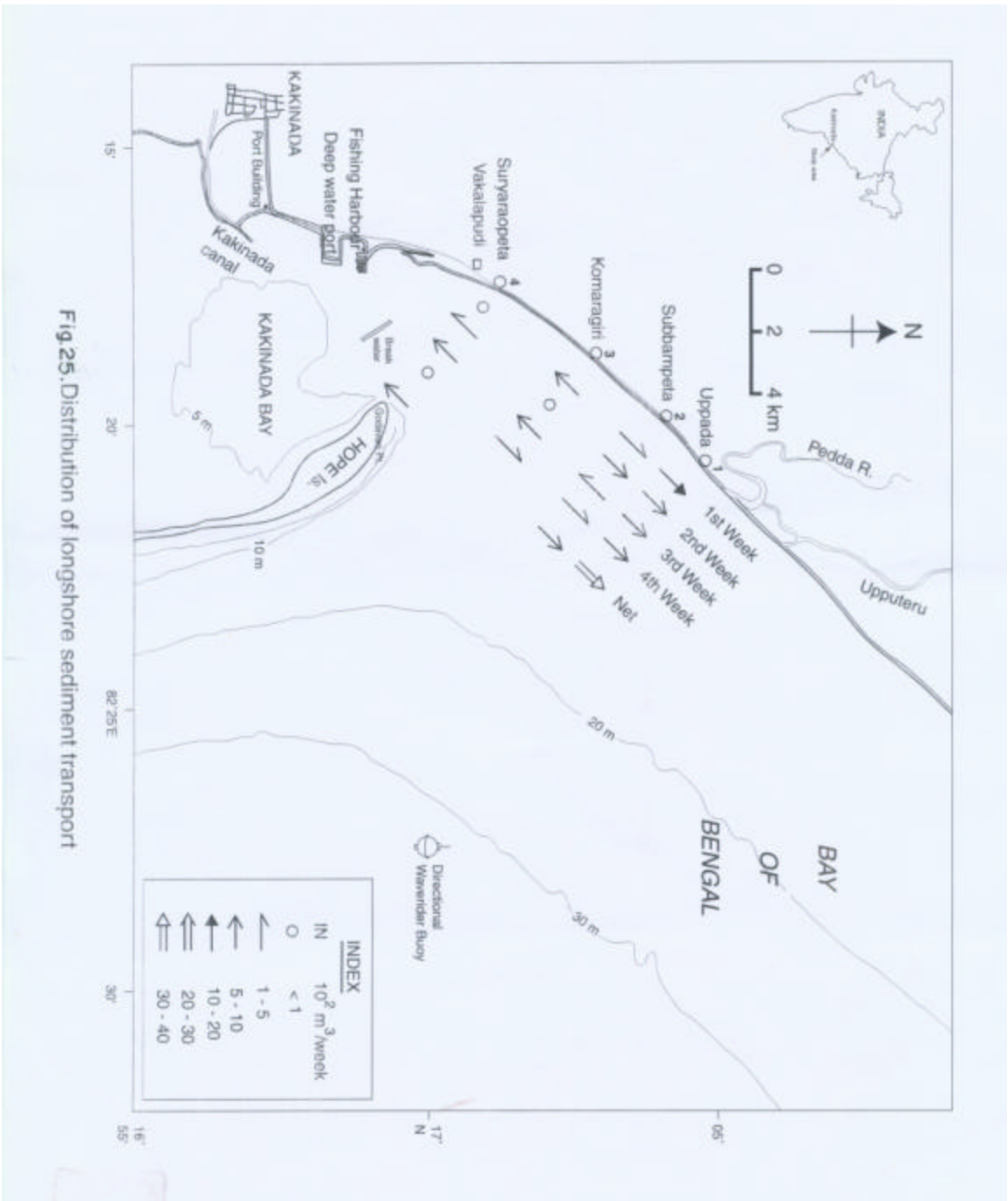


Fig. 24 WEEKLY VARIATION OF BEACH PARTICLE MEDIAN SIZE ( $D_{50}$ )





## APPENDIX-1

### Description of station location and bench mark

Stn. No.	Location	Position		Bench mark
		Latitude	Longitude	
1	Uppada village beach	17 <sup>0</sup> 04.781'N	82 <sup>0</sup> 20.314'E	Marking on the telephone pole 0.5 m above ground level near local market area.
2	Subbampeta (North of SPGL* plant)  *Spectrum Power Generation Ltd.	17 <sup>0</sup> 04 .135 'N	82 <sup>0</sup> 19.690'E	Top of the Furlong stone showing Uppada 2 km on the south side and Vakalapudi 10 km on the north side by Kakinada – Addaripeta road.side. SPGL plant gate situated 150 m south away. Low lying field situated on the backshore.
3	Komaragiri (South of SPGL plant)	17 <sup>0</sup> 02.889'N	82 <sup>0</sup> 18.514'E	Yellow marking on the electric pole No.57 by the roadside 0.5 m above ground level, 20 m north of furlong stone shows Uppada 5 km on the southside and Vakalapudi 7 km on the northside.



4	Suryaraopeta (North of Vakalapudi)	17 <sup>0</sup> 01.214'N	82 <sup>0</sup> 17.471'E	Yellow marking on left side top of the platform situated on the beach, facing towards sea. Casurina plantations and the road exists rear side of this station.
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## APPENDIX -2

### WEEKLY BEACH LEVELS AT STATION 1

18-5-2001		24-5-2001		31-5-2001		7-6-2001		15-6-2001	
*0	** -0.57	0	-0.575	0	-0.58	0	-0.58	0	-0.57
5	-0.74	5	-0.775	5	-0.75	5	-0.75	5	-0.77
10	-0.67	10	-0.675	10	-0.62	10	-0.67	10	-0.68
11	-0.59	11	-0.635	11	-0.63	11	-0.64	11	-0.7
12	-0.94	12	-1.12	12	-1.1	12	-1.22	12	-1.14
13	-1.2	13	-1.405	13	-1.365	13	-1.62	13	-1.35
14	-1.64	14	-1.725	14	-1.67	14	-1.74	14	-1.59
15	-1.84	15	-1.795	15	-1.775	15	-1.79	15	-1.7
20	-2.02	20	-1.945	20	-1.89	20	-1.82	20	-1.83
25	-2.01	25	-1.975	25	-1.99	25	-2.12	25	-2.02
30	-2.26	30	-2.415	30	-2.43	30	-2.53	30	-2.42
35	-2.64	35	-2.935	35	-2.89	35	-2.98	35	-2.85
40	-3.44	40	-3.355	40	-3.32	40	-3.38	40	-3.2
45	-3.98	45	-3.665	45	-3.73	45	-3.65	45	-3.48
50	-4.16	50	-3.925	50	-4.09	50	-3.87	50	-3.72
55	-4.61	55	-4.155	55	-4.25	55	-4.08	55	-4.06
		60	-4.285	60	-4.41	60	-4.37	60	-4.36
		65	-4.475			65	-4.43	65	-4.5
		70	-4.725			70	-4.5	70	-4.52
		75	-4.965			75	-4.6	75	-4.56
						80	-4.6	80	-4.68
						85	-4.75	85	-4.82
						90	-4.96	90	-5.06
						95	-5.2		

\* Seaward distance in metres

\*\* Reduced level in metres



## WEEKLY BEACH LEVELS AT STATION 2

18-5-2001		24-5-2001		31-5-2001		7-6-2001		15-6-2001	
*0	** -1.01	0	-1	0	-1.01	0	-0.995	0	-1
5	-0.75	5	-0.74	5	-0.73	5	-0.735	5	-0.745
10	-0.98	10	-0.95	10	-0.95	10	-0.955	10	-0.965
15	-0.98	15	-0.91	15	-0.85	15	-0.905	15	-0.905
20	-1.28	20	-1.24	20	-1.24	20	-1.235	20	-1.285
25	-1.13	25	-1.18	25	-1.18	25	-1.185	25	-1.205
30	-1.545	30	-1.44	30	-1.395	30	-1.465	30	-1.545
35	-1.665	35	-1.6	35	-1.58	35	-1.585	35	-1.615
40	-1.895	40	-1.78	40	-1.8	40	-1.885	40	-1.955
45	-2.37	45	-2.25	45	-2.28	45	-2.325	45	-2.295
50	-2.805	50	-2.64	50	-2.67	50	-2.755	50	-2.665
55	-3.275	55	-2.98	55	-3.04	55	-3.115	55	-2.985
60	-3.805	60	-3.26	60	-3.39	60	-3.405	60	-3.285
65	-4.085	65	-3.49	65	-3.73	65	-3.63	65	-3.525
70	-4.135	70	-3.7	70	-3.91	70	-3.845	70	-3.705
75	-4.205	75	-3.92	75	-4.06	75	-4.005	75	-3.875
80	-4.395	80	-4.24	80	-4.24	80	-4.125	80	-4.015
85	-4.515	85	-4.31	85	-4.44	85	-4.315	85	-4.145
90	-4.755	90	-4.39	90	-4.7	90	-4.395	90	-4.255
		95	-4.5			95	-4.475	95	-4.345
		100	-4.58			100	-4.575	100	-4.425
		105	-4.8			105	-4.655	105	-4.545
						110	-4.795	110	-4.765
						115	-4.94		
						120	-5.075		

\* Seaward distance in metres

\*\* Reduced level in metres



### WEEKLY BEACH LEVELS AT STATION 3

18-5-2001		24-5-2001		31-5-2001		7-6-2001		15-6-2001	
0	-0.51	0	-0.51	0	-0.495	0	-0.49	0	-0.51
5	-0.38	5	-0.43	5	-0.435	5	-0.43	5	-0.45
10	-0.39	10	-0.26	10	-0.38	10	-0.53	10	-0.49
15	-0.72	15	-0.705	15	-0.715	15	-0.65	15	-0.69
20	-0.62	20	-0.62	20	-0.645	20	-0.64	20	-0.69
25	-0.58	25	-0.55	25	-0.555	25	-0.48	25	-0.555
30	-0.89	30	-0.87	30	-0.88	30	-0.89	30	-0.9
35	-1.15	35	-1.13	35	-1.105	35	-1.1	35	-1.14
40	-1.33	40	-1.34	40	-1.315	40	-1.29	40	-1.35
45	-1.52	45	-1.47	45	-1.455	45	-1.4	45	-1.46
50	-1.47	50	-1.33	50	-1.29	50	-1.26	50	-1.33
55	-1.35	55	-1.16	55	-1.115	55	-1.1	55	-1.18
60	-1.2	60	-1.07	59	-1.04	60	-0.98	60	-1.13
64	-1.21	61	-1.22	60	-1.125	61	-1.09	65	-1.44
65	-1.46	62	-1.41	65	-1.855	65	-1.79	70	-2.11
70	-2.25	63	-1.58	70	-2.465	70	-2.4	75	-2.64
75	-2.77	64	-1.75	75	-2.895	75	-2.74	80	-2.97
80	-3.27	65	-1.91	80	-3.315	80	-2.96	85	-3.2
85	-3.43	70	-2.48	85	-3.495	85	-3.16	90	-3.46
90	-3.49	75	-2.845	90	-3.555	90	-3.5	95	-3.65
95	-3.71	80	-3.09	95	-3.635	95	-3.66	100	-3.77
100	-3.89	85	-3.3	100	-3.7	100	-3.84	105	-3.9
		90	-3.49			105	-3.95	110	-3.92
		95	-3.73			110	-4.11	115	-4
		100	-3.84			115	-4.25	120	-4.12
		105	-4.03			120	-4.38		
		110	-4.13						
		115	-4.28						

\* Seaward distance in metres

\*\* Reduced level in metres



## WEEKLY BEACH LEVELS AT STATION 4

18-5-2001		24-5-2001		31-5-2001		7-6-2001		15-6-2001	
0	-0.28	0	-0.27	0	-0.28	0	-0.26	0	-0.27
5	-0.27	5	-0.28	5	-0.265	5	-0.26	5	-0.27
10	-0.21	10	-0.22	10	-0.22	10	-0.2	10	-0.22
15	-0.28	15	-0.28	15	-0.27	15	-0.275	15	-0.28
20	-0.39	20	-0.36	20	-0.355	20	-0.395	20	-0.37
25	-0.35	25	-0.35	25	-0.365	25	-0.34	25	-0.37
30	-0.32	30	-0.35	30	-0.335	30	-0.29	30	-0.36
35	-0.29	35	-0.36	35	-0.33	35	-0.3	35	-0.33
40	-0.42	40	-0.46	40	-0.44	40	-0.42	40	-0.45
45	-0.56	45	-0.57	45	-0.54	45	-0.54	45	-0.56
50	-0.83	50	-0.845	50	-0.8	50	-0.8	50	-0.82
55	-1.05	55	-1.05	55	-1.04	55	-1.06	55	-1.05
60	-1.15	60	-1.16	60	-1.16	60	-1.16	60	-1.18
65	-1.17	65	-1.15	65	-1.155	65	-1.15	65	-1.15
70	-1.1	70	-1.05	70	-1.03	70	-1.03	70	-1.03
75	-1	75	-0.92	75	-0.93	75	-0.89	75	-0.92
80	-1.46	76	-0.9	76	-0.89	76	-0.85	80	-1.13
85	-2.07	77	-0.9	77	-0.87	77	-0.85	85	-1.61
90	-2.48	78	-1.04	78	-1.01	78	-0.99	90	-1.87
95	-2.96	79	-1.29	79	-1.155	79	-1.13	95	-2.15
100	-3.04	80	-1.42	80	-1.3	80	-1.28	100	-2.39
105	-3.11	85	-2.03	85	-1.82	85	-1.82	105	-2.57
110	-3.21	90	-2.415	90	-2.205	90	-2.18	110	-2.65
115	-3.34	95	-2.6	95	-2.49	95	-2.41	115	-2.74
120	-3.55	100	-2.765	100	-2.74	100	-2.6	120	-2.8
125	-3.76	105	-2.875	105	-2.93	105	-2.74	125	-2.88
		110	-2.975	110	-3.01	110	-2.85	130	-2.95
		115	-3.065	115	-3.09	115	-2.95	135	-3.07
		120	-3.145	120	-3.16	120	-3.15	140	-3.23
		125	-3.205	125	-3.14	125	-3.23	145	-3.37

\* Seaward distance in metres

\*\* Reduced level in metres



### APPENDIX-3

#### DESCRIPTION OF WEEKLY LITTORAL ENVIRONMENTAL PARAMETERS

<u>Column No.</u>	<u>Description</u>
1	Station Number
2 to 4	Date, Month, Year
5	Time in hours
6	Breaking wave height in m
7	Wave period in sec
8	Breaking wave angle in degrees (-) Anti-Clockwise to the coast.
9	Type of breaker 1- Spill, 2-Plunge, 3-Collapse 4-Spill and plunge, 5-Plunge and Spill
10	Width of surfzone in m
11	Longshore current velocity in m/min (+)-South-Westerly (-)-North-Easterly )
12	Wind Speed in kmph
13	Wind direction in deg. from (1- N, 2-NE, 3-E, 4-SE 5-S, 6-SW, 7-W, 8-NW)



## WEEKLY LITTORAL ENVIRONMENTAL PARAMETERS AT DIFFERENT STATION

### STATION 1

1	2	3	4	5	6	7	8	9	10	11	12	13
1	18	5	2001	1415	1.0	9	0	5	30	-17	40	5
1	24	5	2001	1715	0.7	10	0	5	25	-12	20	5
1	31	5	2001	1110	0.8	10	1	1	30	3	5	4
1	7	6	2001	1535	0.6	11	-1	5	28	-27	20	5
1	15	6	2001	1500	1.5	11	-1	5	35	-8	20	6

### STATION 2

1	2	3	4	5	6	7	8	9	10	11	12	13
2	18	5	2001	1315	0.6	10	0	5	40	18	40	5
2	24	5	2001	1640	0.8	10	0	5	30	8	20	6
2	31	5	2001	1030	0.6	9	0	5	40	2	10	4
2	7	6	2001	1610	0.7	12	-1	1	28	-5	20	5
2	15	6	2001	1415	1.3	11	-1	5	28	-10	40	6

### STATION 3

1	2	3	4	5	6	7	8	9	10	11	12	13
3	18	5	2001	1225	0.9	12	1	5	45	20	20	5
3	24	5	2001	1605	0.6	12	-1	5	22	-17	20	6
3	31	5	2001	0940	0.6	13	2	1	35	17	10	4
3	7	6	2001	1645	0.5	12	0	1	25	-2	20	5
3	15	6	2001	1330	1.3	10	1	5	30	-5	20	6

### STATION 4

1	2	3	4	5	6	7	8	9	10	11	12	13
4	18	5	2001	1135	0.4	13	0	5	38	1	20	4
4	24	5	2001	1525	0.4	12	1	1	15	14	20	6
4	31	5	2001	0900	0.5	12	1	5	30	14	10	4
4	7	6	2001	1740	0.3	11	0	1	18	5	20	6
4	15	6	2001	1235	1.0	14	0	5	15	8	20	6



## APPENDIX-4

### DESCRIPTION OF DAILY LITTORAL ENVIRONMENTAL PARAMETERS

<u>Column No.</u>	<u>Description</u>
1	Station Number
2 to 4	Date, Month, Year
5	Time in hours
6	Breaking wave height in m
7	Wave period in sec
8	Breaking wave angle in degrees (-) Anti-Clockwise to the coast.
9	Type of breaker 1- Spill, 2-Plunge, 3-Collapse 4-Spill and plunge, 5-Plunge and Spill
10	Width of surfzone in m
11	Longshore current velocity in m/min (+)-South-Westerly (-)-North-Easterly )
12	Wind Speed in kmph
13	Wind direction in deg. from (1- N, 2-NE, 3-E, 4-SE 5-S, 6-SW, 7-W, 8-NW)



## DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 1

1	2	3	4	5	6	7	8	9	10	11	12	13
1	15	5	2001	1120	1.7	11	2	5	30	-17	20	3
1	16	5	2001	1215	1.6	11	2	5	32	-15	20	3
1	17	5	2001	1235	1.2	10	1	5	25	-18	20	5
1	18	5	2001	1415	1.0	9	0	5	30	-17	40	5
1	19	5	2001	0955	1.2	12	0	5	22	-25	20	8
1	20	5	2001	0930	0.8	11	0	5	22	-12	10	5
1	21	5	2001	0945	1.0	11	0	5	22	-20	10	7
1	22	5	2001	0935	1.1	12	0	5	30	-16	20	7
1	23	5	2001	0930	0.9	12	0	5	20	-10	20	6
1	24	5	2001	1715	0.7	10	0	5	25	-12	20	5
1	25	5	2001	0950	1.2	11	0	5	20	-14	40	6
1	26	5	2001	0950	1.3	11	-2	5	20	-15	5	6
1	27	5	2001	0955	1.1	12	-1	5	30	-9	10	7
1	28	5	2001	0945	1.2	12	0	5	40	-4	10	7
1	29	5	2001	0930	1.4	11	0	5	38	-12	10	7
1	30	5	2001	0945	1.0	9	1	5	32	-6	20	7
1	31	5	2001	1110	0.8	10	1	1	30	3	5	4
1	1	6	2001	0930	0.6	12	-1	5	35	-4	5	4
1	2	6	2001	0955	0.7	10	0	1	28	-12	20	4
1	3	6	2001	0920	0.9	12	1	5	22	-6	20	3
1	4	6	2001	0910	1.1	13	-1	5	20	-10	5	3
1	5	6	2001	0920	1.4	14	-1	5	40	-17	20	5
1	6	6	2001	0935	1.3	13	1	5	35	-5	10	6
1	7	6	2001	1535	0.6	11	-1	5	28	-27	20	5
1	8	6	2001	0930	0.8	11	-1	5	18	-7	10	6
1	9	6	2001	0920	0.8	12	-1	5	20	-5	10	6
1	10	6	2001	0955	0.8	11	-1	5	22	-7	10	6
1	11	6	2001	1010	0.8	12	-1	5	18	-8	20	7
1	12	6	2001	1015	1.0	12	-2	5	22	-20	20	6
1	13	6	2001	1010	1.5	10	-1	5	33	-4	20	6
1	14	6	2001	1025	1.3	11	0	5	30	-7	20	6
1	15	6	2001	1500	1.5	11	-1	5	35	-8	20	6





## DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 2

1	2	3	4	5	6	7	8	9	10	11	12	13
2	15	5	2001	1050	1.8	12	1	5	40	8	20	3
2	16	5	2001	1155	1.5	11	1	5	35	9	20	3
2	17	5	2001	1205	0.9	11	1	5	32	12	20	5
2	18	5	2001	1315	0.6	10	0	5	40	18	40	5
2	19	5	2001	0930	0.6	14	0	5	35	-5	20	8
2	20	5	2001	0910	0.5	12	1	5	32	6	10	5
2	21	5	2001	0920	0.6	11	0	5	20	-10	20	7
2	22	5	2001	0915	1.1	12	-1	5	30	-18	20	7
2	23	5	2001	0905	0.8	13	-1	1	15	-12	20	6
2	24	5	2001	1640	0.8	10	0	5	30	8	20	6
2	25	5	2001	0935	0.9	10	-2	5	18	-27	40	6
2	26	5	2001	0910	1.0	11	-1	5	30	-16	10	6
2	27	5	2001	0930	1.0	12	0	5	32	-14	10	7
2	28	5	2001	0925	1.1	11	0	5	35	-12	10	7
2	29	5	2001	0910	1.0	11	-1	5	40	-5	20	7
2	30	5	2001	0925	1.1	10	-2	5	35	14	20	6
2	31	5	2001	1030	0.6	9	0	5	40	2	10	4
2	1	6	2001	0910	0.5	12	0	1	38	2	10	4
2	2	6	2001	0935	0.5	9	-2	1	30	-10	40	4
2	3	6	2001	0905	0.8	10	0	5	30	3	10	3
2	4	6	2001	0855	0.9	12	1	5	35	5	5	3
2	5	6	2001	0905	1.1	13	0	5	35	4	10	5
2	6	6	2001	0925	1.2	13	1	5	25	13	20	6
2	7	6	2001	1610	0.7	12	-1	1	28	-5	20	5
2	8	6	2001	0910	0.7	12	-1	5	17	-5	20	6
2	9	6	2001	0900	0.6	11	-1	5	20	-9	20	6
2	10	6	2001	0935	0.6	12	-1	5	18	-7	20	7
2	11	6	2001	0940	0.6	12	-2	5	20	-6	20	7
2	12	6	2001	1000	0.7	11	-2	5	30	-14	20	6
2	13	6	2001	0950	1.1	10	-1	5	30	-7	40	6
2	14	6	2001	1010	0.8	10	-2	5	32	-4	40	6
2	15	6	2001	1415	1.3	11	-1	5	28	-10	40	6



### DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 3

1	2	3	4	5	6	7	8	9	10	11	12	13
3	15	5	2001	1030	1.7	12	2	5	35	4	5	3
3	16	5	2001	1130	1.3	11	1	5	40	11	20	3
3	17	5	2001	1145	0.8	11	1	5	40	16	20	5
3	18	5	2001	1225	0.9	12	1	5	45	20	20	5
3	19	5	2001	0915	0.7	12	1	5	35	12	20	8
3	20	5	2001	0855	0.8	12	1	5	35	13	5	5
3	21	5	2001	0900	0.7	11	0	5	14	12	20	7
3	22	5	2001	0845	1.1	12	0	5	10	-3	20	7
3	23	5	2001	0845	1.1	13	-1	5	12	-10	20	6
3	24	5	2001	1605	0.6	12	-1	5	22	-17	20	6
3	25	5	2001	0920	0.9	12	-1	5	10	-14	40	6
3	26	5	2001	0850	0.9	14	0	5	25	4	5	6
3	27	5	2001	0855	0.9	12	0	5	13	8	5	7
3	28	5	2001	0900	0.9	12	0	5	32	9	10	7
3	29	5	2001	0845	0.7	10	0	5	32	-7	20	7
3	30	5	2001	0905	0.6	11	1	5	35	-4	20	6
3	31	5	2001	0940	0.6	13	2	1	35	17	10	4
3	1	6	2001	0840	0.4	11	1	1	40	-3	10	4
3	2	6	2001	0915	0.5	11	2	1	20	4	40	2
3	3	6	2001	0845	0.7	10	1	5	22	3	20	3
3	4	6	2001	0835	1.1	12	1	5	18	5	10	3
3	5	6	2001	0840	1.2	12	2	5	8	15	20	5
3	6	6	2001	0905	1.4	14	1	5	28	17	20	6
3	7	6	2001	1645	0.5	12	0	1	25	-2	20	5
3	8	6	2001	0850	0.6	11	0	5	15	4	10	6
3	9	6	2001	0840	0.6	12	0	5	14	-2	10	6
3	10	6	2001	0915	0.6	12	0	5	12	-5	20	7
3	11	6	2001	0920	0.5	11	-1	5	10	-9	20	7
3	12	6	2001	0940	0.5	11	-2	5	18	-13	40	6
3	13	6	2001	0920	0.9	10	-1	5	27	-10	40	6
3	14	6	2001	0950	0.9	10	-1	5	30	-9	40	6
3	15	6	2001	1330	1.3	10	1	5	30	-5	20	6



## DAILY LITTORAL ENVIRONMENTAL PARAMETERS AT STATION 4

1	2	3	4	5	6	7	8	9	10	11	12	13
4	15	5	2001	1010	1.5	14	1	5	35	14	5	1
4	16	5	2001	1110	1.3	12	1	5	35	7	20	2
4	17	5	2001	1130	0.5	12	0	5	35	4	20	5
4	18	5	2001	1135	0.4	13	0	5	38	1	20	4
4	19	5	2001	0845	0.7	12	1	5	30	11	5	7
4	20	5	2001	0820	0.7	13	0	5	38	2	5	5
4	21	5	2001	0845	0.6	11	0	5	15	-2	10	7
4	22	5	2001	0815	0.8	12	0	5	15	-4	20	7
4	23	5	2001	0820	0.7	12	2	5	17	-5	20	6
4	24	5	2001	1525	0.4	12	1	1	15	14	20	6
4	25	5	2001	0900	0.6	13	0	5	25	-4	20	6
4	26	5	2001	0820	0.8	14	1	5	35	8	5	6
4	27	5	2001	0830	0.7	12	0	5	30	10	20	7
4	28	5	2001	0835	0.5	11	0	5	30	9	5	7
4	29	5	2001	0820	0.5	10	1	5	35	14	5	7
4	30	5	2001	0835	0.4	14	1	5	22	10	20	6
4	31	5	2001	0900	0.5	12	1	5	30	14	10	4
4	1	6	2001	0815	0.4	11	0	1	35	4	5	4
4	2	6	2001	0845	0.4	12	2	1	25	9	20	3
4	3	6	2001	0825	0.6	13	1	5	28	10	5	3
4	4	6	2001	0810	0.8	14	2	5	34	11	5	3
4	5	6	2001	0820	1.1	12	2	5	35	14	5	4
4	6	6	2001	0840	1.2	13	0	5	30	-1	20	6
4	7	6	2001	1740	0.3	11	0	1	18	5	20	6
4	8	6	2001	0830	0.5	12	1	5	22	5	20	6
4	9	6	2001	0820	0.4	12	1	5	20	3	10	6
4	10	6	2001	0850	0.4	12	0	5	22	2	10	7
4	11	6	2001	0900	0.4	12	0	5	23	-1	10	7
4	12	6	2001	0855	0.4	12	0	5	23	-5	20	6
4	13	6	2001	0900	0.5	10	0	5	25	3	20	6
4	14	6	2001	0930	0.6	10	0	5	23	2	40	6
4	15	6	2001	1235	1.0	14	0	5	15	8	20	6



## APPENDIX-5

DESCRIPTION OF BEACH PROFILES OBSERVED WEEKLY BASED ON TIDES AT KAKINADA DURING THE STUDY PERIOD.

WEEK	PERIOD		EFFECTIVE TIDE	REPRESENT
	From	To		
FIRST	18-5-2001	23-5-2001	NEAP TO SPRING	END OF PRE-MONSOON
SECOND	24-5-2001	30-5-2001	SPRING TO NEAP	---- - DO-----
THIRD	31-5-2001	06-6-2001	NEAP TO SPRING	ON SET OF SW-MONSOON
FOURTH	07-6-2001	14-6-2001	SPRING TO NEAP	START OF SW-MONSOON



**PLATE-1**



**PHOTO SHOWS EXTENT OF SEVERE EROSION AT UPPADA**



**PHOTO SHOWS THE EFFECT OF SEA WAVES ATTACK ON COASTAL STRUCTURES**