Mausam, (1986) 37, 2, 211-214

551.466 : 551.553.21(267)

Analysis of instrumental data on waves over Indian seas during Monex-79

T. R. SIVARAMAKRISHNAN

Meteorological Office, Mohanbari Airport, Dibrugarh (Assam)

(*Received 23 October 1984*)

सार — मई से अगस्त 1979 के दौरान एक तरंग अभिलेखी से सुसज्जित भारतीय पोत "गवेषिणी" अरब महासागर और बंगाल की खाड़ी में समुद्र यात्रा पर निकला और तरंग आंकड़े एकत्रित किए । संसाधित तरंग आंकड़ों का विश्लेषण मानसून के दौरान अरब सागर के ऊपर निम्न मानक विचलन वाली तरंग ऊंचाई के लिए उच्च माध्यमान प्रदर्शित करता है, जबकि बंगाल की खाड़ी पर ठीक इसके विपरीत स्थिति होती है । अरब महासागर पर तरंग मानावली अपने उच्चतम मान, मानसून से पूर्व लगभग 4.5 सै. से लेकर, मानसून के आगमन पर 6 सै. तक परिवर्तित होती है । खाड़ी में तरंगों की मानावली का परास इसकी अपेक्षा कम है ।

ABSTRACT. Indian ship *Gaveshini* cruised through Arabian Sea and Bay of Bengal with a wave recorder fitted in it during May to August 1979 and collected wave data. The analysis of the processed wave data shows high mean value for the wave height with low standard deviation over the Arabian Sea during monsoon while reverse is the case over the Bay of Bengal. The peak in wave spectra shifts from about 4.5 sec before monsoon to 6 sec with the arrival of monsoon over Arabian Sea. The spectrum of waves over the Bay is comparatively narrower.

1. Introduction

With the increased marine activities like offshore oil explorations, the study of ocean waves over Indian seas has attained operational significance. Several studies have been made in the recent past on the overall wave behaviour in Arabian Sea and Bay of Bengal (1982 a, 1982 b, 1982 c, 1983, 1984). During monsoon experiments of 1977 extensive wave observations were made by Soviet research vessels and an analysis of the same was reported by Mukherjee and Sivaramakrishnan (1980, 1982 d), but all the observations were non-instrumental either from a moving platform like the ship or a stationary platform like jacked up rigs and anchored ships. During Monex-79 experiments, Indian research vessel *Gaveshini* cruised through Arabian Sea and Bay of Bengal with an ocean wave recorder fitted in it. The results from an analysis of data from these records may be of interest to meteorologists and oceanographers.

2. Cruise plan

Gaveshini made five cruises in all in both Arabian Sea and Bay of Bengal during the months May to August 1979 and collected oceanographic data. She cruised along about 15° N latitude between 71.5° E and 74° E longitude during 17 to 24 May 1979. The first set of data collected from this cruise may be considered to represent the waves during pre-monsoon over Arabian Sea. Again she travelled through about the same latitude between 70° & 73° E longitude during 29 June to 3 July in another cruise. The second set of data over the same latitude from this cruise can very well represent waves during monsoon because the southwest monsoon was well set by that period over central Arabian Sea.

There was a cruise in July over the Bay of Bengal. Between 24 to 30 July *Gaveshini* was stationary at Lat. 16° N/Long. 87° E and recorded the waves. Wave behaviour over the Bay during monsoon can be revealed from an analysis of this third set of data.

3. Methodology

Wave observation was taken more than once an any day. On some day the frequency was about 8 per day. The time of observation was around the synoptic hours

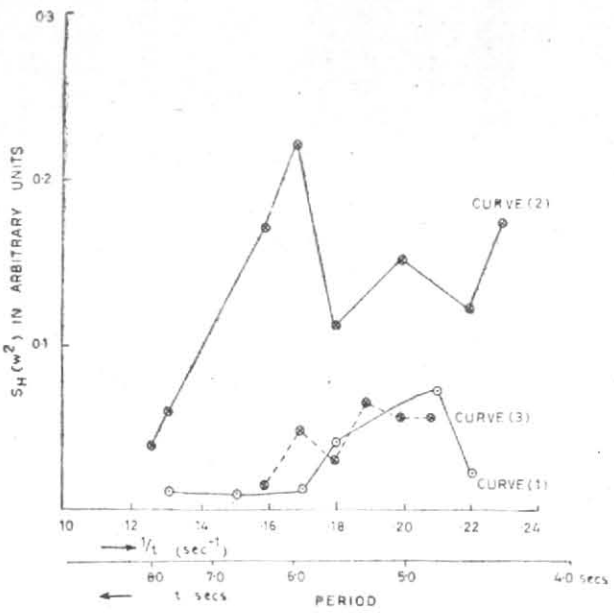

Fig. 1. Energy spectra [curve (1) pertains to waves of pre-monsoon over Arabian Sea, curve (2) pertains to waves during monsoon in Arabian Sea & curve (3) pertains to waves over the Bay during monsoon

followed in meteorological observations, that is, 0830, 1130, 1430 etc IST. The significant wave height and wave period from each observation was arrived at, from the wave record and have been published by National Institute of Oceanography, Goa. Using all these values the mean and standard deviation were worked out for each set. Then the energy spectra for the waves were computed separately, by standard methods.

On certain days during monsoon, that is, during the period when second and third sets of data were collected, there were visually estimated reports of sea and swell by *Gaveshini* as well as a few ships who happend to pass close by to her position. These were mainly at 00 and 12 GMT. These were picked up from *Indian Daily Weather Reports*, and compared with instrumental wave observations taken around the same time.

4. Results and discussion

The mean wave height before the onset of monsoon (wave from the first set) was 0.86 m with $\sigma_n = 0.21$ m. The mean wave height rose to 5.09 m with $\sigma_n = 0.51$ m after the onset of monsoon. Thus the arrival of monsoon brings about a drastic change in wave height over Arabian Sea.

TABLE 1

Wave observation over Arabian Sea

Date (1979)	Time (GMT)	Wave recorder data		Ships obsn.			
				Sea wave		Swell	
		Significant height (m)	Period (sec)	Height (m)	Period (sec)	Height (m)	Period (sec)
30 June	00	5.18	7.5	1.0	2	3.5	—
01 July	00	5.78	6.1	—	—	7.0	8
02 July	00	4.96	4.3	1.0	—	4.0	5
	12	4.4	6	—	—	3.0	5
03 July	00	4.37	4.5	1.0	—	4.0	9

The mean wave height worked out to be 1.85 m with $\sigma_n = 0.63$ m for the Bay of Bengal (from III set of data). Thus the wave height over the Bay is much less compared to Arabian Sea during monsoon. However, it should be remembered that the monsoon was strong to vigorous over Arabian Sea during the observation period while it was only moderate over the Bay during the observation. It can be seen that over Arabian Sea the

TABLE 2

Wave observations over Bay of Bengal

Date (1979)	Time (GMT)	Wave recorder data		Ships observation			
		Significant height (m)	Period (sec)	Sea wave Height (m)	Sea wave Period (sec)	Swell Height (m)	Swell Period (sec)
24 July	00	1.33	5.6	—	—	1.0	6
25 ,,	00	1.27	5.0	—	—	1.0	7
26 ,,	00	1.19	5.3	—	—	1.0	8
27 ,,	00	1.38	5.6	—	—	1.0	6
	12	1.25	4.6	—	—	1.0	7
28 ,,	00	1.8	5.1	—	—	1.0	8
	12	2.5	4.9	—	—	1.5	8
29 ,,	00	2.3	5.0	—	—	2.0	7
30 ,,	00	2.9	5.7	—	—	2.5	8

TABLE 3

Wave heights computed from surface winds

Date (July)	Wind speed (kt)	Wave height (m) as per Nowmann method (a)	Green & Dorreshin (b)	SMB method (c)	Sivaramakrishnan* (d)	Height recorded (m)
		I. Arabian Sea				
01	30	4.0	4.8	5.1	4.5	5.78
02	27	3.0	4.0	4.3	3.3	4.96
03	25	2.3	3.5	3.3	2.5	4.37
		II. Bay of Bengal				
26	10	0.6	1.0	1.1	—	1.19
27	10	0.6	1.0	1.1	—	1.38
28	15	0.8	1.3	1.5		1.8
29	20	1.5	2.4	2.3		2.3
30	20	1.5	2.4	2.3		2.9

*Valid for Arabian Sea only.

(a) Beach Erosion Board Tech. Memo. 43 (1953)

(b) Handbook of wave analysis & forcasting WMO No. 446 (1976),

(c) U.S. Navy Hydrographic office *Publication* No. 601 (1947),

(d) *Mausam*, (1984) **35**, 2, p. 239.

waves have got high mean value with low standard deviation indicating thereby a low value of coefficient of variation. But opposite is the case for Bay of Bengal observation. This is an important difference between the waves at the two seas which deserves notice.

Fig. 1 presents the wave spectra for the three categories. The first point to note is that the energy is distributed in a broader spectrum over Arabian Sea both before and during monsoon, whereas it is comparatively narrower over the Bay (between 4.5 & 6.0 seconds period only) as observed from curve (3). The peak in Arabian Sea wave spectrum before monsoon (curve 1) is between 4.5 & 5 sec period. This shifts to 6 sec after the arrival of monsoon as revealed by curve (2). In fact the peak in energy spectra for waves during monsoon is well defined and rather sharp. The maximum value for Bay spectrum (curve 3) is between 5 and 5.5 sec period, though there is a second peak against the same value where peak appeared in the Arabian Sea wave spectra for monsoon.

Mukherjee and Sivaramakrishnan (1982 a) have observed the appearance of higher period swells and the increase in swell period with the onset of monsoon over Arabian Sea. The shifting of the peak to higher period side from curve (1) to curve (2) confirm this earlier observation.

Tables 1 & 2 show the wave recorder values and the ships reports of sea and swell observations on available days during monsoon over Arabian Sea and Bay of Bengal respectively. It can be seen that the swell wave height is closer to the recorder value than the sea waves. This suggests that the ocean wave spectrum is dominantly influenced by swells rathar than 'sea' waves.

The prevailing surface winds over the area around 00 GMT were taken from the weather charts and the wave heights due to those winds computed by different methods are tabulated in Table 3. It is seen that all the computations yield lower estimate of wave height as recorded by the recorder both over Arabian Sea and Bay of Bengal. This may be an useful information for wave forecasters for operational use.

References

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1980, *Mausam*, **31** 3, p. 443.

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1980, *Mausam*, **31**, 3, p. 447.

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1982 (a), *Mausam*, **33**, 1, p. 59.

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1982 (b), *Mausam*, **33**, 3, p. 391.

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1982 (c), *Mahasagar*, **14**, p. 51.

Sivaramakrishnan, T.R., 1982 (d), *Mausam*, **34**, 3, p. 373.

Sivaramakrishnan, T.R., 1983, *Mahasagar*, 16, p. 73.

Thiruvengadathan, A., 1984 (a), *Mausam*, **35**, 1, p. 103.

Prasad Rao, C.V.K. and Durga Prasad, M., 1984 (b), *Mausam*, **35**, 1, p. 107.

Sivaramakrishnan, T.R., 1984 (c), *Mausam*, **35**, 2, p. 39.