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Swells over the Arabian Sea during the months, May, June and July

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सार — इस शोधपत्र में भारत-रूस मानसून प्रयोग (इसमेक्स) 1973, मानसून प्रयोग 1977 एवं मॉनेक्स 1979 की अवधि में रूसी अनुसंधान पोतों से लिए गए प्रेक्षणों के आधार पर अरबसागर की महातरंगों के जलवायु विषयक अभिलक्षणों को प्रस्तुत किया गया है।

ABSTRACT. The paper presents the climatological features of the swells over the Arabian Sea, based on the observations made by the Russian research vessels during the Indo-Soviet Monsoon Experiment (ISMEX) 1973, Monsoon Experiment 1977 and Monex 1979.

1. Introduction

Studies on the swells over the Arabian Sea during the monsoon months are handicapped by the paucity of observations, partly due to difficulties experienced by the observers in distinguishing swells from the sea waves, since both are nearly from the same direction. However, the Russian research vessels taking part in the Indo-Soviet Monsoon Experiment (ISMEX) 1973, Monsoon Experiment of 1977 and Monex 1979 have reported sea and swell waves separately. Mukherjee and Sivaramakrishnan (1980 & 1982) have studied some aspects based on the swell observations over the Bombay High area taken by the oil rigs of Oil and Natural Gas Commission during the monsoon seasons of 1976 to 1978 and the swell observations during the 1977 monsoon season. In this paper, the climatological behaviour of swells over the Arabian Sea has been studied utilising all available swell reports of the Russian research vessels during the three years. Though the ships have, in general, reported observations at hourly intervals, only one value for a day has been used, except in exceptional cases where the direction of swells during the 24-hour period has varied by more than 20 deg. and/or the swell height changed by 0.5 m or more.

2. Method of analysis

Observations for each of the months, May, June and July have been grouped separately for each 5 deg. Long.-Lat. grids. For each month and for each grid, the scalar mean swell height ($\bar{H}$), its standard deviation (σ_H), coefficient of variation ($\sigma_H/\bar{H}$ expressed as percentage), vector mean swell height ($\bar{h}$), vector mean direction and steadiness ($\bar{h}/\bar{H}$, expressed as percentage) have been computed, provided the number of observations in any grid in the month is at least 20. The results are given in Table 1.

For each of these grids, the percentage number of occasions of swells from the sixteen different compass points (N, NNE, NE, ...) and of heights 2 m or less (low swells), 2.5 to 4 m (moderate swells), 4.5 to 6 m and greater than 6 m have been computed and depicted in diagrams similar to wind roses, provided the number of observations in any grid is at least 10. Figs. 1-3 show the patterns for the months of May, June and July respectively.

3. Results

3.1. *May*

The mean direction is southerly between latitudes 0 deg. and 5 deg. N and also elsewhere to the west of longitude 60 deg. E where it is also quite steady (80 to

TABLE 1

Swells over the Arabian Sea

Long. E/ Lat. N	50 to 55°						55 to 60°						60 to 65°					
	Scalar			Vector			Scalar			Vector			Scalar			Vector		
	a	b	c	d	e	f	a	b	c	d	e	f	a	b	c	d	e	f
May																		
15 to 20																		
10 to 15							1.7	0.67	39	1.5	214	86	1.0	0.46	44	0.5	246	49
5 to 10							2.6	1.14	44	2.4	224	93	1.5	0.83	57	0.9	221	65
0 to 5	1.9	0.54	29	1.7	161	89	2.1	0.88	41	1.8	199	83						
June																		
15 to 20							3.7	1.60	43	3.2	202	86	4.7	1.53	33	4.0	229	85
10 to 15	3.6	1.98	56	2.6	203	74	4.5	2.59	57	4.0	223	87	4.3	1.14	27	3.8	246	90
to 10													3.3	1.73	53	2.9	243	89
0 to 5																		
July																		
15 to 20							3.5	1.44	41	3.3	191	95	3.5	1.52	44	3.2	229	92
10 to 15							4.0	1.76	44	3.6	228	90	4.7	1.40	30	4.5	260	96
5 to 10																		
0 to 5																		

Long. E/ Lat. N.	65 to 70°						70 to 75°						75 to 80°					
	Scalar			Vector			Scalar			Vector			Scalar			Vector		
	a	b	c	d	e	f	a	b	c	d	e	f	a	b	c	d	e	f
May																		
15 to 20	1.7	0.53	30	1.5	245	89												
10 to 15							1.7	0.59	34	0.7	287	41						
5 to 10							1.2	0.39	31	0.5	214	39	1.8	0.83	47	0.8	231	45
0 to 5																		
June																		
15 to 20	3.4	1.59	47	3.2	245	95	3.8	1.46	36	3.4	244	89						
10 to 15	4.7	1.34	29	4.4	263	95	3.4	1.37	41	3.1	249	91						
5 to 10	2.5	0.99	39	2.0	257	78	2.8	1.24	44	2.1	253	74	2.6	0.76	29	1.3	252	53
0 to 5	2.1	0.83	39	1.2	208	55	2.0	0.50	25	1.9	160	98	2.4	0.52	22	1.8	234	37
July																		
15 to 20	3.2	1.19	37	3.2	249	98												
10 to 15	4.5	1.02	23	4.3	257	95	3.3	1.36	41	3.0	259	90						
5 to 10	3.2	1.43	45	2.7	252	84	2.1	1.18	55	1.9	271	88	2.1	0.90	42	1.7	263	81
0 to 5													2.2	0.50	23	0.6	259	26

a—Scalar mean height ($\bar{H}$) (m),
b—Standard deviation of 'a' (σ_H),
c—Coefficient of variation of 'a' (Percentage),
d — Vector mean height ($\bar{h}$) (m),
e — Direction of vector (°),
f — Steadiness (d/a, in Percentage).

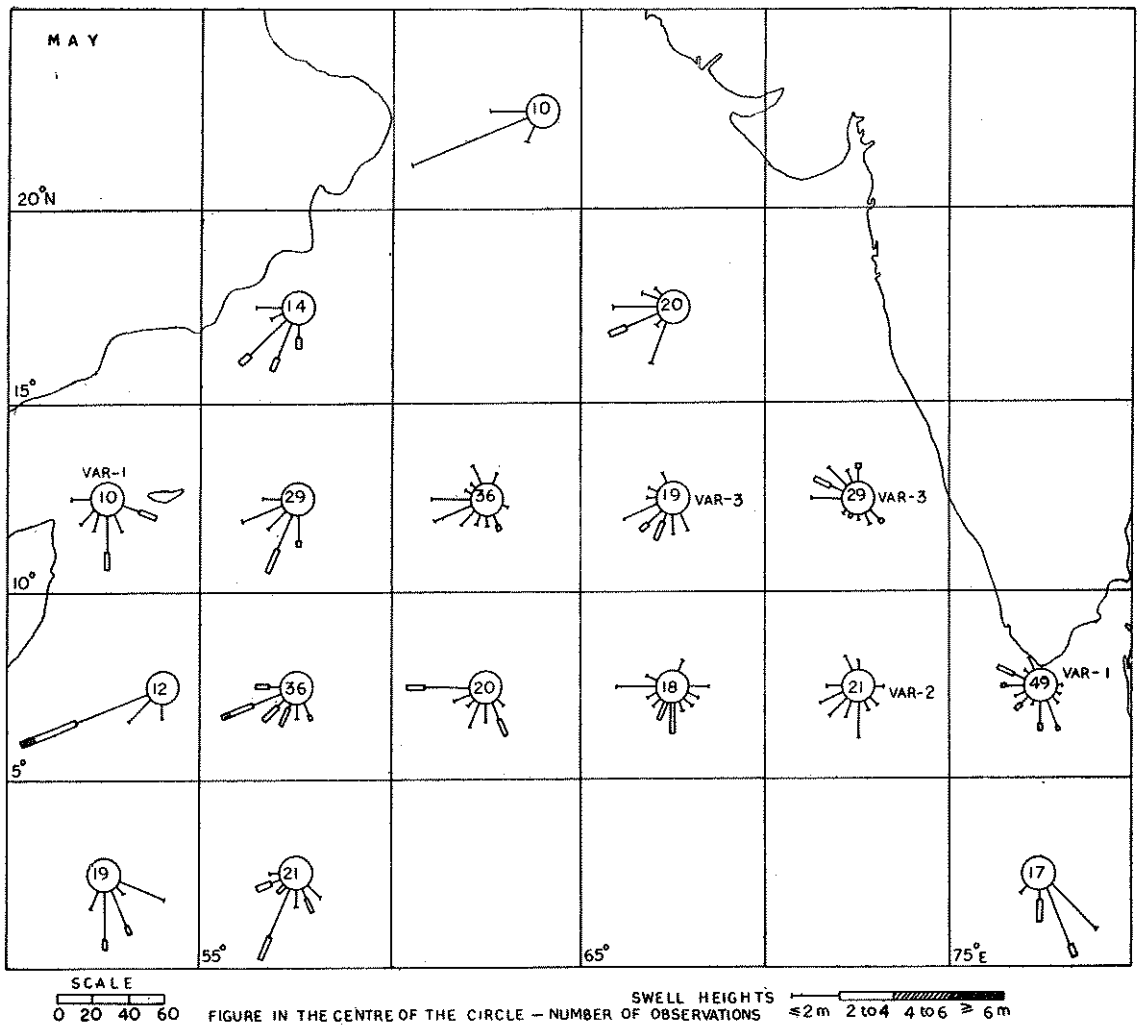

Fig. 1

90%). It is generally southwesterly between latitude 5 deg. and 15 deg. N to the east of longitude 55 deg. E. However, steadiness decreases from 80 to 90% to the west of longitude 60 deg. E to about 40 to 45% to the east of longitude 70 deg. E. Northerlies (NW to NE) prevail on about 20% of the occasions in the grid latitude 10 to 15 deg. N, longitude 60 to 65 deg. E and 25 to 30% in the grid latitude 10 to 15 deg. N, longitude 70 to 75 deg. E. Swell height is maximum to the south of latitude 10 deg. N and west of 60 deg. E and has a mean value of about 2.0 to 2.5 m. Its value is about 1.5 m elsewhere. The coefficient of variation is about 35 to 45% in most of the grids.

Heavy swells (greater than 4 m) are almost absent in the Arabian Sea during this month. Moderate swells (2.5 to 4.0 m) occur on about 40 to 50% of the occasions to the west of longitude 60 deg. E and on less than 20% of the occasions to the east of longitude 60 deg. E.

3.2. *June*

This is the month with the maximum number of observations. The mean direction continues to be generally southerly between latitude 0 and 5 deg. N and also elsewhere to the west of longitude 60 deg. E. However, it is very unsteady in the grid latitude 0 deg. to 5 deg. N, longitude 75 to 80 deg. E and to only a slightly smaller extent in the grid latitude 5 to 10 deg. N, longitude 75 to 80 deg. E.

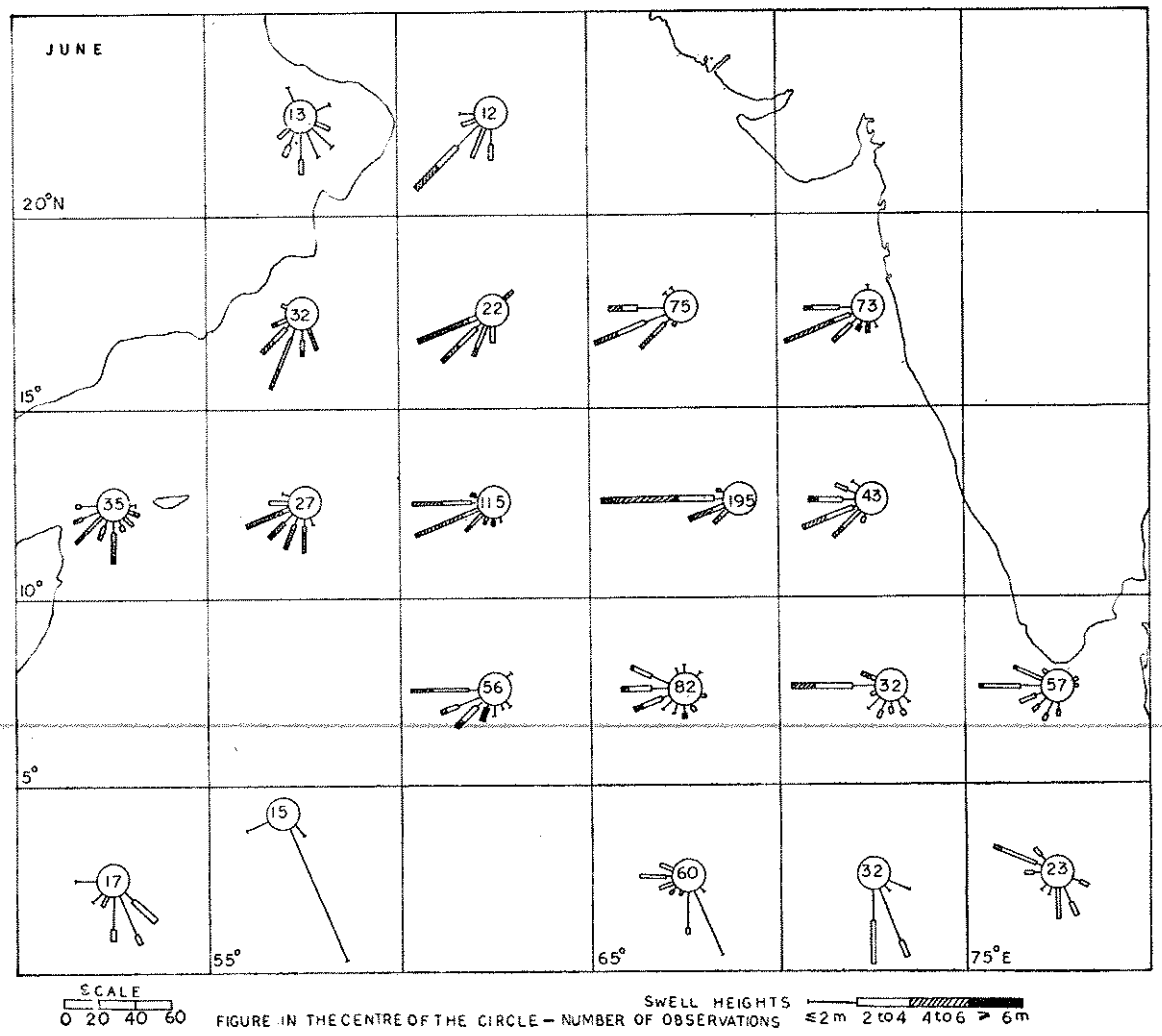

Fig. 2

The mean direction is generally westsouthwesterly between latitude 5 deg. and 20 deg. N to the east of longitude 60 deg. E. Steadiness is quite high (about 90%) between latitude 10 deg. and 20 deg. N and between longitude 55 deg. and 75 deg. E. Swell heights have increased considerably from May to June. In this month the scalar mean height increases with latitude upto about 15 deg. N and later remains nearly steady. The mean values in the latitudinal belts 0 to 5 deg., 5 to 10 deg., 10 to 15 deg. and 15 to 20 deg. N are 2.0 to 2.5 m, 2.5 to 3.0 m, 4.0 to 4.5 m and 4.0 m respectively. The coefficient of variation is about 30 to 40%.

Heavy swell is almost absent south of latitude 5 deg. N. They are maixmum in the latitudinal belt 10 to 20 deg. N, occurring on about 50 to 60% of the occasions in the regions, latitude 10 to 15 deg. N, longitude 55 to 70 deg. E and latitude 15 to 20 deg. N, Long. 55 to 65 deg. E and on more than 30% in the other grids in this latitudinal belt.

3.3. *July*

The swell direction is south to southwest to the west of longitude 60 deg. E and generally westsouthwesterly to west elsewhere. Steadiness exceeds 90% north of latitude 10 deg. N, lies between 80 and 90% between latitudes 5 and 10 deg. N, while it is only about 25% in the grid latitude 0 to 5 deg. N, longitude 75 to 80 deg. E where northerlies prevail on nearly 50% of the occasions. The mean height increases upto latitude 15 deg. N and later decreases. The

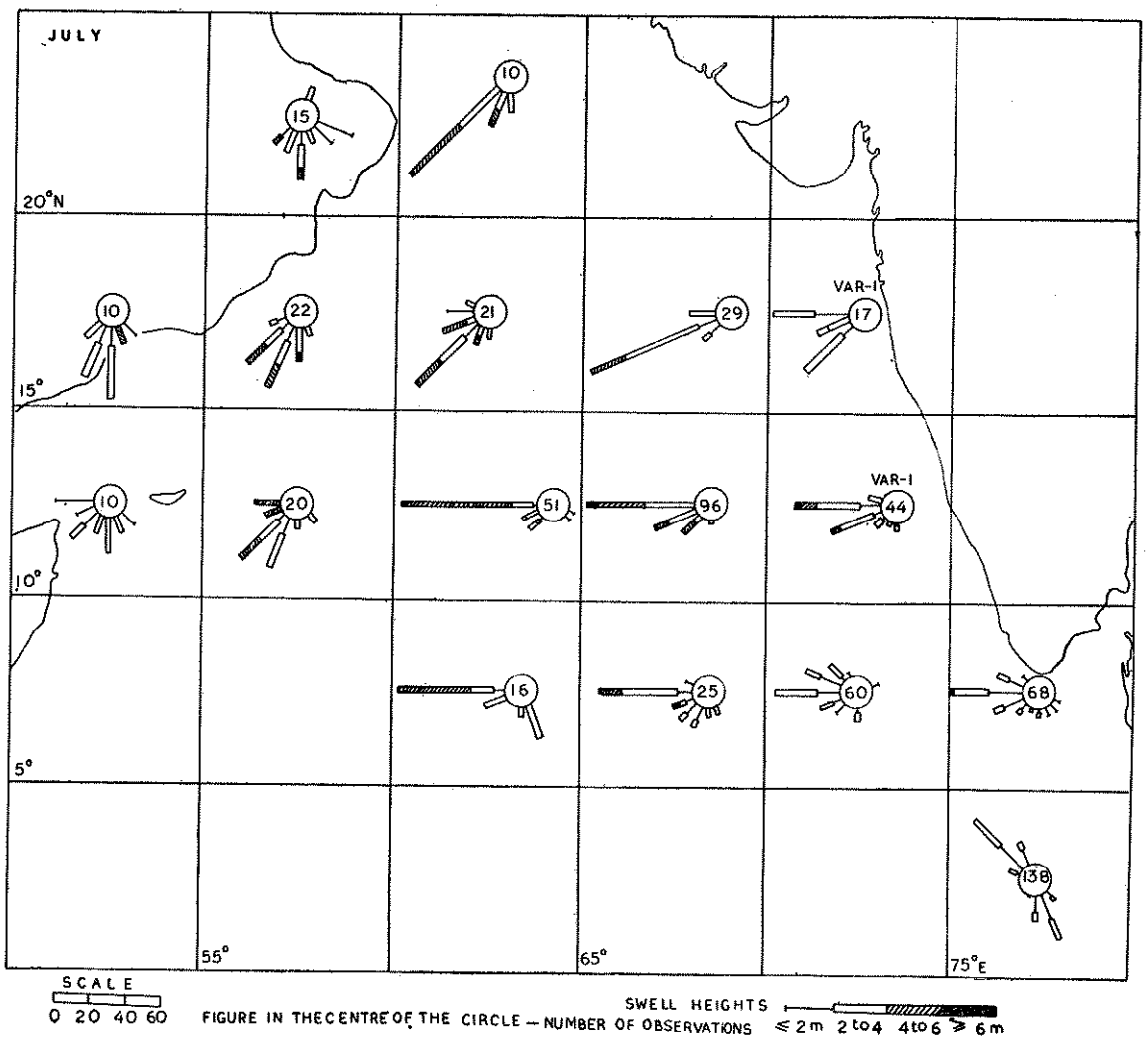

Fig. 3

value is about 2.0 to 3.0 m between latitude 5 and 10 deg. N, 3.5 to 4.5 m between latitude 10 and 15 deg. N and about 3.5 m between latitude 15 and 20 deg. N. The coefficient of variation is quite small (20 to 30%) in the latitudinal belt 10 to 15 deg. N between longitude 60 and 70 deg. E and also in the grid latitudes 0 to 5 deg. N, longitudes 75 to 80 deg. E, while it is about 40 to 50% elsewhere.

Heavy swells occur on about 50 to 70% of the occasions in the latitudinal betl 10 deg. to 15 deg. N, longitudes 60 to 70 deg. E, while they occur on about 30 to 40% occasions from latitude 10 deg. to 20 deg. N, longitudes 55 to 60 deg. E and also in the grid latitudes 15 to 20 deg. N, longitudes 60 to 65 deg. E.

4. Conclusions

1. The direction is generally southerly to the west of longitude 60 deg. E and west to southwest in other grids, the notable exception being the grid 0 to 5 deg. N, 70 to 80 deg. E where the steadiness is very low.

2. The mean swell height increases from about 2.0 m in May to 4.0 to 5.0 m in June and July.

3. The mean height is maximum below 10 deg. N in May. It increases with latitude upto about 15 deg. N in June and July, as pointed out earlier by Mukherjee and Sivaramakrishnan (1980).

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