

## ON THE SPECTRA AND COHERENCE OF SOME SURFACE METEOROLOGICAL PARAMETERS IN THE ARABIAN SEA

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### ABSTRACT

Spectra and cross-spectra of monthly time series of the surface meteorological parameters, sea surface temperature, air temperature, cloudiness, wind speed and sea level pressure were computed for the period 1948-1972 over the Arabian Sea. In addition to peaks in the annual, semiannual and four-month periodicities, the various surface parameters exhibited some energy at 2, 3 and 4 year cycles. It was also found that most of the surface meteorological parameters were coherent (at 95% confidence level) over the Arabian Sea, at annual and semiannual periodicities.

### INTRODUCTION

The characteristic time scales of atmospheric circulation and surface meteorological parameters like sea surface temperature (SST), air temperature (AT), wind speed (WS), cloudiness (CL) and mean sea level pressure (SLP) and their preferred frequency bands for spatial coherence have received little attention for the Arabian Sea (AS). This is a preliminary investigation of spectral characteristics of the above parameters for the AS. It is expected that such studies may throw more light on temporal characteristics of the low level atmospheric circulation.

### DATA AND METHODS

In order to understand the interrelationships between the low level atmospheric circulation and regional climate features the time series of SST, AT, SLP, CL and WS were extracted from the unpublished Bunker data set for the Indian Ocean region for the period 1948 to 1972 for different study regions, namely, western AS (MSQ 67), central AS (MSQ 66), eastern AS (MSQ 65) and the southern AS (MSQ 29) (Fig. 1).

For computation of spectra and cross-spectra, the data series was divided into three ensembles of 96 points (sampled at monthly intervals). Hanning window in the time domain was employed. FFT algorithms were used.

### RESULTS AND DISCUSSION

Fig. 1 gives the spectra of surface meteorological parameters for the southern AS (MSQ 29). Most of the parameters have the annual, semiannual and also the seasonal (4 month) periodicities. These periodicities were noted for the other regions too.

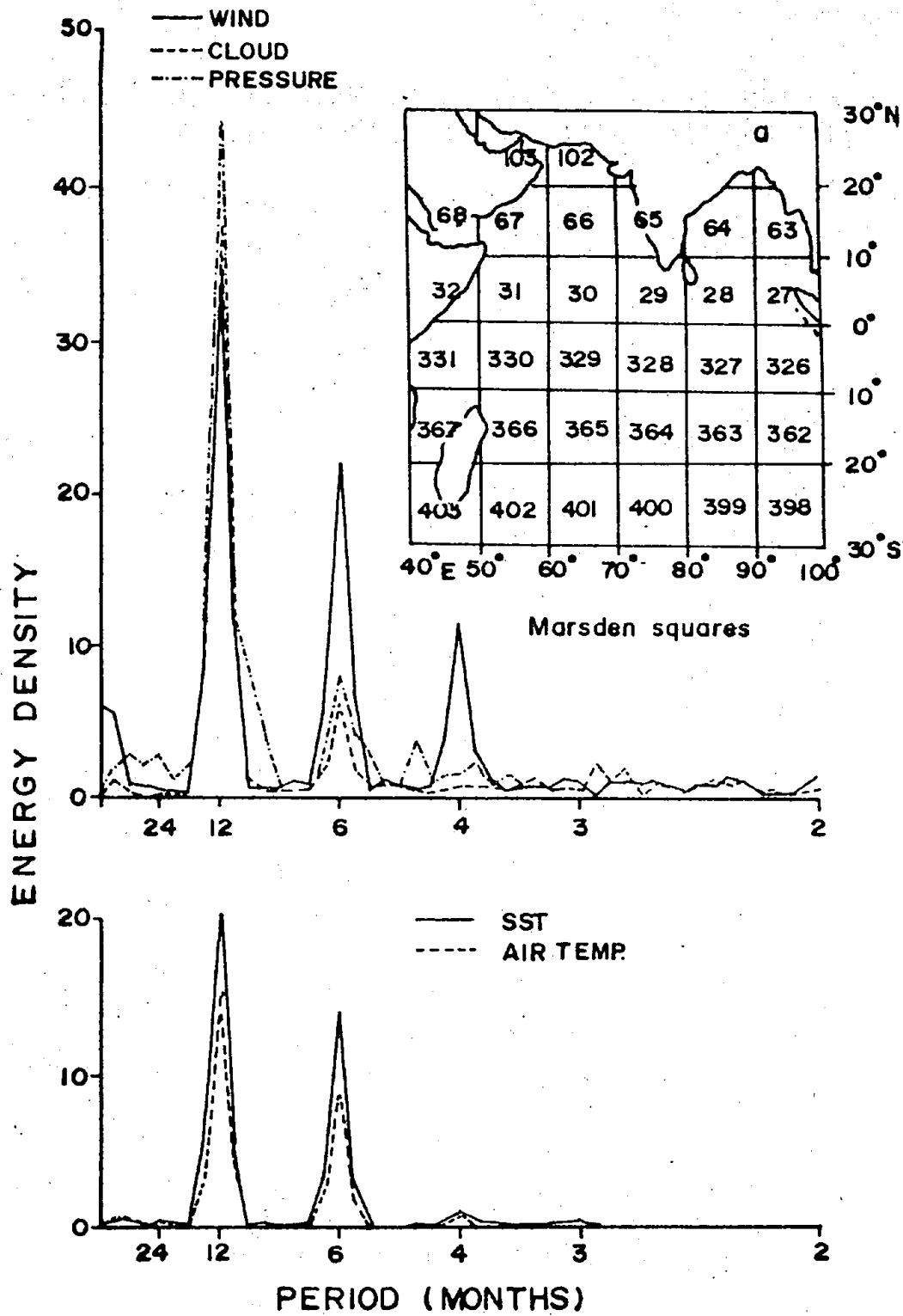


Fig. 1. Spectra of surface meteorological parameters in southern Arabian Sea (MSQ 29)

**Table 1. Spectral energy of surface meteorological parameters at annual (12 months) and semiannual (6 months) periods.**

Parameter	MSQ 29		MSQ 65		MSQ 66		MSQ 67	
	12m	6m	12m	6m	12m	6m	12m	6m
SST	20.5	14.1	13.3	23.4	29.2	39.2	28.6	86.0
AT	15.1	08.7	09.0	19.8	52.8	36.5	52.5	62.8
WS	34.6	21.9	111.9	45.0	231.9	196.8	251.2	198.7
CL	37.5	06.2	194.6	08.9	96.7	31.0	10.8	09.4
SLP	44.2	08.1	239.0	07.9	590.2	23.5	1144.9	27.9

\* All the above surface meteorological parameters exhibited peaks in energy at 12 months and 6 months periods.

**Table 2. Coherence and Phase of Surface meteorological parameters for different study areas**

Parameters	MSQ 29		MSQ 65		MSQ 66		MSQ 67		
	Coh	Phase	Coh	Phase	Coh	Phase	Coh	Phase	
SST/AT	12m	0.97	-18.0	0.97	-11.0	0.99	-12.7	0.99	-30.1
	6m	0.98	12.4	0.98	8.8	0.99	2.6	1.00	1.4
SST/WS	12m	0.95	-114.9	0.98	-73.8	0.98	-38.6	0.99	-78.1
	6m	0.98	-132.0	0.99	-135.3	1.00	-127.8	0.99	-136.8
SST/CL	12m	0.95	-121.8	0.98	-84.2	0.95	-53.0	0.80	-94.8
	6m	0.93	-65.6	0.81	-112.7	0.97	-130.8	0.94	-129.3
SST/SLP	12m	0.96	94.4	0.98	113.9	0.98	154.7	1.00	115.6
	6m	0.93	127.6	0.76	106.9	0.92	78.9	0.95	32.2
AT/WS	12m	0.98	-95.7	0.97	-62.4	0.99	-26.2	0.99	-48.3
	6m	0.98	-145.1	0.97	-145.0	0.98	-130.2	0.99	-138.2
AT/CL	12m	0.96	-103.1	0.97	-72.9	0.95	-41.0	0.75*	-63.7
	6m	0.94	-80.1	0.86	-123.5	0.98	-134.0	0.95	-131.1
AT/SLP	12m	0.96	114.0	0.96	125.7	0.98	167.3	1.00	145.8
	6m	0.92	113.7	0.68	94.5	0.95	75.5	0.95	30.9
WS/CL	12m	0.96	-6.2	0.98	-11.3	0.98	-15.1	0.72*	-17.2
	6m	0.95	65.6	0.86	24.1	0.95	-2.9	0.95	6.4
WS/SLP	12m	0.99	-149.6	0.99	-172.9	1.00	-167.0	0.99	-165.9
	6m	0.95	-100.0	0.82	-120.2	0.91	-153.2	0.97	169.0
CL/SLP	12m	0.97	-143.3	0.99	-161.6	0.98	-152.3	0.77	-151.2
	6m	0.92	-167.9	0.73	-153.7	0.99	-150.5	0.93	161.7

\* indicates that the coherence is less than 0.78 which is not significant at 95% for 6 degrees of freedom.

Table I shows that in most of the cases the energy is maximum in the annual cycle except on a few occasions when the semiannual energy is more than the annual period energy. Most of the parameters are significantly coherent at 95% confidence level over all the study areas (Table 2). Joseph and Pillai (1981) have shown the existence of a triennial oscillation in SST over selected regions over the north Indian Ocean. Our present study shows a similar oscillation in MSQ 65. In addition to the annual, semiannual and 4-month periodicities, most of the parameters exhibit some energy in the 2 to 2.5 year band. In the case of MSQ 66, we observed some energy in the 2 to 4 year band, for all parameters. In the case of MSQ 67, only CL and SLP exhibited periodicity in the 2.5 year cycle; whereas in the case of MSQ 29 we did not observe any periodicities other than the annual, semiannual and 4 month periods.

While the objective of this study was not to explain the monsoon phenomenon and its cyclicity, some long-period oscillations in certain surface meteorological parameters in the Arabian Sea have been identified.

#### REFERENCE

- Joseph, P.V. and Pillai, P.V., 1981. Interannual variations of sea surface temperature and large scale droughts in Indian Summer Monsoon. Paper presented at the WMO Symposium on 'Meteorological aspects of tropical droughts' held at New Delhi 7-11 December, 1981.