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Discussion of some sounding data over the eastern Indian Ocean and central Arabian Sea during 1976 monsoon period

S. K. SUBRAMANIAN

Regional Meteorological Centre, Bombay

ABSTRACT. The upper air observations recorded by the Russian research vessel *Shokalaisky* (UNAC) during the monsoon perod of 1976 were examined.

It was seen that the southeast trades crossed the equator even at Long. 87.8°E. The influence of the southern hemispheric equatorial trough (SHET) in turning the southeast trades to southwesterly or westerly was noticed, below 500 mb level. Moist air prevailed at all levels in the equatorial soundings and the shallow isothermal layers, though present, do not show any evidence of mass subsidence over this area. The relative dryness in the middle troposphere was clearly seen in the soundings over the Arabian Sea.

1. Introduction

Sparseness of observations over the Indian Ocean and the Arabian Sea is a main drawback for explaining the mechanism of the southwest monsoon. During the Indo-Soviet Monsoon Experiment—ISMEX 1973 — systematic surface and upper air observations over the Indian Ocean and the Arabian Sea were recorded. As, in general, upper air observations over the ocean areas are rare it is proposed to discuss in this paper, a few sounding data recorded by the Russian research vessel *Shokalaisky* (UNAC) over the east Indian Ocean and east central Arabian Sea during the monsoon period of 1976.

Of the six soundings available, two were recorded over the equator in east Indian Ocean, three in east central Arabian Sea along Long. 65°E and one sounding in east central Arabian Sea near Long. 68°E.

2. Discussion

2.1. *Sounding data at the equator*

The salient features of the sounding data recorded along the equator at Long. 87·8°E and 83·1°E on 23 and 25 June respectively (Figs. 1a and 1b) are given below :

(*i*) Moist air prevailed at all levels in both the soundings.

(*ii*) Nearly dry adiabatic lapse rate prevailed near the surface with saturation adiabatic lapse rate generally at all levels above.

(*iii*) Two shallow isothermal layers in lower troposphere were seen between 960 and 900 mb and 870 and 820 mb levels in the sounding recorded at 87·8°E whereas the shallow isothermal layer in the sounding at 83·1°E was seen extending from 460 to 430 mb levels only.

(*iv*) At Long. 87·8°E southerly light winds were seen at the surface and at 500 mb level. Stronger winds from southwesterly to westerly direction prevailed at 850 and 700 mb levels. Winds above 500 mb level varied from southeasterlies to northerlies. At Long. 83·1°E, strong winds from southwesterly to westerly direction were noticed from surface to 700 mb level becoming southeasterly to easterly from 500 mb level and above.

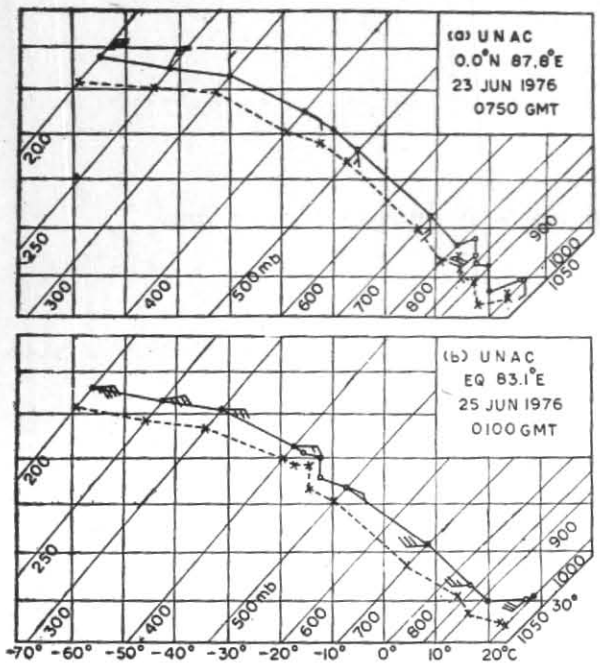

Fig. 1

The satellite pictures received at Bombay APT showed broken to overcast clouding near the equator between the longituditnal belt 80°E and 90°E during this period thereby suggesting the existence of a zone of convergence near about the equator. However, no organised cloud pattern was found to move near the equator during these days.

The moisture and lapse rate distribution prevailed at different levels as mentioned earlier do not show any evidence of mass subsidence inspite of the presence of shallow isothermal layers. The wind observations at different levels indicate that at Long. 83·1°E the southeast trades had already turned to southwesterly/westerly at the equator below 500 mb level which may be due to the existence of the SHET with its axis a little to the south of the equator whereas at Long. 87·8°E the influence of SHET is seen only at 850 mb level and to some extent at 700 mb level also. The southerly light wind at the surface at 87·8°E indicates the crossing of the southern hemispheric trades at the equator in contrast to the condition at 83·1°E.

2. 2. *Sounding data over the central Arabian Sea along Long.* 65°*E*

2. 2. 1. During ISMEX-1973 period the Russian research vessels recorded upper air observations in meridional cruises along Long. 55°E and 65°E but these cruises were made in the month of

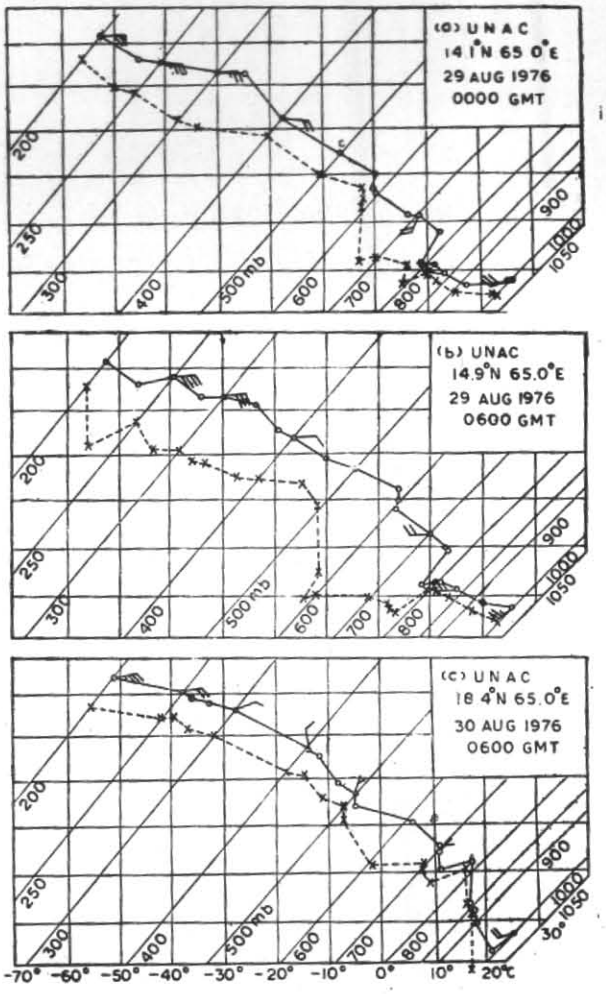

Fig. 2

May well before the establishment of the monsoon over the areas.

During August 1976 the Russian ship UNAC recorded some observations along Long. 65°E at Lat. 14·1°N and 14·9°N. The salient features of these sounding data (Figs. 2a and 2b) are stated below :

(*i*) Relatively dry air prevailed in the middle troposphere between 800 and 400 mb levels. The air was moist at all other levels.

(*ii*) A shallow inversion layer from 780 to 760 mb and a shallow isothermal layer near 600 mb level were seen in both the soundings.

(*iii*) The lapse rate was nearly dry adiabatic in the lower troposphere upto 800 mb level, nearly saturation adiabatic between 800

and 600 mb levels. It varied between saturation adiabatic and dry adiabatic from 600 to 400 mb levels and was less than saturation adiabatic between 400 and 350 mb levels. Above 350 mb level the lapse rate was again saturation adiabatic.

The distribution of lapse rates and humidity mixing ratio values explains localised subsidence taking place between 500 and 600 mb levels at Lat. 14·9°N and the shallow isothermal layer near 600 mb at this latitude may be due to this local subsidence. The variations in humidity mixing ratio values at Lat. 14·1°N do not appear to favour the idea of subsidence at the same level. In both these soundings the inversion seen around 750 mb level is not due to subsidence but due to difference in airmasses above and below this inversion layer. The significant difference in moisture in the middle troposphere between these soundings is difficult to explain with the meagre data available.

2. 2. 2. The tephigram for the sounding recorded at the same longitude at Lat. 18·4°N is given in Fig. 2(c). It may be noticed that this sounding is different from those given in Figs. 2(a) and 2(b). On this day, *viz.*, 30 August, a deep depression was centred near Radhanpur in Gujarat region which was moving westward. The associated circulation pattern might be responsible for the difference.

2. 3. Yet another sounding recorded at 17·1°N, 68·2°E on 1 September was available and the tephigram for the same is given in Fig. 3. This is similar to a typical sounding over the Arabian Sea during the southwest monsoon period.

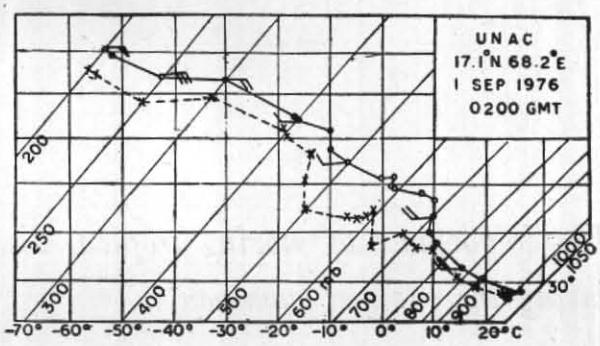

Fig. 3

3. Concluding remarks

The equatorial soundings showed evidence of the southeast trades crossing the equator even at Long. 87·8°E. The influence of the southern hemispheric equatorial trough (SHET) in turning the southeast trades to southwesterly or westerly was observed at levels below 500 mb. Moist air prevailed at all levels in the equatorial soundings. The shallow isothermal layers, though present did not show any evidence of mass subsidence over the equatorial area. Though the soundings over the Arabian Sea showed evidence of localised subsidence at some intermediate levels, the low level inversion would not appear to be due to subsidence but due to airmass differences above and below the inversion layer.

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