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Letters to the Editor

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FLOW CHARACTERISTICS IN INDIAN OCEAN EQUATORIAL REGION DURING ONSET PHASE OF SOUTHWEST MONSOON- 1984

1. From time to time, various aspects of Indian summer monsoon over the equatorial region have been studied by different workers. Experiments like Indian Summer Monsoon Experiment (ISMEX-73) and Monsoon Experiments (MONEX-77 and 79) have been conducted to study the special features of the monsoon and the monsoon systems. Pant (1980) studied the oscillation of equatorial trough and associated phases of summer monsoon over the Indian sub-continent. Based on ISMEX data of 1973, Jambunathan and Ramamurthy (1974) and Desai *et al.* (1976) studied the vertical distribution of winds in the lower troposphere over the Arabian sea. Godbole and Ghosh (1975) showed the existence of broad zone of equatorial westerlies to the south of the Inter Tropical Convergence Zone (ITCZ) in northern hemisphere. They found another trough in southern hemisphere extending from surface to 500 hPa and inclined poleward. Pant (1976) divided the equatorial belt extending from east Africa coast to about Longitude 75° E into three regions having different characteristic features of wind, temperature and moisture *i.e.* (*i*) western region – from east Africa coast to about longitude 56°E, (*ii*) central region – from longitude 56°E to about longitude 65° E and (*iii*) eastern region – east of longitude 65° E. The vertical profile of wind in the planetary boundary layer (below 2.0 km) in the region north of about 7° N is characterized by a sharp wind maximum at a height of about 1.0 km a.s.l. and to the south of latitude 7° N and east of longitude 50° E (Pant 1978). The profile indicates a gradual increase in the wind speed with height with a maximum at about 1.0 km a.s.l.

2. Most of the above studies are confined to equatorial flow west of longitude 70° E. During 1984, Sagar Kanya cruise VIII sailed from Goa from 23 May to 6 July for scientific observations by IMD and NIO and crossed equator along 77.5° E on 29 May 1984. The track of the cruise has been shown in Fig. 1. During 1984, the southwest monsoon advanced into Kerala on 31 May. An attempt has been made to explore the wind structure over Indian Ocean to the east of longitude 70° E during onset phase of monsoon. The ship was made to halt twice daily at 0000 and 1200 UTC for the upper air observations and every time aligned to the true north direction. The radiosonde equipment became defective and hence the upper winds taken by rawin ascents have been utilized in the present study.

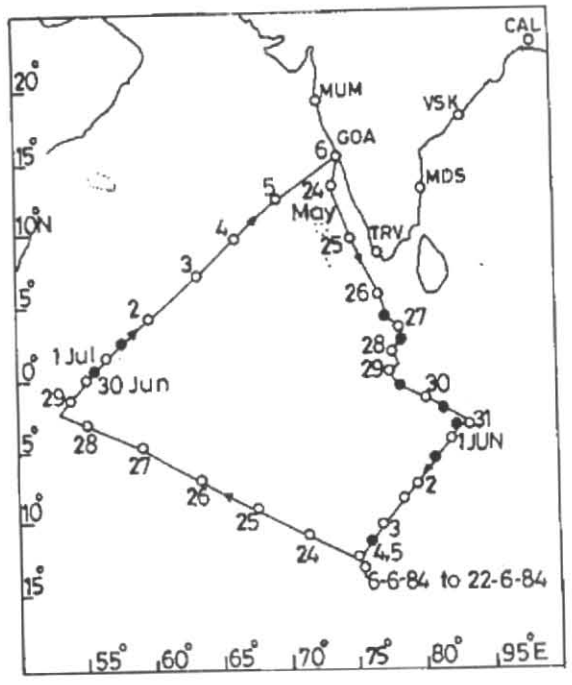

Fig. 1. Track of Sagar Kanya cruise VIII from 23 May to 6 July 1984

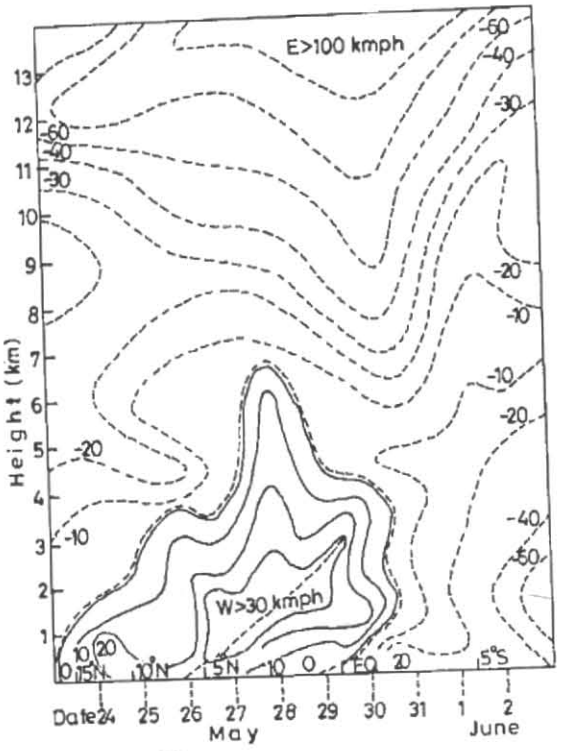

Fig. 2. Zonal components of wind at different latitudes *versus* height

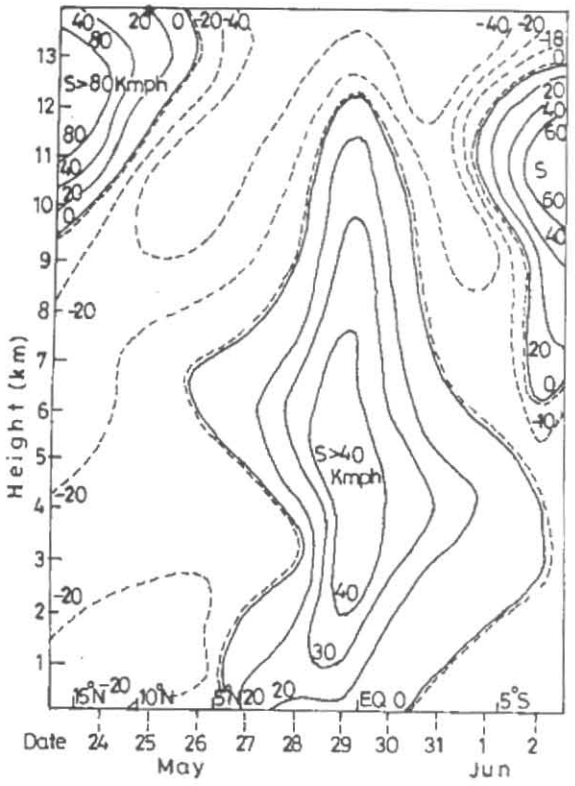

Fig. 3. Meridional components of wind at different latitudes *versus* height

2.1. The winds at different levels have been resolved into zonal and meridional components and plotted *versus* latitudes on different dates. As the observations are on different dates, it is assumed that the atmosphere remains quasi-stationary in the meridional direction during the period of observation so that the gross features of wind flow are not changed and can be examined.

2.2. The vertical cross-section of zonal and meridional components of winds from 23 May to 2 June 1984 have been presented in Figs. 2 & 3. The following features are observed.

2.2.1. *Zonal winds*

(*i*) The depth of westerly flow over Arabian sea increases gradually from about 1.5 km at latitude 15° N to a maximum height of 6.5 km at latitude 2°-3° N and starts decreasing southwards. At the surface level, wind becomes easterly just before the equator whereas wind between 0.5 to 4.5 km over equator is still westerly. Further south, weak easterly wind field prevails.

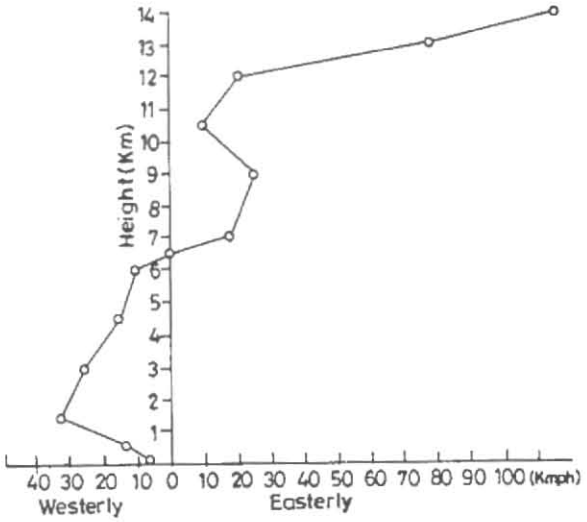

Fig. 4. Vertical profile of zonal components at latitude 2.5° N across longitude 77.5° E on 28 May 1984

(*ii*) The vertical wind shear in the low level westerlies is relatively low upto latitude 5° N and then increases southwards. The wind shear is maximum in the lower levels near or little south of the equator. The vertical wind shear is weak upto 6.0 km in southern hemisphere as compared to that in the northern hemisphere.

(*iii*) The easterlies are found to strengthen with height above 6.0 km in southern hemisphere and become more than 100 km/h beyond 12 km. The core of strong easterly is confined between latitude 5° N and 7° S. This region of strong easterly wind shifts northwards with the progress of the season.

2.2.2. *Meridional winds*

(*i*) Southerly flow at surface level is confined within latitude belt roughly 4° N to 2° S.

(*ii*) Southerly flow over equator initially increases with height and becomes maximum (> 40 km/h) between 2.0 and 7.0 km and decreases thereafter and becomes northerly beyond 12 km.

(*iii*) Due to moving westerly troughs in both the hemispheres, southerly flow away from the equator at higher heights is stronger.

(*iv*) Weak northerly flow prevails in the latitude belt from 5° N to 15° N below 10 km and is replaced by southerly winds as the season advances.

2.3. Fig. 4 depicts the vertical profile of zonal components approximately at latitude 2.5° N and longitude 77.5° E on 28 May 1984. It is seen that in the low levels, westerly component gradually increases and becomes maximum at about 1.5 km (within planetary boundary region). Thereafter, the strength decreases upto 6.5 km and becomes easterly aloft. The easterly flow strengthens with height and becomes quite strong beyond 12 km.

3. The cross equatorial flow in lower troposphere is maximum at the western equatorial region and progressively weakens eastwards and is minimum at the eastern region (Pant, 1976). However, from the observations presented here, it is evident that the cross equatorial flow from the southern to the northern hemisphere is significant even at longitude 77.5° E.

References

Desai, B.N., Rangachari, N. and Subramanian, S.K., 1976, "Structure of low-level jet stream over the Arabian Sea and the peninsula as revealed by observations in June and its probable origin", *Indian J. Met. Geophys.*, **27**, 3, 263-274.

Godbole, R.V. and Ghosh, S.K., 1975, "The structure of the inter tropical convergence zone and equatorial westerlies during MONEX 1973", *Tellus*, **XXVIII**, 2.

Jambunathan, R. and Ramamurthy, K., 1974, "Wind field in the lower and middle troposphere over the Arabian Sea during the southwest monsoon 1973", Indian *J. Met. Geophys.*, **25**, 3, 403-410.

Pant, M.C., 1976, "Structure of the southwest monsoon near the equator during MONEX-1973", *Mausam*, **27**, 1, p 8.

Pant, M.C., 1978, "Vertical structure of the planetary boundary layer in the west Indian ocean during Indian summer monsoon as revealed by ISMEX data", *Mausam*, **29**, 1&2, 88-98.

Pant, P.S., 1980, "Phase of the summer monsoon and oscillations of the equatorial trough", *Mausam*, **31**, 2, 215-221.

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