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ON THE ROLE OF THE PERTURBATIONS OF THE SOUTHWEST MONSOON IN RELATION TO HIGH LEVEL EAST WIND MAXIMA OVER INDIA

1. Recently, Joseph (1967) pointed out that for the Indian area the level of east wind maximum in July 1966 is highest around 15°—18°N and slopes down both to the north and south. Many of the 200-mb charts of this month show two distinct jet axes 10°-15° latitude apart, the northern jet axis being of very limited longitudinal extent. He postulated that double jets occur on 200-mb charts due to the inverted V-shaped nature of the north–south vertical profile of the level of maximum wind. It may be stated that Joseph's study relates mainly to conditions of active monsoon.

1.1. The cause for the above mentioned phenomena can be attributed to the remarkable effect of the monsoon perturbations on the upper tropospheric easterly flow over India and on the topography of the east wind maximum as well. This is illustrated below.

2. To have a proper appreciation of the extent to which the perturbations of the strong monsoon can effect upper tropospheric flow patterns over India, it will be necessary to isolate the contributions due to these perturbations from the typical flow pattern prevailing during the regime of strong monsoon over India. For this purpose, one will have to filter out from strong monsoon flow pattern the residual flow pattern which would have prevailed had there been no monsoon perturbations. In the present study, weak monsoon conditions are taken as representing adequately the essentials of this residual flow pattern. The procedure followed is given here.

2.1. Two epochs, one of strong (8 to 21 August 1963) and another one of weak monsoon (11 to 24 July 1963) were chosen. For each of the two epochs, mean resultant winds for 900, 850 mb and other standard pressure levels aloft upto 150 mb for all the available Indian rawin stations and also for Karachi and Colombo were worked out. In respect of each of the levels mentioned above and for each station, the wind data for weak monsoon were vectorially subtracted from the corresponding values for strong monsoon and the resulting vector differences were taken to represent the effects of perturbations which prevailed during the regime of strong monsoon. Fig. 1 represents these wind vector differences, for different levels.

3. It will be seen from Fig. 1 that in the mean, the perturbations of strong monsoon appear as two cyclonic vortices at either end of a trough line which runs from north Konkan to north Coastal Andhra Pradesh. It is interesting to note that both the vortices and the trough line extend practically from sea level to even as high an altitude as 200-mb level. In this connection it may be stated that the perturbation at western end of the trough line is generally believed to effect only in and near mid-tropospheric levels (Ramage 1963, Miller and Keshavamurty 1967) whereas the method adopted in this study indicates that the effect of this perturbation also extends practically throughout the major part of the troposphere. The consequences of such an effect on the activity of the Arabian Sea branch of the monsoon are being studied in detail using the data of a number of years.

3.1. Considering for the present, the two perturbations and the axis of the trough at 300 and 200-mb levels in Fig. 1, it will be seen that their effect will be to contribute a westerly component to the south of the trough line, *i.e.*, roughly south of 21°N and an easterly component to its north. As the unperturbed currents at these levels are fairly strong easterlies (south of Lat. 25°N) the effect of the perturbations on these will be to increase the (easterly) wind speed north of 21°N and decrease the same south of that latitude. The effect of the perturbations on stations like Trivandrum and Colombo which are far to the south is relatively small as can be seen from the weak westerly components for these stations and

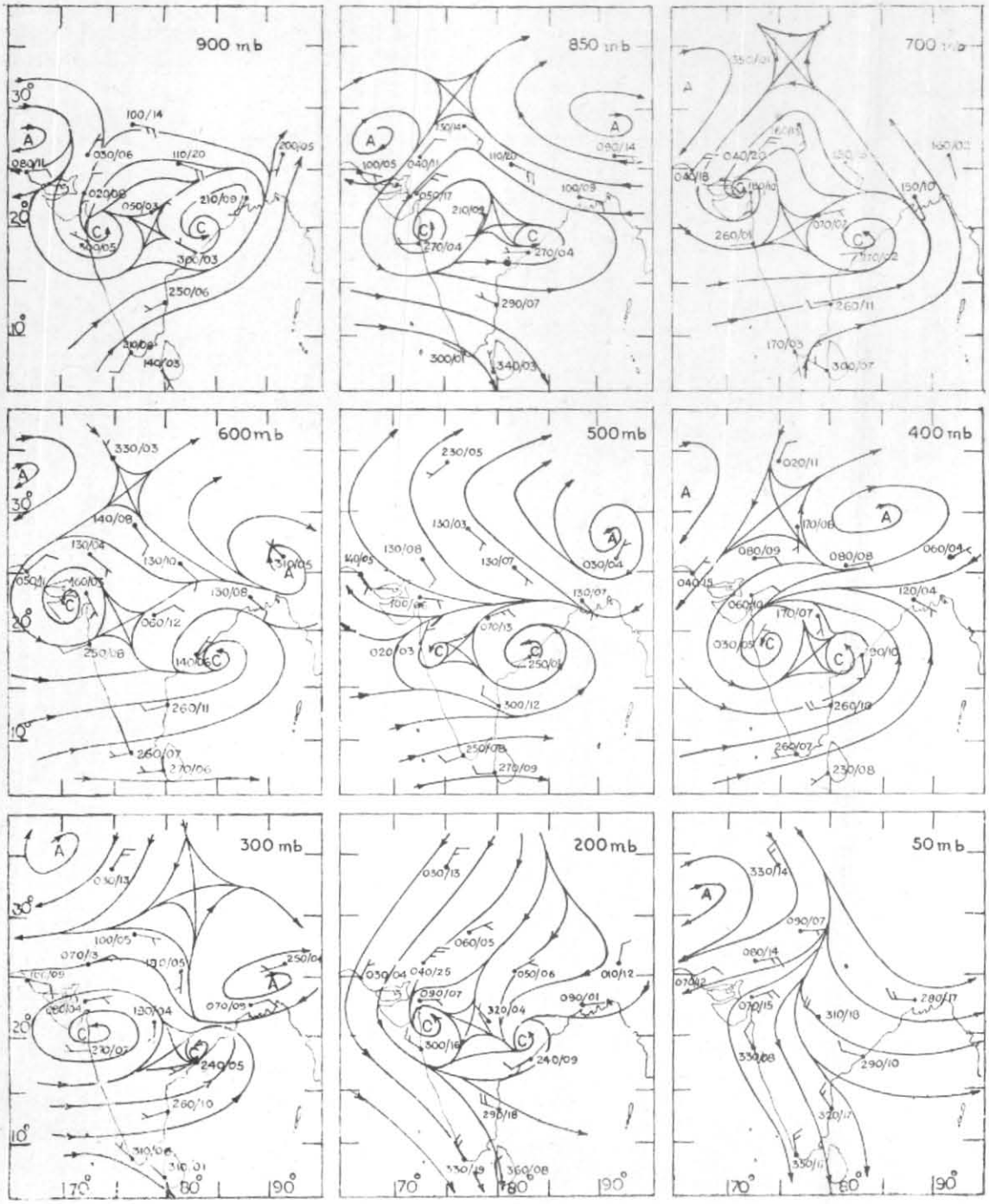

Fig. 1

hence the upper level easterlies over these stations continue to be strong during strong monsoon also. Therefore, the net result is to have two maxima in easterlies, one north of 21°N and another south of 10°N at 200-mb level.

3.2. At the 150-mb level in Fig. 1 the effect of perturbations is less marked. Therefore, over stations in the north Peninsula which fall just south of the trough line, the effect of perturbations (in decreasing the speed of upper tropospheric easterlies) which was maximum upto 200-mb level wanes progressively only above this level. Hence, the east wind maximum over this region occurs at a considerably higher altitude whereas over stations to the north of 20°N the perturbations

contribute to the strengthening of easterlies and hence the east wind maximum occurs at a relatively low altitude. As mentioned in the preceding para, stations like Trivandrum which are far to the south experience only slightly the adverse effect of the perturbations and hence the east wind maximum occurs over these also at a relatively low altitude. This will result in the north-south vertical profile of the level of east wind maximum showing an inverted V-shaped form.

4. From what has been explained in paras 3·1 and 3·2 above, it will be seen that (1) the higher topography of the east wind maximum around 18°-19°N and its sloping down both to the north and to the south and (2) the occurrence of two maxima in easterlies 10—15 degrees latitude apart at the 200-mb level, can be viewed as a consequence of the perturbations of the strong monsoon extending their effects to great heights in the upper troposphere.

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December 27, 1967

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