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VERTICAL WIND SHEAR IN THE LOWEST LAYERS OF THE ATMOSPHERE OVER THUMBA

1. Vertical wind shear exceeding 10 kt/30 m in the lowest layers of the atmosphere, is hazardous to supersonic jet aircraft operations. Hence accurate measurement of vertical wind shear is an operational requirement for aviation purposes. A 200 ft meteorological tower with seven sets of distant indicating wind equipments (DIWE) available at the Thumba Equatorial Rocket Launching Station is a unique facility for low level wind measurements. Rao *et al.* (1965) have reported earlier a preliminary study of the vertical wind shear in the lowest layers of the atmosphere over Thumba during winter months. A statistical investigation of the vertical wind shear for a period of one year, March 1966—February 1967 is presented in this note.

2. The synoptic tower wind observations at 0530, 0830, 1130, 1430, 1730 and 2030 IST for the period March 1966 to February 1967 were analysed to find out the mean monthly winds at levels 2, 10, 17, 30, 41, 48 and 61 m. The standard deviation of wind speed and direction at 1430 IST were also computed. The mean wind speed and direction profiles for the four seasons, summer (March, April, May), southwest monsoon (June, July, August), northeast monsoon (September, October, November) and winter (December, January & February) are shown in Fig. 1. Fig. 2 depict the distribution of the mean monthly vertical wind shear in 6 different layers during the above four seasons.

3. The mean wind speed and direction profiles reveal the following salient features :

Summer — There is change in wind direction after 0830 IST due to the onset of sea breeze. The standard deviation for wind speed is 4 kt and it increases with altitude. The deviation in wind direction is 40 degrees and with the onset of monsoon at the end of May it reduces to 20 degrees.

Southwest monsoon — There is not much variation in direction and the deviation is 20 degrees only. Wind speed becomes maximum during August.

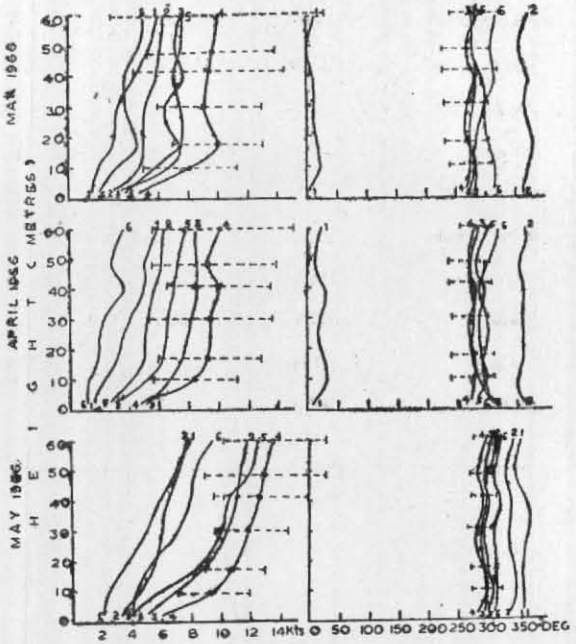

Fig. 1(a). Summer 1966

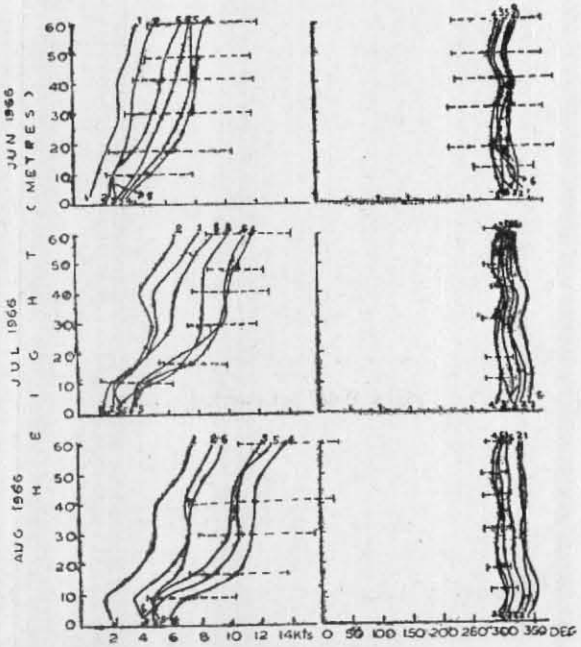

Fig. 1(b). SW Monsoon 1966
Mean tower wind profiles

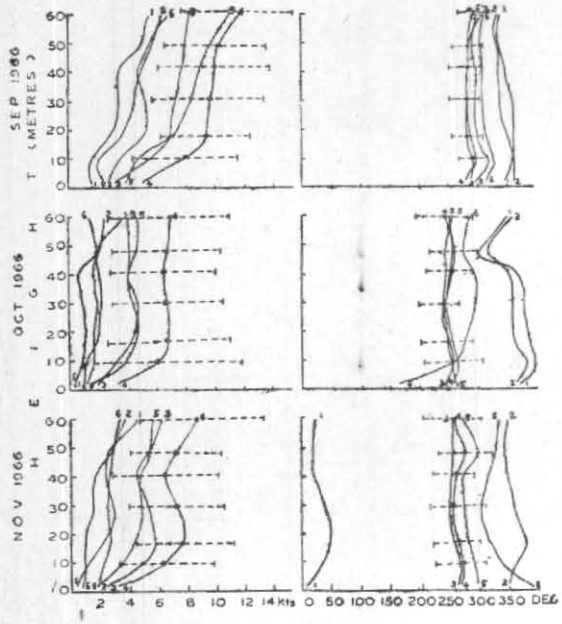

Fig. 1(c). NE Monsoon 1966

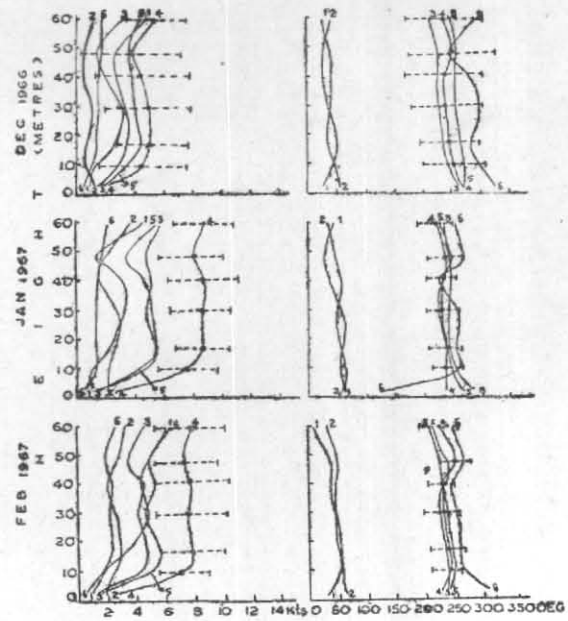

Fig. 1 (d). Winter 1967

Mean tower wind profile
1, 2, 3, 4, 5 & 6 refer to 0530, 0830, 1130, 1430, 1730 and 2030 IST observations respectively

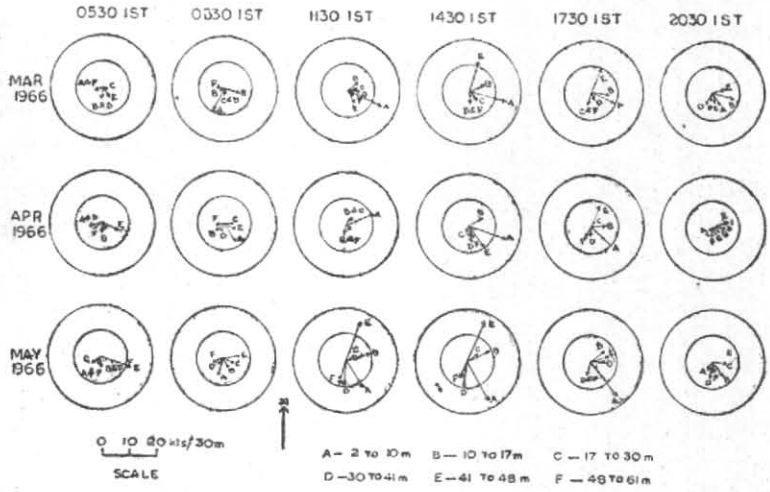

Fig. 2(a). Summer

Monthly distribution of mean vertical wind shear (1966-67)

Northeast monsoon wind speed is reduced to 6-8 kt, but the deviation is high of the same order, 4 kt. After 0830 IST, there is change in wind direction.

Winter — The wind profile is similar to that of summer but speed is very little. The sea breeze setting in around 1130 IST. The deviation in speed is 2 kt.

The main characteristics of the vertical wind hear are indicated.

Summer—Vertical wind shear increases in the afternoon and it is maximum at 1430 IST in the layer 2-10 m and 40-50 m.

Southwest monsoon — Shear is more or less uniform in all the layers. There is increase of wind shear in the layer 10-20 m.

Northeast monsoon — Shear is anti-clockwise with reference to height. 40-50 m layer shows large shear during 1430 and 1730 IST.

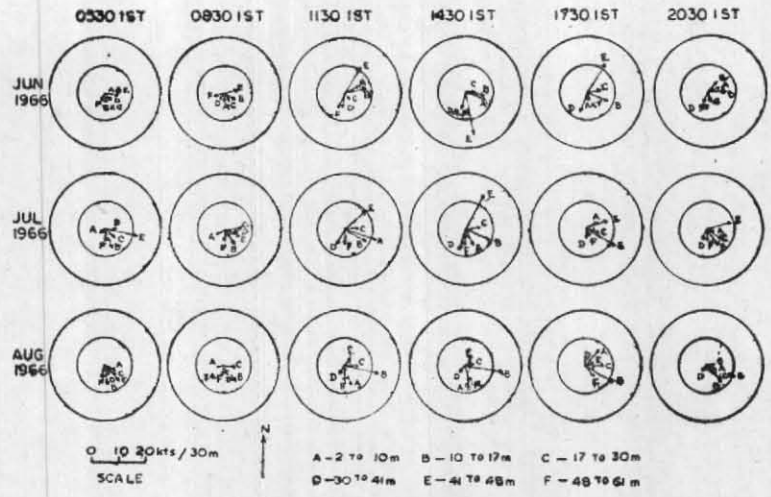

Fig. 2(b). SW Monsoon

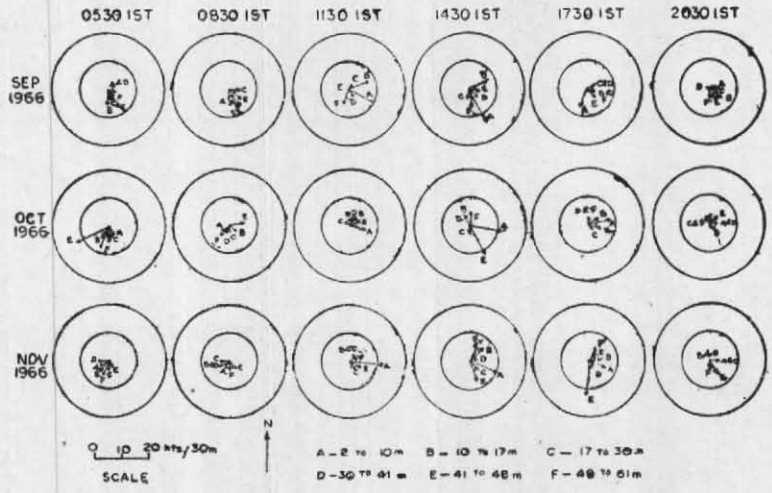

Fig. 2 (c). NE Monsoon

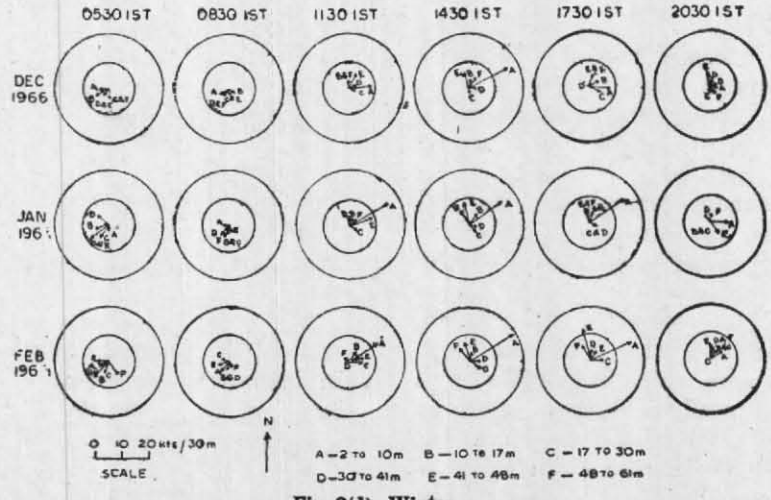

Fig. 2(d). Winter

Monthly distribution of mean vertical wind shear (1966-67)

Winter — Shear is very little in this season.

4. It is found that occurrences of vertical wind shear exceeding 10 kt/30 m that are likely to affect aircraft operations are very few. Hence vertical wind shear may not be dangerous for the landing or taking off supersonic jet aircraft in Trivandrum. The high wind shear noticed in the lowest layer 2-10 m may be attributed to local obstruction near the ground and it will not affect the aircraft operation in an airport adversely in any way. Vertical differences in wind speeds may attain values considerably in excess of those found in the analysis of the mean profiles under conditions of well developed gustiness. Data necessary to resolve this question were not obtained during the present study but some reasonable estimate of differences can be obtained from our knowledge of the vertical distribution of standard deviation of wind speed.

The results obtained from the study, based on wind observations for a period of only one year, may be regarded as tentative. Analysis of more data is required to confirm the results.

5. The authors are grateful to Shri H.G.S. Murthy, Director, Thumba Equatorial Rocket Launching Station for providing the facilities for this study.

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April 6, 1970

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REFERENCES

Charles F. Roberts — 1964 A preliminary analysis of some observation of wind shear in the lowest 100 feet of the atmosphere for application to the problem of the control of aircraft on approach, U. S. Weath. Bur. (MSS.)

Rao, M. S. V., Sikdar, D. N. and Chandrasekharan C. K. — 1965 *Indian J. Met. Geophys.*, **16**, 2, pp. 221.

W.M.O./CAem-III — 1964 W.M.O. No. 157, R.P. 58, Rep. on Agenda Item 1, p. 1