

rawin ascents at Trivandrum reached a height of 21 km or more during 1963. The same elevation was attained by a good number of rawin ascents at Minicoy Island in the southeast Arabian Sea (at the same latitude as Trivandrum and four degrees of longitude to its west) where 12 Z rawin ascents were commenced from May 1963. These high level ascents have revealed certain interesting features of the upper tropospheric—lower stratospheric zonal winds over the extreme south of the Peninsula during the southwest monsoon months which are briefly discussed in this note.

2. It is well known that during the southwest monsoon season, the lower tropospheric westerlies over the south Indian Peninsula change over to easterlies at a height of 6 to 8 km; the easterlies rapidly gain in strength with height and attain maximum speed at about 14 km near Trivandrum and 15/16 km near Madras. The strong upper tropospheric easterlies which have the characteristics of a jet stream are associated with large vertical shears above and below the level of maximum wind, although the horizontal shears are often less pronounced than in the case of the subtropical westerly jet stream of the winter months.

3. A casual examination of the high level winds over Trivandrum and Minicoy during the monsoon season of 1963 showed that on several occasions the upper tropospheric speed maximum of the easterlies was followed by a minimum beyond which the speed showed a further increase with a secondary maximum on some days. To understand these features in greater detail, a study was made of the zonal components of the winds for all the days on which the rawin ascents reached 21 km during the months June to September. There were 75 such cases for Trivandrum and 40 for Minicoy.

4. The high level ascents reaching 21 km or more were grouped into the following three types—

(A) Those in which the easterlies attained maximum speed at or near 14 km followed by

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VERTICAL STRUCTURE OF THE HIGH LEVEL EASTERLIES OVER TRIVANDRUM AND MINICOY DURING THE SOUTHWEST MONSOON SEASON OF 1963

1. Due to the special efforts taken by the India Meteorological Department in connection with the IQSY programme and rocket-launchings from the Tropical Rocket Launching Station at Thumba close to Trivandrum, a fairly large number of the 00 and 12 Z

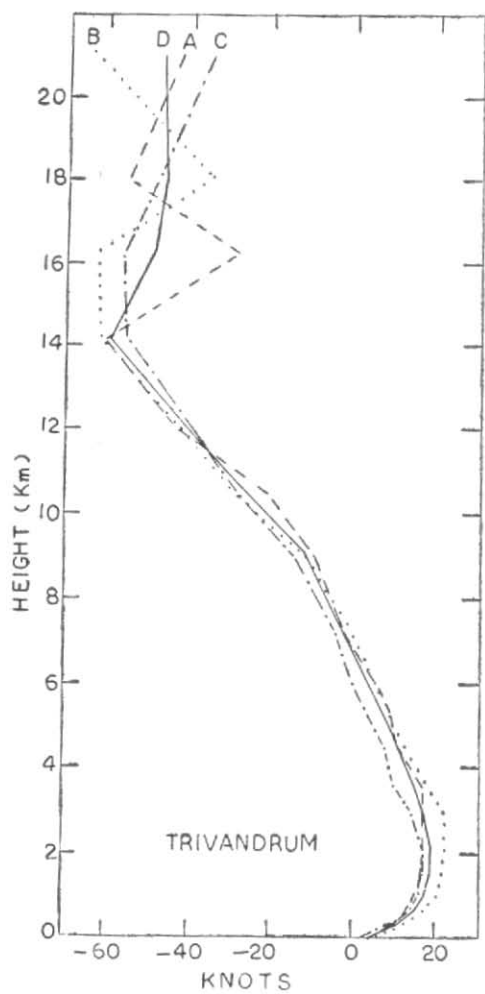


Fig. 1(a)

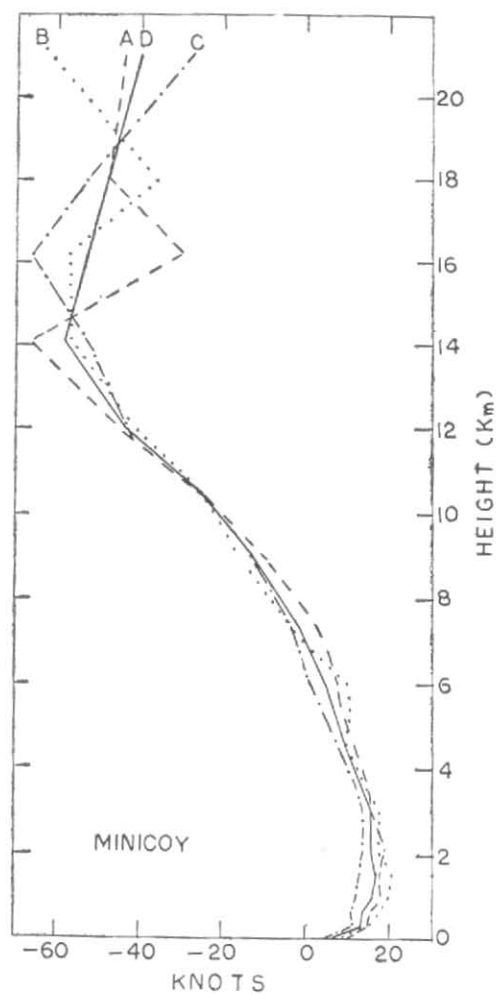


Fig. 1(t)

TABLE 1

	Height							
	14 km		16 km		18 km		21 km	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
TRIVANDRUM								
A	60	59	28	28	55	53	42	46
B	61	66	62	61	35	37	64	62
C	55	58	56	57	48	49	35	41
D	59	59	49	50	46	44	47	52
MINICOY								
A	66	65	30	27	48	48	44	54
B	56	56	57	53	31	37	61	63
C	53	58	66	66	53	52	28	32
D	58	58	53	49	48	46	40	45

The figures are speed in knots

a minimum at 16 km, (B) those in which the easterlies reached maximum speed between 14 and 16 km with a minimum at 18 km and (C) those in which no minimum of wind speed was observed between the level of maximum speed and 21 km.

In the case of Trivandrum it was found that the ascents were equally distributed between the three categories. In the case of Minicoy the numbers falling under these categories were 8, 12 and 20 respectively. The mean zonal winds were calculated separately for the three categories A, B and C as well as for the total number of ascents (D). The corresponding profile for the two stations are shown in Figs. 1 (a) and 1 (b).

5. As can be seen from the figures, the vertical structure of the zonal wind is practically identical at the two stations. In the lower troposphere the westerlies attain a maximum speed of 15/20 knots at about 2 km above which the speed gradually decreases. The zonal wind changes over to easterly

at about 7 km above which the speed increases with height reaching about 60 knots at 14 km. The mean shear is about 4 knots/km from 2 to 9 km and 10 knots/km from 9 to 14 km. These values hold good for the three samples A, B and C as well as for the total population D. However, above 14 km the speeds and shears are widely divergent for the three samples. The mean and median speeds in knots of the easterlies at 14, 16, 18 and 21 km for the different samples are given in Table 1.

Table 2 gives the mean, median and extreme values of the vertical shears in knots per kilometre for the layers 14-16, 16-18 and 18-21 km.

As can be seen from these tables, averaging the samples obliterates the minimum in wind speed at 16/18 km noticed on a large number of occasions and does not give a correct idea of the actual wind structure over Trivandrum and Minicoy above 14 km. Whereas monthly averages give a fairly

TABLE 2

	Layer											
	(14-16) km				(16-18) km				(18-21) km			
	Median	Mean	Min.	Max.	Median	Mean	Min.	Max.	Median	Mean	Min.	Max.
TRIVANDRUM												
A	15	16	6	41	-13	-13	-47	-1	4	4	-7	20
B	-1	-1	-17	24	11	13	1	42	-8	-10	-20	-3
C	-1	-1	-19	12	4	4	-17	19	2	4	-6	20
D	5	5	-19	41	3	2	-47	42	-3	-1	-20	20
MINICOY												
A	19	18	11	28	-11	-9	-1	-21	-2	1	-10	14
B	2	-1	-21	15	8	13	2	28	-9	-10	-16	-3
C	-4	-6	-22	15	7	7	-24	33	7	8	-4	33
D	3	-1	-22	28	3	3	-24	33	3	0	-16	33

Figures represent vertical shears in kt/km

Decrease of easterly with height is taken as positive shear

correct idea of the zonal wind speeds and shears below 14 km, similar averages obliterate important features of the wind structure above 14 km.

6. It was not possible to examine the features of the vertical structure of the high level zonal winds in the monsoon months for earlier years due to lack of data. However, in a recent study Rangarajan (1964) has adduced evidence in support of the occurrence of the 26-monthly stratospheric wind oscillation over the southern parts of India. According to the diagram given in his paper the monsoon months of 1963 coincide with the epoch of maximum easterlies at 21 km

over Trivandrum. It is possible that the features of the high level wind structure over Trivandrum and Minicoy discussed in this note are connected with this. If so, the wind structure above 16 km in the monsoon months would be expected to be different from year to year.

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