551·576/7 : 551·508·99 (548·2)

A radar analysis of equatorial precipitating clouds at Thumba

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(*Received 14 January 1970*)

ABSTRACT. The precipitating cloud echoes detected by a 10 cm radar (S-band) at Thumba (Lat. 08°32′N, Long. 76°52′ E) have been analysed to find out the main characteristics of the equatorial cloud system—horizontal and vertical dimensions, extent and nature of line formation, distance between individual cloud cells and line echoes, structure, development and movement.

Assuming the precipitating system to be circular and moving with uniform speed, the horizontal dimension of a cloud system which passed through a close triangular network of meteorological stations in Trivandrum was calculated and compared with the nearest available radar observations. The cloud dimension and movement were found to be in good agreement with radar observations.

1. Introduction

The present paper contains an analysis of radar echoes of equatorial precipitating systems detected by a S-band Cotal radar on one hundred occasions spread over a period of one year, September 1967 to August 1968.

2. Observations and analysis

Whenever interesting weather phenomena such as thunderstorms, cyclonic storms, depressions etc occurred in the neighbourhood of Kerala and the south Madras coast, the Cotal radar was utilised for hourly weather observations to study the development of the system until it passed over the station. Sketches of echo patterns were prepared on suitable polar diagrams (90 and 180 km). The horizontal dimension, movement, range and distance between individual cells were also noted. The data utilised in the study are given in Table 1.

Fig. 1 shows the frequency distribution of horizontal dimension (d) of 682 radar echoes. The maximum frequency is found round about at 7-8 km. The frequency of the distance (D) between two close radar echoes is plotted and shown in Fig. 2. The frequency is maximum at D=15 km. Particulars of 31 radar line echoes consisting of 5 or more than 5 cells and extending to more than 60 km, with a length to width ratio 10 : 1 are given in Table 2. Fig. 3 depicts the frequency of the length of line echoes (L). The optimum length of the line echoes was observed to be 100 km.

Hem Raj and Billa (1967) have reported a method for the determination of mesoscale precipitating systems over Poona on the assumption that the rainfall at three raingauge stations is caused by one and the same rain cloud which is fairly large in extent. In Trivandrum a still closer triangular network of meteorological observatories is available (Fig. 4). The computed horizontal dimension and movement from the rainfall data on three different occasions for which simultaneous radar observations were also available, are shown in Table 3. In spite of the inherent limitations of the method, the calculated dimension and movement were found to be in fairly good agreement with the radar observation.

3. Concluding remarks

Equatorial precipitating systems at Thumba appears to approach the station in the form of band or lines. During the monsoon season, they develop over the Arabian Sea 100 km off the west coast, move inland and after passing the shore apparently begin to break up into individual cells. There are generally two or three bands visible at the same time with a spacing of 15 km and extending about 100 km in length. The direction of movement is reversed during the premonsoon and post monsoon seasons. Vertical and horizontal dimensions of clouds which generally develop over the Western Ghats during the above period are higher. They move with less speed from land to the sea.

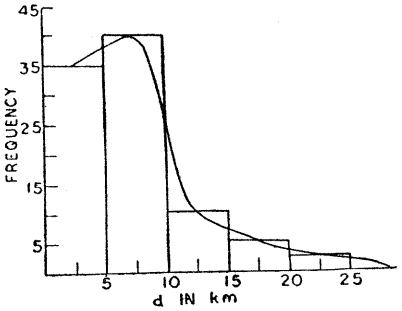

Fig. 1. Frequency distribution of horizontal dismension (d) of radar cloud echoes

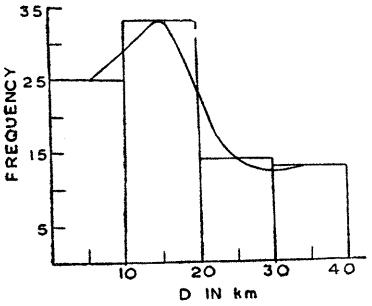

Fig. 2. Frequency distribution of distance between two close radar echoes (D)

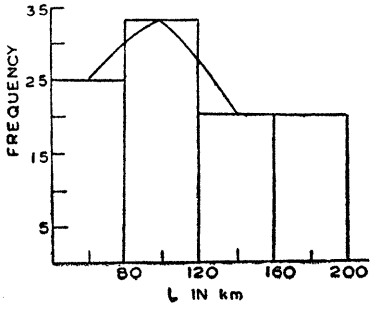

Fig. 3. Frequency distribution of extent of line echoes (L)

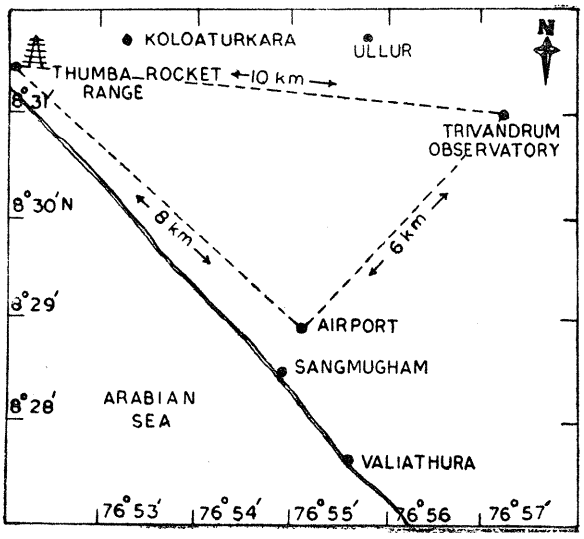

Fig. 4. Location map of triangular network of meteorological observatories at Trivandrum

TABLE 1

Radar observation data at Thumba (September 1967-August 1968)

	No. of observation	No. of echoes observed	No. of line formations
September, 1967	8	74	3
October, 1967	16	86	4
November, 1967	14	105	4
December, 1967	10	47	3
January, 1968	6	5	—
February, 1968	13	—	—
March, 1968	13	73	8
April, 1968	6	48	2
May, 1968	6	64	2
June, 1968	6	68	3
July, 1968	5	45	1
August, 1968	9	67	1
Total	112	682	31

TABLE 2

Details of radar line echoes at Thumba (September 1967—August 1968)

Date	Time (IST)	Length (km)	Width (km)	Date	Time (IST)	Length (km)	Width (km)
	1967				**1968**		
22 Sep	1100	120	15	18 Mar	1500	180	15
23 Sep	1400	100	10	19 Mar	1600	100	10
26 Sep	1400	150	20	20 Mar	1630	120	15
19 Oct	1100	130	15	25 Mar	1545	120	15
20 Oct	1100	210	20	26 Mar	0400	100	10
25 Oct	1600	100	10	28 Mar	1600	180	15
26 Oct	1430	120	10	29 Mar	1600	120	10
4 Nov	1500	180	15	31 Mar	1700	100	10
6 Nov	1100	60	10	17 Apr	1600	100	10
9 Nov	1100	60	10	18 Apr	1545	160	15
29 Nov	1100	60	10	18 May	1045	80	10
2 Dec	1200	60	10	29 May	1600	140	15
7 Dec	1500	60	10	1 Jun	1130	60	10
8 Dec	1100	160	15	3 Jun	1545	120	10
				15 Jun	1115	180	15
				20 Jul	1030	80	10
				9 Aug	1100	150	10

TABLE 3

Horizontal dimension (D) and movement (S) determined by rainfall data and radar

Date	Rainfall			Radar		
	Dimension D	Movement		Dimension D	Movement	
		Speed S	Direction		Speed S	Direction
	(km)	(kmph)	(Deg.)	(km)	(kmph)	(Deg.)
22 Sep 1967	26·4	12·9	210	30	30	215
18 Apr 1968	34·0	32·8	060	30	20	045
15 Jun 1968	11·0	44·4	245	20	40	270

4. Acknowledgements

The author is grateful to Shri H. G. S. Murthy, Director, Thumba Equatorial Rocket Launching Station for the facilities provided for this study. Thanks are due to Shri R. Aravamudan and his group for operating the radar according to my requirements.

REFERENCE

Billa, H. S. and Hem Raj 1967 *Indian J. Met. Geophys.*, **18**, 3, p. 383.