Mausam, (1981), **32**, 1, 97-100

551.553.21:621.396.96

Study of the pre-monsoon squalls from 1975 to 1979 over Dum Dum with reference to radar echoes

P. K. BHATTACHARYA and C. M. BARMA

Meteorological Office, Calcutta

(*Received 19 May 1979*)

ABSTRACT. With the pre-monsoon squall data of Dum Dum from 1975 to 1979 alongwith Dum Dum radar observations, different analyses have been made to find out the significant characteristics of radar echoes with respect to locations, distributions, *Cb* tops, etc. An attempt has been made to get indications of occurrence of squalls at Dum Dum with the above analysed characteristics for issue of timely aerodrome warnings for squalls at Dum Dum.

1. Introduction

Squalls are hazards for aviation operations as well as for aircraft on ground. Timely warnings for squalls are, therefore, essential for aviation. Radar studies on pre-monsoon thunderstorms and squalls (Nor'westers) over Gangetic West Bengal had earlier been done by Das *et al.* (1957), Koteswaram and De (1959) and De and Sen (1961).

An attempt has been made in this paper on the basis of pre-monsoon squalls from 1975 to 1979 to find out how best the radar echoes observed at Dum Dum can be utilised to indicate occurrence of squalls at Dum Dum for issue of timely aerodrome warnings.

2. Radar used

The observations were taken by a BEL-MAKE 501 storm detecting radar which has been installed at Dum Dum in 1972. The radar operates on X-band and has a peak power of 200 kw. Its receiver sensitivity is 120 dB below 1 watt. The beam width of the radar is 1 deg. approx. The radar has both the facilities of PPI and RHI in one display and it has a maximum range of 400 km. The RHI is capable of displaying a maximum height of 20 km. The radar normally operates every hour but is operated more frequently when active *Cb* cells are in the vicinity of the station.

3. Data used

All the squalls in respect of April and May of 1975 to 1979 have been taken into account. Sectorwise distribution of number and percentage of (*i*) initial apearance of radar echoes and (*ii*) maximum development of the radar echoes have been determined and are shown in polar diagrams (a) and (b) respectively (Fig. 1).

The types of *Cb* cells during their initial appearance on the days when squall occurred over Dum Dum during the period of study together with an idea of the distances of such initial appearances of radar echoes are given in Table 1. Table 2 gives a summary of time lapses between the times of maximum development of echoes and their corresponding times

TABLE 1

Total No. of cases studied (including cases where more than one squall occurred)	No. of cases when initial appearance of radar echoes were of the type of				No. of cases when nearest distance of initial appearance of radar echoes noticed at			
	Isolated cells	Scattered cells	Broken line	Continuous line	00-99 (km)	100-199 (km)	200-299 (km)	300 (km) and beyond
44	11	27	5	1	7	13	23	1
	(25%)	(61%)	(11%)	(2%)	(16%)	(30%)	(52%)	(2%)

TABLE 2

Time lapse of occurrence of squall at Dum Dum from the time of max. development of line formation

No. of cases studied	Occurrence of squall between				
	00 & 30 min	31 & 60 min	1 & 2 hr	2 & hr	>3 hr
41	7	12	14	6	2
	(17%)	(29%)	(34%)	(15%)	(5%)

TABLE 3

Number of cases studied

No. of cases studied	Number of hours of duration of squall lines					
	1 hr	2 hr	3 hr	4 hr	5 hr	>5 hr
41	2	11	11	8	3	6
	(5%)	(27%)	(27%)	(20%)	(7%)	(14%)

of occurrence of squalls. A study has been made to get an idea of the duration of squall lines for all such squalls which occurred over Dum Dum during 1975 to 1979. The findings are given in Table 3.

4. Analysis of the data

A perusal of the diagram and tables will show that maximum number of radar echoes are noticed initially between west and northwest (31 per cent) which is closely followed by the initial developments in the sector northwest to north (26 per cent). It is also interesting to note that practically none of the echoes which ultimately culminated to give thundersqualls over Dum Dum had initially developed in the sector between southeast and southwest through south.

The radar echoes with their maximum developed stages which ultimately gave squalls over Dum Dum, took place between west and north through northwest, and account for 51 per

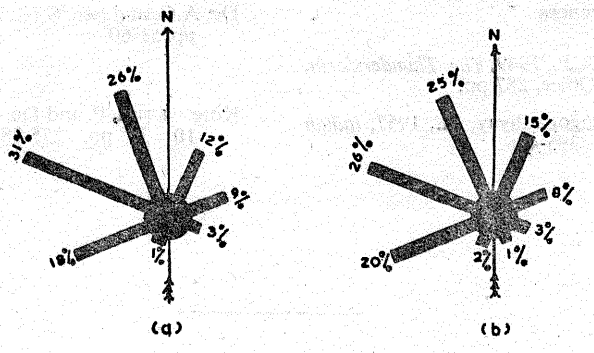

Fig. 1. Sectorwise radar echoes of :
(a) initial appearance
(b) maximum development

cent. It s important to note that a good number of cells (20 per cent) which gave squalls over Dum Dum had their maximum developments in the sector west to southwest.

It s seen that 61 per cent of the radar echoes initially appeared as scattered cells while most of the initial developments (52 per cent) took place between 200 and 299 km from Dum Dum.

No specific relationship could be established among the time of occurrence, direction and speed of the squall quantitatively from the radar echo characteristics and its movement. Nevertheless, the following useful findings were obtained from the study. It was observed that no preferred time exists for occurrence of squalls at Dum Dum. There were instances when squalls occurred as early as at 0950 IST in the morning and as late as 0040 IST in the night. But the maximum number of occurrences (73 per cent) of squalls over Dum Dum were between 1600 IST and 2000 IST. Maximum number of squalls (64 per cent) occurred not before half an hour and not later than two hours from the maximum developed stage of the squall lines. Occurrences of squalls beyond three hours of maximum development of squall lines were found to be extremely rare (5 per cent).

It has also been observed that the duration of a squall line was between 2 to 4 hour in the maximum number of cases (74 per cent).

As regards the directions of squalls, the general direction is that along which the *Cb* lines approach the station. A few cases have, however, been observed when the directions of squalls were contrary to the directions of approach of the *Cb* cells. In a couple of occasions the directions of squalls were even found to be almost opposite to the direction of movement of the *Cb* cells. Following the model suggested by Byers and Braham (1949) it is presumed that in such cells the downdraft from the *Cb* clouds started when the cells were in the process of crossing the station or had just crossed the station. A case has been observed when *Cb* cells approaching from the north crossed Dum Dum, and a southerly squall started as soon as it went to the south of the station. As explained above, the location (azimuth) of the maximum developed echoes where the width and height of the lines are maximum, give a good idea of the direction of the squall. When the line formation is very close to the station, the forecaster will have to be extra cautious in forecasting the direction of squall. No correlation could be obtained between the squall speed and the intensity of the squall lines.

Acknowledgement

Thanks are due to S/Shri S. K. Banerjee and H. L. Chakravorty, Assistant Meteorologists for their assistance in preparation of the work.

References

Byers, H.R. and Braham (Jr), R.P., 1949, *The Thunderstorm*, Washington Govt. Print Office, 287 pp.

Das, P.M., De, A.C. and Gangopadhyay, M., 1957, *Indian J. Met. Geophys.*, **8**, 4, pp. 395-406.

De, A.C. and Sen, S.N., 1961, *Indian J. Met. Geophys.*, **12**, 1, pp. 51-60.

Koteswaram, P. and De, A.C., 1959, *Indian J. Met. Geophys.*, **10**, 3, pp. 275-282.