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Radar cloud observations at Bombay during the monsoon season of 1960

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ABSTRACT. The frequencies of cloud occurrences at different hours in the various sectors around Santacruz aerodrome, as observed by a 3-cm weather radar, have been compiled for the monsoon season of 1960 and presented in this note. The observations indicate certain preferred areas of cloud occurrences at different synoptic hours. The information may be useful to forecaster in connection with the issue of landing forecasts for aviation and particularly in indicating the probability of presence of clouds over the approach sector of the runway in use, causing low ceiling or poor visibility due to precipitation.

1. Introduction

Climatological statistics relating to amount and base of clouds for the various hours in different months are already available for important stations. In addition to the amount and height of base of clouds over the airfield, the pilots of fast moving aircrafts are also interested to know the sector in which the clouds are expected to develop. This information is found to be useful for landing or take off purposes. There is no provision for recording the location of the existing clouds by our observers. Therefore, the radarscope observations, with all their inherent limitations, are the only data which could be used for the study of the frequency distribution of cloud occurrences in the various sectors. The distant clouds may sometimes be obscured on the radarscope by the nearer clouds or rain, and as such the frequency of occurrences of these distant clouds based on the radarscope observations may not be quite representative. For the issue of forecasts for landing or take off purposes, a forecaster is more interested in the climatological information regarding clouds within a small distance of 20—25 miles around the aerodrome. The frequency statistics in respect of these near clouds as obtained from radar observations are not likely to be significantly different from the correct values. For completeness, the frequencies of the distant clouds have also been included in the diagrams.

2. Radar cloud observations

The meteorological office at Santacruz is equipped with a 3-cm radar bearing the following characteristics—

Peak Power	20 KW
Pulse length	2·0 micro sec
P.R.F.	250 c/s
Horizontal beam width	0·75°
Vertical beam width	4°

During the monsoon season of 1960, the above radar was operated a number of times during the day and night when the sky was cloudy or when the weather charts indicated the possibility of development of disturbed weather. The PPI presentations were copied on polar diagrams during the course of the above operations. Over 500 diagrams have been analysed to obtain the frequencies of cloud occurrences in the various sectors around the radar site at the different synoptic hours, *viz.*, 00, 03, 06, 09, 12, 15, 18 and 21 GMT.

3. Analysis of the data

For the purpose of determining the cloud frequencies for different regions, the polar diagram was divided arbitrarily into 60

divisions as shown in Fig. 1. The percentage frequencies of cloud occurrences in the various divisions were computed from the available data, namely, the polar diagrams for June, July, August and September 1960 and tabulated separately for the eight different routine hours of the above months. From these values, the degree of susceptibility of the different divisions to cloud occurrences has been assessed. Figs. 2 (a) to 2 (d) show the hour at which the percentage frequency of cloud occurrences in a particular division was maximum in each month of June, July, August and September 1960. The maximum percentage frequency values are also indicated in these diagrams within brackets. The regions more favourable for cloud developments at different hours have also been shown in the diagrams by drawing isolines of the maximum frequency values at intervals of 25 per cent. Fig. 3 furnishes similar information for the four monsoon months taken together. Figs. 4 (a) to 4 (h) represent the percentage distribution of cloud occurrences at the various routine hours for the whole monsoon season.

4. Discussion of the data

The diagrams mentioned above bring out some interesting features of cloud occurrences in the four different months. It is seen from Fig. 2 (a), that in the month of June, morning is the most favourable time for occurrence of clouds within 20 miles of the radar site. The southwestern sector is the most susceptible spot where clouds were observed on almost 100 per cent occasions. In the month of July (Fig. 2 b), the most favourable spot for clouds is located to the southeast of the station instead of to the west as noticed in June. The mid-day is the most favourable time for such occurrences. The maximum frequency (75 per cent) for this month is lower than that (100 per cent) for June. In August (Fig. 2 c), there is a further fall in the frequency. It is seen that the day-time is more favourable for cloud occurrences in the vicinity of the station. Of the four monsoon months, September has the least cloud frequency (Fig. 2 d). Even in the most cloudy region located to the south and southeast of the station, the frequency is 50 to 60 per cent only. From Fig. 3 which gives frequency figures for the whole monsoon season, it is seen that region upto 30 or 40 miles to the south or southeast of the site is the most favourable area for cloud occurrences.

The diagrams, Figs. 4 (a) to 4 (h), which contain percentage frequencies of cloud appearances in the various divisions at different hours of observation during the whole monsoon season show that the areas of maximum frequency is more extensive towards south at 0530, 0830, 1130, and 2330 hrs and towards east at other hours.

5. Acknowledgement

In conclusion, the authors wish to record their thanks to Shri K. N. Rao, Director, Regional Meteorological Centre, Bombay for his kind interest in this work.

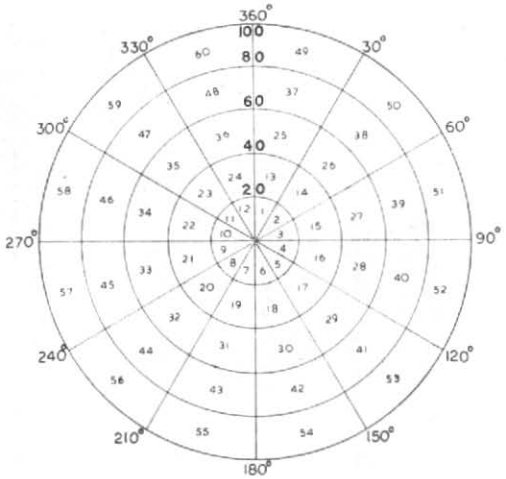

Fig. (1)

Fig. 1. A polar diagram depicting the various divisions for which cloud frequencies have been determined
(Range rings in miles; 20 miles)

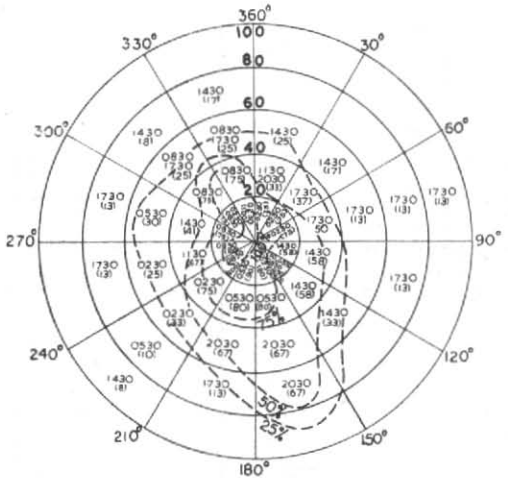

Fig. 2(a) — June 1960

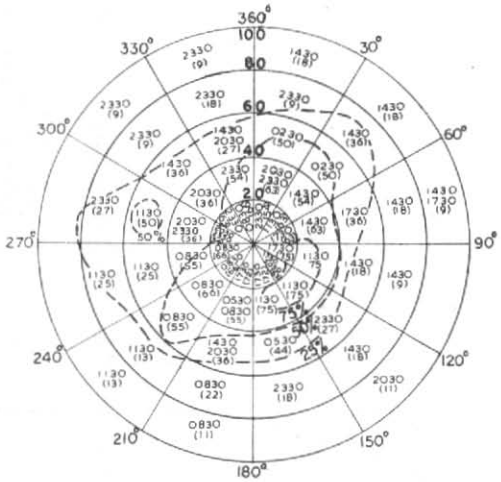

Fig. 2(b) — July 1960

Figs. 2 (a, b). Maximum percentage frequencies of clouds and the time of occurrences

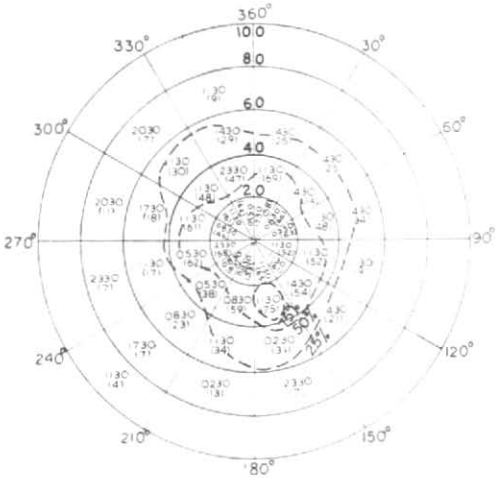

Fig. 2(c) — August 1960

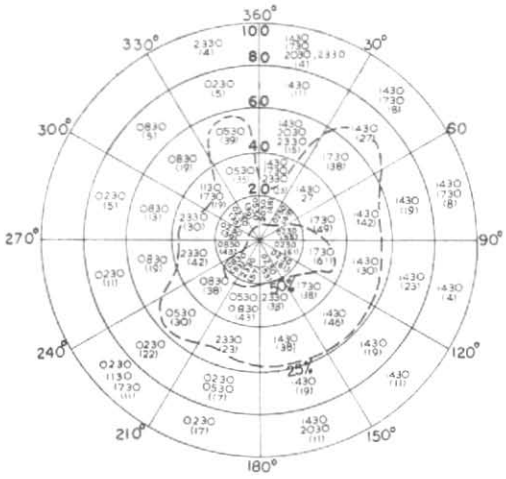

Fig. 2 (d) — September 1960

Figs. 2 (c, d). Maximum percentage frequencies of clouds and the time of occurrences

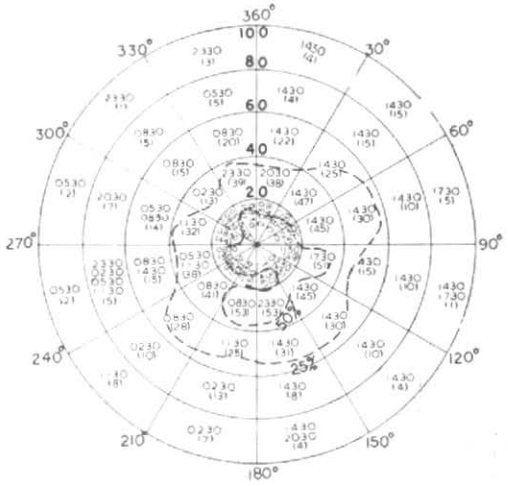

Fig. 3 — Monsoon 1960

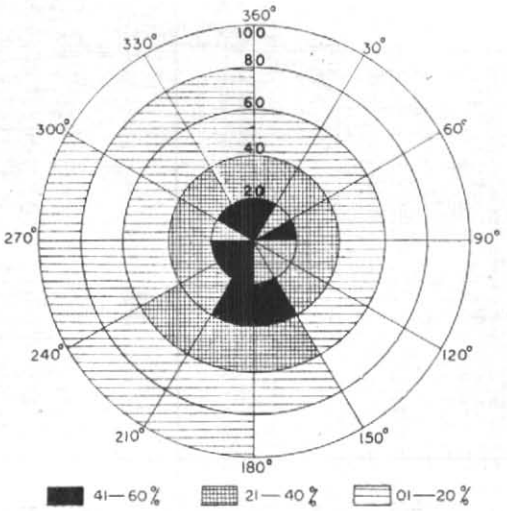

Fig. 4(a). 0530 IST

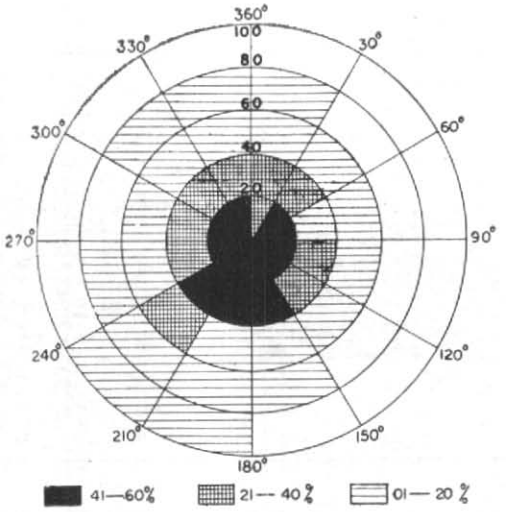

Fig. 4(b). 0830 IST

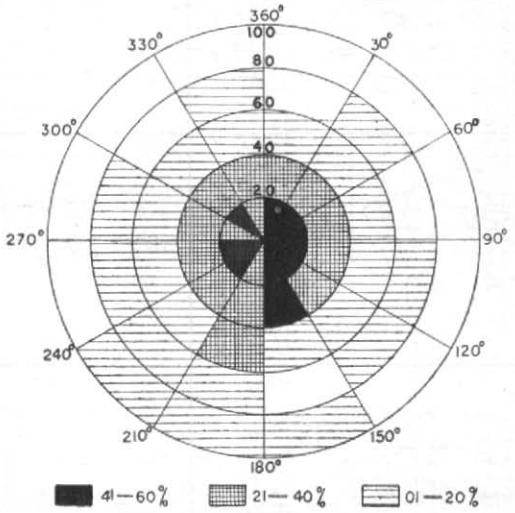

Fig. 4(c). 1130 IST

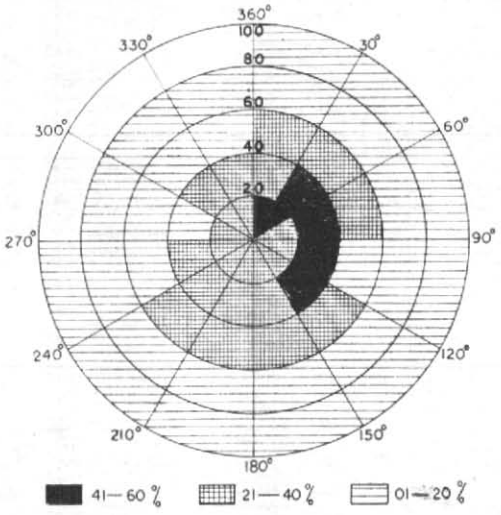

Fig. 4(d). 1430 IST

Figs. 4 (a to d). Percentage frequency of cloud occurrences in the various divisions during the monsoon season 1960

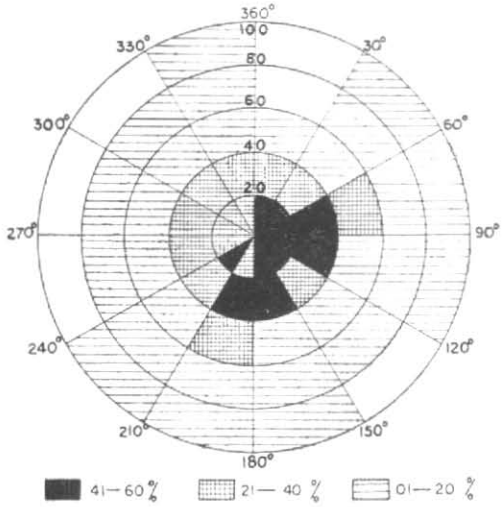

Fig. 4(e). 1730 IST

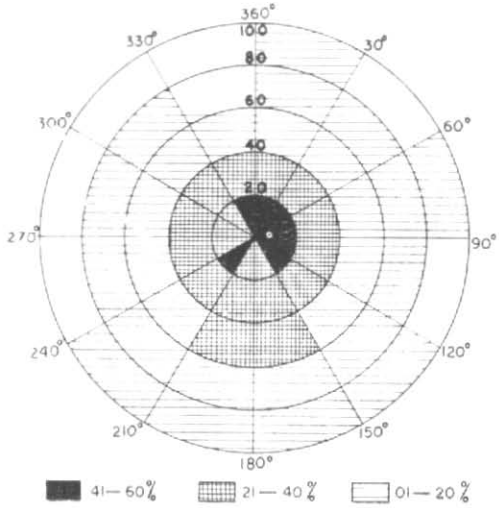

Fig. 4(f). 2030 IST

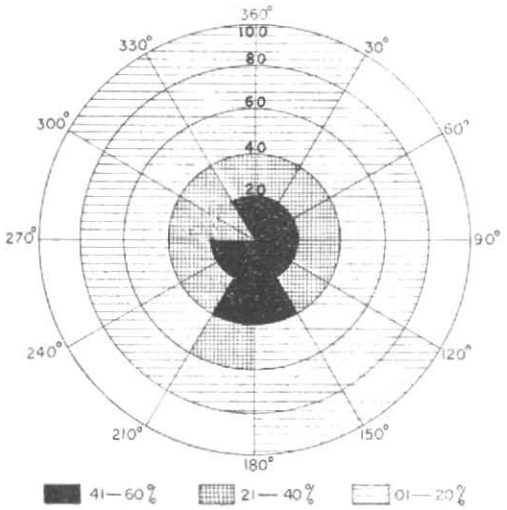

Fig. 4(g). 2330 IST

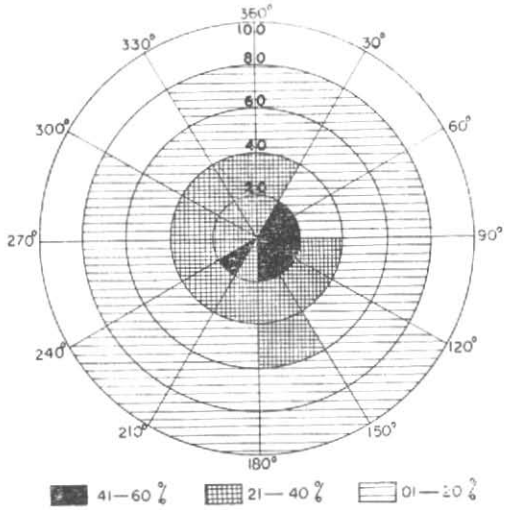

Fig. 4(h). 0230 IST

Figs. 4(e to h). Percentage frequency of cloud occurrences in the various divisions during the monsoon season 1960