551.55.52 : 551.57(548.1)

A study of wind distribution and associated dry or wet weather probability over Madras during monsoon and post-monsoon months

N. C. RAI SIRCAR, S. JAYARAMAN and T. R. SRINIVASAN

Meteorological Office, Madras

(Received 27 December 1966)

ABSTRACT. In this paper, a detailed analysis has been made of the frequency of wind vectors at surface, 850 and 300-mb levels over Madras (Meenambakkam) for the monsoon and post-monsoon months during the eight-year period 1956-63. The relationship between the various wind vectors and the impending dry or wet weather spells for the next 12 hours has also been examined. The results are presented in the form of 'roses' which may be of some use to a forecaster in connection with prediction of dry or wet weather during the next 12 hours on the basis of the prevailing winds.

1. Introduction

Being a coastal station, the winds over Madras, particularly in the lower levels, are liable to appreciable changes during the course of the day. Apart from the land and sea breeze effects, the changes are also caused by the movement of the low pressure system over and near the area. The rainfall is usually caused by the above low pressure systems some of which are feeble and can be detected mainly by the changes in the wind direction. In this paper, a study has been made of the relationship between prevailing wind vectors and the associated weather probabilities during the next 12 hours and the results are presented in the form of roses. The probability percentages of occurrence of precipitation during the next 12 hours in relation to the various wind directions and speed ranges are also shown in the same diagrams. The study is based on the morning (0530 IST) and evening (1730 IST) data for the period 1956 to 1963.

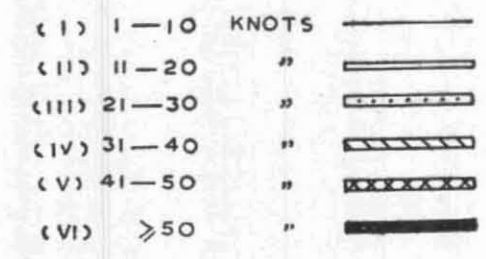
2. Procedure followed

As already mentioned, apart from the examination of the frequency distribution of winds at the three standard levels namely, surface, 5000 ft and 30,000 ft and at 0530 and 1730 IST, the object of the study is also to find out the probability of occurrence of rain or no rain during the 12-hr periods from 0530 to 1730 IST and from 1730 to 0530 IST corresponding to the various wind vectors at 0530 and 1730 IST respectively. Wind data for 0530 and 1730 IST and occasions with rain or no rain between 0530 and 1730 IST and also between 1730 and 0530 IST were collected from the relevant records for the monsoon and post-monsoon months during the 8-year period under study. From these data, the percentage frequencies of wind vectors have been computed for the various months separately and presented in the form of 'roses'. The percentage probability of occurrence of rain during the next 12 hours in relation to the various wind vectors at 0530 or 1730 IST respectively has also been determined and shown in these 'roses'. A legend for the diagrams is given below —

(*a*) The shaded portion of the circle represents the proportionate frequency of wet occasions between 0530 and 1730 IST or 1730 and 0530 IST as the case may be. An occasion has been considered as wet when at least a trace of rain has occurred.

(*b*) The direction of surface wind is given in 16 points of the compass and that of upper winds in tens of degrees.

(*c*) The different wind speed groups with their symbols are given beiow :



(*d*) The total length of each radial arm is proportional to the percentage frequency of the occurrence of winds from that direction, the scale being 5 per cent equal to the length, shown in the first diagram.

(*e*) The figure at the end of each direction represents percentage frequency of wet occasions for the particular direction irrespective of wind speed. Other figures represent percentage frequency of wet occasions for different wind speed ranges in a particular direction.

(*f*) In the cases of the diagrams for the surface level, calm and variable winds are indicated by 'C' and 'V' in these diagrams, the lower figure representing the percentage frequency of its occurrence and the upper figure the correspondig percentage frequency of occurrence of rainfall.

Surface diagrams for June, October and December (Figs. 1 to 3) only are presented in the paper (complete set of diagams are given in pre-published *Scientific Report No. 57*—June 1968).

3. Results as seen from diagrams

(*a*) *Surface level* — In June, S'ly (1—10 kt) WSW'ly (1—10 kt) and W'ly (1—10 kt) winds occur in the morning on 9, 9 and 17 per cent occasions and lead to dry weather on 95, 86 and 83 per cent occasions respectively. In the evening, SW'ly (1—10 kt) winds blow on 7 per cent occasions and the probability of no rain with such winds is 82 per cent. In the post-monsoon season, significant relationship is noticeed in the month of October and December. N'ly (1 to 10 kt) wind occurs on 7 per cent occasions in the morning in the month of October and when this wind is present, the probability of occurrence of rain is 81 per cent. In December, winds are more helpful to forecast dry weather. In this month W'ly (1 to 10 kt), WNW'ly (1 to 10 kt) and NW'ly (1 to 10 kt) winds occur on 7,10 and 26 per cent days in the morning and the corresponding probability of dry weather is 100, 96 and 82 per cent respectively. In the evening the frequency of NNE'ly (11 to 20 kt), ENE'ly (1 to 10 kt) and NE'ly (1 to 10 kt) winds are 11, 8 and 23 per cent respectively and the corresponding dry weather changes are 81, 85 and 81 per cent respectively.

(*b*) *5,000-ft level*—In the month of June there are about half a dozen different wind vectors with frequency more than 5 per cent which are associated with dry weather on more than 80 per cent occasions during the next 12 hours. The most frequent vectors are 270° (11—20 kt) in the morning and 270° (1—10 kt) in the evening. Their frequencies are 19 and 16 per cent and both lead to dry weather on 84 per cent occasions.

The significant wind vectors leading to high precipitation probabilities are 030° (11—20 kt) and 120° (1 to 10 kt) in the evening of October. Their frequencies are 4 and 3 per cent respectively and the associated precipitation probabilities are 80 and 86 per cent respectively. As in June, there are several wind vectors in December whose frequencies are 5 per cent or more with the associated dry weather probabilities exceeding 80 per cent. The most frequent vectors are 060° (11 to 20 kt) in the morning and 090° (1—10 kt) in the evening. Their frequencies are 31 and 11 per cent respectivley, the dry spell probability on both the occasions being 84 per cent.

(*c*) *30,000-ft level* — During the monsoon season, there are quite a number of wind vectors in the morning having the frequency of 5 per cent or more which lead to dry weather on most occasions. The number of such wind vectors are, however, few in the evening. The most important of them are 090° (11—20 kt) in the morning and 030° (1—10 kt) in the evening of June, their frequencies being 13 and 8 per cent and the associated dry probabilities 96 and 81 per cent respectively.

Wind vectors of frequencies 5 per cent or more and leading to dry weather on more than 80 per cent occasions are practically absent in October. There are, however, several such vectors in December, the most important one being 300° (1—10 kt) both in the morning and evening, its frequencies being 6 per cent. The dry weather probability corresponding to the morning wind is 92 per cent and corresponding to the evening wind is 100 per cent.

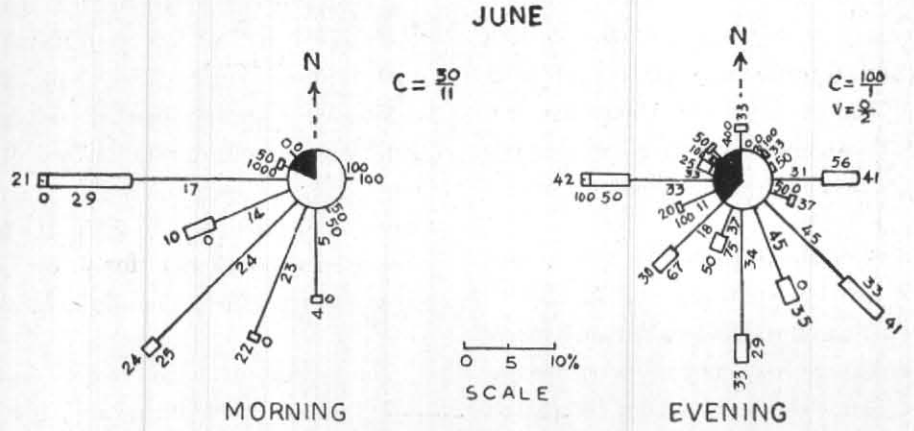


Fig. 1. Percentage frequencies of surface wind vectors of Madras in the form of wind roses for June

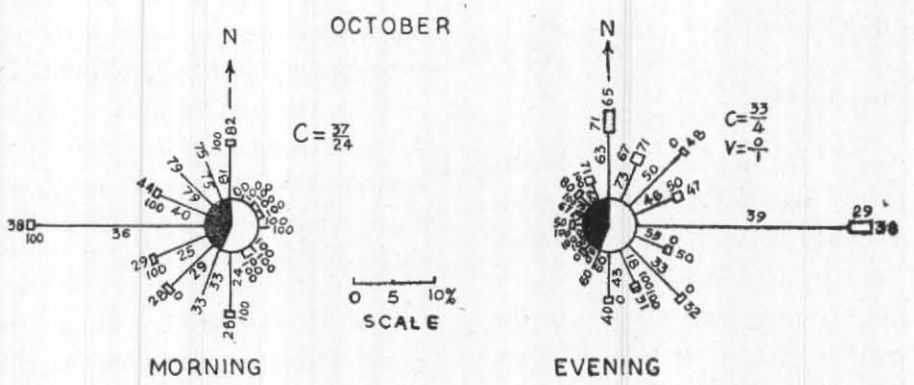


Fig. 2. Percentage frequencies of surface wind vectors of Madras in the form of wind roses for October

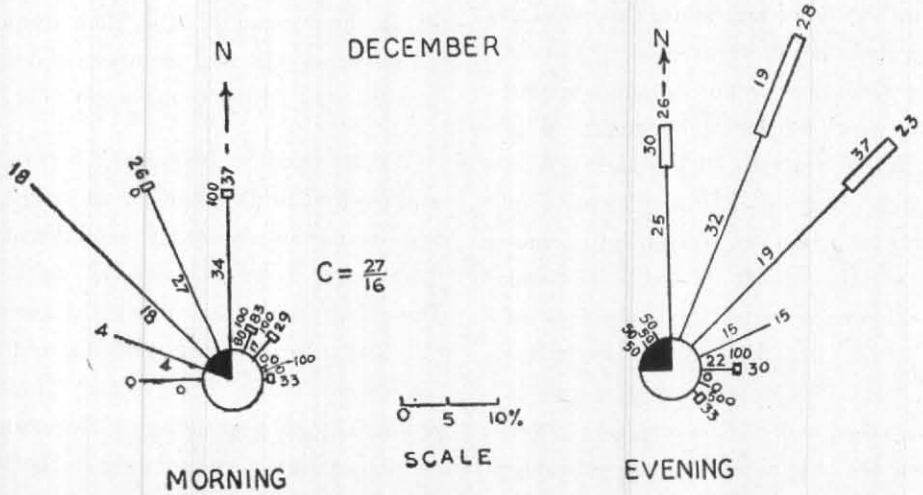


Fig. 3. Percentage frequencies of surface wind vectors of Madras in the form of wind roses for December

It is found that SE/S'ly winds at 30,000-ft level are more favourable for occurrence of precipitation during the post-monsoon season. These winds indicate the movement of high level troughs across the south Peninsula. The significant vectors are 120° (21—30 kt) in the morning and 180° (11 to 20 kt) in the evening of October. Their frequencies are 2 per cent and 3 per cent respectively, wet weather probability being 100 per cent on both the occasions. The percentage of wind vectors leading to precipitation on 80 per cent days or more is insignificant in the month of December.

4. Acknowledgement

The authors are very thankful to Shri S. S. Hashim, Shri K. Venkaya and Shri C.D. Padmanabhan for assistance in the computational work and to Shri R. Dasasathyan for the preparation of the diagrams in connection with this study.