551.553 : 551.524.3 (547.1)

A CASE STUDY OF UNUSUALLY STRONG SEA BREEZE CIRCULATION OVER BOMBAY

1. Sea breeze circulation over Bombay, during the hot weather period of March and April, has been studied by Dixit and Nicholson (1964) and Nicholson (1965). Dekate (1968) has made a statistical study of land and sea breeze over Bombay. However, in these studies, the effect of low level synoptic winds on the development of sea breeze circulation has not been clearly discussed. Sea breeze circulation is primarily a dynamical response to the differential heating of land and sea. However, this differential heating itself largely depends upon the low level synoptic winds. Estoque (1962) has classified the sea breeze circulation into various groups with respect to prevailing synoptic patterns.

An attempt has been made in this study to investigate and discuss the circumstances under which the strong sea breeze circulation developed over Bomby on 9 April 1974.

2. The wind data for 9 and 10 April 1974 have been taken from 00 and 12 GMT, 06 and 18 GMT TEMP and PILOT messages respectively of Santacruz. The surface wind and temperature data have been taken from the anemograph and thermograph charts of Santacruz Observatory, Bombay.

3. The thermograph and anemograph records of 9 and 10 April 1974 are presented in Figs. 1 and 2 respectively. It is seen from Fig. 1 that the sea breeze circulation on 9th started at about 0630 GMT at the surface, built up rapidly, being strongest at about 1200 GMT and continued upto 0130 GMT of 10 April. This observation is in agreement with the results of Nicholson (1965) who found that westerly components persist until midnight or even late on some occasions. It is also seen that easterly component of winds are maximum at about 06 GMT on both 9 and 10 April (Fig. 3). This is also in agreement with the findings of Nicholson, that easterly components are maximum about mid-morning, after the solar heating has been in progress for several hours. The vertical time section of winds starting from 06 GMT of 9 April to 1200 GMT of 10 April 1974 is presented in Fig. 3. Since, the coast line at Bombay is oriented approximately from 350° to 170°, for practical purposes it can be taken as running from north to south, so that the westerly component of winds shown as positive represent the on-shore, *i.e.*, sea breeze and easterly component of winds shown as negative represent the offshore, *i.e.*, land breeze component (Fig. 3).

It is clearly seen from Fig. 3 at 12 GMT of 9 April 1974 that the sea breeze circulation was very strong with maximum speed of 40 kt around 0·6 km level and not around 0·3 km as suggested by Dixit and Nicholson (1964) and Dekate (1968). It is also seen from the figure that the vertical extent of the sea breeze circulation extended upto 1·5 km and not 2·1 km or above, as suggested by Dekate (1968).

It is interesting to note that the vertical extent of sea breeze circulation underwent a sinusoidal fluctuation with a minima after about 1800 GMT. The fluctuation in the vertical extent of sea breeze circulation has also been shown by Ramdas (1932) in his study of sea breeze over Karachi but for day time only.

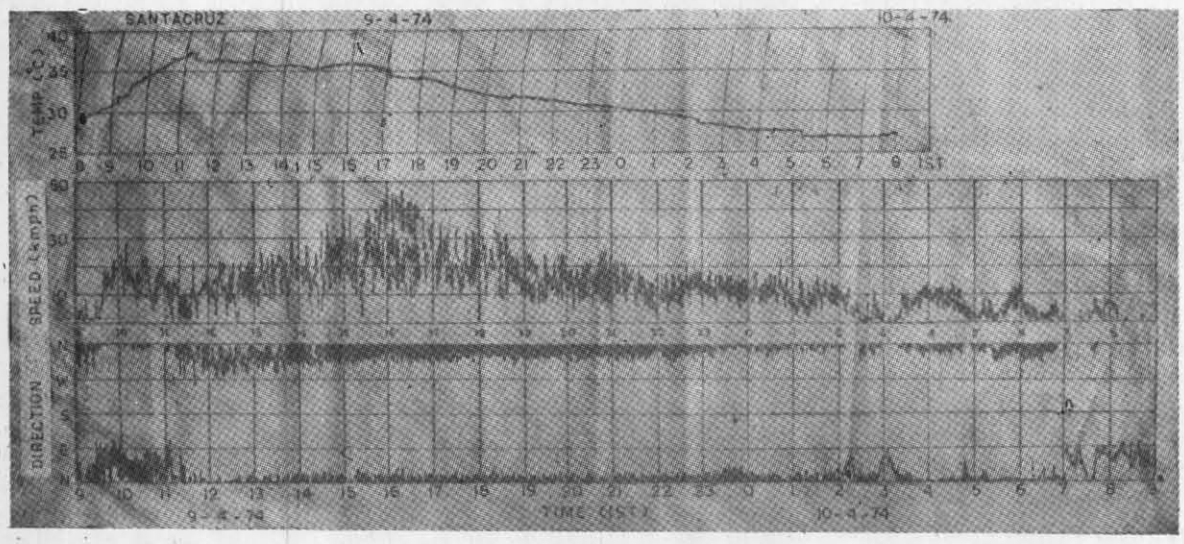

Fig. 1. Thermograph and anemograph records of Santacruz Observatory, Bombay Airport on 9/10 April 1974

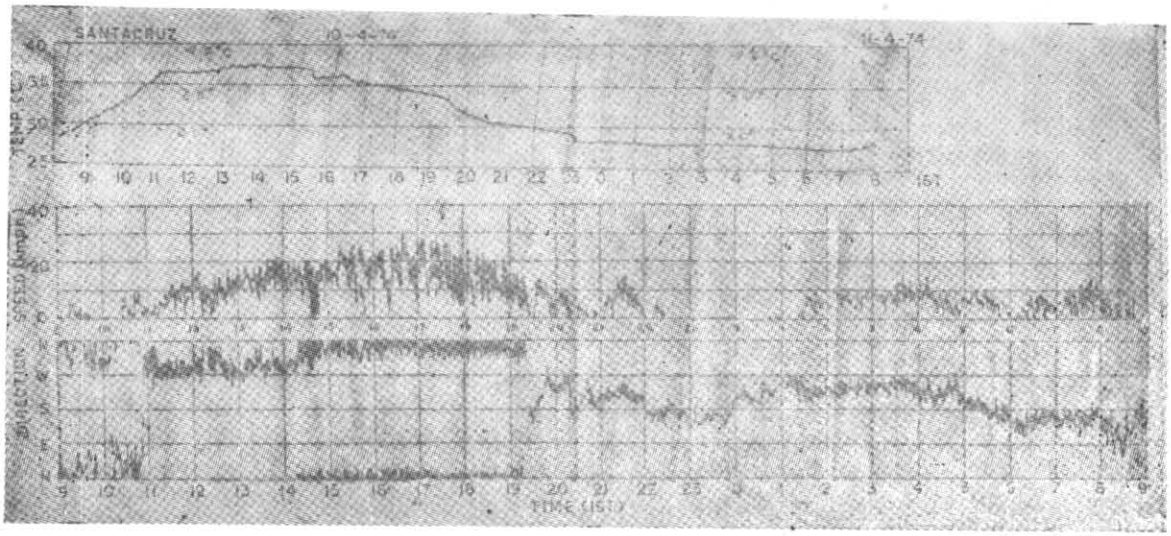

Fig. 2. Thermograph and anemograph records of Santacruz Observatory, Bombay Airport on 10/11 April 1974

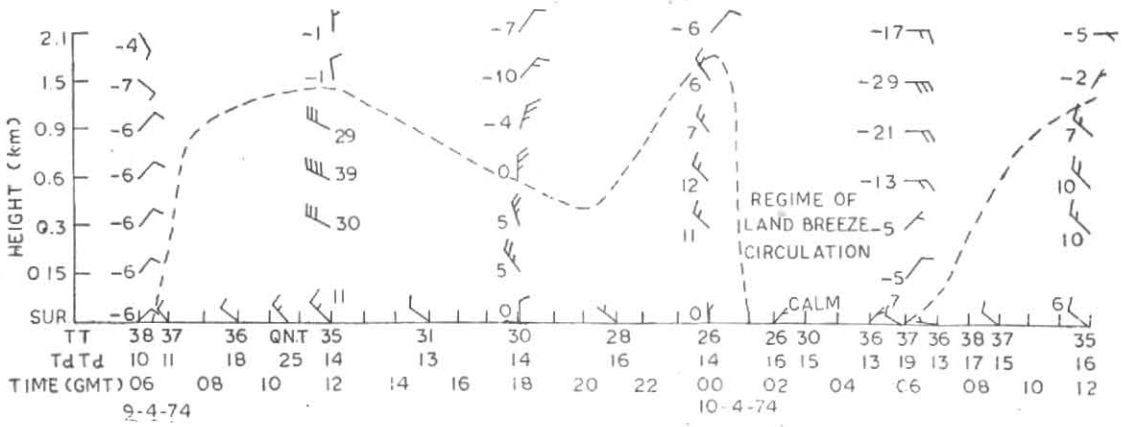

Fig. 3. Vertical time-section of winds showing thickness and development of sea breeze circulation on 9 & 10 April 1974
.....Vertical extent of sea breeze

4. On 9 April 1974 there was an anticyclone over Sind (Pakistan) and adjoining areas of Gujarat which caused light northeasterly flow over Bombay and neighbourhood. These light off-shore synoptic winds inhibited early setting in of sea breeze which resulted in rising of surface temperature of the order of 38°C (Fig. 1). The temperature contrast between land and sea was of higher order as compared to the normal contrast and, therefore, an unusually strong sea breeze circulation developed on 9 April 1974. The maximum speed reached in gust at surface was of the order of 50 kmph. (Fig. 1) between 1030 and 1130 GMT, *i.e.*, 16 and 17 IST.

It is of interest to note that the maximum surface temperature rose to 38°C again on 10 April 1974 (Fig. 2) but the sea breeze circulation was not so strong as that of 9th. The anticyclone over Sind (Pakistan) moved further eastwards and lay over Gujarat and neighbourhood on 10 April. The synoptic winds over Bombay were stronger easterlies on 10 April as can be seen by comparing the 06 GMT winds of 9 and 10 April (Fig. 3). Inspite of the fact that the temperature contrast was equally large on 10 April, strong off-shore winds inhibited the development of strong sea breeze circulation on that day. It is seen from Fig. 1 that on 9th the sea breeze set in at 0630 GMT of 9th and thereafter there was fall in surface temperature which is obvious. But on 10th (Fig. 2) the sea breeze set in at 06 GMT and as a result, there was fall in temperature of the order of 1°C. The temperature again rose and was of the order

of 38°C at 08 GMT and thereafter the temperatures were higher as compared to that of 9th. This can be explained from the fact that the low level wind on 10th were stronger easterlies which were of warmer origin.

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