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Letters to the Editor

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AN APPROACH TO OBJECTIVE METHOD OF FORECASTING PRE-MONSOON THUNDERSTORM AT CALCUTTA AIRPORT

1. Pre-monsoon thunderstorms at Calcutta generally occur in the late afternoon or early night. The forecast for this vulnerable period has to be issued by Meteorological Office, Calcutta by 0300 GMT in the 9-hourly TAFOR valid from 0600 to 1500 GMT. At that time the 00 GMT upper wind chart is practically blank on most of the days. Only 00 GMT Dum Dum radiosonde observation is likely to be available with the Forecasting Officer before 0300 GMT. The present work attempts to find out how far this observation may be utilised for arriving at an objective method of forecasting pre-monsoon thunderstorm at Calcutta airport.

2. In this study a thunderstorm has been said to have occurred if a thunderstorm and/or squall has been reported by Dum Dum Observatory between the period 0600 and 1800 GMT.

A number of predictors were tried. Out of them only the following three were found to be significant: (*i*) Showalter Index, (*ii*) Wind direction at 900 mb level and (*iii*) Wind direction at 600 mb level.

3. The observations taken by Dum Dum Upper Air Observatory after installation of the 1680 MHz Radio-theodolite have been utilised for the work. 00 GMT observations for the following months have been used.

Year	*Month*
1968	May
1969	March, April, May
1970	Do.
1971	Do.

Observations of the years 1972 and 1973 have been used as test set.

Observations have been divided into three groups of Showalter Index (S. I.). The result is shown in Table 1.

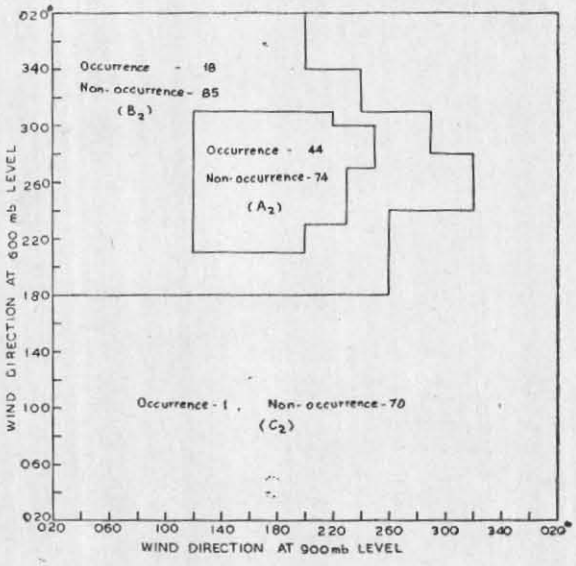

Fig. 1

TABLE 1

	A_1 S.I.$\leq$+1·5	B_1 +1·5<S.I.$\leq$+5.0	C_1 S.I.>5·0
Occurrence	58	5	0
Non-occurrence	101	58	70

If thunderstorm is forecast when S. I. falls in the group A_1, the result obtained is as given in the following contingency table, the skill factor being 0.48.

		Forecast	
		+	—
Observed		+58	5
		—101	128

A scatter diagram has been plotted with wind directions at 900 mb level as abscissa and 600 mb level as ordinate. The whole diagram has been divided into three regions as shown in Fig. 1. The result is shown in the figure itself. If the thunderstorm is forecast when wind directions at 900

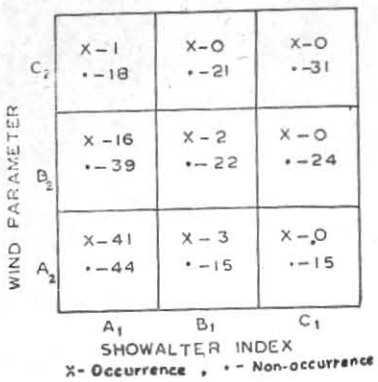

Fig. 2

and 600 mb levels fall in the regions A_2 or B_2 the result obtained is as follows.

		Forecast	
		+	—
Observed	+	+62	1
	—	—159	70

The skill factor as calculated from the above contingency table is 0.29.

Combination of Showalter Index and wind directions increases the skill factor considerably. The effect of the combination is shown in Fig. 2. If thunderstorm is forecast when S. I. and wind directions fall in either of the combinations (A_1 A_2) or (A_1 B_2) the skill factor increases from 0.48 to 0.53 with the following contingency table.

		Forecast	
		+	—
Observed	+	+57	6
	—	—83	146

The percentage of correct forecast is 70. The percentage, however, increases to 77 if thunderstorm is forecast only when S. I. and wind directions fall in the combination (A_1 A_2). Nevertheless, thunderstorm may be predicted for the combination (A_1 B_2) also, indicating a probability of 30 per cent.

4. The above method has been applied to an independent set of data pertaining to the years 1972 and 1973. The result is shown in the following contingency table.

		Forecast	
		+	—
Observed	+	+25	4
	—	—57	91

The skill factor is 0.47 and percentage of correct forecast is 66. Percentage of correct forecast becomes 76 if thunderstorm is forecast only when the predictors fall in the group (A_1, A_2) of Fig. 2.

The Aerodrome Forecasts issued by Meteorological Office, Calcutta during the same period have also been verified for the sake of comparison. The skill factor has been found to be 0.43 and the percentage of correct forecast 64. The contingency table is given below.

		Forecast	
		+	—
Observed	+	+24	5
	—	—58	90

5. The physical significance of S. I. in the formation of a thunderstorm is well understood. In the case of thunderstorms over Calcutta, its effect is quite prominent. It may be seen from Table 1 that almost all the thunderstorms occurred when S.I. was less than or equal to +1.5 and no thunderstorm occurred when it was greater than +5·0. Only a few thunderstorms occurred with S. I. in between +1.5 and +5.0.

The physical significance of the combination of wind directions at 900 mb and 600 mb is not obvious. However, considering the parameters separately, the role of southerlies at lower levels in producing thunderstorms over Calcutta cannot be ignored. Chaudhuri and Rakshit (1970) have shown that movement of squall lines formed in the Gangetic West Bengal during the pre-monsoon season has maximum correlation with the prevailing wind direction at 4.5 km (approx. 600 mb) level.

It is felt that the method can be improved considerably if a parameter based on divergence over the area west of Calcutta is included in it. At present divergence/convergence condition on 18 GMT upper wind chart may be taken into account subjectively to modify the objective method suggested above.

6. The author is grateful to Shri A. K. Sen Sarma, Meteorologist Grade I for the encouragement given by him by offering valuable suggestions.

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