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STUDY OF ROLE OF STABILITY INDEX IN FORECASTING OF THUNDERSTORMS

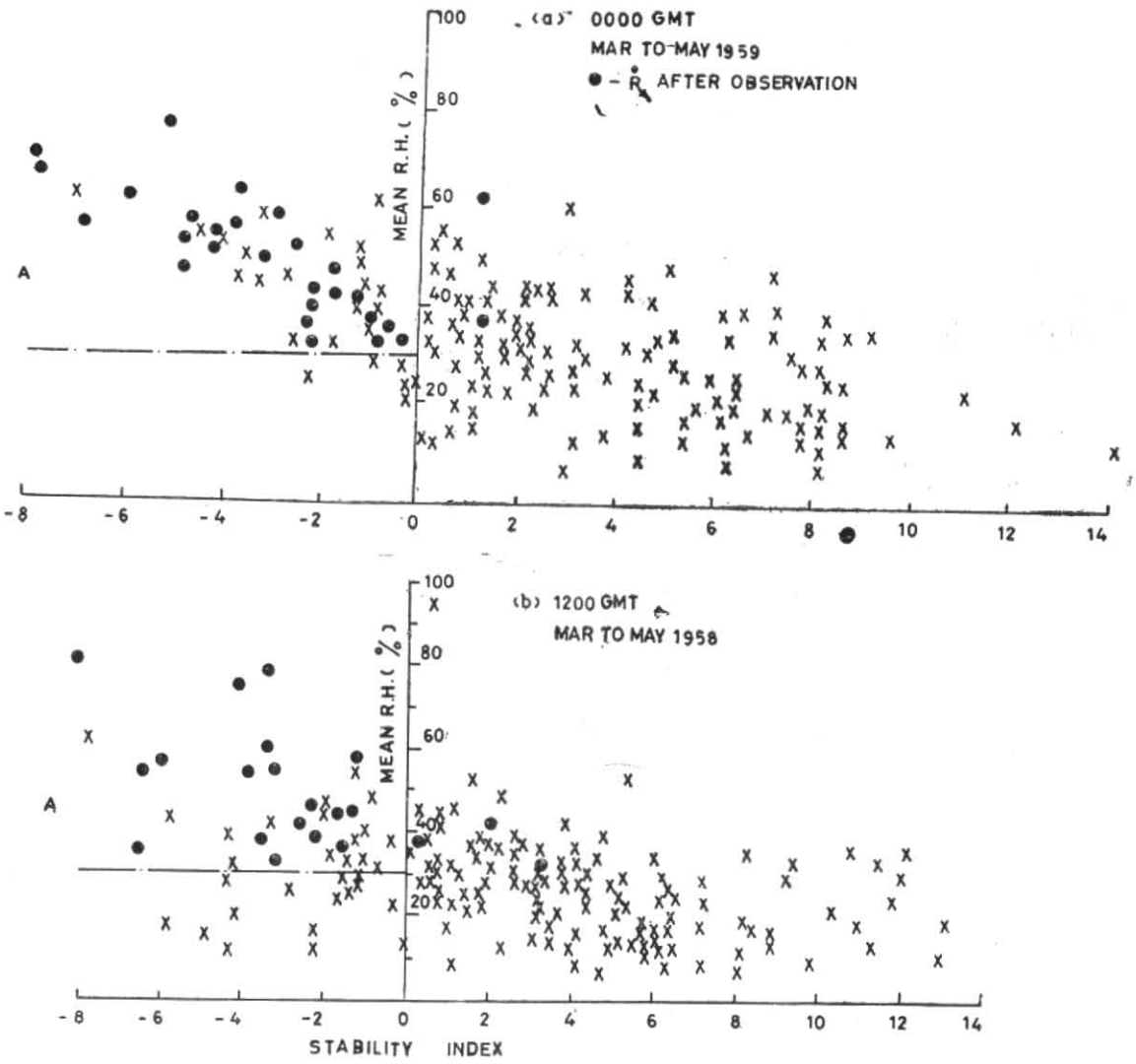
1. This paper deals with the study of utility of the Showalter's index, and Galway index, as predictors to objectively forecast development of local thunderstorms during summer months over north India around New Delhi. The study of radiosonde data of 7 years from 1958 to 1960 and 1963 to 1966 was undertaken. The data relating to the occurrence of thunderstorm cells around Delhi was verified from observations with the high power AN/CPS-9 radar.

The investigation revealed that Galway index is a better predictor, as compared to the Showalter index, for an objective assessment of development of summer thunderstorms in and around New Delhi.

The Showalter index can serve better than Galway index as an approximate guide for estimating cloud top heights in view of the correlation with the maximum heights of cloud tops. It is seen, however, that these indices do not have any value in prediction of maximum cloud top heights due to large standard errors.

2. There has been a great need for a simple and quick check on the possibility of a thunderstorm, one of the greatest hazards to aviation. As an aid to forecasting of thunderstorms, many predictors have been indicated. The stability index formulated by Showalter (1953) and the 'lifted index' due to Galway (1956) are among them.

As a preliminary step to the formulation of an objective method of forecasting thunderstorms occurring at Delhi during the months of March-June, a comparative study was undertaken of the utility of Showalter index and Galway index as predictors.



Figs. 1 (a&b). New Delhi, : (a) 0000 GMT, Mar-May1959 and (b) 1200 GMT, March-May 1958

3. *Data and method of study* — In this paper, the relationship between the above said stability indices and the occurrence of thunderstorms in and around Delhi over an area up to a radius of 160 km for 7 years (March-May) from 1958-60 and (April-June) from 1963-66, were taken up for investigation. The available data for more than 530 days has been included for study. The Showalter's stability index and corresponding mean relative humidity on each day for both 00 and 12 GMT radiosonde soundings have been studied for the period 1958-60. Further, the Showalter index and Galway index have been investigated for the four-year period, 1963-66. In addition, the relationship between maximum echo tops and stability indices of Showalter and Galway has also been examined.

4. *Discussion of results* — This study examined the importance of the predictors, namely, the Showalter's index and the mean R.H. at pressure levels between 850 and 500 mb with the help of the radiosonde data of Delhi for March-May 1958-59. The conclusion drawn are then verified on thunderstorm days during the same period in 1960.

4.1. *Results* — The Figs. 1 (a&b) show the plots of S.S.I. and mean relative humidity percentages for the periods March-May 1959 and 1958 respectively. It is seen that there had been only two thunderstorm occurrences out of a total number of 115 cases in Fig. 1 (a) and three occurrences out of a total of 117 cases in Fig. 1 (b) in the region of positive stability index. Even these very few

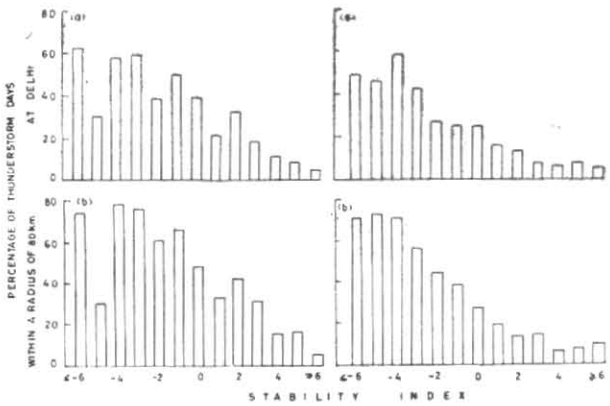


Fig. 2. Showalter index Fig. 3. Galways lifted index

occurrences had been confined to the region where he stability index is less than *plus* 2 and mean R.H. of 30 per cent. In the region of negative stability index, thunderstorm occurrences had been mainly confined to the areas marked 'A' in Figs. 1 (a&b) where S.I. is less than *minus* 1 and mean R.H. more than 30 per cent. Figs. 1 (a&b) reveal that when S.I. is less than *minus* four and mean R.H. greater than 45 per cent, the average percentage of occurrence was 78.1. When S.I. is negative there had been no occurrence where the mean R. H. was 20 per cent.

In 1960, out of a total of 13 cases of thunderstorm, 9 cases occurred when S.I. was less than *minus* two and mean R.H. greater than 30 per cent. It is also seen that on occasions whenever negative stability and favourable R.H. conditions are present the occurrence of thunderstorm had been mostly between 6 and 10 hours after the 00 GMT soundings, and 2 to 6 hours after the 12 GMT observation. This, perhaps, gives a clue to forecasting of thunderstorms at Delhi.

The second stage of the study was made by examining the Showalter's index and Galway lifted index for the four-year period, 1963-66 from the 441 days of available data.

The stability indices were determined from the upper air ascents taken at 00 GMT and the lifted index was computed on the actual maximum temperature recorded during the day. The indices were correlated with the occurrence of thunderstorms by the presence of *Cb* cells over Delhi and neighbourhood. The radar observations of thunderstorm cells around Delhi was extracted from observations recorded by the 3 cm AN/CPS-9 radar.

4.2. *Stability indices in relation to thunderstorm occurrence* — The relationship between the two stability indices and percentage thunderstorm days at Delhi and neighbourhood are shown in Figs. 2 & 3.

It is seen from Figs. 2 (a & b) that thunderstorms occur both when the Showalter index is positive or negative, but with much higher frequeney in the negative range at Delhi.

It is seen that thunderstorms occurred for positive as well as negative Galway indices and with a higher percentage of thunderstorm days on the average for negative indices. [Figs. 3 (a & b)].

4.3. *Favoured periods of the day for formation of Cb cells*—The favoured periods and the percentage frequency of occurrence of thunderstorms within 80 km area around Delhi at different times of the day as observed is given below:

Area (km radius)	Time (GMT) 00-06	00-12	12-18	18-00
80	26	54	15	5

It is seen that the majority of thunderstorms occurred between 06 and 12 GMT. This observation and the relationship noticed between Galway's index and occurrence of thunderstorm cells in Delhi and neighbourhood indicate that index computed from the morning upper air ascent and the forecast maximum temperature for the day may be of use as a probable predictor for forecasting of thunderstorms around Delhi.

5. *Conclusion* — The study tentatively indicates that 'Galway Index' is a better predictor than 'Showalter Index' for an objective method of forecasting summer thunderstorms over Delhi and neighbourhood.

6. The authors are thankful to Shri T.D. Chacko for typing the paper.

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