551·509·31 (54)

Use of stability charts in India as a forecasting tool

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(*Received 11 April 1969*)

ABSTRACT. Showalter's Index has been used on a synoptic scale in charts called stability charts. Stability isopleths are drawn and analysed with distinct low and high stability values.

1. Introduction

Showalter (1953) developed an objective method for forecasting thunderstorm activity by the use of 'Stability Index' (S.I.), derived from local radiosonde data. The temperature and dew point values at 850 mb are the parameters used to compute this value. An air-parcel at 850 mb is lifted dry adiabatically to saturation and then moist adiabatically to 500-mb level. The 500-mb temperature of the parcel so obtained is then subtracted algebraically from the observed 500-mb temperature. A positive value indicates stability where as a negative value indicates instability.

Some attempts were made in India to use S. I. for forecasting thunderstorm phenomena in respect of a particular station. Tripathi (1956) and Joseph (1957) tried to investigate the application of this method in forecasting thunderstorm phenomena over Poona and Madras respectively. They found the method to be reasonably useful. Basu (1961) studied the same for New Delhi on the basis of Showalter's Index and the mean relative humidity at pressure levels between 850 and 500 mb for March, April and May of 1958 and 1959. Both Basu and Seshadri (1961) have found the method to be reasonably satisfactory for forecasting local thunderstorm activity.

In many countries, however, the stability index is plotted on charts and are analysed. It is felt that the synoptic scale analysis of S.I. reveals clearly the areas of probable thunderstorm activity. In the National Weather Analysis Centre, U.S.A., these stability charts are regularly prepared and analysed for areas of stable and unstable atmosphere. To the knowledge of the author no such attempt has been made in India. In this paper results of such an attempt have been presented. In order to get these results the author had calculated the S.I. for each of the fifteen radiosonde stations in India for both 00 and 12 GMT observations during the months of April and May 1967 and 1968. Leaving aside a few cases when either the ascent failed or the ascent did not go upto 500-mb level, the S.I. had to be calculated for more than 1800 cases. The number of cases thus studied may be considered to be reasonably representative.

2. Data

The data utilised are mainly for the premonsoon months, *i.e.*, April and May of 1967 and 1968.

The S. I. of all Indian radiosonde stations had been calculated for each day of the two months at both the timings — 00 and 12 GMT soundings, with the help of tephigrams. After plotting the data, so calculated, on charts, the latter are analysed and studied carefully. Isopleths of S.I. are then drawn and the weather phenomena which occurred within the next 24 hours are plotted below the station. Iso-S. I. lines are drawn at intervals of 4 (Figs. 1 and 2). The same at intervals of 2 have also been drawn. These are shown in dotted lines.

Closed lines showing higher and lower values are indicated by the usual notations as high (H) and low (L).

3. Results

The results obtained are of great interest. Firstly the lows (L) and highs (H) on the charts (Figs. 1 and 2) generally correspond to the same lows and highs on the corresponding sea level charts of the day. Secondly, thunderstorms, lightning, rain, *Cb*-activity etc which occurred

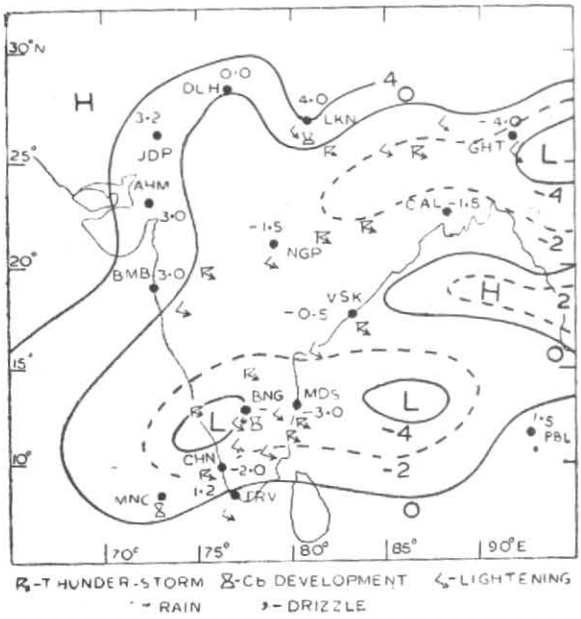

Fig. 1. S. I. at 00 GMT of 15 May 1967

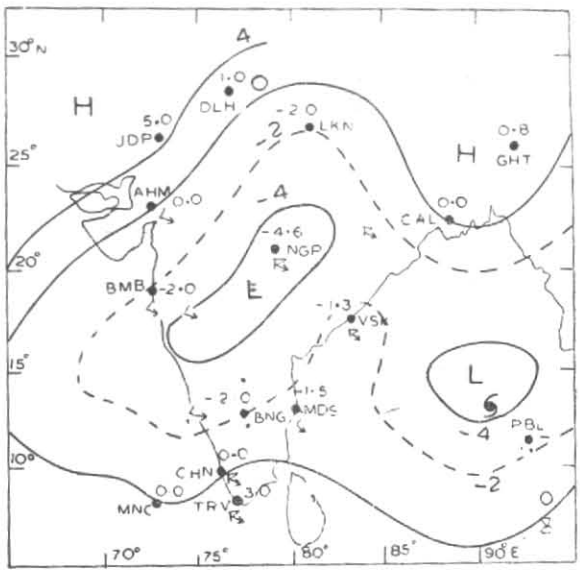

Fig. 2. S. I. at 12 GMT of 16 May 1967

within the next 24 hours are restricted within the lows (L). The areas of highs (H) maintained the same characteristic fair weather.

Maximum intensity of weather phenomenon generally occurred within the areas covered by isopleths of — 4 and more negative values. Reference may be made to Figs. 1 and 2.

4. Concluding Remarks

From an intensive study of nearly 1800 S.I. observations, it was seen that even negative S.I. value did not give any sufficient weather (thunderstorms, etc). This might be explained by the fact that for the development of thunderstorm activity there should be favourable conditions for large scale convection. The conditions are —

(*i*) Mechanism to cause low level convergence and high level divergence which will cause moist air to ascend;

(*ii*) Sufficient moisture feeding the lower layers and

(*iii*) A favourable lapse rate in the lower and middle troposphere.

The above study also reveals that though stability chart gives a reasonably satisfactory method of forecasting areas of active weather conditions, synoptic situations must also support the developments of the same.

Once the stability chart is supported by favourable synoptic situations — both sea level and upper air, it gives almost a definite clue to forecast areas of thunderstorm activity. As an auxiliary chart stability charts may be of great importance to the synoptic meteorologists as an aid to forecast areas of active weather conditions.

5. Acknowledgements

The author acknowledges his great indebtedness to Dr. A. K. Mukherjee, Meteorologist, for his able guidance. Thanks are due to my colleagues at the Main Meteorological Office, Santacruz. Thanks to Dr. A. C. De, Meteorologist, for kindly going through the script.

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