

Forecasting thunderstorms around Delhi and Jodhpur during March and June

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सार — मार्च और जून के दौरान दिल्ली और जोधपुर के आस-पास तड़ित् झंझाओं की सक्रियता के पूर्वानुमान की संभावनाओं का पता लगाने के लिए योग-योग सूची (टी.टी.आई.) का प्रयोग किया गया है। टी.टी.आई. के उच्चतर मूल्य तड़ित् झंझावात सक्रियता की अपेक्षाकृत अधिक अनुकूल अवस्थाओं के साथ सम्बद्ध होते हैं। जब तड़ित्-झंझा के होने और न होने के अवसर समान होते हैं तब टी.टी.आई. की सीमित क्षेत्र के अन्तर्गत तड़ित्-झंझा की प्राग्भित् अनिश्चित होती है।

ABSTRACT. Total-Totals Index (TTI) has been used to explore the possibility of forecasting thunderstorm activity around Delhi and Jodhpur during March and June. Higher values of TTI are associated with more favourable conditions of thunderstorm activity. Prediction of thunderstorm within a limited range of TTI is uncertain when the chances of occurrence and non-occurrence of thunderstorm are equal.

1. Introduction

Thunderstorm activity over northwest India comprising Haryana, Chandigarh, Delhi, Punjab, Himachal Pradesh, Jammu & Kashmir and Rajasthan, during March and June, is a unique phenomenon distinct from that seen in April and May when the thunderstorm activity is quite vigorous accompanied with rain, squall or duststorm locally termed as "Andhi".

It is a well established fact that one of the conditions favourable for the occurrence of thunderstorm activity involves conditional and convective instability along with inflow of moisture at lower levels. The stability index is a factor indicating the instability conditions in the atmosphere (Srinivasan 1961). There are various types of stability indices defined by many workers to forecast thunderstorms. These includes (i) Showalter Stability Index, (ii) Total-Totals Index, (iii) Lifted Index, (iv) Fawbush Miller Stability Index, (v) K-value Index etc (Atkinson 1971).

An attempt has been made in this study to explore the possibility to forecast thunderstorm activity around Delhi and Jodhpur during March and June by using Total-Totals Index (TTI).

2. Data

Thunderstorm activity has been studied within 200-250 km radius around Delhi and Jodhpur. Air temperature and dew point data at 850 and 500 mb of 00 GMT and 12 GMT have been utilized for a period of ten years (1971-1980) to calculate TTI for the months of March and June.

3. Method

The Total-Totals Index has been computed as the sum of the following :

- (a) Vertical Total Index (VTI) — Difference of 850 & 500 mb temperature, i.e., $T_{850} - T_{500}$.

- (b) Cross Total Index (CTI) — Difference of 850 mb dew point temperature and 500 mb temperature, i.e., $T_{d850} - T_{500}$. Thus, $TTI = VTI + CTI$.

TTI is calculated for both thunderstorm as well as non-thunderstorm days for the sake of comparison. The method adopted in this study is advantageous as it does not involve the use of any thermodynamic diagram.

4. Result and discussion

The total-totals stability indices have been calculated for the months of March and June (1971-1980) for equal number of thunderstorm as well as non-thunderstorm days around Delhi and Jodhpur. The analysis of TTI of these stations for thunderstorm activity within 200-250 km is shown in Table 1.

The empirical value of TTI has been taken as 48° as suggested by Srinivasan *et al.* (1973). It may be seen that the number of thunderstorm days over northwest India during the month of March is less than that in June as supported by the normal thunderstorm days shown in Fig. 1 (India Me. Dep. 1931-60). The percentage frequency of occurrence of thunderstorm days is more than 68% and 59% during March and June respectively, when the TTI is equal to or greater than the empirical value. Since the cross total index includes moisture contents, i.e., dew point temperature at 850 mb, it plays an important role in the occurrence of thunderstorm. It is also observed that the variation in vertical total index, i.e., $T_{850} - T_{500}$ is very insignificant during March and June whereas the variation in cross total index, i.e., $T_{d850} - T_{500}$ is large enough depending on availability of moisture and hence higher values of TTI were mostly due to cross total index.

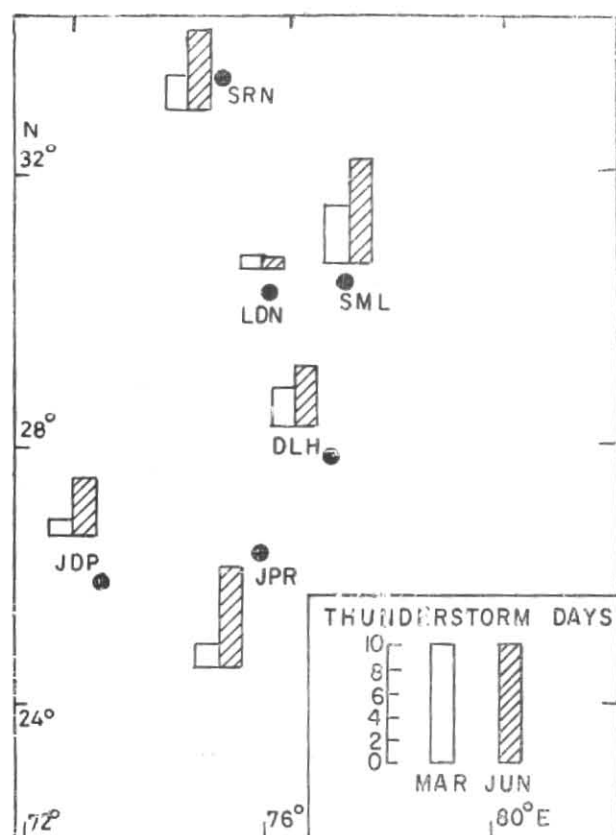


Fig. 1. Locator map of northwest India showing thunderstorm days in March and June

TABLE I

Total-Totals Index of New Delhi and Jodhpur associated with thunderstorm and non-thunderstorm days in March and June (1971-1980) based on 00 and 12 GMT observations

Days	Total frequency	Frequency for	
		TTI < 48°	TTI ≥ 48°
March (1971-1980)			
Thunderstorm	56	18 (32%)	38 (68%)
Non-thunderstorm	56	34 (61%)	22 (39%)
June (1971-1980)			
Thunderstorm	92	38 (41%)	54 (59%)
Non-thunderstorm	92	60 (65%)	32 (35%)

The frequency of thunderstorm and non-thunderstorm days has been tested for normal distribution and it is found that the data is not normally distributed but an indication of positive skewness and platykurtic nature is confirmed on applying β_1 and β_2 tests for thunderstorm and non-thunderstorm days. Two free hand curves between number of thunderstorm/non-thunderstorm days and TTI values of March and June are shown in Figs. 2 (a) & (b) respectively. It is seen from these curves that the occurrence and non-occurrence of thunderstorm overlaps in a common region (shaded) where the prediction of thunderstorm or non-thunderstorm becomes uncertain and hence, difficult because the probability of their occurrence is equal in the common

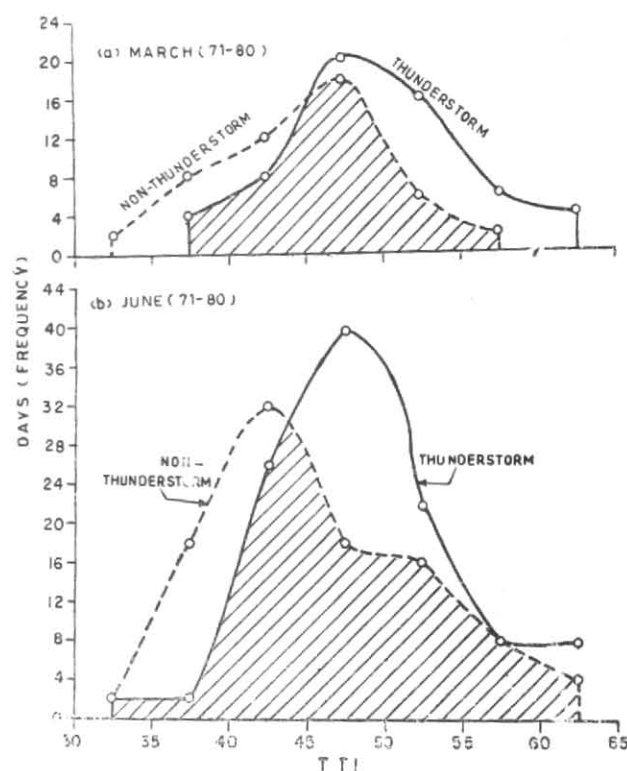


Fig. 2. Probability of thunderstorm and non-thunderstorm days

region. A careful examination of these curve reveals that higher values of TTI correspond to more favourable conditions of thunderstorm activity.

5. Conclusion

(i) In general, thunderstorm activity over northwest India particularly around Delhi and Jodhpur, is more conspicuous in March than in June.

(ii) The dew point temperature at 850 mb, *i.e.*, lower incursion of moisture plays a crucial role in occurrence of thunderstorm.

(iii) Higher the TTI values, more favourable becomes the conditions for occurrence of thunderstorm.

(iv) Prediction of thunderstorms, when TTI lies between 38° and 58°, is uncertain as the probability of occurrence and non-occurrence of thunderstorms is equal within this range.

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