

RELATIONSHIP BETWEEN MAXIMUM ECHO TOP AND STABILITY OF THE ATMOSPHERE

Many efforts have been made in the past to correlate the maximum heights of echo tops of convective clouds and certain parameters of the prevailing thermodynamic state of the atmosphere. In particular, Schuetz (1957) attempted to explore the relationship between max. echo top and stability. An effort has been made to examine whether such relationships exist in tropical regions also. To begin with, the present study is confined to the region in the neighbourhood of Delhi.

Radiosonde data were collected from the *Indian Daily Weather Reports* of the years 1958—60 in respect of the hot weather period for New Delhi. The heights of echo tops have been collected from the routine radar observations taken by the high power 3 cm radar AN/CPS-9 located at Safdarjung Airport, New Delhi. The radiosonde data closest to the time of occurrence of maximum tops were used.

The variables studied—The following assumptions have been made in this study—(1) The maximum echo tops have been taken as the dependent variable and the stability indices as independent variables, (2) To obviate the error in heights due to the *Cb* cells being at various stages of development, only the maximum height reached during the day has been chosen, in preference to the average height of *Cb* cells of that day; as this only will afford an opportunity to compare the echo tops on different days of cells in the same stage, *viz.*, mature stage of development. This perhaps justifies the comparison of the echo tops on different days as it can then be reasonably assumed that the cells are in the same stage of development.

The stability indices considered here are based on the parcel theory of convection. The first index is Showalter's Stability Index (S.S.I.) (Showalter 1953). The second index, denoted by CSI (Convective Stability Index),

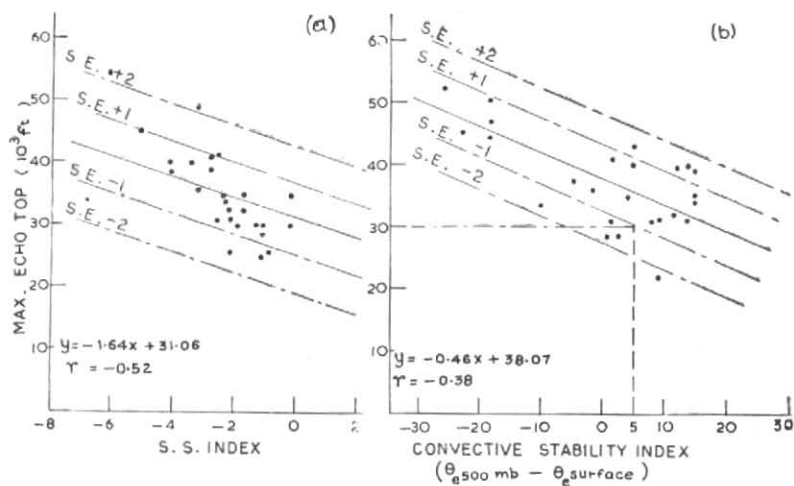


Fig. 1(a). Height vs Showalter Index

Fig. 1(b). Height vs Convective Index

TABLE 1

	Correlation coefficient	Standard error of correlation	Standard error of correlation (ft)	Line of fit for scattergram
SSI	-.520	.143	8000	$y = -1.64x + 31.06$
CSI	-.38	.171	10000	$y = -.46x + 38.07$

TABLE 2
Showalters' Stability Index (SSI)

S.S.I.	No. of occasions of height of <i>Cb</i> top (in thousands of feet)			
	25-30	31-35	36-40	>40
0 to -2.0	7	3
-2.1 to -4.0	1	5	3	2
-4.1 to -6.0	..	2	2	1
-6.1 to -8.0	1	1

is based on the change of equivalent potential temperature between 500-mb level and the surface level.

Analysis—The results of the correlation analysis are given in Table 1.

Better correlation was obtained using SSI. The second column shows the standard errors of the regression equations fitted approximated to the nearest full hundred feet. It is seen that the SSI can in a way be indicative of the maximum echo tops growth within an error of about 8000 ft over 68 per cent of the time on the assumption of normal distribution of the error parameter of the population. However, the maximum echo top indications on the basis of the CSI do not seem to be of much value as the error in heights is of the order of 10,000 ft.

Fig. 1(a) shows the relationship between SSI and maximum echo top. Grouping of these data in Table 2 shows that maximum height of tops was higher than 31,000 ft in 17 out of 18 cases when SSI was less than -2 and in seven out of ten cases the heights were

either 30,000 ft or less when SSI was between -2 and 0.

Fig. 1(b) shows the scattergram showing the relationship between CSI and maximum echo top. Due to weaker correlation the data could not be arranged into significant groups.

Conclusion

The analysis shows that there is good correlation between the Showalter Stability Index and the height of cloud tops whereas in the case of the C.S. Index, the correlation seems to be weak. The SSI can perhaps serve as an approximate guide for estimating the maximum probable echo tops of *Cb* clouds within the error limits of 8000 ft on a majority of occasions even though the possibility of the concept of using the radar echo tops for approximating the stability of the atmosphere in the area where the facility for radiosonde observations are lacking cannot be ruled out.

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REFERENCES

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