551·515·3 (545·2) "234-1971"

A DUSTSTORM OVER CHANDIGARH ON 1 NOVEMBER 1971

1. Widespread thunderstorm, preceded at some places by duststorms and associated with strong surface squalls, occurred over an area extending from Jammu to Ambala in northwest India on 1 November 1971. Chandigarh in particular, experienced a duststorm reducing visibility to 500 metres associated with a northwesterly surface squall of 50 kt at 2115 hr on that date. The duststorm was followed by long duration of thunderstorm activity which continued till the early hours of the following day.

Although post monsoon thunderstorms are quite common in Punjab, in general and Chandigarh, in particular, a duststorm with squall of 50 kt is rather unusual occurrence. During the preceding nine years (1962-70) for which records are available no duststorm with such wind speed ever occurred over Chandigarh in the post monsoon season. In order to study the widespread and intense dust/thunderstorm activity the synoptic situations have been studied with a special emphasis on horizontal velocity divergence and the advection of temperature over Punjab and its close vicinity. The results of the same are discussed in this note.

2. *Synoptic situation*

The significant synoptic situation was an extended low pressure area over Pakistan and adjoining west Rajasthan, with an upper air cyclonic circulation extending upto 2·1 km and trough aloft up to 6·0 km. In the Figs. 1(a) and 1 (b) we present the flow pattern at surface and 1·5 km a.s.l.

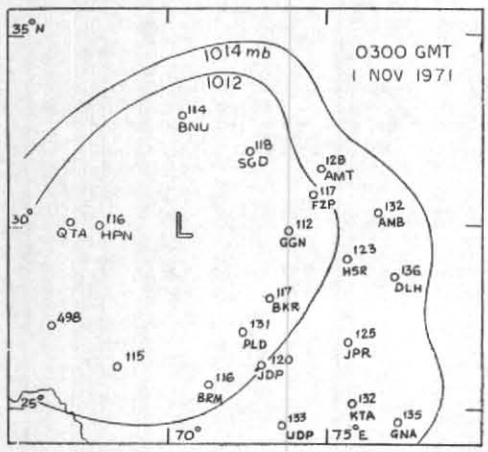

Fig. 1(a)

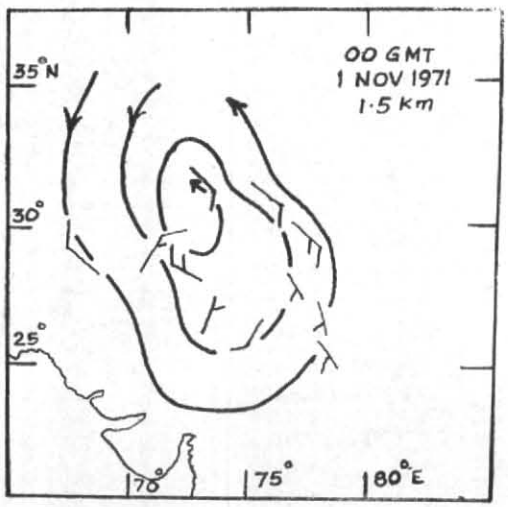

Fig. 1(b)

TABLE 1

Height (km)	Wind direction/speed (kt) Chandigarh	Bikaner	Sargoda	Div. per hour
0·9	120/35	280/15	120/10	—0·14
1·5	140/40	270/15	120/15	—0·23
2·1	140/35	260/15	070/05	—0·15
6·0	200/35*	270/40	250/45†	—0·13

*At 6·0 km, wind taken is for Srinagar, since for Chandigarh data was not available

†Dehra Dun wind

TABLE 2

Height (km)	31 Oct 1971 Wind Dir/ Speed (kt)	Advection	1 Nov 1971 Wind Dir/ Speed (kt)	Advection	2 Nov 1971 Wind Dir/ Speed (kt)	Advection
0·6	130/22		125/35		130/15	
		29		213		26
0·9	135/15		135/15		140/10	
		0		246		49
1·5	135/17		140/40		220/05	
		27		0		
2·1	130/18		140/41			
		0				
3·0	130/18					

3. *Vergence field*

In order to study the further details, we have worked out the vergence field for 00 GMT of 1 November 1971, using the available wind observations of Chandigarh, Sargoda and Bikaner for lower levels and Srinagar, Bikaner and Dehra Dun at upper level (6·0 km). This has been done because of the existing position of observation is available; however, it is felt that the computations based on these observations will suffice for the purpose of this study. Bellamy's (1949) method has been used to compute the vergence. The values are given in Table 1. It may be seen that the computation confirms the existence of low level convergence and upper level divergence, in the region in the vicinity of Chandigarh, a situation favourable for thunderstorm activity.

4. *Influence of thermal advection*

If we compare the wind observations of Chandigarh on three consecutive days (31 October, 1 November and 2 November 1971), it is noticed that winds veered with heights on all three days indicating warm air advection. For quantifying this, we have used relation after Haltiner and Martin (1956) where thermal advection is given by :

$$-\bar{\mathbf{V}}_g \cdot \nabla_p \bar{T}_v \propto -\bar{\mathbf{V}}_g \cdot (\mathbf{V}_g \times K)$$

= 2 times area made by the hodograph of $\mathbf{V}_g$

$$= | V_{g1} V_{g2} \sin \theta |$$

where θ is the angle between $\mathbf{V}_{g1}$ and $\mathbf{V}_{g2}$ and $\bar{T}_v$ is the mean vertical temperature. The results are given in Table 2. It is seen that the maximum advection was on 1 November 1971.

4.1. It may also be observed from the wind observations of Chandigarh from 31 October to 2 November 1971 (not presented) winds were having continuously southerly component, indicating no movement of trough. There was marked increase of wind speed between 31 October to 1 November 1971 and decrease in wind speed between 1 and 2 November 1971. This may indicate that although apparently there was no movement of trough, but the system deepened between 31 October to 1 November and weakened subsequently. This process could also influence the increase in activity on 1 November.

5. The following conclusion can therefore be drawn from the present study.

(*i*) The intense duststorm in Chandigarh occurred with the pronounced convergence in lower levels coupled with divergence in higher levels.

(*ii*) Appreciable warm air advection also favoured the process.

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