

551.515 (545.8) "1980.10.11"

UNUSUAL DUSTSTORM OVER AGRA ON 11 OCTOBER 1980

Severe duststorms are known to occur over north-west India during pre-monsoon months. Their occurrence is rare during post-monsoon months. The frequency of occurrence of duststorm during post-monsoon months over Agra is 0.1 day per month. However in the evening/night of 11 October 1980 violent thunderstorms were reported from a number of places in west and east Uttar Pradesh regions. Over Agra a *Cb* cell was reported in northwest direction at 1130 GMT. Duststorm commenced over Agra and neighbourhood at 1200 GMT with mean speed of 30 kt from northwest direction. Maximum wind speed recorded during storm at Agra was 44 kt at 1200 GMT. The visibility in raised dust reduced to 800 m. It was immediately followed by thundershowers at 1210 GMT. By 1300 GMT, *Cb* cell had moved to east/southeast direction and surface wind changed to easterly. The lightning flashes continued till 2220 GMT. The amount of rainfall recorded during this period was 22.0 mm.

2. A western disturbance was located over Afghanistan and adjoining Pakistan region on 10 October 1980. It moved eastward and on morning and evening charts of 11th it was located over north Pakistan and adjoining Jammu & Kashmir region. On 10th this western disturbance induced a low level circulation upto 7000' over west Rajasthan. On the morning charts of 11 October 1980, this circulation was located over west Uttar Pradesh and adjoining region and there was a trough in mid tropospheric w'lies (north of 25 deg. N) along 72 deg. E. On 11th October 1980 strong wind speeds of 60-65 kt at 200 & 150 mb was reported from Delhi and Gwalior. Bikaner, Bhatinda, Churu and Delhi reported thunderstorms during morning hours of 11 October 1980 while in the evening/night hours of 11 October 1980 thunderstorm activities were reported from Delhi, Agra, Kanpur, Allahabad, Varanasi, Gorakhpur and Gwalior.

3. The tephigram of Delhi showed instability on 10 and 11 October 1980. However, Showalter Index was maximum negative on 11th in the morning hours. Depth of moist layer shows that atmosphere was moist in lower troposphere. The mean mixing ratios at 850 and 700 mb were maximum at 1200 GMT on 10th and at 0000 GMT on 11th. This factor is favourable for occurrence of dust cum thunderstorm (Surinder Kumar 1971), level of free convection was lowest on the morning hours of 11 Oct 1980, when it was observed to be 850 mb (below 650 mb) which is one of the favourable factor for strong thunderstorm activity (Faw Bush *et al.* 1951). The values of Showalter Index depth of moist layer, mean mixing ratio at 850 and 700 mb and level of free convection at Delhi from 10 to 11 October 1980 are shown in Table 1.

4. Divergence/Convergence over Agra from 0000 GMT on 10 October 1980 to 0000 GMT on 12 October 1980 at various levels was calculated by following Graham's method of using observed winds for three stations at the vertices of an equilateral triangle ABC

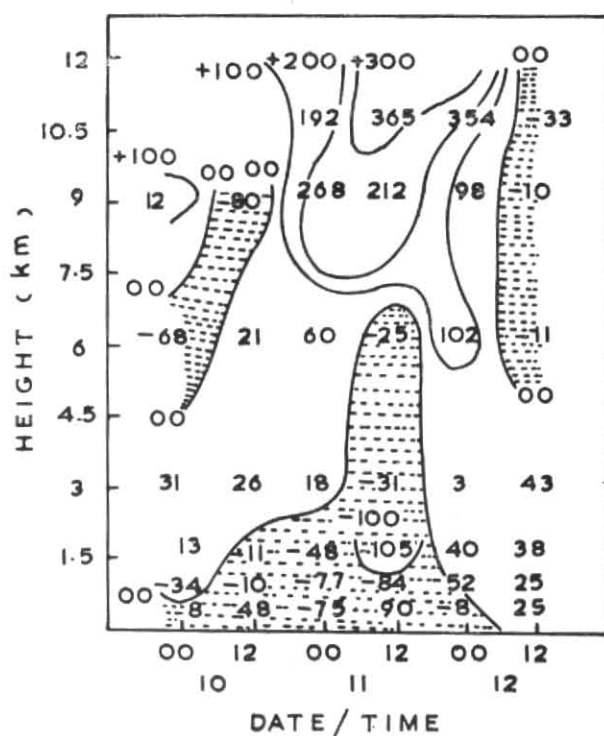


Fig. 1. Vertical time-section of divergence values over Agra from 10 Oct to 12 Oct 1980 (convergence values are dotted)

TABLE 1

Date (Oct 1980)	Time (GMT)	Showalter Index	Depth of moist layer	Mean mixing ratios at 850 & 700 mb (g/kg)	Level of free convection (mb)
10	0000	-8	730	7	790
10	1200	-10	650	9	820
11	0000	-11	730	9	850

Showalter Index (SI), level of free convection (LFC), depth of moist layer (DML-Level at the inter section point of 5 gm/kg isohyric line with dew point curve) and mean mixing ratios at 850 & 700 mb from 10 to 11 October 1980 over Delhi.

of fixed altitude with vertex A pointing to towards north and base BC oriented east west. In a triangle ABC

$$\text{Divergence} = \frac{VA_n}{h_A} + \frac{VB_n}{h_B} + \frac{VC_n}{h_C}$$

Where h_A , h_B , h_C are altitudes through vertices ABC and VA_n etc are components of winds perpendicular to opposite side of triangles. By using upper charts from 0000 GMT on 10 October 1980 to 0000 GMT on 12 October 1980 the winds were estimated at various levels at three vertices of Graham's equilateral triangle with altitude 200 n miles, the centroid of the triangle being at Agra. By using these winds the contribution of divergence (10^{-3} / hours) was calculated at vertices of the triangle. Algebraic sum of three values obtained gave value of divergence at Agra. The procedure was repeated for obtaining all

desired values. These values in the form of a vertical time section are shown in Fig. 1. It is seen that convergence values were maximum and also extended upto higher levels (upto 20,000') on 11 Oct 1980 at 1200 GMT. Divergence values aloft at 30,000' and 40,000' were also maximum on 11 Oct 1980 at 1200 GMT. On 12 October 1980 there is divergence at lower levels and convergence at higher levels. The increasing values of convergence upto 5000' and increasing values of divergence at 30,000 and above, at 0000 GMT on 11 October 1980 may be considered as a fore-warner of possibility of severe weather development in the afternoon/evening hours when atmospheric instability increases due to insolation.

5. It is seen that severe duststorm followed by thundershowers over Agra and neighbourhood in the evening/night hours of 11 October 1980 occurred in association with a low level circulation induced by a western disturbance moving across northern parts of country. The high level divergence provided by wind

maxima and upper level westerly trough was in phase with low level convergence over the region. Atmosphere over the region was unstable. It was moist in lower troposphere and level of free convection was significant for severe weather development. Development of severe duststorm followed by thundershowers over Agra and neighbourhood and fairly widespread convective activities over west Uttar Pradesh, east Uttar Pradesh and adjoining regions on 11 October 1980 could be attributed to presence of several such factors in the region. Over Agra convergence values were seen to be maximum and also extended upto higher levels (upto 20,000') the divergence values were also seen to be maximum at 30,000' and 40,000' on evening hours of 11 Oct 1980. The divergence/convergence values at Agra are seen to be forewarner of possibility of severe weather development.

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