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Vertical Distribution of Wind and Hygrothermal Regime During a Severe Duststorm – A Case Study

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The duststorm activity is a major weather phenomena in the arid region of north-west India influencing the ecological balance by wind erosion and nutrient losses. Studies carried out by Mann (1979) and Mann and Ramakrishna (1980)indicated that the frequency of duststorms decreased with the increase in monsoon rainfall occurred during the previous year. Ramakrishna *et al.* (1987) found that the large quantities of dust suspended in the air for considerable time depleted in the incoming radiation upto 80%. Absorption and scattering in the atmosphere due to the presence of dust resulted with a decrease in diurnal temperature range and lower maximum temperatures.

All these studies were based on surface meteorological observations only whereas in the present study the vertical distribution of thermal, moisture and wind regime during the presence of a severe duststorm over Jodhpur has been quantified using data from programme on Monsoon Trough Boundary Layer Experiment (MONTBLEX). Intensive meteorological data were collected at CAZRI, Jodhpur on 28th June, 1990 between 16 00 h and 17 00 h at different heights (viz. ,1,2,4,8,15 and 30 m) through the sensors installed on meteorological tower during the different phases of the strom. The results are discussed below ;

Wind profiles : The profile (Fig.1) studies indicated that windspeed increased with height during all phases of the duststorm, but the mean wind speed was highest during onset phase with a maximum 66.1 km hr^{-1} at 1 m height and 83.2 km hr^{-1} at 30 m height in the surface boundary layer. However, wind shear was maximum during peak dusty phase between surface and 30 m height. The lowest mean wind speed was seen below 8m height during withdrawal phase and above 8 m height during clear phase.

The wind direction recorded (Table 1) during different stages of the duststorm revealed that dust storm arrived over the region from south to south-westerly (SSW) direction thereby indicating its coincedence with the arrival phase of SW monsoon over the region. This finding is also supported by weather report issued from India Meteorological Department (IMD). In the IMD report it is mentioned that the south- west monsoon system entered into Rajasthan through south-east on 28th June and covered whole of the State by 1st July, 1990, the usual date of onset in western Rajasthan (Indian Daily Weather Reports 1990). Later on wind direction changed to south east and finally after the withdrawal of the duststorm, it became almost southerly.

Table 1 *Wind direction (in degrees) during a dustorm at Jodhpur*

Height (m)	Wind direction during different phases of the dustorm			
	Onset	Peak dusty	With drawal	Clear
1	196	117	129	162
2	201	122	134	167
4	209	130	143	172
15	207	128	136	169
30	211	135	144	172

Humidity profiles : Fig.1 revealed that the relative humidity was lowest (39.9 to 47.4%) during the onset phase and later on it gradually increased to a maximum of 66.4% at 4 m height during the withdrawal phase of the duststorm, which finally caused small condensation over the region. This condensation helped in settling down of the dust

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particles suspended in the atmosphere and thereby slowly improved the visibility. This is a common and usual feature associated with every duststorm over the region during the pre-monsoon period. Afterwards humidity decreased to usual conditions prevailed during its clear (post dust storm phase. However, humidity gradient was found highest during the arrival phase and lowest during the withdrawal phase.

Temperature profiles : Temperature profiles indicated that it has a general decreasing trend with height during all the time of prevailing duststorm in lower boundary layer over the region. However, temperature during the onset phase was recorded highest with a maximum value of 50°C at all levels in comparison to other phases of the storm. This sudden increase in temperature at all levels is mainly because of the hot surface dust particles which

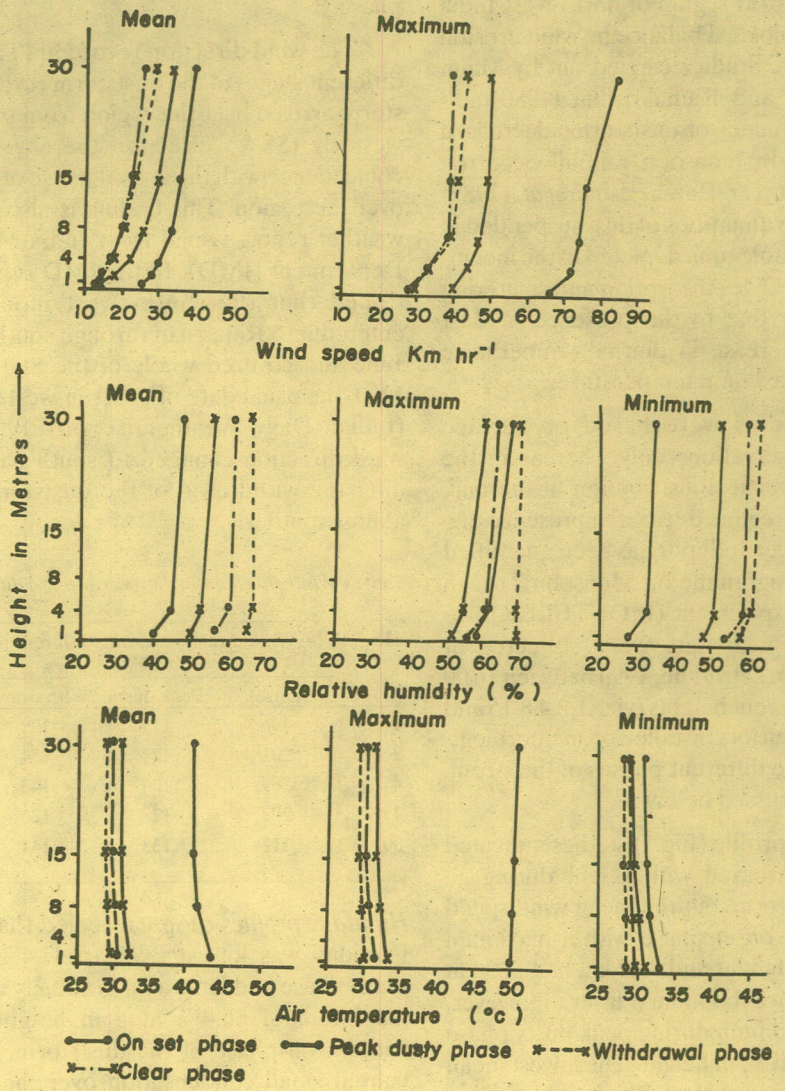

Fig.1 Wind speed, humidity and temperature profile during different phases of duststorm.

have been lifted and brought by strong winds from source place over the region. Within half an hour this temperature was suddenly decreased by more than 12°C and recorded below 30°C at all levels with the result of increase in the humidity followed by condensation over the region. But after condensation, temperature again increased slightly by 1°C because of release of latent heat at all levels in the lower surface boundary layer.

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