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## UNPRECEDENTED HEAVY RAINFALL IN JAIPUR (RAJASTHAN) DURING 18-20 JULY 1981

Synoptic situation leading to unprecedented and all time record heavy rain, which occurred in Jaipur during the period 18 to 20 July 1981 has been studied. The heavy rains occurred due to a monsoon low which formed over northwest India within the monsoon trough—an uncommon synoptic situation. The low moved slowly in a southeasterly direction till 20 July and merged with the monsoon trough over northwest Madhya Pradesh.

1.1. Rajasthan gets heavy to very heavy rainfall during the monsoon season when depressions from the Bay of Bengal traverse westnorthwestwards across Orissa, Madhya Pradesh and neighbouring areas. Sometimes a depression intensifies into a deep depression and travels northwestwards upto west Rajasthan and even beyond, to south Pakistan giving very heavy rains along its track. Then dry areas of west Rajasthan also get very heavy rains. If the track of the depression is more westwards, Saurashtra, Kutch and Gujarat receive very heavy rains. Northeast Rajasthan and adjoining areas of northwest Madhya Pradesh and of Haryana receive heavy rainfall when monsoon depressions recurve towards north apparently under influence of a trough in westerlies in the middle troposphere. In the case under study some parts of northeast Rajasthan experienced very heavy rainfall during the period 18 to 20 July 1981 in association with a low pressure area which developed *in situ* over the area. Jaipur city, recorded 82 centimetres of rain and Jaipur airport 62 centimetres during the 3 day period. The heaviest 24-hour rainfall amounts of 35 and 33 centimetres respectively were recorded at Jaipur on 19 July 1981. These concentrated heavy rains in Jaipur completely paralysed the life in the city, which was cut-off from the rest of the country.

Tonk district also received very heavy rainfall during this period resulting in heavy flooding in the rivers *Dhund* and *Moreal*, which completely washed away the village Hingonia. Extensive loss of life and property was reported from these areas.

The heavy rains amounting to 35 centimetres in 24 hours are not unlikely but these are generally associated with an intense depression. In the present case rainfalls of this magnitude were recorded with a low pressure area which formed *in situ* over northwest India. The synoptic situation leading to the formation of this low pressure area and the heavy rainfall resulting from it are discussed in this paper.

2. Break monsoon conditions set in on 15 July with the shifting of the axis of monsoon trough close to the foot hills of Himalayas. The trough was well marked and could be seen up to 500 mb with embedded vortices in it. One such vortex lay over the north Rajasthan, Haryana and adjoining Punjab areas on the morning of 16 July (Fig. 1). The vortex became well marked by the same evening and built its circulation downwards. The circulation intensified and a low developed on the mean sea level chart on the evening of 18 July centred south of Delhi (Fig. 2a). Circulations at 850 and 500 mb are seen in Figs. 2(b) & 2(c).

The low pressure area moved very slowly southeastwards and was centred between Delhi and Gwalior on 19th morning, continuing to move slowly it lay centred east of Gwalior, close to the station, on 20th morning. It merged with the seasonal trough on 21st. Track of the low pressure area is shown in Fig. 3.

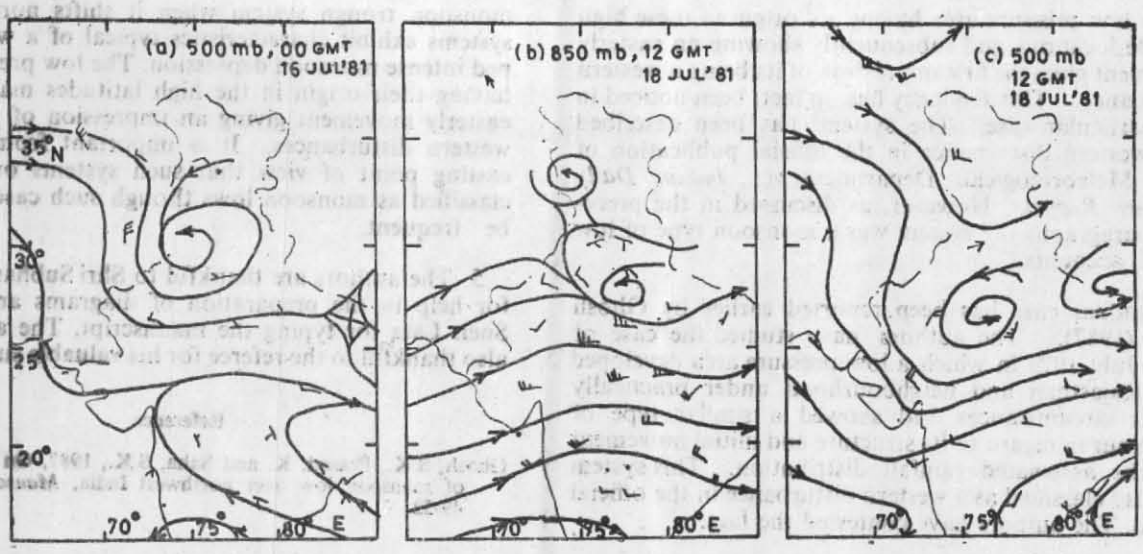
3. It is evident that the exceptionally heavy rainfall in Rajasthan during the period 18-20 July 1981 occurred in association with a low pressure area which developed *in situ* over the area. The development of the system took place in a manner typical of a monsoon depression forming over Bay of Bengal, where in some cases a disturbance first appears in the upper levels and descends, culminating in development at sea level.

In this case also a vortex embedded in the monsoon trough in the upper levels gave rise to development of a low at sea level. Apart from the mechanism of formation, the system exhibited the characteristics of a monsoon depression. It is well known that the monsoon depressions usually slope southward with height. This feature was noticed in the present case also. The positions of the system at 850 mb and 500 mb on 19 July (00 GMT) are shown in Fig. 4. The southward slope is very evident as can be inferred from the wind at Gwalior being W/45 kt at 850 mb becoming S/10 kt at 500 mb.

The low presssure area produced a rainfall distribution characterstic of a monsoon depression. The heavy rainfall occurred in the southwest sector of the closed circulation. The 24-hr rainfall amounts which were recorded in this case, are indicative of the intensity of the low pressure area even though it could not be classified as a depression as per the criterion followed by India Meteorological Department.

The movement of the low pressure area was unusual, against the direction normally followed by the monsoon low depression. However, one has to consider the fact that this low was positioned in a fairly high latitude at the time of formation. In these locations, even the monsoon lows/depressions which have had their origin further east and the normal westward movement, show a tendency to recurve or stagnate. This situation arises as the systems come under the influence of westerlies. In the present case no upper westerly trough which could cause the eastward movement of the low, could be located. However, the low pressure area lay beneath the peripheral boundary of the upper tropospheric subtropical anticyclone or the col region between the two subtropical anticyclone cells usually present over the area. As a result the upper steering flow over the low level circulation was weak. The low had a very slow movement. It could even be described as practically stagnating over the same area.

The main cause for the exceptionally heavy rainfall could be attributed to the stagnation of the low pressure area. The stagnating system causing such heavy amounts of rainfall is a well known fact, and cases have been documented earlier.




Figs. 1 (a-c). Upper winds at (a) 500 mb, 0000 GMT on 16 July 1981, (b) 850 mb 1200 GMT on 18 July 1981 and (c) 500 mb for 1200 GMT on 18 July 1981

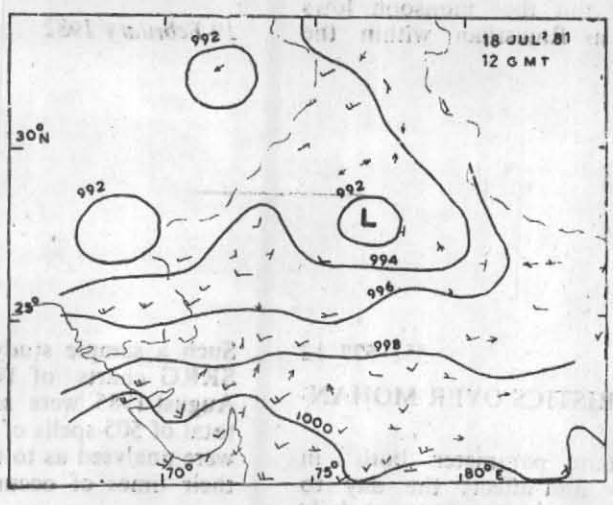



Fig. 2. Sea level isobaric chart for 1200 GMT on 18 July 1981


Figs. 3. (a) Track of upper level (500 mb) low at 00 GMT of 16-19 July 1981, and upper winds at 00 GMT of 19 July 1981 for (b) 850 mb level and (c) 500 mb level

The low pressure area having its origin in these high latitude locations and subsequently showing an easterly movement gives the first impression of its being a western disturbance. This tendency has, in fact, been noticed in this particular case. The system has been described as a western disturbance in the official publication of India Meteorological Department, *viz.*, *Indian Daily Weather Report*. However, as discussed in the preceding paragraphs the system was a monsoon type of low by all accounts.

A similar case has been reported earlier by Ghosh *et al.* (1987). The authors have studied the case of 18-26 July 1978 in which a low pressure area developed over Rajasthan and neighbourhood under practically similar circumstances and showed a similar type of behaviour in regard to its structure and initial movement and the associated rainfall distribution. This system was also classified as a western disturbance in the official record. The authors have contested the fact.

It will be seen from the above arguments that monsoon lows do develop as far inland as Rajasthan within the monsoon trough system, when it shifts north and exhibit features typical to the monsoon depressions. The lows may have a movement in an easterly direction giving an impression of their being western disturbances.

4. The study has brought out that monsoon lows may develop as far inland as Rajasthan within the monsoon trough system when it shifts north. These systems exhibit characteristics typical of a well developed intense monsoon depression. The low pressure areas having their origin in the high latitudes may show an easterly movement giving an impression of their being western disturbances. It is important from the forecasting point of view that such systems ought to be classified as monsoon lows though such cases may not be frequent.

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