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A STUDY ON A RARE OCCURRENCE OF RAIN OVER ANDHRA PRADESH, TAMIL NADU AND KERALA DURING 10 AND 11 MARCH 1989

1. Occurrence of widespread thunderstorm activity in Andhra Pradesh, Tamil Nadu and Kerala in the early part of March is quite rare. According to India Met. Dep. (1973), during this period, on rare occasions synoptic systems of the lower and higher latitudes interact with each other when translatory waves in the easterlies approach the waves in the westerlies near about the same longitude belt. When the meridional component of the flow pattern is predominant both the easterly and westerly waves slow down and their amplitude increases when they reach the same meridian in their respective latitude belts. A recent case of such a super-position is described in the following paragraphs.

2. To cary out the study the 24 hours rainfall ending at 0830 IST of 11 and 12 March 1989 for some selected stations were collected and presented in Table 1 along with the monthly normal values and climatological extremes available in climatological tables. The synoptic and upper wind charts during the period have been studied along with the satellite cloud imagery from NOAA-11. The instability parameters over the available RS/RW station were also examined.

3. From Table 1 it is noticed that the 24 hours rainfall at most of the stations exceeded several times that of the monthly normals and at one place it even exceeded the climatological extreme value for that place.

On the morning of 10 March under the influence of a western disturbance over Jammu & Kashmir an induced cyclonic circulation developed over north Rajasthan and adjoining areas in the lower tropospheric levels. A trough in westerlies from this system ran up to south interior Karnataka where another cyclonic circulation was observed extending up to 1.5 km above sea level. A wind discontinuity was also seen from south Kerala to south interior Karnataka in the lower tropospheric levels [Fig. 1 (a)]. The anticyclone in the Bay of Bengal in the lower levels was located roughly along 20° N and 88° E at 0530 IST on 10 March. During this period a system in easterlies was also moving across south Bay. On 8th and 9th it was located in southeast Bay and 10 March it reached southwest Bay of Srilanka-south Tamil Nadu coasts. Another important feature noticed was the southward shift of sub-tropical jet stream up to 10° N with jet maximum over eastern parts of Andhra Pradesh. By 1730 IST the high pressure cells over Bay of Bengal moved southward and located around 16° N, 88° E. Positive dew point change in Maharashtra, Andhra Pradesh and interior Tamil Nadu suggest large moisture incursion over the areas. By 2030 IST thunderstorm and lightening was reported from many stations in Andhra Pradesh. By early morning of 11th the trough in westerlies ran from Gangetic West Bengal to south Tamil Nadu extending up to 3.1 km above sea level with an embedded cyclonic circulation over south coastal Andhra Pradesh

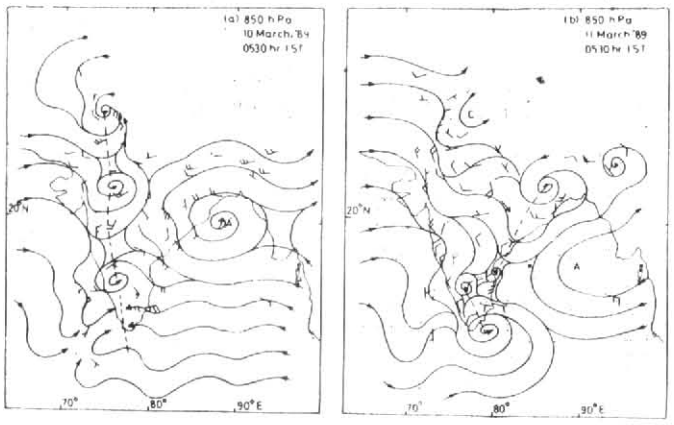
TABLE 1

Rainfall at 0830 IST of 11 March 1989

Stations	24 hrs rainfall ending at 0830 IST of 11 Mar (in mm corrected)	Duration of rainfall (Max. intensity) (IST)	Monthly normal	Climatological extremes
Ramagundam	20	18-0230	13.6	
Kalingapattinam	60	00-04	11.8	84.3 on 9-3-1940
Hanamkonda	60	NA	11.3	71.1 on 13-3-1928
Visakhapatnam	30	01-05	10.8	64.5 on 10-3-1926
Waltair	30	01-05	10.4	
Sangararedy	40	NA	10.4	
Hyderabad	50	18-23	13.4	103.1 on 31-3-1928
Khammampet	40	NA	15.4	
Gulbarga	20	NA	11.2	76.0 on 10-3-1960
Nidadavolu	40	NA	9.5	
Kakinada	20	03-07	13.6	71.6 on 24-3-1905
Narsapur	40	NA	10.7	
Nandigama	30	NA	10.2	
Gannavaram	30	NA	13.5	
Vijayawada	30	NA	13.5	
Kurnool	70	21-02	6.7	50.0 on 18-3-1898
Masulipattinam	30	04-07	12.7	150.4 on 9-3-1926
Bapatla	80	NA	7.2	
Ongole	60	03-07	4.6	
Ananthapur	50	03-06	13.4	103.1 on 31-3-1928
Medikari	20	NA	20.6	55.4 on 31-3-1928
Satyamangalam	80	NA	23.7	
Omalur	30	NA	13.2	
Coimbatore	40	04-07	12.5	

[Fig. 1(b)]. The high pressure cell over Bay shifted further south and was located around 13° N, 88° E. The movement of trough in lower tropospheric westerlies and the position of the wind discontinuity and the trough in easterlies are shown in Fig. 2.

The wind direction over Madras was easterly at 0530 IST of 10th it became southeasterly at 1730 IST and by



Figs. 1 (a & b). Upper wind chart for 850 hPa for: (a) 10 Mar 1989, and (b) 11 Mar 1989

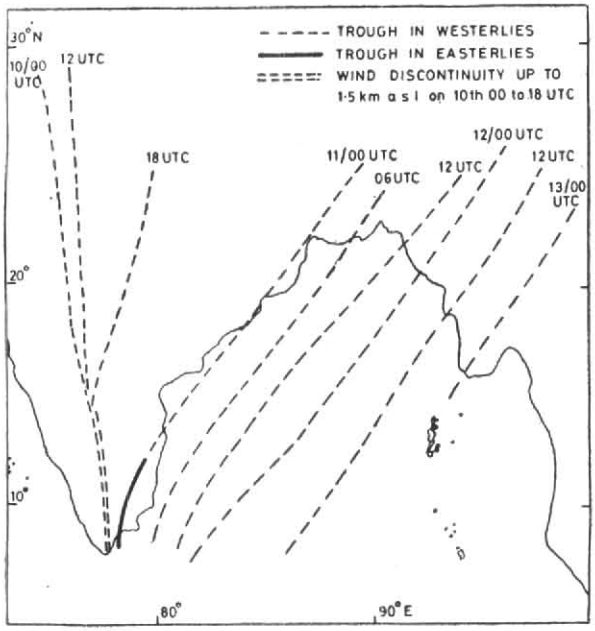


Fig. 2. Position of lower tropospheric trough up to 3.1 km a.s.l.

0530 IST of 11th it changed to southerly. By 1130 IST the wind has changed to northeasterly 25 kt up to 0.9 km above sea level and westerly prevailed aloft up to 2.1 km above sea level. The change in wind direction suggested that the trough in easterly perturbation has moved inland and subsequently it interacted with long amplitude westerly trough. The latitude belt south of 13° N including Madras received rain during this period. The easterly perturbation was probably captured by the westerly trough. The cyclonic change in wind direction suggests the generation of large positive vorticity in the lower levels. At 1730 IST of 11th the trough had moved further east and the rainfall was confined to coastal stations with reduced amounts. By 12th evening the dew point changes were all negative over the Peninsula suggesting the cessation of moisture incursion.

The presence of strong anticyclonic circulation over Bay of Bengal around latitude 20°N on 10th morning and its subsequent shifting towards southern latitude as time progresses to latitude 13° N by 11 morning was one of the major events which contribute large moisture incursion over southeast peninsula. The maximum rainfall over most of the stations of Andhra Pradesh occurred between 0000 and 0400 IST of 11th whereas in Tamil Nadu maximum rainfall occurrence was during the forenoon and afternoon of 12 March. The instability parameters over the available RS/RW stations were examined and it is observed that the atmospheric layer above 850 hPa level were moist and unstable to a considerable height. The precipitable water vapour content of Madras at 0530 IST on 11 March is calculated by using the formula $W=p.\ (1000/980)\ q$ and is equal to 3.7156 gm. It is well observed that the amount of precipitabl

water vapour content agrees with the actual rainfall occurred.

4. The study leads to the conclusion that the unprecedented occurrence of widespread rainfall activity on 10th night and 11th morning is mainly due to the passage of an eastward moving long amplitude westerly trough and subsequently its interaction with an easterly trough in the south peninsula. The position of subtropical jet stream south of its mean position at higher levels and the anticyclonic circulation over Bay of Bengal in a southerly latitude and the presence of easterly disturbance in the south peninsula altogether contributed to large influx of moisture. Most of the rainfall was confined to the region between 9°N and 19°N east of longitude 76°E.

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