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NORTHWARD MOVEMENT OF A LOW LEVEL CYCLONIC VORTEX ACROSS COASTAL ANDHRA PRADESH DURING 1-3 NOVEMBER 1986

A cyclonic circulation lay embedded in the lower tropospheric easterly trough over west Bay of Bengal off south Andhra-north Tamil Nadu coast on 1 November 1986. The circulation moved northwards across coastal Andhra Pradesh during next two days and caused fairly widespread rain with scattered heavy to very heavy falls in the coastal districts of north Andhra Pradesh and adjoining areas of coastal Orissa on 2 and 3 November. The synoptic situation associated with the above system is presented in this note.

2. A trough in lower tropospheric easterlies had moved westwards across the Bay Islands between 30 and 31 Oct 1986 and lay at mb 850 (hPa) over the east central and adjoining southeast Bay at 1200 GMT (UTC) of 31 Oct. A cyclonic vortex was embedded in the trough with its centre near 13°N, 88°E, as seen from the INSAT-1B satellite cloud imagery of 1200 GMT of 31st. By the morning of 1 November the trough in

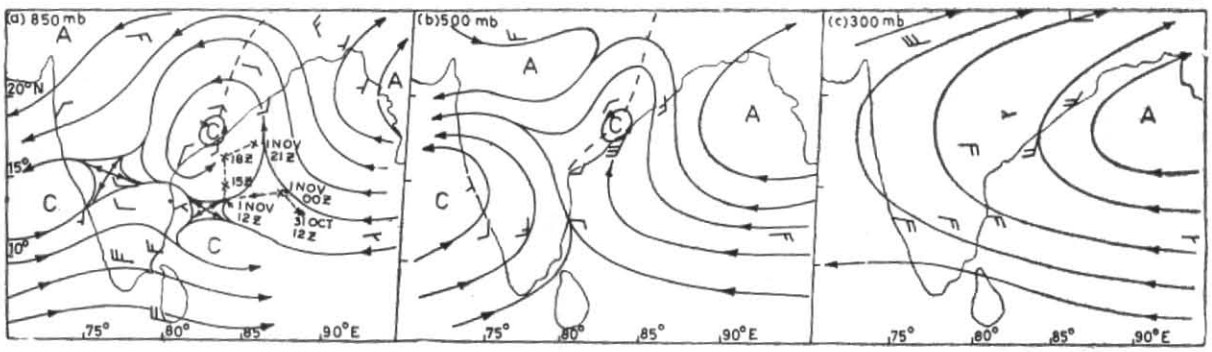

Fig. 1. Streamline charts of (a) 850, (b) 500 and (c) 300 mb (hPa) for 1200 GMT (UTC) of 2 November 1986. Position of low level vortex as seen in INSAT-1B satellite cloud imageries are marked on 850 mb chart

the easterlies moved to the west central and adjoining southwest Bay. The embedded low level vortex moved northwestwards and lay centred near 14°N, 87°E at 0000 GMT of 1st as the vortex centre was well defined in the INSAT-1B cloud imagery of 0000 GMT. Scattered intense convective clouds were present over the west central Bay and adjoining coastal Andhra Pradesh in association with the above system. By the afternoon the easterly trough moved further westwards and lay at 850 mb level with its axis running in SSW-NNE direction from south Andhra-north Tamil Nadu coast to Bihar plains at 1200 GMT of 1 November. The trough extended upwards up to 500 mb on this day. The low level cyclonic vortex also moved westwards and was centred near 13.6°N, 83.4°E and a better cloud organisation was seen around the system in the satellite cloud imagery of 1200 GMT of 1st. The vortex showed a northward movement during the next 12 hours. At 0000 GMT of 2 November, the cyclonic circulation associated with the vortex was clearly seen in the lower tropospheric streamline charts. The vortex centre, however, was not well defined in the morning cloud imageries. The circulation lay close to Andhra coast between Machilipatnam and Visakhapatnam at 850 mb and was well marked up to 600 mb (4.5 km a.s.l.) tilting northeastward with height. The trough in the lower tropospheric easterlies also persisted over the region extending northeastwards from south Andhra coast to Bihar plains. By afternoon of 2nd, the cyclonic circulation moved further northwards and became more marked. Its upwards extension was seen up to 500 mb level. The cyclonic circulation at 850 mb lay over central parts of coastal Andhra Pradesh at 1200 GMT of 2nd and tilted northeastward with height. During the next twelve hours the system weakened and was seen only as a feeble cyclonic circulation at 500 mb over north coastal Andhra Pradesh and adjoining south Orissa at 0000 GMT of 3 November. The trough in the lower tropospheric easterlies, however, still persisted over the region on this day. Fig. 1 illustrates the streamline charts for 850, 500 and 300 mb for 1200 GMT of 2 November 1986. The positions of the low level vortex centre as seen in the INSAT-1B satellite cloud imageries during 31 October and 1 November are also marked on the 850 mb streamline chart.

It may be mentioned that the sub-tropical ridge line at 300 mb and above lay at about Lat. 18° N over the Peninsula during the period of study. Southerly to southeasterly winds prevailed over the west Bay and adjoining coastal areas on the southern periphery of the anticyclone above the low level cyclonic vortex. The high level southerly flow over the region apparently provided the necessary steering field to the low level system to move in a northerly direction across north coastal Andhra Pradesh.

3. It may be noted from Fig. 1 that northward movement of low level cyclonic vortex over west Bay from 1200 to 2100 GMT of 1 November was more clearly seen in 3 hourly INSAT-1B satellite cloud imageries. The vortex centre, which was seen near 13.6° N, 83.4° E in the satellite cloud imagery of 1200 GMT of 1 November, moved northwards and lay near 14.7° N, 83.7° E at 1500 GMT and was associated with intense to very intense convective clouds over the region to the west of Long. 90° E between Lats. 15° N and 20° N. At 1800 GMT, the vortex centre showed further northwards movement and was seen near 15.8° N, 83.3° E, with a curved cloud band of 2 degrees width around the centre running from southwest to north (through east) and intense to very intense convective clouds over north coastal Andhra Pradesh and adjoining south coastal Orissa. The vortex, however, showed a northeastward movement in the cloud imagery after 1800 GMT and was located near 16.9° N, 85.1° E at 2100 GMT of 1 November. The vortex centre was not clearly defined in subsequent cloud imageries but intense to very intense convective clouds peristed over north coastal Andhra Pradesh and adjoining areas of Orissa till the morning of 3 November 1986.

4. On the sea level chart a separate low could not be drawn in associated with the low level cyclonic circulation, particularly on 2 November, as the system remained more marked in the lower and mid-tropospheric levels on this day. 24-hour pressure changes of the coastal stations were, however, negative but varied only between 1 and 2 mb and thus, were not very significant. On the other hand, the east-west seasonal trough on the sea level chart running across south Peninsula showed a marked northward shift with the northward movement of the system from 1 to 3 November. The trough moved northwards by 4 to 5 degrees latitude

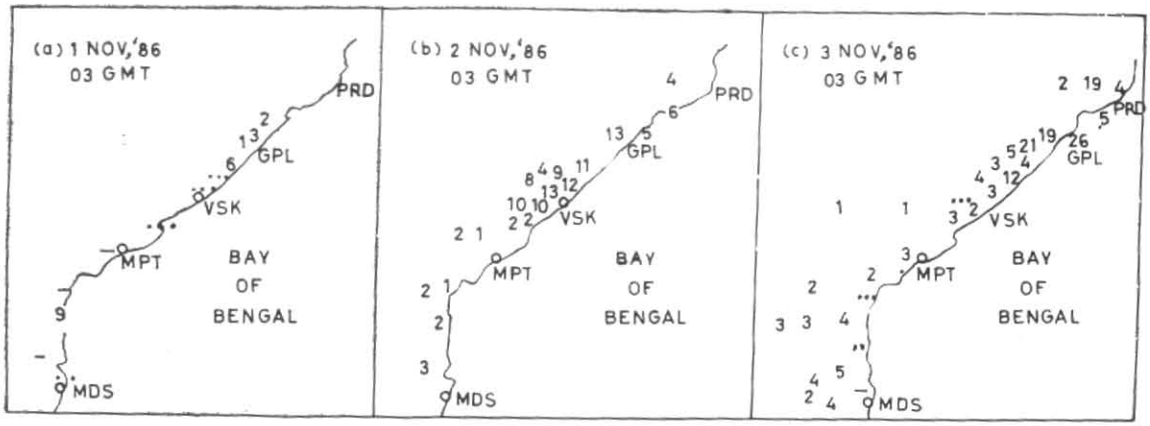

Fig. 2. 24-hour rainfall amounts (cm) recorded at 0300 GMT (UTC) of : (a) 1 Nov, (b) 2 Nov & (c) 3 Nov 1986

over south Peninsula from 1 to 2 November, and shifted further northwards by about 2 deg. latitude, reaching at about Lat. 17° N on the 3rd. On 4 November, the seasonal trough again shifted southwards to its normal position, to about 12° N after the system had weakened.

5. 0300 GMT rainfall maps for 1 to 3 November 1986 are presented in Fig. 2. It may be seen that on 1 November generally small amounts of rainfall were recorded over coastal Andhra Pradesh and Orissa. An isolated heavy rain of 9.0 cm, however, occurred in south coastal Andhra Pradesh at Kavali. On 2 November, the rainfall activity over the region significantly increased, particularly in north coastal Andhra Pradesh where fairly widespread rain with scattered heavy falls occurred during the 24 hours period ending at 0300 GMT of 2nd. The meteorological observatory at the Cyclone Warning Centre, Visakhapatnam recorded a very heavy rainfall of 13.5 cm on this day. Further north along the coast, Kalingapatnam observatory recorded a heavy rainfall of 12 cm. 0600 radar observation of 1 November of the cyclone detection radar at Dolphin's Nose, Visakhapatnam reported a squall line from SW to NE along the coast near the station over a length of about 200 km.

6. It may be of interest to note from Fig. 2 that heavy rainfall was mainly confined to the northern districts of north coastal Andhra Pradesh (Srikakulam, Vizianagaram and Visakhapatnam) on 2 November, whereas other parts of the region recorded comparatively less rainfall amounts. On the 3rd, the heavy rainfall belt shifted northeastward to south coastal Orissa and adjoining extreme northern parts of coastal Andhra Pradesh. Gopalpur, on the south coast of Orissa, recorded exceptionally heavy rainfall of 26 cm on this day. Scattered very heavy rain also occurred in the extreme northern parts of coastal Andhra Pradesh. On the 4th the rainfall over the region had significantly decreased.

7. It may be seen that the marked enhancement of rainfall activity over coastal Andhra Pradesh and adjoining parts of coastal Orissa on 2 and 3 November 1986 occurred mainly in association with the northward movement of the cyclonic disturbance over west Bay off Andhra coast. As mentioned earlier, the system also intensified as it moved northwards and lay over north coastal Andhra Pradesh on the morning of 2nd. The trough in the lower tropospheric easterlies extended northeastwards from the centre of the cyclonic circulation towards Bihar plains during the above period and its rear portion continued to lie over north coastal Andhra Pradesh and coastal Orissa on 1 and 2 November. It is well known that the rear portion of an easterly trough is a region of convergence, as the absolute cyclonic vorticity of air columns increases in this region while they move towards the trough line from the east (Riehl 1965). Under the synoptic situation described above, convergence continued to occur in the lower troposphere over north coastal Andhra Pradesh and adjoining area of coastal Orissa during 1 and 2 November 1986, resulting in the occurrence of heavy rains in these areas.

Reference

Riehl, H., 1965, *Introduction to the Atmosphere*, McGraw Hill Book Co., New York, p. 358.

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