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Tamil Nadu, Kerala and Karnataka floods of November 1992 — A meteorological study

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सार — नवंबर 1992 में, ट्यूटीकोरिन चक्रवात से तमिलनाडु, केरल और कर्नाटक में मूसलाधार वर्षा के कारण विनाशकारी बाढ़ आई। इनसेट चित्रों की मदद से लिए गए प्रेक्षणों से इस चक्रवात के विकास और भ्रमण-पथ का अध्ययन करने पर ज्ञात हुआ कि :

(*i*) चक्रवात की गति मध्य क्षोभ मंडल में पूर्वी और पश्चिमी द्रोणियों से प्रभावित हुई जिनमें परिसंचरण धीरे-धीरे समाहित हो गया,

(*ii*) तमिलनाडु तट पर पहुंचते ही चक्रवात ने पुनः संगठित बादलों के रूप में उग्र रूप धारण कर लिया और

(*iii*) पश्चिमी तट के पास थल क्षेत्र पर, गहरे अवदाब के बादलों का समूह अपने चक्रवाती परिसंचरण से आगे गतिशील हुआ जो इस समय तक समुद्र पर ही केन्द्रित था।

ABSTRACT. Observations made with the help of INSAT imageries in connection with the development and track of the Tuticorin cyclone, which gave heavy rains causing devastating floods in Tamil Nadu, Kerala and Karnataka in November 1992, reveal the following :

(*i*) The movement of the Cyclonic Storm (CS) was affected by the mid-tropospheric easterly and westerly troughs into which its circulation got embedded successively.

(*ii*) The CS reintensified on approaching the Tamil Nadu coast.

(*iii*) Near the west coast the cloud body of the deep depression moved over land ahead of its circulation which was still centred over sea.

Key words — Equatorial Zone of Maximum Cloudiness (EZMC), Equatorial Trough (ET), Tropical cyclone, Depression, System, Orography.

1. Introduction

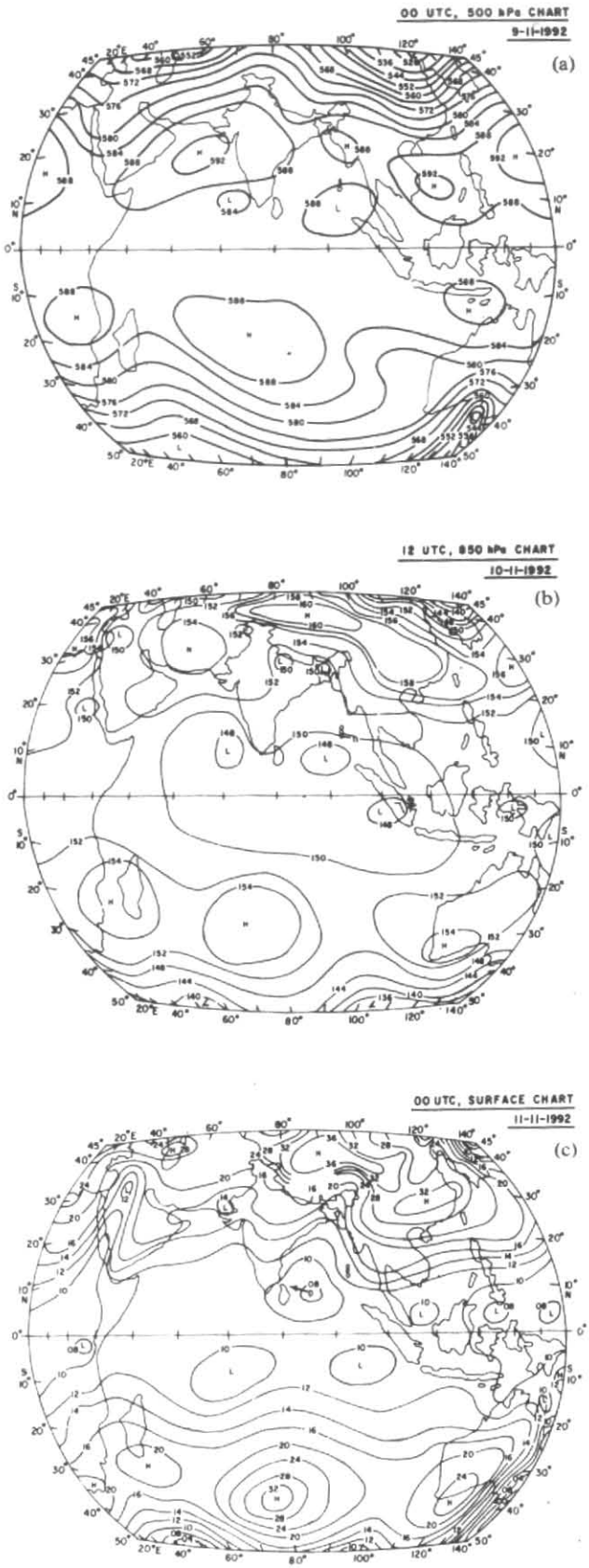
According to press reports, about 200 persons lost their lives and damage to property worth 500 crores of rupees occurred in Tamil Nadu due to heavy rains on 13 and 14 November 1992, from a Cyclonic Storm (CS). In Kerala, the storm took a toll of about 20 lives due to heavy rains during the same period. The same storm gave torrential rains in Karnataka for 3 days from 16 November causing severe floods in which 88 persons lost their lives and damage to property worth Rs. 200 crores occurred. A meteorological study has given some new information about the development and path of this CS, which is the subject matter of present study.

2. Methodology

The formation and northward propagation of the Equatorial Zones of Maximum Cloudiness (EZMC) over Indian region in 30-40 day mode is a feature which is observed almost throughout the year. During November, the EZMC normally coincides with the Equatorial Trough (ET) at 850 hPa and 700 hPa. Depressions and cyclonic storms form in the Bay of Bengal from the concentration of cyclonic disturbances in this ET (Ranjit Singh 1989). With this background understanding, the development and track of the present CS (Fig. 5) have been studied by examining the conventional charts (Figs. 1 & 2) and the INSAT-cloud imageries (Fig. 4) together, and the new observed phenomena presented.

3. Synoptic analysis

A disturbance was noticed, embedded in an ET at 850 and 700 hPa in the Gulf of Thailand on 8 November. It moved westward in the southeast Bay, where a low pressure formed on the evening of 10



Figs. 1 (a-c). Charts depicting cross-equatorial flow in the wake of Southern Hemisphere westerly trough

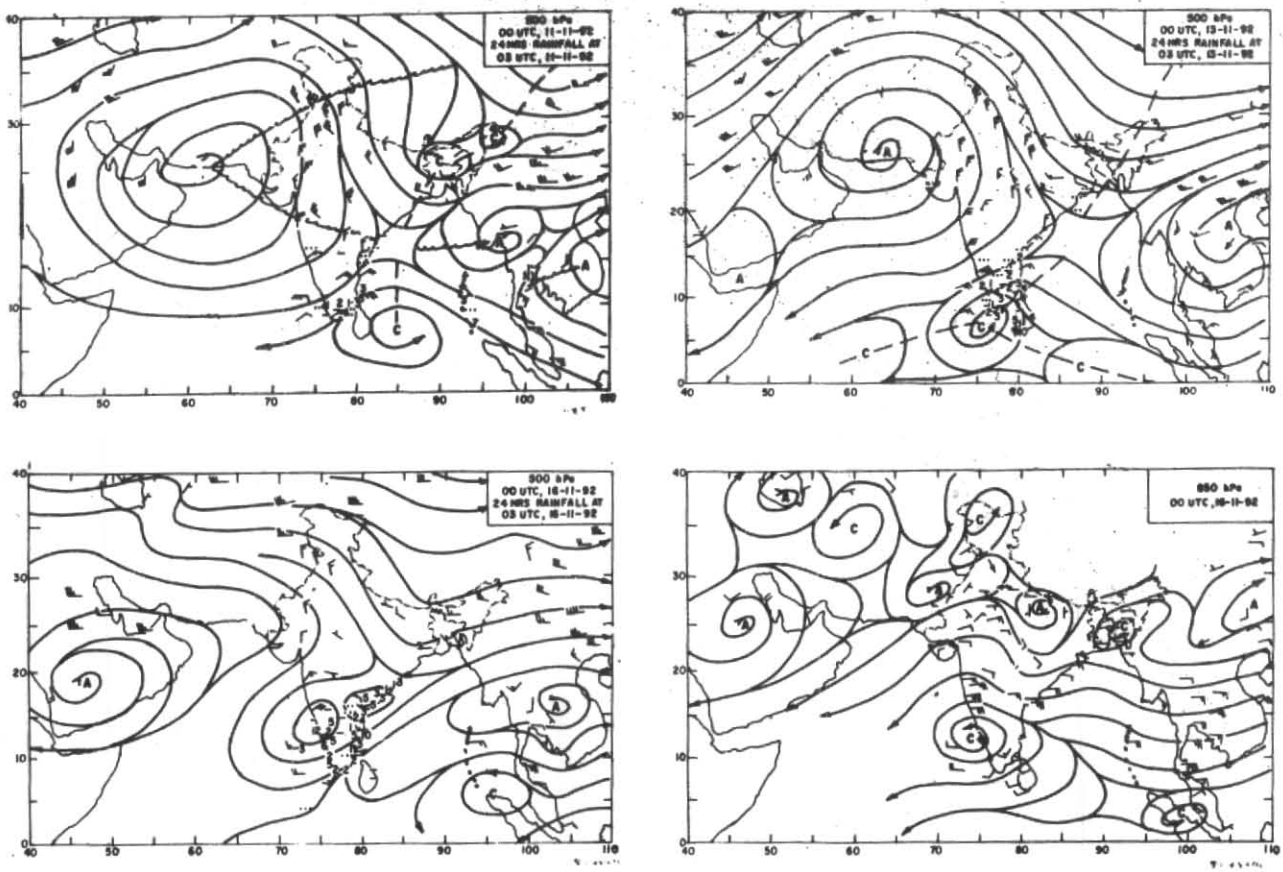


Fig. 2. Tropics-extratropics interaction, easterly wave, steering current and 24-hr rainfall distribution in context with Tuticorin cyclonic storm

November 1992. From the alignment of clouds on INSAT imagery of 10 November moisture feed from the Southern Hemisphere (SH) could be inferred. This took place in the wake of eastward moving mid-latitude westerly troughs in the SH in lower and mid-tropospheric levels and is shown by presenting charts for these levels covering the SH between 9 and 11 November (Fig. 1). The southerlies in the wake of westerly trough travel equatorward and cross it around the cyclonic vortices embedded in the ET. During their equatorward movement, the cold extra tropical air get destabilised over the tropical warm waters due to steep lapse rate and excessive evaporation. Therefore, cross-equatorial flow can be identified from the development and alignment of cloudiness from SH into the Northern Hemisphere (NH). In Figs. 1 and 4 on 10 November the ET at 850 hPa in NH, coincides with the NH, EZMC on INSAT cloud imagery. The low concentrated into a depression over the same area centered near 7.5°N, 86.5°E at 0000 UTC of 11 November. This happened in the presence of a mid-tropospheric westerly trough seen extending upto 20°N at 500 hPa over the Bay of Bengal. An easterly trough developed at this time over the ET, suggesting tropics-extratropics interaction.

Extratropical northerly flow swept the Peninsular India between 0000 and 1200 UTC of 11 November in the lower and mid-tropospheric levels. This provided the baroclinic settings with the warm moisture in the east. The system, therefore, intensified into a CS at 1200 UTC of 11 November (Ranjit Singh 1989). On the satellite imagery of 0600 UTC of 11 November, it evolved into a tightly bound cluster with constant supply of moisture with rainbands extending into the SH. The CS moved in a westsouthwesterly direction steered by the forward portion of the mid-tropospheric easterly trough. It crossed the Sri Lanka coast by the noon of 12 November and emerged into the Gulf of Mannar at 0000 UTC of 13 November. Thereafter, it moved in a northwesterly direction, this time, steered by the winds in the rear sector of the easterly trough. It intensified into a Severe Cyclonic Storm (SCS), before crossing the Tamil Nadu coast close to Tuticorin, at 0900 UTC of 13 November. On the satellite imagery at 0600 UTC of 13 November, eye

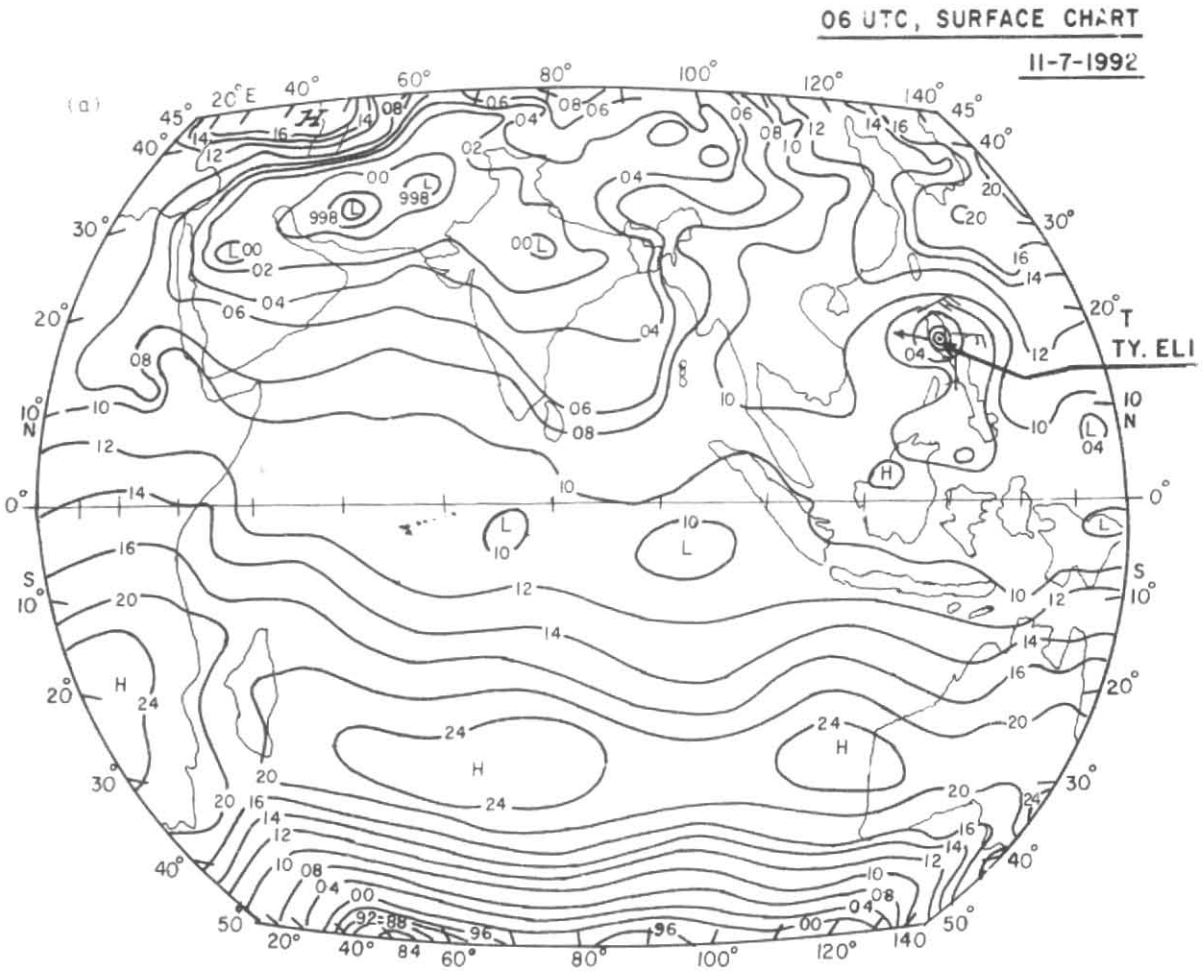
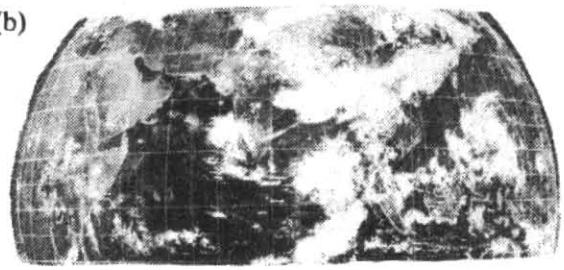


Fig. 3 (a). Typhoon ELI in west-north Pacific

of the SCS was observed. Rainbands converged from southwest and northeast. This intensification near the coast occurred because the air streams got ascending motions on the slopes of the Nilgiri hills and Western Ghats. The SCS had its landfall near Tuticorin at about 1200 UTC of 13 November. The strong winds and the heavy rains that accompanied it caused severe destruction in Tamil Nadu. It moved northwestward and emerged into the southeast Arabian Sea as a depression in the afternoon of 14 November. It weakened because of the following reasons : (*i*) the lee-side effect (descending motions) of Western Ghats, (*ii*) the supply of moisture was cut off from underneath when it was over land. It reintensified into a Deep Depression (DD) on 15 November when the air streams over the Arabian Sea got ascending motions on the slopes of Western Ghats.

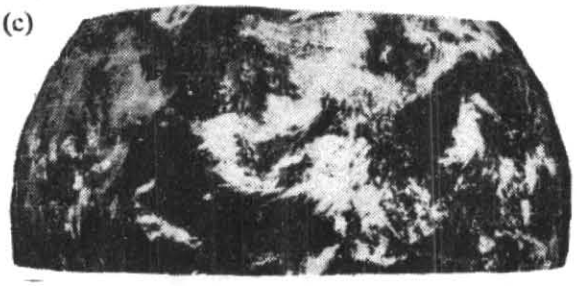
On the INSAT-imageries of 14 and 15 November, convective cloud organisation extended well in the Bay of Bengal and covered Tamil Nadu, Kerala, coastal Andhra Pradesh, Rayalaseema and Karnataka. This happened because (*i*) the system was embedded in an easterly trough superposed over the ET, and (*ii*) the air streams in the trough got ascending motions on the slopes of Eastern Ghats. This is confirmed from the development of a mid-tropospheric meso-scale Cyclonic Circulation (CC) covering the area over coastal Andhra Pradesh and Telangana at 0000 UTC of 16 November. According to INSAT-bulletin, the DD crossed the Karnataka coast at 1500 UTC of 15 November near Mangalore. On INSAT-imagery at 0600 UTC of 16 November, the entire convective cloudiness associated with the DD lay over north Interior Karnataka. It coincided with the CC embedded in a westerly trough at 500 hPa. However, on the sea level chart, the DD crossed the Karnataka coast near Honovar in north Canara district in the noon of 17 November. This shows that cloudiness had crossed the west coast ahead of the CC at mean sea level. The system lay as

(b)



0600 UTC, 10 July 1992

(c)



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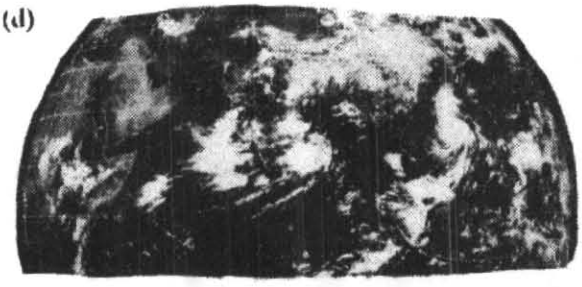
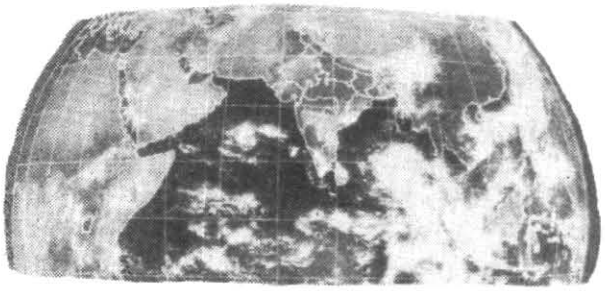


0600 UTC, 12 July 1992

Figs. 3 (b-d). Typhoon ELI in west-north Pacific

(a)

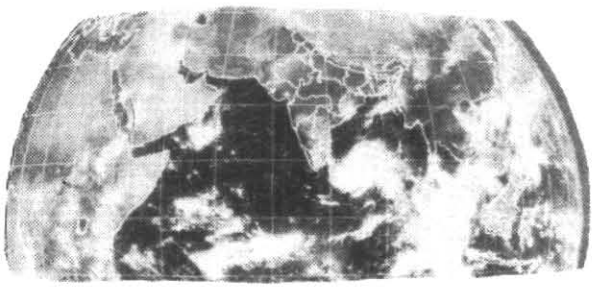


0600 UTC. 10 Nov. 1992

(d)

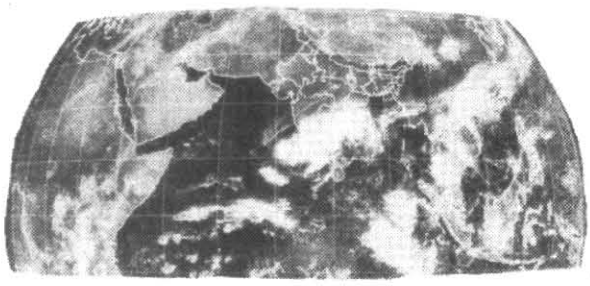
0600 UTC. 14 Nov. 1992

(b)



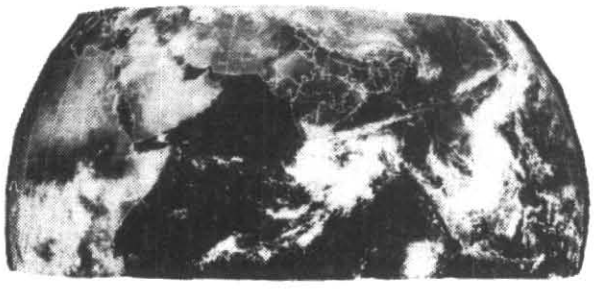
0600 UTC. 11 Nov. 1992

(e)



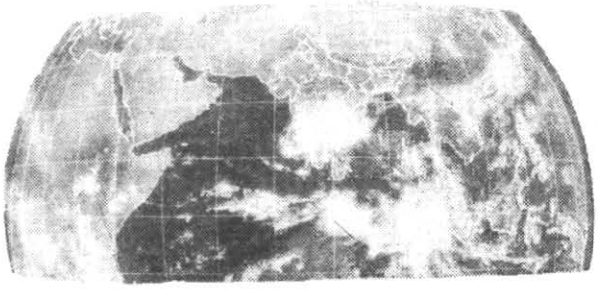
0600 UTC. 15 Nov. 1992

(c)



0600 UTC. 13 Nov. 1992

(f)



0600 UTC. 16 Nov. 1992

Figs. 4 (a-f). Tuticorin cyclonic storm on INSAT-imageries (visible)

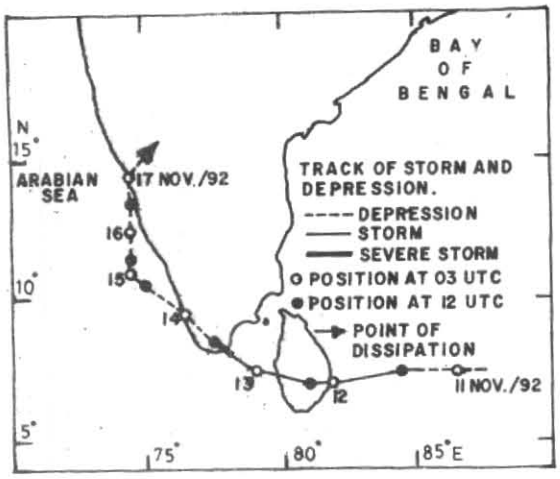


Fig. 5. Track and life history of Tuticorin cyclone storm

a low pressure area over north Interior Karnataka on 16 November. Similar instances of CSs, which formed in the low latitude in the Bay of Bengal crossed Sri Lanka and then hit the Indian coast in the month of the November, have taken place in 1912, 1922, 1925, 1966 and 1978 (IMD 1979 and Srinivasan *et al.* 1980).

The devastating effect of this CS appears to be much severe in south Indian states than in Sri Lanka. This happened because of the ascending motions on the slopes of hills and formation of meso-scale vortices which gave heavy rains 30 to 50 cm causing flash floods, and landslides. The significant amount of rainfall (cm) between 13 and 18 November 1992 are given below :

November 13 : Chidambaram (TN) 12.
14 : Ambasundram (TN) 37, Thenmala (Ker.) 35, Manimuthar (Ker.) 33, Kaveli (CAP) 9.
15 : Coonoor (TN) 43, Kunnamkulam (Ker.) 13, Kandukar (Ker.) 11, Nuggehilli (Ker.) 5.
16 : Hosdurg (Kar.) 18, Mangalore (Kar.) 17, Arasalu (Kar.) 16, Madras (TN) 14, Kalingapatnam (CAP) 13.
17 : Ranchennur (Kar.) and Harihora (Kar.) 32 each, Kundapur (Kar.) 31, Usilanpatti (TN) 16, Arakapalli (CAP) 13.
18 : Masiki (Kar.) 22, Mangalore City (Kar.) and Kaveli (CAP) 16 each, Hosdurg (Kar.) 15, Hompet (Kar.) 12, Kulithalai (TN) 7.

TN — Tamil Nadu, Ker. — Kerala, Kar. — Karnataka, CAP — Coastal Andhra Pradesh.

4. Tropical cyclones of west Pacific

The phenomena discussed in the case of Tuticorin severe cyclonic storm, have been observed in the case of west Pacific Tropical Cyclones (TCs) also. According to Guam and Washington bulletins the TC THELMA was centred over the sea to the east of Philippines at 1200 UTC of 4 November 1991. The wind observations supported the position. However, the associated cloudiness was located over Central Philippines [Figs. 1 (a & b) of Ranjit Singh 1993], and the system was more organised now under the orographic effect than its preceding observation at 0600 UTC of 4 November 1991. Moving westward the remnant of TC THELMA moved into the Andaman Sea on 10 November 1991. It concentrated into a depression over southeast Bay on 12th morning and became a deep depression over southwest Bay on 13th morning. It intensified into a cyclonic storm (CS) at 1200 UTC of 13th near the Tamil Nadu coast of India. On 14th the CS was still centred over sea, when its entire cloudiness lay over peninsular India giving rains. [Fig. 1 (c) of Ranjit Singh 1993]. The system crossed the Tamil Nadu coast on 15th morning.

Similar observations have been made in the case of Typhoon ELI on 10 and 11 July 1992 in a slightly different way [Figs. 3 (a-c)]. The system had intensified on reaching the Philippines coast on 10 July. It was centred over land at 0600 UTC of 11 July when the associated cloudiness had emerged over sea and was less organised. The weakening occurred under the lee side effect of Philippines orography. Thus, close to the land where it is easy to determine the correct position of the cyclonic storms, it is observed that the cloud system had always moved ahead of the circulation on sea level. The ELI re-intensified on 12 July and was tightly bound on reaching near the south China coast on 13 July, confirming the earlier orographic effect.

5. Conclusion

The satellite study of the Tuticorin cyclonic storm has given us a new understanding that near the coast the cloudiness associated with a cyclonic storm moves ahead of its circulation on mean sea level chart and the system intensifies on approaching the coast under the effect of coastal orography. Its movement is controlled by the mid-tropospheric easterly and westerly troughs into which it is embedded. The cloudiness developed in the easterly wave under the influence of coastal orography and feed

from the SH through the ET. form the rain bands of the CS. These observations are common for tropical cyclones of westnorth Pacific and cyclonic storms of the Indian region.

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