

Cyclones and depressions over the north Indian Ocean during 2008*

1. Introduction

During 2008, in all 10 intense low pressure systems formed over the Indian seas. These include one Very Severe Cyclonic Storm (NARGIS), three Cyclonic Storms (RASHMI, KHAI MUK and NISHA), 3 Deep Depressions, 2 Depressions and 1 land Depression. Out of these 10 systems, one (the Very Severe Cyclonic Storm (NARGIS)) occurred during the pre-monsoon season, four (1 Deep Depression, 2 Depressions and a land Depression) occurred during the southwest monsoon season and the rest five (Cyclonic Storms, RASHMI, KHAI MUK and NISHA and 2 Deep Depressions) occurred during the post-monsoon season. The Arabian sea was devoid of any Cyclonic Storm.

The Very Severe Cyclonic Storm (NARGIS) crossed Myanmar coast. Out of the three cyclonic storms which formed over the Bay of Bengal during the post monsoon season, 2 had landfall over the Indian coast and one struck Bangla Dosh coast.

A Depression formed each during the monsoon season and post monsoon season over the Arabian Sea. Both the Depressions moved in a northwesterly to westnorthwesterly direction and dissipated over Sea.

The track / intensity of these systems are given in Fig. 1. A brief history and monthly distribution are given in Tables 1 & 2. The relevant ships and buoy observations are given in Table 3. Detailed seasonwise description of these systems is given below.

2. Disturbances formed during the winter season (January and February)

No intense system formed during the season.

3. Disturbances formed during the Pre-monsoon season (March to May)

Only one very severe cyclonic storm formed during the season. The details are as follows.

3.1. Very Severe Cyclonic Storm (NARGIS) over the Bay of Bengal (27 April – 3 May 2008)

3.1.1. Life cycle

A trough of low lay over the southeast Bay and adjoining south Andaman Sea on 24. It persisted with a

cyclonic circulation extending upto 1.5 km a.s.l. over the region on 25 and organised into a low pressure area over the southeast Bay and neighbourhood on 26. It concentrated into a Depression and lay centred at 0300 UTC of 27, near Lat. 12.0° N/ Long. 87.0° E, about 750 km eastsoutheast of Chennai. Moving slightly westwards, it intensified into a Deep Depression and lay centred near Lat. 12.0° N / Long 86.5° E at 1200 UTC of 27. Subsequently moving northwestwards under the steering influence of an anticyclone located to the east of the system and the ridge along Lat. 14° N, it further intensified into a Cyclonic Storm (NARGIS) and lay centred at 0000 UTC of 28, near Lat. 13.0° N / Long. 85.5° E, about 550 km. east of Chennai. For the following 24 hrs, it remained practically stationary and intensified into a severe Cyclonic Storm at 0900 UTC of 28. A trough in the extra tropical westerlies which extended roughly along Long 60° E, to the north of Lat. 15° N, helped in this intensification by providing added upper level divergence. Then it moved northwards and intensified into a Very Severe Cyclonic Storm and lay centred at 0300 UTC of 29, near Lat. 13.5° N / Long. 85.5° E and at 1200 UTC, near Lat. 14.0° N / Long. 85.5° E. As the system lay very close to the upper tropospheric ridge, its northward movement was slowed down. Once the system centre crossed the ridge position, it came under the joint influence of the upper level anticyclone lying to the southeast and the mid-latitude upper tropospheric westerlies. Thereby re-curving northeastwards, it lay centred near Lat. 14.5° N / Long. 86.5° E at 0300 UTC and near Lat. 14.5° N / Long. 87.0° E at 1200 UTC of 30 April. It continued to move northeastwards and lay centred at 0300 UTC of 1 May, near Lat. 15.5° N / Long. 89.0° E and at 1200 UTC, near Lat. 16.0° N/ Long. 90.5° E. Subsequently moving eastwards, it lay near Lat. 16.0° N / Long. 93.0° E at 0300 UTC of 2, near Lat. 16.0° N/ Long. 94.0° E at 1200 UTC and crossed southwest coast of Myanmar between 1200 & 1400 UTC, along Lat. 16.0° N. It moved northeastwards across Myanmar and weakened into a Severe Cyclonic Storm at 2100 UTC of 2 and lay centered near Lat. 16.5° N / Long. 95.5° E. It further weakened into a Cyclonic Storm near Lat. 17.5° N / Long. 96.5° E at 0600 UTC of 3 and further into a well marked low pressure area over east central Myanmar by the evening of 3.

3.1.2. Satellite cloud features and other observations

The system was mainly tracked by satellite. The maximum intensity of T. No. 5.0 was reported from 0500

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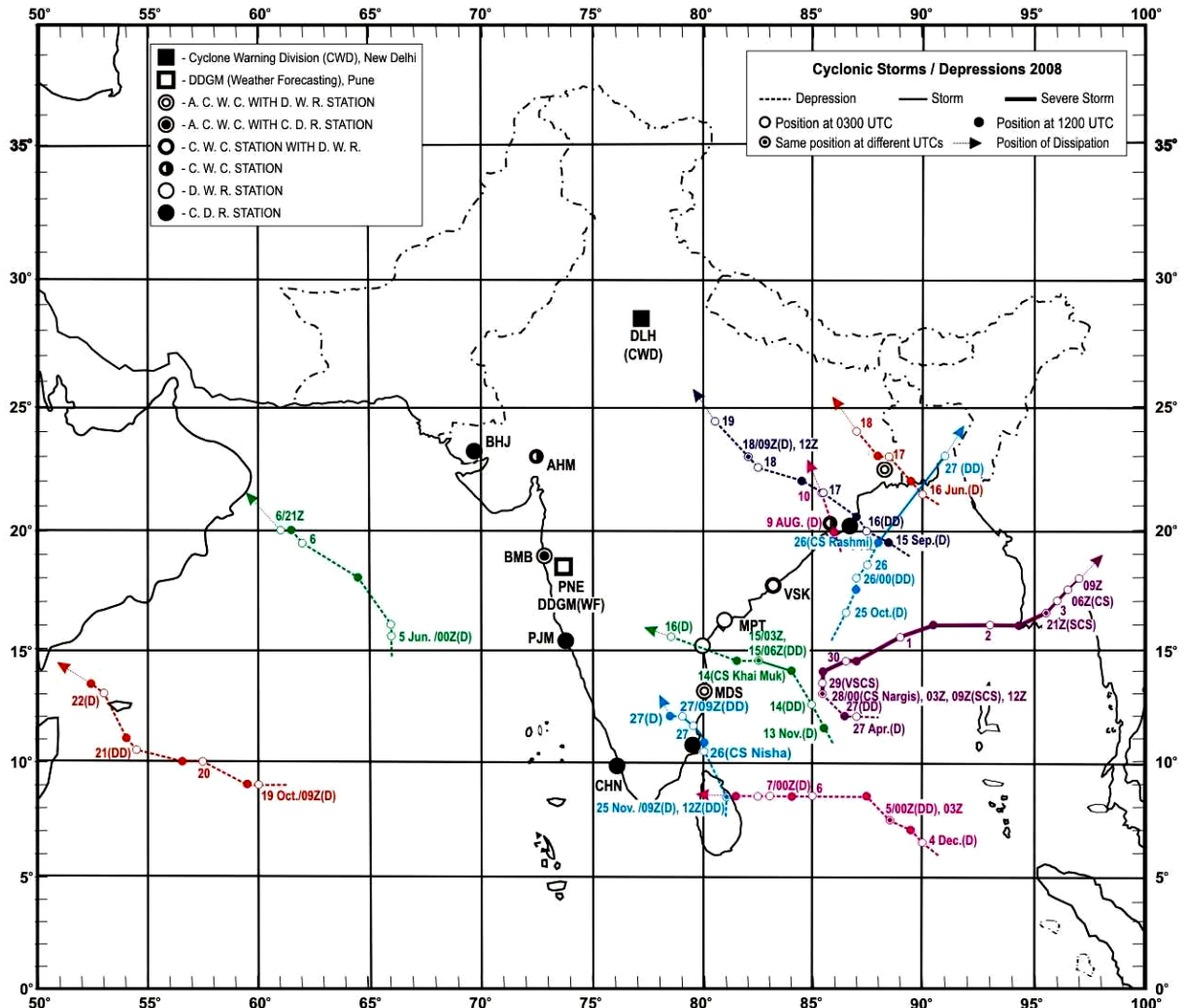


Fig. 1. Tracks of cyclonic storms/depressions during 2008

to 1200 UTC of 2 May (Fig. 2). An “Eye” was seen from 0400 UTC of 1 May to 1200 UTC of 2 May.

The system centre was never closer than 550 km from DWR Chennai, but at that distance it remained practically stationary for quite some time.

3.1.3. Other features observed

The lowest Estimated Central Pressure (ECP) was 962 hPa at 0600 UTC of 2 May. The maximum estimated mean wind speed was 90 kts at this time. The system moved initially in northwesterly direction, then northerly and then recurved into northeasterly direction and crossed

southwest coast of Myanmar between 1200-1400 UTC of 2 May. The system continued to intensify even after recurvature. It moved almost in an easterly direction from 0600 UTC of 1 May till 1500 UTC of 2 May. Also it maintained the intensity of Cyclonic Storm for about 12 hrs after the landfall causing extensive loss of life and property.

3.1.4. Weather and damage

Widespread rainfall activity from 27 April to 2 May with isolated heavy falls (on 29 April, 1 and 2 May) occurred in Andaman & Nicobar Islands.

TABLE 1
Brief history of cyclonic storms and depressions over the Indian seas and neighbourhood during 2008

S. No.	Category	Life Period	Place / Time of landfall	Lowest Estimated central Pressure (hPa)	Max. wind (Estimated/observed) (kts)	Highest "T" No.
1.	VSCS (Nargis)	27 Apr - 3 May	Southwest coast of Myanmar between 1200-1400 UTC of 2 May	962	90	5.0
2.	D	5 - 7 Jun	-	996	25	2.0
3.	D	16 - 18 Jun	Bangladesh coast along near Lat. 22.0° N / Long. 89.5° E between 1100 UTC & 1200 UTC of 16	988	25	1.5
4.	D	9 - 10 Aug	-	988	25	-
5.	DD	15 - 19 Sep	Orissa coast near Chandbali between 1600 and 1700 UTC of 16	988	30	2.0
6.	DD	19 - 22 Oct	-	1000	30	2.0
7.	CS (Rashmi)	25 - 27 Oct	Bangladesh coast near 89.5° (about 50 km west of Khepupara) between 2200 and 2300 UTC of 26	984	45	3.0
8.	CS (Khai Muk)	13 - 16 Nov	South Andhra coast, close to Kavali between 2200 and 2300 UTC of 15	994	40	2.5
9.	CS (Nisha)	25 - 27 Nov	Tamil Nadu coast, north of Karaikal (near Lat. 11.3° N / Long. 79.8° E) between 0000 and 0100 UTC of 27	996	45	3.0
10.	DD	4 - 7 Dec	-	1004	30	2.0

D - Depression, DD - Deep Depression, CS - Cyclonic Storm, VSCS - Very Severe Cyclonic Storm

TABLE 2
Storms / depressions statistics 2008

Name of the system	Winter	Pre-monsoon			Monsoon			Post-monsoon				Total
	Jan-Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Over Bay of Bengal												
Depressions/Deep Depressions	-	-	-	-	1	-	-	1	-	-	1	3
Cyclonic Storms	-	-	-	-	-	-	-	-	1	2	-	3
Severe Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Very Severe Cyclonic Storms	-	-	1	-	-	-	-	-	-	-	-	1
Super Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Total	0	0	1	-	1	-	-	1	1	2	1	7
Land Depression												
Deep Depressions	-	-	-	-	-	-	1	-	-	-	-	1
Over Arabian Sea												
Depressions/Deep Depressions	-	-	-	-	1	-	-	-	1	-	-	2
Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Severe Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Very Severe Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Super Cyclonic Storms	-	-	-	-	-	-	-	-	-	-	-	0
Total	0	0	0	0	1	0	0	0	1	0	0	2

TABLE 3
Crucial Ship/buoy observations during the storm/depression periods 2008

Call Sign	Date/Time (UTC)	Position of the Ship		Wind		Pressure PPPP (hPa)
		Lat. (Deg. N)	Long. (Deg. E)	Dir. (Deg.)	Speed (kts)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Very Severe Cyclonic Storm (Nargis) over the Bay of Bengal (27 April-3 May 2008)						
SFMN	270000	6.3	88.5	260	25	1005.9
SFQG	270000	5.8	86.5	260	15	1006.9
VTZJ	271200	12.3	85.2	30	20	1002.0
Buoy	280300	14.0	82.1	285	10	1003.4
Buoy	280900	14.2	83.4	315	15	1000.4
Buoy	280900	9.2	89.3	225	02	1003.7
ATSF	290000	12.8	83.2	330	10	1000.0
Buoy	290300	14.0	83.2	315	05	1003.0
Buoy	291200	14.0	83.2	315	10	1001.9
ATSF	291200	10.4	83.1	225	15	1003.0
Buoy	300300	14.0	83.2	225	10	1005.7
Buoy	301200	14.0	83.2	270	10	1003.2
(B) Depression over the east central Arabian Sea (5 – 7 June 2008)						
VRZN8	050000	19.7	70.3	135	20	1004.0
VRAR6	050000	17.7	69.8	225	30	1004.5
ZQDI9	050000	13.4	57.3	250	20	1002.6
A8IFS	050000	10.7	62.5	250	25	1005.2
MQPF2	050000	9.5	68.8	250	20	1003.7
Buoy	050300	17.9	71.2	180	20	1005.6
Buoy	051200	17.9	71.2	250	20	1003.3
9MBG3	051200	14.8	69.5	225	20	1003.7
MGPF2	051200	10.5	65.5	250	25	1001.0
NPNV	051200	16.5	55.5	250	25	999.0
9MBG3	061200	18.1	65.2	250	20	997.6
(C) Deep Depression over the Arabian Sea (19 – 22 October 2008)						
DDJSZ	191200	11.3	63.1	270	35	1003.7
A8LL9	210000	12.6	58.7	160	25	1005.5
DFGXZ	211200	12.5	59.5	160	20	1006.6
DYKY	220000	11.6	51.0	180	30	1006.8
DYKY	221200	9.7	52.3	135	10	1008.5
(D) Cyclonic Storm (Rashmi) over the Bay of Bengal (25 – 27 October 2008)						
ONEU	250000	14.8	85.9	270	30	998.0
ONEU	260000	18.6	87.3	020	30	993.0
(E) Cyclonic Storm (Khai Muk) over the Bay of Bengal (13 – 16 November 2008)						
Buoy	131200	14.9	87.2	225	15	1003.3
Buoy	140300	14.0	83.2	045	20	1004.4
VTXL	140000	15.8	85.9	270	20	1004.5
Buoy	141200	14.0	83.2	270	15	1001.5
Buoy	150300	14.0	83.2	135	30	1003.4
VTXL	150000	11.7	84.2	225	20	1002.9
(F) Cyclonic Storm (Nisha) over the Bay of Bengal (25 – 27 November 2008)						
A8HS	251200	5.9	86.3	200	20	1009.5
ATSS	250000	10.4	84.3	135	30	1007.5
DPZD2	250000	5.7	83.7	200	20	1007.0
(G) Deep Depression over the Bay of Bengal (4 – 7 December 2008)						
MLXDS	040000	3.7	91.6	270	15	1008.4
VRWQZ	040000	6.0	87.1	330	15	1010.5
DDZF2	040000	5.9	88.5	110	20	1011.5
DDZF2	041200	5.9	88.5	310	25	1008.5
AUCU	050000	6.1	88.7	180	15	1005.8
AUCU	051200	6.0	90.0	310	15	1007.1
DGCR2	060000	5.8	83.9	310	15	1010.8
VVFI	070000	10.3	83.7	110	15	1008.8
PHKL	070000	5.9	87.6	-	-	1008.3
PHKL	071200	5.8	83.5	090	10	1006.1



Fig. 2. Satellite imagery of Nargis 2nd May 2008 1200 UTC, T5.0

Some chief amounts of rainfall (in cms) are:

29 April : Port Blair 8, Maya Bandar 7.

1 May : Car Nicobar 7.

2 May : Long Island 11, Maya Bandar & Port Blair 6 each.

The system caused widespread damage in Myanmar.

4. Disturbances formed during the monsoon season (June to September)

It was an active season. In all, 4 intense low pressure systems formed during the season, the details of which are given below:

4.1. Depression over the east central Arabian Sea (5 – 7 June 2008)

4.1.1. Life cycle

A low pressure area formed over the east-central Arabian Sea and neighbourhood on 4. It concentrated into

a Depression and lay centred at 0000 UTC of 5, near Lat. 15.5° N / Long. 66.0° E. It lay centred near Lat. 16.0° N / Long. 66.0° E, about 800 km southwest of Mumbai at 0300 UTC and near Lat. 18.0° N / Long 64.5° E at 1200 UTC of 5. Moving westwards, it lay centred over the west central and adjoining northwest Arabian Sea, centred near Lat 19.5° N / Long. 62.0° E at 0300 UTC and near Lat. 20.0° N / Long. 61.5° E at 1200 UTC of 6. Further moving northwestwards, it weakened and lay as a well marked low pressure area over the northwest and adjoining west central Arabian sea and adjoining Oman coast in the early morning of 7 and as a low pressure over the same region in the morning hours. Subsequently it moved away westwards.

4.1.2. Satellite cloud features and other observations

The maximum intensity of T. No. 2.0 was reported by satellite imagery from 0300 to 1100 UTC of 6 June. As per the satellite account, the central feature started disorganizing due to dry air intrusion from Saudi Arabia and land interaction after 1100 UTC of 6 June.

As the system moved away from the coast, it was not tracked by RADAR.

4.1.3. *Other features observed*

The lowest estimated central pressure was 996 hPa at 1200 UTC of 5. The maximum estimated mean wind speed was 25kts. The system moved initially in a northerly and then in a northwesterly direction and dissipated over the west central and adjoining northwest Arabian Sea.

4.1.4. *Weather and damage*

As the system moved away from the Indian coast, it did not affect the weather over the country. It caused heavy rainfall over coastal Oman.

4.2. *Depression over the North Bay of Bengal (16 – 18 June 2008)*

4.2.1. *Life cycle*

A cyclonic circulation extending upto mid tropospheric levels lay over the northwest Bay and adjoining West Bengal-north Orissa coasts on 14. Under its influence, a low pressure area formed over the northwest Bay off West Bengal – north Orissa coasts on 15. It concentrated into a Depression over the North Bay off Bangladesh coast and lay centred at 0300 UTC of 16, near Lat. 21.5° N / Long. 90.0° E, about 220 km southeast of Kolkata. Moving northwards, it crossed Bangladesh coast along Long. 89.5° E, between 1100 & 1200 UTC of 16 and lay over coastal Bangladesh, near Lat. 22.0° N / Long. 89.5° E at 1200 UTC. It lay over Gangetic West Bengal and adjoining Bangladesh, centred close to Krishnanagar (Lat. 23.0° N / Long. 88.5° E), about 80 km northnortheast of Kolkata, at 0300 UTC of 17 and over Gangetic West Bengal, close to Burdwan (Lat. 23.0° N / Long. 88.0° E), about 100 km northwest of Kolkata at 1200 UTC. Further moving northwestwards, it lay centred at 0300 UTC of 18, over Jharkhand (near Lat. 24.0° N / Long. 87.0° E), about 50 km southwest of Dumka. It subsequently weakened and lay as a well marked low pressure area over Jharkhand and neighbourhood, in the evening. It further weakened into a low pressure area and lay over east Uttar Pradesh and adjoining east Madhya Pradesh on 19 & 20 and became less marked on 21.

4.2.2. *Satellite cloud features and other observations*

The maximum intensity of T 1.5 was reported by satellite imagery from 0600 to 1200 UTC of 16.

4.2.3. *Other features observed*

The lowest ECP was 988 hPa at 0900 UTC of 16. The maximum estimated wind speed was 25 kts at 0300 UTC of 16.

4.2.4. *Weather and damage*

Widespread rainfall activity with very heavy to extremely heavy falls at isolated places occurred from 16 to 18 in Orissa; on 17 and 18 in Gangetic West Bengal and on 18 in Jharkhand. The system caused flood over East Midnapore district of Gangetic West Bengal and in Orissa, many people were affected and huge damage to crops occurred. Even though heavy rainfall occurred mostly in the left forward sector of the system, the northern sector which fell over Sub-Himalayan West Bengal & Sikkim also received heavy rainfall on 18 & 19, which may be attributed to the interaction between the system and a mid-latitude westerly trough over the region.

Some chief amounts of rainfall (in cms) are:

Gangetic West Bengal

16 June : Alipore 7.

17 June : Contai 26, Uluberia & Kharagpur 24 each, Midnapore 21, Kalaikunda 19, Canning town 18, Digha 17, Durgachak 14, Alipore 11, Harinkhola 8, Dengarparaghat 7.

18 June : Kalaikunda 53, Midnapore 37, Mohanpur 31, Phulberia 17, Kharidwar 15, Simulia 12, Kansabati Dam & Dengarparaghat 10 each, Harinkhola 8, Tusuma & Digha 7.

Orissa

16 June : Chandbali 17, NH-5 15, Jeypore & Nilgiri 12 each, Telkoi, Harabhanga & Baripada 11 each, Balasore 10, Balimundali 9, Rajghat & Bangiriposhi 8 each, Athamalik, Rajkishore Nagar & Jamsolaghat 7 each.

17 June : Rairangapur 32, Jaleswar & Rajghat 25 each, Bhogari 19, Joshipur 17, NH-5, Balasore, Nilgiri, Baripada & Jamsolaghat 14 each, Tiring & Khandapada 13 each, Jeypore & Balimundali 12 each, Ghatagaon, Bengiriposh, Karanjia & Thakurmunda 11 each, Suro Sukinda,

Anandpur, Telkoi & Palkhara 9 each, Champua 8, Jhumpura, Keonjhar, Athamalik, Bijapur, Paikmal & Lahunipara 7 each.

18 June : Rairangapur 32, Jaleswar 29, Rajghat 28, Baripada 25, Bangiriposhi 20, Joshipur & Karanhia 19 each, Jhumpura & Chandanpur 17 each, Champua 16, Balimundali & Thakurmunda 15 each, Ghatgaon 14, Swampatna 13, Telkoi & Pallahara 12 each, Balasore, Jeypore & Udala 10 each, Nilgiri, Baragaon & Lhunjpara 9 each, Anandpur 8, Rangali, Deogarh & Panposh 7 each.

Jharkhand

18 June : Jamshepur 34, Ranchi 14, Chaibasa 13, Tenughat 9, Konner & Pupunki 8 each, Ramgarh 7.

4.3. Land Depression over Orissa (9 – 10 August 2008)

4.3.1. Life Cycle

Under the influence of a cyclonic circulation extending upto mid tropospheric levels over the northwest Bay and adjoining coastal areas of Orissa and Gangetic West Bengal, a low pressure area formed over the northwest Bay and adjoining coastal areas of Orissa and adjoining Gangetic West Bengal on 8. It became well marked over the same region on 9 morning and concentrated into a Depression over south Orissa-north Andhra coasts, close to Puri (Lat. 20.0° N / Long. 86.0° E) at 1200 UTC of 9. Moving in a northwesterly direction, it lay over interior Orissa, close to Keonjhar (Lat. 21.5° N / Long. 85.5° E) at 0300 UTC of 10 and weakened into a well marked low pressure area in the evening. It lay as a low pressure area over north Chattisgarh and neighbourhood on 11 morning and became less marked in the evening. The associated cyclonic circulation extending upto mid tropospheric levels tilting southwestwards with height lay over Madhya Pradesh on 11 evening. It lay over southeast Rajasthan and adjoining Gujarat region on 12 & 13; over west Rajasthan and neighbourhood on 14 & 15; over Punjab and neighbourhood during 16 – 21 and became less marked on 22.

4.3.2. Satellite cloud features and other observations

Since the system was over land, no 'T' Number was assigned to it by the satellite.

4.3.3. Other features observed

The lowest pressure 988.0 hPa was reported by Bhubaneswar at 1200 UTC of 9. The maximum estimated wind speed was 25 kts.

4.3.4. Weather and damage

Widespread rainfall activity with isolated very heavy falls occurred at Orissa from 8 to 11 and at coastal Andhra Pradesh and Telangana on 9 and 10.

In Andhra Pradesh, heavy rain caused the rivers Nagavali, Vamsadhara etc., to overflow above the danger levels and resulted in floods in the districts of Srikakulam and Vizianagaram. The rivers/drains flooded with heavy rains inundating many villages in East & West Godavari, Krishna and Guntur districts. Due to heavy to very heavy rain, standing crops were damaged in Orissa.

Some chief amounts of rainfall in cms are:

Andhra Pradesh

9 Aug : Paleru Bridge 21, Nandigama 14, Prakasam Barrage 12, Nuzivedu 11, Gannavaram & Avanigadda 10 each, Machilipatnam & Amalapuram 9 each, Tiruvur & Gudivada 7 each.

10 Aug : Nuzivedu 17, Tiruvur 13, Eleru & Paleru Bridge 12 each, Prakasam Barrage, Koyyalagudem, Amalapuram, Nandigama & Chintalapudi 11 each, Tanuku 10, Bhimavaram, Guntur & Kaikalur 9 each.

Orissa

8 Aug : Madanpur-Rampur 19, Baragaon 17, Junagarh 14, Lanjigarh & Jaipatna 11 each.

9 Aug : Madanpur-Rampur 22, Kotagarh & Lanjigarh 16 each, Bolangir & Bhawanipatna 13 each, Paradip & Baliguda 12 each, Kotraguda 10, Khairamal 9, Sambalpur, Gopalpur, Titlagarh & Bissan Cuttack 8 each, Chandbali, Berhampur, Boudhgarh & Kakatpur 7 each.

10 Aug : Nawarangapur 15, Gunpur 12, Kosagumuda, Kotagarh & Junagarh 11 each, Jaipatna 10, Parlakhemundi 9, Mohana & Phulbani 7 each.

11 Aug : Jaleswar 13, Rengali 12, Bhubaneswar 11, Deogaon 9, Reamal, Paikmal & Tureikela 7 each.

4.4. *Deep Depression over the north Bay and neighbourhood (15 -19 September 2008)*

4.4.1. *Life cycle*

Under the influence of a cyclonic circulation over the north Bay and neighbourhood, a low pressure area formed over there on 15. It concentrated into a Depression and lay centred at 1200 UTC of 15, near Lat. 19.5° N / Long. 88.5° E, about 230 km eastsoutheast of Paradip. Moving northwestwards, it intensified into a Deep Depression and lay centred at 0300 UTC of 16, near Lat. 20.0° N/ Long 87.5° E, about 130 km southeast of Chandbali. It lay centred near Lat. 20.5° N / Long. 87.0° E, about 50 km southeast of Chandbali at 1200 UTC of 16. Further moving westnorthwestwards, it crossed Orissa coast near Chandbali between 1600 & 1700 UTC of 16. It lay centred at 0300 UTC of 17, over Orissa, near Keonjhar (Lat. 21.5° N / Long. 85.5° E) and at 1200 UTC, near Jharsuguda (Lat. 22.0° N / Long. 84.5° E). Continuing the westnorthwestward movement, it lay centred at 0300 UTC of 18, over north Chattisgarh (Lat. 22.5° N / Long. 82.5° E), about 50 km north of Champa. It subsequently weakened into a Depression and lay centred at 0900 UTC of 18, close toendra (Lat. 23.0° N / Long. 82.0° E) and remained practically stationary over there at 1200 UTC. Thereafter it moved westnorthwestwards and lay centred at 0300 UTC of 19, over northeast Madhya Pradesh, close to Satna (Lat. 24.5° N / Long. 80.5° E) and weakened into a well marked low pressure area over Central parts of Uttar Pradesh in the evening. It further weakened into a low pressure area over northwest Uttar Pradesh and neighbourhood on 20 morning and became less marked on 21. However, the associated upper air cyclonic circulation extending upto mid-tropospheric levels persisted there on 21 and 22, which lay over west Uttar Pradesh and neighbourhood on 23, over east Uttar Pradesh and neighbourhood on 24 and 25 and became less marked on 26.

4.4.2. *Satellite cloud features and other observations*

The maximum intensity of T2.0 was reported by the satellite imageries from 0300 UTC to 1700 UTC of 16. As per the satellite account, the system crossed coast at 2100 UTC of 16.

4.4.3. *Other features observed*

The lowest ECP was 988 hPa at 1800 UTC of 16. The maximum estimated wind speed was 30 kts. The

maximum wind of 40 kts and lowest pressure of 982.9 hPa was reported by Chandbali at 1700 UTC of 16, at the time of crossing coast.

4.4.4. *Weather and damage*

Widespread rainfall activity with isolated heavy to very heavy rainfall occurred over Orissa on 15 & 16; on 18 & 19 in Chattisgarh and on 19 in east Madhya Pradesh and with isolated extremely heavy falls on 17 & 18 in Orissa. Some chief amounts of rainfall (in cms) are:

Orissa

15 Sep : Chandbali, Angul & Jharsuguda 7 each.

16 Sep : Paradeep 16, Lanjigarh & Madanpur-Rampur 11 each, Paikmal, Telkoi & Komna 10 each, Patamundai 9, Bissam-Cuttack 8, Keonjhar, Athagarh, Kendrapada, Rajkanika, Rengali, Kakatpur, Khandapada & Kotraguda 7 each.

17 Sep : Akhuapada 31, Jenapur 30, Baliguda 24, Rajkanika 23, Patamundai & Mundali 22 each, Tikabali 21, Nawana & Madanpur – Rampur 20 each, Belgaum, Bolangir, Binika & Daringibadi 19 each, Chandbali, Kendrapada & Bhavanipatna 17 each, Ghatagaon & Athagarh 16 each, Paradip & Kotagarh 15 each, Alipingal, Langigarh & Kalinga 14 each, Jajpur, Tikarpada & Titlagarh 13 each, Khairamal, Cuttack, Naraj, Patnagarh, Sonapur & Phulbani 12 each, Bonth, Thakurmunda & Bhubaneswar 11 each, Rajghat, Athamlik, Baragarh, Khairar & Kantamal 10 each, Bhogari, Altuma, Bijepur, Paikmal, Bhanjanagar, Junagarh & Barmul 9 each, Keonjhar, Aska, Madhabharida, Khandapada & Dunguripalli 8 each, Anandpur, Jhumpura, Swampatna, Dhenkanal, Jaipatna, Komna, Kakatpur, Nimapara, Pipli, Dashpalla & Kotraguda 7 each.

18 Sep : Patnagarh 27, Kantamal 26, Titlagarh 25, Rairakhol 24, Kotagarh 23, Sambalpur 22, Batagaon, Komna, Madanpur-Rampur & Bolangir 20 each, Hirakud, Jharsuguda, Laikera & Baliguda 19 each, Tikabali 18, Kuchinda, Rajkishorenagar, Junagarh &

Belgaon 17 each, Khairamal, Hemgiri & Sonepur 16 each, Deogaon & Boudhgarh 15 each, Jamankira, Deogarh & Lanjigarh 14 each, Rajghat, Naktideul, Pallahara, Reamal, Ambabhona, Paikmal, Bhavani Patna, Dunguripalli & Phulbani 13 each, Baragarh, Tensa & Jaipatna 12 each, Athamalik, Bijepur, Sohela, Daringibadi & Kotraguda 11 each, Telkoi & Padampur 10 each, Chendipada, Rengali, Baragaon, Binika & Kalinga 9 each, Lahunipara 8, Rajgangapur, Harbhanga, Nawarangpur, Bissam-Cuttack & Gudari 7 each.

Chattisgarh

18 Sep : Naharpur 19, Pusor 17, Nagari 18, Gariaband & Raigarh 13 each, Champa 12, Raipur & Chhura 11 each.

19 Sep : Katghora 17, Durg 16, Bilaigarh 14, Pithora & Bansa 13 each, Pamgarh, Pendra, Baloda & Sanja 12 each, Chhura, Gariaband & Mahasamund 11 each, Pali, Uproad, Masturi Dhabra, Dharamjaigarh, Raipur, Arang, Rajim & Akaltara 10 each, Rajnandgaon, Dongargarh, Kurud, Mana, Kharsia, Lailunga & Saraipali 9 each, Takhatpur, Marwahi, Malkharoda & Bemetara 8 each, Dongargaon, Korba, Kartala, Abhanpur, Tilda, Gurur, Bilha, Pusar, Palani Bhagbahra, Simga, Berla, Pandaria, Sakti & Jaijaipur 7 each.

East Madhya Pradesh

19 Sep : Umariya 15.

In Orissa, due to extremely heavy to very heavy rain, many districts were affected. The damage caused due to floods are furnished below:

Affected districts	19
Affected Block	137
Affected Grampanchayat	1581
Affected villages	6339
Total people affected	42,02,065
Total number of human casualties	72 lives

Total number of livestock casualties 314

Total livestock affected 40,35,545

Total areas of crop affected 4,78,387 hectare

In coastal Andhra Pradesh, the overflowing rivers Nagavali, Vamsadhara etc. caused floods in the districts of Srikakulam and Vizianagaram in the northern parts.

Apart from these, the system caused an enhanced rainfall over western parts of the country. Also there was interaction with mid-latitude westerlies leading to increased rainfall over the Western Himalayan region and adjoining plains causing flood over the Yamuna river basin affecting Haryana, Delhi and Uttar Pradesh.

5. Disturbances formed during the Post-Monsoon Season (October to December)

Two deep depressions and three cyclonic storms formed during the season. The details are given below.

5.1. Deep Depression over the Arabian Sea (19 – 22 October 2008)

5.1.1. Life cycle

A trough of low at sea level lay over the southeast Bay on 10 & 11; the southwest and adjoining southeast Bay on 12 and over the southwest Bay on 13. It organized into a feeble low pressure area over Commorin area and neighbourhood on 14 and lay over Maldives and adjoining Commorin areas on 15 and over the southeast Arabian Sea on 16 & 17. Moving westwards, it became well marked over the southwest Arabian Sea and neighbourhood on 18. It subsequently concentrated into a Depression in the evening of 19 and lay centred at 1200 UTC, near Lat. 9.0° N / Long. 59.5° E. Moving westnorthwestwards, it lay centred at 0300 UTC of 20 over the southwest Arabian Sea near Lat. 10.0° N / Long. 57.5° E and at 1200 UTC near Lat. 10.0° N / Long. 56.5° E. Continuing the westnorthwestward movement, it intensified into a Deep Depression and lay centred at 0300 UTC of 21, over the southwest Arabian Sea, near Lat. 10.5° N / Long. 54.5° E and at 1200 UTC near Lat. 11.0° N / Long. 54.0° E. Further moving northwestwards, it weakened into a Depression and lay centred at 0300 UTC of 22 over the westcentral Arabian Sea, near Lat. 13.0° N / Long. 53.0° E and at 1200 UTC near Lat. 13.5° N / Long. 52.5° E. It further moved in a northwesterly direction and weakened into a well marked low pressure area over west central Arabian Sea and adjoining Gulf of Aden on 23.

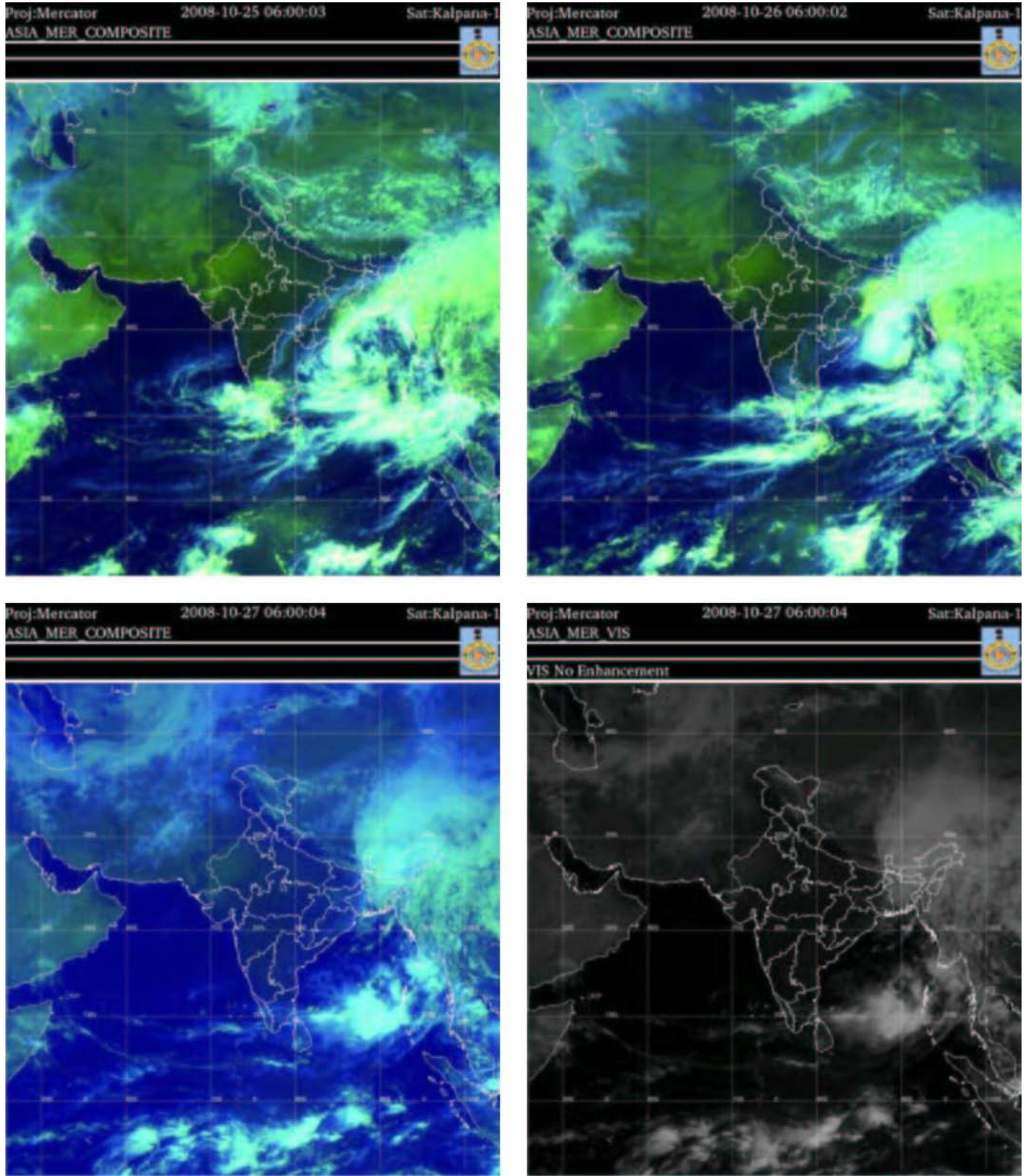


Fig. 3. Satellite imageries of cyclonic storm - Rashmi

5.1.2. Satellite cloud features and other observations

The system was mainly tracked by satellite. The maximum intensity of T 2.0 was reported from 0600 UTC of 21 to 1200 UTC of 21.

5.1.3. Other features observed

The lowest ECP was 1000 hPa at 0300 UTC of 21. The maximum estimated wind speed was 30 kts. The system moved in a westerly to westnorthwesterly direction and dissipated over west central Arabian Sea and adjoining Gulf of Aden. The *in situ* weakening of the system over the ocean could be attributed to colder sea surface temperatures and the shearing of the convective cloud tops to the west.

5.1.4. Weather and damage

The system caused no damage over the country as it was far away from the west coast. However, according to press reports, it caused flood in Yemen due to heavy rainfall.

5.2. Cyclonic Storm (RASHMI) over the Bay of Bengal (25 – 27 October 2008)

5.2.1. Life cycle

Under the influence of a trough of low over the southwest Bay of Bengal off Andhra Pradesh-Tamil Nadu coasts, a low pressure area formed on 24 over the west central Bay of Bengal off Andhra Pradesh coast. It rapidly concentrated into a Depression at 0300 UTC on 25 with its center near Lat. 16.5° N / Long. 86.5° E and at 1200 UTC, near Lat. 17.5° N / Long. 87.0° E. It moved northwards and intensified into a Deep Depression, at 0300 UTC of 26, centered near Lat. 18.5° N / Long. 87.5° E, about 460 kms southwest of Kolkata. Moving in a northnortheasterly direction, it intensified into a Cyclonic Storm (Rashmi) and lay centred at 1200 UTC of 26 near Lat. 19.5° N / Long. 88.0° E about 350 km south of Kolkata. It further moved in a northnortheasterly direction and crossed Bangladesh coast near Long. 89.5° E about 50 km west of Khepupura between 2200 & 2300 UTC of 26. Subsequently, it weakened into a Deep Depression and lay centred at 0300 UTC of 27 near Lat. 23.0° N / Long. 91.0° E. It rapidly weakened into a low pressure area over Meghalaya on 27 evening and became less marked on 28. However associated cyclonic circulation between 1.5 & 2.1 km a.s.l. lay over the region on 28 & 29.

5.2.2. Satellite cloud features and other observations

The maximum intensity of T 3.0 was reported from 1300 to 1700 UTC of 26. (Fig. 3) As per the satellite account, the vortex moved in northeasterly direction and crossed the Bangladesh coast near 22.1° N / 89.3° E at 2100 UTC of 26 October, 2008.

CDR Paradip

Special RADAR observations were taken from 0000 UTC of 25 to 0300 UTC of 27 and three hourly observations from 0000 UTC of 25 to 0300 UTC of 26. The centres were fixed based on curved line till 1300 UTC and the spirals at 1500 and 1800 UTC. No echoes were observed from 0600 UTC of 27 on the RADAR scope. Curved lines with some banding features could be seen at 1200 UTC of 26 when the system was along the Stations latitude. The position of the centre reported was Lat. 20.4° N/Long. 88.4° E. Similar observations were recorded at 1300 UTC and 1500 UTC of 26. There after the echo strength reduced gradually and no centre could be defined due to absence of prominent features.

The centres of the Cyclonic Storm 'RASHMI' of 25-27 October 2008, as fixed by the Radar, based on the Curved line(LN) / Spiral band echoes, at various times are furnished below.

Date	Time (UTC)	Lat. (Deg.)	Long. (Deg.)	Confidence	Character
26 Oct 2008	0000	19.7° N	87.6° E	Poor	LN
26 Oct 2008	0300	19.1° N	88.2° E	Poor	LN
26 Oct 2008	0600	18.8° N	87.8° E	Poor	LN
26 Oct 2008	0900	19.7° N	88.3° E	Poor	LN
26 Oct 2008	1200	20.4° N	88.4° E	Fair	LN
26 Oct 2008	1300	20.6° N	88.5° E	Fair	LN
26 Oct 2008	1500	20.6° N	88.5° E	Fair	Spiral
26 Oct 2008	1800	21.2° N	88.6° E	Fair	Spiral
26 Oct 2008	2000	21.7° N	88.3° E	Poor	LN
26 Oct 2008	2100	Not Defined	-	-	-

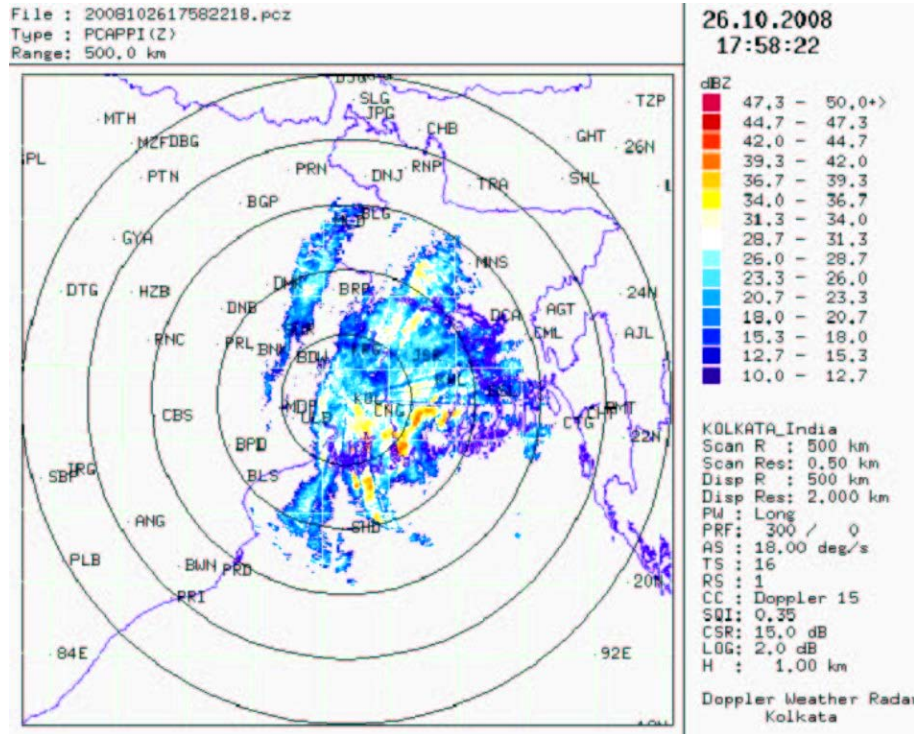


Fig. 4. Radar echos of Rashmi (DWR Kolkata)

DWR Kolkata

The signatures of the depression were first observed at 0844 UTC of 26. Spiral bands could be seen at a distance of 250-280 km SSW of Kolkata. However, better organized spiral bands were observed at 0934 UTC. At 1209 UTC, when the system became a Cyclonic Storm, a clear circular eye was seen at a distance of 280 km southsoutheast of DWR Kolkata. A lot of convective clouds could also be seen associated with the system. The estimated diameter was about 20-22 km. The shape of the circular eye was maintained till 1239 UTC. The eye was seen till 1400 UTC but the shape got disorganized. No eye was visible at 1500 UTC and it appeared that the system got weakened. From the DWR images it appeared that the system entered Bangladesh coast around 1800 UTC of 26 (Fig. 4).

The maximum radial wind recorded by DWR Kolkata from PPI-V pictures was about 24 m/s (70 km/h) at 1239 UTC of 26 at a distance of 240 km from DWR.

5.2.3. Other features observed

The lowest ECP was 984 hPa at 2100 UTC of 26. The maximum estimated wind speed was 45 kts at 2100

UTC of 26. The lowest pressure (984.5 hPa) was reported by Khepupara at 2100 UTC of 26.

The system showed intensification in the sustained wind speed reaching upto 45 kts just before the landfall. It rapidly (within a span of 12 hrs) weakened over land into a low pressure area. It had moved northeastwards skirting the coast causing rainfall over coastal Andhra Pradesh, Orissa, West Bengal and Bangladesh.

In the past, only 3 cyclonic storms (one each during 1905, 1967 & 1988) out of 9 cyclonic storms originated over the region between 15° - 20° N & 85° - 90° E have crossed Bangladesh coast during the period 1891 - 2007.

5.2.4. Weather and damage

Fairly widespread rainfall occurred over coastal Andhra Pradesh on 24 & 25, coastal Orissa during 24 - 26 and Nagaland-Manipur-Mizoram-Tripura during 25 - 28. Widespread rainfall with isolated heavy to very heavy falls occurred on 27 in Gangetic West Bengal, Sub-Himalayan West Bengal on 28 and over Arunachal Pradesh and Assam & Meghalaya on 28 & 29.

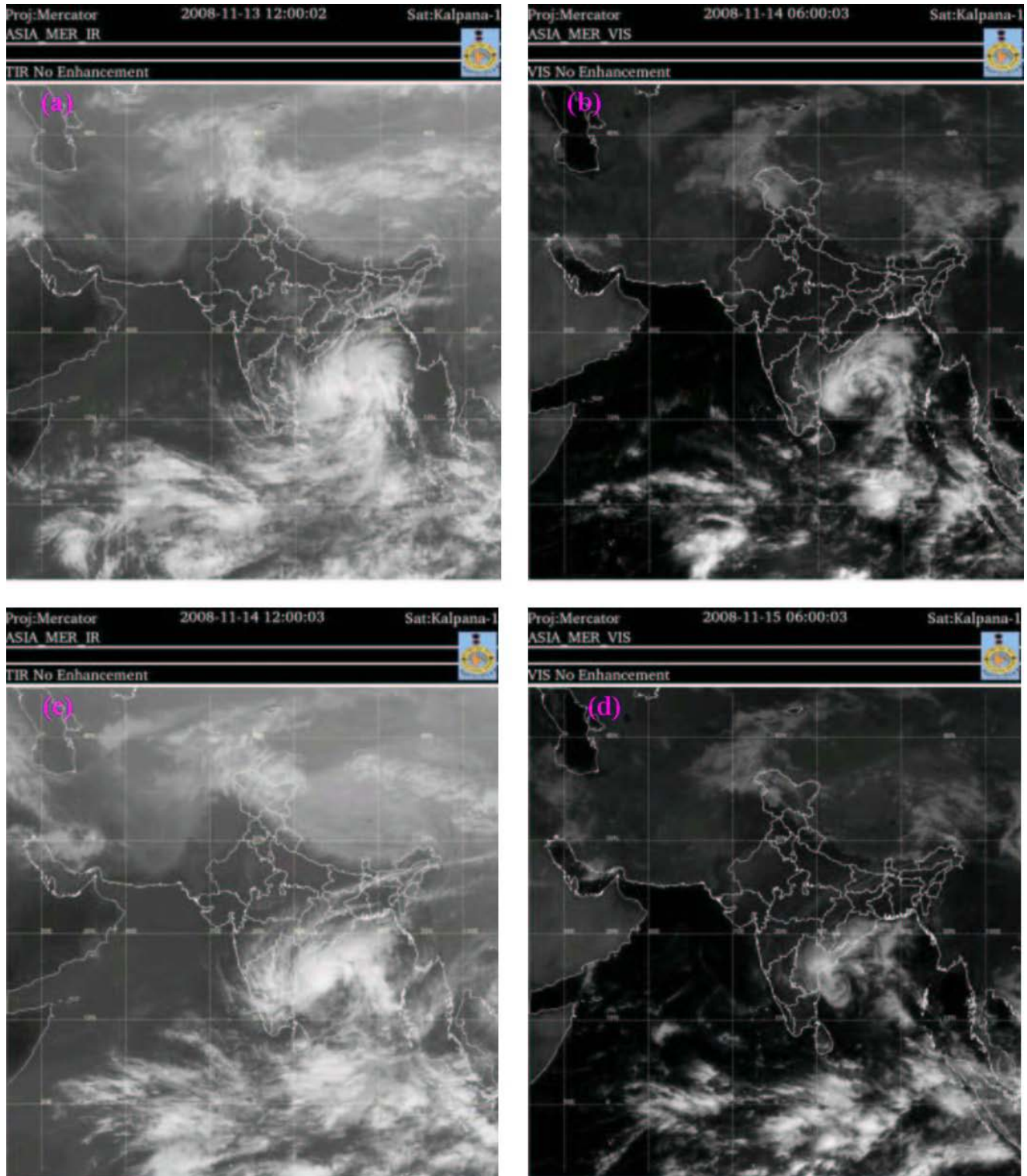


Fig. 5. Satellite imageries of cyclonic storm - Khai Muk

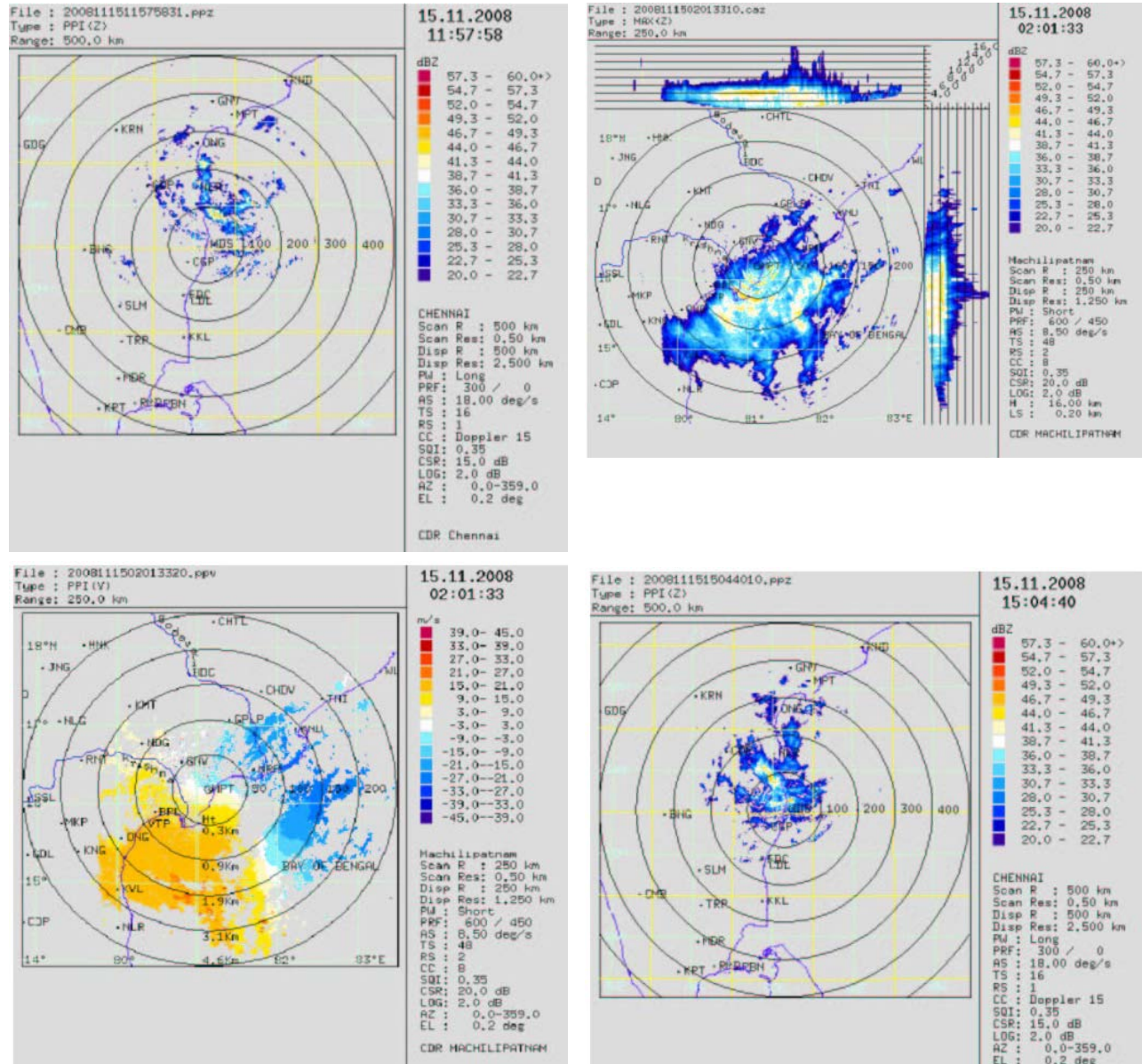


Fig. 6. Radar echos of Khai Muk (DWR Machilipatnam)

Some chief amounts of rainfall in cms are:

West Bengal

27 Oct : Canning Town 14, Haldia 9, Basirahat, Kolkata & Diamond Harbour 8 each, Krishnanagar 7.

Northeastern States

26 Oct : Sabroom & Dharmanagar 12 each, Agartala & Belonia 10 each, Kailashahar, Arundhatinagar & Gharmura 9 each, Silchar & Sonamara 8 each, Dholai 7.

27 Oct : Williamnagar 15, Shillong 11, Cherrapunji 10.

28 Oct : Cherrapunji 15, Basar & Bomdila 11 each, Melabazar 9, Shillong 8, Williamnagar, Goalpara, Manas & NH Xing 7 each.

According to media reports, the damage over the northeastern states are as follows :

The death toll in Meghalaya and Arunachal Pradesh was 5 and 8 respectively.

Incessant rains and winds uprooted electric poles in Shillong. Power supply was affected in many parts of Guwahati. Severe thundersquall and continuous heavy rain lashed vast areas of Tawang and Bomdila of west Arunachal Pradesh during the nights of 27 – 28. The road and other communication links were disrupted over these areas. It was reported that several road bridges were broken down and a number of dwelling houses were devastated besides many persons being injured by the devastating thunder squall.

It caused major damage in Bangladesh as well.

5.3. Cyclonic Storm (KHAI MUK) over the Bay of Bengal (13 – 16 November 2008)

5.3.1. Life cycle

A trough of low over the southeast Bay and neighbourhood organized into a low pressure area over there on 12 evening and became well marked over the southeast and adjoining southwest Bay on 13 morning. It concentrated into a Depression and lay centred at 1200 UTC of 13, near Lat. 11.5° N / Long. 85.5° E. Moving northnorthwestwards, it intensified into a Deep Depression and lay centred at 0300 UTC of 14, near Lat. 12.5° N / Long. 85.0° E, (about 550 km eastsoutheast of Nellore). Moving in a northwesterly direction it intensified into a Cyclonic Storm (Khai muk) and lay centred at 1200 UTC of 14, near Lat. 14.0°N / Long. 84.0° E (about 400 km southeast of Machilipatnam). Subsequently moving westnorthwestwards, it lay centred at 0300 UTC of 15, near Lat. 14.5°N/ Long. 82.5° E (about 230 km southeast of Machilipatnam). Then it remained practically stationary and weakened into a Deep Depression at 0600 UTC of 15. Further moving westwards, it lay centred at 1200 UTC of 15, near Lat. 14.5° N / Long. 81.5° E. It slowly moved westnorthwestwards and crossed south Andhra coast to the north of Kavali between 2200 & 2300 UTC of 15. Continuing the westnorthwest-ward movement, it weakened into a Depression and lay centred at 0300 UTC of 16, close to Nandyal (Lat. 15.5° N / Long. 78.5° E). It weakened into a: well marked low pressure area over Rayalaseema and neighbourhood in the afternoon; into a low pressure area over the same region in the evening of 16 and became less marked on 17. However, the associated upper air cyclonic circulation extending upto lower tropospheric levels lay over the eastcentral and adjoining southeast Arabian Sea off Karnataka-Goa coasts during 17-19.

5.3.2. Satellite cloud features and other observations

The maximum intensity of T 2.5 was reported from 1100 UTC of 14 to 0500 UTC of 15 (Fig. 5).

DWR Chennai

Neither 'EYE' nor any spiral band could be seen in the RADAR during the course of the system.

DWR Machilipatnam

The Doppler weather radar was in continuous operation and ten minutes radar observations of PPZ, PPV, SRI and VVP2 were obtained.

Most of the Radar observations did not show any clear spiral bands to fix the center. However, a Vortex (an ill defined eye) featuring Maximum Reflectivity of 54 dBZ, Maximum Velocity of 30 mps at 3.3 km height centered at 14.3° N / 81.2° E was observed with Very Poor confidence level (Fig. 6). Track of cyclone could not be drawn since centre could not be fixed confidently.

5.3.3. Other features observed

The lowest ECP was 994 hPa at 2100 UTC of 14. The maximum estimated wind speed was 40 kts. The lowest mean sea level pressure of 995.2 hpa was reported at Kavali at 2200 UTC of 15.

Surface observations (Machilipatnam)

Hourly surface observations were taken and transmitted w.e.f. 1200 UTC of 13 Nov 2008 to 0000 UTC of 16 Nov 2008.

The maximum surface wind observed was	(i)	N/28 kmph at 0900 UTC of 15 Nov 2008
	(ii)	N/28 kmph at 1200 UTC of 15 Nov 2008
	(iii)	NE/28 kmph at 1400 UTC of 15 Nov 2008
The lowest surface pressure observed was		1000.1 hPa at 1000 UTC of 15 Nov 2008
The Highest surface Pressure Fall (P24)observed was :		4.4 hPa at 0900 UTC of 15 Nov 2008

It's weakening into a Deep Depression while over the ocean is a peculiar feature of this system.

5.3.4. Weather and damage

Widespread rainfall activity with isolated heavy to very heavy falls occurred over coastal Andhra Pradesh on

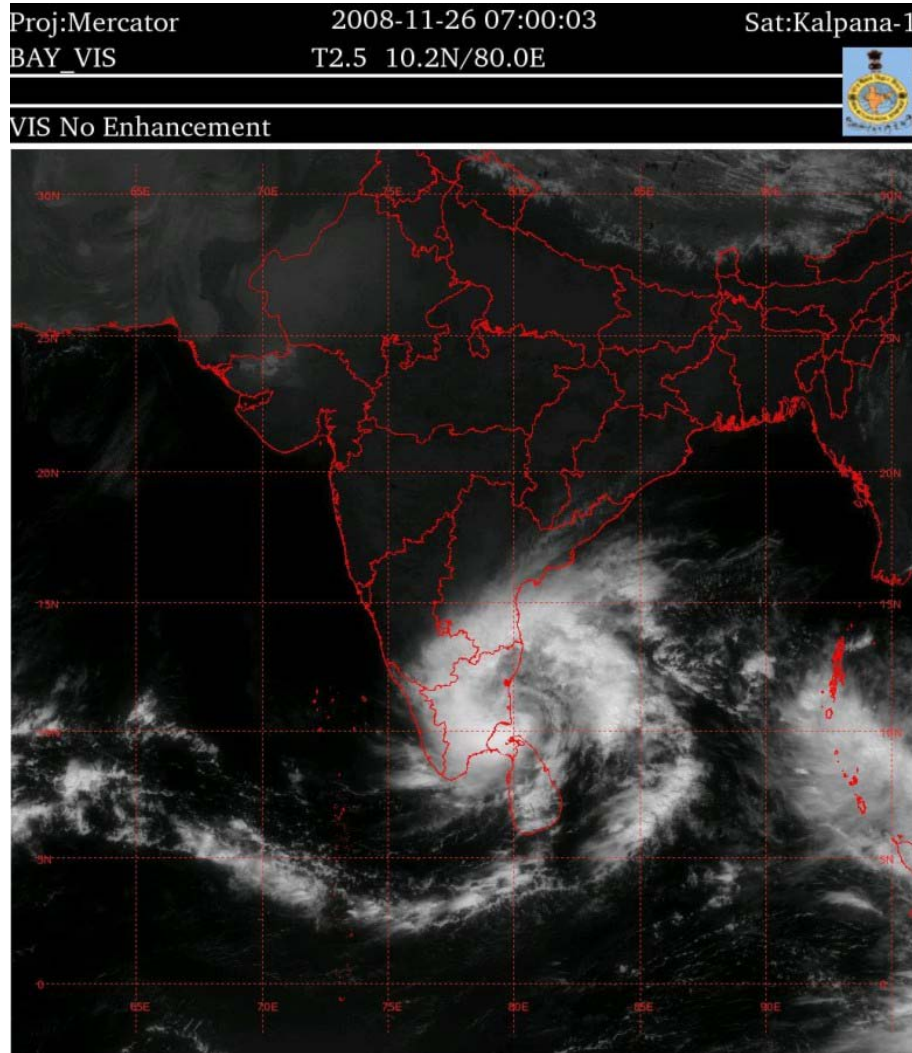


Fig. 7. Satellite imagery of Nisha 26 November 2008 0700 UTC, T2.5

16 and 17. Widespread rainfall activity also occurred over Rayalaseema on 16. Some chief amounts of rainfall (in cms) are:

Andhra Pradesh

16 Nov : Buntumilli & Kruthivenu 17 each, Machilipatnam 14, Seethampuram 13, Kaikalur 12, Narsapur, Kothapeta, Allavaram, Gannavaram, Sakinetipalli, Koduru, Movva, Gudivada, Mandavalli, Mudinapalli & Pamarru 11 each, Palkol, Penumanthra & Penuganta 10 each, Achanta, Palakoderu, Pedepapu, Avanigadda & Rapur 9 each, Udayagiri, Bhimavaram, Bhimadole, Dendulur, Undrajayavam, Iragavaram, Undi,

Akividu & Ravulupalem 8 each, Eluru, Tanuku, Repalle, Tpgudem, Gudur, Koyyalagudem, D. Tirumala, Ganapavaram, Pentapadu, Veeravasaram, K. P. Puram, Rajole, Malikipuram, Upplagutham & Ainaville 7 each.

17 Nov : Polavaram 23, Mogaltur 19, Pamarru 11, Kajuluru & Mummidibvaram 10 each, RC Puram, Eluru, Pedapadu, Bhimavaram, Kaikalur & Ambajipeta 9 each, Undi & Mandapeta 8 each, Kalla 7.

Damage : In Andhra Pradesh

(i) Major erosion of coast occurred at Uppada near Kakinada.

(ii) In many areas in East & West Godavari and Krishna districts, paddy fields got inundated.

(iii) Twenty Catamarans, twenty country boats and one boat washed off in the sea off Konapapeta in Kothapalli Mandal of East Godavari.

(iv) A big ship was carried away by the waves along the Wakalapudi beach near Kakinada of East Godavari districts.

(v) Many boats and fishing nets were swept off in the areas adjoining Wakadu, Alluru, Mypad, Gangapatnam in Nellore district.

(vi) A big old tree (100 years old) fallen down in Bhimavaram in West Godavari district.

Total loss estimated by state Govt.

(A) Krishna district

Population affected	4112
Number of cattle/live stock perished	26
Crop area affected	29287 hectares
Number of houses damaged (fully)	12
(partly)	12
Irrigation loss	11.70 lakhs
Electricity loss	157.24 lakhs
R&B loss	257 lakhs
Fisheries loss	21.77 lakhs

(B) Guntur district

Human Loss	1
Live stock perished	2 bulls
Houses damaged (fully)	6
(partly)	3

(C) Prakasam district

Agriculture Crop Area affected	50.80 hectares
Fisheries dept. loss	140.30 lakhs

(D) Visakhapatnam district

House damage	1
Fisheries dept. loss	Rs. 7,41,000/-

(E) East Godavari district

No. of Mandals affected	26
No. of Villages affected	124
No. of Fisheries affected	838
Houses fully damaged	237
Houses severely damaged	297
Agricultural Loss	Rs. 625.0 Lakhs
Loss to fishermen	Rs. 1.20 lakhs
Road damage	Kakinada to Uppada roads damaged (10 kms) and loss about Rs. 400 Lakhs

(F) West Godavari district

Paddy fields got inundated leading to crop loss.

(G) Nellore district

No. of Coastal Mandals affected	11
No. of villages affected	104
No. of persons affected	7509
No. of boats / nets damaged	846 boats
Estimated loss : boats	Rs. 171.07 lakhs
: Nets	Rs. 972.03 lakhs

5.4. Cyclonic Storm (NISHA) over the Bay of Bengal (25 – 27 November 2008)

5.4.1. Life cycle

A low pressure area formed over Sri Lanka and neighbourhood on 24. It became well marked on 24 evening. It concentrated into a Depression over Sri Lanka and neighbourhood at 0900 UTC of 25 near Lat. 8.5° N/ Long. 81.0° E. It further intensified into a Deep Depression at 1200 UTC on the same day near

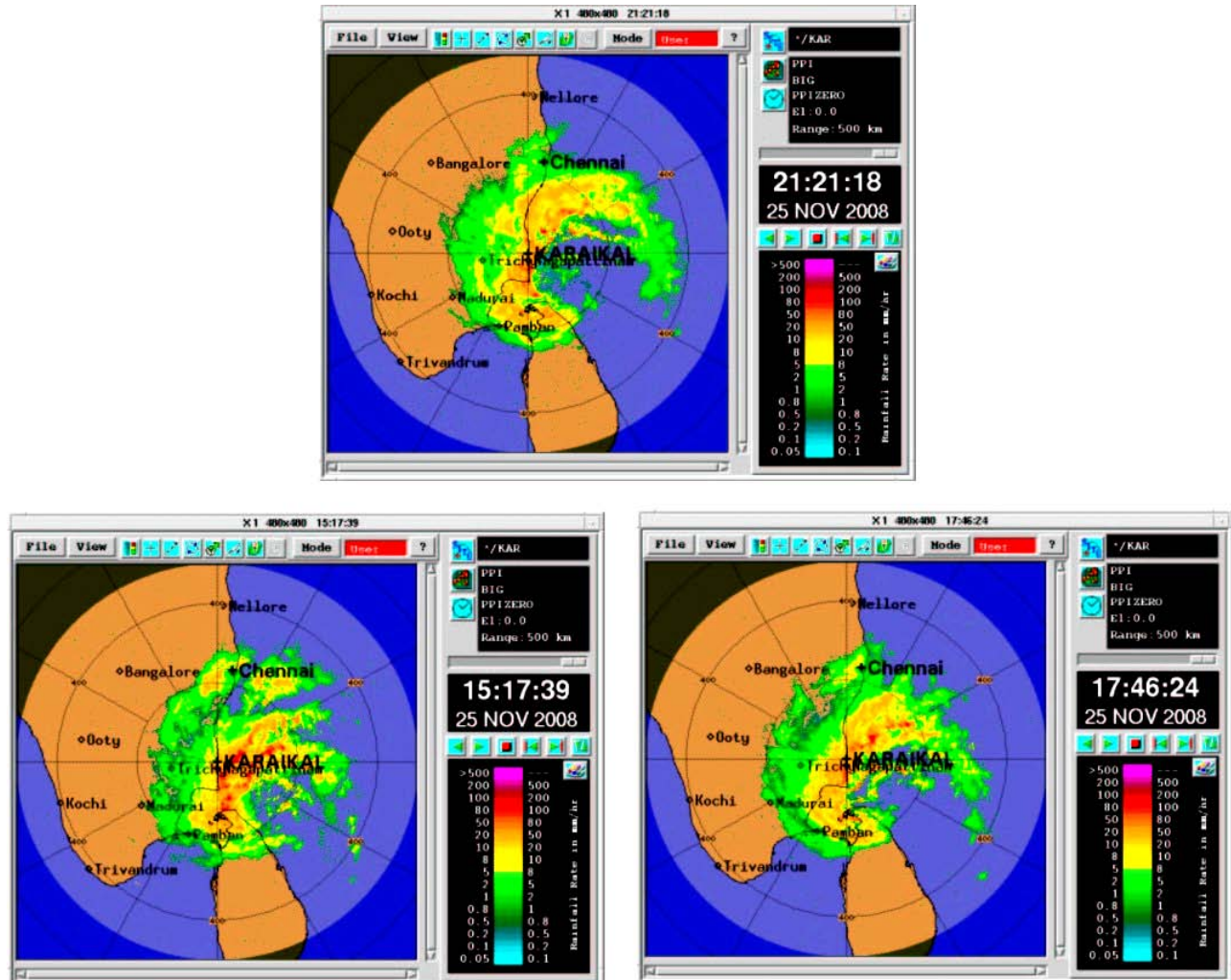


Fig. 8. Radar echos of Nisha (CDR Karaikal)

Lat. 8.5° N / Long. 81.0° E, about 200 kms southeast of Pamban. It further intensified into a Cyclonic Storm (NISHA) at 0300 UTC on 26 near Lat. 10.5° N / Long. 80.0° close to Vedaranyam and at 1200 UTC near Lat. 10.8° N / Long. 80.0° E. It crossed Tamil Nadu coast to the north of Karaikal between 0000 and 0100 UTC on 27 and lay centred 50 kms northwest of Karaikal (Lat. 11.3° N / Long. 79.8° E) at 0300 UTC on 27. It further weakened into a Deep Depression at 0900 UTC of 27 over coastal Tamil Nadu and lay centered near Lat. 12.0° N / Long. 79.0° E. Moving, westwards it further weakened into a Depression over interior Tamil Nadu and lay centered at 1200 UTC on 27 near Lat. 12.0° N / Long. 78.5° E. Moving northwestwards, it further weakened into a well marked low pressure area over North Interior Tamil Nadu and adjoining areas of south interior Karnataka and Rayalaseema in the early morning of 28. It moved

westnorthwestwards and lay as a feeble low pressure area over the Southeast Arabian Sea off Karnataka – Kerala coasts on 28 morning. A trough from this system extended upto west central Bay of Bengal across south Karnataka, Rayalaseema and south coastal Andhra Pradesh with an embedded cyclonic circulation extending upto mid-tropospheric level over south Interior Karnataka and neighbourhood. The feeble low pressure area lay as a low pressure area over southeast Arabian Sea and neighbourhood at 1200 UTC of 28 and the trough from this system extended to north Maharashtra across north Konkan-Goa and south Madhya Maharashtra. This low pressure area lay over eastcentral and adjoining southeast Arabian Sea off Karnataka coast and a trough from the low pressure area extended upto south Gujarat coast on 29 and 30 Nov. The low pressure area and the trough from the system became less marked on 1 December.

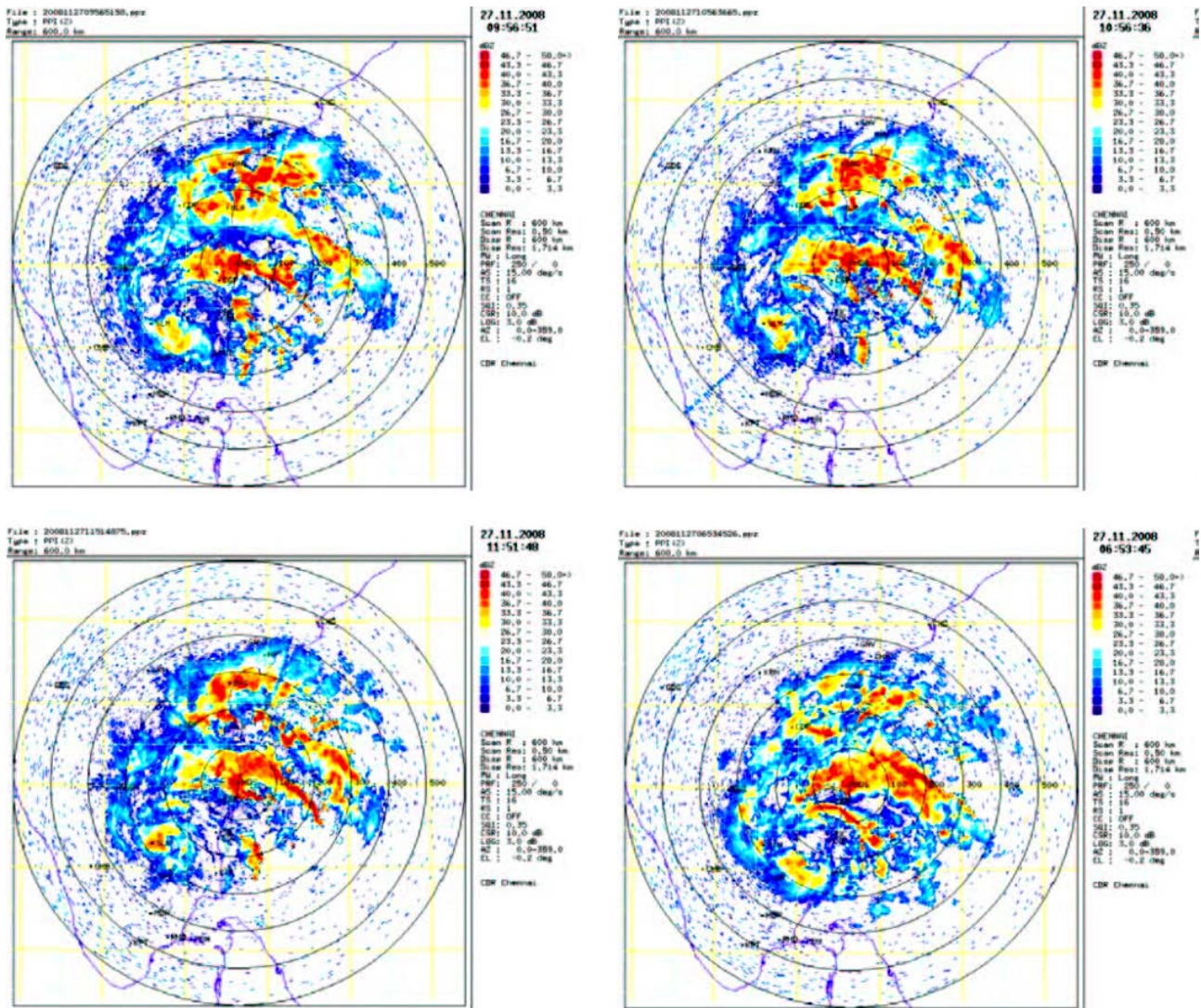


Fig. 9. Radar echos of Nisha (DWR Chennai)

5.4.2. Satellite cloud features and other observations

The maximum intensity of T 3.0 was reported by the satellite imageries from 0800 UTC to 1100 UTC of 26. The system attained the intensity of T 3.0 at 0800 UTC of 26 Nov, 2008 with centre 10.3° N / 79.9° E and crossed the coast near centre 10.5° N / 79.8° E with intensity T3.0. (Fig. 7).

CDR Karaikal

The Radar Observations were started at 0600 UTC of 25 and RAREPS were reported as broken clouds at

12-15 km. Three-hourly Radar Cloud imageries were reported to ACWC Chennai upto 0000 UTC of 26 November 2008. At 2100 UTC of 25 November, Spiral Bands were first noticed in the Radarscope and the System Centre was located at 10.4° N / 80.3° E. Spiral Bands were reported to ACWC Chennai upto 0000 UTC of 26 November. Hourly RAREPS were started at 0000 UTC of 26 to 0600 UTC of 27.

The first CYREP was reported at 0700 UTC of 26 at 10.8° N / 80.2° E. The system centre was reported at 0800 UTC of 26 at 10.8° N / 80.2° E. (Fig. 8).

The centres fixed by CDR Karaikal are:

<i>Date</i>	<i>Time (UTC)</i>	<i>Lat. (°N)</i>	<i>Long. (°E)</i>	<i>Features</i>	<i>Date</i>	<i>Time (UTC)</i>	<i>Lat. (°N)</i>	<i>Long. (°E)</i>	<i>AZ. Deg.</i>	<i>Range (km)</i>	<i>Confidence</i>
					27 Nov 2008	0500	11.55	79.60	204	185	Fair
26 Nov 2008	0900	10.8	80.1	Spiral	27 Nov 2008	0600	11.65	79.51	208	180	Fair
26 Nov 2008	1000	10.8	80.3	Spiral	27 Nov 2008	0700	11.77	79.31	216	180	Poor
26 Nov 2008	1100	10.8	80.2	Spiral	27 Nov 2008	0800	11.67	78.93	223	215	Poor
26 Nov 2008	1130	10.8	80.2	Spiral	27 Nov 2008	0900	12.0	79.0	230	185	Poor
26 Nov 2008	1200	10.9	80.3	Spiral	27 Nov 2008	1000	11.92	79.26	221	170	Poor
26 Nov 2008	1400	10.9	80.3	Spiral	27 Nov 2008	1100	11.62	78.69	227	237	Poor
26 Nov 2008	1500	-	80.3	Spiral	27 Nov 2008	1200	11.52	78.69	225	245	Fair
26 Nov 2008	1600	-	80.2	Spiral	27 Nov 2008	1300	11.48	78.52	227	262	Fair
26 Nov 2008	1700	-	80.3	Spiral							
26 Nov 2008	1800	10.9	80.2	Spiral							
26 Nov 2008	1000	10.8	80.3	Spiral							
26 Nov 2008	2000	10.9	79.9	Spiral							
26 Nov 2008	2100	10.9	79.8	Spiral							
26 Nov 2008	2200	10.9	79.8	Spiral							
26 Nov 2008	2300	10.9	79.8	Spiral							
26 Nov 2008	0000	11.0	79.7	Spiral							
26 Nov 2008	0100	11.4	79.8	Spiral							
26 Nov 2008	0300	11.5	79.6	Spiral							
26 Nov 2008	0400	11.5	79.5	Spiral							
26 Nov 2008	0500	11.6	79.6	Spiral							

DWR Chennai

Throughout its sea-track, the system features as seen by DWR Chennai were not sufficient to attempt centre-fixing. However after crossing the coast, as the system came closer to DWR Chennai, features grew prominent and thus could fix the centre, based on a few spiral bands and in some cases with partial eye-wall. Confidence from poor to fair only could be assigned. The centre fix was done from 0500 to 1300 UTC of 27.

Maximum velocity observed in the cyclone field was not associated with the eyewall region, but mostly associated with strong echoes in spiral bands. Maximum observed radial velocity was around 28mps. Maximum observed reflectivity was about 52 dBZ.

On a few occasions when "eye" in the form of Bounded Weak Echo Region (BWER) could be seen around the centre, the shape was irregular and reflectivities were much weaker than the spiral band values. (Fig. 9).

5.4.3. Other features observed

The lowest ECP was 996 hPa. The maximum estimated wind speed was 45 kts. The system moved in a northwesterly direction and skirted the Tamil Nadu coast from 1200 UTC of 26 to 0000 UTC of 27 and crossed Tamil Nadu coast, north of Karaikal, between 0000 and 0100 UTC of 27. Some of the salient features are (a) The cyclogenesis took place over the land region (north Srilanka) (b) the system remained quasi-stationary for about 24 hours, close to the coast, causing extremely heavy rainfall.

Post cyclone survey report : The extensive survey of the areas from Chennai to Vedaranyam and with the available information gathered from various coastal villagers and their weather experience on 26 and 27, the exact place of landfall could be located near Kaveripatinam (11° 54' N / 79° 31' E), close to Poombukhar, a Cauvery river outlet, about 12 km north of Karaikal. Local people around these areas experienced strong winds from north direction on 27 around 0500 hrs, suddenly wind became calm, lasting for nearly one hour, and then strong wind started to flow from southerly direction after 1 hour. Trees started falling by this time. The system came very close to Karaikal from Nagapattinam, remained stationary over the same position and then moved in the north- westerly direction along Karaikal coast and crossed this point.

From the post cyclone survey report, the maximum sustained winds associated with this system have been of the order of 50 to 60 kmph and in some isolated pockets reached upto 80 kmph. At CDR Karaikal, Heavy Wind Speed Recorder recorded the maximum wind of 63 kmph on 27 Nov 2008 at 0018 hrs UTC. The lull period lasted for a max of half an hour to one hour, suggesting that the eye diameter could be of the order of 30 to 40 kms range at the time of land fall. Radar pictures show that the system had circular-open eye. M. O. Nagapattinam which was close to the system recorded the lowest pressure of 994.3 hPa on 26 at 0900 UTC. On 27 after 0500 UTC it

started moving slowly along the coast in a north-westerly direction and the cyclonic eye crossed coast near Kaveripattinam 12 km north of Karaikal around between 0000-0100 hours UTC of 27 and moved through Virudhachalam areas weakening into a Depression and moved westerly direction after weakening into a low pressure area over Salem region on 27 (1200 UTC). No significant storm surge was reported in the coastal areas.

5.4.4. *Weather and damage*

Fairly widespread rainfall activity with very heavy falls to extremely heavy falls at scattered places occurred over Tamil Nadu from 25 to 29. Exceptionally heavy rainfall occurred over the districts of Cauvery Delta. Heavy to very heavy falls also occurred over Rayalaseema on 27 and 28 and over coastal Andhra Pradesh from 27 to 29.

Some chief amounts of rainfall (in cms) are:

Tamil Nadu

25 Nov : Thiruvudalmarthu 30, Tanjavur 25, Rameswaram 23, Orathanadu 19, Mayiladuthurai 17, Pamban 16, Viralimalai & Tirukattupalli 15 each, Tiruvaiyaru 14, Sirkali & Kollidam 13 each, Papanasam & Ramanathapuram 12 each, Kumbhakonam 11, Sethiyathope Anicut & Chidambaram 10 each, Kattumannarkoil, Tiruchirappalli, R.S. Mangalam & Vedaranniyam 9 each, Tarangambadi & Karaikal 8 each, Tondi, Adirampattinam, Cuddalore, Nagapattinam & Puducherry 7 each.

26 Nov : Orathanadu & Vedaranniyam 33 each, Chidambaram & Parangipettai 28 each, Thiruvudalmarthu & Myiladuthurai 26 each, Sirkali 25, Kattumannarkoil 23, Cuddalore 22, Sethiyathope Anicut & Kollidam 21 each, Tiruturaipundi & Nagapattinam 20 each, Karaikal 19, Tiruvarur, Kodavasal, Puducherry & Adirampattinam 18 each, Nannilam 17, Tanjavur 16, Valangiman, Kumbhakonam & Tarangambadi 15 each, Needamangalam 14, Rameswaram, Papanasam, Pattukottai, Mannargudi, Muthupet & Jayamkondam 13 each, Srimushnam 12, Meenambakkam 11, Anna University 10, Marina & Virudhachalam 9 each, Tambaram, Utteriramerul & Kancheepuram 8 each.

27 Nov : Orathanadu, Tanjavur, Vedaranniyam, & Adirampattinam 33 each, Muthupet 30, Prangipettai & Chidambaram 28 each, Kumbhakonam & Thiruvudaimaruthur & Mayiladuthurai 26 each, Mannargudi & Sirkali 25 each, Needamangalam 24, Pattukottai, Kattumannarkoil & Paruti 23 each, Valangiman 22, Sethiyathope & Kollidam 21 each, Thiruvudalmarthu & Thiruthuraipoondi 20 each, Tiruvaiyaru, Karaikal & Nagapattinam 19 each, Tirukattupalli 18, Kodavasal, Nannilam, Tiruvarur 17 each, Kumbhakonam 16, Valangaiman & Tarangambadi 15 each, Papanasam, Pattukottai, Mannargudi, Muthupet, Rameswaram, Jayamkondam 13 each, Srimushnam & Adirampattinam 12 each, Meenambakkam, Anna University, Cheyyur 11 each, Sriperumpudur & Tanjavur 10 each, Virudhachalam, Madukur & Karambakudi 9 each, Tambaram, Kanchipuram & Uthiramerur 8 each, Chengalpattu, Poonamalle, Korattur, Gingee, Vannur, Villupuram, Manamelkudi & Ariyalur 7 each.

28 Nov : Minambakkam 28, Anna University, Guind 23, Cuddalore & Kallakurichi 22 each, Puducherry 21, Tirutani & Tiruvallur 20 each, Thanjavur & Tiruchi town 18 each, Ariyalur, Pullambadi & Vellore 17 each, Pallipattu, Villupuram, Poonamallee, Muthupet & Poondi 16 each, Lalgudi, Chettykulam, Padallur, Red Hills & Tiruchirappalli 15 each, Tozhudur, Perumbalur, Parangipettai, Srimushnam, Tiruvaiyaru, Cholavaram, Ponneri & Vanur 14 each, Tambaram, Tirukkattupalli, Kodavasal, Gingee & Kanchipuram 13 each, Kollidam, Grand Anicut, Arni, Polur, Tirutani Vandavasi, Tindivanam & Sriperumpudur 12 each, Thiruvudalmarthu, Samayapuram, Ulundurpet & Marina 11 each, Tiruchi Town, Tiruvarur, Velagaiman, Vembavur, Kumbhakonam & Orathanadu 10 each, Nannilam 9, Papanasam 8, Sendamagalam 7 each.

29 Nov : Arakonam 25, Erode 19, Sriperumbudur 14, Attur 11.

Andhra Pradesh

- 27 Nov : Srikalahasti 16, Tirupati 14, Sullurpeta, Tada 12, Satyavedu 11, Puttur 10, Gudur 9.
- 28 Nov : Udayagiri 16, Vinjamur 15, Ongole, Puttur 14, Satyavedu, Tirupati & Rapur 13 each, Kavali, Atmakur, Venkatgiri & Chittur 12 each, Pakala, Sullurpeta & Gudur 11 each, Palamaner & Kaudukur 10 each, Nellore 9.
- 29 Nov : Rapur 18, Srisailam, Cumbum & Ongole 16 each, Udayagiri & Podili 15 each, Kandukur 13, Badvel 12, Macherla 11, Srikalahasti, Sattenpalli & Darsi 10 each, Kavali 7.

As per the Tamil Nadu Govt. Revenue website, loss of life was 100 over the state during 24 to 28 November due to drowning/ electrification/wall collapse/tree fallen etc. As per media reports, 8 lakhs acres of Paddy in Nagapattinam, Thanjavur and Tiruvarur (delta) districts and 55,250 hectares of Paddy in Cuddalore district were submerged due to heavy rain. The uprooted trees fallen across roads or on electric wires resulted in cut off power supply and disruption in road traffic.

The general public was of the opinion that “Nisha” is a friendly cyclone which brought copious rain to Tamil Nadu that will help to enhance agricultural activities, improve ground water level and also solve drinking water problem.

The top most revenue officials, Port officers, fishermen and agriculturists appreciated the department’s services.

As per the post Cyclone Survey report, the system did not generate any tidal waves. The damage due to the Gales was also less owing to heavy downpour.

In Andhra Pradesh, Chittur, Nellore and Prakasam districts of South Coastal Andhra Pradesh were affected by heavy rains / strong winds. As per News paper reports, 3.63 lakh hectares of crop were damaged due to heavy rains. The heavy rains led to floods in these districts.

5.5. Deep Depression over the Bay of Bengal (4-7 December, 2008)

5.5.1. Life cycle

A trough of low at sea level lay over the southeast Bay of Bengal and neighbourhood on 2 and 3. Under its

influence a low pressure area formed over the same area in the evening of 3. It concentrated into a Depression and lay centred at 0300 UTC of 4, near Lat. 6.5° N / Long. 90.0° E (about 1300 km southeast of Chennai). It moved northwestwards and lay centred at 1200 UTC of 4, near Lat. 7.0° N / Long. 89.5° E. Continuing the northwestward movement, it intensified into a Deep Depression at 0000 UTC of 5, near Lat. 7.5° N / Long. 88.5° E, remained practically stationary over there upto 0300 UTC and lay centred near Lat. 8.5° N / Long. 87.5° E at 1200 UTC. Thereafter, it moved westwards and lay centred at 0300 UTC of 6, near Lat. 8.5° N / Long. 85.0° E and at 1200 UTC, near Lat. 8.5° N / Long. 84.0° E. Subsequently it weakened into a Depression and lay centred at 0000 UTC of 7 near Lat 8.5° N / Long 83.0° E, at 0300 UTC, near Lat. 8.5° N / Long 82.5° E and at 1200 UTC, near Lat. 8.5° N / Long. 81.5° E (close to Trincomalee). Moving further westwards, it weakened into a well marked low pressure area over Sri Lanka and adjoining southwest Bay of Bengal at 1500 UTC of 7. It lay as a low pressure area over Sri Lanka and neighbourhood on 8 morning and lay over Sri Lanka and adjoining Commorin area in the evening. The low pressure area moved over to Commorin area and neighbourhood on 9 and lay over Lakshadweep – Maldives areas on 10.

5.5.2. Satellite cloud features

The system was mainly tracked by Satellite. The maximum intensity of T 2.0 was reported from 0300 UTC of 5 to 2300 UTC of 6.

5.5.3. Other features observed

The lowest ECP was 1004 hPa at 0000 UTC of 5. The maximum estimated wind speed was 30 kts. Due to interaction with land surface, the system weakened into a well marked low pressure area over Sri Lanka and adjoining southwest Bay of Bengal at 1500 UTC of 7.

5.5.4. Weather and damage caused

The system caused heavy rainfall at isolated places in Tamil Nadu.

Chief amounts of rainfall in cms are :

9 Dec : Puducherry 9, Nagapattinam 8.

No damage was reported due to this system over the country.