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551.515.1 (267) "2013"

# Cyclones and depressions over the north Indian Ocean during 2013*

## 1. Introduction

During 2013, in all 10 intense low pressure systems formed over the Indian Seas. These include; three Very Severe Cyclonic Storms (VSCS Phailin, Lehar and Madi), one Severe Cyclonic Storm (SCS Helen), one Cyclonic Storm (CS, Viyaru) and five Depressions/Deep Depressions. Out of these ten systems, eight systems formed over the Bay of Bengal, one each over Land and over the Arabian Sea. The Cyclonic Storm Viyaru and a Depression formed over the Bay of Bengal during the pre-monsoon season. Monsoon Season witnessed formation of two depressions one over Bay of Bengal and the other over Land. Post-monsoon season was cyclogenically active with successive formations of intense low pressure areas VSCS Phailin, Lehar and Madi, SCS Helen and a Depression over the Bay of Bengal and one Deep Depression over the Arabian Sea. There had been only two years viz., 1922 & 1966 in the recorded history during which intense low pressure systems reaching the intensity of SCS and above formed over Bay of Bengal during Post Monsoon Season.

The tracks/intensity of these systems is given in Fig. 1. A brief history and monthly distribution are given in Tables 1 & 2. The relevant ship and buoy observations are given in Table 3. Detailed season wise descriptions of these systems are given below:

## 2. Disturbances formed during the post-monsoon season (October - December)

### 2.1. *Cyclonic storm (Viyaru) over the Bay of Bengal ($10^{th}$ – $16^{th}$ May 2013)*

2.1.1. A low pressure area formed over southeast Bay of Bengal on $8^{th}$ May and became well marked on $10^{th}$. It concentrated into a Depression over the same area at 0900 UTC of $10^{th}$ near Lat. 5.0° N / Long. 92.0° E and intensified into a Deep Depression at 1200 UTC near Lat. 5.5° N / Long. 92.0° E. Moving northwestwards, it further intensified into Cyclonic Storm (Viyaru) and lay centered near Lat. 7.0° N / Long. 90.5° E, about 350 km southsouthwest of Car Nicobar at 0300 UTC of $11^{th}$ and near Lat. 8.0° N / Long. 89.5° E at 1200 UTC. Continuing its northwestward movement, it lay centered near Lat 10.0° N / Long. 87.5° E, about 600 km westsouthwest of Car Nicobar at 0300 UTC of $12^{th}$ & near Lat 10.5° N / Long. 87.0° E at 1200 UTC, near Lat 12.0° N / Long. 86.5° E, about 690 km southeast of Chennai at 0300 UTC of $13^{th}$ & near Lat. 12.0° N / Long. 86.0° E at 1200 UTC and near Lat. 13.5° N / Long. 85.5° E, about 600 km east of Chennai at 0300 UTC of $14^{th}$. It then re-curved northeastwards and lay centered near Lat. 14.5° N / Long. 86.0° E, about 460 km southeast of Visakhapatnam at 1200 UTC of $14^{th}$. Moving further north-northeastwards, it lay centered near Lat. 16.5° N / Long. 87.0° E, about 380 km east southeast of Visakhapatnam at 0300 UTC of $15^{th}$ and near Lat. 18.0° N / Long. 88.0° E at 1200 UTC. It moved further northeastwards and lay over west central Bay of Bengal near Lat. 21.0° N / Long. 90.0° E at 0300 UTC of $16^{th}$ about 240 km south southeast of Kolkata. Moving north northeastwards, it crossed Bangladesh coast between Chittagong and Feni near Lat. 22.8° N / Long. 91.4° E around 0800 UTC of $16^{th}$ and weakened into a Deep Depression over Mizoram at 1200 UTC of $16^{th}$ and lay centered near Lat. 24.0° N / Long. 92.5° E, about 35 km north of Aizwal. Continuing its northeastward movement, it further weakened into a Depression over Manipur at 1800 UTC of $16^{th}$ near Lat. 25.0° N / Long. 93.5° E, about 40 km west northwest of Imphal. It weakened into a well marked low pressure area over Nagaland and neighbourhood at 0000 UTC of $17^{th}$. It moved away towards Myanmar and became unimportant at 0300 UTC.

2.1.2. *Other features observed*

The lowest Estimated Central Pressure (ECP) was 990 hPa from 0600 UTC of $15^{th}$ to 0600 UTC of $16^{th}$. The maximum estimated mean wind speed was 45 kts during the same period. Patuakhali in Bangladesh recorded the lowest pressure of 990.2 hPa and wind speed of 50 kts at 0300 UTC of $16^{th}$ May. The system moved in a northwesterly direction initially, then northerly and finally in northeast direction and crossed Bangladesh coast between Chittagong and Feni near Lat. 22.8° N / Long. 91.4° E around 0800 UTC of $16^{th}$.

*Surface Wind* - Maximum surface wind of 92 kmph was reported over Patuakhali, Bangladesh during the time of landfall of Cyclonic Storm, VIYARU against the forecast wind speed of 75-85 kmph gusting to 95 kmph. Surface wind of 35-45 kmph prevailed over Mizoram, Manipur and Tripura against forecast of 55-65 kmph.

* *Compiled by* : Medha Khole and S. Sunitha Devi, Meteorological Office, Pune – 411 005, India.

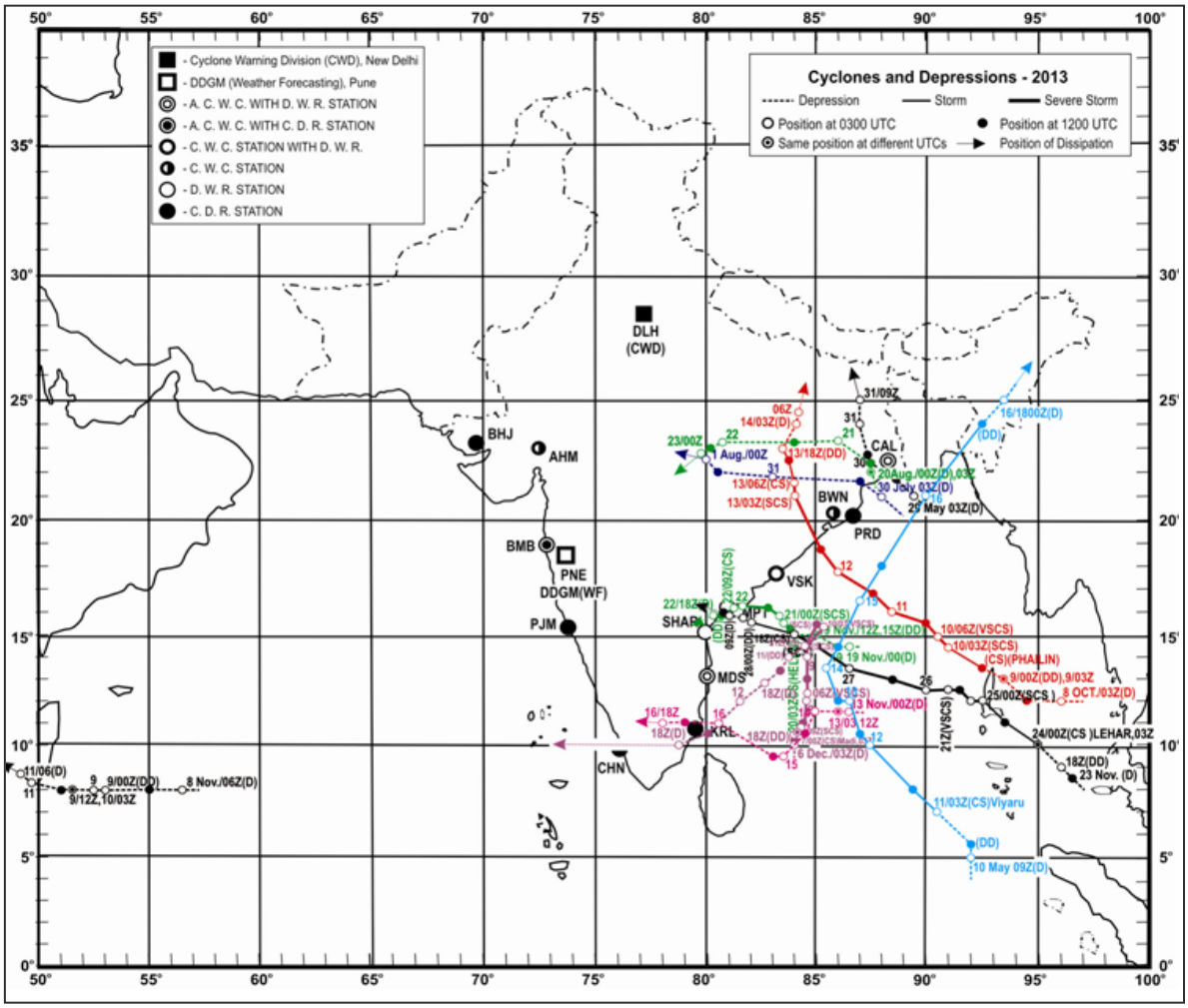


**Fig. 1.** Tracks of Cyclones and Depressions over North Indian Ocean during the year 2013

*Storm surge* - A storm surge of height of about 1 metre has been reported in section of media.

2.1.3. *Weather and damage caused*

Fairly widespread rainfall with isolated heavy rainfall occurred over Mizoram, Manipur and Tripura on 16th and 17th May and over Assam & Meghalaya on 17th and 18th May.

Chief amounts of rainfall are :

**16th May 2013**

Nagaland-Manipur-Mizoram-Tripura : Arundhutinagar 9, Agartala AP and Bishalgarh 8 each, Sonamura 7

**17th May 2013**

Nagaland-Manipur-Mizoram-Tripura : Kohima 7

Assam & Meghalaya : Cherrapunji (Rkm) 11, Cherrapunji 10, Jowai 7

**18th May 2013**

Assam & Meghalaya : Cherrapunji (Rkm) 23, Cherrapunji 20, Haflong 13

**TABLE 1**

**Brief Summary of cyclonic storms and depressions over the Indian seas and neighbourhood during 2013**

| S. No. | Category | Life period | Place / Time of landfall | Lowest estimated central Pressure (hPa) | Max. wind (Estimated/ observed) (kts) | Highest "T" No. |
|---|---|---|---|---|---|---|
| 1 | Cyclonic Storm (Viyaru) | 10 - 16 May | Bangladesh coast between Chittagong and Feni near Lat. 22.8° N / Long. 91.4° E around 0800 UTC of 16th May | 990 | 45 | 3.0 |
| 2 | Depression | 29 - 31 May | West Bengal coast near Lat. 21.8° N / Long. 88.7° E between 1330 & 1430 UTC of 29th May | 990 | 25 | 1.5 |
| 3 | Depression | 30 Jul - 1 Aug | North Odisha and adjoining West Bengal coast between Balasore and Digha around 0700 UTC of 30th July | 990 | 25 | 1.5 |
| 4 | Land Depression | 20 - 23 Aug | – | 990 | 25 | - |
| 5 | Very Severe Cyclonic Storm (Phailin) | 8 - 14 Oct | The system crossed Andaman & Nicobar Island, South of Portblair around 0000 UTC of 25 November. Odisha and adjoining north coastal Andhra Pradesh near Gopalpur (19.2° N / 84.9° E) around 1700 UTC of 1200 October | 940 | 115 | 6.0 |
| 6 | Deep Depression | 8 - 11 Nov | Somalia coast near Lat. 8.2° N and Long. 50.1° E between 2300 UTC of 1000 & 0000 UTC of 11 November | 1002 | 30 | 2.0 |
| 7 | Depression | 13 - 17 Nov | Tamil Nadu coast near Nagapattinam around 0730 UTC of 16 November | 1003 | 25 | 1.5 |
| 8 | SCS (Helen) | 19 - 23 Nov | Andhra Pradesh coast close to south of Machilipatnam near Lat. 16.1° N / Long. 81.2° E between 0800 & 0900 UTC of 22 November | 990 | 55 | 3.5 |
| 9 | VSCS (Lehar) | 23 - 28 Nov | The system crossed Andaman & Nicobar Island near Maya Bandar between 0700 – 0800 UTC of 9 October. Andhra Pradesh coast near Lat. 15.9° N / Long. 81.1° E, close to south of Machilipatnam around 0830 UTC of 28 November | 980 | 75 | 4.0 |
| 10 | VSCS (Madi) | 6 - 13 Dec | Tamil Nadu coast, close to Vedaranyam around 1300 UTC of 12, emerged into Palk Strait and then crossed Tondi around 1700 UTC of 12 | 986 | 65 | 4.0 |

**TABLE 2**

**Storms / depressions statistics 2013**

| Name of the system | Winter | Pre-monsoon | | | Monsoon | | | | Post-monsoon | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan –Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| **Over the Bay of Bengal** | | | | | | | | | | | | |
| Depressions/Deep Depressions | - | - | - | 1 | - | 1 | - | - | - | 1 | - | 3 |
| Cyclonic Storms | - | - | - | 1 | - | - | - | - | | - | - | 1 |
| Severe Cyclonic Storms | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| Very Severe Cyclonic Storms | - | - | - | - | - | - | - | - | 1 | 1 | 1 | 3 |
| Super Cyclonic Storms | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | - | - | - | - | - | - | - | - | - | | - | - |
| **Land Depression** | | | | | | | | | | | | |
| Depressions | - | - | - | - | - | - | 1 | - | - | - | - | 1 |
| **Over the Arabian Sea** | | | | | | | | | | | | |
| Depressions/Deep Depressions | - | - | - | - | - | - | - | - | - | 1 | - | 1 |
| Cyclonic Storms | - | - | - | - | - | - | - | - | - | - | - | - |
| Severe Cyclonic Storms | - | - | - | - | - | - | - | - | - | - | - | - |
| Very Severe Cyclonic Storms | - | - | - | - | - | - | - | - | - | - | - | - |
| Super Cyclonic Storms | - | - | - | - | - | - | - | - | - | - | - | |
| Grand Total | - | - | - | 2 | - | 1 | 1 | - | 1 | 4 | 1 | 10 |

**TABLE 3**

**Ships' Observations during 1st January to 31st December 2013**

| S. No. | Call Sign | Date and time of observation | Position of Ship Lat. °N / Long. °E |
|---|---|---|---|
| | | **I. Cyclonic Storm (Viyaru) over Bay of Bengal (10 – 16 May 2013)** | |
| 1. | A8VC4* | 101200 | 3.3/92.5 |
| 2. | DJAZZ* | 101200 | 6.3/92.8 |
| 3. | TBWUK52 | 110300 | 5.3/89.6 |
| 4. | A81Y8 | 111200 | 5.3/91.0 |
| 5. | WNDP | 121200 | 5.7/87.0 |
| 6. | VTST | 131200 | 8.0/86.0 |
| | | **II. Very Severe Cyclonic Storm (Phailin) over Bay of Bengal (08 – 14 October 2013)** | |
| 7. | A8UT7* | 081200 | 6.04/88.34 |
| | | **III. Severe Cyclonic Storm (Helen) over the Bay of Bengal (19 – 23 November 2013)** | |
| 8. | KAOU* | 190000 | 15.8/86.8 |
| 9. | KAOU* | 190300 | 16.0/87.0 |
| 10. | KAOU* | 191200 | 16.1/87.0 |
| 11. | KAOU* | 191500 | 16.0/86.9 |
| 12. | KAOU | 200300 | 16.0/86.9 |
| 16. | KAOU | 201200 | 16.0/86.9 |
| 14. | KAOU | 210000 | 16.0/86.9 |
| 15. | KAOU | 210300 | 16.2/86.7 |
| 16. | KAOU | 211200 | 16.2/87.0 |
| | | **IV. Very Severe Cyclonic Storm (Lehar) over Bay of Bengal (23 – 28 November 2013)** | |
| 17. | DDYL2* | 231200 | 5.8/96.5 |
| 18. | SHIP* | 231200 | 5.5/94.3 |
| 19. | LGWS | 240000 | 14.3/94.0 |
| 20. | SHIP | 240000 | 6.0/96.8 |
| 21. | LGWS | 240300 | 14.3/94.0 |
| 22. | LGWS | 241200 | 14.0/94.3 |
| 23. | LGWS | 250000 | 15.0/94.4 |
| 24. | LGWS | 251200 | 15.2/94.9 |
| 25. | LGWS | 252100 | 14.5/89.5 |
| | | **V. Very Severe Cyclonic Storm (Madi) over the Bay of Bengal (06 – 13 December 2013)** | |
| 26. | KAOU* | 060300 | 11.9/85.4 |
| 27. | KAOU* | 061200 | 11.0/86.4 |
| 28. | MCJL8* | 061200 | 6.0/85.0 |
| 29. | KAOU* | 061800 | 10.5/87.1 |
| 30. | MCJL8 | 070000 | 5.8/82.7 |
| 31. | A8CP6 | 070000 | 7.0/78.3 |
| 32. | KAOU | 070000 | 10.1/87.8 |
| 33. | SHIP | 080300 | 5.5/84.1 |
| 34. | KAOU | 080600 | 9.4/88.8 |
| 35. | KAOU | 081200 | 9.3/88.8 |
| 36. | KAOU | 090300 | 9.2/88.9 |

2.1.4. *Satellite and RADAR observations*

The system was tracked with the help of satellite (Kalpana–1) cloud imageries from 0300 UTC of 8 to 0800 UTC of 16th. The maximum intensity of T No 3.0 was reported from 0400 UTC of 15th to 0600 UTC of 16th.

The Cyclonic Storm, Viyaru was monitored mainly with satellite supported by meteorological buoys, coastal and island observations. It was monitored by Doppler Weather Radar (DWR), Kolkata, Agartala and Cox's Bazar (Bangladesh) on 16th May. The half hourly INSAT/ Kalpana imageries and every 10 minutes DWR imageries and products were used for monitoring of cyclonic storm.

2.2. *Depression over the Bay of Bengal (29th – 31st May 2013)*

2.2.1. *Under the influence of a cyclonic circulation over northwest Bay of Bengal off Odisha* - West Bengal coasts, a low pressure area formed over the North Bay of Bengal and neighbourhood. It concentrated into a Depression and lay centred near Lat. 21° N and Long. 89.5° E, about 200 kms southeast of Kolkata at 0300 UTC of 29th May. Moving north-northwestwards, it lay centred near Lat. 21.7° N and Long. 88.8° E, about 60 kms south-southeast of Canning at 1200 UTC of 29th and crossed West Bengal coast near Lat. 21.8° N and Long. 88.7° E (close to Canning) between 1330 & 1430 UTC on the same day. It further moved west-northwestwards and lay centred near Lat. 22.3° N and Long. 87.5° E, about 30 kms southeast of Midnapore at 0300 UTC and near Lat. 22.7° N and Long. 87.3° E, over Gangetic West Bengal about 30 kms north of Midnapore at 1200 UTC of 30th May. It further moved north-northwestwards and lay near Lat. 24.0° N and Long. 87.0° E, over Jharkhand and neighbourhood about 80 kms north of Bankura at 0300 UTC of 31st May and weakened into a well marked low pressure area over Bihar and adjoining Jharkhand in the same evening. It lay as a low pressure area over north Chhattisgarh and adjoining east Madhya Pradesh on 1st June and became less marked on 2nd June.

2.2.2. *Other features observed*

The lowest ECP was 990 hPa from 0300 UTC of 30th to 0300 UTC of 31st. The maximum estimated mean wind speed was 20 kts during the same period. The lowest observed pressure of 990.6 hPa was reported by Midnapore at 1200 UTC of 30th, when the system was to the north of Midnapore. The system moved in northwest to northnorthwesterly direction.

2.2.3. *Weather and damage caused*

Widespread rainfall activity with heavy to very heavy rainfall with isolated extremely heavy rainfall occurred over Gangetic West Bengal on 30th and 31st May. Fairly widespread to widespread rainfall activity with isolated heavy to very heavy rainfall occurred over: Sub-Himalayan West Bengal & Sikkim from 29th to 31st May; Jharkhand on 31st May and over Bihar on 31st May and 1st June. Heavy to very heavy rainfall also occurred in Odisha on 30th & 31st May.

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC of 30th May-1st June, 2013 are given below.

**29th May 2013**

| | |
|---|---|
| Sub-Himalayan W. B. & Sikkim | : Falakata 7 |

**30th May 2013**

| | |
|---|---|
| Sub-Himalayan W. B. & Sikkim | : Gajoldoba 13, Sevoke 11, Nagarkata 8, Bagrakote, Darjeeling, Champasari, Murti, Damthang and Namchi AWS 7 each |
| Gangetic West Bengal | : Contai 26, Sagar Island AWS 17, Kalaikunda 12, Kharagpur (I.I.T) 11, Kansabati Dam, Digha, Phulberia and Midnapore CWC 8 each, Midnapore, Tusuma, Kharidwar, Purihansa and Durgachak 7 each |
| Odisha | : Rajghat 12, Jamsolaghat and Dhamnagar ARG 11 each, Bangiriposi, Rairangpur, Baripada, Jaleswar and Samakhunta AWS 9 each, Soro, Basudevpur AWS, Pattamundai and Chandbali 8 each, Chandanpur, Jaipur, Chandipur AWS, Tihidi ARG, Udala, Nh5 Gobindpur, Paradip, Betanati ARG and Nilgiri 7 each |

**31st May 2013**

| | |
|---|---|
| Gangetic West Bengal | : Kansabati Dam 41, Tusuma 24, Purihansa 21, Phulberia and Kharidwar 19 each, D. P. Ghat 17, Simula 16, Midnapore and Mohanpur 13 each, Midnapore CWC 12, Bankura CWC 11, Bankura 10, Kharagpur (I.I.T) 8 |

| | |
|---|---|
| Sub-Himalayan West Bengal and Sikkim | : Darjeeling 17, Gajoldoba 11, Sukiapokhri and Sevoke 10 each, Bagrakote 8, Champasari and Damthang 7 each |
| Odisha | : Tiring 14, Rairangpur 12, Bangiriposi 10, Jhorigam ARG and Chandahandi ARG 8 each |
| Jharkhand | : Jamshedpur AP 13, Jamshedpur 11, Mohanpur 7 |
| Bihar | : Saraiya 17, Motihari 12, Jammu 10, Marsrakh, Patna AP, Vaishali, Gaya AP, Islampur, Chapra, Muzaffarpur and Hisua 9 each, Mahedi / Mehshi, Marhaura and Chakia 8 each, Sono 7 |

**1st June 2013**

| | |
|---|---|
| Bihar | : Jammu 12, Purnea and Katihar 9 each, Siswan 7 |

2.2.4. *Satellite and RADAR observations*

The maximum intensity of T 1.5 was reported from 0300 UTC to 1200 UTC of 29th.

2.3 *Depression over the Bay of Bengal (30th July – 1st August 2013)*

2.3.1. A low pressure area formed over northeast Bay of Bengal and adjoining Bangladesh and coastal areas of West Bengal on 29th and lay over North Bay of Bengal and adjoining Bangla Desh and Gangetic West Bengal on 30th evening. It concentrated into a Depression and lay centered near Lat. 21.0° N / Long. 88.0° E, over northwest Bay of Bengal about 180 kms eastsoutheast of Balasore at 0300 UTC of 30th July. It moved northwestwards and crossed Odisha coast between Balasore and Digha around 0700 UTC, remained practically stationary and lay centred over Odisha, close to Balasore (21.7/87.0) at 1200 UTC of 30th July. It moved westwards and lay over Chhattisgarh and adjoining Odisha, centred about 50 kms southeast of Champa (21.8/83.0) at 0300 UTC of 31st July; over east Madhya Pradesh and adjoining Chhattisgarh, about 50 kms south of Mandla (22.0/80.5) at 1200 UTC of 31st July 2013 and about 30 kms west of Mandla (22.5/80.0) at 0000 UTC of 1st August. It further moved westwards and weakened into a well marked low pressure area and lay over southeast Madhya Pradesh and neighbourhood on 1st August and lay as a low pressure area over west Madhya Pradesh and neighbourhood on 2nd. It lay over west Madhya Pradesh and adjoining east Rajasthan on 2nd evening and merged with the monsoon trough on 3rd.

2.3.2. *Other features observed*

The lowest ECP was 990 hPa from 0300 UTC to 1200 UTC of 30th. The maximum estimated mean wind speed was 25 kts. The lowest observed pressure of 990.0 hPa was reported by Mandla at 1200 UTC of 31st, when the system was to the south of Mandla. The system moved in a northwest to westerly direction and finally in a northwest direction.

2.3.3. *Weather and damage caused*

Active to vigorous monsoon conditions prevailed in - Gangetic West Bengal on 29th and 30th July; Odisha & Chhattisgarh on 30th -31st July; Telangana on 31st July and 1st August, west Madhya Pradesh from 31st July - 2nd August; Vidarbha from 31st July - 2nd August, Madhya Maharashtra 31st July - 3rd August, east Rajasthan on 1st August, Gujarat Region on 2nd -3rd August and Saurashtra & Kutch on 3rd August. Widespread rainfall with isolated extremely heavy rainfall occurred on 29th August in Gangetic West Bengal and on 1st August in west Madhya Pradesh, Madhya Maharashtra and Chhattisgarh. Fairly widespread to widespread rainfall activity with isolated heavy to very heavy rainfall occurred over: Odisha during 29th -31st July; Chhattisgarh on 30th -31st July, Telangana on 31st July - 1st August, west Madhya Pradesh during 29th July - 2nd August, east Madhya Pradesh on 1st August, Vidarbha on 31st July - 2nd August, Madhya Maharashtra 31st July - 3rd August, Marathwada on 1st August, east Rajasthan on 1st - 2nd August and Gujarat Region on 1st -3rd August. Heavy rainfall also occurred in west Rajasthan on 2nd -3rd August.

No damage was reported from Odisha.

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC of 29th July - 2nd August, 2013 are given below:

**29th July 2013**

| | |
|---|---|
| Gangetic West Bengal | : Midnapore CWC 25, Midnapore 24, Kharagpur (I.I.T) 23, Kalaikunda and Mohanpur 21 each, Baruipur AGRO – AWS 13, Phulberia 12, Kharidwar 11, Kansabati Dam 10, Diamond Harbour and D. P. Ghat 9 each, Tusuma, Harinkhola, Durgachak and Kolkata 8 each, Bashirhat 7 |

**30th July 2013**

Gangetic West Bengal : Baniband 9

Odisha : Chandanpur 17, Rairangpur 16, Hemgiri 15, Mandira Dam 14, Rajgangpur and Sundargarh 13 each, Bangiriposi 12, Jharsuguda AP, Joshipur, Laikera and Nawana 11 each, Ghatagaon, Kirmira ARG, Lakhanpur ARG, Bargaon and Tiring 10 each, Deogaon, Champua, Bamra ARG, Bijepur, Kuchinda and Pallahara 9 each, Kolabira ARG, Panposh, Talcher, Komna, Jhumpura and Tensa 8 each, Batagaon, Nawapara, Banki ARG, Jamsolaghat, Hindol, Altuma CWC, Khariar, Kankadahad ARG, Balisankara ARG and Jamankira 7 each

West Madhya Pradesh : Chanderi 11, Isagarh 9

Chhattisgarh : Raigarh 23, Sakti 14, Mahasamund 11, Rajim 9, Mana AP 7

**31st July 2013**

Odisha : Komna 19, Khariar 17, Jujumura ARG 16, Padampur, Bijepur, Raighar ARG and Titlagarh 13 each, Kesinga ARG 12, Boden ARG and Chandahandi ARG 11 each, Patnagarh, Sinapali ARG, Turekela and Sonepur 10 each, Batagaon, Salebhatta ARG, Pallahara and Junagarh 9 each, Banaigarh AWS, Gurundia ARG, Khaprakhol ARG, Ullunda ARG, Paikmal, Belgaon, Dunguripalli, Madanpur Rampur, Nawapara, Khairamal and Jhorigam ARG 8 each, Sohela, Laikera, Atabira ARG, Boudhgarh, Birmaharajpur ARG, Rajkishorenagar, Batli ARG, Ambabhona, Tarva ARG, Kirmira ARG, Kolabira ARG, Loisingha ARG and Saintala ARG 7 each

West Madhya pradesh : Ganjbasoda 16, Betul 10, Pachmarhi 9, Hoshangabad and Raisen 7 each

Madhya Maharashtra : Mahabaleshwar 14, Gaganbawada 9, Igatpuri 8, Vadgaon Maval and Gargoti / Bhudargad 7 each

Vidarbha : Bramhapuri, Desaiganj and Mulchera 19 each, Kurkheda, Armori, Arjuni Morgaon and Deori 18 each, Korchi 17, Nagbhir and Lakhandur 16 each, Pauni 15, Sakoli, Bhiwapur and Maregaon 14 each, Gadchiroli, Sadakarjuni, Saoli and Sindewahi 13 each, Chimur, Lakhani, Mul and Dhanora 11 each, Salekasa and Chamorshi 10 each, Etapalli, Chandrapur, Umrer, Bhandara and Bhamragad 9 each, Kuhi, Zarizamni, Hinganghat and Chikhalda 8 each, Korpana, Goregaon, Mauda, Ralegaon and Tirora 7 each

Chhattisgarh : Ambagarh Chowki 17, Bemetara 16, Simga and Dongargaon 15 each, Dhamtari 14, Raipur, Bijapur, Rajnandgaon and Arang 13 each, Dongargarh and Dondilohara 12 each, Balod 11, Gariabund 10, Rajim, Saraipali and Mana AP 9 each, Deobhog and Sarangarh 8 each, Durg 7

Telangana : Shriramsag and Pocha 8 each, Luxettipet, Sirpur and Bheemgal 7 each

**1st August 2013**

Odisha : Saintala (ARG) 7

Chhattisgarh : Bijapur 27, Bhopalpatnam 12, Sukma 7

Vidarbha : Armori 22, Desaiganj 21, Chikhalda and Dharni 17 each, Kurkheda, Gadchiroli and Saoli 14 each, Katol, Mahagaon and Wani 13 each, Arjuni Morgaon 12, Narkheda, Kamptee, Zarizamni, Umerkhed, Arni, Etapalli and Perseoni 11 each, Ballarpur, Chamorshi, Nagpur AP, Kalmeshwar, Sironcha and Saoner 10 each, Korpana, Lakhani, Joiti, Yeotmal, Rajura, Mangrulpir, Mul, Pandherikawara, Warora and Amraoti 9 each, Ahiri, Ner, Digras, Maregaon, Pombhurna, Manora, Chandrapur, Washim, Selu, Morsi and Bramhapuri 8 each, Risod, Paratwada, Akola, Anjangaon,

Karanjalad, Nandgaonkazi, Patur, Darwha, Ghatanji, Ramtek, Gondpipri, Chandur Rlwy, Umrer, Amgaon, Murtajapur, Bhadravati, Bhiwapur and Hinganghat 7 each

East Madhya Pradesh : Sausar 10

West Madhya Pradesh : Chicholi 28, Pachmarhi 25, Betul 21, Khandwa 20, Khaknar 19, Shajapur 17, Sarangpur and Khirkiya 15 each, Bhainsdehi, Sabalgarh and Alipur (Jaura) 14 each, Harda and Nusrulgunj 13 each, Susner 12, Tarana 11, Nepanagar and Pandhana 10 each, Bijaypur (Adp), Morena, Atner, Tonkhurd and Barwaha 9 each, Harsud, Karera and Kannod 8 each, Datia, Bhikangaon, Khategaon, Ashta, Kolaras, Multai, Maheshwar and Sonkatch 7 each

Telengana : Perur and Sirpur 13 each, Venkatapuram, Eturnagaram, Adilabad AP and Adilabad 12 each, Utnoor and Mulug 11 each, Parkal 10, Kaleswaram 9, Asifabad and Nirmal 8 each

Madhya Maharashtra : Mahabaleshwar 25, Gaganbawadam 10, Igatpuri, Chandgad, Ajra and Peint 7 each

Marathawada : Kinwat 8, Bhokar, Kallamnuri, Sengaon and Hingoli - Hyd 7 each

East Rajasthan : Dholpur Tehsil and Neemkathana 10 each, Tizara 9, Atru 8, Shahabad 7

Gujarat Region : Valsad and Daman 7 each

**2nd August 2013**

West Rajasthan : Pali and Rohat 9 each, Marwar Junction 7

East Rajasthan : Vallabhnagar 9, Dungarpur Tehsil and Kanva 7 each

West Madhya Pradesh : Badnagar and Ratlam 11 each, Mhow, Nalchha and Petlawad 10 each, Sardarpur and Dewas 9 each, Thandla, Jabot, Kasarwad and Jhabua 8 each, Badnawar, Khachrod and Bhabhra 7 each

Gujarat Region : Madhbun 19, Umergam 15, Silvassa and Idar 14 each, Sankheda and Dohad 13 each, Pardi and Daman 12 each, Surat 11, Rajpipala and Vapi 10 each, Tilakwada, Limkheda, Bodeli, Chhota Udepur and Kaprada 9 each, Bhiloda and Nanipalson 8 each, Naswadi, Jalalpor, Nandod, Navsari, Halol, Jetpur Pavi, Vijapur, Morva Hadaf and Choryasi 7 each

Madhya Maharashtra : Mahabaleshwar 17, Gaganbawada 14, Ozharkheda – FMO 9, Shahuwadi 7

Vidarbha : Lakhani and Deori 11 each, Mahagaon 10, Sakoli, Sadakarjuni and Washim 9 each, Digras, Arni and Malegaon 8 each, Joiti and Manora 7 each

Telangana : Adilabad 8

**3rd August 2013**

West Rajasthan : Sanchore and Raniwada 8 each

West Madhya Pradesh : Raisen 7

Gujarat Region : Tilakwada ARG 22, Tilakwada 21, Nandod 20, Prantij and Rajpipala 17 each, Kamrej 16, Dahegam 15, Gandhinagar and Umergam 14 each, Dholka, Talod, Viramgam ARG and Kathalal 13 each, Ghandinagar AWS 12, Olpad, Kalol (G) and Himatanagar 11 each, Dholka ARG and Songadh 10 each, Vyara, Valod and Padra 9 each, Surat, Navsari, Sankheda, Sinor, Bhabhar, Sanand, Surat AWS, Kaprada and Umerpada 8 each, Mahuva, Mangrol, Mahudha, Kalol ARG, Karjan, Bardoli ARG, Choryasi, Thasra, Ahmedabad, Jalalpor, Palsana, Wav, Dascroi, Khambhat and Bavla 7 each

Saurashtra & Kutch : Amreli 14, Jamnagar IAF 13, Liliya ARG 12, Gariadhar and Lilia 11 each, Palitana and Lathi 10 each, Lodhika, Jafrabad and Jafrabad ARG 9 each, Una, Talaja, Botad and Kodinar 8 each, Lodhika ARG, Gondal and Lalpur 7 each

Madhya Maharashtra : Mahabaleshwar and Ajra 9 each, Gaganbawada 8

2.3.4. *Satellite and RADAR observations*

The maximum intensity of T1.5 was reported from 0300 to 0600 UTC of 30th July.

2.3.5. *Action taken*

Action taken by ACWC Kolkata and CWC Bhubaneswar was timely and adequate.

2.4. *Land Depression over Gangetic West Bengal (20th - 23rd August 2013)*

2.4.1. Under the influence of a cyclonic circulation, a low pressure area formed over North Bay of Bengal and adjoining Gangetic West Bengal and Bangladesh coasts on 18th. It lay as a well marked low pressure area over northwest Bay of Bengal and adjoining coastal areas of West Bengal and Odisha on 19th morning and over Gangetic West Bengal and adjoining Odisha and Jharkhand in the same evening. It concentrated into a Depression over Gangetic West Bengal and adjoining northwest Bay of Bengal, north Odisha and Jharkhand and lay centred near Lat. 22.0° N and Long. 87.5° E, about 150 kms southeast of Jamshedpur at 0000 UTC of 20th August remained practically stationary at 0300 UTC and near Lat. 22.3° N and Long. 87.5° E at 1200 UTC of 20th August. Then it moved northwestwards and lay over Jharkhand and adjoining areas of Gangetic West Bengal and north Odisha centred near Lat. 23.3° N and Long. 86.0° E, about 60 kms southeast of Ranchi at 0300 UTC of 21st August. Moving westwards, it lay centred near Lat. 23.2° N and Long. 84.0° E at 1200 UTC of 21st over Jharkhand and adjoining north Chhattisgarh about 100 km east of Ambikapur. Continuing its westward movement, it lay centered near Lat. 23.2° N and Long. 80.7° E over east Madhya Pradesh, about 70 kms east-northeast of Jabalpur at 0300 UTC and near Lat. 23.0° N and Long. 80.1° E over east Madhya Pradesh, about 50 kms southeast of Jabalpur at 1200 UTC of 22nd. It moved west-southwestwards and lay centered near Lat. 22.8° N and Long. 79.8° E at 0000 UTC of 23rd August and weakened into a well marked low pressure area over central parts of south Madhya Pradesh and adjoining Vidarbha in the morning of 23rd and lay as a low pressure area over central parts of Madhya Pradesh in the same evening. It persisted there on 24th morning and lay over west Madhya Pradesh and adjoining east Rajasthan in the evening. It became less marked on 25th.

2.4.2. *Other features observed*

The lowest ECP was 990 hPa from 0000 UTC of 20th to 0000 UTC of 21st August. The maximum estimated mean wind speed was 25 kts.

2.4.3. *Weather and damage caused*

Active to vigorous monsoon conditions prevailed in Telangana during 16th -18th August, east Madhya Pradesh from 17th -23rd August, Chhattisgarh from 17th - 19th August, Marathwada on 18th August, Vidarbha 18th - 19th August, 21st & 23rd August, Gangetic West Bengal from 19th - 22nd August, Odisha on 18th & 20th August, Jharkhand from 20th -22nd August, west Madhya Pradesh from 20th - 24th August, Sub-Himalayan West Bengal & Sikkim on 21st August and Gujarat Region on 25th August.

Extremely heavy rain occurred on 23rd August in west Madhya Pradesh. Isolated /scattered heavy to very heavy rainfall occurred over: Odisha from 17th - 21st August, Jharkhand from 17th - 22nd August, West Madhya Pradesh from 17th - 26th August, east Madhya Pradesh and Chhattisgarh from 17th - 23rd August, Vidarbha from 17th - 19th August and 23rd & 24th August, Telangana on 17th - 18th August, east Rajasthan from 17th -22nd August and 24th & 25th August, Marathwada on 18th, Gangetic West Bengal from 19th - 21st August, Sub-Himalayan West Bengal & Sikkim on 21st and Gujarat Region on 24th & 25th August.

No damage was reported from Odisha.

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC of 17th August – 25th August, 2013 are given below:

**17th August 2013**

Odisha : Kalinga, Deogaon and Komna 8 each, Malkangiri and Jharsuguda AP 7 each

Jharkhand : Tilaiya 12, Koderma 9, Bishrampur 7

East Rajasthan : Alwar 8

West Madhya Pradesh : Gwalior 8

East Madhya Pradesh : Jabalpur 17, Hatta 10, Chahtarpur 9, Nainpur 8, Ghansore 7

Vidarbha : Kurkheda and Amgaon 8 each, Perseoni, Gadchiroli, Saoli and Mul 7 each

Chhattisgarh : Bhopalpatnam 13, Sukma 11, Arang, Dondilohara and Bijapur 9 each

Telangana : Suryapet 23, Miryalguda 13, Venkatapuram 9, Mahbubabad 8, Parkal 7

**18th August 2013**

Odisha : Tigiria ARG 12, Mandira Dam 11, Khandapara 10, Narsinghpur 9, Athgarh, Barkote and Kalinga 8 each, Balimundali, Rajgangpur, Jaipur, Athmalik, Bamra ARG, Junagarh and Angul 7 each

Jharkhand : Torpa 8

East Rajasthan : Sawai Madhopur, Sawaimadhopur Tesil and Baseri 7 each

West Madhya Pradesh : Datia 10

East Madhya Pradesh : Patan 17, Jabalpur 11, Nainpur and Ghansore 10 each

Marathwada : Nanded 8

Vidarbha : Sadakarjuni 10, Kurkheda 9, Lakhani 8, Desaiganj, Bramhapuri, Dhanora, Bhiwapur and Armori 7 each

Chhattisgarh : Pali 9, Bilaspur 7

Telangana : Mednoor 7

**19th August 2013**

Gangetic West Bengal : Diamond Harbour and Canning Town 13 each, Baruipur AGRO – AWS 11, Tamluk AWS 9, Durgachak, Mohanpur, Midnapore CWC, SagarIsland AWS and Midnapore 7 each

Odisha : Madanpur Rampur, Balasore and Balimundali 9 each, Baliguda and Chandbali 8 each, Saintala ARG, Betanati ARG, Tangi, Belgaon, NH5 Gobindpur, Dunguripalli, Odagaon ARG and Reamal 7 each

Jharkhand : Torpa 7

East Rajasthan : Kotkasim 14, Kishanganj 12, Baran 10, Atru 8, Pipalda, Baseri, Mangrol and Chaksu 7 each

West Madhya Pradesh : Alipur (Jaura) 20, Udaipura 17, Salwani / Silvani 10, Manasa 9, Datia and Bareli 8 each

East Madhya Pradesh : Jabalpur 17, Nainpur 16, Tendukheda 13, Mandla 11, Gadarwara, Khurai and Ghansore 9 each

Vidarbha : Sakoli 10, Sadakarjuni and Arjuni Morgaon 9 each

Chhattisgarh : Dongargaon and Dondilohara 9 each

**20th August 2013**

Gangetic West Bengal : Durgachak and Diamond Harbour 17 each, Jagatballarpur 15, Canning Town 11, Contai 10, Harinkhola, Baruipur AGRO - AWS, Kolkata and SagarIsland AWS 9 each, Tamluk AWS 8, Kalyani Smo, Kalaikunda and Jagatballavpur ARG 7 each

Odisha : Deogarh 22, Batagaon 20, Chandanpur 13, Rengali 12, Danagadi ARG, Rairangpur and Baripada 11 each, Jaleswar, Pallahara, Reamal and Jamsolaghat 10 each, Keongjhargarh, K Nuagaon ARG, Bangiriposi and Ghatagaon 9 each, Samakhunta AWS, Sundargarh, Tensa, Kuchinda, Joda ARG, Bargaon, Komna, Soro and Nawana 8 each, Nawapara, Bhograi, Joshipur, Tiring, Korei ARG, Udala, Baliguda, Rajghat and Kesinga ARG 7 each

Jharkhand : Ghatsila 10

East Rajasthan : Aklera 16, Bakani, Nadoti, Jhalawar, Jhalarapatan and Hindaun 11 each, Asnawar 10, Khanpur and Jhalawar AWS 9 each, Manohar Thana 8, Mandana, Ramganjmandi and Sangod 7 each

West Madhya Pradesh : Khilchipur 16, Rajgarh 15, Pachmarhi 12, Begumganj 10, Biaora 9, Sarangpur 7

East Madhya Pradesh : Sagar 15, Rehli 13, Khurai, Deori and Chahtarpur 7 each

Chhattisgarh : Baikunthpur 13

**21st August 2013**

Sub-Himalayan West Bengal & Sikkim : Barobhisha and Chepan 15 each, Alipurduar CWC 11, Kumargram 9, Falakata 7

Gangetic West Bengal : Tusuma 19, Purihansa 12, Kolkata, Phulberia, Barrackpur IAF, Shekhampore ARG and Canning Town 9 each, Baruipur AGRO - AWS and Kolkata AP 8 each, Simula, Kotshila ARG, Jagatballavpur ARG, Mohanpur and Suri CWC 7 each

Odisha : Baripada 16, Rairangpur 15, Jaleswar and Rajghat 13 each, Nawana 12, Betanati ARG 10, Jamsolaghat, Bangiriposi, Samakhunta AWS, Joshipur and Tensa 9 each, Kaptipada ARG, Chandanpur and Udala 8 each, Sundargarh, Balimundali, Paradip, Nilgiri, Deogarh and Balasore 7 each

Jharkhand : Messenjore 7

East Rajasthan : Shahabad 15, Govindgarh and Atru 13 each, Bakani and Todabhim 11 each, Asnawar 9, Mahwa 8, Manohar Thana, Alwar, Indergarh and Pirawa 7 each

West Madhya Pradesh : Pachmarhi 12, Biaora 11, Sarangpur 9, Shujalpur 8, Betul and Agar 7 each

East Madhya Pradesh : Damoh 16, Garhakota 8, Hatta, Kaneli and Sagar 7 each

**22nd August 2013**

Jharkhand : Papunki 13, Dumri 11, Bagodar I 10, Barkisuriya 9, Topchanchi 8, Japla 7

East Rajasthan : Sarmathura 9, Thanagazi 8, Dholpur Tehsil 7

West Madhya Pradesh : Nimach 15, Pachmarhi 13, Multai 9, Chicholi, Betul and Bhainsdehi 8 each, Karera, Agar, Ambah and Morena 7 each

East Madhya Pradesh : Damoh 19, Garhakota 14, Rehli 13, Ghansore and Patan 12 each, Maihar 11, Jabalpur, Kaneli and Katni 9 each, Bichhia and Rajnagar 8 each, Deori, Narsingpur, Sausar, Lakhnadon, Kotma, Dindori, Malanjkhand, Gotegaon and Hatta 7 each

Chhattisgarh : Manendragarh 12

**23rd August 2013**

West Madhya Pradesh : Pachmarhi 25, Betul 23, Chicholi 22, Multai 21, Bhainsdehi 18, Harda 16, Khategaon, Budhni and Raisen 13 each, Nusrulgunj and Bhopal 12 each, Hoshangabad 11, Atner, Ichhawar, Khirkiya and Vidisha 10 each, Ganjbasoda, Khaknar, Sehore and Ashta 9 each, Kannod, Tonkhurd and Khandwa 8 each, Harsud, Narsingarh, Biaora, Shujalpur and Kurwai 7 each

East Madhya Pradesh : Gadarwara and Seoni 12 each, Lakhnadon 10, Narsingpur 9, Sohagpur, Khurai and Panna 8 each, Chindwara and Ghansore 7 each

Vidarbha : Chikhalda 15, Narkheda 9, Warud 7

Chhattisgarh : Manendragarh 11

**24th August 2013**

East Rajasthan : Khushalgarh 10, Shergarh 9, Sallopat and Badesar 8 each, Bagidora, Arthuna, Sajjangarh and Danpur 7 each

West Madhya Pradesh : Gautampura 19, Depalpur 17, Dewas 16, Badnagar and Dhar 15 each, Bagli, Indore, Tonkhurd and Mhow 14 each, Nalchha and Sonkatch 13 each, Ujjain, Kasarwad, Maheshwar and Barwaha 11 each, Badnawar, Jhabua, Petlawad and Mahidpur 10 each, Khaknar, Thikri, Sardarpur, Sarangpur, Thandla and Susner 9 each, Khandwa, Bhikangaon, Khachrod, Shujalpur and Manawar 8

each, Gandhwani, Bhabhra, Ashta, Agar, Tarana, Shajapur, Khargaon and Kannod 7 each

Gujarat Region : Godhra, Dohad, Fatepura and Kalol 7 each

Vidarbha : Chikhalda 7

**25th August 2013**

East Rajasthan : Dug 9

Gujarat Region : Sankheda 10, Dohad, Jambughoda and Kalol 7 each

2.5. *Very Severe Cyclonic Storm (Phailin) over the Bay of Bengal (8th - 14th October 2013)*

2.5.1. Under the influence of a cyclonic circulation over Tenasserim coast and neighbourhood, a low pressure area formed over the same area on 7th. It concentrated into a Depression and lay centred at 0300 UTC of 8th near Lat. 12° N / Long. 96° E, over north Andaman Sea about 350 kms eastnortheast of Portblair. Moving westwards it lay centred near Lat. 12.0° N / Long. 94.5° E at 1200 UTC of 8th. It moved northwestwards and intensified into a Deep Depression and lay centred at 0000 UTC of 9th over north Andaman Sea near Lat. 13.0° N / Long. 93.5° E, about 50 kms east of Maya Bandar and remained practically stationary there at 0300 UTC of 9th. Subsequently moving west-northwestwards, it crossed Andaman Islands near Maya Bandar between 0700 & 0800 UTC of 9th. Then it moved northwestwards and further intensified into a Cyclonic Storm (Phailin) and lay centred at 1200 UTC of 9th, near Lat. 13.5° N / Long. 92.5° E, about 220 km north-northwest of Port Blair. The Cyclonic Storm (Phailin) moved westwards and intensified into a Severe Cyclonic Storm over east central Bay of Bengal and lay centred near Lat. 14.5° N and Long. 91.0° E, about 820 kms southeast of Paradip at 0300 UTC of 10th ; moved northwestwards and intensified into a Very Severe Cyclonic Storm at 0600 UTC of the same day and lay centred near Lat. 15.0° N and Long. 90.5° E. Continuing its northwestwards movement, the system intensified at each of the following hours between 1200 UTC of 10th to 12th and lay near; Lat. 15.5° N and Long. 90.0° E at 1200 UTC of 10th; Lat. 16.0° N and Long. 88.5° E, about 520 kms south-southeast of Paradip at 0300 UTC & Lat. 16.8° N and Long. 87.7° E at 1200 UTC of 11th; near Lat. 17.8° N and Long. 86.0° E, about 200 kms southeast of Gopalpur, at 0300 UTC & near Lat. 18.7° N / Long. 85.2° E at 1200 UTC of 12th. It further moved north-northwestwards and crossed Odisha and adjoining north coastal Andhra Pradesh coasts near Gopalpur (Lat. 19.2° N / Long. 84.9° E) around 1700 UTC of 12th. It continued to move north-northwestwards and weakened into a Severe Cyclonic Storm and lay over Odisha, near Lat. 21.0° N / Long. 84.0° E, about 50 kms south of Sambalpur at 0300 UTC of 13th. It moved north-nortwestwards and weakened into a Cyclonic Storm and lay over Odisha, near Lat. 21.5° N / Long. 84.0° E close to Jharsuguda at 0600 UTC of the same day. It moved northwards and weakened into a Deep Depression and lay over north Chhattisgarh and adjoining areas of Odisha and Jharkhand near Lat. 23.0° N / Long. 83.5° E, 70 kms north-northwest of Jharsuguda at 1800 UTC of 13th. Moving north-northeastwards it weakened into a Depression and lay over Jharkhand, centred near Lat. 24.0° N / Long. 84.1° E, about 25 kms southwest of Daltonganj at 0300 UTC of 14th. Further moving north-northeastwards it weakened into a well marked low pressure area and lay over southwest Bihar and neighbourhood at 0900 UTC of the same day and persisted there in the evening. It weakened into a low pressure area over the same region during the early morning and became less marked on 15th morning. However, the associated cyclonic circulation extending upto 3.1 kms a.s.l. lay over Bihar & neighbourhood on 15th and over Bihar and adjoining areas of Jharkhand and Gangetic West Bengal on 16th.

2.5.2. *Other features observed*

The lowest ECP was 940 hPa from 0300 UTC of 11th to 1500 UTC of 12th. The maximum estimated mean wind speed was 115 kts during the same period. The lowest observed pressure of 955.3 hPa was reported by Gopalpur at 1600 UTC of 12th, after that data was not available from it. Puri reported the maximum sustained wind speed of 120 kts from 2100 UTC of 12th to 0000 UTC of 13th. Puri and Gopalpur reported wind speed of the order of 100 kts from 1500 UTC of 12th.

*Post cyclone survey report by CWC Bhubaneswar* - The lowest pressure of 938 hPa was recorded by Gopalpur from 1645 UTC to 1715 UTC of 12th and the wind also remained calm during the period indicating the crossing of the cyclonic storm. Highest maximum wind speed of the order of 200-250 kmph (108-135 kts) from the southerly direction was estimated by the Gopalpur Port Authority on 12th. The tide height of 1.0 m above the maximum tide height was estimated by Gopalpur Light House.

*Post cyclone survey report by CWC Visakhapatnam* - The lowest pressure of 986.6 hPa was recorded at Visakhapatnam at 0950 UTC of 12th October. The estimated maximum wind speed was 150- 200 kmph or

more. The height of the sea wave reached to a maximum height of 3.5 meters at Donkuru. As per the report, the wind speed significantly increased from around 2000 UTC of 12th and started decreasing from the morning of the 13th.

2.5.3. *Weather and damage caused*

About 42 people died in Odisha. 80 lakh people were affected by the cyclone. fourteen thousand five hundred villages of 1900 grampanchayats in 99 blocks were affected. 39 urban local bodies have also been affected. Phailin damaged six lakh hectares of crop area. In Odisha, 8.73 lakh people were evacuated and in Andhra Pradesh, 1.35 lakh people had been evacuated. The storm destroyed around 26 lakh trees in Odisha. Incessant rains caused major rivers and tributaries to overflow, submerging more villages and leaving thousands stranded. The total loss to fisheries and shrimp sectors during the cyclone and torrential rain in the state was estimated to be around Rs 364 crore. Fish farmers in Balasore, Bhadrak, Ganjam, Jagatsinghpur, Jajpur and Kendrapada districts were the worst affected.

Two people died and thousands of people were displaced in Andhra Pradesh. Srikakulam was the major district hit by the system in north coastal Andhra Pradesh. There was huge loss of crops as Paddy, Coconut, Teak, Mango, Banana over twelve thousands hectare of land were damaged. Many houses were partly or fully damaged.

In West Bengal, 13 people died and about hundreds of houses damaged. In Andaman & Nicobar Isalnds damage to old thatched houses and huge loss of agriculture was reported.

In Bihar 24 people died due to heavy rainfall incidents. In Jhakhand, air and rail services was disrupted. Many trees were uprooted and kutcha houses collapsed. Water logging was reported from low lying areas. Widespread to fairly widespread rainfall occurred in Andaman & Nicobar Isalnds from 8th to 12th with isolated very heavy to extremely heavy rainfall during 8th -10th.

Monsoon was vigorous: in Telangana on 10th, Gangetic West Bengal from 13th -15th, over Odisha and Jharkhand on 13th -14th, Sub-Himalayan West Bengal & Sikkim and Bihar on 14th -15th, and active in coastal Andhra Pradesh on 10th and in Odisha on 12th. Heavy rainfall to very heavy rainfall at isolated places occurred in Odisha from 9th - 15th October with extremely heavy falls on 13th; Gangetic West Bengal from 13th - 15th; Jharkhand from 12th - 15th; Sub-Himalayan West Bengal & Sikkim and Bihar on 14th - 15th. Isolated heavy rainfall also occurred over coastal Andhra Pradesh on 10th and 13th and over Telangana on 10th and 11th.

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC from 8th to 15th October are given below:

**8th October 2013**

| | |
|---|---|
| Andaman & Nicobar Islands | : Maya Bandar 24, Port Blair 9, Long Islands 7 |

**9th October 2013**

| | |
|---|---|
| Andaman & Nicobar Islands | : Long Islands and Maya Bandar 34 each, Port Blair and Car Nicobar 7 each |

**10th October 2013**

| | |
|---|---|
| Andaman & Nicobar Islands | : Maya Bandar 16, Car Nicobar 10, Car Nicobar IAF 8 |
| Coastal Andhra Pradesh | : Vijaywada AP, Narsapur and Srungavarapukota 8 each, Gudivada and Koderu 7 each |
| Telangana | : Yellandu and Hyderabad 10 each, Aswaraopet AP and Hyderabad AP 9 each, Kothagudam 8, Dubak, Medchel / Manchal, Chevella, Madhira and Hakimpet 7 each |

**11th October 2013**

| | |
|---|---|
| Telangana | : Chinnoor and Kaleswaram 7 each |

**12th October 2013**

| | |
|---|---|
| Odisha | : Kujanga ARG and Jagatsinghpur AWS 9 each, Brahmagiri AWS, Korei ARG and Akhuapada 8 each, Soro, Dhamnagar ARG, Danagadi ARG, Kaptipada ARG, Puri, Alipingal and Raghunathpur ARG 7 each |
| Jharkhand | : Mohanpur 8, Ghatsila 7 |

**13th October 2013**

| | |
|---|---|
| Gangetic West Bengal | : Phulberia 7 |

| | |
|---|---|
| Odisha | : Banki ARG 38, Balimundali 31, Ranpur 30, Bangiriposi 28, Jaipur and Kalinga 26 each, Mundali 25, Nilgiri, Hindol and Kaptipada ARG 23 each, Soro and Odagaon ARG 21 each, Banpur, Nawana, Parjang ARG and Mohana 20 each, Kantamal, Korei ARG, R. Udaigiri, Nuagada ARG, Joda ARG and Danagadi ARG 19 each, Purushottampur and Nayagarh 18 each, Khandapara, Bhubaneshwar AP, Samakhunta AWS, Balipatna ARG, Bolagarh ARG, Daringibadi,Pallahara and Tikarpara 17 each, Daitari, Phiringia ARG and Tangi 16 each, Betanati ARG, Udala, Raikia ARG, Keongjhargarh, Nimpara, Chandikhol ARG, Basudevpur AWS, Tiring and Pattamundai 15 each, Rairangpur, Phulbani, K Nuagaon ARG, Jhumpura, Daspalla, Akhuapada, Baripada, Rambha AWS, Ghatagaon and Narsinghpur 14 each, Naraj, Dhenkanal, Nh5 Gobindpur, Tikabali, Thakurmunda, G Udayagiri AWS, Barmul, Kankadahad ARG and Narla ARG 13 each, Chandbali, Gania ARG, Bari ARG, Talcher, Lanjigarh, Puri, Athgarh and Dhamnagar ARG 12 each, Anandpur, Nischintakoili ARG, Angul, Batagaon, Balasore, Cuttack, Kendrapara, Derabis ARG, Jamsolaghat, Athmalik, Madanpur Rampur, Jujumura ARG, Rairakhol and Salepur ARG 11 each, Jenapur, Alipingal, Swam -Patna and Telkoi 10 each, Bhadrak AWS, Reamal, Kaniha ARG, Mahanga ARG, Rajkanika, Sukinda, Boudhgarh, Champua, Rajghat, Bhuban ARG, Niali ARG, Tirtol ARG, Joshipur, Tigiria ARG, Jaleswar, Baliguda, Binjharpur ARG and Jagatsinghpur AWS 9 each, Banarpal ARG, Kotagarh, Balikuda ARG, Bonth, Muniguda ARG, Tihidi ARG, Chendipada, Karanjia and Paradip 8 each, Altuma CWC, Bijepur, Kamakhyanagar, Harichandanpur ARG, Jajpur, Raghunathpur ARG, Belgaon, Kantapada ARG and Gurundia ARG 7 each |
| Jharkhand | : Chaibasa 20, Mandar 11, Dumri and Mohanpur 9 each, Sarath 8, Ranchi AP, Tenughat, Papunki, Ghatsila, Gumla, Hiranpur and Kharsema 7 each |
| Coatal Andhra Pradesh | : Itchapuram 20, Kanchili and Kaviti 15 each, Sompeta and Katobommali 11 each, Mandasa and Palasa 10 each, Santhabommali 9, Saravakota 8, Kalingapatnam and Vajrapukutturu 7 each |

**14th October 2013**

| | |
|---|---|
| Sub-Himalayan West Bengal & Sikkim | : Sukiapokhri 10, Ratua ARG 7 |
| Gangetic West Bengal | : Purihansa 18, Simula and Tusuma 15 each, Khariduar 13, Asansol CWC 12, Bankura CWC and Bankura 10 each, Phulberia, Bagati (Magra) and D, P. Ghat 9 each, Kolkata and Barrackpur IAF 8 each, Kansabati Dam, Krishnanagar and Mukutmonipur ARG 7 each |
| Odisha | : Korei ARG 16, Jamsolaghat 13, Bangiriposi, Tensa and Baripada 11 each, Samakhunta AWS 10, Balimundali, Thakurmunda, Jaipur, Chandikhol ARG and Salepur ARG 9 each, Nawana, Bonth and Karanjia 7 each |
| Jharkhand | : Godda 17, Sarath, Papunki and Barkisuriya 16 each, Tenughat, Chakradharpur, Gomia, Bokaro, Jamtara and Koderma 15 each, Tilaiya 14, Topchanchi and Panki 13 each, Mehgawan 12, Japla, Nandadih and Jarmindi 11 each, Deoghar, Putki, Hindgir, Jamshedpur AP, Panchet and Jamshedpur 10 each, Barhi, Chandil, Maithon, Pathargama and Hiranpur 9 each, Amrapara, Maheshpur, Dhanbad and Nimdih 8 each, Ramgarh, Pakur, Pakuria, Palkot, Hariharganj, Simdega, Daltonganj, Madhupur, Gobindpur and Moharo 7 each |

| | |
|---|---|
| Bihar | : Kodawanpur / C.Bii. 22, Bodh Gaya 17, Hasanpur 16, Udai Kishanganj and Gaya AP 15 each Jhajha, Rosera and Hayaghat 14 each, Banka, Monghyr, Garhi and Sahebpur Kanal 13 each, Arwal, Colgaon, Jamui, Baltara and Ekangersarai 12 each, Kinjar, Bhagalpur, Benibad, Samastipur and Purnea 11 each, Katihar, Basua, Araria, Kuratha, Sheikhpura, Sirmari B.Pur, Khagadia, Kamtaul, Manihari, Murliganj and Jhanjharpur 10 each, Rajauli, Bihar Shrif, Palmerganj, Jahanabad, Minapur, Sono, Rewaghat, Belsand, Dehri, Sripalpur, Vaishali, Koilwar and Islampur 9 each, Mahedi / Mehshi, Siswan, Bhimnagar, Makhdumpur, Barbigha, Sahebganj, Nirmali, Saraiya and Patna AP 8 each, Hisua, Madhwapur, Nawada, Gopalganj and Bairgania 7 each |
| East Uttar Pradesh | : Salempur 10, Zamania and Ghazipur CWC 8 each, Churk, Ballia, Mohammedabad (Y) and Ghazipur 7 each |
| Chhattisgarh | : Jashpurnagar 7 |

**15th October 2013**

| | |
|---|---|
| Sub-Himalayan West Bengal & Sikkim | : Gangarampur ARG 22, Darjeeling 18, Bagrakote 16, Champasari, Murti, Kalingpong, Pedong, Malda and Siliguri ARG 13 each, Jalpaiguri, Dinhata ARG, Gajoldoba and Namchi AWS 12 each, Domohani, Gangtok, Sevoke and Soreng ARG 11 each, Baghdogra AP and Damthang 10 each, Khanitar, Neora, Mekhliganj ARG, Mathabhanga and Singla Bazar 9 each, Tadong, Chepan, Nagarkata, Sukiapokhri and Gyalsing AWS 8 each, Cooch Behar and Pundibari AWS 7 each |
| Gangetic West Bengal | : Narayanpur 7 |
| Odisha | : Astaranga ARG 9 |
| Jharkhand | : Maheshpur 19, Pakur and Hiranpur 9 each, Mehgawan 8, Godda 7 |
| Bihar | : Katihar and Kursela 24 each, Purnea 23, Madhipura 17, Murliganj 16, Barahara and Chargharia 15 each, Udai Kishanganj and Bhagalpur 14 each, Colgaon 12, Araria and Manihari 11 each, Chanpatia 10, Phulparas 8, Koilwar, Ramnagar, Taibpur, Jainagar and Basua 7 each |
| East Uttar Pradesh | : Gorakhpur 10, Deoria 8, Khalilabad, Regoli, Deogaon Lalganj and Mukhlispur 7 each |

2.5.4. *Satellite and RADAR observations*

The observations from satellite and coastal observations including conventional observatories and Automatic Weather Stations (AWS) were used. The coastal surface observations were taken on hourly basis and the satellite imageries at every half hour were used for the monitoring of Phailin. The maximum intensity of T No 6.0 was reported from 0600 UTC of 11th to 1500 UTC of 12. Ragged EYE was seen when the system intensity was T3.5. EYE was reported from 0600 UTC of 10 to 0900 UTC of 12th.

DWR at Visakhapatnam continuously monitored the system from 0100 UTC of 12th when the system was about 310 km east-southeast of Visakhapatnam coast and continued till 1800 UTC of 12th. Every 10 minute DWR imageries, available microwave imageries and scatterometry products were used for monitoring of Phailin.

2.6. *Deep Depression over the Arabian Sea (8th - 11th November 2013)*

2.6.1. A cyclonic circulation extending upto 0.9 km a.s.l. lay over Lakshadweep area and neighbourhood on 2nd and lay as a trough of low at mean sea level from Lakshadweep-Maldives areas to east central Arabian Sea on 4th & 5th. It moved westwards and organised into a low pressure area over southeast Arabian Sea and adjoining Maldives area on 6th and lay as a well marked low pressure area over southeast Arabian Sea on the same evening. Moving westwards, it concentrated into a Depression and lay centred near Lat. 8.0° N and Long. 56.5° E at 0600 UTC of 8th and Lat. 8.0° N and Long. 55.0° E at 1200 UTC. Continuing its westward movement, it intensified into a Deep Depression and lay centred near Lat. 8.0° N and Long. 53.0° E at 0000 UTC of 9th. It then lay centered near Lat. 8.0° N and Long. 52.5° E, about 390 kms south southeast of Ras Binnah (Somalia) at 0300 UTC and near Lat. 8.0° N and Long. 51.5° E at 1200 UTC of 9th. It moved slowly westwards and lay centred within half a deg. of Lat. 8.0° N and Long. 51.0° E, about

350 kms south of Ras Binnah (Somalia) at 0300 UTC of 10th and remained practically stationary there at 1200 UTC. It then moved westnorthwestwards and crossed Somalia coast near Lat. 8.2° N and Long. 50.1°E between 2300 UTC of 10th and 0000 UTC 11th. It lay near Lat 8.4° N and Long. 49.6° E over coastal Somalia at 0300 UTC of 11th and weakened into a Depression near Lat 8.7° N and Long. 49.3° E at 0600 UTC. It further weakened into a well marked low pressure area over Somalia and neighbourhood on the same evening.

2.6.2. *Other features observed*

The lowest ECP was 1002 hPa from 0000 UTC of 9th to 0300 UTC of 11th. The maximum estimated mean wind speed was 30 kts during the same period. Maximum observed wind of 28 kts was recorded by Socotra Island at 1500 UTC of 9th and it was also reported by the two ships at 0000 UTC of 11th.

2.6.3. *Weather and damage caused*

As the system formed and moved away from the west coast, it did not cause any damage to the mainland of India.

2.6.4. *Satellite observations*

The maximum intensity of T No 2.0 was reported from 0000 UTC of 9th to 0000 UTC of 11th.

2.7. *Depression over the Bay of Bengal (13th -17th November 2013)*

2.7.1. A low pressure area lay over Tenasserim coast and neighbourhood on 8th. It lay as a well marked low pressure area over southeast Bay of Bengal and neighbourhood on 11th & 12th and concentrated into a Depression over southwest and adjoining southeast Bay of Bengal and lay centred near Lat. 11.5° N and Long. 86.5° E, about 700 kms east-southeast of Chennai at 0000 UTC of 13th. It lay centered near Lat. 11.5° N and Long. 86.0° E at 0300 UTC and lay centered near Lat. 11.5° N and Long. 86.0° E, about 650 kms east-southeast of Chennai, at 1200 UTC of 13th. Moving westwards it lay centred near Lat. 11.5° N and Long. 85.0°E, about 550 kms east-southeast of Chennai, at 0300 UTC of 14th. It moved southwestwards and lay centered near Lat. 10.5° N and Long. 84.5° E, about 650 kms southeast of Chennai at 1200 UTC of 14th. Continuing its southwestwards, it lay centred over southwest Bay of Bengal near Lat. 9.5° N and Long. 83.5° E, about 530 kms southeast of Chennai and 420 kms east-southeast of Nagapattinam at 0300 UTC of 15th. It moved westwards and lay centred nearLat. 9.5° N and Long. 83.0° E, about 490 kms southeast of Chennai at 1200 UTC of 15th. Subsequently moving west-northwestwards it lay centered over southwest Bay of Bengal near Lat. 11.0° N and Long. 80.5° E, about 75 kms east of Nagapattinam at 0300 UTC of 16th. The Depression continued to move westwards and crossed Tamil Nadu coast near Nagapattinam between 0700 and 0800 UTC 16th and lay centred over north Tamil Nadu near Lat. 11.0° N and Long. 79.0° E, about 40 kms north-northeast of Tiruchirapalli at 1200 UTC and near Lat. 11.0° N and Long. 78.0° E at 1800 UTC of 16th. It further moved west-northwestwards and weakened into a well marked low pressure area over north interior Tamil Nadu at 0000 UTC of 17th and lay as a low pressure area over Lakshadweep area and adjoining Kerala on 17th and became less marked on 18th.

2.7.2. *Other features observed*

The lowest ECP was 1003 hPa from 1200 UTC of 13th to 0600 UTC of 16th. The maximum estimated mean wind speed was 25 kts . The system moved in a westerly direction initially, then in a southwesterly direction and then northwesterly to westerly direction. The lowest observed pressure of 1003.7 hPa was reported by Karaikal at 0600 UTC of 16th. The maximum sustained wind speed of 28 kts was reported by the Ship KAOU at 0900 UTC of 13th.

2.7.3. *Weather and damage caused*

Northeast monsoon was vigorous in Kerala on 13th and in Tamil Nadu on 17th. Isolated heavy to very heavy falls occurred over Tamil Nadu on 13th, 14th, 16th, 17th and 19th, in Kerala on 13th, 15th, 18th & 19th and in south interior Karnataka on 17th.

In Tamil Nadu, 17 persons lost their lives, 6 in rain related incidents, 11 due to strong winds and heavy rain. About 40 houses were fully damaged and 150 houses were partially damaged. Thousands of trees uprooted, banana plantations damaged and around 2500 acres of salt field submerged.

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC from 13th to 19th are given below:

**13th November 2013**

Tamil Nadu : Colachel 10, Eraniel 9, Kanyakumari and Kalugumalai 8 each

Kerala : Thiruvananthapuram City & AP, Aryankavu 9 each, Nedumangad, Neyyantinkara, Kayamkulam and Piravom 8 each, Chengannur and Kurudamannil 7 each

**14th November 2013**

Tamil Nadu : Srivaikuntam 7

**15th November 2013**

Kerala : Kanjirappally 10, Piravom and Kurudamannil 8 each

**16th November 2013**

Tamil Nadu : Chidambaram AWS 7

**17th November 2013**

Coastal Andhra Pradesh : Tada 10, Atmakur and Shriharikota 7 each

Rayalaseema : Tirumalla 9

Tamil Nadu : Mayiladuthurai 22, Tiruchirapalli AP 14, Sathanur Dam, Vandavasi, and Chembarabakkam 13 each, Chennai AP, Tiruchirapalli Town and Poonamallee 12 each, Tiruvallur, Maduranthagam, Musiri, Gingee and Harur 11 each, Tindivanam, Upper anaicut, Puducherry, Tiruttani and Pullambadi 10 each, Uthangari, Poondi, Pochampalli, Mylam AWS, Dharmapuri PTO, Thiruvalangadu, Thogamalai, Lalgudi and Penucondapuram 9 each, Panchapatti, Chettikulam, Vembavur, Thuraiyur, Dharamapuri. Thuvakudi IMTI, Vanur, Kollidam, Chennai, Tozhudur, Samayapuram, Barur and Tiruvannamali 8 each, Anna University, Chengam, Perambalur, DGP Office, Jayamkondam, Thammampatty, Thathiengarpet, Virudhachalam, Padalur, Tirukoilar, Coonoor PTO, Pallipattu, Grand Anaicut, Ulunderpet, Alangayam, Palakkad, Sirkali, Chidambaram, Uthiramerur, Tramgambadi, Thiruvidaimaruthur 7 each

South Interior Karnataka : MM Hills 7

**18th October 2013**

Coastal Andhra Pradesh : Kavali and Nellore 7

Kerala : Vadakkancherry 7

Lakshadweep : Amini 7

**19th October 2013**

Tamil Nadu : Sankarapuram 10, Mayiladuthurai 8, Karaikal and Kodavasal 7 each

Kerala : Piravom 8

2.7.4. *Satellite and RADAR observations*

The system was tracked mainly by satellite, buoys and ship. The maximum intensity of T 1.5 was reported by the satellite from 0000 UTC of 13th to 0900 UTC of 16th.

DWR Chennai monitored the system from 0300 UTC of 16th till its landfall.

2.8. *Severe Cyclonic Storm (Helen) over the Bay of Bengal (19th-23rd November 2013)*

2.8.1. A trough at mean sea level lay over Andaman Sea on 17th. It organised into a low pressure area over southeast and adjoining central Bay of Bengal on 18th. It rapidly concentrated into a Depression over westcentral Bay of Bengal and lay centred near Lat. 14.5º N and Long 86.5º E, about 500 kms southeast of Vishakhapatnam at 0000 UTC of 19th. It moved westwards and lay centred near Lat.14.5° E and Long. 86.0° N, about 450 kms southeast of Vishakhapatnam at 0300 UTC of 19th and near Lat. 15.0° N and Long 85.0° E, about 350 kms south-southeast of Vishakhapatnam at 1200 UTC. It remained practically stationary, intensified into a Deep Depression and lay centred at 1500 UTC of 19th, near Lat. 15.0° N and Long 85.0° E. Then it moved westwards and intensified into Cyclonic Storm (Helen) and lay centred at 0300 UTC of 20th, near Lat.15.0° N and Long. 84.0° E, about 310 kms south-southeast of Vishakhapatnam. It further moved slightly northwestwards and lay centred near Lat. 15.3° N and Long. 83.9° E, about 280 kms south southeast of Vishakhapatnam at 1200 UTC of 20th. It moved west-northwestwards and intensified into a Severe Cyclonic Storm and lay centred near Lat. 15.6°N and Long. 83.5° E, about 230 kms south-southeast of Vishakhapatnam at 0000 UTC of 21st. Further moving northwestwards, it lay centred near Lat. 15.8° N and Long. 83.4° E, about 240 kms east-southeast of Machilipatnam, at 0300 UTC 21st. It moved slightly west-northwestwards and lay centred near Lat. 16.1° N and Long. 82. 9° E, about 180 kms east-southeast of Machilipatnam at 1200 UTC of 21st. It moved slightly westwards and lay centred near Lat. 16.2° N and Long. 81.7° E, about 25 kms south of Narsapur and 60 kms east

of Machilipatnam at 0300 UTC of 22nd and crossed Andhra Pradesh coast close to south of Machilipatnam near Lat. 16.1° N and Long 81. 2° E, between 0800 and 0900 UTC of 22nd. It moved west southwestwards and weakened into a Cyclonic Storm and lay centred near Lat. 16.1º N and Long 81. 2° E, at 0900 UTC of 22nd, further into a Deep Depression lay centred over the same area near Lat. 15.9° N and Long 80. 7° E, around 60 kms southwest of Machilipatnam at 1200 UTC of the same evening. It moved westwards, weakened into a Depression and lay centred over coastal Andhra Pradesh near Lat. 15. 9° N and Long 80. 4° E, close to Bapatla at 1800 UTC of 22nd. It further moved west southwestwards and weakened into a low pressure area over coastal Andhra Pradesh and neighbourhood at 0000 UTC of 23rd and became unimportant.

2.8.2. *Other features observed*

The lowest ECP was 990 hPa from 0600 UTC of 21st to 0600 UTC of 22nd. The maximum estimated wind speed was 55 kts during the same period. The system moved in a westerly to northwesterly direction and after crossing it moved in a southwesterly direction. The system weakened very rapidly after crossing Andhra Pradesh coast.

2.8.3. *Weather and damage caused*

Ten persons lost their lives. It caused extensive damage to paddy crops spread over 3.5 lakh hectares. In addition, horticulture plantations spread over 8,700 hectares, mostly coconut and banana plantations in East Godavari suffered damage. Coastal districts of East Godavari, West Godavari and Krishna bore the brunt of the heavy rains and gale winds. Helen brought extensive damage to Machilipatnam in Krishna district, with uprooted trees and electric lines. The total loss incurred by Krishna and West and East Godavari districts in the state of Andhra Pradesh due to the cyclone Helen was estimated to be Rs.1,628.73 crore.

Northeast Monsoon was vigorous in Coastal Andhra Pradesh on 23rd. Heavy to very heavy rainfall occurred at isolated places in Coastal Andhra Pradesh on 22nd and 23rd.

Rainfall amounts more than 7cm, recorded at 0300 UTC of respective dates are given below:

**18 November 2013**

Coastal Andhra Pradesh : Kavali and Nellore 7 each

**19th November 2013**

Tamil Nadu : Sankarapuram 10, Mayiladuthurai 8, Karaikal and Kodavasal 7 each

**21st November 2013**

Tamil Nadu : Colachel 12, Thuckalay 9, Eraniel 8

**22nd November 2013**

Coastal Andhra Pradesh : Visakhapatnam 11

Tamil Nadu Sivagiri 9

**23rd November 2013**

Coastal Andhra Pradesh : Gudivada 13, Vijaywada AP and Visakhapatnam AP 10 each, Machilipatnam DWR 9, Visakhapatnam 7

2.8.4. *Satellite and RADAR observations*

The maximum intensity of T 3.5 was reported from 0600 UTC of 23rd to 0000 UTC of 22nd.

The system was also tracked by DWR Machilipatnam from 1200 UTC of 20th till its landfall.

2.9. *Very Severe Cyclonic Storm (Lehar) over the Bay of Bengal (23rd -28th) November 2013*

2.9.1. A low pressure area lay over Sumatra coast and neighbourhood on 21st and lay as a well marked low pressure area over south Andaman Sea and neighbourhood on 23rd. It concentrated into a Depression and lay centred near Lat. 8.5° N and Long. 96.5° E, about 550 kms south-southeast of Port Blair at 1200 UTC of 23rd. It moved northwestwards, intensified into Deep Depression and lay centred near Lat. 9.0°N and Long. 96.0° E, about 470 km south-southeast of Port Blair at 1800 UTC of 23rd. It further moved northwestwards, intensified into a **Cyclonic** Storm (Lehar) and lay centred over Andaman Sea near Lat. 10.0° N and Long. 95.0° E, about 300 km south-southeast of Port Blair at 0000 UTC of 24th. It remained practically stationary over Andaman Sea at 0300 UTC and further moved west-northwestwards and lay centred near Lat. 11.0° N and Long. 93.5° E, about 120 kms east-southeast of Port Blair at 1200 UTC of 24th. It moved northwestwards and intensified into a Severe Cyclonic Storm, crossed Andaman & Nicobar Islands, close to Port

Blair in the early morning of 25th and lay centred over southeast Bay of Bengal near Lat. 12.0° N and Long. 92.5° E, close to Port Blair, 1300 kms east-southeast of Machilipatnam at 0000 UTC of 25th. It further moved west-northwestwards and lay centred near Lat. 12.0° N and Long. 92.0° E, about 80 kms west-northwest of Port Blair at 0300 UTC and near Lat. 12.5° N and Long. 91.5° E, about 200 kms west-northwest of Port Blair at 1200 UTC of 25th. It remained practically stationary and intensified into a Very Severe Cyclonic Storm at 2100 UTC of 25th. It moved westwards and lay centred over southeast Bay of Bengal near Lat. 12.5° N and Long. 90.0° E, about 300 kms west-northwest of Port Blair, at 0300 UTC of 26th. It moved west-northwestwards and lay centred over southeast and adjoining central Bay of Bengal near Lat. 13.0° N and Long. 88.5° E, about 480 kms west-northwest of Port Blair, at 1200 UTC of 26th. Continuing its west-northwestwards movement, it lay centred over west central and adjoining south Bay of Bengal near Lat. 13.5° N and Long. 86.5° E, about 600 kms east-southeast of Kakinada at 0300 UTC of 27th and weakened into a Severe Cyclonic Storm and lay centred over west central Bay of Bengal near Lat. 14.5° N and Long. 85.0° E, about 400 kms east-southeast of Kakinada at 1200 UTC of 27th. It moved west-northwestwards, weakened into a Cyclonic Storm and lay centred over the west central Bay of Bengal near Lat. 15.0° N and Long. 84.0° E at 1800 UTC of the same day. It further weakened into a Deep Depression and lay centred over the west central Bay of Bengal near Lat. 15.5° N and Long. 82.0° E at 0000 UTC and near Lat. 15.7° N and Long. 81.7° E, about 80 kms east-southeast of Machilipatnam at 0300 UTC of 28th. It crossed Andhra Pradesh coast near Lat. 15.9° N and Long. 81.1° E, close to south of Machilipatnam around 0830 UTC of the same day. It weakened into a Depression at 0900 UTC of 28th and lay centred over coastal Andhra Pradesh near Lat. 15.9° N and Long. 81.0° E and near Lat. 16.0° N and Long. 80.8° E, about 50 kms southwest of Machilipatnam at 1200 UTC on the same evening. It further weakened and lay as a well marked low pressure area over coastal Andhra Pradesh and adjoining Telangana at 1800 UTC of 28th and as a low pressure area over Telangana and neighbourhood on 29th November and became less marked on 30th November.

2.9.2. *Other features observed*

The lowest ECP was 980 hPa from 1800 UTC of 26th to 0300 UTC of 27th. The maximum estimated wind speed was 75 kts during the same period. It generally moved in a west northwesterly direction. Port Blair reported the lowest observed m.s.l. pressure of 995.9 hPa at 0000 UTC of 25th. The maximum wind speed of 92 kts was reported by Machilipatnam 0900 UTC of 27th.

2.9.3. *Weather and damage caused*

As per press/media reports, three persons died due to wall collapse on 25th due to rain in Tamil Nadu. As the system weakened before crossing, scattered to isolated rainfall occurred in coastal Andhra Pradesh during 28th Nov-3rd Dec and in Telangana and Rayalaseema on 29th and 30th. Isolated heavy rainfall occurred in coastal Andhra Pradesh on 29th. The amount in cm is given below.

**29th November 2013**

Coastal Andhra Pradesh : Macharla 7

2.9.4. *Satellite observations*

The maximum intensity of T 4.0 was reported based on satellite imageries from 0000 UTC of 26th to 0000 UTC of 27th.

2.10. *Very Severe Cyclonic Storm (Madi) over the Bay of Bengal (6th -13th) December 2013*

2.10.1. Under the influence of a trough of low at mean sea level, a low pressure area formed over southeast Bay of Bengal and neighbourhood on 1st December, became a well marked low pressure area over southwest Bay of Bengal and persisted there from 2nd to 5th. It concentrated into a Depression over the same area and lay centred within half a degree of Lat. 10.0°N and Long. 84.0° E, about 530 kms southeast of Chennai at 0300 UTC of 6th. It remained practically stationary over the same area and lay centred within half a degree of Lat. 10.2° N and Long. 84.0° E, about 530 kms southeast of Chennai at 1200 UTC of 6th. It further intensified into a Deep Depression and lay centred over the same region near Lat. 10.4° N and Long. 84.0° E, at 1800 UTC of 6th. It moved northwards and intensified into a Cyclonic Storm (MADI) and lay centred over southwest Bay of Bengal within half a degree of Lat. 10.5°N and Long. 84.1° E, about 500 kms southeast of Chennai at 0000 UTC of 7th. It remained practically stationary and lay centred within half a degree of Lat. 10.5° N and Long. 84.1° E, at 0300 UTC of the 7th. It intensified into a Severe Cyclonic Storm and lay centred over the same region within half a degree of Lat. 10.8° N and Long. 84.3° E, at 0900 UTC of the 7th. It moved northeastwards and lay centred near Lat. 11.0°N and Long. 84.4° E, about 520 kms east-southeast of Chennai at 1200 UTC of the same evening. It further moved northwards and lay centred over southwest and adjoining west central Bay of Bengal near Lat. 12.0° N and Long. 84.6° E, about 490 kms east-southeast of Chennai at 0300

UTC of the 8th. It further moved slightly north-northeastwards and intensified into Very Severe Cyclonic Storm and lay centred over the same area within half a degree of Lat. 12.3° N and Long. 84.7° E, at 0600 UTC of 8th. It moved slightly northwards and lay centred over the same area near Lat. 13.0° N and Long. 84.7° E, about 490 kms east-southeast of Chennai at 1200 UTC of 8th. Continuing its northward movement, it lay centred over west central and adjoining southwest Bay of Bengal near Lat. 14.0° N and Long. 84.7° E, about 500 kms east-northeast of Chennai at 0300 UTC and weakened into a Severe Cyclonic Storm near Lat. 14.6° N and Long. 84.7° E, about 520 kms east-northeast of Chennai at 1200 UTC of 9th. It intensified again into Very Severe Cyclonic Storm while moving northeastwards and lay centred near Lat. 15.3° N and Long. 85.3° E, about 600 kms east-northeast of Chennai at 0300 UTC and weakened into Severe Cyclonic Storm near Lat. 15.4°N and Long. 85.0°E at 1200 UTC of 10th. It further moved southwestwards, weakened into a Cyclonic Storm near Lat. 14.6°N and Long. 84.6° E, 500 kms northeast of Chennai at 2100 UTC of 10th. It further moved southwestwards and weakened into a Deep Depression and lay centred, over west central Bay of Bengal, near Lat. 14.0° N and Long. 83.8°E, 400 kms east northeast of Chennai at 0300 UTC and near Lat. 13.3° N / Long. 83.3° E at 1200 UTC of 11th. Continuing its southwestwards movement, it weakened into a Depression and lay centred over southwest Bay of Bengal, near Lat. 12.9° N /Long. 82.7° E at 1800 UTC of 11th. Further moving southwestwards, it lay over southwest Bay of Bengal off north Tamil Nadu coast near Lat. 12.0°N / Long. 81.5° E at 0300 UTC and near Lat. 10.5° N / Long. 80.0° E at 1200 UTC of 12th. It further moved west southwestwards and crossed Tamil Nadu coast, close to Vedaranyam around 1300 UTC of 12th, emerged into Palk Strait at 1500 UTC, moved west southwestwards and crossed again Tamil Nadu coast, near Tondi around 1700 UTC and lay centred near Lat. 10.0° N / Long. 78.8° E, about 50 kms east-northeast of Madurai at 1800 UTC of 12th. It moved westwards, weakened into a well marked low pressure area over southeast Arabian Sea and adjoining Kerala at 0000 UTC and lay as a low pressure area over Lakshadweep area and neighbourhood at 0300 UTC of of 13th. It persisted there on 14th and became less marked on 15th. Associated cyclonic circulation extending upto lower troposhperic levels persisted over southeast Arabian Sea on 15th and moved away westwards subsequently.

2.10.2. *Other features observed*

The lowest ECP was 986 hPa from 0600 UTC of 8th to 0900 UTC of 9th. The maximum estimated mean wind speed was 65 kts during the same period. The system moved initially in northerly direction, then made a loop and finally moved in a west southwesterly direction and crossed Tamil Nadu coast. Maximum observed wind of 49 kts was reported by a buoy at 1800 UTC 8th.

2.10.3. *Weather and damage caused*

Northeast monsoon was vigorous with isolated heavy rainfall on 13th in Tamil Nadu. Isolated to scattered rainfall occurred in Tamil Nadu (except on 13th) and Kerala from 13th to 16th.

The rainfall amounts more than 7cm reported at 0300 UTC are given below.

**13th December 2013**

Tamil Nadu : Colachel, Kaynakumari, Kallakurichi Tindivanam and Cheyyur 11 each, Puducherry 10, Ulundurpet and Virudhunagar 9 each, Attur 8, Madurai AP, Tirumangalam and Vilupuram 7 each

2.10.4. *Satellite and RADAR observations*

The maximum intensity of T 4.0 was reported from 0600 UTC of 8th to 0900 UTC of 9th and from 0300 UTC to 0900 UTC of 10th. The system was also tracked by DWR.