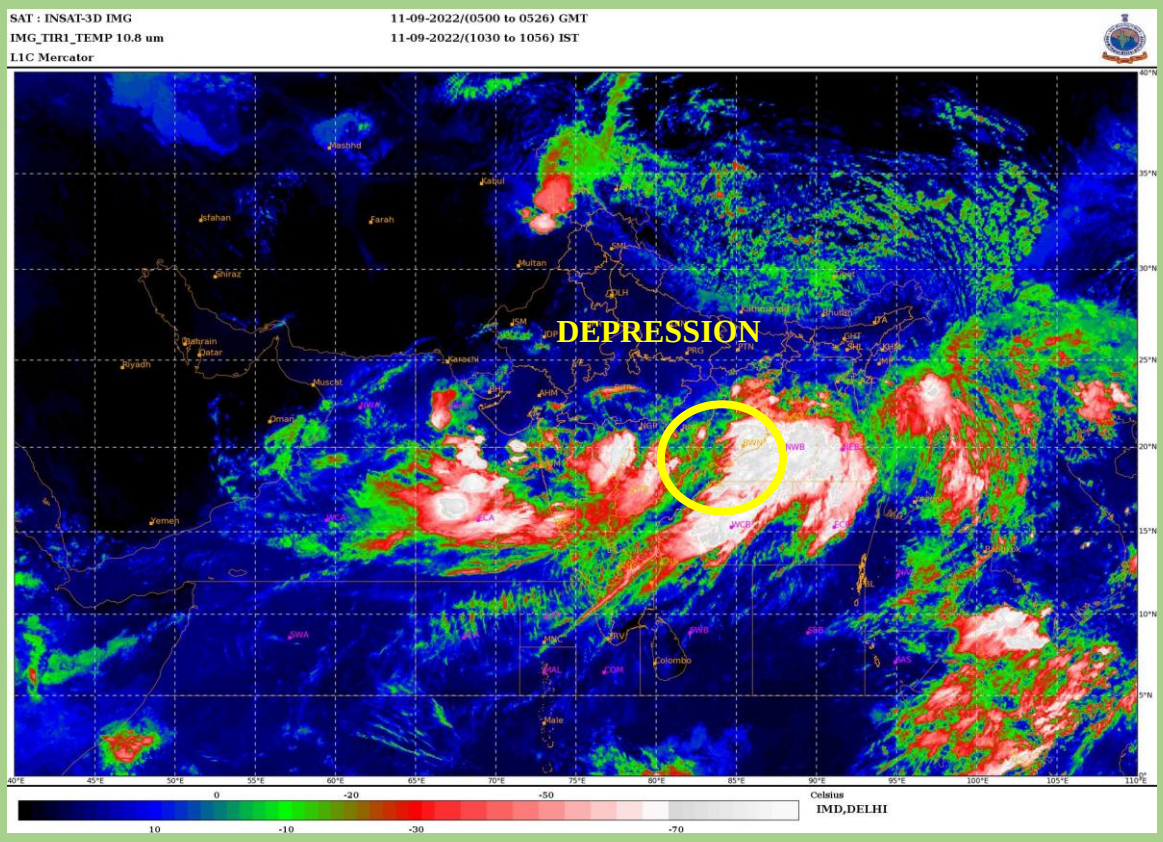
**GOVERNMENT OF INDIA**
**MINISTRY OF EARTH SCIENCES**
**INDIA METEOROLOGICAL DEPARTMENT**

# Depression over Coastal Odisha (11th– 12th September 2022): A Report




**INSAT-3D enhanced Colored IR imagery based on 0500 UTC of 11th September, 2022**

## Cyclone Warning Division

## India Meteorological Department

## New Delhi

## September, 2022

**Depression over coastal Odisha (11-12 September, 2022)**

## 1. Introduction

Under the influence of a cyclonic circulation over eastcentral Bay of Bengal (BoB) formed at 0300 UTC (0830 IST) of the 07th September, a low pressure area (LPA) formed over westcentral and adjoining eastcentral BoB at 0300 UTC(0830 IST) of the 8th September 2022. The LPA lay over the westcentral and adjoining northwest BoB off north Andhra Pradesh & south Odisha coasts at 0300 UTC (0830 IST) of the 9th September. Under favourable conditions it became a Well-Marked Low Pressure Area (WML) over the same area at 0300 UTC (0830 IST) of 10th September. Then the WML moved west-northwestwards and concentrated into a Depression and lay centered at 0000 UTC (0530 IST) of 11th September over south coastal Odisha and neighbourhood. Further moving west-northwestwards initially, the depression lay centred over south Chhattisgarh and adjoining south Odisha at 1200 UTC (1730 IST) of 11th September. It then moved northwestwards and lay centred at 0000 UTC (0530 IST) of 12th September over south Chhattisgarh and adjoining southeast Madhya Pradesh & Vidarbha, subsequently moved nearly northwestwards and weakened into a WML at 0300 UTC (0830 IST) of 12th September over southeast Madhya Pradesh & neighbourhood.

The best track parameters of the system are presented in table 1 and observed track of the system is presented in Fig. 1.

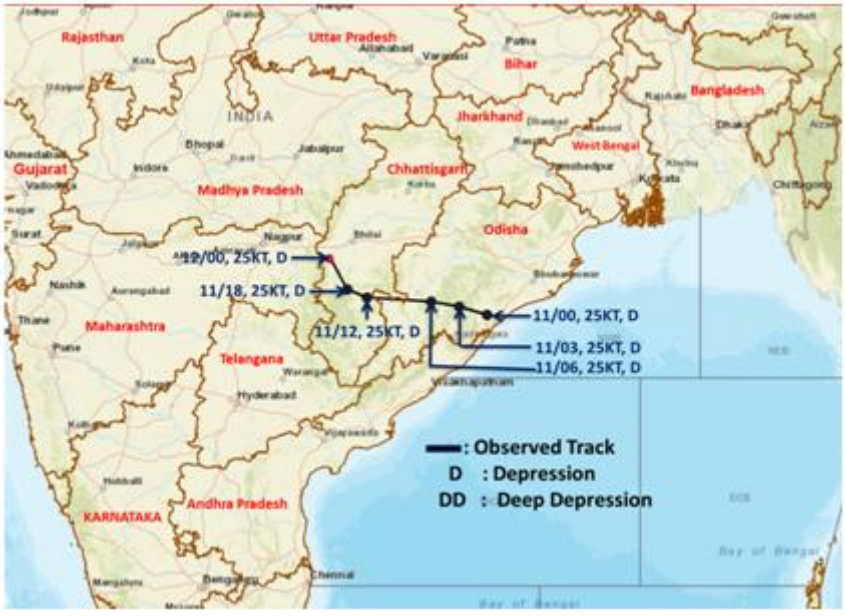



**Fig.1: Observed track of Depression (11-12 September 2022)**
**Time in UTC (IST=UTC+ 0530 hrs)**
**KT: Knots (nautical mile per hour), 1 KT=1.85 kmph**

**Table1: Best track positions and other parameters of depression over coastal Odisha (11-12 September 2022)**

| Date | Time (UTC) | Lat. | Long | C.I. No | Estimated Central Pressure (hPa) | Estimated Maximum Sustained Surface Wind(kt) | Estimated Pressure drop at Centre (hPa) | Category |
|---|---|---|---|---|---|---|---|---|
| 11.09.22 | 0000 | 19.5 | 84.7 | - | 998 | 25 | 4 | D |
| | 0300 | 19.7 | 84.0 | - | 998 | 25 | 4 | D |
| | 0600 | 19.8 | 83.3 | - | 998 | 25 | 4 | D |
| | 1200 | 19.9 | 81.7 | - | 998 | 25 | 4 | D |
| | 1800 | 20.1 | 81.2 | - | 998 | 25 | 4 | D |
| 12.09..22 | 0000 | 20.8 | 80.8 | - | 999 | 20 | 3 | D |
| | 0300 | Weakened into a well marked low pressure area over southeast Madhya Pradesh & neighbourhood. | | | | | | |

## 2. Brief life history

### 2.1. Genesis, Intensification and movement

Under the influence of a cyclonic circulation over eastcentral Bay of Bengal (BoB) formed at 0300 UTC (0830 IST) of the 07th September, a low pressure area (LPA) formed over westcentral and adjoining eastcentral BoB at 0300 UTC(0830 IST) of the 8th September 2022. The LPA lay over the westcentral and adjoining northwest BoB off north Andhra Pradesh & south Odisha coasts at 0300 UTC (0830 IST) of the 9th September. Under favourable conditions it became a Well-Marked Low Pressure Area (WML) over the same area at 0300 UTC (0830 IST) of 10th September. Then the WML moved west-northwestwards and concentrated into a Depression and lay centered at 0000 UTC (0530 IST) of 11th September over south coastal Odisha and neighbourhood. Further moving west-northwestwards initially, the depression lay centred over south Chhattisgarh and adjoining south Odisha at 1200 UTC (1730 IST) of 11th September. It then moved northwestwards and lay centred at 0000 UTC (0530 IST) of 12th September over south Chhattisgarh and adjoining southeast Madhya Pradesh & Vidarbha, subsequently moved nearly northwestwards and weakened into a WML at 0300 UTC (0830 IST) of 12th September over southeast Madhya Pradesh & neighbourhood.

## 3. Monitoring of depression over coastal Odisha and neighbourhood

India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean and the system was monitored since 01st September (10 days prior to formation of depression over south coastal Odisha and neighbourhood on 11th

September) when it was indicated that there was likelihood of formation of cyclonic circulation/low pressure area over westcentral and adjoining northwest Bay of Bengal with nearly 2 weeks lead time. The Extended Range Outlook for Cyclogenesis (EROC) on 08th September also predicted about the low probability of cyclogenesis (formation of depression) over westcentral and adjoining northwest BoB off North Andhra Pradesh & Odisha coasts during first half of week 1. Accordingly, the system was monitored with the help of available satellite observations from INSAT 3D and 3DR and polar orbiting satellites throughout its whole life time. Various numerical weather prediction models developed by Ministry of Earth Sciences (MoES) institutions and dynamical-statistical models were utilized to predict the genesis, track, landfall and intensity of the cyclone. A digitized forecasting system of IMD was utilized for analysis and comparison of various model guidance, decision making process and warning product generation.

### 3.1 Features observed through satellite

Satellite monitoring of the system was mainly done by using half hourly INSAT-3D and 3DR imageries. Satellite imageries of international geostationary satellites Meteosat-8 & MTSAT, high resolution polar orbiting satellites and scatterometer imageries from ASCAT were also considered for monitoring the system. Typical INSAT-3D visible/ IR imageries, and enhanced colored imageries are presented in Fig.2(a-d). The organized cloud mass sheared southwestward was tracked and observed during the life cycle of the depression.

At 0300 UTC of 11$^{th}$ September, INSAT 3D imagery indicated scattered to broken low and medium clouds with embedded intense to very intense convection lay over westcentral & adjoining northwest Bay of Bengal off north Andhra Pradesh south Odisha coasts. Minimum Cloud Top Temperature was -93$^{0}$C. At 0300 hrs UTC of 11th September 2022, INSAT 3D imagery indicated that cloud mass associated with the system moved nearly westward and lay over Odisha & adjoining north coastal Andhra Pradesh.

At 0300 hrs UTC of 12$^{th}$ September 2022, as the depression weakened into a well-marked low pressure area, the INSAT 3D imagery indicated the disorganization of cloud mass around the system.

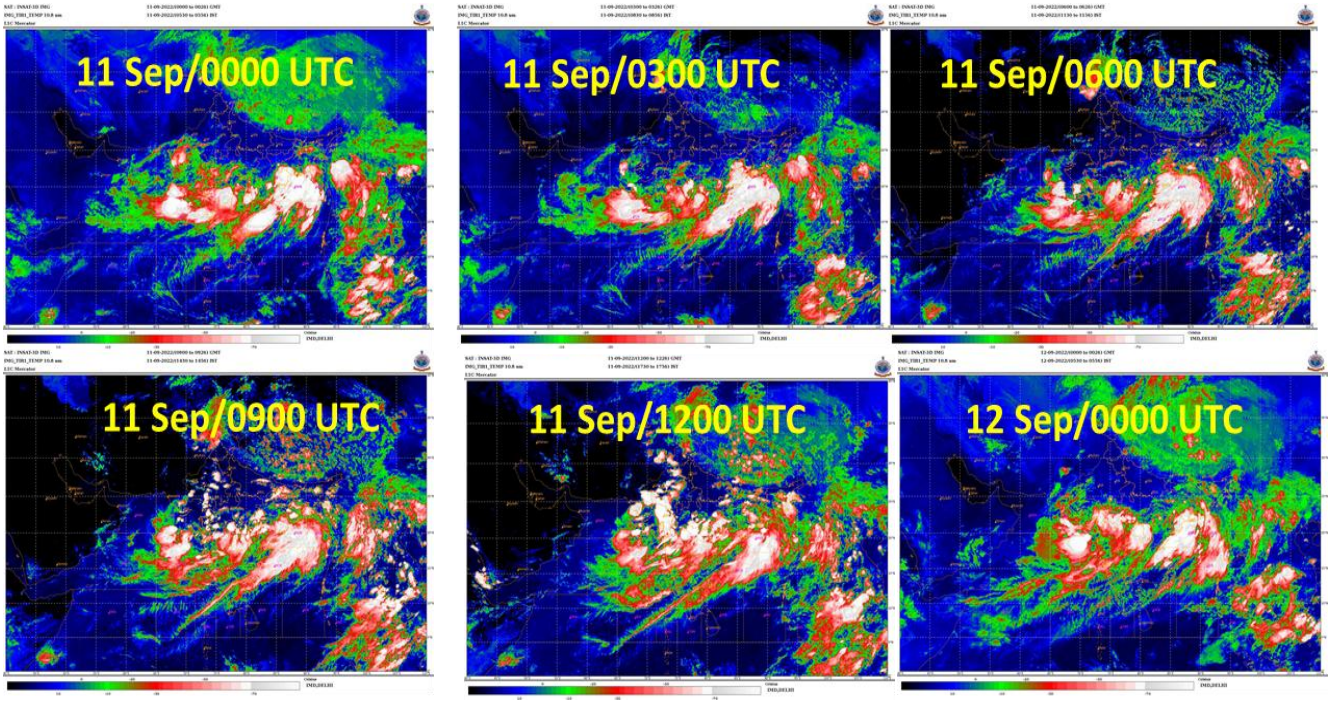



**Fig. 2a: INSAT-3D enhanced colored imageries of Depression during 11-12 September, 2022**

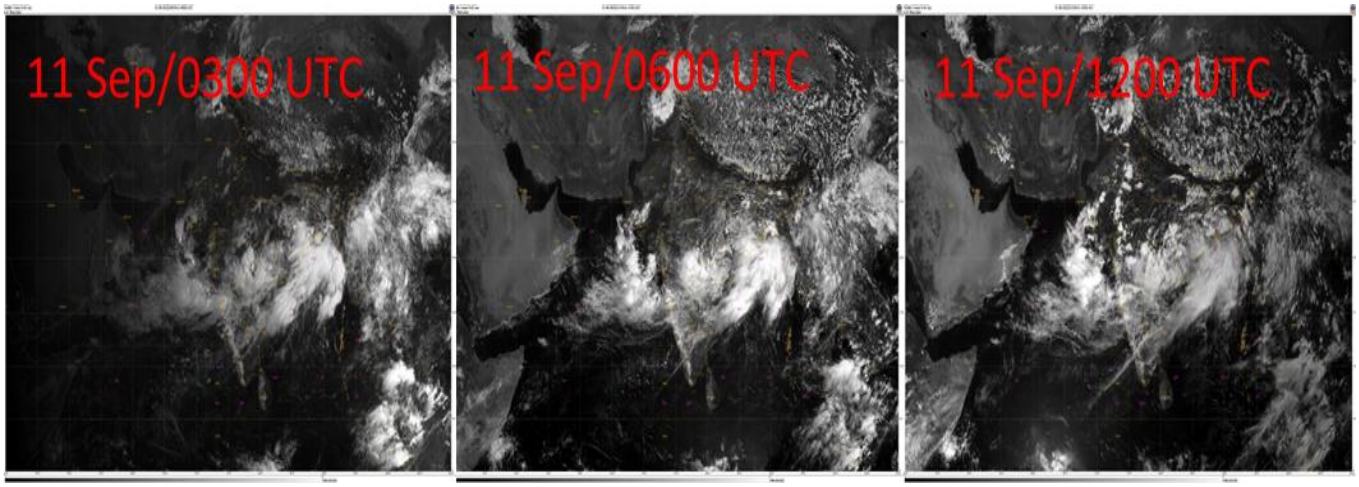



**Fig. 2b: INSAT-3D visible imageries of Depression during 11-12 September, 2022.**

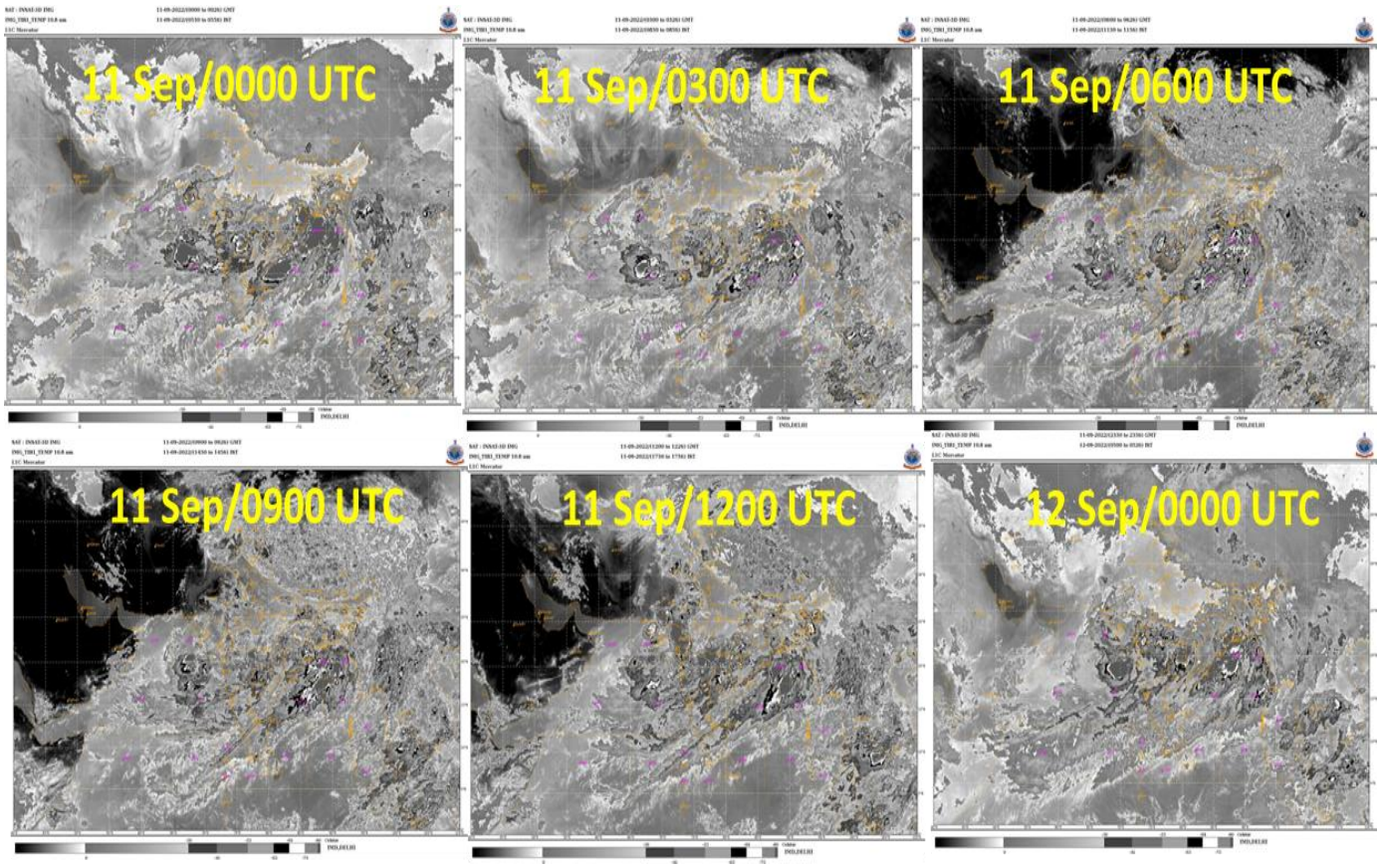



**Fig. 2c: INSAT-3D BD imageries of Depression during 11-12 September, 2022.**

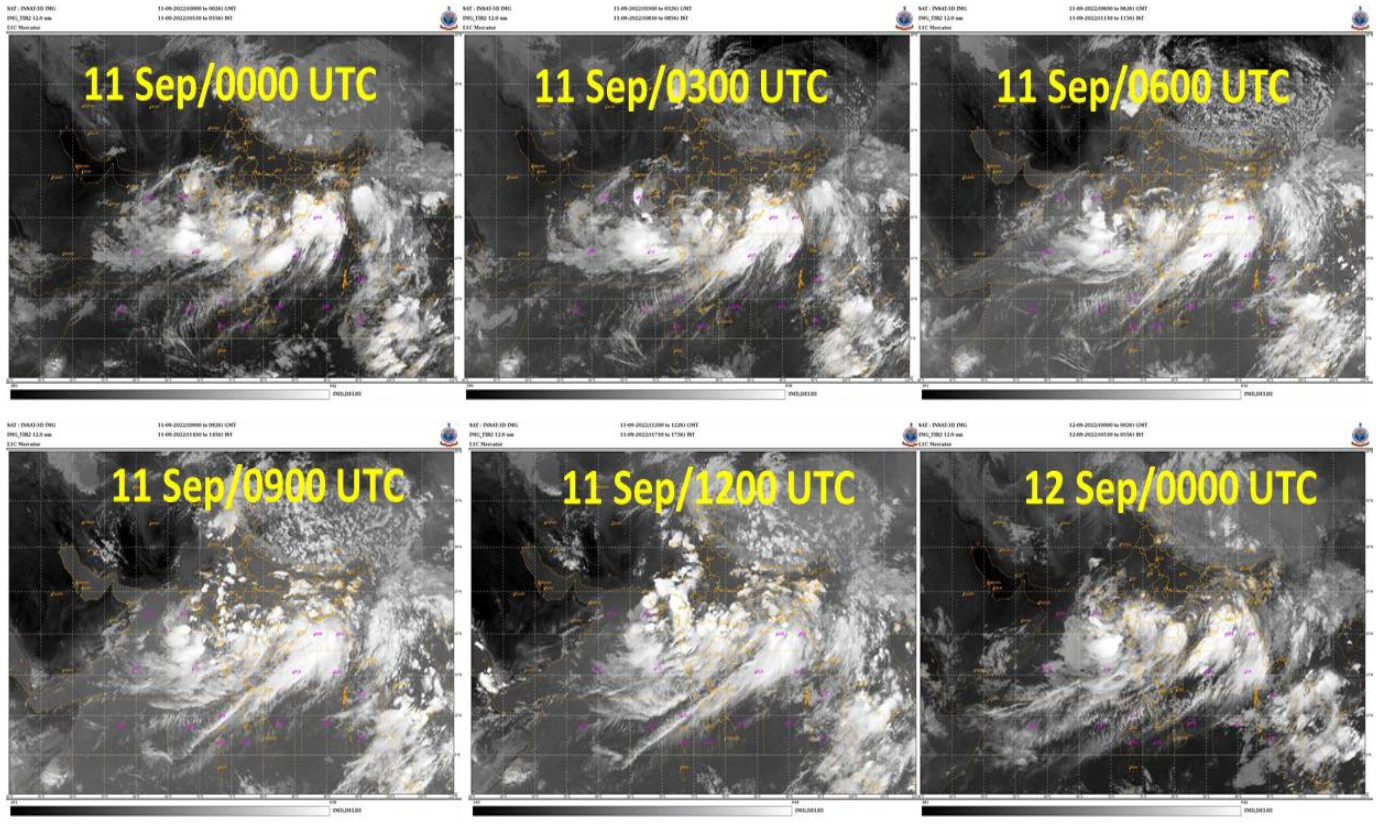



**Fig. 2d: INSAT-3D IR imageries of Depression during 11-12 September, 2022.**

## 4. Dynamical features

The mean sea level pressure and wind analyses at 10 m, 850 hPa, 500 hPa and 200 hPa based on 0000 UTC during 11th and 12th September are presented in Fig. 3.

The analysis based on 0000 UTC of 11th September indicated a low pressure system over coastal Odisha and adjoining area but the intensity of the system was underestimated as the system was observed as a depression over the same region. The cyclonic circulations in the wind pattern were extending up to 500 hPa pressure level and clearly furnished a southwestward tilt with height. The upper-level ridge at 200 hPa was seen north of the system near $18^0$N.

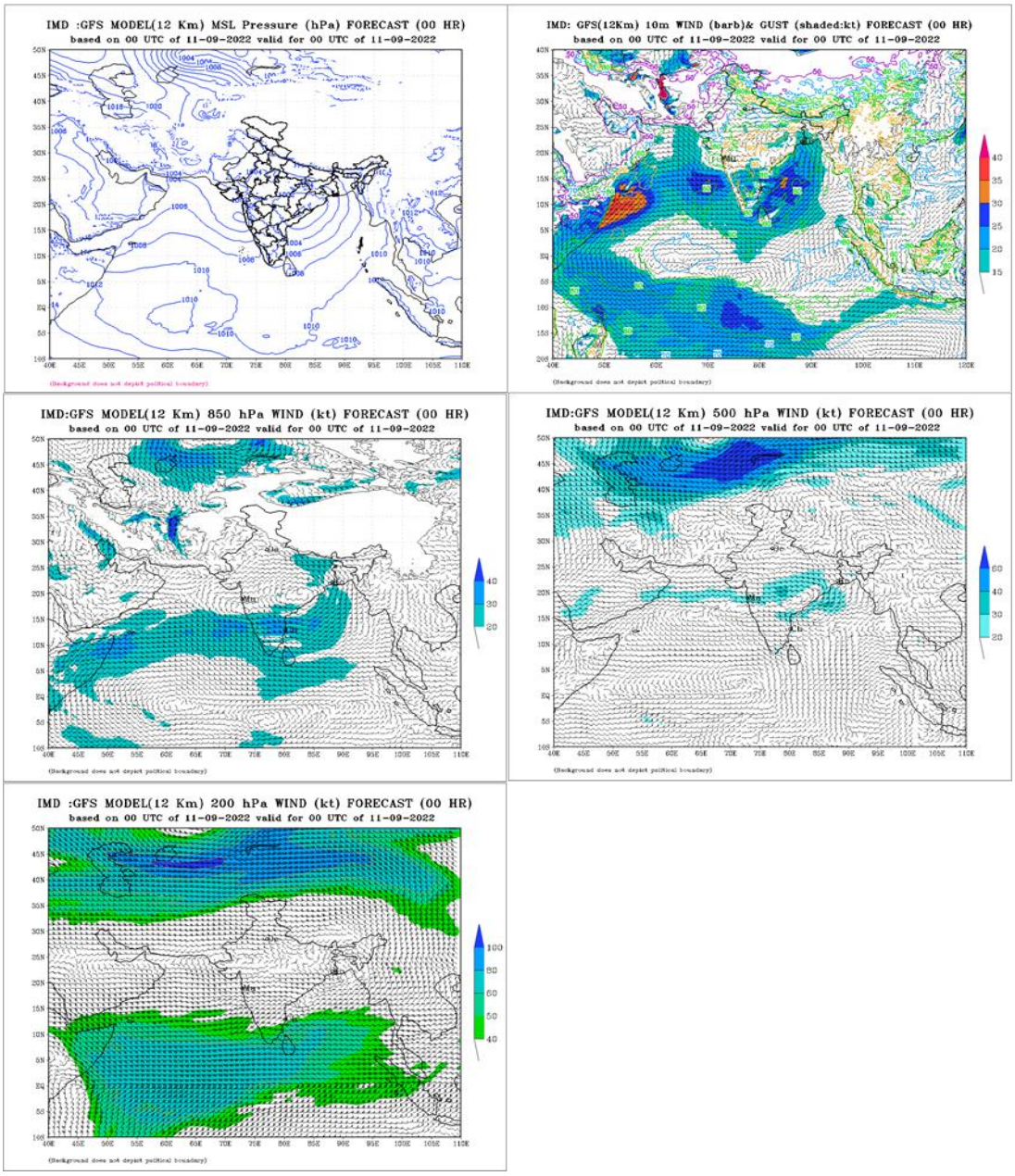



**Fig.3 (a): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500and 200 hPa levels based on 0000 UTC of 11th September 2022**

The analysis based on 0000 UTC of 12th September indicated that the system over south Chhattisgarh and the pattern of isobars depicted weakening of the system but the isobaric analysis underestimated the pressure drop of the WML. The associated cyclonic circulations in different pressure levels up to 500 hPa also moved along with the system and contrary to the changes at the surface level the upper-air wind showed strengthening of easterly winds north of the system.

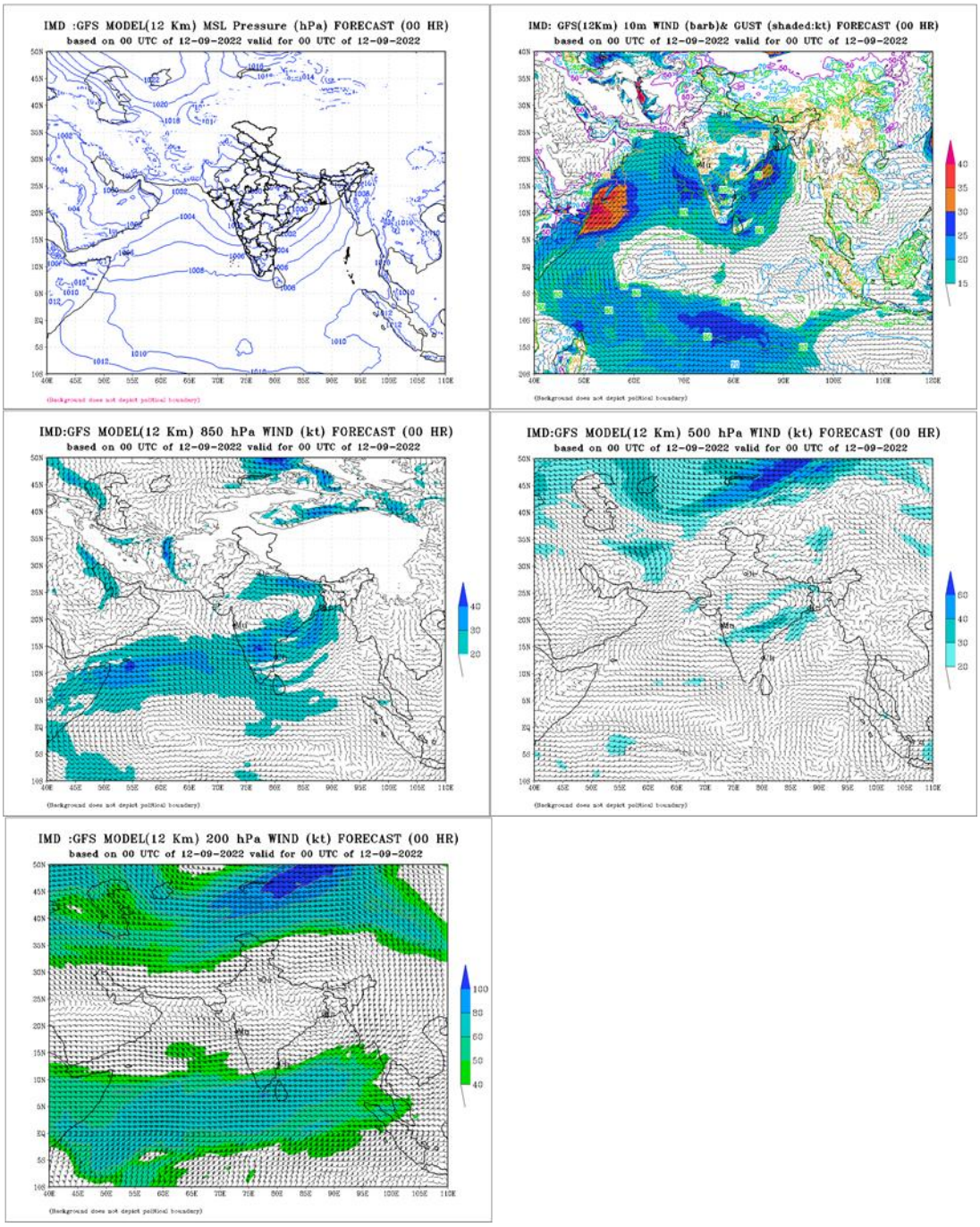



**Fig.3 (b): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 12thSeptember 2022**

## 5. Realized Weather:

Rainfall associated with the depression based on IMD-NCMRWF GPM merged gauge rainfall data is depicted in **Fig 4**. It indicates a rainfall zone with higher rainfall associated with the system lay over Odisha, Chhattisgarh and adjoining Telangana during 12 and 13$^{th}$ September. Therefore, it was clearly seen that the higher rainfall activity occurred mainly in the southern sector relative to the system center. Fig 5 indicated widespread moderate rainfall over the area mentioned above due to depression along with isolated heavy to very heavy rainfall over Telangana and isolated heavy rainfall occurred over Odisha and Chhattisgarh during 12$^{th}$ and 13$^{th}$ September.

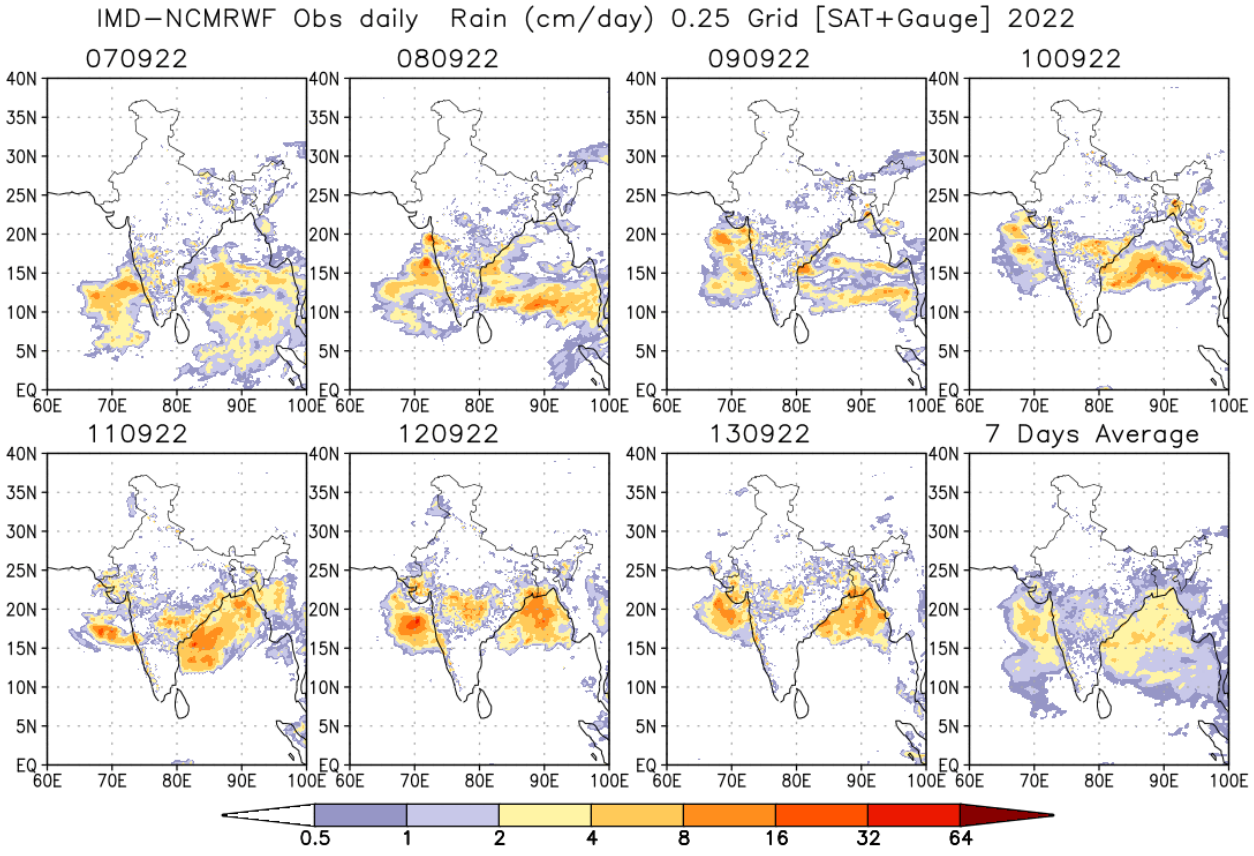



**Fig.4: IMD-NCMRWF GPM merged gauge rainfall during 01$^{st}$ - 07$^{th}$ September and 7 days average rainfall (cm/day)**

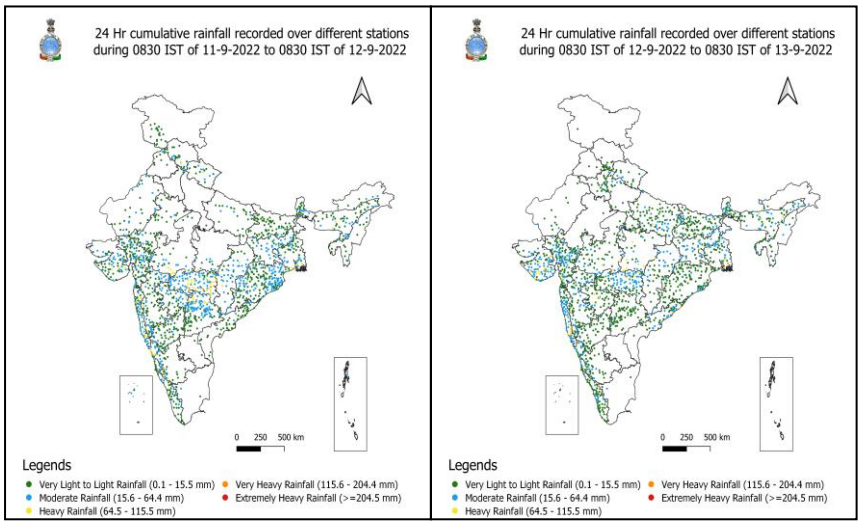



**Fig.5: 24 hour cumulative rainfall distribution recorded over different stations of IMD during 12th - 13th September (cm/day)**

The spatial distribution of station-wise daily cumulative rainfall indicated moderate to extremely heavy rainfall over the region of depression during 12th and 13th September are shown in Fig 5.

## 6. Damage due to the system

No damage was reported in association with this system.

## 7. Operational Forecast Performance

- The EROC issued on 1st September provided first information about likely formation of a cyclonic circulation over westcentral and adjoining northwest Bay of Bengal during week 1 and subsequent formation of low and depression during week 2.

- The daily tropical weather outlook issued at 1130 hours IST of 5th Sept, 2022 indicated about the likely development of a cyclonic circulation over eastcentral Bay of Bengal around 07th September. It was also mentioned that under the influence of the cyclonic circulation a low pressure would form northwest Bay of Bengal and adjoining costal area of Odisha during subsequent 48 hours.

- The tropical weather outlook issued on 7th September mentioned clearly about the formation of low pressure area over coastal Odisha and neighbourhood during next 24 hours and probable intensification further into a depression during subsequent 48 hours.

- Actually, a low pressure area formed over coastal Odisha and neighbourhood on 8th September which intensified further into a depression at 0300 UTC of the 11th September over the same region.

- Thus, the track, initial movement of the depression over coastal Odisha and neighbourhood, intensification/weakening of the system was well predicted by IMD/RSMC New Delhi.

The verification of rainfall forecast issued by IMD is presented in Table 2.

**Table 2: Rainfall forecast verification for the depression (11-12 September 2022).**

| Date/ Time of issue | Heavy rainfall forecast | 24 hr heavy rainfall realized at 0300 UTC of date |
|---|---|---|
| 11 Sept /0300 UTC | **11th September:** Heavy to very heavy rainfall at isolated places is very likely over Odisha, coastal Andhra Pradesh, Gangetic West Bengal, Chhattisgarh, Telangana and heavy rainfall at isolated places very likely over Vidarbha<br><br>**12th September:** Heavy to very heavy rainfall at isolated places is likely over Gangetic West Bengal and heavy rainfall at isolated places is likely over Odisha, Chhattisgarh, Telangana and | **11 September/0300 UTC:**<br>**Gangetic West Bengal:-** Durgachack-7.<br>**Odisha:-** Dhenkanal Pto-15, Jaipur-14, Gobindpur-13, Kotpad-11, Bhuban, Balasore, Banki and Remuna-10 each, Balimundali, Patrapur, Tigiria, Udala, Tangi, Ghasipura, and Sukinda-9 each, G B Nagar, Kalinga, Nawana, Khandapara, Jhorigam, Barmul, Sheragada, Bahanga, G Udayagiri and Dhenkanal-8 each, Betanati, Pottangi, Khaira, Malkangiri, Chakapad, Bhapur, Begunia, Balikuda, Bolagarh, Dabugan, Lamataput, Mathili, Nandpur, Daringibadi and Basudevpur-7 each.<br>**Bihar:-** Katihar North-7.<br>**West Madhya Pradesh:-** Ghatiya-7.<br>**Madhya Maharashtra:-**Gaganbawada-16, Ajra-11, Chandgad-8.<br>**Marathwada:-** Kinwat-12, Mahur-7.<br>**Vidarbha:-** Sironcha-7,<br>**Chhattisgarh:-** Bijapur-25, Bastanar-14, Konta and sukma-12, Darbha,Chhindgarh and dantewara-11 each, Kuakonda, Katekalyan, Jagdalpur, and lohandiguda-10 each, Gidam, Bastar and usoor-7 each.<br>**Coastal Andhra Pradesh & Yanam:-** Palakoderu-14, Nuzvid-11, Pusapatirega and Balajipeta-9 each, Bhimadole, Kalingapatnam and Bheemavaram-8 each, Chintalapudi, Therlam, Jiyyamma Valasa and Bobbili-7 each.<br>**Telangana:-** Yellareddypeta, Alladurg, Venkatapuram and Vavipet-19 each, Mustabad, Tekmal and Papannapet-17, Sirsilla-16, Regode, Govindaraopet and Konaraopeta-15 each, Yeda Palle-14, Balkonda, Shayampet, Ranjal and Peddapalle-13 each, Naga Reddipet and Boinpalle-13 each, Chigurumamidy, Kamareddy and Parkal-12 each, Venkatapur, Armur, Machareddy and gambhiraopet-11 each, Kotapalle, Sultanabad, Medak, Makloor, Tadwai Mlg, Medak(Arg), Velpur and Mortad-10 each, Bodhan, Dubbak, Chandurthi, Bejjanki, Atmakurwrgl, Tamsi, Dich Palle, |

| | | |
|---|---|---|
| | Madhya Pradesh.<br><br>**13th September:** Heavy to very heavy rainfall at isolated places is likely over East Madhya Pradesh and heavy rainfall at isolated places is likely over Chhattisgarh, Odisha and Vidarbha. | Armoor(Arg), Garla and Jakranpalle-9 each, Shankarapatnam, Kowdipalle, Thimmapur, Laxmanchanda, Huzurabad, Yellareddy, Bhiknur, Pinapaka, Mulug, Gandhari and Elagaid-8 each, Boath, Jammikunta, Srirampur, Bheemgal, Bhupalpalle, Karimnagar, Lingampet, Ramayampet, Nizam Sagar, Sadasivanagar, Mogullapalle, Mirdoddi and Narayankhed-7 each.<br><br>**12th September/0300 UTC:**<br>**Odisha:-**Jajpur Pto-9, Lamataput-8, Derabis, Bhograi, Kalinga, Jaleswar, Bolangir, Bijepur and Rajghat-7 each.<br>**East Rajasthan:-** Reodar Sr-7.<br>**West Madhya Pradesh:-** Nepanagar and Khaknar-11 each, Bhainsdehi-10, Jhirnya-9, Khargone-Aws and Gogawan-8 each, Khandwa, Bhikangaon, Pansemal, Pandhana and burhanpur-7 each.<br>**East Madhya Pradesh:-**Seoni-9, Sausar-8.<br>**Madhya Maharashtra:-**Gaganbawada-11, Chandgad-9, Paud Mulshi and Radhanagari-7 each.<br>**Marathwada:-** Bhokar and Mahur-8 each.<br>**Vidarbha:-** Arjuni Morgaon and Ballarpur 13 each, Chandrapur, Gadchiroli, and Dhanora 12 each, Arni, Korchi, Chandur Rlwy and ahiri 11 each, Darwha, Dhamangaon Rlwy, and Lakhandur 10 each, Wani, Gondpipri, Kurkheda,Ner and Pandherikawara 9 each, Chamorshi, Bhamragad, Nagpur Aerodrome, Zarizamni, Nandgaonkazi, Babulgaon, Mulchera, Bhiwapur, and ghatanji 8 each Saoli, Pombhurna, Sangrampur, Deori, Armori, Arvi, Narkheda, Deoli and Kalamb 7 each.<br>**Chhattisgarh:-**Mohla-13, Durgkondal-12, Pakhanjur and bijapur-11 each, Manpur-10, Bhanupratappur, Usoor, and katekalyan-9 each, Doundi, and Bhairamgarh-8 each, Korba, Kartala, and Chhuria-7 each |
| 12 Sept /0300 UTC | **12th September:** Heavy to very heavy rainfall at isolated places is likely over Vidarbha, Chhattisgarh, Gangetic West Bengal and East Madhya Pradesh and heavy rainfall at isolated places is likely over Odisha and Telangana. | **Telangana:-** Laxmanchanda-15, Khanpur-13, Sarangapurnrl, Dahegaon and Bazarhathnoor 12 each, Bejjur,Boath, Mudhole, Kotapalle and Nirmal 10 each, Dilawarpur, Navipet and Metpalle 9 each, Mallapur 8, Chennur, Yellareddy, Velpur, Kathlapur, Ramgundam, Yeda Palle, Mortad, Kammar Palle, Jainoor, Wankdi and Mancherial 7 each. |

## 8. Warning Services

**Bulletins issued by Cyclone Warning Division, New Delhi**

Statistics of bulletins issued by RSMC New Delhi in association with this system are given in Table 3.

**Table 3: Bulletins issued by RSMC New Delhi**

| S.N | Bulletin type | No. of Bulletins | Issued to |
|---|---|---|---|
| 1 | National Bulletin | 7 | 1. IMD's website, RSMC New Delhi website<br>2. FAX and e-mail to Control Room Ministry of Home Affairs & National Disaster Management Authority, Cabinet Secretariat, Minister of Science & Technology, Headquarter Integrated Defence Staff, Director General Doordarshan, All India Radio, National Disaster Response Force, Chief Secretary, Government of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Puducherry, Gujarat, Maharashtra, Chhatisgarh, Jharkhand, Telangana, Madhya Pradesh |
| 2 | RSMC Bulletin | 3 | 1. IMD's website<br>2. WMO/ESCAP member countries through GTS and E-mail. |
| 3 | GMDSS Bulletins | 3 | 1. IMD website, RSMC New Delhi website<br>2. Transmitted through WMO Information System (WIS) to Joint WMO/IOC Technical Commission for Ocean and Marine Meteorology (JCOMM) |
| 4 | Warnings through SMS | Frequently | Disaster managers and registered public |
| 5 | Warnings through Social Media | Daily | Cyclone Warnings were uploaded on social networking sites (Face book and Tweeter) since inception to weakening of system (every six hourly). |

## 9. Summary:

A cyclonic circulation lay over eastcentral Bay of Bengal (BoB) at 0830 hours IST of the 07$^{th}$ September and under its influence a low pressure area (LPA) formed over westcentral and adjoining eastcentral BoB at 0300 UTC of the 8th September. This LPA persisted over westcentral and adjoining northwest BoB off north Andhra Pradesh & south Odisha coasts till 0830 hours IST of the 9th September and under favourable conditions concentrated into a WML over the same area at 0830 hours IST of 10th September, 2022. Moving west-northwestwards the WML concentrated into a depression and lay centered at 0530 hrs IST of 11$^{th}$ Sept 2022 over south coastal Odisha and neighbourhood. Further moving nearly westward the depression crossed south

Odisha coast reached south Chhattisgarh and weakened into a WML over south Chhattisgarh and adjoining southeast Madhya Pradesh & Vidarbha at 0830 hrs IST of 12th September 2022. Due to the formation of the depression over coastal Odisha and neighbourhood and its movement nearly west-northwestward up to southeast Madhya Pradesh, widespread moderate rainfall activity with isolated heavy to very heavy rainfall occurred over the region south of the system track during 12th and 13th September. The operational forecasts predicted the genesis, intensification and movement of the depression very well and necessary warning for the heavy to very heavy rainfall episodes were issued in a timely manner during the life period of the system.

## 10. Acknowledgement:

India Meteorological Department (IMD) and RSMC New Delhi duly acknowledge the contribution from all the stake holders and disaster management agencies who contributed to the successful monitoring, prediction and early warning service of the system. We acknowledge the contribution of all sister organisations of Ministry of Earth Sciences including National Centre for Medium Range Weather Forecasting Centre (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), National Institute of Ocean Technology (NIOT), Indian Institute of Tropical Meteorology (IITM) Pune, research institutes including IIT Bhubaneswar, and Space Application Centre, Indian Space Research Organisation (SAC-ISRO) for their valuable support. The support from various Divisions/Sections of IMD including Area Cyclone Warning Centre (ACWC) Kolkata, Cyclone Warning Centre (CWC) Bhubaneswar, Meteorological Centre (MC) Raipur, Bhopal, Numerical Weather Prediction Division, Satellite and Radar Division, Surface & Upper air instruments Divisions, New Delhi and Information System and Services Division at IMD is also duly acknowledged.