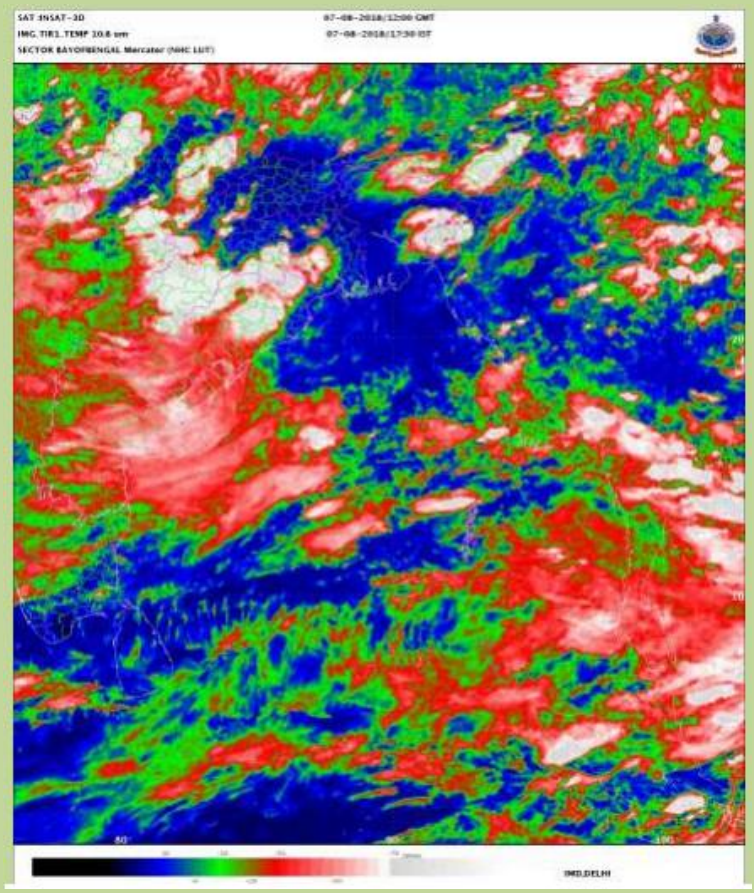
GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT

Depression over northwest Bay of Bengal and neighbourhood (07-08 August, 2018): A Report



INSAT-3D enhanced coloured IR imagery based on 0900 UTC of 7th August

Cyclone Warning Division

India Meteorological Department

New Delhi

August 2018

Depression over northwest Bay of Bengal and neighbourhood
(07-08 August, 2018)

1. Introduction

A low pressure area formed over northwest Bay of Bengal (BoB) and neighbourhood in the morning (0300 UTC) of 6th July, 2018. It lay as a well marked low pressure area (WML) over northwest BoB and adjoining West Bengal & Odisha coasts in the early morning (0000 UTC) of 7th. It concentrated into a depression over northwest BoB in the same afternoon (0900 UTC) of 7th. Moving west-northwestwards it crossed north Odisha-West Bengal coasts close to Balasore during same night (1430 to 1630UTC). Moving further west-northwestwards, it weakened into a WML over north Chattisgarh and neighbourhood in the morning (0300 UTC) of 8th August, 2018.

The salient features of the system were as follows:

(i) It had a straight moving track.
(ii) It had a life period of 18 hours.
(iii) It had a track length of 372 km.
(iv) Under the influence of depression, widespread rainfall activity with isolated heavy to extremely heavy rainfall was observed over eastcentral India including Gangetic West Bengal, Odisha, Chattisgarh, Madhya Pradesh and east Rajasthan during 6-10th August.

IMD mobilised all its resources to track the system and regular warnings w.r.t. track, intensity, landfall and associated adverse weather were issued to concerned central and state disaster management agencies, print & electronic media and general public. Regular advisories were also issued to WMO/ESCAP Panel member countries including Bangladesh. Its genesis, movement and associated adverse weather could be predicted well by IMD

The brief life history, associated weather and forecast performance of IMD/RSMC, New Delhi are presented in following sections.

2. Brief life history

Along the axis of monsoon trough, a low pressure area formed over northwest Bay of Bengal (BoB) and neighbourhood at 0300 UTC of 6th August, 2018. Under favourable environmental conditions, it lay as a WML over northwest BoB and adjoining West Bengal & Odisha coasts at 0000 UTC of 7th.

On 7th, the Madden Julian Oscillation (MJO) index lay over phase 6 with amplitude greater than 1. MJO phase was not supporting convective activity over BoB on 7th. The sea surface temperature (SST) was 29-30^{0}C over northwest BoB and adjoining Odisha coast. The tropical cyclone heat potential was around 40-60 KJ/cm^2 over major parts of central BoB and off Odisha coast. It was becoming less than 40 KJ/cm^2 over north BoB above 20^{0}N. The low level relative vorticity was about 100x10^{-6}sec^{-1} over northwest BoB and adjoining Odisha & West Bengal coasts. BoB and was oriented in northeast-southwest direction. It was extending upto 500 hpa level. The lower level convergence and upper level divergence were about 20 x10^{-5}sec^{-1} over northwest BoB & adjoining westcentral BoB to the southwest of system centre. The upper level divergence was about 40 x10^{-5} sec^{-1} over westcentral BoB. The vertical wind shear was low to moderate (10-15 knots) over northwest BoB off adjoining Odisha & West Bengal coasts. All these conditions supported further intensification and west-northwestward movement of the system.

At 0900 UTC of 7th, similar environmental conditions prevailed. The divergence and convergence field further organized and the WML concentrated into a depression over northwest BoB and neighbourhood. No further intensification took place due to it's proximity with land surface. Under the influence of , the system moved west-northwestwards and crossed north Odisha-West Bengal coasts close to Balasore during 1430-1630 UTC of same night. Moving west-northwestwards, the system gradually weakened into a WML over north Chattisgarh and neighbourhood at 0300 UTC of 8th.

The observed track of depression over northwest BoB is presented in Fig.1.

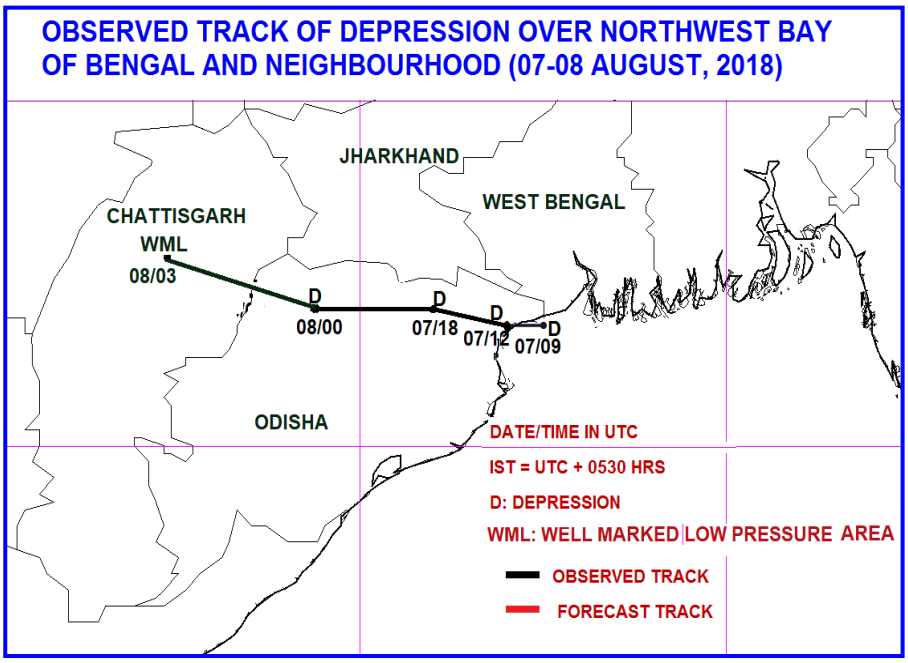


Fig.1. Observed track of Depression over northwest Bay of Bengal and neighbourhood (07-08 August, 2018)

The best track parameters of the system are presented in Table 1. The typical satellite imageries are presented in Fig. 2.

Table 1: Best track positions and other parameters of the Depression over northewest BoB during 07-08 August, 2018

Date	Time (UTC)	Centre lat.^{0} N/ long.^{0} E		C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade
07/08/2018	0900	21.5	87.5	1.5	992	25	4	**D**
	1200	21.5	87.0	1.5	994	25	3	D
	Crossed north Odisha-West Bengal coasts close to Balasore during 1430-1630 UTC							
	1800	21.6	86.0	-	995	25	3	D
08/08/2018	0000	21.7	84.5	-	996	20	3	D
	Weakened into a well-marked low pressure area over north Chattisgarh & neighborhood at 0300 UTC							

3. Feature observed through Satellites and Radar:

Satellite monitoring of the system was mainly done by using half hourly INSAT-3D imageries. Satellite imageries of international geostationary satellites Meteosat-7 and microwave & SCAT Sat imageries were also considered. Typical INSAT-3D IR, visible, enhanced colored and cloud top brightness temperature imageries are presented in Fig. 2.

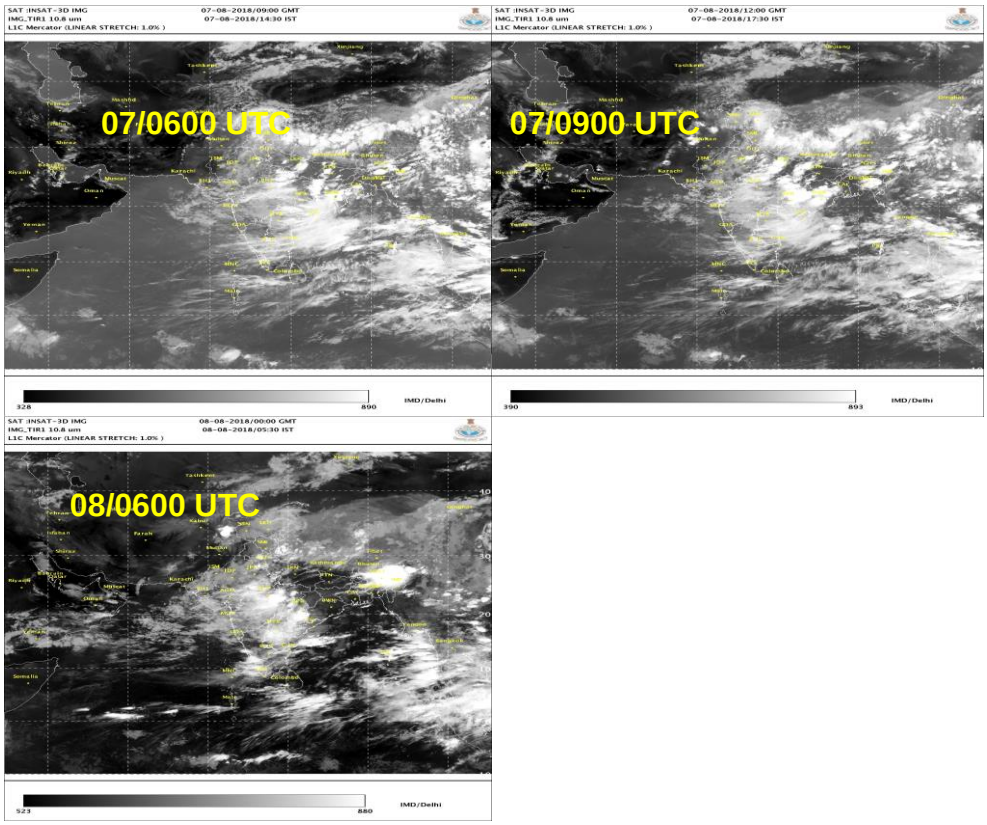


Fig. 2(i): INSAT-3D IR imageries based during 07-08 August, 2018

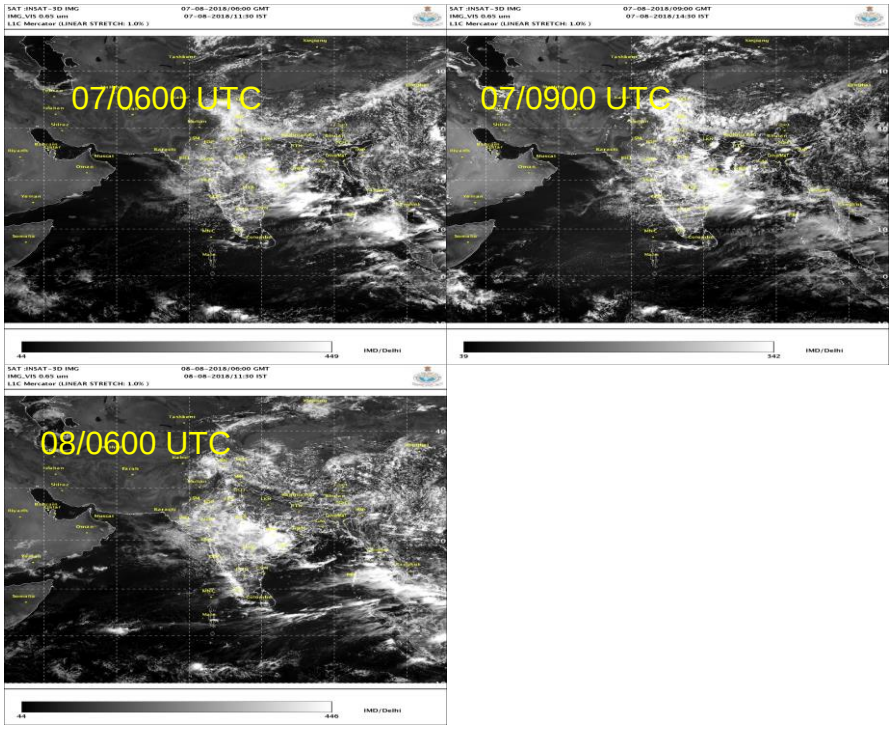


Fig. 2(ii): INSAT-3D Visible imageries during 06-08 August, 2018

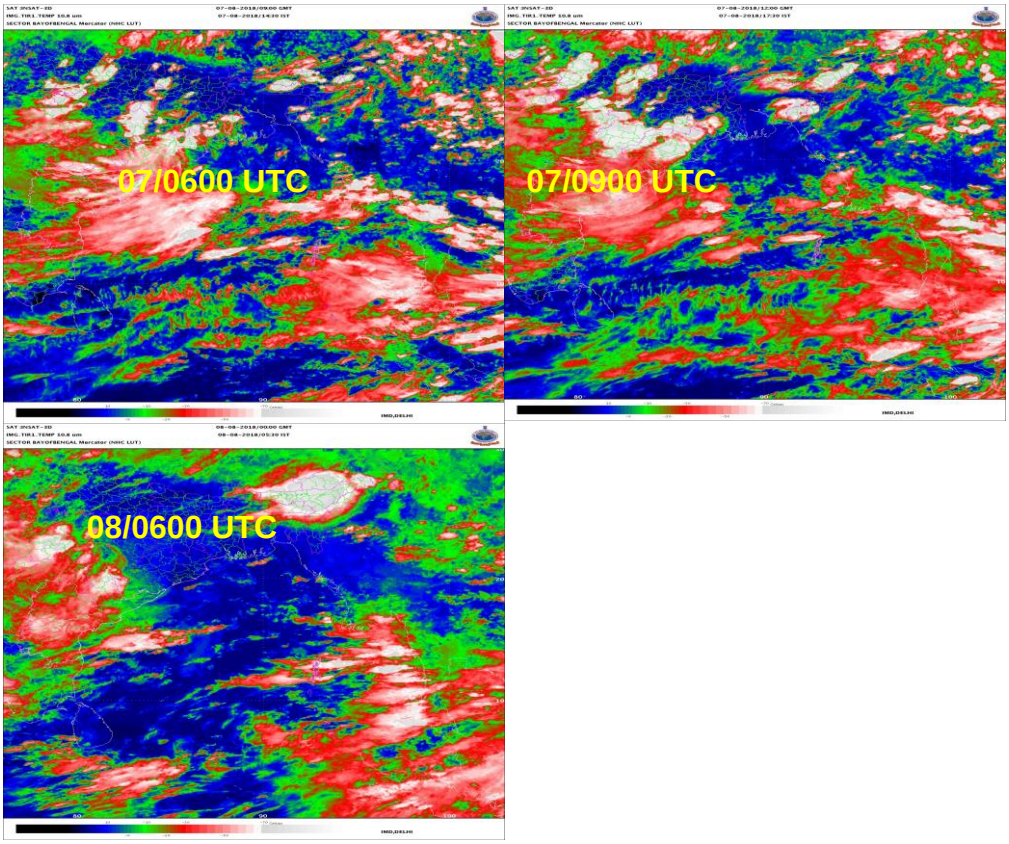


Fig. 2(iii): INSAT-3D enhanced coloured imageries during 07-08 August, 2018

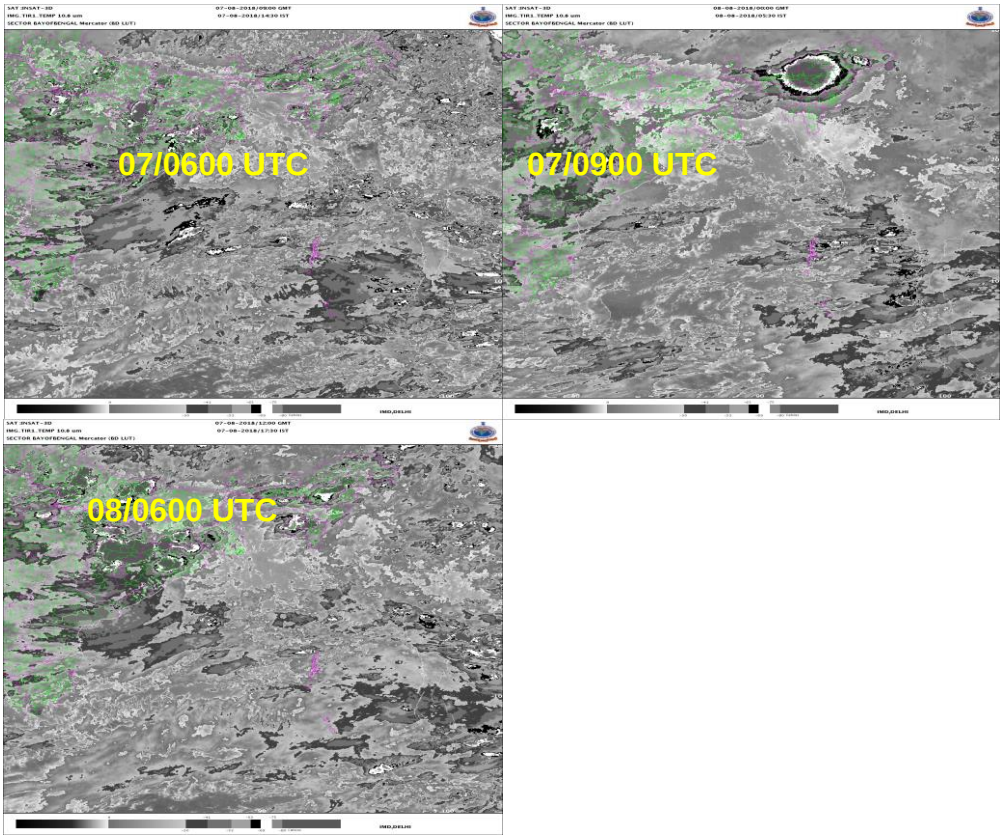


Fig. 2(iv): INSAT-3D enhanced colored imageries during 07-08 August, 2018

3. Dynamical features

IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10 m, 850, 500 and 200 hPa levels are presented in Fig.4. At 0000 UTC of 6th August, it indicated a low pressure area over northwest BoB off West Bengal and Bangladesh coasts. The circulation was seen upto 500 hPa level tilting southeastwards with height.

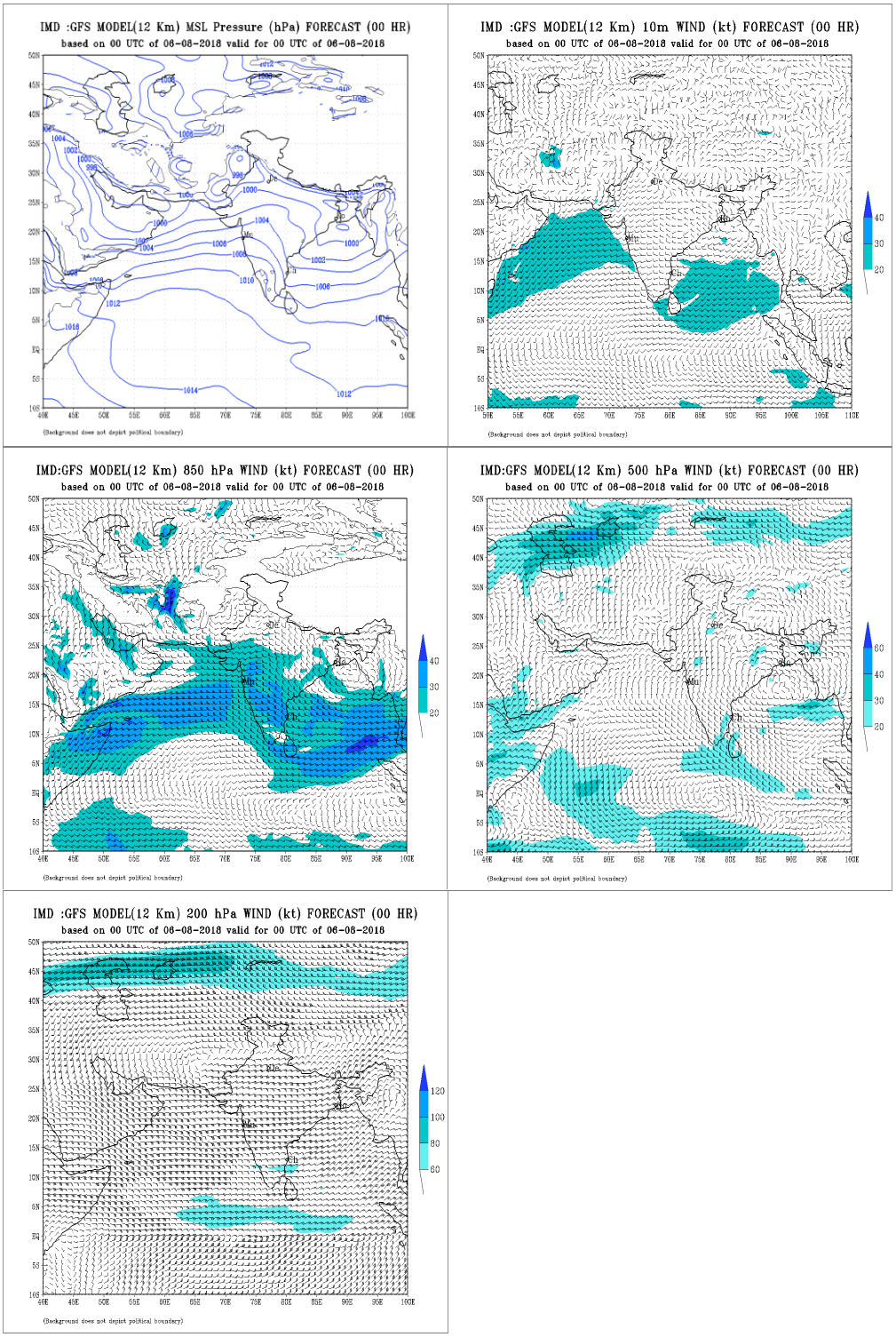


Fig4 (i): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 6th August

The initial conditions of 0000 UTC of 7th August indicated low pressure area over Gangetic West Bengal and adjoining north Odisha coasts. The cyclonic circulation was extending upto 500 hPa level tilting southwestwards with height.

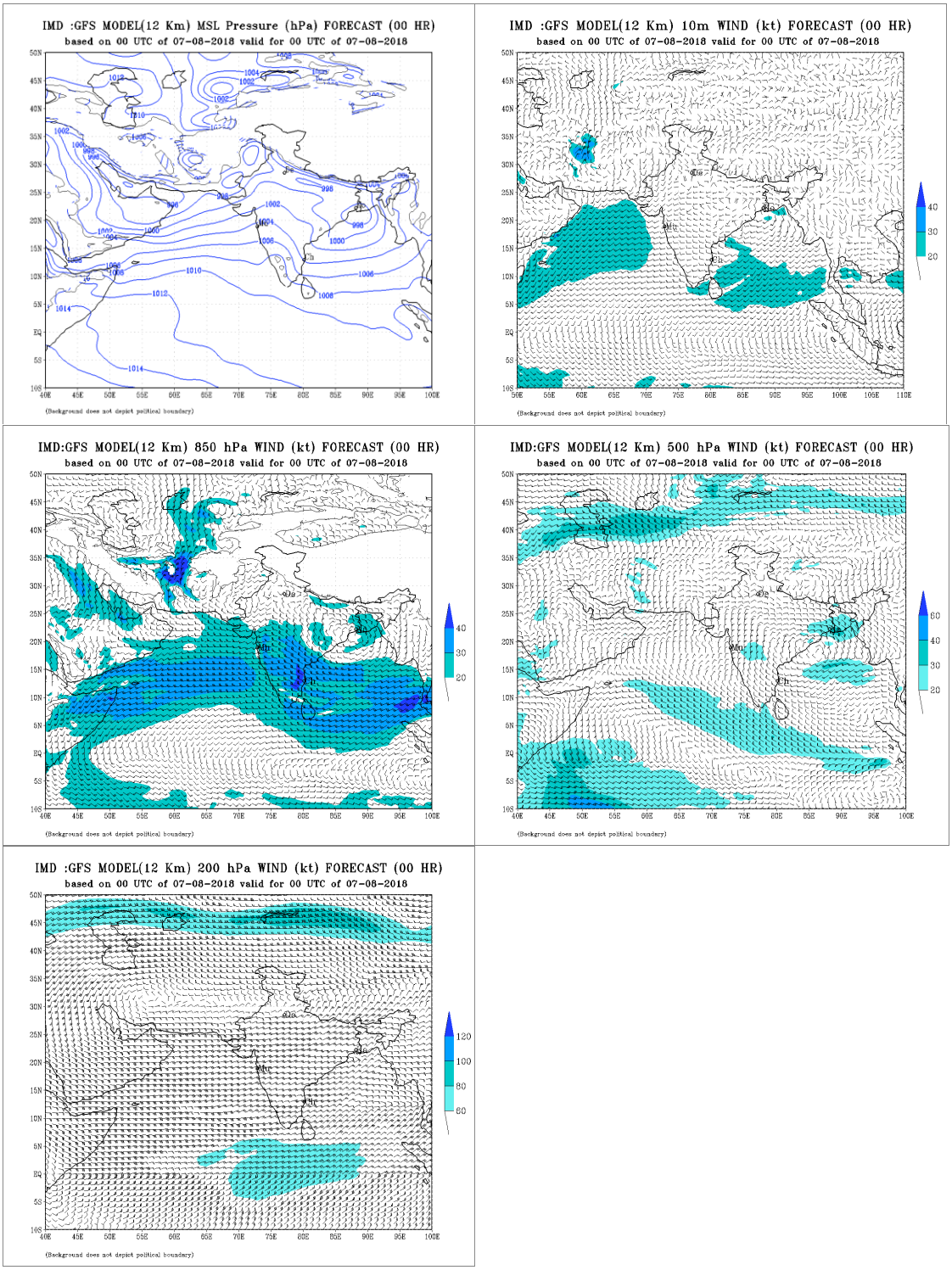


Fig.4 (ii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 22nd July

The initial conditions based on 0000 UTC of 8th indicated an extended low over south Odisha and adjoining Chattisgarh. The circulation was seen extending upto 500 hPa level tilting southwestwards with height.

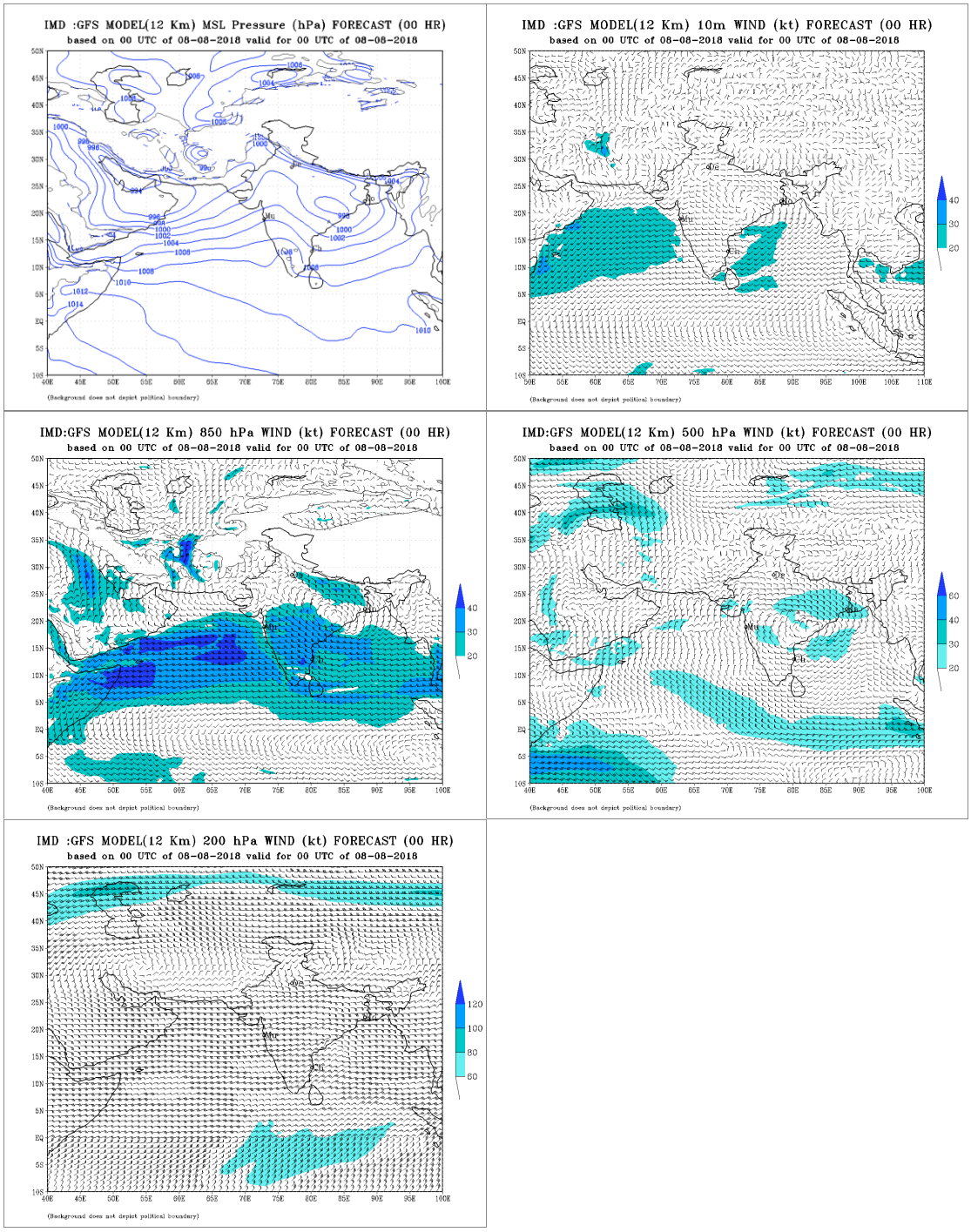


Fig3 (ii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 23rd July

Thus IMD GFS could not capture the genesis, intensification and weakening of the system.

4. Realized Weather:

4.1 Rainfall:

Under the influence of depression, widespread rainfall activity with isolated heavy to extremely heavy rainfall was observed over eastcentral India including Gangetic West Bengal, Odisha, Chattisgarh, Madhya Pradesh and east Rajasthan during 6-10th August. The 24 hour cumulative rainfall (≥ 7 cm) ending at 0830 hours IST of date during 7-11th August is presented below:

7th August

Gangetic West Bengal: Kharidwar 11,
Odisha: Puri 39, Satyabadi 18, Bhubaneswar & Brahmagiri 17 each, Pipili 16, Banki 15, Nimpara, Bolagarh & Paradeep 13 each, Niali 12, Khandapara 11, Kakatpur & Athgarh 10 each

8th August

Odisha: Junagarh -19, Deogaon – 15, Dharmagarh & Similiguda -13 each, Raighar, Kuchinda & Anandpur – 10 each, Jhorigam, Bijepur, Umarkote, Boden, Malkangiri, Jharsuguda, Hirakud, Lakhanpur & Kirmira – 9 each, Sinapali, Laikera, Bhawanipatna & Jeypore - 8 each and Kashipur, Marsaghai, Dabugan, Kankadahad, Kolabira, Tarva, Chandahandi, Ambabhona, Batli – 7 each

Chattisgarh: Deobhog – 15, Champa – 9, Sukma – 8 and Dantewara, Raigarh, Narayanpur & Sakti – 7 each

9th August
West Madhya Pradesh: Ashoknagar, Bhanpura & Neemuch – 8 each and Kurwai – 7 each
East Madhya Pradesh: Tendukheda – 7 each
Chhattisgarh: Kawardha – 9 and Simga & Bemetara – 8 each
East Rajasthan: Shahabad – 11, Chhotisadri – 9 and Bari-Sadri - 8

10th August
East Rajasthan: Pratapgarh and Dungla – 8 each
West Madhya Pradesh: Isagarh – 8 and Jawad -7
East Madhya Pradesh: Garhakota – 9 and Panna – 8

(Heavy rainfall distribution: Isolated places : upto 25%, A few places: 26-50%, Many places : 51-75%, Most places: 76-100% of total stations in the region;
Heavy rainfall: 64.5 – 115.5 mm, Very heavy rainfall: 115.6 – 204.4 mm, Extremely heavy rainfall: 204.5 mm or more).

The daily rainfall distribution ending at 0300 UTC of each date during 07-08 August, 2018 based on merged gridded rainfall data of IMD/NCMRWF is shown in Fig.4.

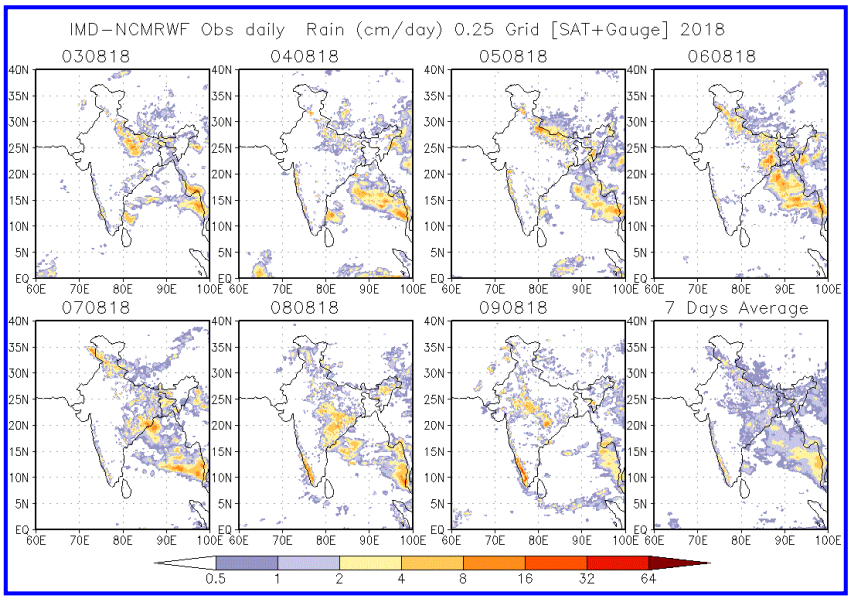


Fig.4: Daily rainfall distribution based on merged grided rainfall data of IMD/NCMRWF during 03-09 August, 2018

5. Bulletins issued by IMD

IMD issued regular bulletins to WMO/ESCAP Panel member countries including Bangladesh and Myanmar, National & State Disaster Management Agencies of Andhra Pradesh, Odisha, Chattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Telangana, Uttar Pradesh and Rajasthan, general public and media. Regular Bulletins every six hourly were issued since formation of depression over northwest BoB. In addition, RSMC New Delhi also issued Press Release and SMS to registered users.

5.1.: Bulletins issued by Cyclone Warning Division, New Delhi

Bulletins issued by Cyclone Warning Division of IMD in association with the system are given in Table 2

Table 2(a): Bulletins issued by Cyclone Warning Division, IMD, New Delhi

S. No.	Bulletins	No. of Bulletins	Issued to
1	National Bulletin	5	1. IMD's website 2. FAX and e-mail to Control Room NDM, Ministry of Home affairs, Control Room NDMA, Cabinet Secretariat, Minister of Sc. & Tech, Secretary MoES, DST, HQ Integrated Defence Staff, DG Doordarshan, All India Radio, DG-NDRF, Director Indian Railways, Indian Navy, IAF, Chief Secretary: Andhra Pradesh, Odisha, Chattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Telangana, Uttar Pradesh and Rajasthan.
2	RSMC Bulletin	3	1. IMD's website 2. All WMO/ESCAP member countries through GTS and E-mail. 3. Indian Navy, IAF by E-mail

3	Press Release	2	1. Disaster Managers, Media persons by email and uploaded on website
4	Facebook /Twitter	3 times	Highlights uploaded on facebook/twitter since formation of depression.

Table-2(b): Bulletins issued by Area Cyclone Warning Centre (ACWC) Kolkata/ Meteorological Centre (MC) Raipur

S. N.	Type of Bulletin	Number of Bulletins	
		ACWC Kolkata	MC Raipur
1.	Sea Area Bulletins	05	NIL
2.	Coastal Weather Bulletins	WB Coast- 04 A & N Coasts-04	NIL
3.	Fishermen Warnings issued	WB Coast -04 A & N Coasts-04	NIL
4.	Port Warnings	WB -Nil A & N Ids -Nil	NIL
5.	Heavy Rainfall Warning	GWB-01 SHWB & Sikkim- Nil A & N Islands- 01	03
6.	Gale Wind Warning	WB coast-Nil A & N-Nil	NIL
7.	Storm surge warning	NIL	NIL
8.	Information & Warning issued to State Government and other Agencies	04	03
9.	SMS/ Whatsapp (message in group)	650	10

6. Operational Forecast Performance

- The first information regarding formation of low pressure area over northwest BoB and adjoining Gangetic West Bengal during next 48 hours with low (1-25%) probability of formation of depression during subsequent 24 hours was issued by RSMC New Delhi in its Tropical Weather Outlook (TWO) issued at 0600 UTC of 5th August (21 hours in advance of formation of LPA and 51 hours in advance of formation of depression). The low pressure area formed over northwest BoB and neighbourhood at 0300 UTC of 6th August and depression formed over northwest BoB at 0900 UTC of 7th August.
- The information was further updated in the TWO issued at 0600 UTC of 7th August that depression would form over northwest BoB during next 24 hours with high probability (75-100%) (about 3 hours in advance). Depression formed over northwest BoB at 0900 UTC of 7th.
- In the first bulletin issued on 7th evening (1200 UTC), it was predicted that depression would move west-northwestwards with no further intensification and cross north Odisha and West Bengal coasts close to Balasore in the night (1430-1800 UTC) of 7th (about 4 hours in advance). The system moved west-northwestwards and crossed

north Odisha & West Bengal coasts close to Balasore in the night (1430-1630 UTC) of 7th.

IMD issued regular warning bulletins to the concerned central and state disaster management authorities and press & media. The verification of heavy rainfall warnings issued by IMD for the depression during 7th - 9th August is presented in Table 3. It can be found that the occurrence of heavy rainfall in association with the system could be predicted well in advance.

7. Summary and Conclusions:

A low pressure area formed over northwest Bay of Bengal (BoB) and neighbourhood in the morning (0300 UTC) of 6th July, 2018. It lay as a well marked low pressure area (WML) over northwest BoB and adjoining West Bengal & Odisha coasts in the early morning (0000 UTC) of 7th. It concentrated into a depression over northwest BoB in the same afternoon (0900 UTC) of 7th. Moving west-northwestwards it crossed north Odisha-West Bengal coasts close to Balasore during same night (1430 to 1630UTC). Moving further west-northwestwards, it weakened into a WML over north Chattisgarh and neighbourhood in the morning (0300 UTC) of 8th August, 2018.

8. Acknowledgements:

India Meteorological Department (IMD) duly acknowledges the contribution from all the stake holders who contributed to the successful monitoring, prediction and early warning service of the system. We specifically acknowledge the contribution from Indian Space Research Organisation (ISRO) and all sister organizations of Ministry of Earth Sciences including National Centre for Medium Range Weather Forecasting Centre (NCMRWF) NOIDA, National Institute of Technology (NIOT) Chennai & Indian National Centre for Ocean Information Services (INCOIS). The support from various Divisions/Sections of IMD including Area Cyclone Warning Centre Kolkata, Regional Meteorological Centre Nagpur, Cyclone Warning Centre Bhubaneswar, Raipur & Ranchi, Jaipur, Numerical Weather Prediction (NWP) Division, Information System & Services Division (ISSD) and Satellite and Radar Division at IMD HQ New Delhi is also duly acknowledged for monitoring and predicting the system.

Table 3 : Verification of heavy rainfall warning issued by IMD for Depression over northwest Bay of Bengal (7th-9th August, 2018)

Date/Time of Issue	Meteorological Sub-division	Forecast Rainfall for	Realised Rainfall (ending at 0830 IST of date)
07/ 0300 UTC		**Day-1 (upto 0830 IST of 8th August)**	**8th August** **Odisha:** Junagarh -19, Deogaon – 15, Dharmagarh & Similiguda -13 each, Raighar, Kuchinda & Anandpur – 10 each, Jhorigam, Bijepur, Umarkote, Boden, Malkangiri, Jharsuguda, Hirakud, Lakhanpur & Kirmira – 9 each, Sinapali, Laikera, Bhawanipatna & Jeypore - 8 each and Kashipur, Marsaghai, Dabugan, Kankadahad, Kolabira, Tarva, Chandahandi, Ambabhona, Batli – 7 each **Chattisgarh:** Deobhog – 15, Champa – 9, Sukma – 8 and Dantewara, Raigarh, Narayanpur & Sakti – 7 each **9th August:** **West Madhya Pradesh:** Ashoknagar, Bhanpura & Neemuch – 8 each and Kurwai – 7 each **East Madhya Pradesh:** Tendukheda – 7 each **Chhattisgarh:** Kawardha – 9 and Simga & Bemetara – 8 each **East Rajasthan:** Shahabad – 11, Chhotisadri – 9 and Bari-Sadri - 8 **10th August** **East Rajasthan:** Pratapgarh and Dungla – 8 each **West Madhya Pradesh:** Isagarh – 8 and Jawad -7 **East Madhya Pradesh:** Garhakota – 9 and Panna - 8
	Odisha	Heavy to very heavy rainfall at a few places and extremely heavy falls at isolated places	
	South Chattisgarh	Heavy to very heavy rainfall at a few places and extremely heavy falls at isolated places	
	North coastal Andhra Pradesh, Telengana, north Chhattisgarh	Heavy to very heavy falls at isolated places	
		Day-2 (upto 0830 IST of 9th August)	
	South Chhattisgarh	Heavy to very heavy rainfall at a few places and extremely heavy falls at isolated places	
	Madhya Pradesh	Isolated Heavy to very heavy falls at isolated places over Madhya Pradesh and isolated heavy falls over Vidarbha	
		Day-3 (upto 0830 IST of 10th August)	
	Madhya Pradesh	Isolated heavy to very heavy falls at Madhya Pradesh and isolated heavy falls over Vidarbha	
08/ 0300 UTC		**Day-1 (upto 0830 IST of 9th August)**	
	South Chhattisgarh	Heavy to very heavy rain at a few places	
	north Chhattisgarh	Heavy rainfall at isolated places	
	East Madhya Pradesh	Isolated heavy to very heavy rainfall very likely.	
	West Madhya Pradesh	Isolated heavy to very heavy falls	
	East Rajasthan	Heavy rainfall at isolated	
	Vidarbha & Telangana	Heavy falls at isolated places	
		Day-2 (upto 0830 IST of 10th August)	
	East Madhya Pradesh	Heavy rainfall at isolated places	
	West Madhya Pradesh	Heavy to very heavy falls at isolated places	
	East Rajasthan	Heavy to very heavy rainfall at isolated places	
		Day-3 (upto 0830 IST of 11th August)	
	West Madhya Pradesh	Heavy rainfall at isolated places	