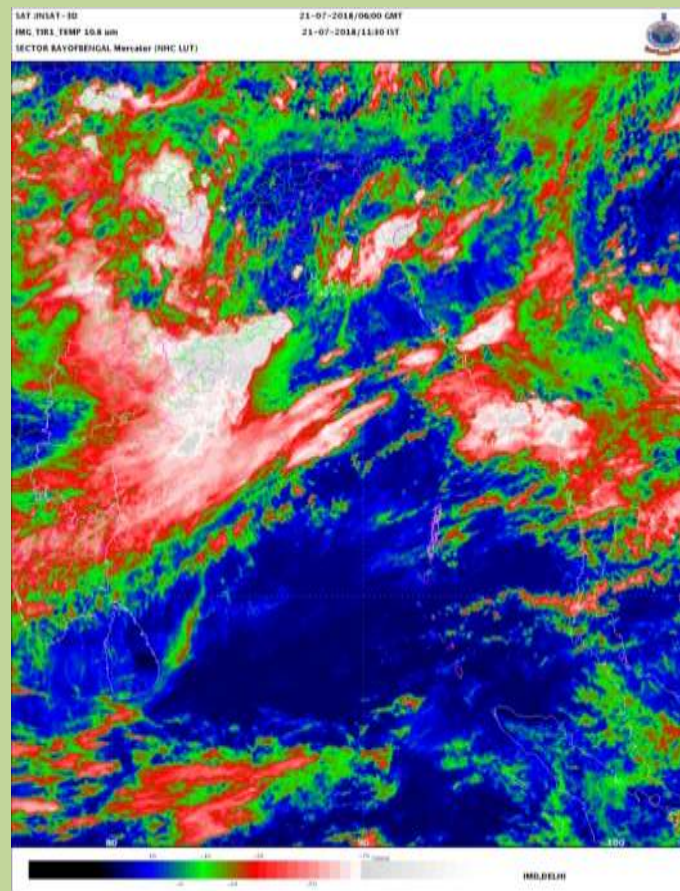




**GOVERNMENT OF INDIA  
MINISTRY OF EARTH SCIENCES  
INDIA METEOROLOGICAL DEPARTMENT**

**Depression over northwest Bay of Bengal  
(21-23 July, 2018): A Report**



INSAT-3D enhanced coloured IR imagery based on 0600 UTC of 21<sup>st</sup> July

**Cyclone Warning Division  
India Meteorological Department  
New Delhi  
July 2018**

## **Depression over northwest Bay of Bengal (21-23 July, 2018)**

### **1. Introduction**

A low pressure area formed over northwest Bay of Bengal (BoB) and adjoining Gangetic West Bengal & Odisha in the morning (0300 UTC) of 19<sup>th</sup> July, 2018. It lay as a well marked low pressure area (WML) over northwest BoB and adjoining West Bengal & Odisha in the morning (0300 UTC) of 20<sup>th</sup>. It concentrated into a depression over northwest BoB in the morning (0300 UTC) of 21<sup>st</sup>. Moving northwestwards, it crossed north Odisha - West Bengal coasts in the same evening (1100-1200 UTC) between Balasore and Digha. Moving further west-northwestwards, it weakened into a WML over northwest Jharkhand & neighbourhood in the morning (0300 UTC) of 23<sup>rd</sup>. The salient features of the system were as follows:

- (i) It had a straight moving track.
- (ii) It had a life period of 48 hours.
- (iii) It had a track length of 590 km.
- (iv) Under the influence of this system and its remnant low pressure area widespread and intense rainfall activity was observed over the northern and central parts of the country extending from Odisha, Gangetic West Bengal, Chattisgarh, Jharkhand, Madhya Pradesh, Uttar Pradesh, Uttarakhand, Himachal Pradesh, Rajasthan, Haryana, Chandigarh & Delhi. Extremely to exceptionally heavy rainfall occurred over Odisha on 20<sup>th</sup> & 21<sup>st</sup> leading to flood situations in some parts of the state.

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 and Myanmar. 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.

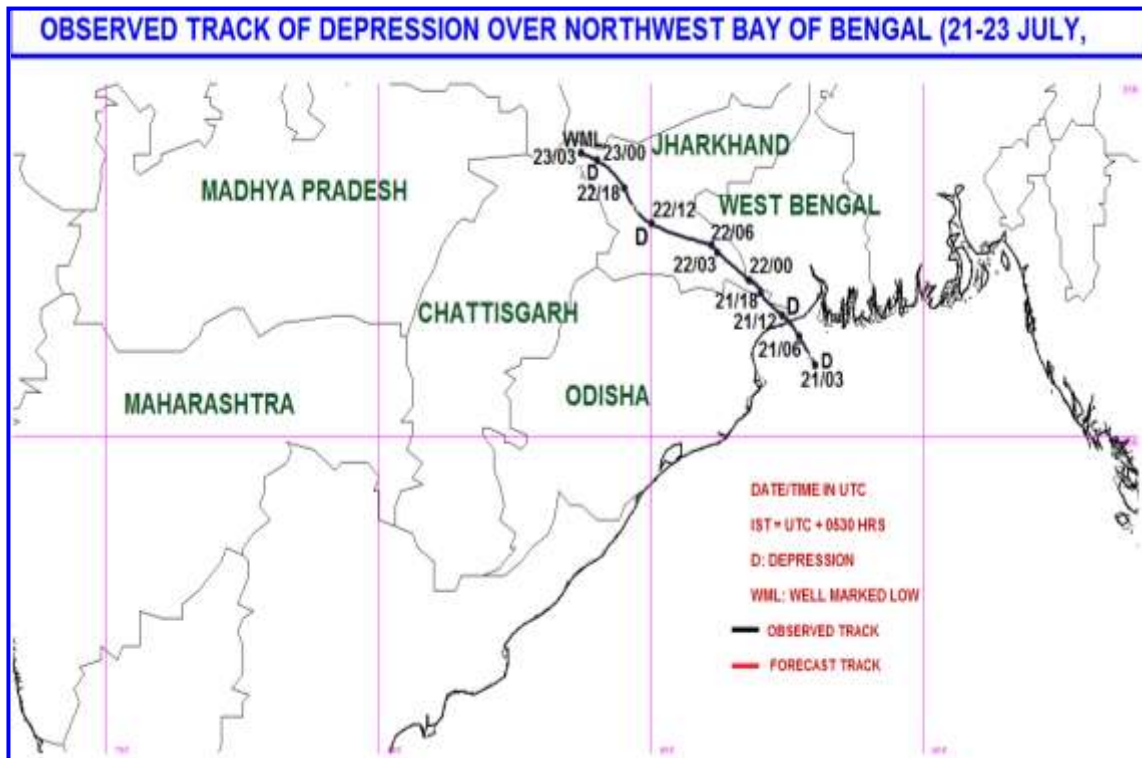
### **2. Brief life history**

Along the axis of monsoon trough, a low pressure area formed over northwest Bay of Bengal (BoB) and adjoining Gangetic West Bengal & Odisha at 0300 UTC of 19<sup>th</sup> July, 2018. Under favourable environmental conditions, It lay as a WML over northwest BoB and adjoining West Bengal & Odisha at 0300 UTC of 20<sup>th</sup>. On 20<sup>th</sup>, the Madden Julian Oscillation (MJO) index lay over phase 5 with amplitude greater than 1. MJO phase was favourable for enhancement of convective activity over BoB on 20<sup>th</sup>. The sea surface temperature (SST) was 28-30°C over north BoB. The tropical cyclone heat potential was around 60-80 KJ/cm<sup>2</sup> over southern parts of north BoB. The low level relative vorticity was about  $200 \times 10^{-6} \text{sec}^{-1}$  over westcentral BoB and was oriented in northeast-southwest direction. It was extending upto 500 hpa level. The lower level convergence was about  $30 \times 10^{-5} \text{sec}^{-1}$  to the southwest of system centre over westcentral BoB. The upper level divergence was about  $40 \times 10^{-5} \text{sec}^{-1}$  over westcentral BoB. The vertical wind shear was low to moderate (10-15 knots) over northwest BoB off West Bengal & Odisha coasts. The upper tropospheric ridge ran along 28°N. All these conditions supported further intensification and west-northwestward movement of the system.

At 0300 UTC of 21<sup>st</sup>, the system concentrated into a depression over northwest BoB. Considering the environmental conditions, the MJO index currently lay over phase 6 with amplitude greater than 1. The SST was 28-30°C over north BoB. The low level relative vorticity increased and was about  $150 \times 10^{-6} \text{sec}^{-1}$  in the southwest sector of the system centre. The lower level convergence was about  $20 \times 10^{-5} \text{sec}^{-1}$  to the southwest of system centre. The upper level divergence was about  $20 \times 10^{-5} \text{sec}^{-1}$  to the southwest of the system centre. The vertical wind

shear was moderate (10-20 knots) over northwest BoB between lower and middle tropospheric levels and high (> 20 knots) between lower and upper tropospheric levels. The steering flow suggested that the system would move west-northwestwards to northwestwards.

Moving northwestwards, the system crossed north Odisha-West Bengal coasts between Balasore and Digha in the same evening during 1100-1200 UTC. Though the environmental conditions and land interactions were not supporting intensification of system, the system maintained its intensity because of continuous moisture influx for next 36 hours and weakened into a WML at 0300 UTC of 23<sup>rd</sup> over northwest Jharkhand and neighbourhood. The observed track of depression over northwest BoB is presented in Fig.1.



**Fig.1. Observed track of Depression over northwest Bay of Bengal (21-23 July, 2018)**

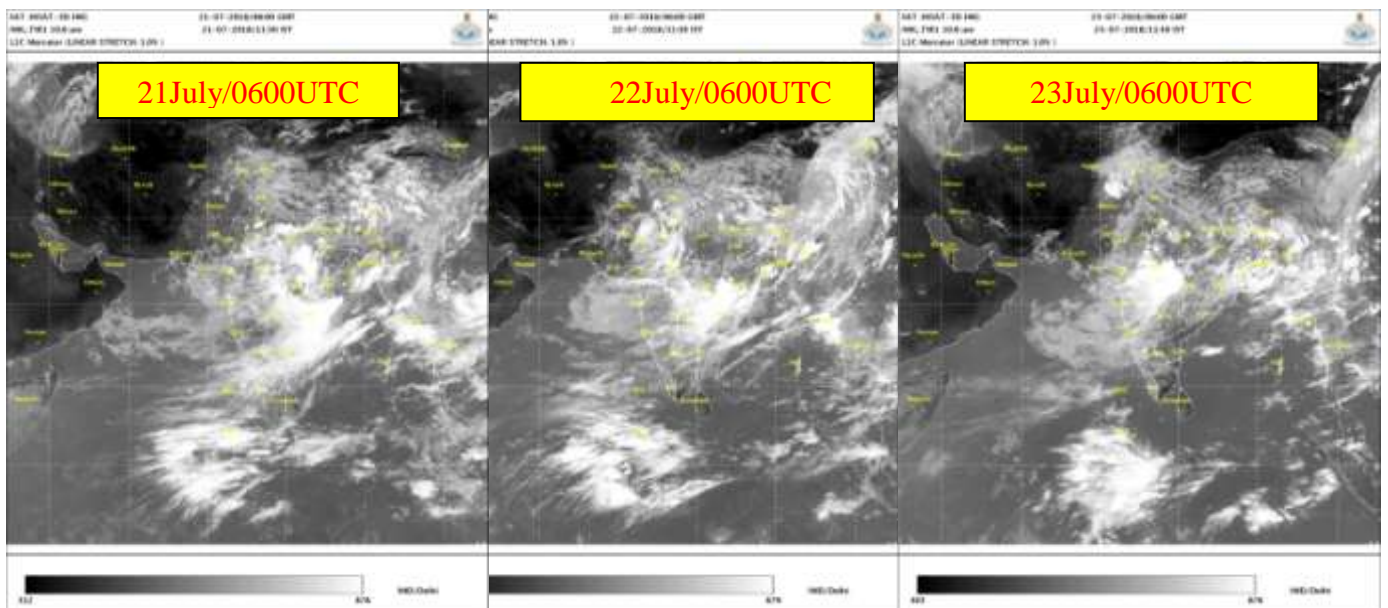
The best track parameters of the system are presented in Table 1. The typical satellite imageries are presented in Fig. 2.

**Table 1: Best track positions and other parameters of the Depression over northwest BoB during 21-23 July, 2018**

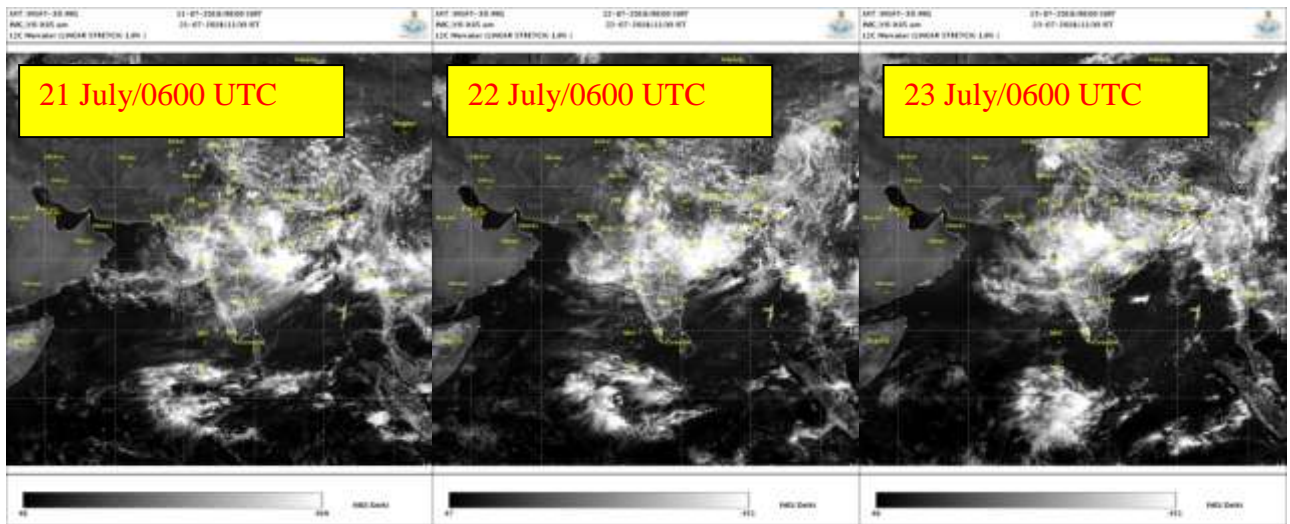
Date	Time (UTC)	Centre lat. <sup>o</sup> N/ long. <sup>o</sup> E	C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade
21.07.2018	0300	21.0/88.0	1.5	989	25	4	D
	0600	21.4/87.7	1.5	989	25	4	D
	Crossed north Odisha-West Bengal coasts between Balasore and Digha during 1100-1200 UTC						
	1200	21.7/87.4	-	989	25	4	D
	1800	22.0/87.0	-	990	25	3	D
22.07.2018	0000	22.2/86.8	-	992	25	3	D
	0300	22.6/86.2	-	992	25	3	D
	0600	22.7/86.1	-	992	25	3	D
	1200	23.0/85.0	-	992	25	3	D
	1800	23.5/84.5	-	993	20	3	D
23.07.2018	0000	23.9/84.0	-	993	20	3	D
	0300	Weakened into a Well Marked Low Pressure Area over northwest Jharkhand and neighbourhood at 0300 UTC					

### 3. Feature observed through Satellites:

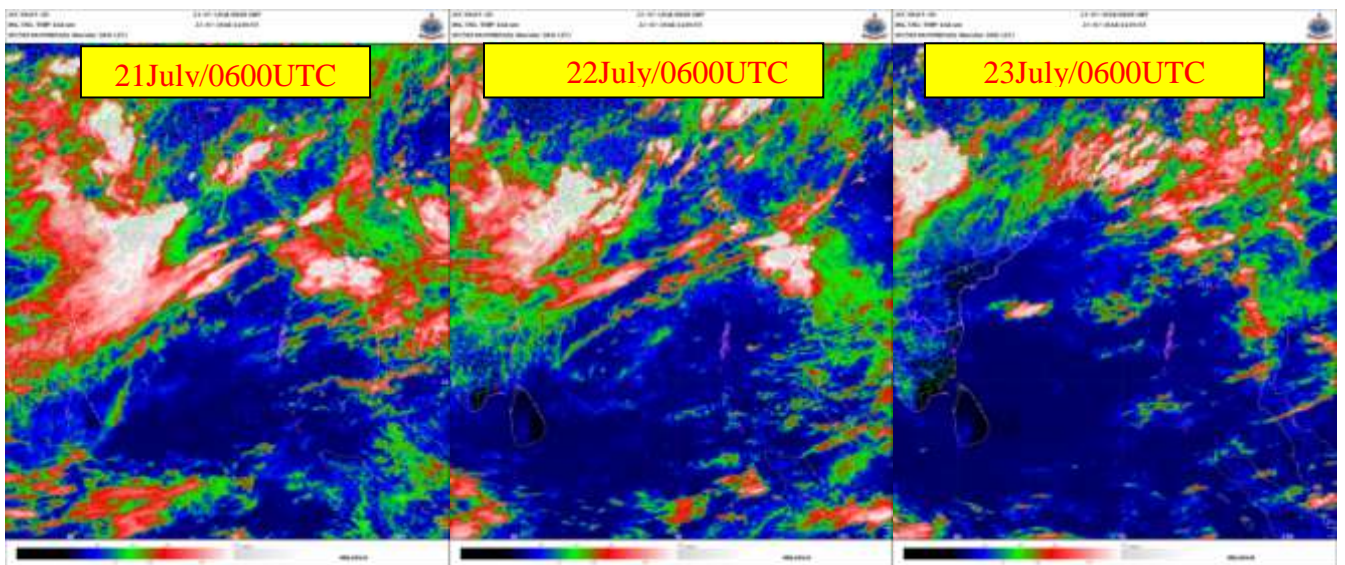
Satellite monitoring of the system was mainly done by using half hourly INSAT-3D imageries. Satellite imageries of international geostationary satellites Meteosat-7 and microwave & SCAT Sat imageries were also considered. Typical INSAT-3D IR, visible, enhanced colored and cloud top brightness temperature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



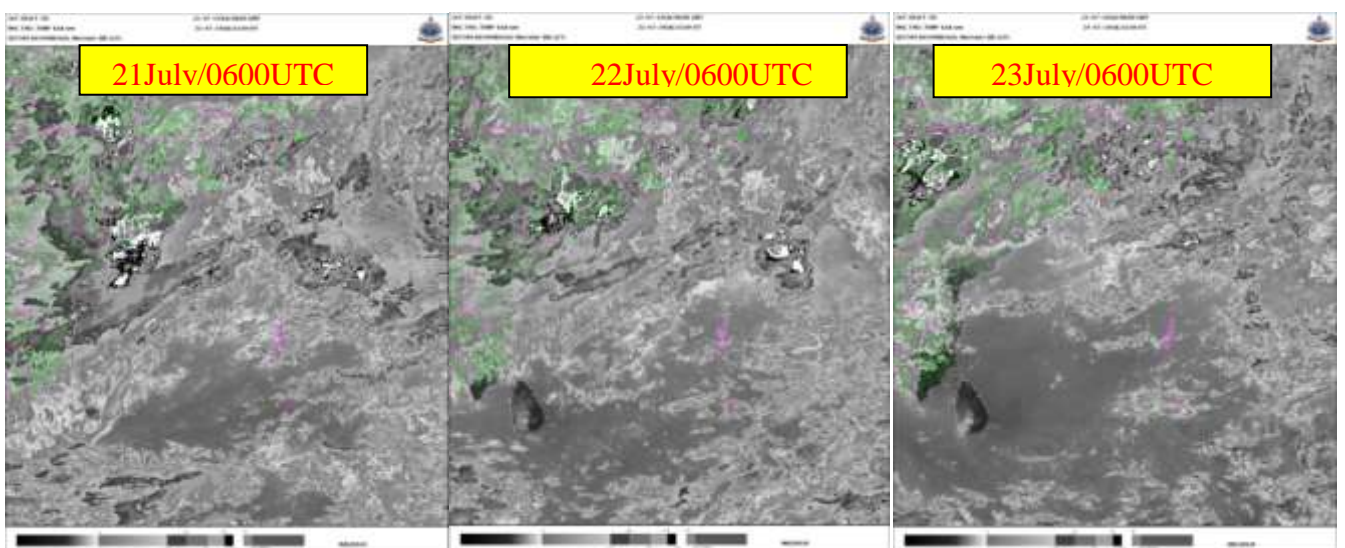
**Fig. 2(i): INSAT-3D IR imageries based on 0600 UTC during 21-23 July, 2018**



**Fig. 2(ii): INSAT-3D Visible imageries based on 0600 UTC during 21-23 July, 2018**



**Fig. 2(iii): INSAT-3D enhanced colored imageries based on 0600 UTC during 21-23 July, 2018**



**Fig. 2(iv): INSAT-3D cloud top brightness temperature imageries based on 0600 UTC during 21-23 July, 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.3. GFS (T1534) could simulate the genesis of the system and the associated circulation features during the life period of Depression. At 0000 UTC of 21<sup>st</sup>, it indicated a depression over northwest BoB off Odisha and West Bengal coasts.

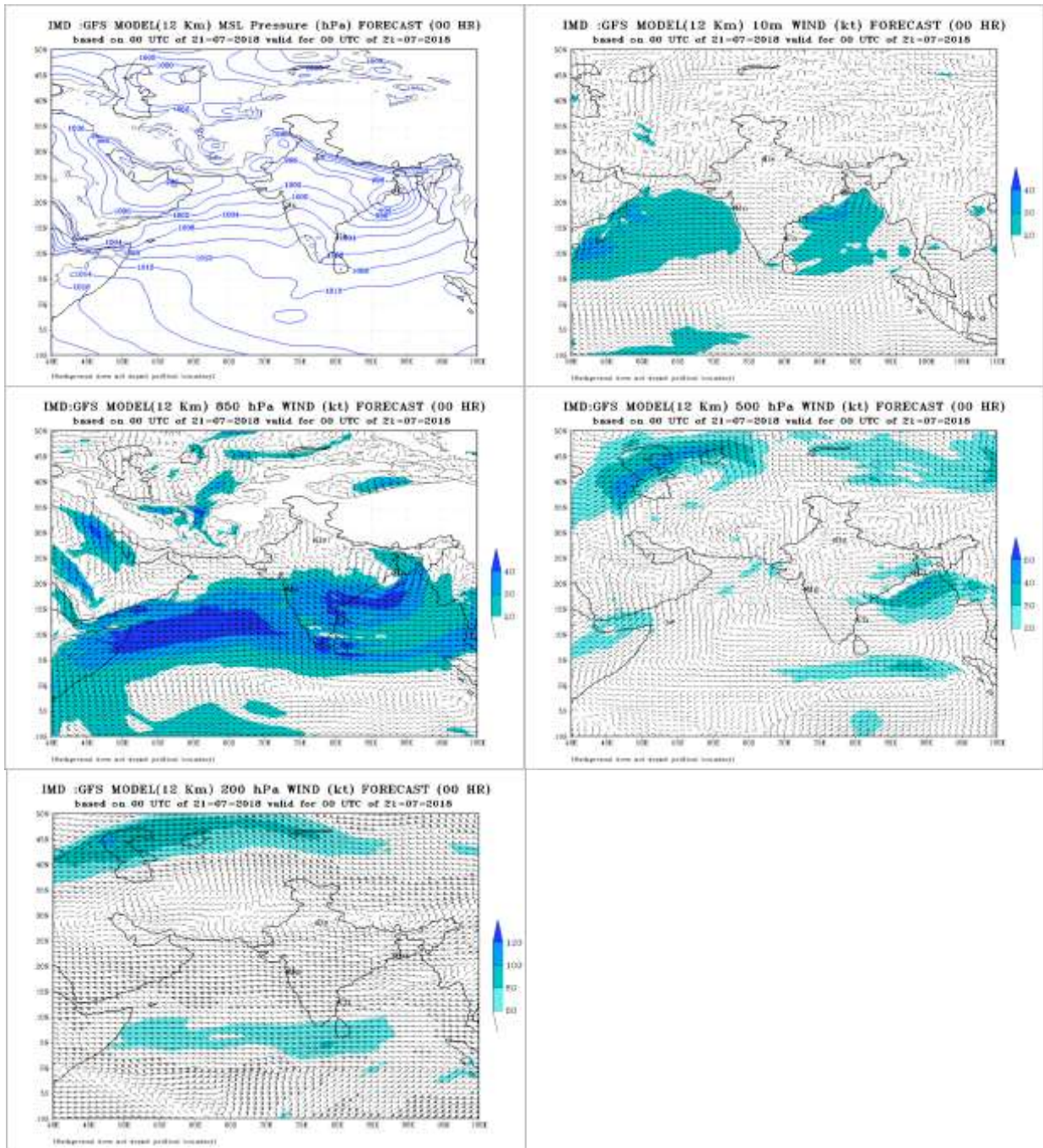
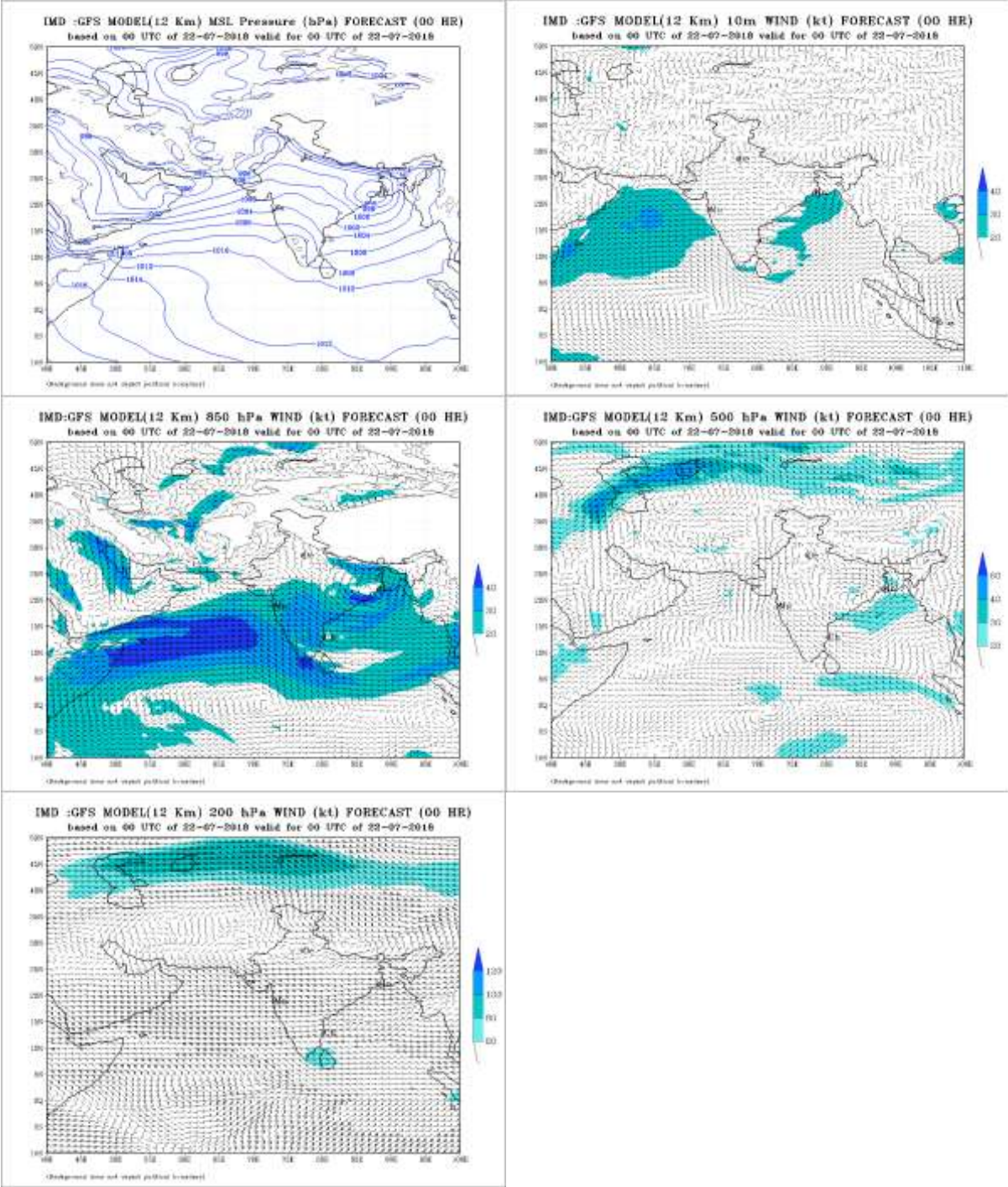


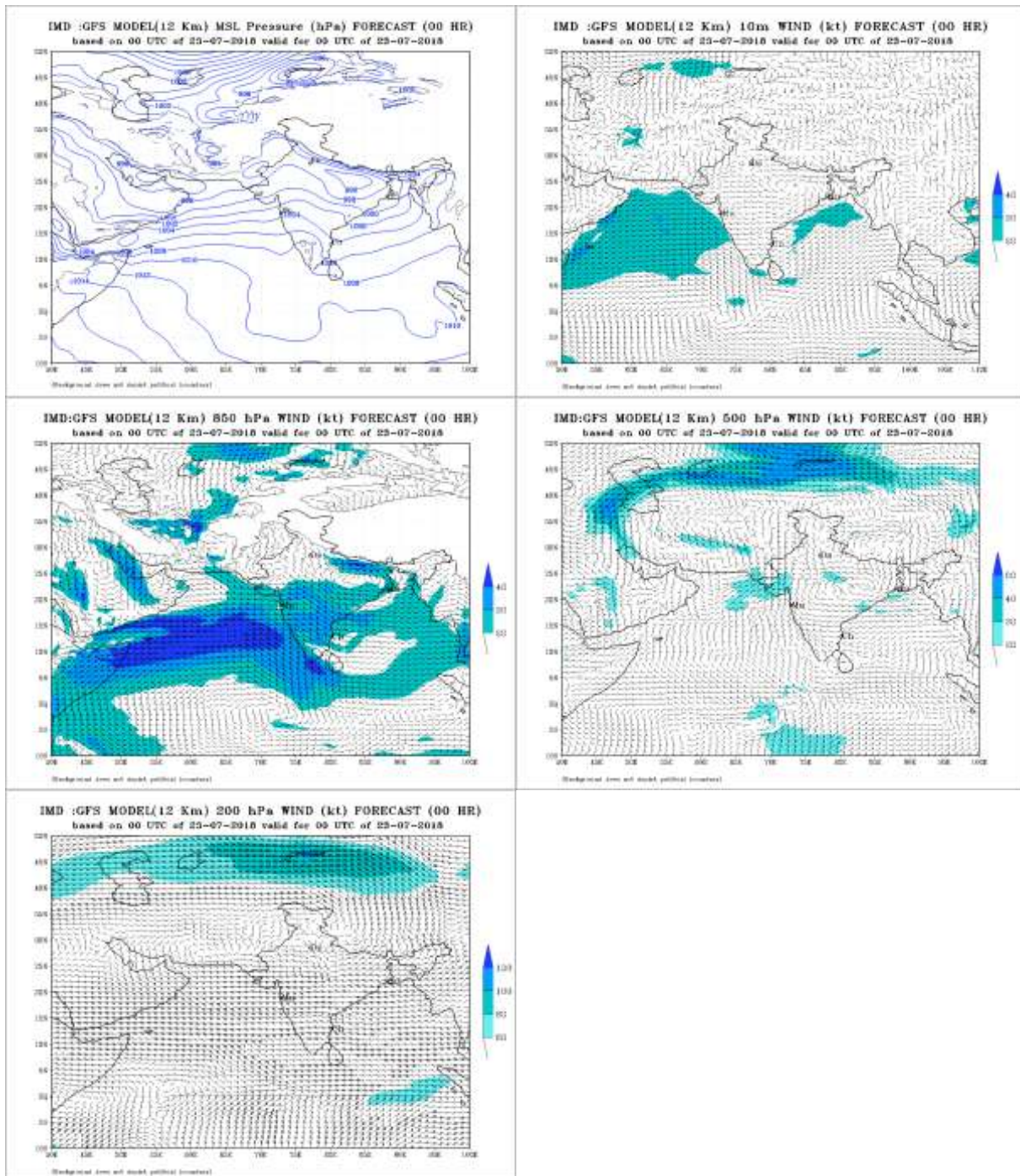
Fig3 (i): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 21<sup>st</sup> July

The initial conditions of 0000 UTC of 22<sup>nd</sup> July indicated the depression over Gangetic West Bengal and adjoining north Odisha.



**Fig3 (ii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 22<sup>nd</sup> July**

The initial conditions based on 0000 UTC of 23<sup>rd</sup> indicated weakening of system into a WML over Jharkhand and adjoining areas.



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

Thus IMD GFS could capture the genesis, movement and weakening of the system well.

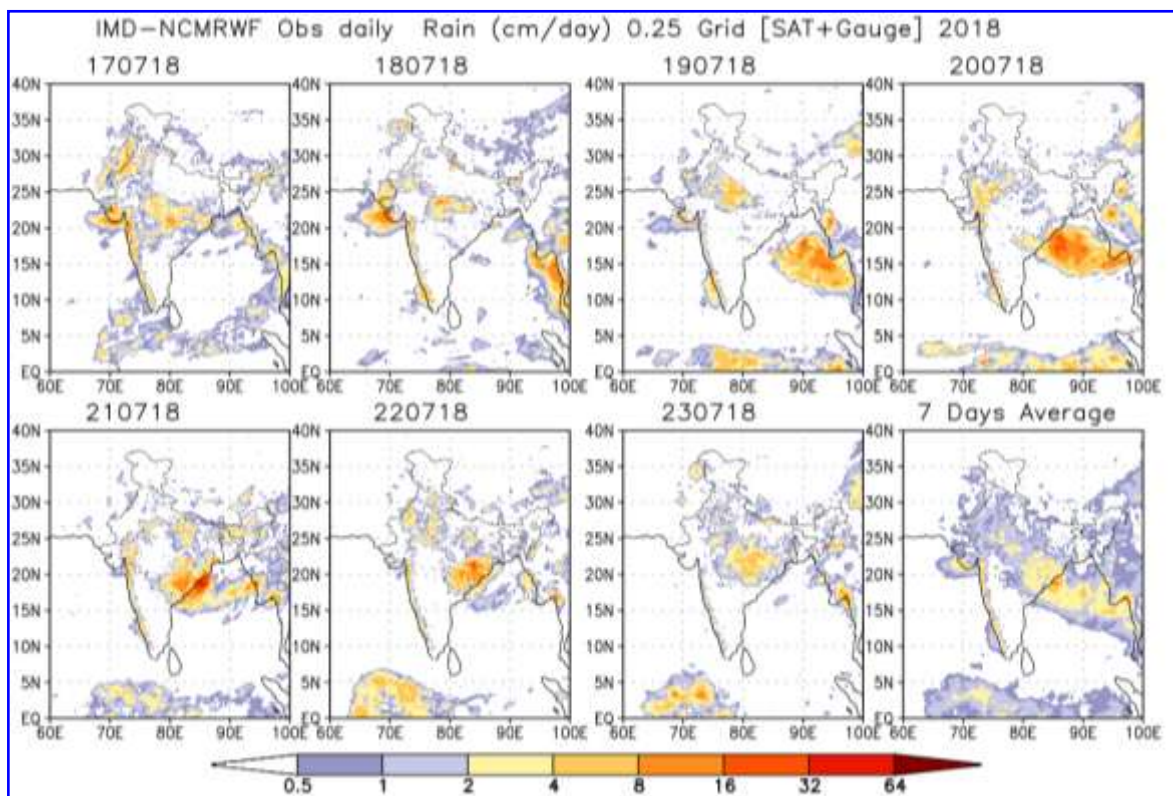


#### 4. Realized Weather:

##### 4.1 Rainfall:

Under the influence of depression, on 20<sup>th</sup> July, heavy to very heavy rainfall occurred at a few places with extremely heavy falls at isolated palces over Odisha, heavy to very heavy rainfall at a few places over Jharkhand & at isolated isolated places over north coastal Andhra Pradesh and heavy rainfall at isolated places over Telangana. On 21<sup>st</sup>, heavy to very heavy rainfall occurred at a few places with extremely heavy rainfall at isolated places over Odisha, heavy to very rainfall at isolated places over Chattisgarh and heavy rainfall at isolated places over Jharkhand, Gangetic West Bengal & west Madhya Pradesh. On 22<sup>nd</sup> heavy rainfall occurred at isolated places over Jharkhand, Chattisgarh, west Madhya Pradesh & east Rajasthan and at a few places over east Madhya Pradesh. On 23<sup>rd</sup>, heavy to very rainfall at isolated places occurred over west Madhya Pradesh and east Rajasthan, heavy rainfall at isolated places over east Madhya Pradesh and moderate rainfall at many places over Jharkhand. On 24<sup>th</sup>, heavy to very heavy rainfall occurred at isolated places over Bihar & east Rajasthan and heavy rainfall occurred at isolated places over Uttar Pradesh.

The daily rainfall distribution ending at 0300 UTC of each date during 17-23 July, 2018 based on merged gridded rainfall data of IMD/NCMRWF is shown in Fig.4.



**Fig.4: Daily rainfall distribution based on merged gridded rainfall data of IMD/NCMRWF during 12-18 March 2018**

(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 24 hour cumulative rainfall ( $\geq 7$  cm) ending at 0830 hours IST of date during 21<sup>st</sup>-25<sup>th</sup> July is presented below:

### **21<sup>st</sup> July**

#### **Odisha:**

Brahmagiri -29, Puri-27, Junagarh-26, Tentulikhunti, Pipili & Kesinga -24 each, Kashipur-22, Narla, Cuttack & Jaipatna-21 each, Madanpur Rampur-20, Satyabadi, Bhubaneswar, Koraput & Similiguda -19 each, Mundali-17, Banki -16, Nuagada -15, Naraj & Jeypore -14 each, Bhawanipatna-13, Paralakhemundi, Nawarangpur & Salebhatta -12 each, Korei & Titlagarh-11 each, Balipatna, Tigiria, Krishnaprasad & Rajghat-10 each, Jajpur, Pottangi, R.Udaigiri, Akhuapada, Berhampur, Tangi, Gunupur, Kotagarh, Athgarh, Dhamnagar, Rayagada, Kantapada & Banpur-9 each, Lanjigarh, Malkangiri, Bolagarh, Paradeep, Gopalpur, Bonth, Astaranga, Kaptipada & Chandikhol-8 each, Dhenkanal, Danagadi, Dharmagarh, Kashinagar, Gop, Chhatrapur, Tarva, Kakatpur, Nayagarh, Kujanga, Kosagumda & Jaleswar-7 each

#### **Coastal Andhra Pradesh:**

Palasa-15, Sompeta & Mandasa-12 each, Tekkali & Pathapatnam-11 each, Ichchapuram-10, Araku Valley-9, Chintapalle-8 and Palakonda, Paderu & Kalingapatnam-7 each

### **22<sup>nd</sup> July**

**Chhattisgarh:** Sarangarh -12, Saraipali -7.

**Gangetic West Bengal:** Canning - 7

**Odisha:** Burla – 62, Sambalpur – 57, Birmaharajpur – 43, Hirakud – 40, Atabira -35, Barh-31, Rairakhol - 30, Ullunda - 26, Jujumura – 22, Binika, Khairamal & Athmalik- 21 each, Rajkishorenagar, Barpalli , Jagannath Prasad & Batli – 19 each, Tikabali, Satyabadi & Salebhatta – 17 each, Odagaon , Phiringia , Brahmagiri AWS & Dunguripalli – 16 each, Sonapur & Banki – 15 each, Kuchinda – 14, Ambabhona & Daspalla – 13 each, Akhuapada, Puri, Kendrapara, G Udayagiri, Agalpur , Krishnaprasad, Altuma, Jajpur & Tikarpara -12 each, Bijepur, Nawana, Laikera, Korei , Naktideul, Jamankira, Kirmira , Telkoi, Belaguntha , Bhanjnagar, Derabis , Marsaghai , Kolabira & Kamakhyanagar - 11 each, Sohela, Kotagarh, Parjang , K Nuagaon , Nayagarh & Madanpur Rampur – 10 each, Banarpal , Hindol, Keonjharh, Binjharpur , Chandbali, Batagaon, Reamal, Madhabarida, Talcher, Gurundia , Gaisilet , Banpur, Thakurmunda, Tarva , Jharsuguda, Kaptipada , Pallahara, Kashipur, Lahunipara, Gania , Dhenkanal, Danagadi , Soro, Bamra , Rajkanika, Barmul, Junagarh, Bari , Chandanpur & Jenapur – 8 each and Astaranga , Phulbani, Deogaon, Baliguda, Tangi, Chandikhol , Rengali, Chendipada, Narsinghpur, Mohana, Jhumpura, Raikia , Purushottampur, Bolagarh , Jaipatna & Sorada – 7 each

**Jharkhand:** Chaibasa – 7.

### **23<sup>rd</sup> July**

#### **Odisha:**

Kuchinda & Gaisilet - 9 each, Paikmal – 8, Jharbandh, Joshipur & Hirakud – 7 each,

#### **Gangetic West Bengal:**

Diamond Harbour -17 each, Alipore – 8

#### **Jharkhand:**

Rajmahal & Chakradharpur – 10 each, Raidih & Jamshedpur -7 each,

#### **Chattisgarh:**

Bemetara-10, Kawardha & Saraipali -9 each, Simga -8, Ambagarh Chowki & Jashpurnagar – 7 each

#### **East Madhya Pradesh:**

Bichhia – 11, Singrauli, Katni & Mandla – 9 each, Patan, Sagar & Kotma – 7 each

#### **West Madhya Pradesh:**

Ratlam – 11, Ashok Nagar – 9, Khachrod – 8

### **24 July**

**Bihar:** Taibpur & Thakurganj-14 each and Kishanganj-7

**East Rajasthan:** Sawaimadhopur Tesil -12, Sawai Madhopur-10, Kishanganj, Manohar Thana & Shahabad-9 each, Anta-8, Dug and Kota-Aero, Chabra, Baran, Asnawar, Atru & Bakani Sr-7 each

**West Madhya Pradesh:** Nalkheda-13, Kolaras-11, Sabalgarh-10, Pachmarhi-9, Shivpuri, Gandhwani, Biaora & Kurwai-8 each and Dewas & Sarangpur-7 each

**East Madhya Pradesh:** Rehli & Deori-7 each

### 25 July

**Bihar:** Rajauli-17, Jhanjharpur-14, Palmerganj-11, Hisua-10, Madhwapur-8 and Nawada & Bhabhua-7 Each

**East Uttar Pradesh:** Gyanpur-10, Pratapgarh-9

**West Uttar Pradesh:** Meerut-9 and Budhana, Muzaffarnagar & Atrauli-7 each,

**East Rajasthan:** Neemkathana-19, Shahabad & Srimadhopur-14, Sanganer Tehsil-10, Jaipur Aero-9, Nayanagar/Beawar-8

## **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	11	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	3	1. Disaster Managers, Media persons by email and uploaded on website
4	Facebook /Twitter	5 times	Highlights uploaded on facebook/twitter twice daily since formation of depression.

**Table-2(b): Bulletins issued by Area Cyclone Warning Centre (ACWC) Kolkata/ Cyclone Warning Centre (CWC) Bhubaneswar**

S. N.	Type of Bulletin	Number of Bulletins	
		ACWC Kolkata	CWC Bhubaneswar
1.	Sea Area Bulletins	5	NIL
2.	Coastal Weather Bulletins	WB Coast- 5 A & N Coasts-5	09
3.	Fishermen Warnings	WB Coast -9 A & N Coasts-5	15
4.	Port Warnings	WB -3 A & N-2	09
5.	Heavy Rainfall Warning	WB-3	04
6.	Gale Wind Warning	WB coast-2 A & N-Nil	NIL
7.	Information & Warning to State Government and other Agencies	West Bengal Govt – 07	07
8.	SMS	1000 (approx)	1260
9.	Press Release	-	4

## 6. Operational Forecast Performance

- The first information regarding formation of low pressure area over northwest BoB around 19<sup>th</sup> July was issued by RSMC New Delhi in its Tropical Weather Outlook (TWO) issued at 0600 UTC of 15<sup>th</sup> July (96 hours in advance). The low pressure area formed over northwest BoB and adjoining Gangetic West Bengal & Odisha coasts at 0300 UTC of 19<sup>th</sup> July.
- The first information regarding formation of depression over northwest BoB around 22<sup>nd</sup> was predicted in the TWO issued at 0600 UTC of 18<sup>th</sup> with probability LOW (1-25%)
- The information was further updated in the TWO issued at 0600 UTC of 20<sup>th</sup> that depression would form over northwest BoB around 21<sup>st</sup> with moderate probability (51-75%) (about 24 hours in advance). Depression formed over northwest BoB at 0300 UTC of 21<sup>st</sup>.
- In the first bulletin issued on 21<sup>st</sup> morning (0640 UTC (1210 IST)), it was predicted that depression would move west-northwestwards with no further intensification and cross Odisha and West Bengal coasts between Chandbali and Digha close to Balasore around evening of 21<sup>st</sup>. The system moved west-northwestwards and crossed West Bengal & north Odisha coasts between Balasore & Digha around evening of 21<sup>st</sup> between 1100-1200 UTC (1630-1730 IST).

IMD issued warning bulletins to the concerned central and state disaster management authorities & press and media. The verification of heavy rainfall warnings issued by IMD for the depression during 21<sup>st</sup> -25<sup>th</sup> July 2018 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.

**Table 3 : Verification of heavy rainfall warning issued by IMD for Depression over northwest Bay of Bengal (21<sup>st</sup> -25<sup>th</sup> July, 2018)**

Date/Time of issue (UTC)	Met. Sub-division	Forecast for Day-1 (upto 0830 IST of 22 July 2018)	Realised 24 hour Rainfall (cm) ending at 0830 of date
21 <sup>st</sup> July/0300 UTC	Odisha	Heavy to very heavy rainfall at a few places and extremely heavy rainfall at isolated places.	<b>22<sup>nd</sup> July</b> <b>Chhattisgarh:</b> Sarangarh -12, Saraipali -7.
	<b>Gangetic West Bengal</b>	Heavy to very heavy rainfall at isolated places	<b>Gangetic West Bengal:</b> Canning - 7
	<b>Jharkhand</b>	Heavy to very heavy rainfall at isolated places	<b>Odisha:</b> Burla – 62, Sambalpur – 57, Birmaharajpur – 43, Hirakud – 40, Atabira -35, Barh-31, Rairakhol - 30, Ullunda - 26, Jujumura – 22, Binika, Khairamal & Athmalik- 21 each, Rajkishorenagar, Barpalli , Jagannath Prasad & Batli – 19 each, Tikabali, Satyabadi & Salebhatta – 17 each, Odagaon , Phiringia , Brahmagiri AWS & Dunguripalli – 16 each, Sonapur & Banki – 15 each, Kuchinda – 14, Ambabhona & Daspalla – 13 each, Akhuapada, Puri, Kendrapara, G Udayagiri, Agalpur , Krishnaprasad, Altuma, Jajpur & Tikarpara -12 each, Bijepur, Nawana, Laikera, Korei , Naktideul, Jamankira, Kirmira , Telkoi, Belaguntha , Bhanjnagar, Derabis , Marsaghai , Kolabira & Kamakhyanagar - 11 each, Sohela, Kotagarh, Parjang , K Nuagaon , Nayagarh & Madanpur Rampur – 10 each, Banarpal , Hindol, Keonjharh, Binjharpur , Chandbali, Batagaon, Reamal, Madhabarida, Talcher, Gurundia , Gaisilet , Banpur, Thakurmunda, Tarva , Jharsuguda, Kaptipada , Pallahara, Kashipur, Lahunipara, Gania , Dhenkanal, Danagadi , Soro, Bamra , Rajkanika, Barmul, Junagarh, Bari , Chandanpur & Jenapur – 8 each and Astaranga , Phulbani, Deogaon, Baliguda, Tangi, Chandikhol , Rengali, Chendipada, Narsinghpur, Mohana, Jhumpura, Raikia , Purushottampur, Bolagarh , Jaipatna & Sorada – 7 each
	<b>Chattisgarh</b>	Heavy to very heavy with extremely heavy rainfall at isolated places	<b>Jharkhand:</b> Chaibasa – 7.
	<b>Vidharbha</b>	Heavy to very heavy rainfall at isolated places	<b>23<sup>rd</sup> July</b> <b>Odisha:</b> Kuchinda & Gaisilet - 9 each, Paikmal – 8, Jharbandh, Joshipur & Hirakud – 7 each,
	<b>Telangana and North coastal Andhra Pradesh</b>	Heavy to very heavy rainfall at isolated places	<b>Gangetic West Bengal:</b> Diamond Harbour -17 each, Alipore – 8
		<b>Forecast for Day-2 (upto 0830 IST of 23 July 2018)</b>	<b>Jharkhand:</b> Rajmahal & Chakradharpur – 10
	Odisha	Heavy to very heavy rainfall at a few places and extremely heavy rainfall at isolated places.	
	<b>Gangetic West Bengal</b>	Heavy to very heavy rainfall at isolated places	
	<b>Jharkhand</b>	Heavy to very heavy rainfall at isolated places	
	<b>Chattisgarh</b>	Heavy to very heavy rainfall at a few places and extremely heavy rainfall at isolated places	
	<b>Vidharbha</b>	Heavy to very heavy rainfall at isolated places	
<b>Telangana and North coastal Andhra Pradesh</b>	Heavy to very heavy rainfall at isolated places		
22 July/0300 UTC		<b>Forecast for Day-1 (upto 0830 IST of 23<sup>rd</sup> July 2018)</b>	
	Odisha	<b>Interior Odisha:</b> Heavy to very heavy rainfall at a few places and <b>extremely heavy rainfall</b> at isolated places. <b>Coastal Odisha:</b> Heavy rainfall at isolated places.	
	<b>Gangetic West Bengal</b>	Heavy rainfall at isolated places	
	<b>Jharkhand</b>	Heavy to very heavy rainfall at isolated places	
	<b>Chattisgarh</b>	<b>South Chattisgarh:</b> Heavy to very heavy at a few places & <b>extremely heavy rainfall</b> at isolated places. <b>North Chattisgarh:</b> Heavy to very heavy at isolated places.	
<b>Vidharbha</b>	<b>East Vidharbha:</b> Heavy to very heavy at a few places & <b>extremely heavy rainfall</b> at		

		isolated places <b>West Vidharbha:</b> Heavy to very heavy rainfall at isolated places	each, Raidih & Jamshedpur -7 each, <b>Chattisgarh:</b> Bemetara-10, Kawardha & Saraipali - 9 each, Simga -8, Ambagarh Chowki & Jashpurnagar – 7 each <b>East Madhya Pradesh:</b> Bichhia – 11, Singrauli, Katni & Mandla – 9 each, Patan, Sagar & Kotma – 7 each <b>West Madhya Pradesh:</b> Ratlam – 11, Ashok Nagar – 9, Khachrod – 8
	<b>East Madhya Pradesh</b>	Heavy at a few places and very heavy with <b>extremely heavy rainfall</b> at isolated places	
	<b>West Madhya Pradesh</b>	Heavy to very heavy rainfall at isolated places	
	<b>Telangana</b>	Heavy to very heavy rainfall at isolated places	
		<b>Forecast for Day-2 (upto 0830 IST of 23 July 2018)</b>	
	<b>Odisha</b>	Heavy rainfall at isolated places over Interior Odisha	<b>24 July</b> <b>Bihar:</b> Taibpur & Thakurganj-14 each and Kishanganj-7 <b>East Rajasthan:</b> Sawaimadhopur Tesil -12, Sawai Madhopur-10, Kishanganj, Manohar Thana & Shahabad-9 each, Anta-8, Dug and Kota-Aero, Chabra, Baran, Asnawar, Atru & Bakani Sr-7 each <b>West Madhya Pradesh:</b> Nalkheda-13, Kolaras-11, Sabalgarh-10, Pachmarhi-9, Shivpuri, Gandhwani, Biaora & Kurwai-8 each and Dewas & Sarangpur-7 each <b>East Madhya Pradesh:</b> Rehli & Deori-7 each
	<b>Gangetic West Bengal</b>	Rainfall at many places	
	<b>Jharkhand</b>	Heavy rainfall at isolated places	
	<b>Chattisgarh</b>	<b>South Chattisgarh:</b> Heavy to very heavy at isolated places <b>North Chattisgarh:</b> Heavy at isolated places	
	<b>Vidharbha</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
	<b>East Madhya Pradesh</b>	Heavy to very heavy rainfall at isolated places	
	<b>West Madhya Pradesh</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
	<b>Telangana</b>	Heavy rainfall at isolated places	
		<b>Forecast for Day-1 (upto 0830 IST of 24 July 2018)</b>	
	<b>Jharkhand</b>	Heavy rainfall at isolated places	<b>25 July</b> <b>Bihar:</b> Rajauli-17, Jhanjharpur-14, Palmerganj-11, Hisua-10, Madhwapur-8 and Nawada & Bhabhua-7 Each <b>East Uttar Pradesh:</b> Gyanpur-10, Pratapgarh-9 <b>West Uttar Pradesh:</b> Meerut-9 and Budhana, Muzaffarnagar & Atrauli-7 each, <b>East Rajasthan:</b> Neemkathana-19, Shahabad & Srimadhopur-14, Sanganer Tehsil-10, Jaipur -9, Nayanagar/Beawar-8
	<b>Chattisgarh</b>	Heavy to very heavy at isolated places	
	<b>Vidharbha</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
	<b>East Madhya Pradesh</b>	Heavy to very heavy rainfall & <b>extremely heavy rainfall</b> at isolated places	
	<b>West Madhya Pradesh</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
	<b>East Rajasthan</b>	Heavy to very heavy at isolated places	
		<b>Forecast for Day-2 (upto 0830 IST of 25 July 2018)</b>	
	<b>Vidharbha</b>	Heavy falls at isolated places	
	<b>East Madhya Pradesh</b>	Heavy rainfall at isolated places	
	<b>West Madhya Pradesh</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
	<b>East Rajasthan</b>	Heavy to very heavy & <b>extremely heavy rainfall</b> at isolated places	
<b>23 July/0300 UTC</b>			

## 7. Summary and Conclusions:

A low pressure area formed over northwest BoB and adjoining Gangetic West Bengal & Odisha in the morning (0300 UTC) of 19<sup>th</sup> July, 2018. It lay as a well marked low pressure area (WML) over northwest BoB and adjoining West Bengal & Odisha in the morning (0300 UTC) of 20<sup>th</sup>. It concentrated into a depression over northwest BoB in the morning (0300 UTC) of 21<sup>st</sup>. Moving northwestwards, it crossed north Odisha - West Bengal coasts in the same evening

(1100-1200 UTC) between Balasore and Digha. Moving further west-northwestwards, it weakened into a WML over northwest Jharkhand & neighbourhood in the morning (0300 UTC) of 23<sup>rd</sup>.

#### **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, 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.

---