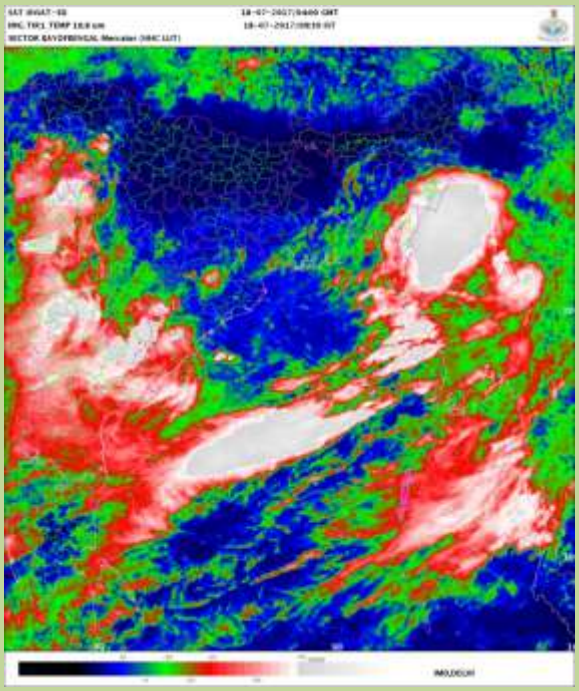
GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT

Depression over the Bay of Bengal (18-19 July, 2017): A Report



INSAT-3D enhanced coloured IR imagery based on 0400 UTC of 18th July

Cyclone Warning Division

India Meteorological Department

New Delhi

July 2017

Depression over the Bay of Bengal
(18-19 July 2017)

1. Introduction

In association with active monsoon conditions, an upper air cyclonic circulation developed over eastern parts of Gangetic West Bengal & neighbourhood in the morning of 12th July. Under its influence, a low pressure area formed over northwest Bay of Bengal (BoB) off north Odisha & Gangetic West Bengal coast on 15th morning. It lay as a well marked low pressure area over northwest & adjoining westcentral BoB and coastal areas of Odisha & north Andhra Pradesh in the morning of 17th. It concentrated into a depression over northwest and adjoining westcentral BoB & coastal areas of Odisha in the morning of 18th. Thereafter, it moved west-northwestwards and crossed Odisha coast near Puri around 2030 hours IST on the same day. It weakened into a well marked low pressure area in the morning of 19th over interior Odisha & neighbourhood and into a low pressure area over interior Odisha & adjoining Chhattisgarh in the evening of 19th July 2017. It continued to move west northwestwards and weakened gradually.

2. Brief life history

2.1. Genesis and intensification

An upper air cyclonic circulation lay over northwest BoB extending upto 7.6 Km above mean sea level tilting southwestwards with height on 12th, over North Bay of Bengal & neighbourhood on 13th; over northwest BoB & neighborhood on 14th July. Under its influence, a low pressure area formed over northwest BoB off north Odisha & West Bengal coast on 15th with the associated upper air cyclonic circulation extending upto 7.6 km above mean sea level. It persisted over the same region on 16th July. It lay as a well marked low pressure area over northwest BoB and adjoining westcentral BoB and coastal areas of Odisha & north Andhra Pradesh with associated upper air cyclonic circulation extending up to 7.6 Km above mean sea level tilting southwestwards with height on 17th July. It concentrated into a depression over northwest and adjoining westcentral BoB & coastal areas of Odisha centered near Lat.19.0°N and Long.86.0°E, about 120 km east-southeast of Gopalpur (Odisha) and about 80 km south-southeast of Puri at 0830 hours IST on 18th July. It moved west-northwestwards and crossed Odisha coast near Puri around 2030 hours IST on the same day and lay over interior Odisha & neighbourhood as a well marked low pressure with associated upper air cyclonic circulation extending up to 7.6 Km above mean sea level tilting southwestwards with height in the morning on 19th; It weakened further and lay over interior Odisha and adjoining Chhattisgarh as a low pressure area in the evening of 19th July 2017.

According to satellite imageries, the intensity of the system was CI.1.5 at the time of formation of depression. The estimated central pressure was 992 hPa. The maximum sustained wind speed was 25 knots gusting 35 knots. Sea condition was rough to very rough around system centre. Associated broken low and medium clouds with embedded moderate to intense to very intense convection lay over Bay of Bengal between latitude 16.0^0N and 19.0^0N & west of longitude 89.0^0E, south coastal Odisha, north coastal Andhra Pradesh and adjoining areas.

The sea surface temperature (SST) was around 28-29˚C. The ocean heat content was < 50 kJ/cm^2 near Odisha coast. The low level convergence was about $20x10^{-5}$ second^{-1} to the southwest of system centre, the upper level divergence was around $10x\ 10^{-5}$ second^{-1} to the southwest of system centre and the low level relative vorticity was around $100x10^{-6}$ second^{-1}. The vertical wind shear of horizontal wind was moderate (15 knots) around the system centre and was increasing towards northwest. The Madden Julian Oscillation (MJO) index lay in phase 4 with amplitude <1. The upper tropospheric ridge ran along 30^0N. All the above favourable

environmental parameters led to intensification of the system into depression. However, the proximity towards the land surface, unfavourable amplitude of the MJO index and higher wind shear towards northwest (direction of motion of depression) did not favour further intensification. Rather, it led to gradual weakening of the system.

The best track parameters are shown in Table 1. The track of the depression is shown in Fig.1. The typical satellite imageries are shown in Fig. 2.

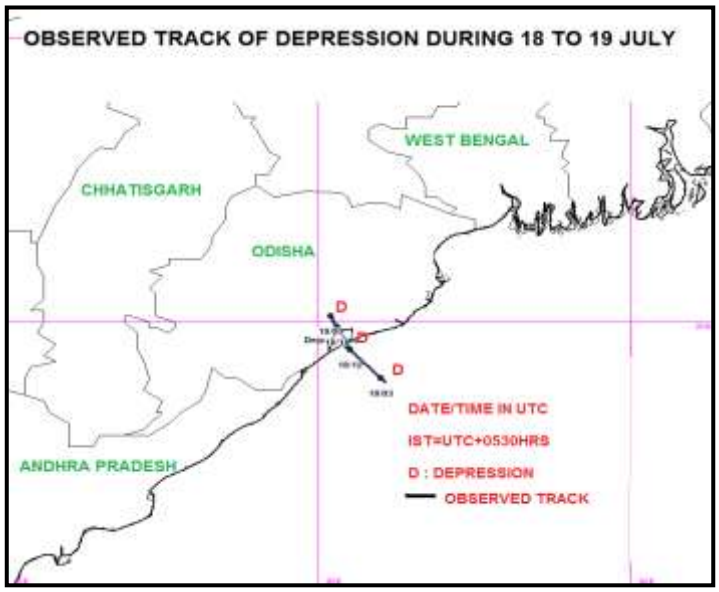


Fig.1.Observed track of Depression over northwest Bay of Bengal (18-19 July 2017)

Table 1: Best track positions and other parameters of the Depression over the west central Bay of Bengal and coastal areas of Odisha & north Andhra Pradesh during 18-19 July, 2017

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
18/07/2017	0000	19.0/86.0	1.5	992	25	4	D
	0300	19.0/86.0	1.5	992	25	4	D
	0600	19.5/85.5	1.5	992	25	4	D
	1200	19.9/85.3	1.5	992	25	4	D
	Crossed South Odisha coast close to south of Puri around 1300 UTC of 18.07.2017						
	1800	19.9/85.3	-	994	25	3	D
19/07/2017	0000	20.1/85.2	-	994	25	3	D
	0300	Weakened into a Well-marked low pressure area over interior Odisha and neighbourhood					

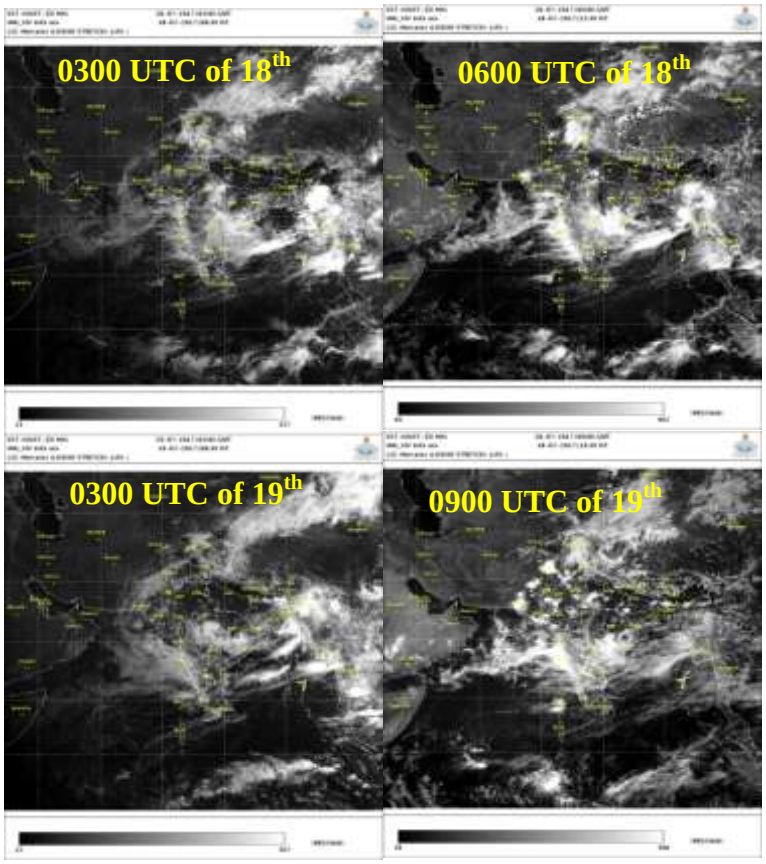


Fig. 2(i): INSAT-3D visible imageries during Depression (18-19 July, 2017)

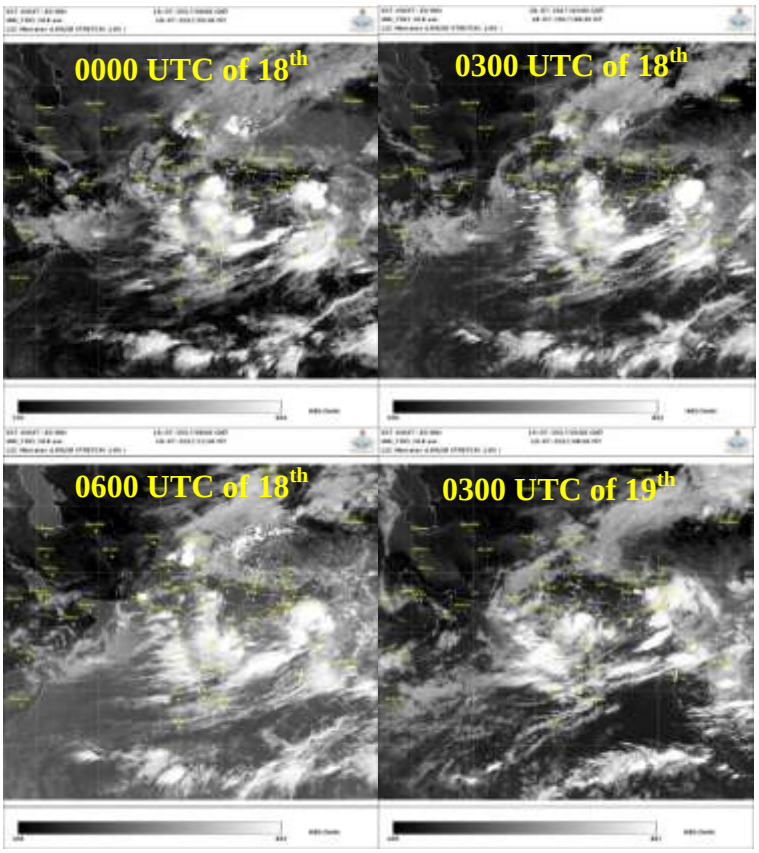


Fig. 2(ii): INSAT-3D IR imageries during Depression (18-19 July, 2017)

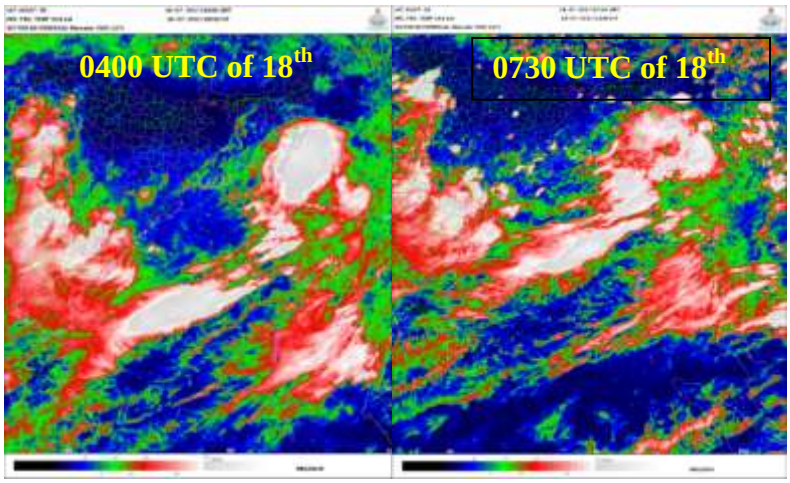


Fig. 2(iii): INSAT-3D enhanced coloured imageries during Depression (18-19 July, 2017)

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.

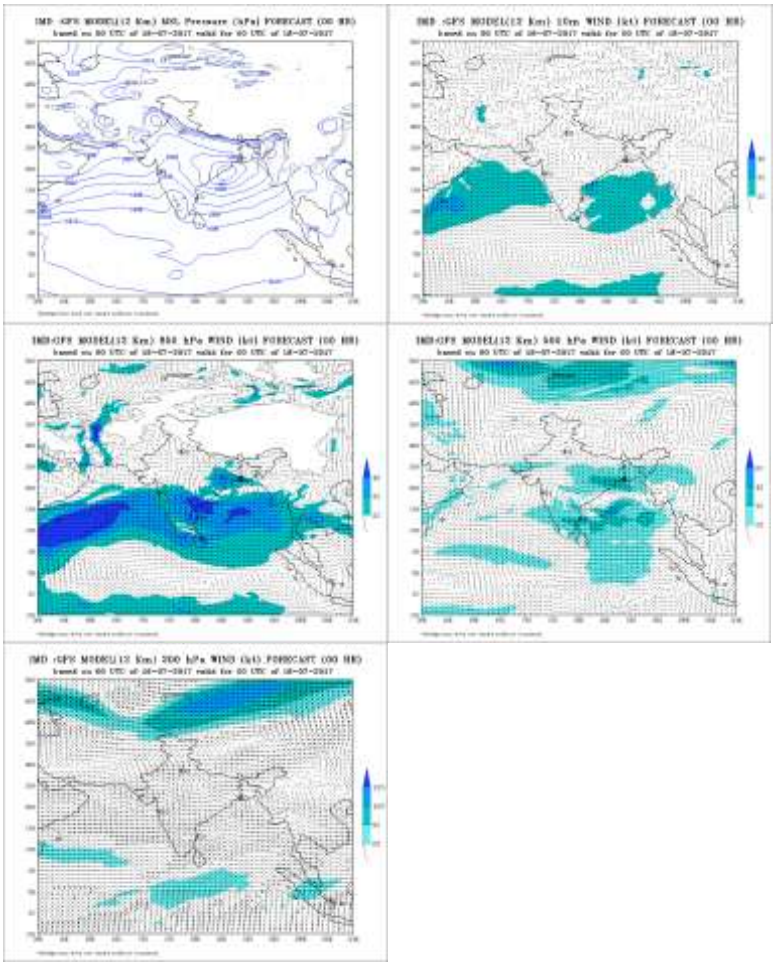


Fig3 (i): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 18th July

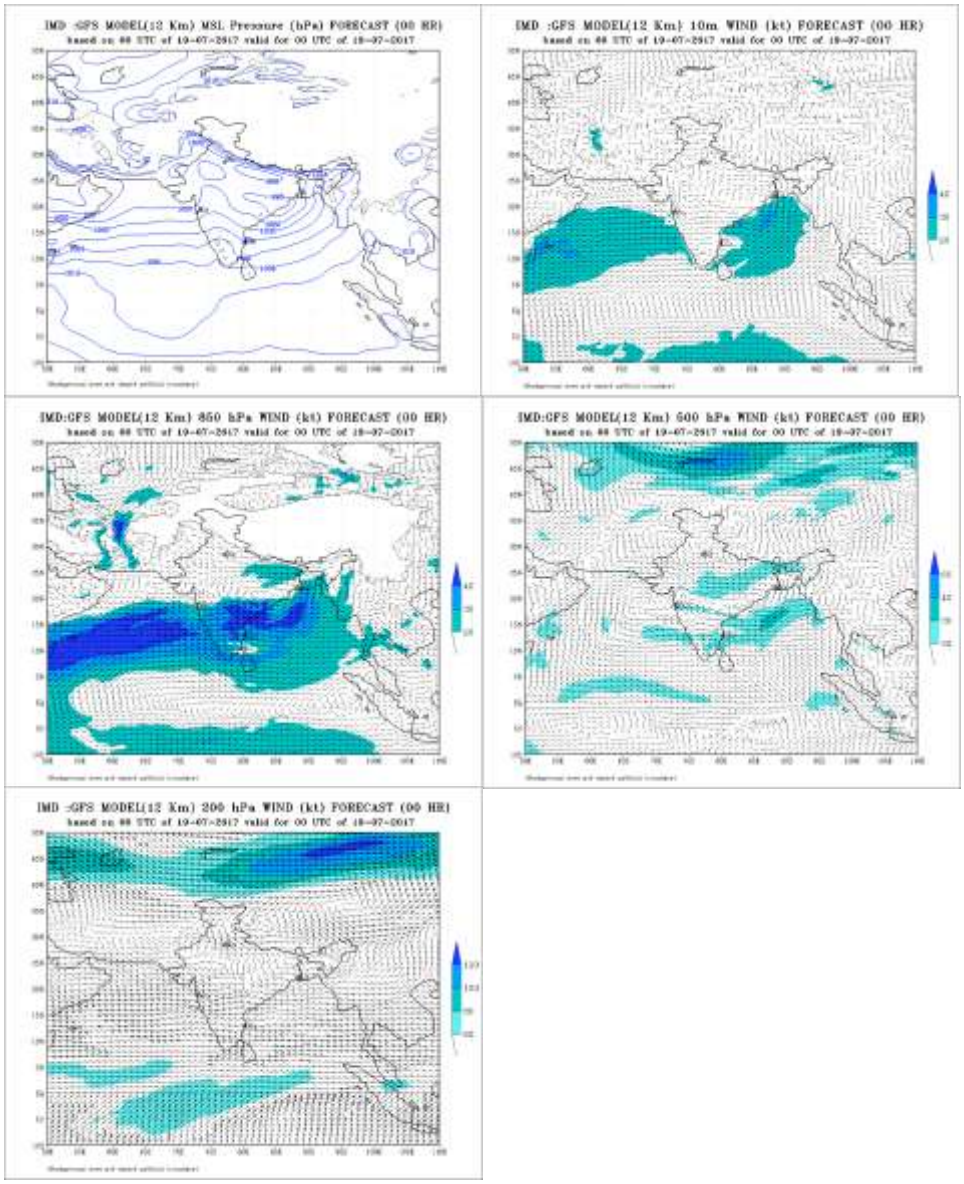


Fig. 3 (ii): IMD GFS (T1534) mean sea level pressure (MSLP), winds at 10m, 850, 500 and 200 hPa levels based on 0000 UTC of 19th July

4. Realized Weather:

4.1 Rainfall:

Under the influence of the Depression, rainfall at most places with heavy to very heavy rainfall at a few places and isolated extremely heavy rainfall occurred over Chhattisgarh on 17th and Vidarbha on 18th July. Rainfall at most places with heavy to very heavy rainfall at isolated places occurred over Odisha, Vidarbha, coastal Andhra Pradesh, Telangana on 17th, over Odisha, West Madhya Pradesh, Chhattisgarh and coastal Andhra Pradesh on 18th, over Vidarbha & Chhattisgarh on 190th and over West Madhya Pradesh, East Madhya Pradesh and Chhattisgarh on 20th July. The realised rainfall as per the gridded rainfall data of IMD/NCMRWF based satellite estimation over sea area and point rainfall over land region during 18-20 July 2017 is shown in Fig.4.

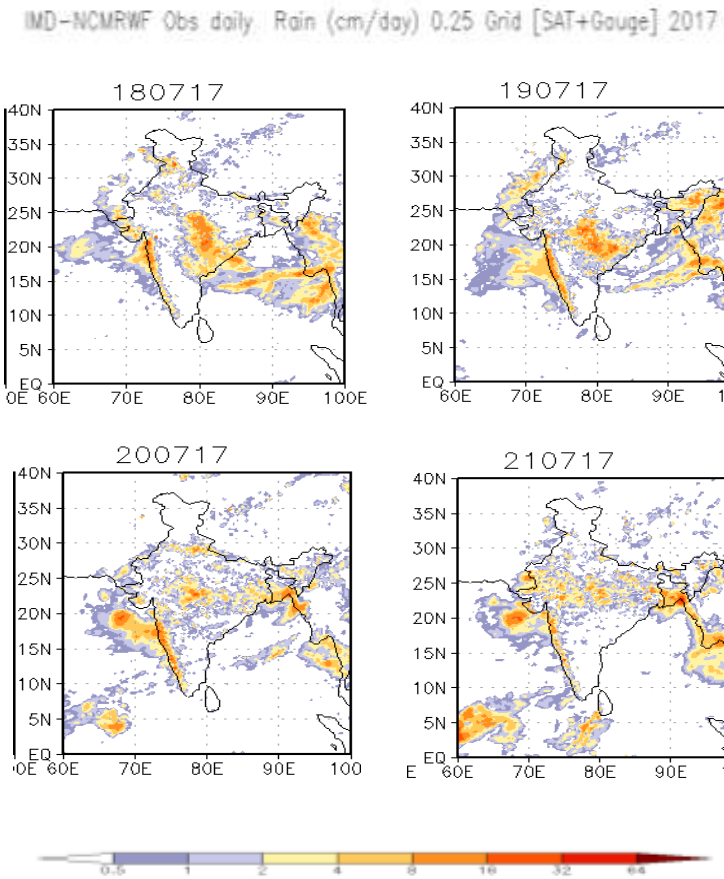


Fig.4: Daily rainfall distribution based on merged grided rainfall data of IMD/NCMRWF during 18-21 July 2017.

Realized 24 hrs accumulated rainfall (≥7cm) ending at 0830 hrs IST of date during the life cycle of the system are presented below:

18 July 2017

Odisha: Kosagumda-17, Tentulikhunti ARG-14, Dabugan, Banki Arg-13 each, Jeypore-12, Koraput, Binjharpur, Mundali-11 each, Dharmagarh, Jhorigam, Similiguda, Jaipatna-9 each, Junagarh, Umarkote, Raighar, Kaptipada-8 each, Bhawanipatna, Bari, Hindol, Pottangi-7 each.

Chhattisgarh: Dondilohara-27, Kanker-16, Balod-14, Ambagarh Chowki, Jagdalpur-12 each, Dhamtari-10, Bhanupratappur-9, Kondagaon, Simga, Konta-8 each, Dongargarh, Gandai, Katghora, Deobhog, Gariabund-7 each,

Vidarbha: Nagpur Aerodrome-13, Kamptee-12, Amgaon, Korchi-11 each, Armori, Mauda-10 each, Salekasa-9, Kurkheda-8, Bhamragad, Pauni, Gondia-7 each.

Coastal Andhra Pradesh: Kalingapatnam, Gudivada-9 each, Chintur, Bondapalle, Paleru Bridge-8 each, Gajapathinagaram, Vijayawada A.P.-7 each.

Telangana: Madhira-9, Bonakal-8, Hayathnagar, Koida, Chinthakam-7 each.

19 July 2017

Odisha: Dabugan-20, Jhorigam-19, Chandahandi-16, Kosagumda, Jaipatna-15 each, Dharmagarh-14, Raighar, Tentulikhunti-13 each, Umarkote, Junagarh-11 each, Gudari, Mohana, Jeypore, Nawarangpur-10 each, Bhawanipatna, Kashipur-0 each, Koraput, Malkangiri-8 each, Narla, Nawana, Belpada, Odagaon-7 each.

West Madhya Pradesh: Pachmarhi-12, Khandwa-Aws-9, Bhainsdehi-7, East Madhya Pradesh: Chindwara-AWS, Seoni-AWS-7 each
Vidarbha: Bhamragad-34, Chamorshi-26, Bramhapuri-21, Sindewahi-19, Mul-17, Etapalli, Pauni, Pombhurna, Ahiri-13 each, Gadchiroli, Mulchera, Warora-12 each, Hinganghat-11, Bhadravati, Samudrapur, Saoli, Chandrapur-10 each, Gondpipri, Lakhandur, Armori, Ballarpur, Ramtek-9 each , Dhanora, Chandur Rlwy, Bhiwapur8, Nagbhir, Rajura-8 each, Wani, Warud, Deoli, Mauda, Arjuni Morgaon, Narkheda, Saoner, Wardha, Pandherikawara, Babulgaon-7 each
Chhattisgarh: Jagdalpur-19, Dantewara-14, Deobhog-13, Kanker, Dondilohara-9 each, Narayanpur-8, Kondagaon-7
Coastal Andhra Pradesh: Gudivada-9, Vijayawada A.P, Vararamachandrapur-7 each.

20 July 2017
Vidarbha: Risod-15, Gondia Ap-11, Ramtek-10, Mohadi-9, Chhattisgarh: Katghora-9, Korba, Janjgir7, Champa-7 each.

21 July 2017
West Madhya Pradesh: Khategaon-11, Nusrulgunj-Arg-10, Thandla, Bhopal-AWS-9 each, Petlawad, Ashta, Pichhore, Ichhawar-8 each, Sehore-AWS, Depalpur-7 each.
East Madhya Pradesh: Jabalpur-New--Aws-12, Lakhnadon-10, Dindori-AWS-8, Katni-AWS, Ghansore, Malanjkhand, Umaria-AWS-7 each, Chhattisgarh: Pathalgaon-8

5. Bulletins issued by IMD

IMD issued warning bulletins to the concerned central and state disaster management authorities and press & media.

5.1 Bulletins issued by Cyclone Warning Division, New Delhi

Bulletins issued by Cyclone Warning services of IMD in association with the system are given in Table 2(a-b).

Table 2 (a): Bulletins issued by Cyclone Warning Division, India Meteorological Department

S.No.	Bulletin	No. of Bulletins	Issued to
1	National Bulletin	7	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, West Bengal, Odisha, Chhatisgarh, Madhya Pradesh , Telangana
2	RSMC Bulletin for WMO/ ESCAP Panel	5	1. IMD's website 2. All WMO/ESCAP member countries through GTS and E-mail. 3. Indian Navy, IAF by E-mail

	countries		
3	Warnings through Social Media	1	Warnings were uploaded on Social networking sites like Face book and Tweeter.

Table-2(b): Bulletins issued by ACWC Chennai/ACWC Kolkata/CWC Bhubaneswar (BBN)/ CWC Vishakhapatnam (VSK)

S.No.	Type of Bulletin Number				
		ACWC Chennai	ACWC Kolkata	CWC BBN	CWC VSK
1.	Sea Area Bulletins	-	5	-	-
2.	Coastal Weather Bulletins	3	WB Coast-4 A & N Coast- 4	10	4
3.	Fishermen Warnings issued	4	WB Coast- 8 A & N Coast- 7	17	8
4.	Port Warnings	2	WB Coast- 2 A & N Coast- 4	4	3
5.	Heavy Rainfall Warning(HRW)	2	WB-1,A & N Islands-Nil	7	-
6.	Information & Warning issued to State Government and other Agencies	-	Govt. of WB- 2 Govt. of A & N Administration-2	7	-
7.	SMS	-	HRW for 1day -14 nos. Fishermen warnings -40 nos.	-	147

"-" : Not Applicable , **WB :** West Bengal , **A& N:** Andaman and Nicobar Islands

6. Operational Forecast Performance

Forecast Performance

(i) The first information regarding genesis of depression on 18th July over northwest Bay of Bengal off north Odisha and West Bengal coast was issued by RSMC New Delhi with probability low on 15th July (about 72 hours in advance) and with probability moderate on 17th of July (about 24 hours in advance).

(ii) In the first bulletin issued on 18th morning, it was predicted that depression would cross Odisha coast between Puri and Gopalpur coast on 18th night and the depression crossed Odisha coast near Puri around 2030hrs IST of 18th July.

(iii) IMD issued warning bulletins to the concerned central and state disaster management authorities & press and media. The verification of heavy rainfall warning 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 during Depression (18-19 July 2017)

Date/Time (IST)	Heavy rainfall warning issued	Realised 24-hour heavy rainfall ending at 0300 UTC of date
18.07.2017/ **0830**	Heavy to very heavy rainfall at a few places and isolated extremely heavy rainfall over south Odisha during next 48 hrs and over north coastal Andhra Pradesh during next 24 hrs. Isolated heavy to very heavy rainfall during next 24 hrs and heavy to very heavy rainfall at a few places and isolated extremely heavy rainfall during subsequent 24 hrs over Chhattisgarh. Heavy to very heavy rainfall at a isolated places over Telengana and north Odisha during next 48 hrs and over east Madhya Pradesh on 19th and 20th and over west Madhya Pradesh on 20th and 21st July.	**<u>18 July 2017</u>** **Odisha:** Kosagumda-17, Tentulikhunti Arg-14, Dabugan, Banki Arg-13 each, Jeypore-12, Koraput, Binjharpur, Mundali-11 each, Dharmagarh, Jhorigam, Similiguda, Jaipatna-9 each, Junagarh, Umarkote, Raighar, Kaptipada-8 each, Bhawanipatna, Bari, Hindol, Pottangi-7 each, **Chhattisgarh:** Dondilohara-27, Kanker-16, Balod-14, Ambagarh Chowki, Jagdalpur-12 each, Dhamtari-10, Bhanupratappur-9, Kondagaon, Simga, Konta-8 each, Dongargarh, Gandai, Katghora, Deobhog, Gariabund-7 each, **Vidarbha:** Nagpur Aerodrome-13, Kamptee-12, Amgaon, Korchi-11 each, Armori, Mauda-10 each, Salekasa-9, Kurkheda-8, Bhamragad, Pauni, Gondia-7 each, **Coastal Andhra Pradesh:** Kalingapatnam, Gudivada-9 each, Chintur, Bondapalle, Paleru Bridge-8 each, Gajapathinagaram, Vijayawada A.P.-7 each, Telangana: Madhira-9, Bonakal-8, Hayathnagar, Koida, Chinthakam-7 each.

		<u>19 July 2017</u> **Odisha:** Dabugan-20, Jhorigam-19, Chandahandi-16, Kosagumda, Jaipatna-15 each, Dharmagarh-14, Raighar, Tentulikhunti-13 each, Umarkote, Junagarh-11 each, Gudari, Mohana, Jeypore, Nawarangpur-10 each, Bhawanipatna, Kashipur-0 each, Koraput, Malkangiri-8 each, Narla, Nawana, Belpada, Odagaon-7 each. **West Madhya Pradesh:** Pachmarhi-12, Khandwa-Aws-9, Bhainsdehi-7. **East Madhya Pradesh:** Chindwara-AWS, Seoni-AWS-7 each, Vidarbha: Bhamragad-34, Chamorshi-26, Bramhapuri-21, Sindewahi-19, Mul-17, Etapalli, Pauni, Pombhurna, Ahiri-13 each, Gadchiroli, Mulchera, Warora-12 each, Hinganghat-11, Bhadravati, Samudrapur, Saoli, Chandrapur-10 each, Gondpipri, Lakhandur, Armori, Ballarpur, Ramtek-9 each , Dhanora, Chandur Rlwy, Bhiwapur8, Nagbhir, Rajura-8 each, Wani, Warud, Deoli, Mauda, Arjuni Morgaon, Narkheda, Saoner, Wardha, Pandherikawara, Babulgaon-7 each. **Chhattisgarh:** Jagdalpur-19, Dantewara-14, Deobhog-13, Kanker, Dondilohara-9 each, Narayanpur-8, Kondagaon-7 **Coastal Andhra Pradesh:** Gudivada-9, Vijayawada A.P, Vararamachandrapur-7 each.
		<u>20 July 2017</u> **Vidarbha:** Risod-15, Gondia Ap-11, Ramtek-10, Mohadi-9, Chhattisgarh: Katghora-9, Korba, Janjgir7, Champa-7 each,
		<u>21 July 2017</u> **West Madhya Pradesh:** Khategaon-11, Nusrulgunj-Arg-10, Thandla, Bhopal-AWS-9 each, Petlawad, Ashta, Pichhore, Ichhawar-8 each, Sehore-AWS, Depalpur-7 each. **East Madhya Pradesh:** Jabalpur-New--Aws-12, Lakhnadon-10, Dindori-Aws-8,

		Katni-AWS, Ghansore, Malanjkhand, Umaria-AWS-7 each. **Chhattisgarh:** Pathalgaon-8

7. Summary and Conclusion:

- A low pressure area formed over northwest BoB off north Odisha & Gangetic West Bengal coast on 15th July, 2017, became a well-marked low pressure area over northwest & adjoining westcentral BoB and coastal areas of Odisha & north Andhra Pradesh on 17th July and concentrated into a depression in the morning of 18th. Moving nearly northwestwards it crossed south Odisha coast close to south of Puri around 2030 hours IST of 18th July 2017 and weakened into a well- marked low pressure area over Interior Odisha & neighbourhood at 0830 hours IST of 19th July, 2017.
- The first information regarding genesis of depression was issued by RSMC New Delhi with probability low on 15th July (about 72 hours in advance) and with probability moderate on 17th of July (about 24 hours in advance).
- In the first bulletin issued on 18th morning, it was predicted that depression would cross Odisha coast between Puri and Gopalpur coast on 18th night and it crossed Odisha coast near Puri around 2030 hrs IST of 18th July.
- The associated rainfall was also well predicted as shown in Table-3.
- IMD utilized all its available resources to provide warning and advisories at nation, state and district levels and also to WMO/ESCAP Panel countries.

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 Depression. We specifically acknowledge the contribution of all sister organisations of Ministry of Earth Sciences including National Centre for Medium Range Weather Forecasting Centre (NCMRWF). The support from various Divisions/Sections of IMD including Area Cyclone Warning Centre (ACWC) Chennai & Kolkata, Cyclone Warning Centre (CWC) Vishakhapatnam & Bhubaneswar, Numerical Weather Prediction (NWP) Division, Information System & Services Division (ISSD) and Satellite Division at IMD HQ New Delhi is also acknowledged.