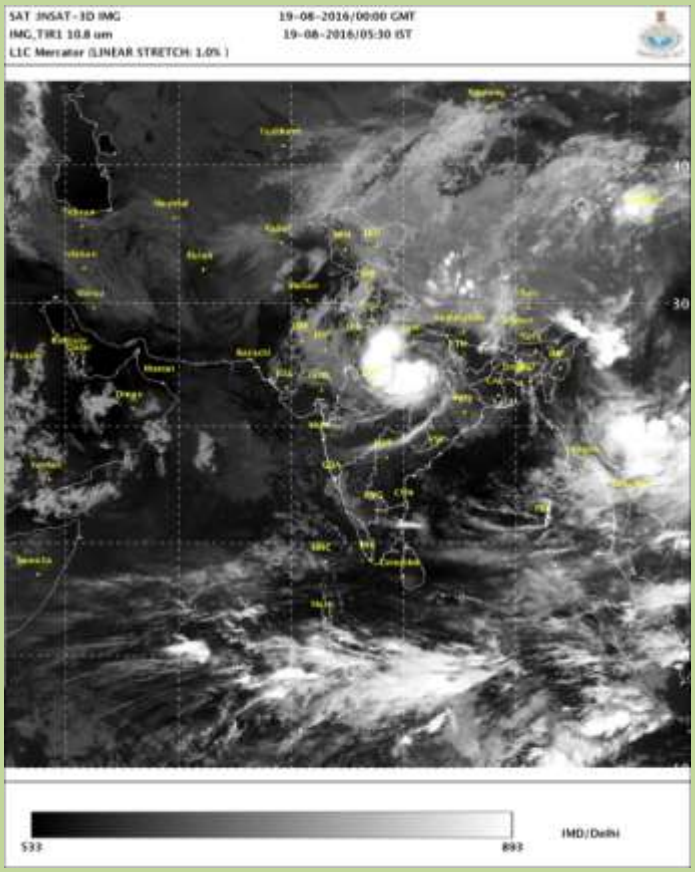
GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
INDIA METEOROLOGICAL DEPARTMENT

Deep Depression over the Bay of Bengal (16-21 August 2016): A Report



INSAT-3D IR imagery based on 0000 UTC of 19th August

Cyclone Warning Division

India Meteorological Department

New Delhi

December 2016

Deep Depression over Bay of Bengal (16-21 August 2016)

1. Introduction

A depression formed over north Bay of Bengal (BoB) in the evening of 16th August in association with active monsoon condition. Moving initially northwestwards along the monsoon trough, it intensified into a deep depression over northwest BoB in the afternoon of 17th. It maintained its intensity of deep depression till 20th evening and gradually weakened thereafter while moving wes-northwestwards.

Under its influence southwest monsoon was active/ vigorous over Odisha on 17th, Gangetic West Bengal and Jharkhand on 18th , Chhattisgarh and east Madhya Pradesh on 19th & 20th, west Madhya Pradesh on 20th & 21st, east Rajasthan during 20th - 24th and Gujarat during 23rd & 24th August.

The salient characteristics like genesis, intensification, movement and associated adverse weather are discussed in the following sections.

2. Genesis

A low pressure area formed over northeast Bay of Bengal and neighbourhood in the morning of 15th August, 2016. The environmental parameters became favourable on 16th with increase in low level vorticity at 850 hPa level, which was about $100x10^{-6}$ sec^{-1} at 0300 UTC of 9th. The lower level convergence at 850 hPa level was about $20x10^{-5}$ sec^{-1} and upper level divergence at 200 hPa level was about $20x10^{-5}$ sec^{-1}. The vertical wind shear of horizontal wind was 10-20 knots. The upper tropospheric ridge lay far to the north in association with the Tibetan high along latitude 30^0N. Under these favourable environmental conditions, the low pressure area became well marked over northwest BoB and neighbouhood in the morning of 16th and concentrated into a depression over north BoB in the evening of 16th.

3. Intensification and movement:

Similar favourable conditions prevailed on 17th and became more favourable on 18th to 20th with increase in relative vorticity to $200x10^{-6}$ sec^{-1} at 0300 UTC of 30th. Thus the depression moved northwestwards and intensified into a deep depression over northwest BoB in the afternoon of 17th and crossed West Bengal coast between Digha and Diamond Harbour around 1700 hours IST of 17th. Continuing its northwest to west-northwest journey along the monsoon trough, it maintained its intensity of deep depression till evening of 20th. As the vertical wind shear increased on 20th to 15-20 knots in association with the interaction with mid-latitude trough in westerlies to the west of the system centre at middle and upper tropospheric levels, it weakened into a depression in the night of 20th. It further weakened into a well marked low pressure area over east Rajasthan and adjoining west Madhya Pradesh in the morning of 21st August.

The observed track of the system is shown in Fig.1 and the best track parameters are shown in Table 1. The typical satellite imageries of the system are presented in Fig.2. The model analyses based on IMD GFS model at 0000 UTC of 16-21 August 2016 are presented in Fig.3.

Table 1. Best track and other parameters of the Deep Depression over northwest Bay of Bengal and neighbourhood (16th -20th August 2016)

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
16th August	1200	21.0/89.0	1.5	996	20	3	D
17th August	0300	21.5/88.5	1.5	996	20	3	D
	0900	21.6/88.4	2.0	994	25	4	DD
	It further moved northwest-wards and crossed west Bengal coast between Digha and Diamond Harbour around 1130 UTC.						
	1200	22.0/88.2	-	994	25	4	DD
18th August	0300	24.0/85.0	-	994	25	4	DD
	0900	24.0/83.8	-	994	25	4	DD
	1200	24.1/83.4	-	994	25	4	DD
19th August	0300	25.0/82.3	-	994	25	4	DD
	1200	24.7/79.0	-	994	25	4	DD
20th August	0300	24.8/77.5	-	994	25	4	DD
	1200	24.8/77.2	-	994	20	4	DD
	1500	25.0/76.5	-	996	15	3	D
20th August	2100	25.0/76.5	-	996	15	3	D
	Weakened into a well marked low pressure area, over east Rajasthan & adjoining west Madhya Pradesh by 0000 UTC of 21st						

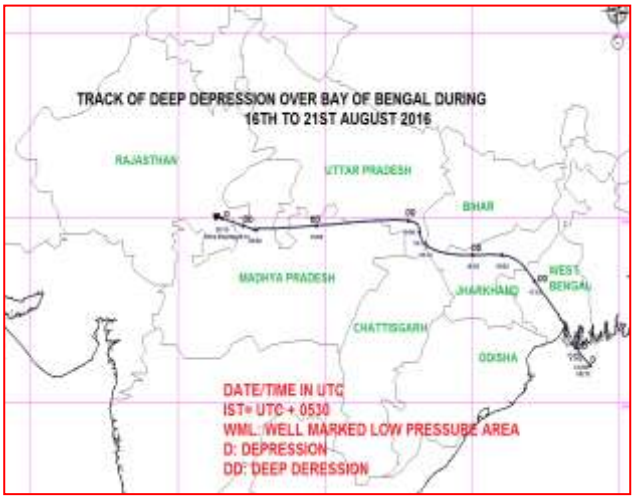


Fig.1: Track of deep depression over Bay of Bengal during 16th – 21st August

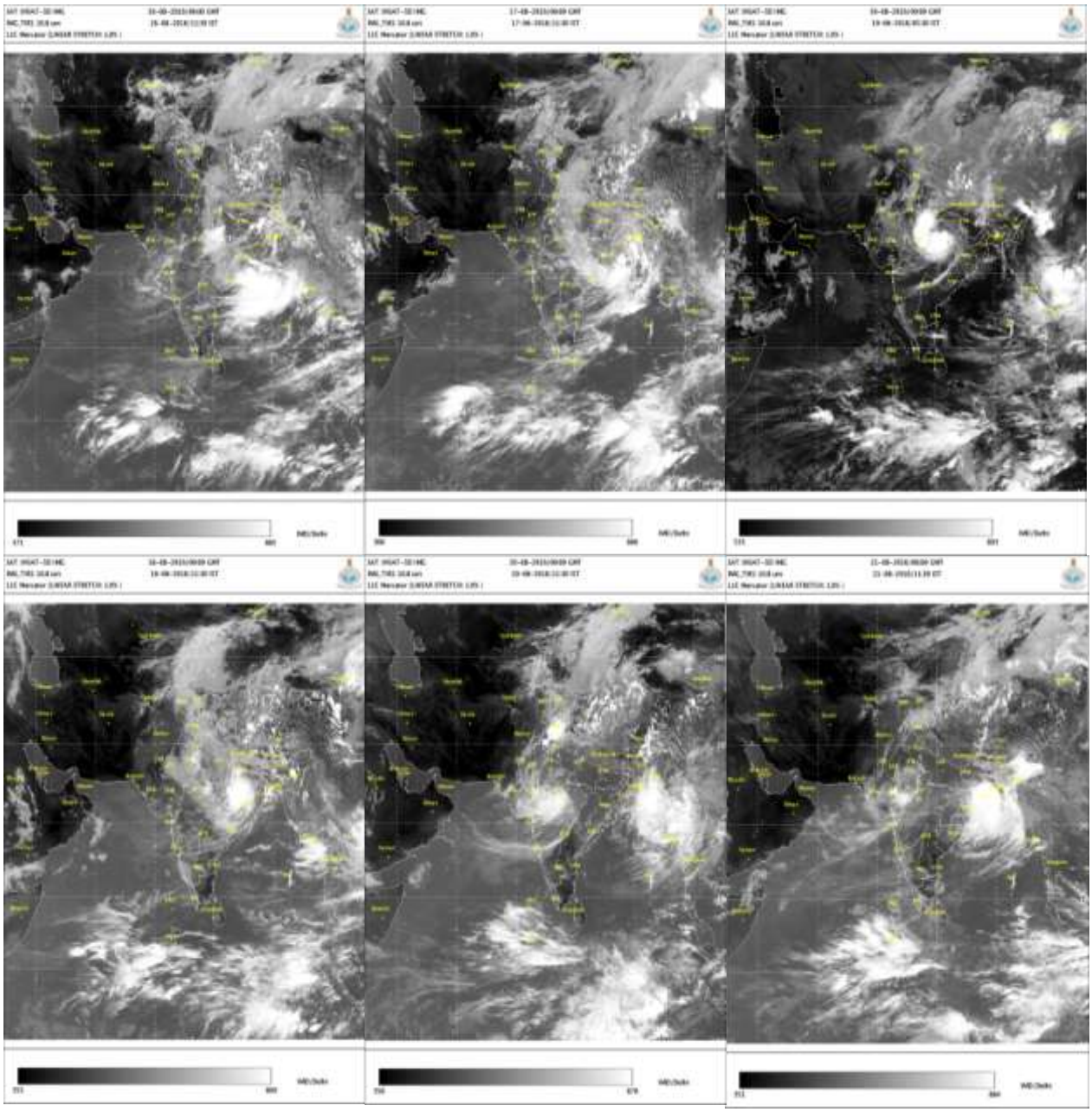


Fig.2 INSAT 3D based imagery of deep depression at 0600 UTC of 16-21 August 2016

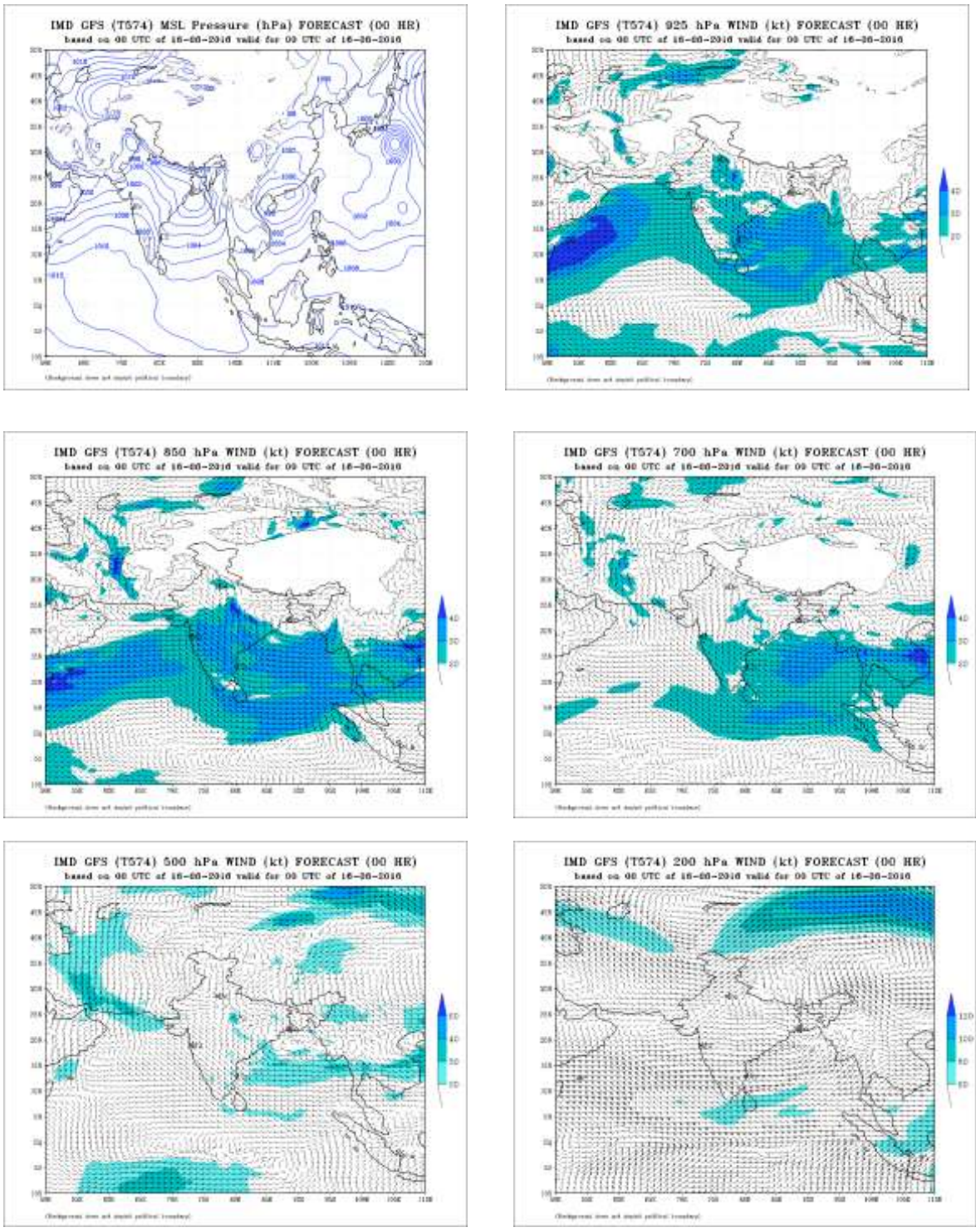


Fig.3 (i) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 16 August 2016

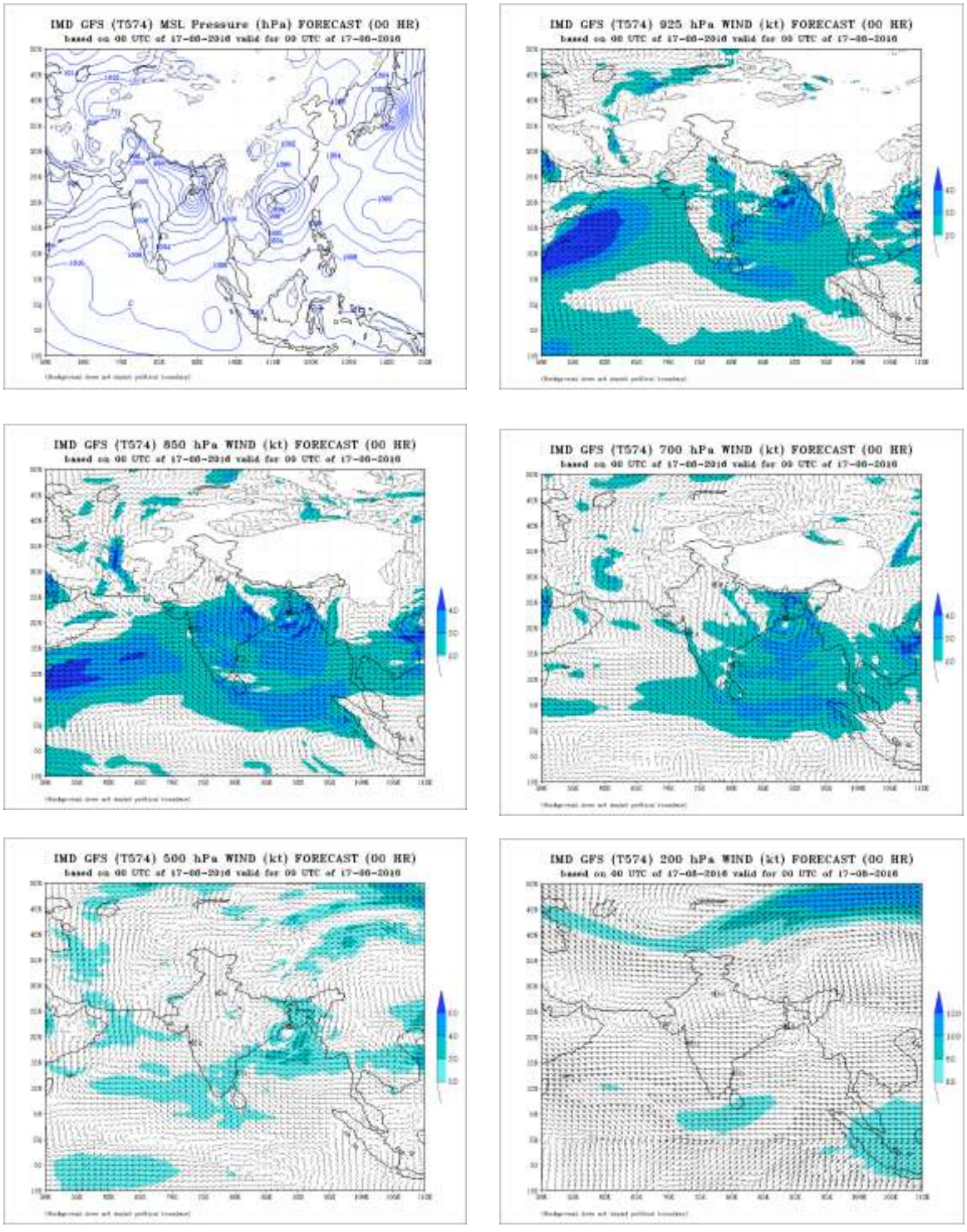


Fig.3 (ii) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 17 August 2016

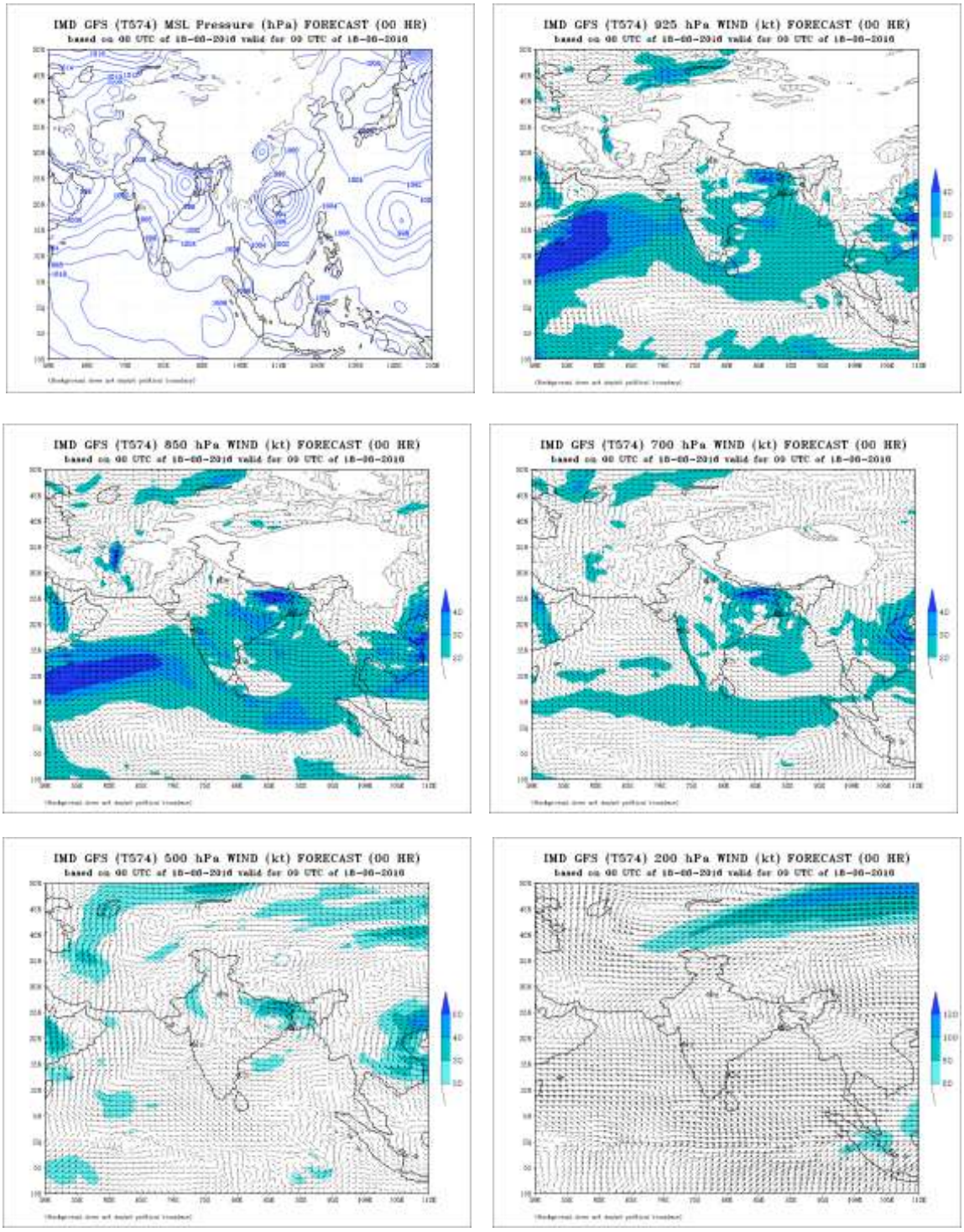
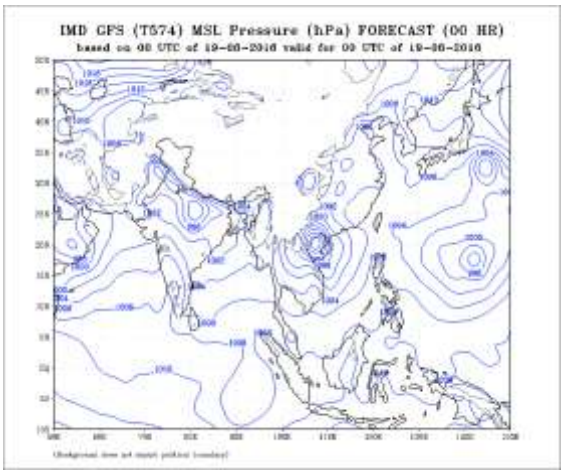
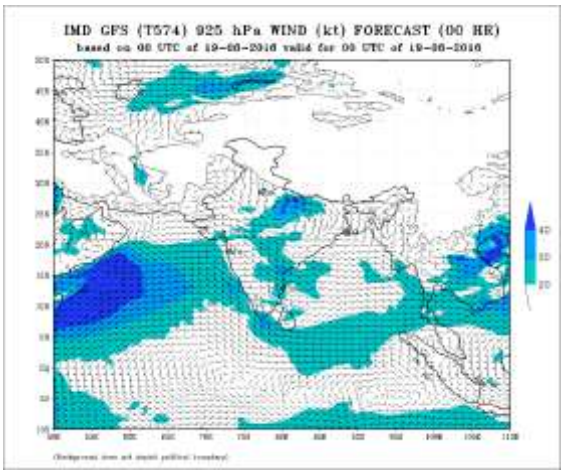
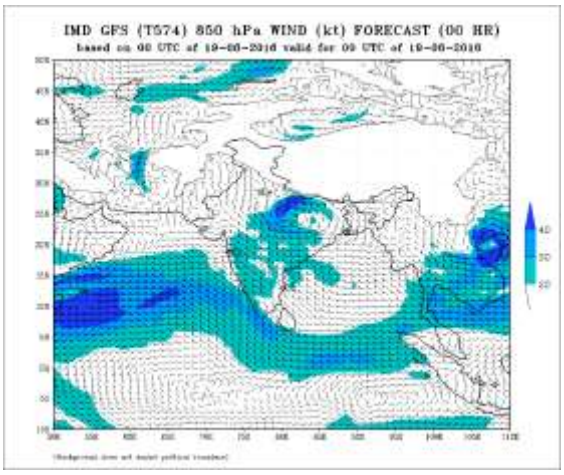
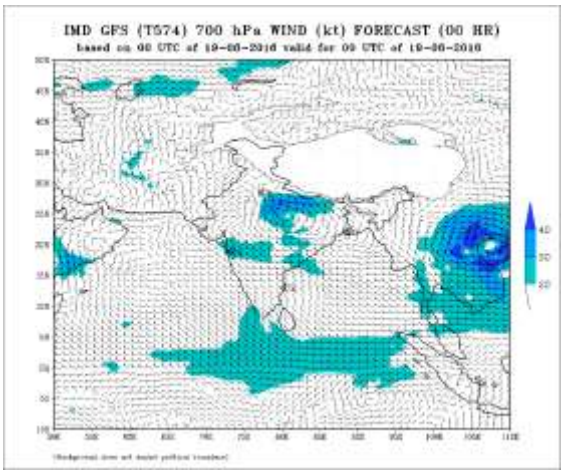


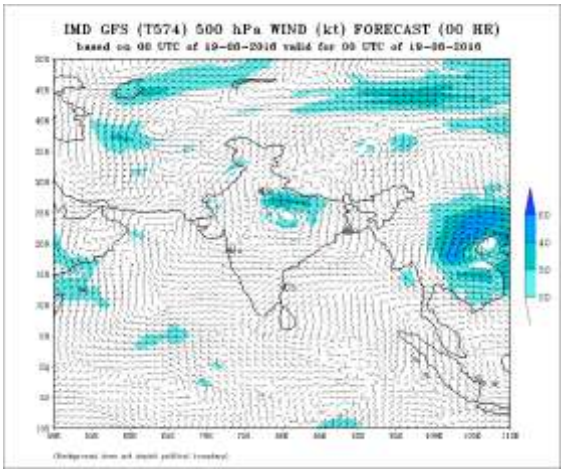
Fig.3 (iii) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 18 August 2016











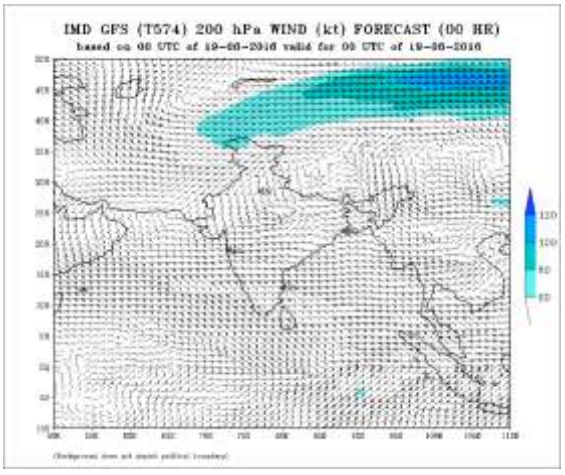


Fig.3 (iv) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 19 August 2016

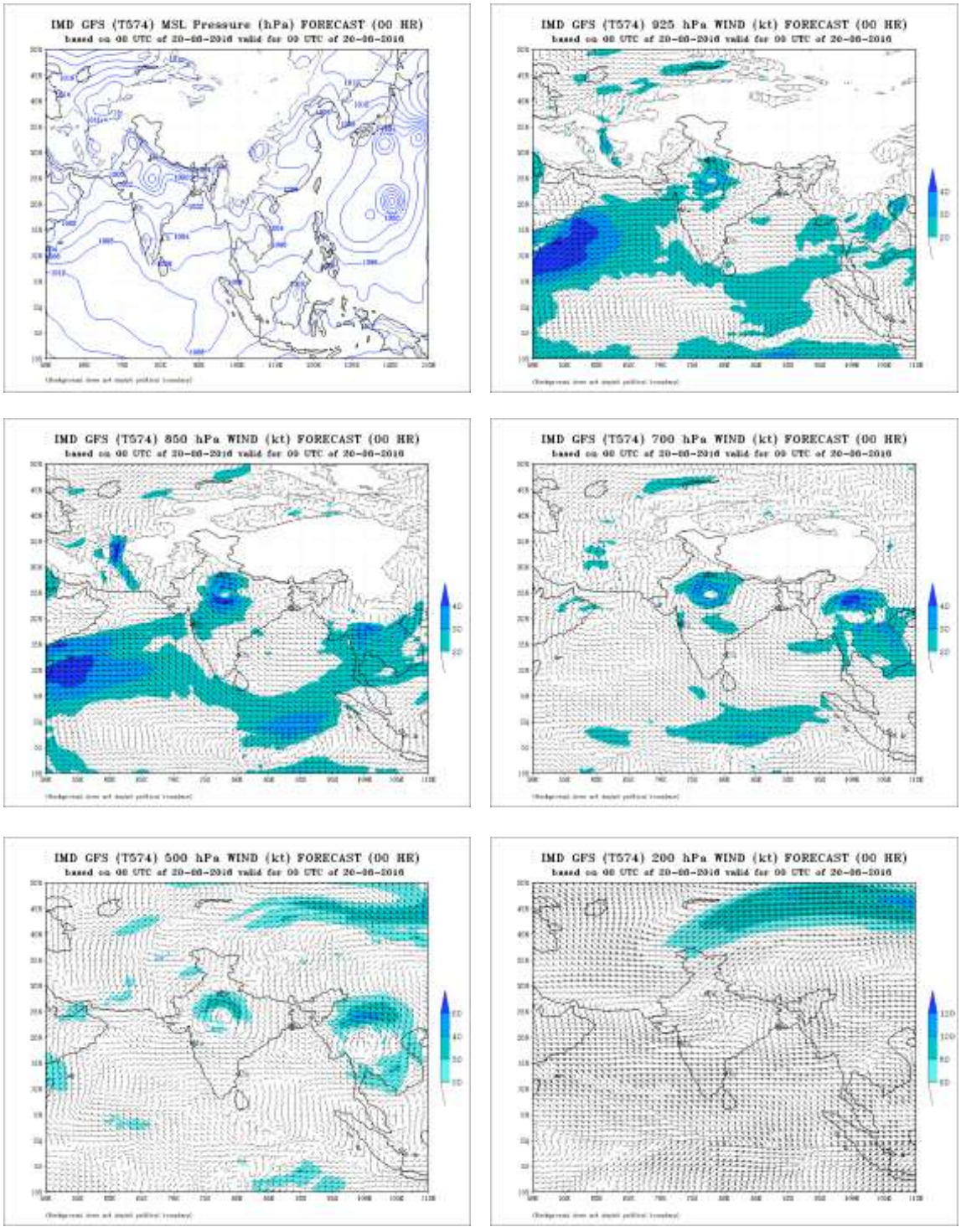


Fig.3 (v) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 20 August 2016

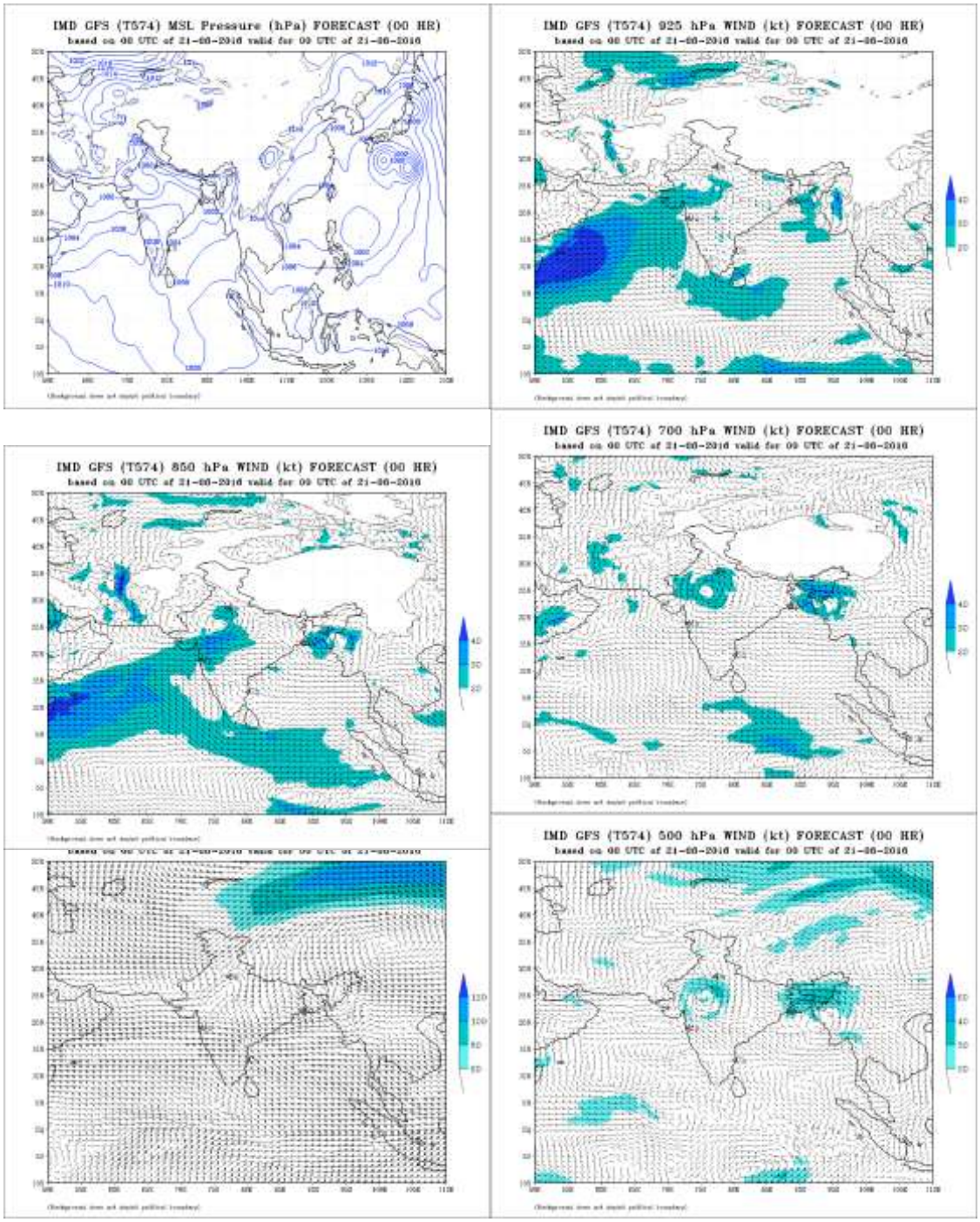


Fig.3 (vi) IMD GFS Model analyses of mean sea level pressure (MSLP), and wind at 925, 850, 700, 500 and 200 hPa levels at 0000 UTC of 21 August 2016

Realised weather:

Heavy to very heavy rainfall occurred over Gangetic West Bengal & Odisha on 18th, Chhattisgarh & east Madhya Pradesh on 19th & 20th and west Madhya Pradesh on 20th & 21st and east Rajasthan during 20th to 24th with extremely heavy rainfall over Jharkhand on 18th, east Madhya Pradesh on 19th, west Madhya Pradesh and east Rajasthan on 20th & 21st. (Description of rainfall terminologies: ***Heavy***: 64.5 to 124.4 mm; ***Very Heavy***: 124.5 to 244.4 mm and ***Extremely Heavy***: ≥244.5 mm) as well as spatial distribution [***Isolated (ISOL)***: (1-25% of stations reporting rainfall); ***Scattered (SCT / A few places)*** : 26-50% of stations reporting rainfall; ***Fairly WideSpread (FWS/ Many places)***: 51-75% of stations reporting rainfall; ***Widespread (WS/ Most places)***: 76-100% of stations reporting rainfall during the last 24 hours ending at 0300 UTC of every day).

The rainfall received (≥ 7 cm) in various subdivisions due to the depression are given below:

16 AUGUST 2016

Odisha: Telkoi-13, Pallahara-11, Sonepur-9, Khairamal-7
Jharkhand: Deoghar-7,
Bihar: Barbigha-11, Sheikhpura, Pusa-9 each,
East Uttar Pradesh: Azamgarh, Dhaurahara, Naraini-9 each, Sultanpur, Amethi, Sultanpur CWC-8 each, Biswan, Kheri Lakhimpur, Elgin Bridge, Mau-7 each,
East Madhya Pradesh: Ajaigarh-14, Nagode-12, Panna-Aws-9, Hanumana-8, Jabalpur, Rewa and Maihar-7 each.

17 August 2016

Odisha: Rajkanika-18, Chandbali-17, Binjharpur ARG-15, Pattamundai, Bari & Dhamnagar-13 each, Akhuapada-12, Marsaghai, Jajpur, Bonth, Derabis & Salepur-11 each, Paradip, Tirtol, Kujanga & Kendrapara-10 each, Jagatsinghpur, Balasore, Soro & Thakurmunda-9 each, Raghunathpur & Mahanga-8 each, Remuna, Garadapur, Alipingal, Chandikhol, Nilgiri, Tihidi, Balikuda & Basudevpur-7 each,
Jharkhand: Hunterganj & Manatu-7 each, **Bihar:** Nawada-8,
East Uttar Pradesh: Mau Tehsil-12, Lucknow-11, Fatehpur Obsy-10, Akbarpur, Phoolpur-9 each, Lucknow, Attarra-7 each,
East Madhya Pradesh: Maihar-18, Nagode-17, Satna-17, Ajaigarh-14, Khajuraho airport-14, Rajnagar & Kotma-13 each, Rewa & Umaria-12 each, Panna-11, Sohagpur-10, Gudh-7,
Chhattisgarh: Janakpur-9.

18 August 2016

Sub-Himalayan West Bengal & Sikkim: Chepan-7,
Gangetic West Bengal: Purihansa-13, Kharidwar-12, Asansol (CWC), Tusuma-10 each, Asansol & Phulberia-9 each, Harinkhola & Kolkata (Alipore)-8 each, Diamond Harbour-7,
Odisha: Tiring-15, Rairangpur-14, Tensa-11, Baripada & Mandira Dam-9 each, Nawana & Keonjhargarh-7 each,
Jharkhand: Jamshedpur Aero-27, Jamshedpur-24, Latehar-14, Nimdih & Dhanbad-13 each, Chakradharpur & Bokaro-11 each, Kuru-10, Bagodari, Jaridih, Simdega & Lohar-Daga, Gobindpur-9 each, Torpa, Manatu & Topchanchi-8 each, Hazaribagh, Sarath, Jarmindi, Kolebira, Panki, Daltonganj & Madhupur-7 each,

East Uttar Pradesh: Chunar-9,
East Madhya Pradesh: Katni & Panna-7 each.

19 August 2016
Gangetic West Bengal: Simula-9, Purulia-8,
Jharkhand: Lohar-Daga-7,
East Uttar Pradesh: Banda CWC-14, Banda & Beberu-12 each, Churk-11, Attarra-10, Dudhi-9, Naraini & Robertsganj-8 each, Mirzapur CWC, Mau & Chilaghat-7 each,
East Madhya Pradesh: Maihar-28, Nowgong & Nagode-21 each, Panna-AWS-19, Ajaigarh-18, Rajnagar & Chahtarpur-17 each, Gudh-15, Rewa & Khajuraho Airport-14 each, Satna-AWS-13, Buxwaha & Sidhi-10 each, Hanumana-9, Katni-8 and Tikamgarh-7,
Chhattisgarh: Ramanujganj-17, Janakpur-8 and Ambikapur (Surguja) -7.

20 August 2016
East Rajasthan: Manohar Thana-31, Chipabarod-25, Chabra-20, Aklera-17, Atru-13, Bakani Sr-11, Shahabad-9, Asnawar Sr-8, Kotri, Mandana, Ramganjmandi, Shahpura-7 each,
West Madhya Pradesh: Biaora-25, Kurwai-21, Rajgarh, Ganjbasoda-16 each, Lateri, Begumganj-15 each, Raisen, Narsingarh-14 each, Isagarh-12, Mungaoli, Bhopal, Khilchipur, Vidisha-11 each, Salwani-10, Chanderi, Sironj-9 each, Udaipura, Guna, Sarangpur, Agar-8 each, Ashoknagar, Tarana, Shajapur, Pichhore-7 each,
East Madhya Pradesh: Khurai-19, Sagar-Aws-16, Hatta-14, Damoh, Garhakota-13 each, Rehli-11, Deori-10, Tikamgarh-Aws-9, Tendukheda-8.

21 August 2016
East Rajasthan: Danpur, Arnod, Badesar, Nimbahera-23 each, Pipalkhunt, Bari-Sadri-22 each, Chhotisadri, Dhariabad-21 each, Pratapgarh-18, Pirawa-17, Gangrar, Dungla-16 each, Ghatol-14, Dug, Jagpura, Chittorgarh-13 each, Bhungra-12, Pachpahar, Banswara, Ramganjmandi-11 each, Bhopalsagar, Gangdhar, Kapasan, Bhilwara-10 each, Rashmi, Bakani, Nithuwa, Khushalgarh, Kesarpura, Loharia-9 each, Sabla-8, Garhi, Aspur, Arthuna, Begu, Galiakot, Bagidora-7 each,
West Madhya Pradesh: Sailana-30, Ratlam-AWS-20, Agar-18, Ujjain, Gautampura-17 each, Jaora, Neemuch-16 each, Vidisha, Khachrod, Jawad-15 each, Tarana, Susner, Sarangpur-14 each, Suvasara, Badnagar, Khilchipur, Depalpur-13 each, Badnawar, Tonkhurd, Shajapur, Biaora-12 each, Narsingarh, Garoth, Shujalpur, Mandsaur-11 each, Petlawad, Mahidpur-10 each, Rajgarh, Thandla-9 each, Manasa, Sironj, Gandhwani, Dewas-8 each, Bhanpura, Jabot, Dhar-7 each.

5. Damage

No damage has been reported due to this system.