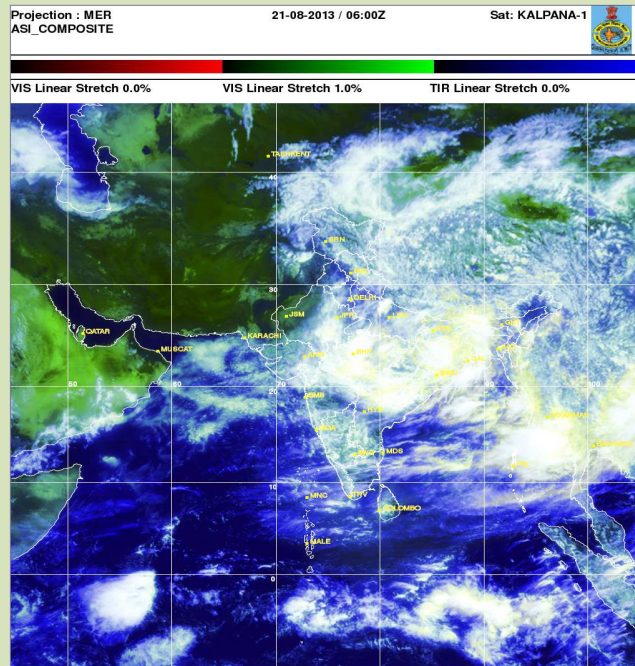




GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
EARTH SYSTEM SCIENCE ORGANIZATION
INDIA METEOROLOGICAL DEPARTMENT

A Preliminary Report on Land Depression
(20th August – 23rd August, 2013)



CYCLONE WARNING DIVISION, NEW DELHI

AUGUST, 2013

Land Depression (20th August – 23rd August, 2013)

1. Introduction:

A land depression formed over Gangetic West Bengal and adjoining areas of north Odisha, Jharkhand and north Bay of Bengal on 20th August, 2013 morning about 100 km southeast of Jamshedpur and 100 km south of Bankura. It moved westward upto central part of south Madhya Pradesh during 20th August – 22nd August, 2013 and weakened on 23rd morning. It caused heavy to very heavy rainfall over north Odisha, Gangetic West Bengal, Jharkhand, Chhattisgarh and Madhya Pradesh.

The salient features of this depression are given below:

- (i). Though it was a land depression, it originated from a low pressure area over the northwest Bay of Bengal.
- (ii). It activated the southwest monsoon condition over the country.
- (iii). It moved slowly initially for about 24 **hours** and then moved westward upto east Madhya Pradesh and then west southwestwards upto central part of south Madhya Pradesh.

2. Monitoring and Prediction:

The depression was monitored with satellite, meteorological buoys, coastal, observations and Doppler Weather Radar (DWR), Kolkata & Nagpur. The half hourly INSAT/ Kalpana imageries & scattrometer wind and every 10 minutes DWR imageries and products were used for monitoring of depression. The intensity of the depression was mainly monitoring through synoptic observations from surface stations. Various numerical weather prediction (NWP) models including IMD's global and meso-scale models were utilized to predict the track and intensity of the depression. The Tropical Cyclone Module in the digitized forecasting system of IMD was utilized for analysis and comparison of various NWP models and decision making process.

3. Genesis :

During second week of August, the eastern end of the monsoon through lay significantly to the south of its normal position passing through south Chhattisgarh and south Odisha to southeast Bay of Bengal across westcentral Bay of Bengal. An upper air cyclonic circulation lay over west central Bay of Bengal, off coastal Andhra Pradesh extending between 3.1 km and 5.8 km above

mean sea level on 11th August. It persisted over the same area and extended upto med-tropospheric level on 13th August. It moved northward and lay over west central Bay, off north coastal Andhra Pradesh and adjoining south Odisha coast on 14th and persisted there on 15th. Under its influence, a low pressure area formed over west central and adjoining northwest Bay of Bengal off north coastal Andhra Pradesh and south coastal Odisha on 16th with associated cyclonic circulation extending upto mid-tropospheric level. It further moved northward and lay over northwest Bay of Bengal on 17th and over northwest Bay of Bengal and adjoining areas of Gangetic West Bengal on 18th. It lay as a well-marked low pressure area over northwest Bay of Bengal and adjoining areas of north Odisha and Gangetic West Bengal on 19th. It concentrated into a depression at 0000 UTC of 20th and lay centered over Gangetic West Bengal and adjoining areas of north Odisha, northwest Bay of Bengal and Jharkhand near latitude 22.0°N and longitude 87.5°E about 50 km north-northeast of Digha (West Bengal).

Table 1: Best track positions and other parameters of Depression over Gangetic West Bengal during 20th August – 23rd August, 2013

Date	Time (UTC)	Centre lat. ^o N/ long. ^o E	C.I. NO.	Estimated Central Pressure (hPa)	Estimated Maximum Sustained Surface Wind (kt)	Estimated Pressure drop at the Centre (hPa)	Grade	
20.08.2013	0000	22.0/87.5	-	0990	25	3	D	
	0300	22.0/87.5	-	0990	25	3	D	
	0600	22.0/87.5	-	0990	25	3	D	
	1200	22.3/87.5	-	0990	25	3	D	
	1800	22.5/87.5	-	0990	25	3	D	
21.08.2013	0000	23.3/87.0	-	0990	20	3	D	
	0300	23.3/86.0	-	0992	20	3	D	
	0600	23.2/85.7	-	0992	20	3	D	
	1200	23.2/84.0	-	0991	20	3	D	
	1800	23.2/82.2	-	0994	20	3	D	
22.08.2013	0000	23.2/82.0	-	0994	20	3	D	
	0300	23.2/80.7	-	0994	20	3	D	
	0600	23.2/80.3	-	0996	20	3	D	
	1200	23.0/80.1	-	0998	20	3	D	
23.08.2013	0000	22.8/79.8	-	0998	20	3	D	
23.08.2013	0300	Weakened into a well marked low pressure area over central part of south Madhya Pradesh and adjoining Vidarbha.						

4. Intensification and movement:

The depression initially moved north-northwest wards upto 0000 UTC of 21st August across Gangetic West Bengal. It then moved nearly westwards till the morning of 22nd August and moved west-southwestwards thereafter upto central part of south Madhya Pradesh. It weakened into a well-marked low pressure area over central part of south Madhya Pradesh and adjoining Vidarbha at 0300 UTC by 23rd August and into a low pressure area over the same region in 23rd evening. It became less marked on 24th August, 2013.

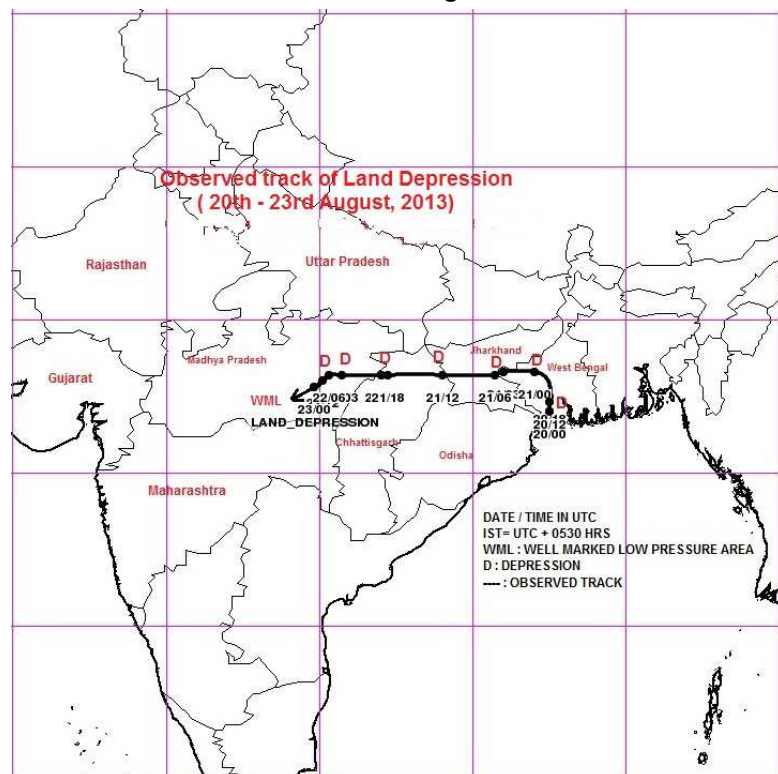


Fig.1. Track of depression over the Bay of Bengal (20th August – 23rd August)

The track of the depression is shown in Fig. 1. The best track parameters are shown in table 1. Typical satellite and Radar imageries are shown in Fig.2 and Fig.3 respectively.

The 24 hours accumulated precipitation received by DWR Kolkata indicates most intense rainfall in the southwest sector of the depression covering southern part of Gangetic West Bengal and north Odisha on 20th and 21st August. Similar imageries from DWR, Nagpur indicates an east-ward oriented precipitation to the north of Nagpur on 20th & 21st August. It spread to the south on 22nd & 23rd August. However, most intense rainfall occurred to the northwest of Nagpur covering southwest Madhya Pradesh.

5. Dynamical features:

The IMD GFS analyses at 0000UTC of 20th -23rd August, 2013 are shown in Fig. 4. It indicates that the geneses of the system could be well captured by the model on 20th as it showed a low pressure area over Gangetic West Bengal and neighborhood.

The model could not detect the intensity. It also showed slow northwest ward movement till 21st August and then westward movement and west-southwestward movement upto 79°E till 23rd August. Considering the prediction by the model it could predict the track reasonably. But the intensity of the system was under predicted. Initial north-northwestward movement of the depression was mainly due to the steering southerly to south-southeasterly wind at 200 hpa level in association with anti-cyclonic circulation over Mizoram and neighborhood. After that it moved westward till 22nd and then west-southwestwards with the steering wind at 200 hpa level as shown in Fig.4.

6. Warning services:

IMD mobilised all its resources for monitoring and prediction of depression. It issued 3/6 hourly warning/advisory bulletins to national disaster management agencies including National Disaster Management (NDM), Ministry of Home Affairs (MHA), concerned state Govts. and other users at regular intervals. A whole fourteen bulletins were issued by Cyclone Warning Division, IMD, New Delhi in connection with this depression.

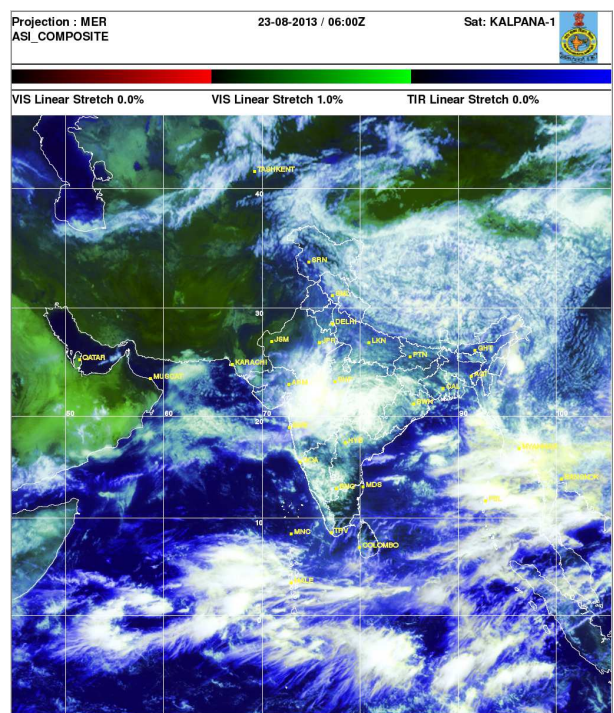
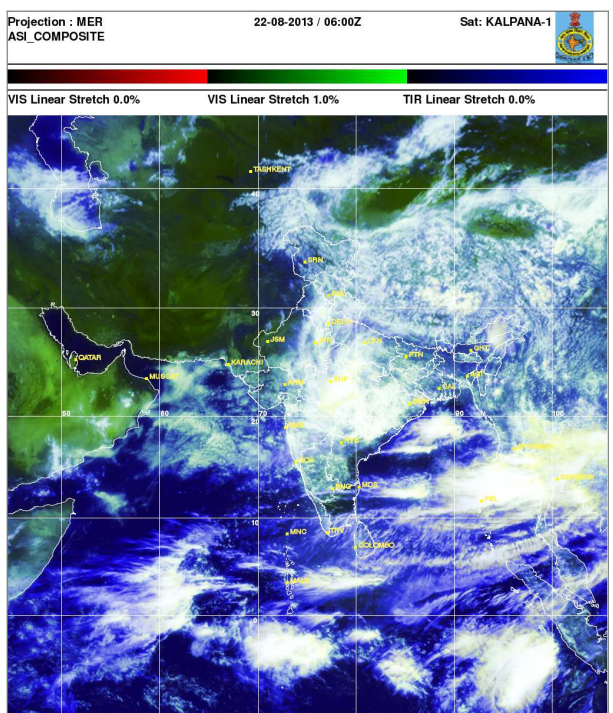
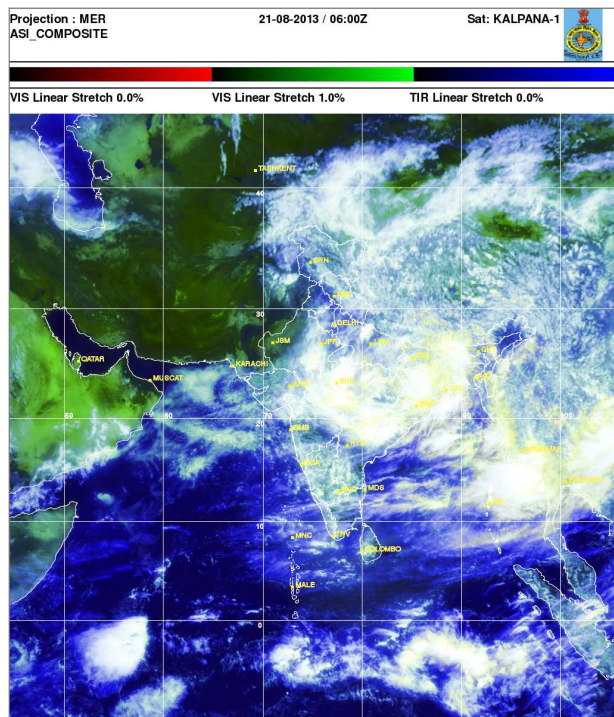
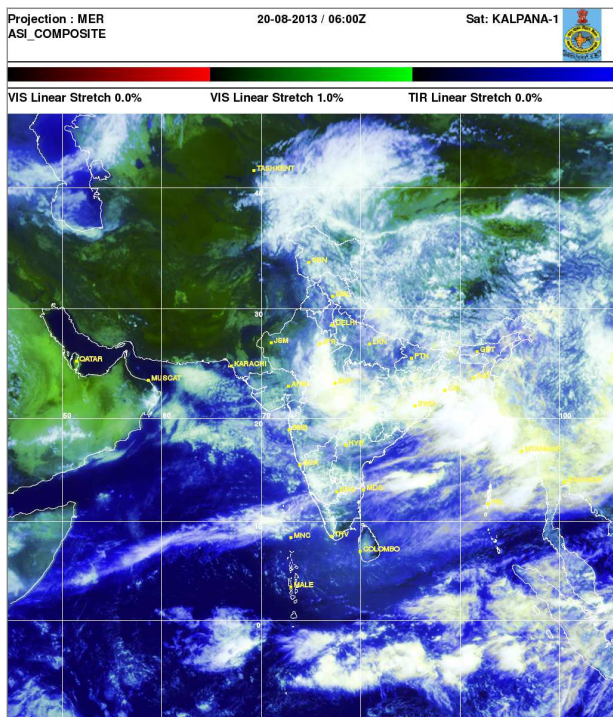


Fig.2. Typical Kalpana-1 Satellite imageries of depression at 0600 UTC of 20th August to 23rd August, 2013

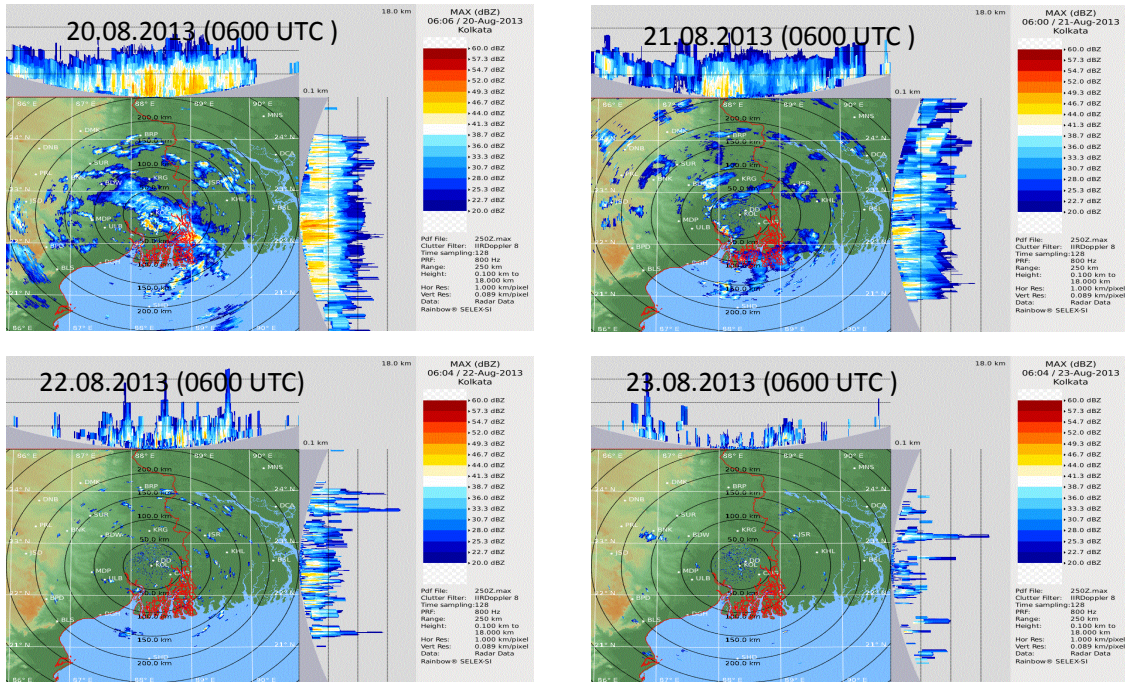


Fig.3 (a). Reflectivity imageries (Max Z) of DWR Kolkata at 0600 UTC of 20TH August – 23rd August, 2013

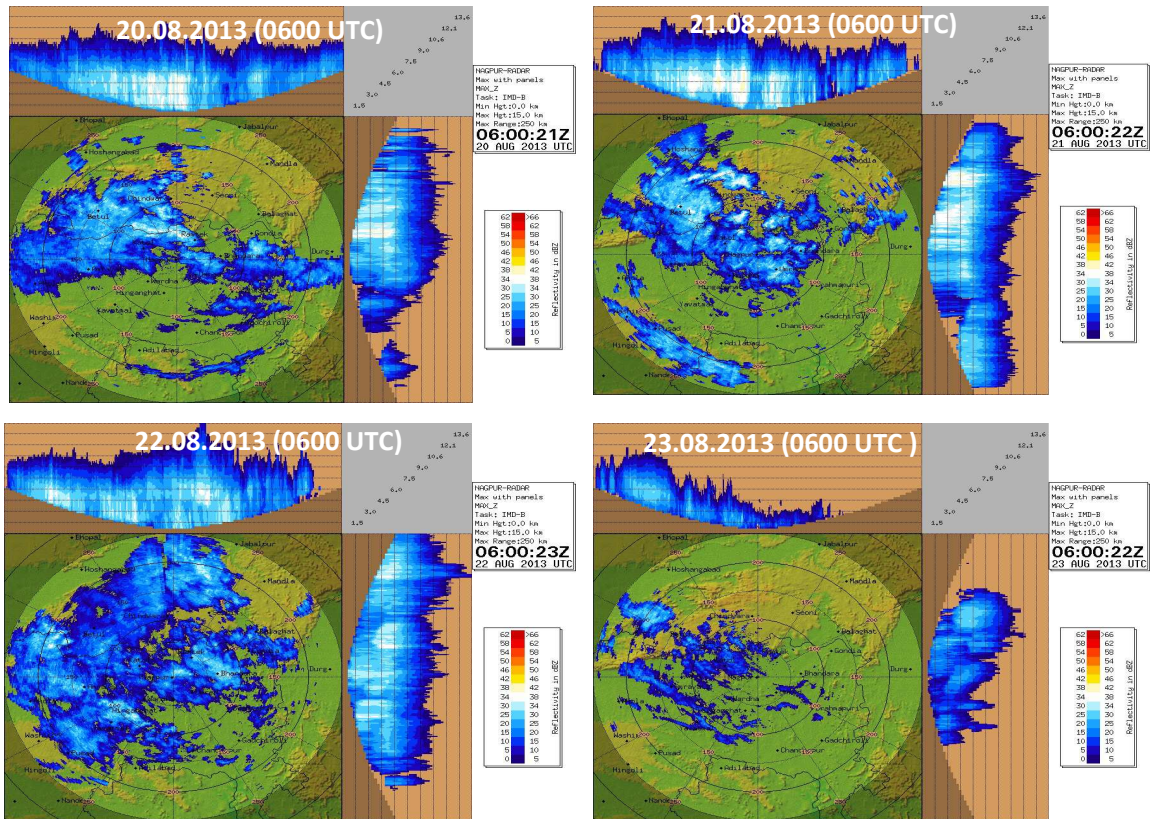


Fig.3 (b). Reflectivity imageries of DWR Nagpur at 0600 UTC of 20th August – 23rd August, 2013

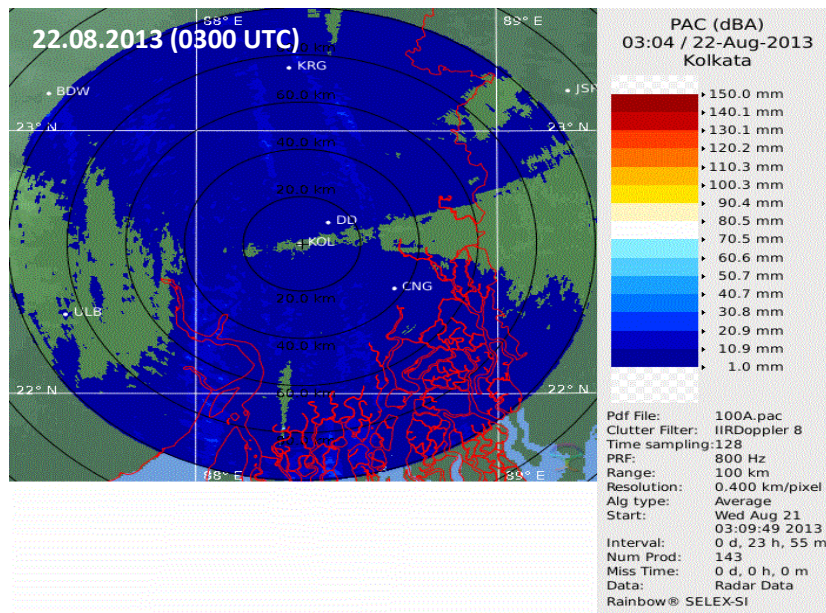
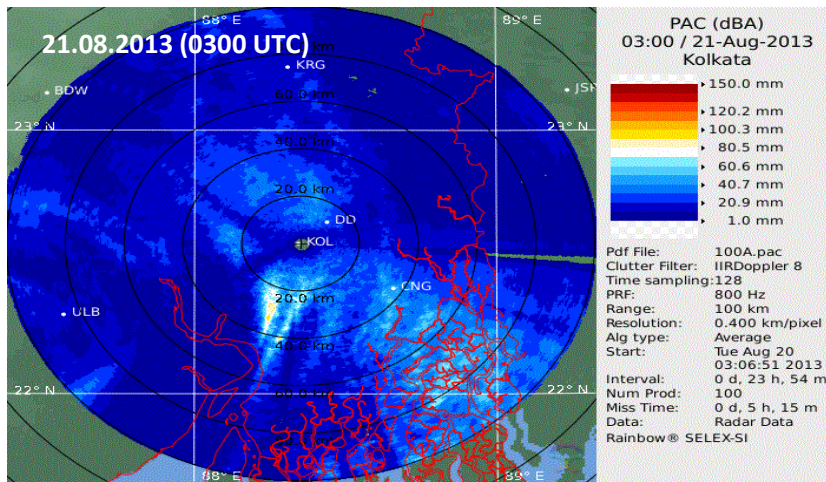
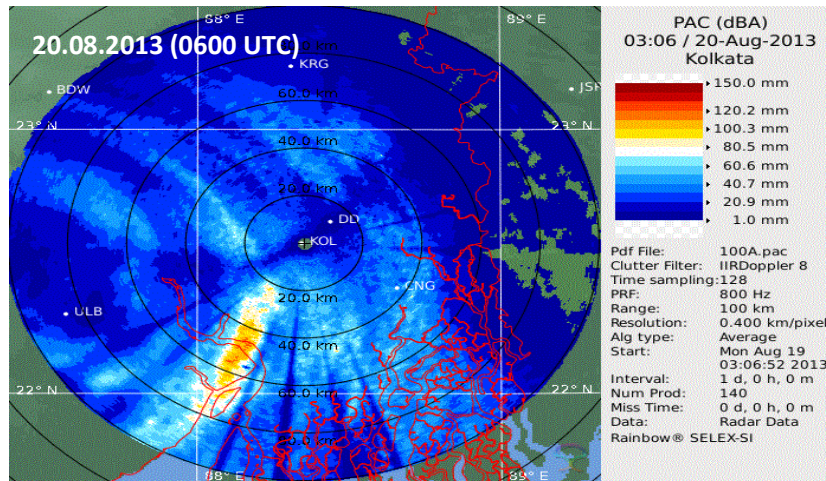


Fig.3 (c). Cumulative Rainfall imageries of DWR Kolkata at 0300 UTC of 20th August – 22nd August, 2013

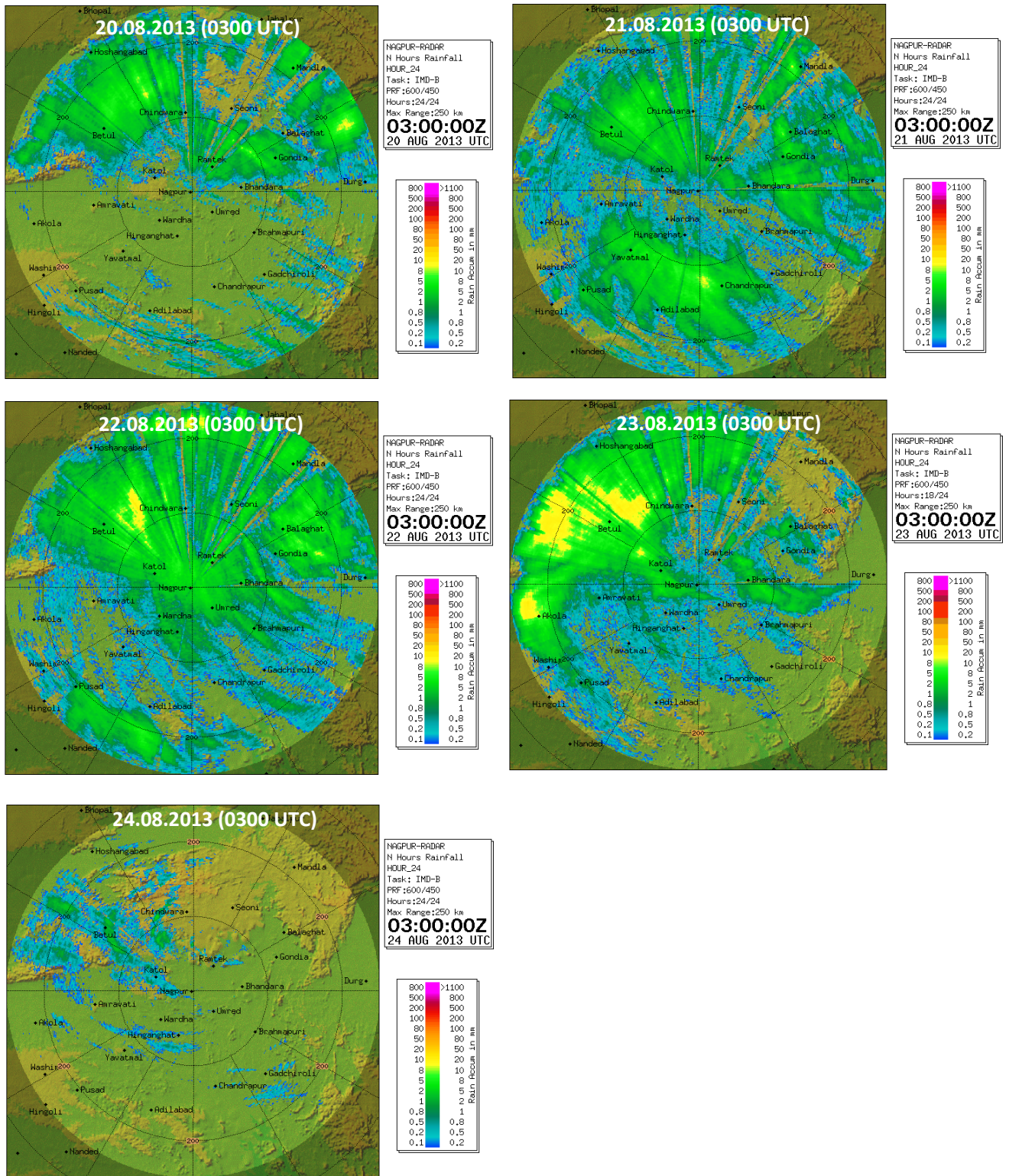


Fig.3 (d). Cumulative Rainfall imageries of DWR Nagpur at 0300 UTC of 20th August – 24th August, 2013

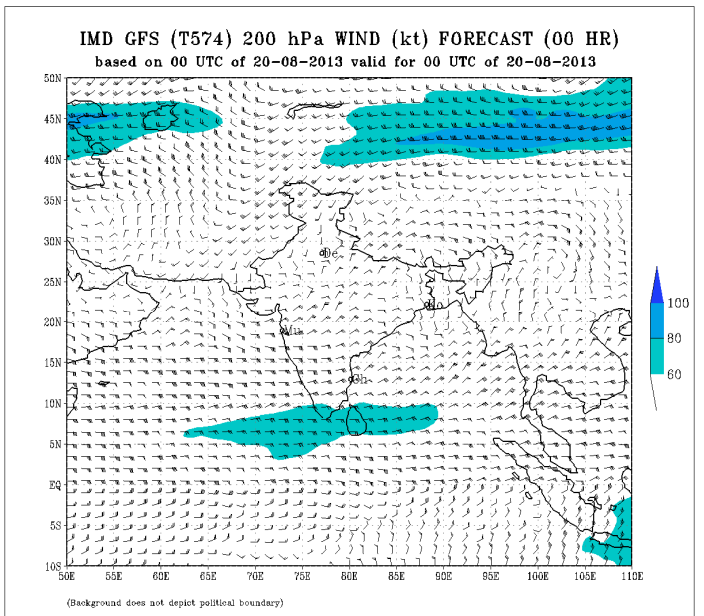
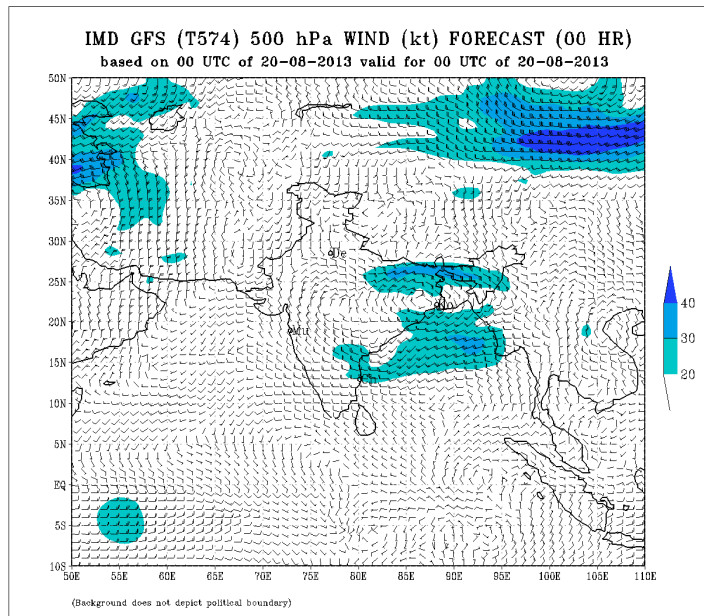
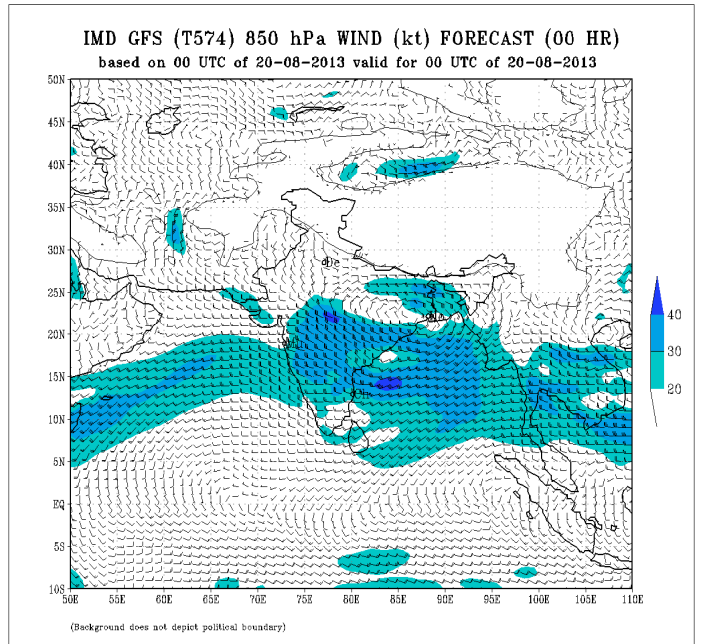
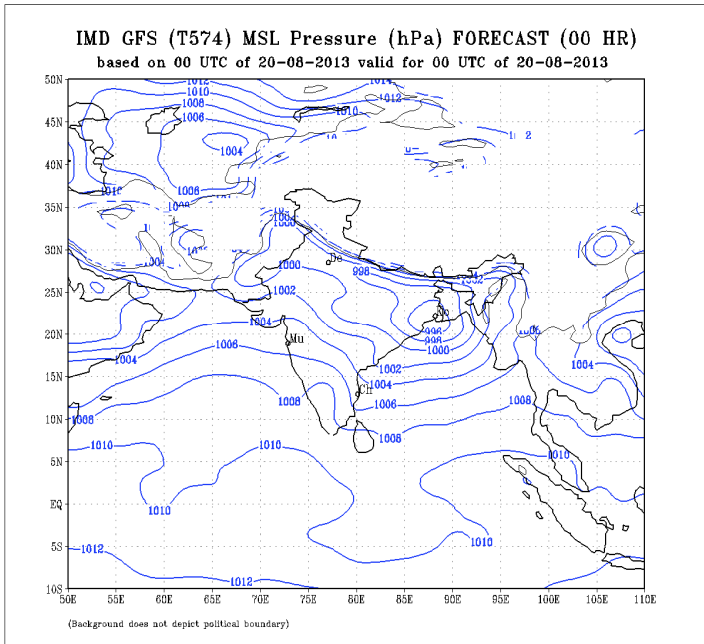


Fig.4 (a). IMD GFS Analysis of Mean Sea Level Pressure (MSLP) and wind at 850,500 & 200 hpa based on 0000 UTC of 20th August, 2013

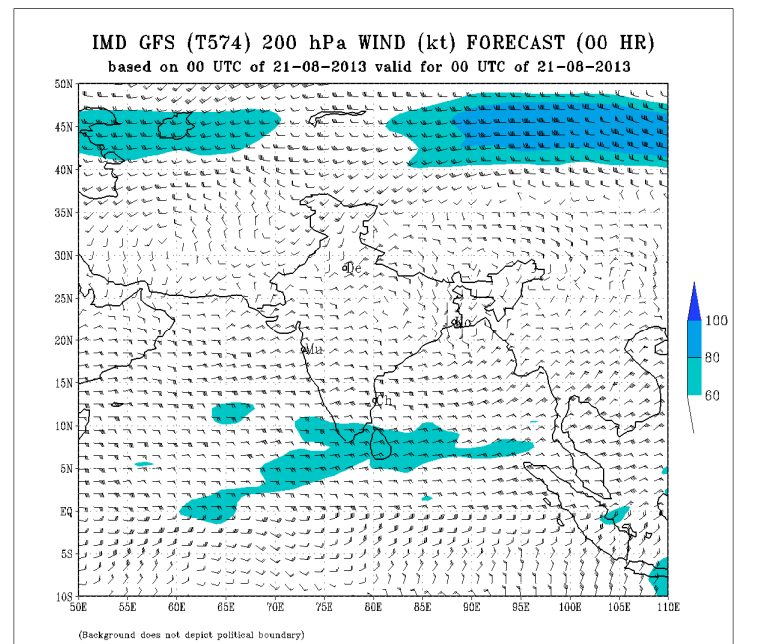
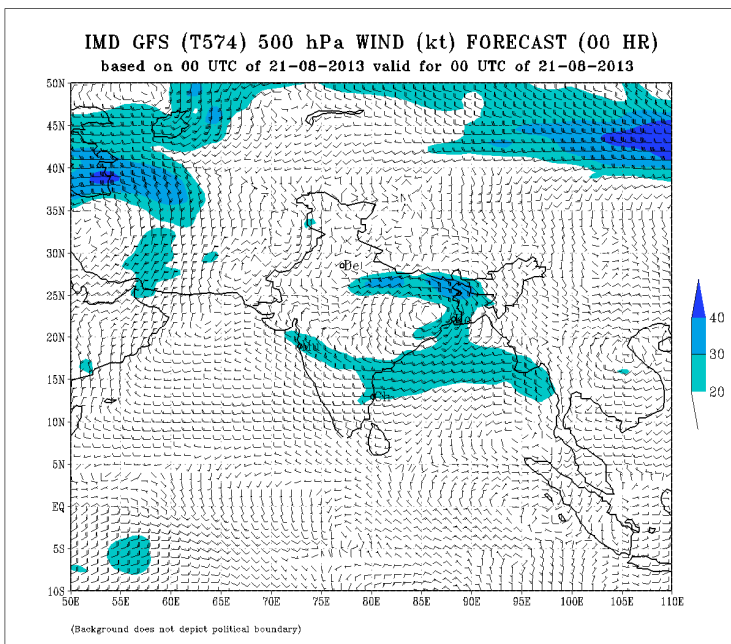
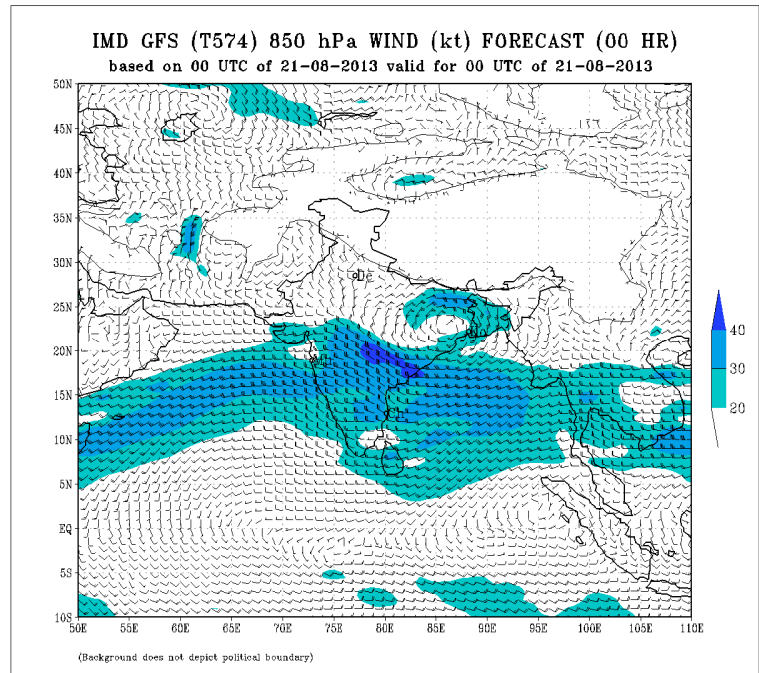
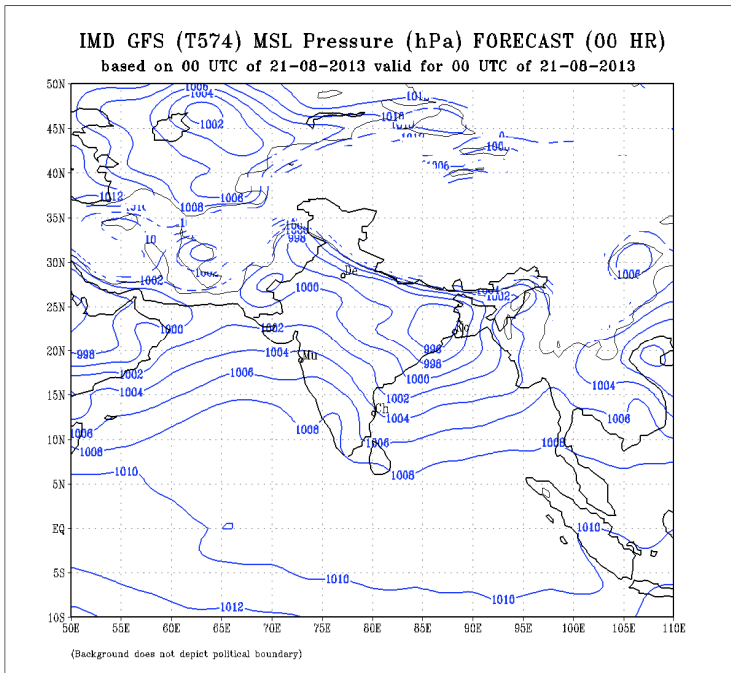


Fig.4 (b). IMD GFS Analysis of Mean Sea Level Pressure (MSLP) and wind at 850,500 & 200 hpa based on 0000 UTC of 21st August, 2013

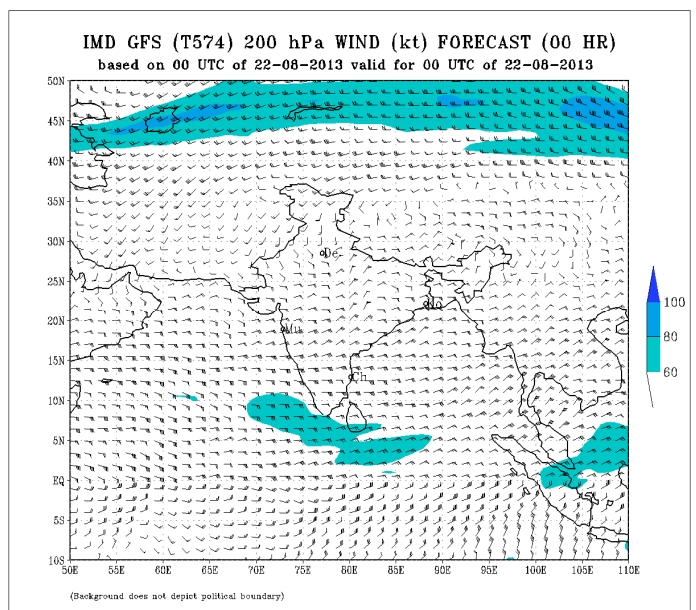
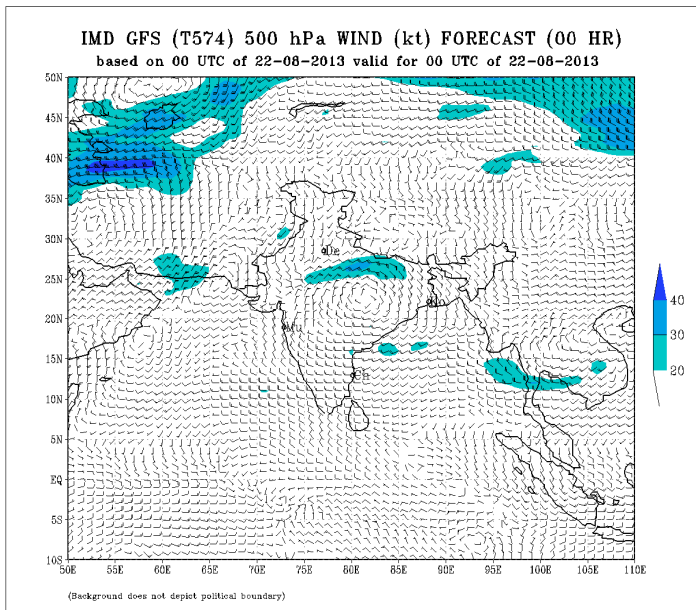
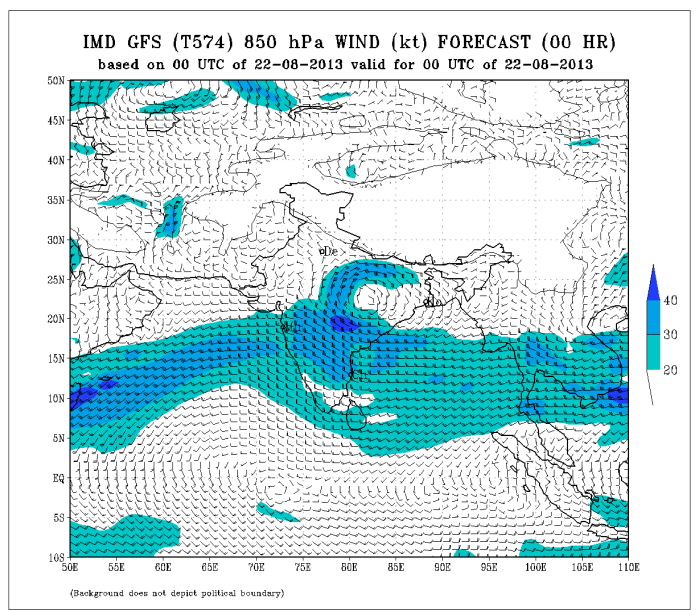
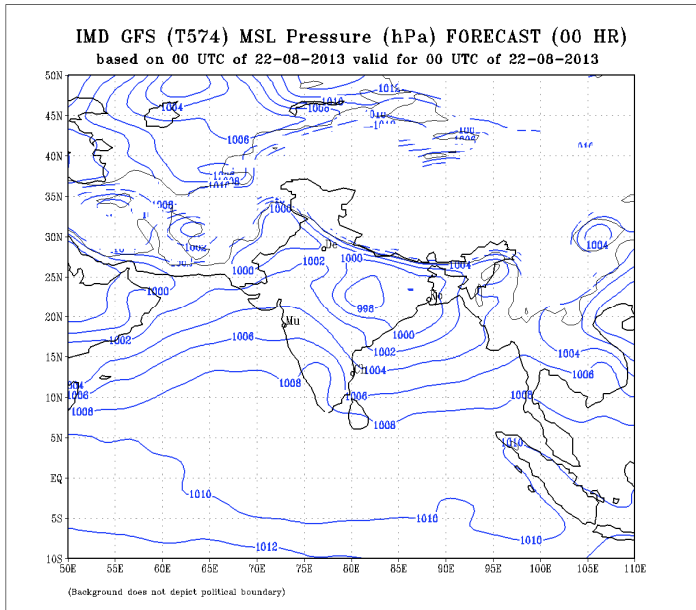


Fig.4 (c). IMD GFS Analysis of Mean Sea Level Pressure (MSLP) and wind at 850,500 & 200 hpa based on 0000 UTC of 22nd August, 2013

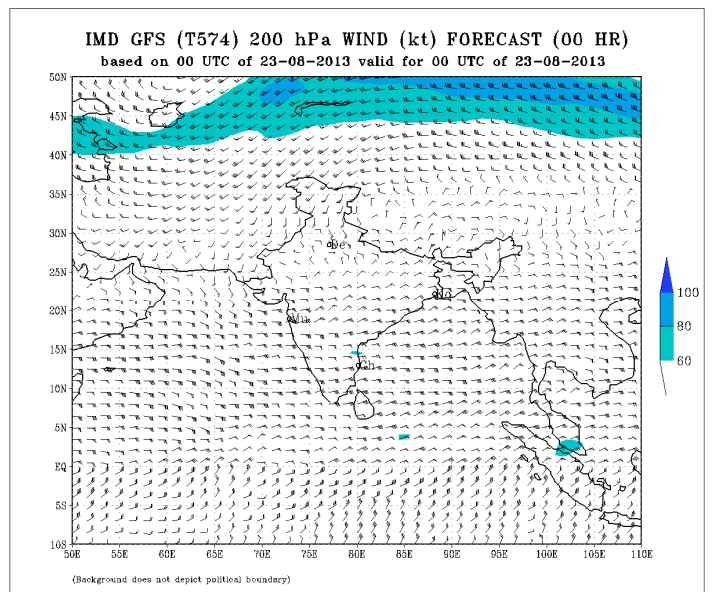
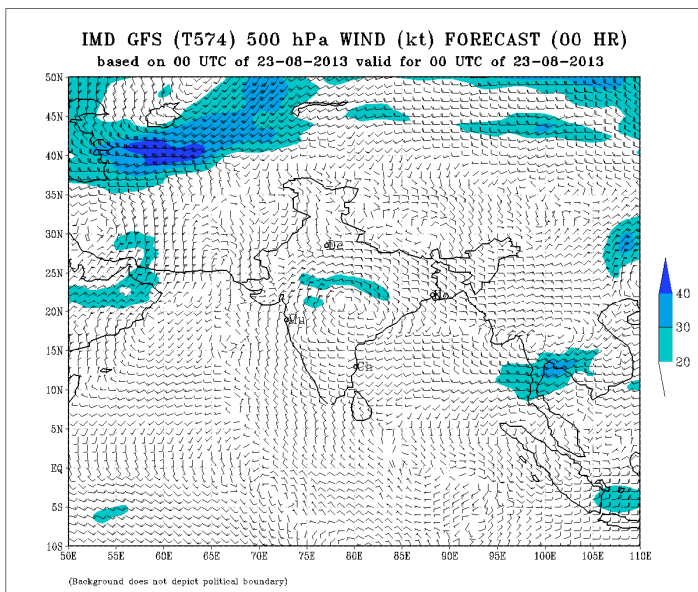
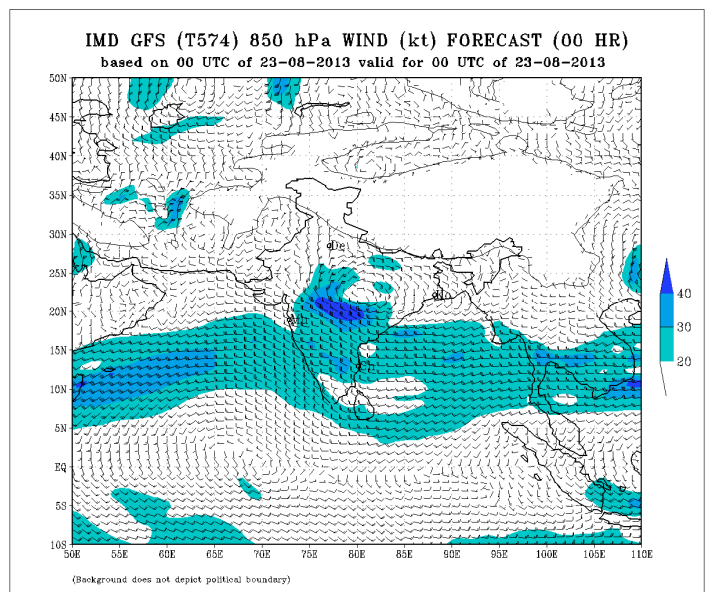
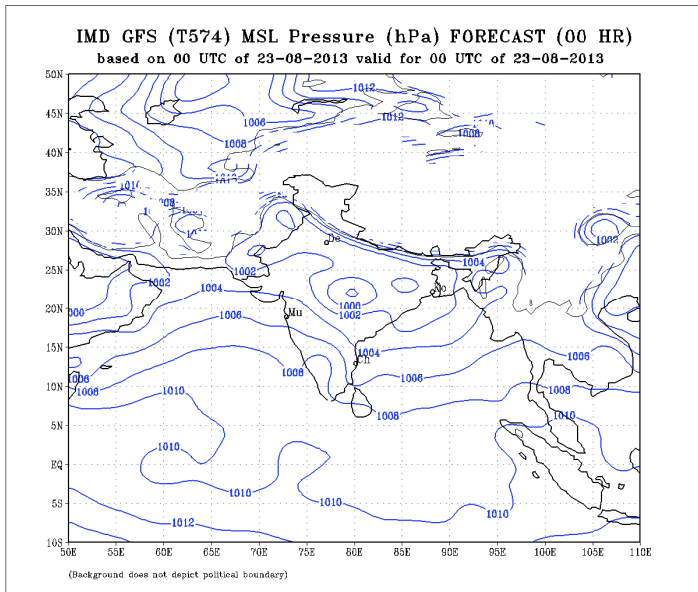


Fig.4 (d). IMD GFS Analysis of Mean Sea Level Pressure (MSLP) and wind at 850,500 & 200 hpa based on 0000 UTC of 23rd August, 2013

6. Realised Weather:

Chief amounts of 24 hrs. rainfall (7 cm or more) ending at 0300 UTC of 20th August – 25th August, 2013 are given below:

20.08.2013:

Odisha: Deogarh- 22; Batagaon-20, Chandanpur- 13, Rengali-12, Danagadi-ARG, Rairangpur, Baripada -11each, Jaleswar, Pallahara, Reamal and Jamsolaghat-10 each, Keonjhar, K Nuagaon ARG, Bangiriposi and Ghatagaon-9 each, Samakhunta AWS, Sundargarh, Tensa, Kuchinda, Joda ARG Komna, Soro and Nawana- 8 each, Nawapara, Bhograi, Joshipur, Tiring, Korei ARG, Udala, Baliguda, Rajghat and Kesinga ARG - 7 each.

Gangetic West Bengal: Durgachack, Diamond Harbour -17 each, Jagatballarpur-15, Canning-11, Contai-10, Harinkhola, Baruipur Agro-AWS, Kolkata (Alipore), Sagar_Island AWS- 9 each, Tamluk AWS- 8, Kalyani, Kalaikunda- 7each.

21.08.2013:

Gangetic West Bengal: Tusuma -19; Purihansa -12, Barrackpur, Shekhampore ARG and Canning- 9 each, Baruipur Agro-AWS and Dum Dum- 8 each, Simula, Kotshila ARG, Jagatballavpur Arg, Mohanpur and Suri -7 each.

Odisha: Baripada- 16, Rairangpur- 15, Jaleswar and Rajghat- 13 each, Nawana -12, Betanati ARG- 10, Jamsolaghat, Bangiriposi, Samakhunta AWS, Joshipur and Tensa- 9 each, Kaptipada ARG, Chandanpur and Udala- 8 each, Sundargarh, Balimundali, Paradeep, Nilgiri, Deogarh and Balasore- 7 each.

West Madhya Pradesh: Pachmarhi- 12, Sujalpur- 8, Betul and Agar- 7 each.

East Madhya Pradesh: Damoh- 16, Garhakota- 8, Hatta, Kaneli and Sagar- 7 each.

Chattishgarh: Manendragarh- 13.

Jharkhand: Messonjori -7.

22.08.2013:

Jharkhand: Papunki-13, Dumri-11, Bagodar-10, Barkisuriya-9, Topchanchi-8, Japla-7

Chhattisgarh: Manendragarh-12

East Madhya Pradesh: Damoh-19, Garhakota-14, Rehli-13, Ghansore-12, Maihar-11, Jabalpur-New—9, Kaneli, Deori, Narsinghpur, Sausar, Lakhnadon, Hatta and Gotegaon-7 each.

West Madhya Pradesh: Neemuch-15, Pachmarhi-13, Multai-9, Chicholi, Betul and Bhainsdehi-8 each, Ambah, Agar and Morena-7each.

Vidarbha: Chikhaldhara 7.

23.08.13

West Madhya Pradesh : Pachmarhi-25, Betul -23, Chicholi -22, Multai-21, Bhainsdehi -18, Khategaon, Budhni,Raisen-13 each, Nusrulgunj, Bhopal -12 each, Hoshangbad-11, Atner,Ichhawar,Vidisha-10 each, Ganjbasoda, Khaknar, Sehore, Ashta – 9 each, Kannod, Tonkhurd, Khandwa-8 each, Harsud, Narsingarh, Biaora, Shujalpur, Kurwai-7each.

East Madhya Pradesh: Gadarwara, Seoni-12 each, Lakhnadon-10, Narsinghpur-9, Sohagpur, Khurai, Panna-8 each, Chindwara, Ghansore-7 each.

Vidarbha: Chikhaldha-15, Narkheda-9, Warud-7.

Chhattisgarh: Manendragarh-11

24/08/13

East Rajasthan : Khushalgarh-10, Shergarh- 9, Sallopat, Badesar-8 each, Bagidora, Arthuna, Sajjangarh, Danpur-7 each.

West Madhya Pradesh : Gautampura-19, Depalpur-17, Dewas-16, Badnagar, Dhar-15 each, Bagli, Indore, Tonkhurd, Mhow- 14 each, Nalchha, Sonkatch-13 each, Ujjain, Kasarwad, Maheshwar, Barwaha-11 each, Badnawar, Jhabua, Petlawad, Mahidpur-10 each, Khaknar, Thikri, Sardarpur, Sarangpur, Thandla, Susner-9 each, Khandwa, Bhikangaon, Khachrod, Shujalpur, Manawar-8 each, Gandhwani, Bhabhra, Ashta, Agar, Tarana, Kannod, Khargone, Shajapur-7 each.

Gujarat Region : Godhra, Dahod, Fatepura, Kalol-7each.

Vidarbha : Chikhaldha-7,

25.08.2013

East Rajasthan : Dug-9,

Gujarat Region : Sankheda-10, Dahod, Jambughoda, Kalol-7 each.

AWS : Automatic Weather Station; ARG : Automatic Rain Gauge; AP: Airport

6. Rainfall forecast verification

The heavy rainfall warning issued by IMD along with the actual heavy rainfall is given in Table 2.

Table 2: Heavy rainfall warning issued by IMD, New Delhi

Date	Synoptic System	Warning issued	24 hr heavy rainfall realised at 0830 IST of date
20 th August 2013 0300 UTC	depression lies over Gangetic West Bengal, adjoining northwest Bay of Bengal, north Orissa and Jharkhand at 0530 hrs IST of today, the 20 th August, 2013 near latitude 22.0 ⁰ N and longitude 87.0 ⁰ E. The system would move west northwestwards and weaken gradually.	Extremely heavy rainfalls- isolated places over north Odisha during next 48 hrs. Heavy to very heavy rainfall at a few places – north Odisha during next 48 hours Heavy to very heavy rainfall at Isolated places - Gangetic West Bengal, south Odisha, Jharkhand, Chhattisgarh and Madhya Pradesh during next 48 hours	<u>21.08.2013:</u> Heavy to very heavy rainfall at a few places- North Odisha and Gangetic West Bengal. Heavy to very heavy rainfall at a few places- East & West Madhya Pradesh, Chhattisgarh and Jharkhand.

<p>20th August 2013 1200 UTC</p>	<p>The depression over Gangetic West Bengal and adjoining areas of northwest Bay of Bengal, north Orissa and Jharkhand remained practically stationary and lay centred at 1730 hrs IST of today, the 20th August, 2013 near latitude 22.0°N and longitude 87.0°E. The system would move slowly west-northwestwards and weaken gradually into a well-marked low pressure area during next 48 hours.</p>	<p>Extremely heavy rainfalls- isolated places over north Odisha during next 24 hrs. Heavy to very heavy rainfalls at a few places - north Odisha during next 48 hours.</p> <p>Heavy to very heavy rainfalls at isolated places - Gangetic West Bengal, south Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh and Vidarbha during next 48 hours</p>	<p><u>22.08.2013:</u></p> <p>Isolated Heavy to very heavy rainfall-</p> <p>Jharkhand, East & West Madhya Pradesh</p> <p>Isolated heavy rainfall - Chhattisgarh and Vidarbha.</p> <p><u>23.08.13</u></p> <p>Isolated extremely Heavy to very heavy rainfall- West Madhya Pradesh</p> <p>Isolated heavy rainfall- Chhattisgarh, east Madhya Pradesh and Vidarbha.</p> <p><u>24.08.2013</u></p> <p>Isolated Heavy to very heavy rainfall-</p> <p>West Madhya Pradesh</p> <p>Isolated heavy rainfall- east Rajasthan, Gujarat region and Vidarbha.</p>
<p>21st August 2013 0300 UTC</p>	<p>The depression over Gangetic West Bengal and adjoining areas of north Odisha and Jharkhand moved west-southwestwards during past six hours and lay centred over Gangetic West Bengal and adjoining areas of Jharkhand & north Odisha near latitude 23.0°N and longitude 86.0°E at 0830 hrs IST of today, the 21st August, 2013. The system would move slowly westwards and weaken gradually into a well-marked low pressure area during next 24 hours.</p>	<p>Heavy to very heavy rainfall at isolated places – Gangetic West Bengal, Jharkhand and Odisha during next 24 hours and isolated heavy falls in subsequent 24 hrs.</p> <p>Heavy to very heavy rainfall at isolated places- Chhattisgarh, Madhya Pradesh and Vidarbha during next 48 hours.</p>	<p><u>25.08.2013</u></p> <p>Isolated heavy rainfall- East Rajasthan and Gujarat region.</p>
<p>21st August 2013 1200 UTC</p>	<p>The depression over Jharkhand and neighbourhood moved westwards during past six hours and lay centred over Jharkhand and adjoining north Chhattisgarh, about 100 km east of Ambikapur and 100 km south-southeast Daltongang at 1730 hrs IST of today, the 21st August, 2013. The system would move slowly west-northwestwards and weaken gradually into a well-marked low pressure area during next 24 hours.</p>	<p>Heavy to very heavy rainfall at isolated places – Chhattisgarh and Madhya Pradesh during next 48 hrs.</p> <p>Heavy rainfall at Isolated places - Gangetic West Bengal, Jharkhand and Odisha during next 24 hrs and over Vidarbha during next 48 hours.</p>	<p><u>25.08.2013</u></p> <p>Isolated heavy rainfall- East Rajasthan and Gujarat region.</p>

<p>22nd August 2013 0300 UTC</p>	<p>The depression over Jharkhand and adjoining north Chhattisgarh moved westwards during past 03 hours and lay centred at 0830 hrs IST of today, the 22nd August, 2013 over east Madhya Pradesh, about 70 km east-northeast of Jabalpur. The system would move west-northwestwards and weaken gradually into a well-marked low pressure area during next 12 hours.</p>	<p>Heavy to very heavy rainfalls at isolated places- west Madhya Pradesh during next 48 hrs. Isolated heavy rainfalls - east Madhya Pradesh during next 24 hrs and over Vidarbha during next 48 hrs. Heavy rainfalls at Isolated places - east Rajasthan, Gujarat region and north Madhya Maharashtra on 23rd and 24th August 2013.</p>	
<p>22nd August 2013 1200 UTC</p>	<p>The depression over east Madhya Pradesh moved west-southwestwards during past 06 hours and lay centred at 1730 hrs IST of today, the 22nd August, 2013 over east Madhya Pradesh, about 50 km southeast of Jabalpur. The system would move westwards and weaken gradually into a well marked low pressure area by tomorrow.</p>	<p>Heavy to very heavy rainfalls at isolated places-west Madhya Pradesh during next 48 hrs. Heavy rainfalls at Isolated places - east Madhya Pradesh during next 24 hrs. Heavy rainfalls at Isolated places - east Rajasthan on 23rd and 24th and over north Madhya Maharashtra and Vidarbha on 23rd August 2013</p>	
<p>23rd August 2013 0300 UTC</p>	<p>The depression over east Madhya Pradesh moved west-southwestwards and weakened into a well marked low pressure area over central part of south Madhya Pradesh and adjoining Vidarbha at 0830 hrs IST of today, the 23rd August, 2013</p>	<p>Heavy to very heavy rain falls at isolated places-west Madhya Pradesh during next 48 hrs. Heavy rainfalls at Isolated places - Vidarbha and Gujarat region during next 24 hrs. and over southeast Rajasthan and north Madhya Maharashtra during next 48 hours.</p>	