

Depression over Bay of Bengal (22-23 Sept 2011)

5.1 Introduction

A **depression** formed over northwest Bay of Bengal on 22 September, 2011 morning. Moving in a westerly direction, it crossed north Orissa coast, close to Balasore and then moved northwestwards across north Orissa and Jharkhand and weakened gradually into a well marked low pressure area on 23rd September 2011 afternoon over Jharkhand and neighbourhood. Under the influence of this system heavy to very heavy rainfall occurred over north Orissa, Jharkhand, north Chhattisgarh, east Uttar Pradesh and Bihar. The genesis, intensification and movement and other characteristic are described below.

5.2 Genesis

In association with an active monsoon trough, a low pressure area formed over the north Bay of Bengal on 21st September, 2011. The sea surface temperature over the Bay of Bengal was about 28-32^oC. The vertical wind shear of horizontal wind between 850 and 200 hPa was low to moderate (10-20 knots). The associated intense convection persisted over the region, mainly to the southwest sector of the low pressure area. There was increase in lower level relative vorticity and upper level divergence also over the region. The upper tropospheric ridge in association with the Tibetan high ran along 22^oN. Under these favourable synoptic and environmental conditions, the low pressure area concentrated into a depression at 0830 hrs IST of 22nd September, 2011 over the northwest Bay of Bengal near Lat. 21.5^oN and long. 87.5^oE, about 50 km east-southeast of Balasore. The estimated central pressure was about 998 hPa and the lowest MSLP of 998.2 hPa was reported by Balasore followed by 998.3 hPa at Digha at 0830 hrs IST of 22nd September, 2011.

5.3 Intensification and movement

Though the sea surface temperature was favourable being 28-32^oC, the Ocean heat content was not favourable for intensification as it was about 40KJ/cm² over the north Bay of Bengal. Further the system was interacting with land surface as it lay close to coast. It moved slowly in the westerly direction and crossed north Orissa coast, close to Balasore between 2230 and 2330 hrs IST of 22nd September, 2011. After the landfall, the depression moved northwest wards across north Orissa and Jharkhand and weakened gradually. It weakened into a well marked low pressure area over Jharkhand and neighbourhood at 1430 hrs IST of 23rd September 2011. However the well marked low pressure area moved to east Uttar Pradesh on 24th and to Bihar on 25th September under the influence of westerly trough. It became less marked on 26th September, 2011.

The best track of depression is given in Fig. 5.1. The best track parameters are shown in Table 5.1. The typical satellite imageries of the system are shown in Fig.5.2

The ECMWF model analysis of lower level vorticity, upper level divergence, lower level wind and wind shear during 21-23 September 2011 are shown in Fig. 5.3

Table: 5.1 Best track position and other parameters of depression over the northwest Bay of Bengal during 22-23 September, 2011

Date	Time	Centre (lat ⁰ N/long ⁰ E)	C. I. No.	Estimated centre pressure (hPa)	Estimated pressure drop at the centre (hPa)	Estimated Maximum sustained wind (kts)	Grade
22-9-2011	0300	21.5/87.5	1.5	998	4	25	D
	0600	21.6/87.3	1.5	998	4	25	D
	1200	21.7/87.2	1.5	995	4	25	D
	The system crossed north Orissa coast close to Balasore between 1700 & 1800 UTC						
23-9-2011	1800	21.8/87.0		998	4	25	D
	0000	22.5/86.5		1000	4	25	D
	0300	22.5/86.5		1002	4	25	D
	0600	22.5/86.5		1004	4	25	D
	0900	The system weakened into a low pressure area over Jharkhand close to Jamshedpur.					

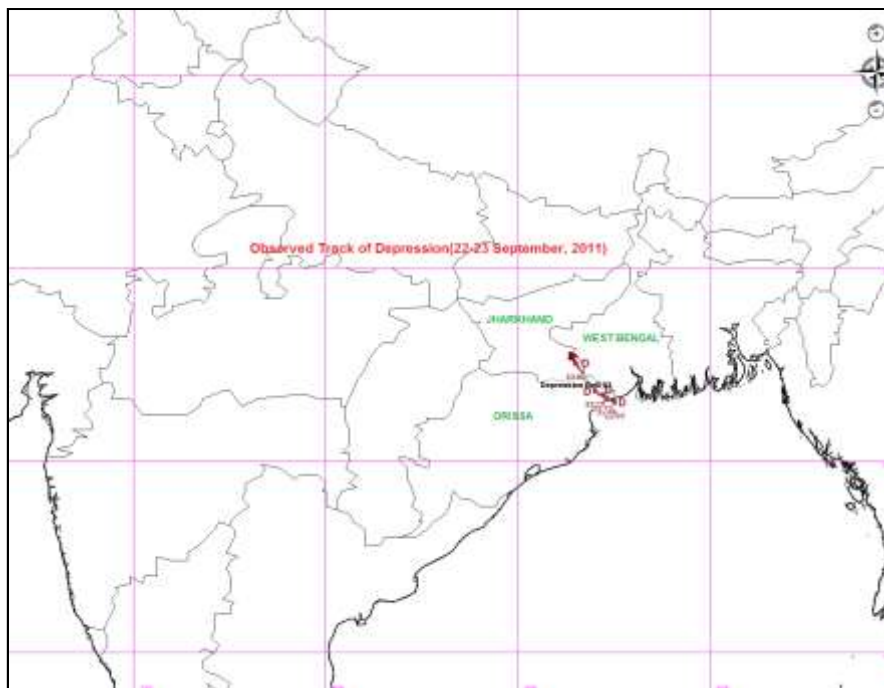


Fig. 5.1 Track of the deep depression over the Bay of Bengal (22-23 September, 2011).

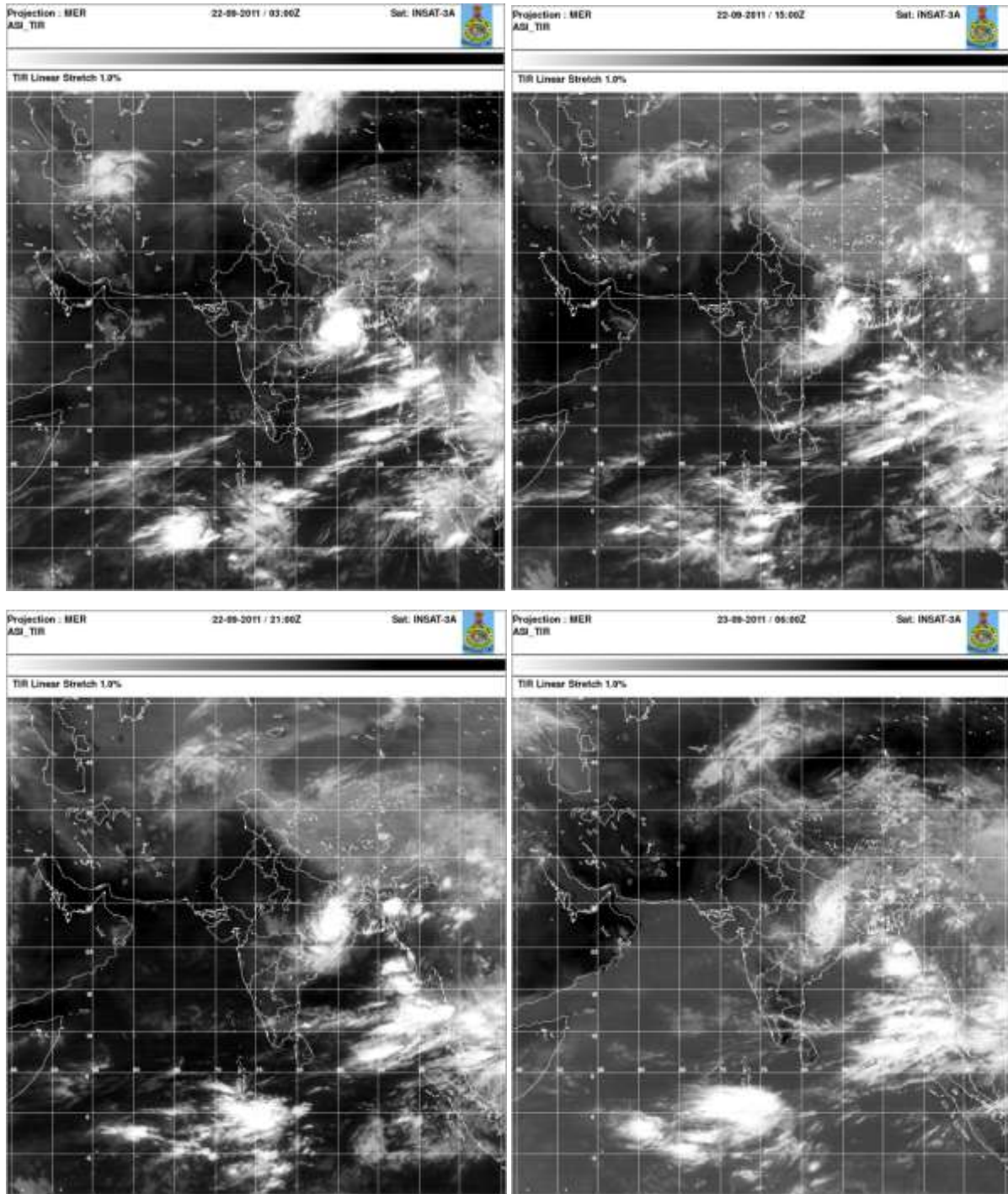
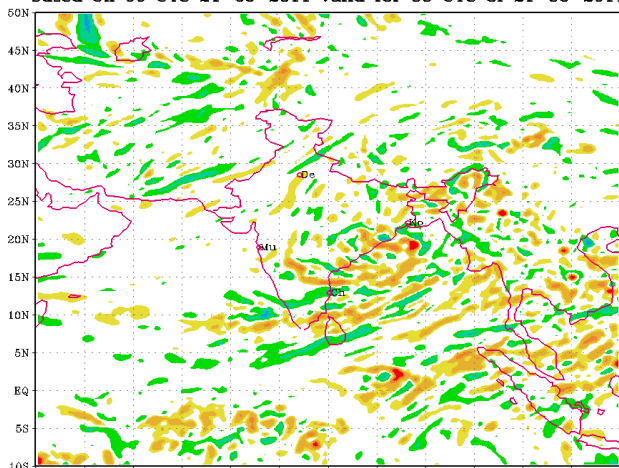
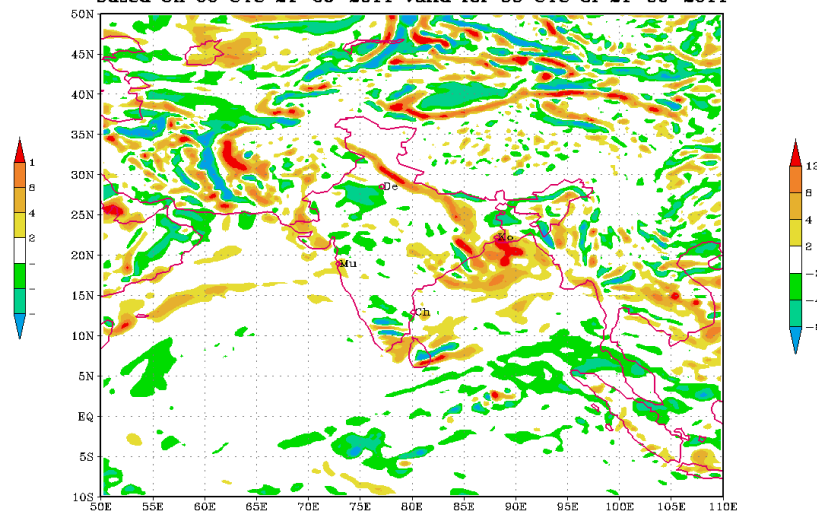


Fig. 5.2 Typical Satellite imageries at 0300, 1500 and 2100 UTC of 22-09-2011 and 0600 UTC of 23-09-2011 in association with the depression over the Bay of Bengal.

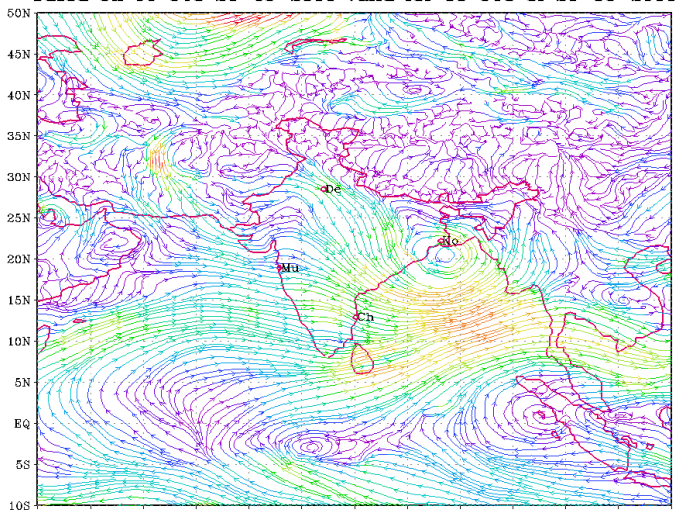
Divergence ($1e5 \text{ s}^{-1}$) at 200 hPa ECMWF Forecast (0 hr.)
based on 00 UTC 21-09-2011 valid for 00 UTC of 21-09-2011



Vorticity ($1e5 \text{ s}^{-1}$) at 850 hPa ECMWF Forecast (0 hr.)
based on 00 UTC 21-09-2011 valid for 00 UTC of 21-09-2011



850 hPa WIND ECMWF FORECAST (0 Hr.)
based on 00 UTC 21-09-2011 valid for 00 UTC of 21-09-2011



Wind Shear between 200 & 850 hPa ECMWF FORECAST (0
based on 00 UTC 21-09-2011 valid for 00 UTC of 21-09-2011

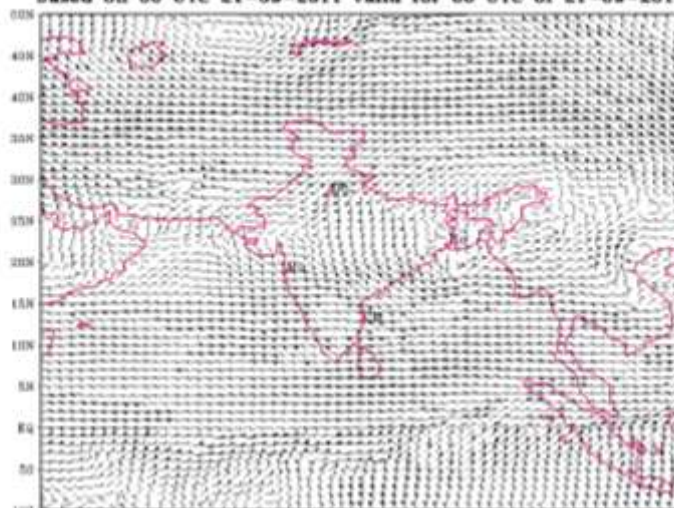


Fig. 5.3 (a) (i) upper level divergence at 200 hPa level (ii) low level relative vorticity at 850 hPa level (iii) wind at 850 hPa level (iv) vertical wind shear of horizontal wind between 200 and 850 hPa level based on the ECMWF model analysis of 0000 UTC of 21st September, 2011.

Divergence ($1e5 \text{ s}^{-1}$) at 200 hPa ECMWF Forecast (0 hr. Vorticity ($1e5 \text{ s}^{-1}$) at 850 hPa ECMWF Forecast (0 hr.)
 based on 00 UTC 22-09-2011 valid for 00 UTC of 22-09-2011

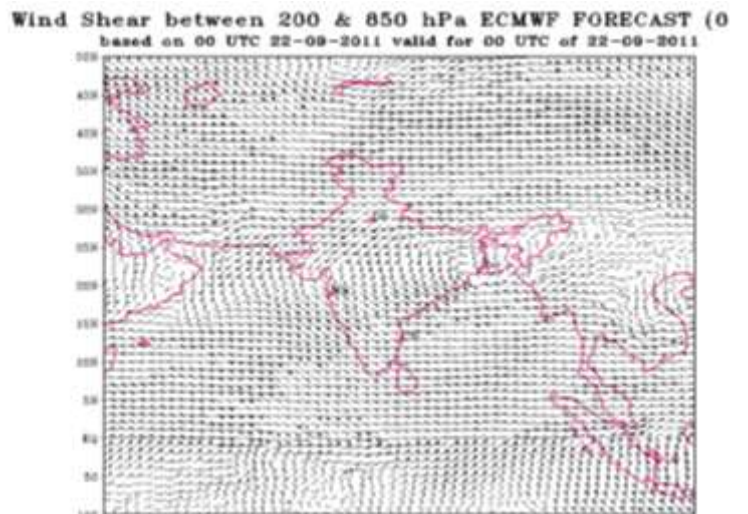
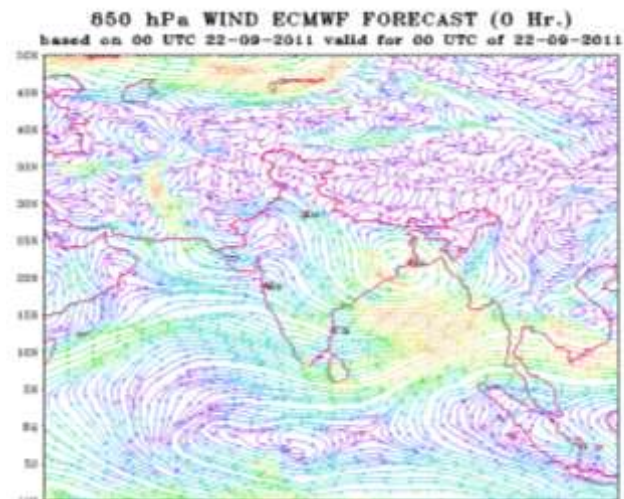
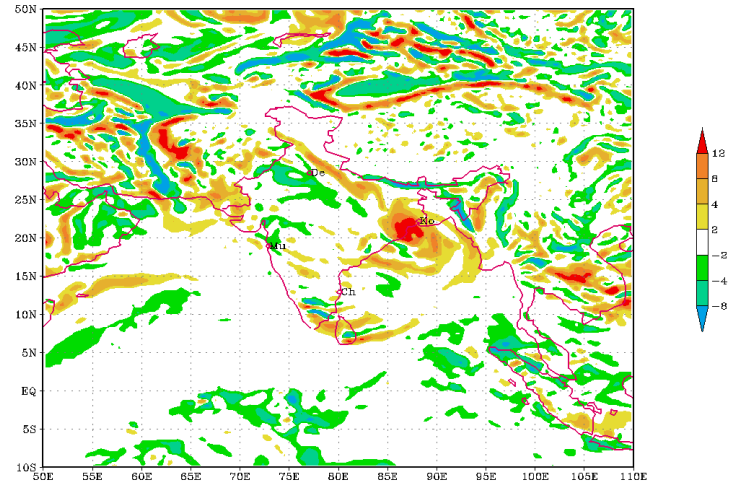
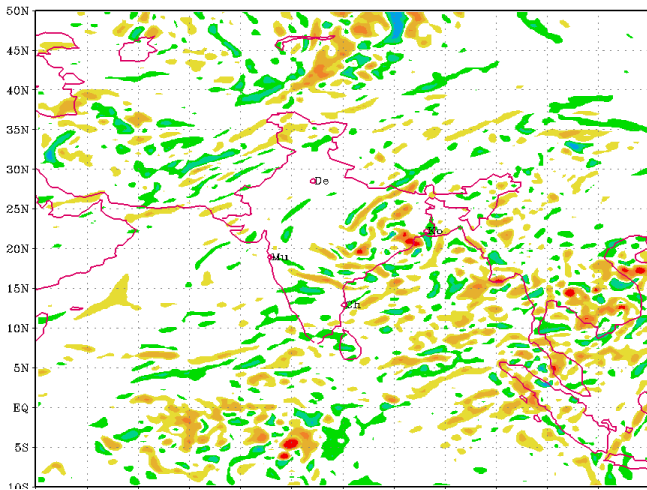
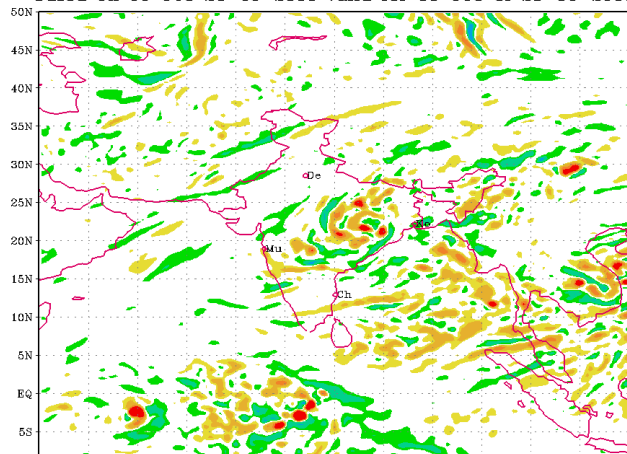
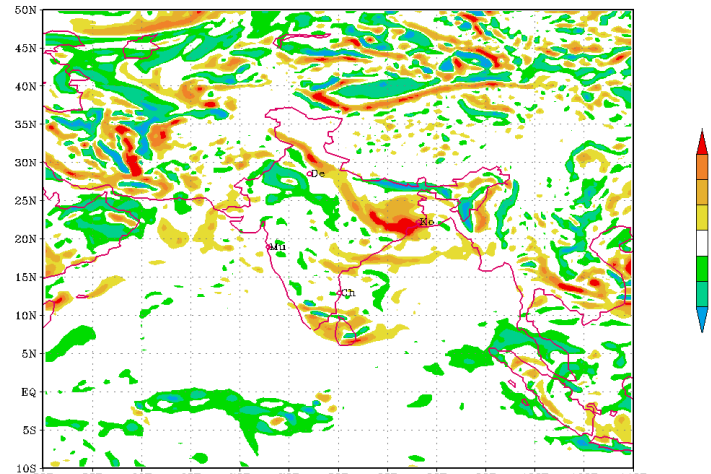


Fig. 5.3(b) (i) Upper level divergence at 200 hPa level (ii) low level relative vorticity at 850 hPa level (iii) wind at 850 hPa level and (iv) vertical wind shear of horizontal wind between 200 and 850 hPa level based on the ECMWF model analysis of 0000 UTC of 22nd September, 2011.

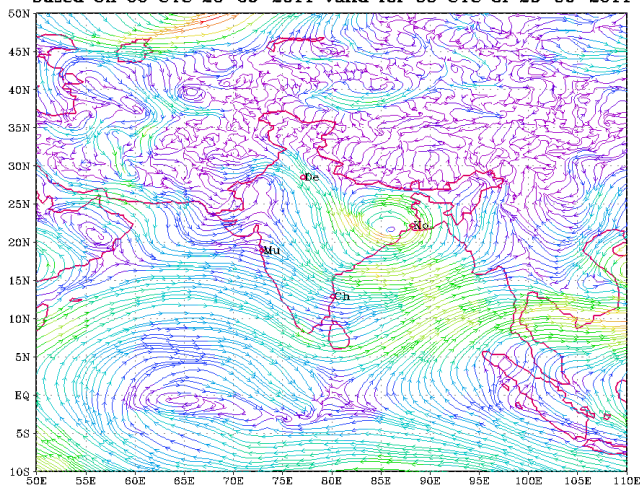
Divergence ($1e5 \text{ s}^{-1}$) at 200 hPa ECMWF Forecast (0 hr.)
based on 00 UTC 23-09-2011 valid for 00 UTC of 23-09-2011



Vorticity ($1e5 \text{ s}^{-1}$) at 850 hPa ECMWF Forecast (0 hr.)
based on 00 UTC 23-09-2011 valid for 00 UTC of 23-09-2011



850 hPa WIND ECMWF FORECAST (0 Hr.)
based on 00 UTC 23-09-2011 valid for 00 UTC of 23-09-2011



Wind Shear between 200 & 850 hPa ECMWF FORECAST ()
based on 00 UTC 23-09-2011 valid for 00 UTC of 23-09-2011

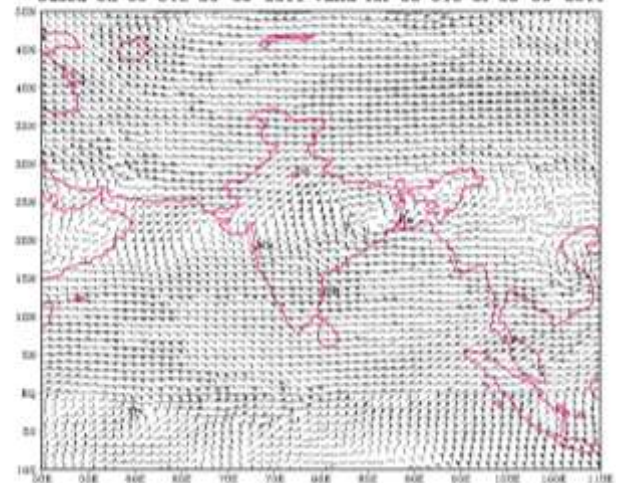


Fig. 5.3 (c) (i) Upper level divergence at 200 hPa level (ii) low level relative vorticity at 850 hPa level (iii) wind at 850 hPa level and (iv) vertical wind shear of horizontal wind between 200 and 850 hPa level based on the ECMWF model analysis of 0000 UTC of 23rd September, 2011.

5.4 Realised weather

Under the influence of this system heavy to very heavy rainfall occurred over north Orissa, Jharkhand, north Chhattisgarh, east Uttar Pradesh and Bihar. The significant amount of 24 hours cumulative rainfall (>7 cm) recorded at 0830 hrs IST of date are as follows:

22 September 2011

Gangetic West Bengal:

Kharagpur (AWS)-11, Kharagpur (I.I.T)-10, Kalaikunda (IAF)-9, and Tilpara Barrage-7.

Orissa:

Nawana-16, Udala-16, Soro-15, Thakurmunda-14, Balimundali, Tensa-13 each, Champua, Swampatna-12 each, Joshipur, Bangiriposi-11 each, Karanjia-10,

Keonjhar, Jaipur, Rairakhol, Akhuapada, Pallahara, Harabhanga, Chandbali-9, Baripada, Binjharpur, Chandanpur, Sukinda and Bonth 9 each, Anandpur, Jamsolaghat, Tihidi and Nilgiri-8 each, Rengali, Boudhgarh, Tikarpara-7 each,

Jharkhand:

Chaibasa-7,,

BIHAR: Lakhisarai, Benibad and Barhiya-11 each, Phulparas and Dhengraghat-7each

23 September 2011

Orissa:

Keonjhar and Tensa-19 each, Panposh-14, Rajgangpur, Lahuni para and, Mandira Dam-13 each, Nawana-12, Ghatagaon-11, Swam-Patna-10, Bargaon and Pallahara-9 each, Bonth-8, Keiri, Jenapur, Rajkishorenagar, Joshipur, Laikera, Kuchinda, Kankadahad, Tiring and Chiplima-7 each,

Jharkhand:

Lohar-Daga and, Kuru-13 each, Ranchi Aero-9, Japla-7,

Bihar:

Indrapuri-15, Dehri and Aurangabad-8 each, Palmerganj-7,

24 September 2011

Orissa:

Pallahara-7,

Jharkhand:

Garhwa-9,

East Uttar Pradesh:

Basti-17, Dudhi-16, Robertsganj-15, Basti-14, Churk-13, Haraiya and Elgin Bridge-11 each, Patti, Bansi, Salon, Bikapur and Sultanpur-9 each, Handia-8, Akbarpur-7,

5.5 Damage

The heavy rain caused flood over Orissa leading to loss of life and property. The death and damage over Orissa are given below.

Number of human deaths: 42
Number livestock death: 981
Houses damaged: 157770
Crop area affected: 252266 hectare

5.6. Bulletins issued by IMD

Cyclone Warning Division monitored and predicted the depression and issued the warning/advisory bulletins to national and international agencies. The statistics of bulletins issued by Cyclone Warning Division are given below.

Number of bulletins issued for National disaster management agencies : 08
 Number bulletins issued to WMO/ESCAP Panel countries : 03

5.7. Verification of forecast

(i) Track, intensity and landfall forecast:

In the first bulletin issued at 1120 hrs IST of 22nd September, 2011, it was predicted that the system would cross north Orissa-West Bengal coast between Balasore and Digha by evening of 22nd September 2011. As the system crossed close to Balasore between 2230 and 2330 hrs IST there was landfall error of 30 km and time error of 5 hrs with the lead period of 12 hrs. In the next bulletin issued at 1400 hrs IST it was indicated that the system would cross close to Balasore. The system was not predicted to intensify further from the first bulletin itself issued at 1120 hrs IST of 22nd September, 2011.

(ii) Heavy rainfall warning:

F/C Date & Time(IST)	Sub-Division	F/C Valid for 24 hrs.	F/C Valid for 48 hrs.	Realized weather during 24 hrs.	Realized weather during 48 hrs.
22.9.2011 0830 hrs	N.Orissa	SCT H-VH	---	SCT H-VH	---
	S.Orissa	ISOL H-VH	---	ISOL H-VH	---
	Jharkhand	ISO H-VH	---	ISOL H-VH	ISOL H-VH
	N. Chattisgarh	ISOL H-VH	---	-	ISOL H-VH
	Gangetic WB	ISOL H-VH	---	-	-
23.9.2011 0830hrs	N. Chattisgarh	ISOL H-VH	---	ISOL H-VH	ISOL H-VH
	Jharkhand	ISOL H-VH	ISOL H-VH	ISOL H-VH	-
	Bihar	ISOL H-VH	ISOL H-VH	-	ISOL H-VH
	East Uttar Pradesh	ISOL H-VH	ISOL H-VH	ISOL H-VH	ISOL H-VH

Legend: H: Heavy (7-12 cm) VH: Very heavy (13-24 cm)

(III) Squally Wind Warning:

Date& Time(IST)	Region	Warning Valid for 24 hrs	Realised Wind
22.09.2011 0830 hrs	Along and off Orissa coast	45-55 Gusting to 65 kmph	45-55 kmph along and off Orissa and West Bengal coast
	West Bengal coast	45-55 Gusting to 65 kmph	