

Cyclones and depressions over north Indian Ocean during 2004*

1. Introduction

The storm activity was subdued over the Bay of Bengal this year as well, with the month of November, known for the occurrence of intense storms, witnessing hardly any system of tropical cyclone intensity. Compared to this, the Arabian Sea had been quite active. Altogether 4 cyclonic storms (3 over the Arabian Sea and 1 over the Bay of Bengal) and 5 depressions (out of which 3 were during monsoon season) formed during the year. The first one was a severe cyclonic storm over the Arabian Sea, during 5 – 10 May, which weakened over the sea off Saurashtra coast by 10th evening. Subsequently a very severe cyclonic storm formed over the Bay of Bengal during 16 – 19 May which re-curved and crossed Myanmar coast on 19th forenoon. Two monsoon depressions formed during June, viz., the deep depression over the Arabian Sea (10-13 June) and the second deep depression over the Bay of Bengal (11-14 June). The first one dissipated over the ocean and the second one crossed Orissa coast close to Puri on 13th forenoon. The third one was a land depression (12 – 15 September) over Gangetic West Bengal close to Kolkata. Towards the end of SW monsoon season, a severe cyclonic storm formed over Arabian Sea (30 September – 3 October), which also weakened over the ocean, off Saurashtra coast. The first system during the post monsoon season was a depression (2 – 4 October) over the Bay of Bengal, which crossed north Andhra coast close to Kalingapatnam on the forenoon of 4. Another land depression formed over Gangetic West Bengal during the period (7 - 8 October) and weakened over northern parts of Bangladesh and neighborhood in the evening of 8 October. Only one deep depression formed during November over the Arabian Sea (2 – 7 November), which weakened over the ocean. The last system of the year was a severe cyclonic storm formed over the Arabian Sea (29 November – 2 December), which also weakened over the ocean off Somalia coast.

The track/intensity of these systems are given in Fig. 1. The brief history and monthly distribution are given in Tables 1 and 2 respectively. The relevant ship and buoy observations are given in Table 3. Season wise description of these systems are given below.

2. Disturbances formed during the Winter season (January and February)

No intense cyclonic disturbance formed during the season.

3. Disturbances formed during the Pre-monsoon season (March to May)

During the season, a very severe cyclonic storm formed over the Bay of Bengal and another severe cyclonic storm formed over the Arabian Sea. Details are given below :

3.1. Severe cyclonic storm over the Arabian Sea (5-10 May 2004)

3.1.1. Life cycle

A trough in the easterlies at sea level lay over southeast Bay on 29 & 30 April. It organised into a low pressure area over southeast and adjoining southwest Bay on 30 April evening and persisted there on 1 May; became well marked over there in the same evening and lay over southwest Bay off Sri Lanka coast on 2. It moved over to northern parts of Sri Lanka and adjoining south Tamil Nadu, Commorin area and southwest Bay on 3 and lay over Kerala and adjoining areas of Tamil Nadu, south interior Karnataka and southeast Arabian Sea on 4. Moving westwards, it emerged into Arabian Sea and concentrated into a depression over Lakshadweep area, adjoining Kerala coast and southeast Arabian Sea which lay centred at 0300 UTC of 5, near Lat. 11.5° N / Long. 73.5° E. It remained practically stationary over there, intensified into a deep depression in the forenoon and further into a cyclonic storm in the evening of 5. Moving slightly westwards, it lay centred near Lat. 11.5° N / Long. 73.0° E, about 50 km northeast of Amini Divi at 0300 UTC of 6 and remained practically stationary over there until the evening. Subsequently, moving in a northwesterly direction, it further intensified into a severe cyclonic storm and lay centred near Lat. 12.5° N / Long. 72.0° E, at 0300 UTC of 7; near Lat. 13.0° N / Long. 71.5° E, at 1200 UTC of 7 and near Lat. 13.5° N / Long. 71.0° E, at 0300 UTC of 8. Thereafter, it remained practically stationary over there and weakened into a cyclonic storm at 1200 UTC of 8. Moving in a northnorthwesterly direction, it lay centred near Lat. 15.0° N / Long. 70.5° E at 0300 UTC of 9 and near Lat. 16.5° N / Long. 70.0° E at 1200 UTC of 9. Thereafter, it moved in a northerly direction and lay centred near Lat. 19.0° N / Long. 70.0° E at 0300 UTC of 10. Remaining practically stationary over there, it weakened into a deep depression at 0600 UTC of 10 and into a depression at 0900 UTC of 10; lay centred near Lat. 19.5° N / Long. 70.0° E and

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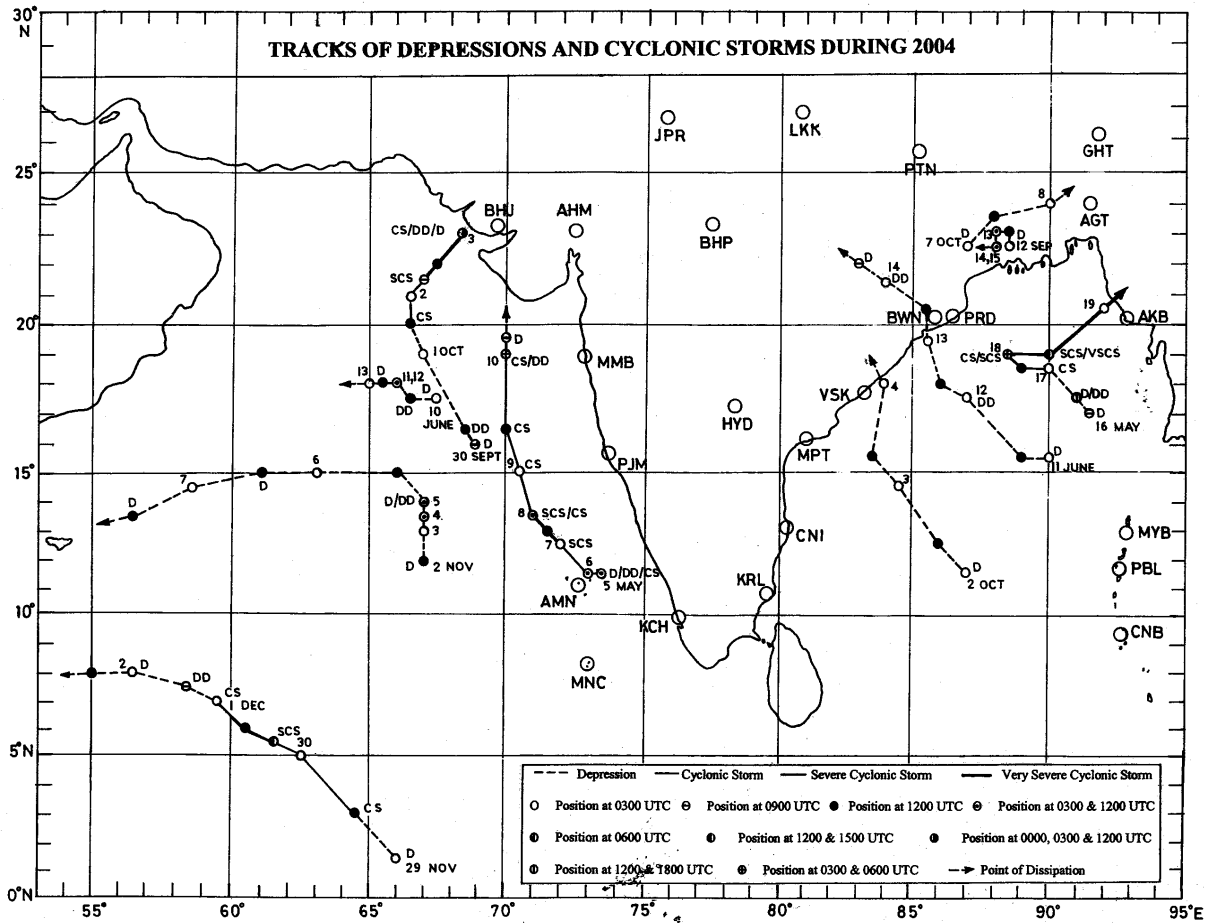


Fig. 1. Tracks of depression/storms during 2004

further into a well-marked low pressure area off Saurashtra coast in the same evening. It lay as a low pressure area over Saurashtra & Kutch coast on 11 morning, over south Pakistan and adjoining Kutch on 11 evening and became less marked on 12.

3.1.2. *Satellite cloud features and RADAR observations*

Maximum intensity of the system as given by Kalpana I imagery was T – 3.5 from 0400 UTC of 7 to 1000 UTC of 8.

There were no significant RADAR observations as the system was out of RADAR range throughout its life period. However, some scattered to broken convective cells were observed by CDRs of Goa, Mumbai and Bhuj.

3.1.3. *Other features observed*

The estimated lowest central pressure of the system was 984 hPa at 1200 UTC of 7. The maximum estimated wind speed was 55 kts. The system formed as a low

pressure area in south Bay of Bengal and emerged into Arabian Sea crossing southern parts of Indian peninsula. It initially moved in a northwesterly direction and thence in a northerly direction till it dissipated over the sea areas off Gujarat coast. The weakening over the oceanic area might be attributed to the cold waters present over the northeast Arabian Sea and possible dry air incursion from the northwest.

3.1.4. *Weather and damage*

The system did not cause any damage over the mainland, as it dissipated over the sea. But in its formative stage it caused wide spread damage to Lakshadweep Island. Amini recorded an unprecedented rainfall of 117 cm for the 24 hours period ending on 0300 UTC of 6 May.

The system caused the following damage in Kerala and Lakshadweep.

- (i) Communication between mainland and island cut off.

TABLE 1
Brief history of cyclonic storms and depressions over the Indian seas and neighbourhood during 2004

S. No.	Type of system	Life period	Point of crossing the coast	Lowest estimated central pressure (hPa)	Recorded max. wind (kts)	Highest "T" No. (estimated)
1.	SCS	5 – 10 May	Weakened over sea, off Saurashtra coast	984	55	3.5
2.	VSCS	16 – 19 May	Myanmar coast on 19 forenoon	952	90	5.0
3.	DD	10 – 13 June	Dissipated over the ocean	990	30	2.0
4.	DD	11 – 14 June	Crossed Orissa coast close to Puri on 13 forenoon	990	30	2.0
5.	D	12 – 15 September	Formed over land	996	25	-
6.	SCS	30 September– 3 October	Weakened over the ocean, off Saurashtra coast	990	55	3.5
7.	D	2 – 8 October	North Andhra coast close to Kalingapatnam on 4 forenoon	1002	25	1.5
8.	DD	2 – 7 November	Weakened over the ocean	1004	25	2.0
9.	SCS	29 November – 2 December	Weakened off Somalia coast	994	55	3.5

D- Depression, DD-Deep depression, SCS - Severe cyclonic storm and VSCS – Very severe cyclonic storm

TABLE 2
Storms/depressions statistics 2004

Name of the system	Winter		Pre-monsoon			Monsoon				Post-monsoon			Total
	Jan-Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Over Bay of Bengal													
Depressions/Deep depressions	0	0	0	0	1	0	0	0	1	0	0	2	
Cyclonic storms	0	0	0	0	0	0	0	0	0	0	0	0	
Severe cyclonic storms	0	0	0	0	0	0	0	0	0	0	0	0	
Very severe cyclonic storms	0	0	0	1	0	0	0	0	0	0	0	1	
Super cyclonic storm	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	0	0	1	1	0	0	0	1	0	0	3	
Over Land													
Depressions/Deep depressions	0	0	0	0	0	0	0	1	0	0	0	1	
Over Arabian Sea													
Depressions/Deep depressions	0	0	0	0	1	0	0	0	0	1	0	2	
Cyclonic storms	0	0	0	0	0	0	0	0	0	0	0	0	
Severe cyclonic storms	0	0	0	1	0	0	0	1	0	1	0	3	
Very severe cyclonic storms	0	0	0	0	0	0	0	0	0	0	0	0	
Super cyclonic storm	0	0	0	0	0	0	0	0	0	0	0	0	
Total	0	0	0	1	1	0	0	1	0	2	0	5	
Grand Total	0	0	0	2	2	0	0	2	1	2	0	9	

TABLE 3

Crucial Ship observations during the storm periods

Call sign SHIP/BUOY	Date/Time (UTC)	Lat. Deg. (N)	Long. Deg. (E)	Wind		Pressure (hPa)
				Dir. (Deg.)	Speed (kts)	
Severe cyclonic storm over the Arabian Sea (5-10 May 2004)						
<i>SHIP</i>						
1. ELZN5	05/0000	9.0	70.1	Westerly	25	1009.4
2. V7DN3	05/1200	7.0	74.2	230	32	1002.0
3. 9VAP5	06/0000	8.2	71.1	270	30	1007.0
4. MRGU3	06/0000	8.5	73.8	270	30	1000.5
5. MRGU3	06/1200	9.4	70.1	280	38	1001.9
6. MZDL7	09/0000	10.4	71.5	290	15	1004.6
<i>BUOY</i>						
1. DS2	05/0300	135 kms southeast of the system		Northwesterly	30	
Very severe cyclonic storm over the Bay of Bengal (16-19 May 2004)						
<i>SHIP</i>						
1. ATVY	18/0300	13.3	83.1	230	25	1001.0
2. ATGH	19/1200	18.9	89.5	210	89.5	995.2
<i>BUOY</i>						
1.	16/0300	17.6	89.8	275	10	1000.2
2.	17/0300	17.4	89.9	Southwesterly	40	994.3
3. MB12	17/1200	17.6	89.8	220	35	995.5
4. MB12	18/1200			Westsouthwesterly	30	995.5
5. MB12	18/1500			Westsouthwesterly	33	993.7
Deep depression over the Arabian Sea (11-14 June 2004)						
<i>SHIP</i>						
1. 7DN3	10/1200	17.6	64.7	250	40	997.0
2. ZQAYA	10/1200	13.1	63.0	270	30	1008.3
3. VVZU	11/1200	17.7	66.5	180	35	991.2
4. VVZU	12/0600	16.3	70.0	250	35	-
5. DHZR	12/1200	14.9	69.6	200	35	1002.0
6. DASO	13/1200	17.5	66.3	270	30	996.5
<i>BUOY</i>						
1. MBI	10/0300	20.0	67.5	Northnortheasterly	20	1000.4
2. DSI	10/0300	15.5	69.1	Southsouthwesterly	25	1002.3
3.	12/1200	20.0	67.5	110	15	998.6
4.	13/0300	15.5	69.2	Southwesterly	25	1003.3
Deep depression over the Bay of Bengal (11-14 June 2004)						
<i>BUOY</i>						
1. MB12	11/1200	17.5	89.9	Southeasterly	25	994.8
2. MB12	12/1200	17.6	90.0	Southerly	25	997.0
3. MB12	13/0300	17.5	89.9	Westsouthwesterly	25	1001.0
Severe cyclonic storm (SCS) over the Arabian Sea (30 September-3 October 2004)						
<i>SHIP</i>						
1. VZOB8	01/0000	17.1	71.3	180	10	1010.0
<i>BUOY</i>						
1. MBI	02/0300	20.0	67.5		20	
Depression over the Bay of Bengal (2- 8 October 2004)						
<i>SHIP</i>						
1. MZBNZ	02/0000	3.4	84.2	270	15	1012.0
2. FNAT	02/0000	6.0	88.4	220	25	1012.0
Deep depression over the Arabian Sea (2 – 7 November 2004)						
<i>SHIP</i>						
1.	04/0300	10.8	63.6	Southwesterly	15	
2.	04/0300	19.7	66.9	Northeasterly	10	
Severe cyclonic storm over the Arabian Sea (29 November-2 December 2004)						
1.	30/1200	9.8	63.2	Northeasterly	15	1001.0

- (ii) Several houses in Island damaged due to wind, falling of trees, sea waves and floods.
- (iii) 45 houses and 35 boats and small mechanized sailing cargo ships lost in the sea near land.
- (iv) 16 boats reported sunk and a cargo boat damaged.
- (v) Sea erosion reported over Kerala.
- (vi) In Kerala 9 persons reported dead and 17 persons missing.
- (vii) Total loss worth Rs. 30 crores.

Heavy to very heavy rainfall (cms) amounts recorded in Kerala and Lakshadweep are stated below :

5 May 2004 : Amini Divi 43, Agathi 10 and Kodungallur 9.

6 May 2004 : Amini Divi 117, Kodungallur 20, Kochi AP 19, Agathi 17, Piravom 15, Cherthala 14 and Aluva 12.

7 May 2004 : Amini Divi 24, Kozhikode AP 21, Thiruvalla & Kunnankulam 15 each, Kollam 14 and Vadamkara 12.

8 May 2004 : Kozhikode 10 and Vadakancherry 6.

9 May 2004 : Kannur 15, Panambur 13 and Mangalore 11.

3.2. *Very severe cyclonic storm over the Bay of Bengal (16-19 May 2004)*

3.2.1. *Life cycle*

Under the influence of a trough of low at sea level a low pressure area formed over east-central Bay and adjoining north Andaman Sea on 15, which became well marked over there on 16 morning. Subsequently, it concentrated into a depression and lay centred at 0900 UTC of 16 near Lat. 17.0° N / Long. 91.5° E and near Lat. 17.5° N / Long. 91.0° E at 1200 UTC of 16. Remaining practically stationary over there, it intensified into a deep depression by 1800 UTC of 16 and further into a cyclonic storm near Lat. 18.5° N / Long. 90.0° E, at 0300 UTC of 17. It lay centred at 1200 UTC of 17, near Lat. 19.0° N / Long. 89.0° E and remained practically stationary over there for some time. Slowly moving westwards, it lay centred at 0300 UTC of 18 near Lat. 19.0° N / Long. 88.5° E and intensified into a severe cyclonic storm over there at 0600 UTC of 18. It subsequently drifted

eastwards and lay centred at 1200 UTC of 18, near Lat. 19.0° N / Long. 90.0° E and intensified into a very severe cyclonic storm over there by 1500 UTC of 18. Further moving northeastwards, it lay centred near Lat. 20.5° N / Long. 92.0° E, at 0300 UTC of 19 and crossed Myanmar coast north of Akyab between 0400 and 0500 UTC of 19.

3.2.2. *Satellite cloud features and RADAR observations*

Maximum intensity of the system as given by Kalpana I imageries was T 5.0 at 0300 UTC of 19. "EYE" was clearly visible in the morning of 19 May.

CDR Paradip reported spiral bands and gave centres from 0100 UTC to 0900 UTC of 18 based on them. The system was all along out of the range of Doppler Weather RADAR, Kolkata and only some dense convection was seen at 0000 UTC of 19.

3.2.3. *Other features observed*

The estimated lowest central pressure was 952 hPa at 0300 UTC of 19 May. The maximum estimated wind speed was 90 knots. The system moved in a northwesterly direction initially. Thereafter it recurved and moved in an easterly direction. Finally moving in a northeasterly direction, it crossed Myanmar coast between 0400 UTC and 0500 UTC of 19. Its movement was steered by an upper tropospheric trough in westerlies.

The system showed characteristics of a monsoon system in the initial stages, like southwestward tilt with height, more cloud cover in the southwest sector etc. but the features changed drastically subsequent to recurvature.

3.2.4. *Weather and damage*

No damage was reported in the eastern coast, as the system moved far off the coast. However, light to moderate rainfall occurred at many places over north Orissa and at isolated places over south Orissa.

Chief amounts of rainfall (cms) recorded in Orissa are :

16 May 2004 : Mahendragarh & Nimapada 4 each.

17 May 2004 : Angul 3.

4. **Disturbances formed during the monsoon season (June to September)**

During this season, one severe cyclonic storm over the Arabian Sea and three depressions, one each over the

Bay of Bengal, Gangetic West Bengal and the Arabian Sea, formed. Details are presented below :

4.1. *Deep depression over the Arabian Sea (10 – 13 June)*

4.1.1. *Life cycle*

Under the influence of an upper air cyclonic circulation, a low pressure area formed in the off-shore trough over east central Arabian Sea on 8. It lay as a well marked low pressure area off south Maharashtra-Goa coasts with associated cyclonic circulation extending upto mid tropospheric levels on 9. It concentrated into a depression and lay centred at 0300 UTC of 10 near Lat. 17.5° N / Long. 67.5° E. Moving slightly westwards, it intensified into a deep depression which lay centred near Lat. 17.5° N / Long. 66.5° E at 0900 & 1200 UTC of 10. It then moved northwestwards and lay centred near Lat. 18.0° N / Long. 66.0° E at 0300 UTC and remained practically stationary till 0300 UTC of 12. Moving westwards, it weakened into a depression and lay centred near Lat. 18.0° N / Long. 65.5° E at 1200 UTC of 12, and near Lat. 18.0° N / Long. 65.0° E at 0300 UTC of 13. It weakened into a well marked low pressure area over there on 13 forenoon.

4.1.2. *Satellite cloud features and RADAR observations*

The maximum intensity reported based on the satellite imagery was T 2.0 from 0900 of 10 to 0600 UTC of 12.

The RADARs along the west coast did not track the system.

4.1.3. *Other features observed*

The estimated lowest central pressure of the system was 990 hPa at 0900 UTC of 14. The maximum estimated wind speed was 30 knots. The system moved in a westerly direction, then slightly northwestwards and again in a westerly direction and dissipated over the sea, probably due to strong vertical wind shear.

4.1.4. *Weather and damage*

No damage occurred due to this system, as the system dissipated over the sea.

4.2. *Deep depression over the Bay of Bengal (11 – 14 June)*

4.2.1. *Life cycle*

A trough of low organised into a low pressure area over east central Bay and adjoining Andaman Sea on 10

evening. It concentrated into a depression and lay centred at 0300 UTC of 11 near Lat. 15.5° N / Long. 90.0° E and near Lat. 15.5° N / Long. 89.0° E at 1200 UTC of 11. Subsequently, moving in a northwesterly direction, it intensified into a deep depression and lay centred near Lat. 17.5° N / Long. 87.0° E at 0300 UTC of 12 and near Lat. 18.0° N / Long. 86.0° E at 1200 UTC of 12 and lay centered near Lat. 19.5° N / Long. 85.5° E at 0300 UTC of 13. Moving northwards, it crossed south Orissa coast near Puri between 0400 and 0500 UTC of 13. Thereafter, moving in a westnorthwesterly direction, it lay close to Phulbani (about 200km west of Bhubaneswar) at 1200 UTC of 13 and near Sambalpur at 0300 UTC of 14. Subsequently moving northwestwards, it weakened into a depression and lay close to Rajgarh at 0900 UTC of 14 and further into a well marked low pressure area over northwest Chattisgarh and adjoining east Madhya Pradesh on 14 evening.

4.2.2. *Satellite cloud features and RADAR observations*

The system was tracked by satellite from 0000 UTC of 10 to 0300 UTC of 14. The maximum intensity reported from the imagery was T 2.0 from 2100 of 11 to 0600 UTC of 13.

4.2.3. *Other features observed*

The lowest estimated central pressure was 990 hPa at 0900 UTC of 14. The maximum estimated wind speed was 30 knots. The system moved in a northwesterly direction and crossed Orissa coast between Gopalpur and Puri between 0400 & 0500 UTC of 13 June.

4.2.4. *Weather and damage*

No damage was reported from the coastal districts of Andhra Pradesh, Orissa and West Bengal. However, widespread rainfall activity with isolated falls was realised.

Chief amounts of rainfall (cms) recorded are

Orissa

12 Jun 2004 : Painagarh 13, Pottangi 10, Junagarh 9 and Paralakhemundi 8.

13 Jun 2004 : Madanpur & Rampur 32 each, Kharalar 31, Junagarh 28, Lanjigarh 20, Bhogiri & Jeypore 15 each, Jaleswar, Malkangiri & Umargot 12 each, Rajghat, Rajkanika & Pottangi 10 each, Balasore, Akhuapada, Soro & Jenapur 9 each and Swampatna & Kotraguda 8 each.

14 Jun 2004 : Titlagarh 31, Komna, Kantamal & Balimundali 18 each, Dashpalla & Turoikola 16 each, Bhavanipatna & Kolagarh 15 each, Panagarh 14, Kharlar & Nawarangpur 13 each Umerkote, Navapura & Malkaguri 12 each, Jaleswar 11, Pottangi, Jeypore, Swampatna, Narsingpur & Baliguda 10 each, Rajghat, Bangurposhi, Baripada, Binka & Sonapur 9 each and Keonjharagarh, Tikarpada, Guddar & Raigada 8 each.

Andhra Pradesh

12 Jun 2004 : Dowleswaram 8.

13 Jun 2004 : Paderu 16, Tekkali 13, Kalingapatnam 11, Narsipatnam 10 and Tuni & Yelamanchili 8 each.

14 Jun 2004 Parvathipuram 7, Salur 6.

West Bengal

12 Jun 2004 : Digha 15, Contai 11 and Durgachak 7.

13 Jun 2004 : Midnapore 8.

4.3. *Land depression over Gangetic West Bengal (12-15 September)*

4.3.1. *Life cycle*

Under the influence of an upper air cyclonic circulation, a low pressure area formed over northwest Bay off West Bengal-north Orissa coasts on 10. It concentrated into a depression and lay centred near Lat. 22.5° N / Long. 88.5° E at 0300 UTC of 12. It moved slightly in a northeasterly direction until the evening of 12 and lay centred near Lat. 23.0° N / Long. 88.5° E at 1200 UTC of 12. It then drifted slowly southwestwards and lay centred near Lat. 23.0° N / Long. 88.0° E at 0300 & 1200 UTC of 13. It once again moved over to Gangetic West Bengal and lay close to Kolkata on 14 & 15. Subsequently it weakened into a well marked low pressure area over there on 16.

4.3.2. *Other features observed*

The lowest estimated central pressure was 996 hPa. The maximum estimated wind speed was 25 knots.

4.3.3. *Weather and damage*

According to press reports, 4 people lost their lives due to heavy rains.

Chief amounts of rainfall (cms) recorded are

Sub-Himalayan West Bengal & Sikkim :

9 Sep 2004 : Chepan 34, Mathabhanga 28, Damohani 21, Alipurduar 20, Gajoldoba & Jalpaiguri 19 each, Barobisa 18 and Champasarai, Hasimara & Murti 13 each.

Gangetic West Bengal

12 Sep 2004 : Jhalda 9.

13 Sep 2004 : Canning Town 9.

14 Sep 2004 : Krishnanagar 9.

15 Sep 2004 : Krishnanagar 10.

After weakening, the system moved as a low pressure area over northeast India. Some heavy to very heavy rainfall amounts are :

Assam & Meghalaya

13 Sep 2004 : Cherrapunji 16 and Gharmura 7.

Nagaland-Manipur-Mizoram-Tripura

13 Sep 2004 : Sonmura 25, Belonia 24, Sabroom 11, Kailashahar 8, Dharmanagar 7.

4.4. *Severe cyclonic storm (SCS) over the Arabian Sea (30 September-3 October)*

4.4.1. *Life cycle*

A trough of low organised into a low pressure area over Lakshadweep area and adjoining southeast Arabian Sea on 20, became well marked over east central Arabian Sea on 30 September morning. It concentrated into a depression at 0900 UTC of 30 and lay centred near Lat. 16.0° N / Long. 69.0° E. It further concentrated into a deep depression, centred near Lat. 16.5° N / Long. 68.5° E at 1200 UTC of 30 and near Lat. 19.0° N / 67.0° E at 0300 UTC of 1 October. It intensified into a cyclonic storm and lay centred near Lat. 19.5° N / Long. 66.5° E at 0900 UTC of 1 and remained near Lat. 20.0° N / Long. 66.5° E at 1200 UTC of 1 and near Lat. 21.0° N / Long. 66.5° E at

0300 UTC of 2. It intensified into a severe cyclonic storm at 0900 UTC of 2 and lay centred near Lat. 21.5° N / Long. 67.0° E. It lay centered near Lat. 22.0° N / Long. 67.5° E at 1200 UTC of 2. It weakened into a cyclonic storm and lay centred near Lat. 23.0° N / Long. 68.5° E at 0000 UTC of 3. It further weakened into a deep depression over the same area at 0300 UTC of 3 and into a depression at 1200 UTC of 3 over the same region. The system weakened into a well marked low pressure area over northeast Arabian Sea off Kutch coast on 4 morning.

4.4.2. *Satellite and RADAR observations*

The maximum intensity based on satellite imagery was T 3.5 from 0600 UTC to 1500 UTC of 2.

CDR Bhuj tracked the storm from 0300 UTC of 1 to 1500 UTC of 3.

4.4.3. *Other features observed*

The estimated lowest central pressure was 990 hPa from 0900 UTC to 1500 UTC of 2 October. The maximum estimated wind speed was 55 knots. The system remained almost stationary and weakened *in situ* without crossing the coast under the influence of a weak steering environment between two ridges. Low level circulation associated with the system, meandered over northeast Arabian Sea for a few more days.

4.4.4. *Weather and damage*

No damage was reported in Gujarat state.

5. **Disturbances formed during the Post-monsoon season (October to December)**

During this season, one severe cyclonic storm over Arabian Sea and two depressions, one each in Bay of Bengal and Arabian Sea formed. Details are presented below :

5.1. *Depression over the Bay of Bengal (2 - 4 October 2004) & Land depression (7 - 8 October 2004)*

5.1.1. *Life cycle*

A low pressure area formed over south east Bay of Bengal in the morning of 30th September and became well

marked in the evening of same day. Moving in north-westerly direction, it concentrated into depression in the morning of 2nd October and lay centred near Lat. 11.5° N and Long. 87.0° E at 02/0300 UTC. Subsequently moving in a northwesterly direction it lay centred near Lat. 14.5° N and Long. 84.5° E & Lat. 15.5° N and Long. 83.5° E at 03/0300 UTC and 03/1200 UTC respectively. Buoys DS3 (Lat. 12.5° N / Long. 72.0° E) & MB 11 (Lat. 15.1° N / Long. 87.6° E) reported wind south-southwesterly / 15 kt pressure 1009.6 hPa and easterly / 15 kt. These Buoys were located at east and north of the depression during that period. The 24 hour pressure fall was of the order of 2-3 hPa over south coastal Andhra Pradesh and of the order of 4 hPa over the same area on 3rd October. The depression started giving weather in the form of rain and wind prior to reaching the coast. The depression crossed north Andhra Pradesh coast close to Kalingapatnam (43105) in the forenoon of 4th October and weakened into a well marked low pressure area over north central Andhra Pradesh and adjoining Orissa and sea areas in the evening.

The well marked low the pressure area moved northeastwards and re-intensified into a depression overland and lay centred at 07/0300 UTC, close to Bankura (42706) in Gangetic West Bengal. It further moved in an east-northeasterly direction and lay centred in the afternoon of the same day close to Shantiniketan (42708) and at 08/0300 UTC over Bangladesh (near Lat. 24.0° N / Long. 90° E). Due to incursion of moisture from the Bay of Bengal, the system caused exceptionally heavy rainfall over Gangetic West Bengal and northeastern states during its life span. The system weakened gradually into a low pressure area over northern parts of Bangladesh and neighbourhood in the evening of 8 October 2004.

5.1.2. *Satellite cloud features and RADAR observations*

The maximum intensity based on satellite imagery was T 1.5 throughout the life period of the system.

5.1.3. *Other features observed*

The estimated lowest central pressure was 1002 hPa at 1200 UTC of 2 October. The maximum estimated wind speed was 25 knots. The 24 hours pressure tendency was of the order of 2-3 hPa over south coastal Andhra Pradesh on 2 and 4 hPa over the same area on 3. The depression started giving weather in the form of rain and wind prior to its reaching the coast.

5.1.4. *Weather and damage*

As per the report from CWC Visakhapatnam, most of the damage occurred in north coastal Andhra Pradesh, particularly in Srikakulam district.

- (i) Villages marooned in Srikakulam – 25
- (ii) Villages partially marooned – 15
- (iii) Number of acres of paddy submerged – 50,000
- (iv) Number of tanks breached – 200
- (v) Number of houses collapsed – 50

Heavy to very heavy rainfall occurred over north coastal Andhra Pradesh. The amounts of rainfall (cms) are :

- 1 Oct 2004 : Venkatagiri 4.
- 2 Oct 2004 : Chittoor 3.
- 3 Oct 2004 : Yelamanchili 2
- 4 Oct 2004 : Kalingapatnam 27, Santhabommali 25, Tekkali 23, Vajrapur, Kothur & Nandigama 21 each, Pallana 20, Kotabommali 17, Kanchili & Ranasthalam 16 each, Sompeta, Narsannapeta & Laveru 15 each, Srikakulam 14, Jalmuru, Polaki & Iohapuram 13 each, Kaviti 12, Kakinada & Nagarjunsagar Dam 11 each, Waltair 9 and Koderu 7.

Rainfall also occurred at most places with isolated heavy falls over Orissa. Some of the rainfall amounts are given below :

- 4 Oct 2004 : Jeypore, Soro & Balasore 8 each and Nilgiri 7.
- 5 Oct 2004 : Athagarh 18, Balasore 14, Chandbali 12, Rajkanika 11, Jeypore, Rajghat & Akhuapada 10 each, Jaleswar, Soro & Alipingal 9 each, Pottangi & Raigarh 16 each, Khandapada 14, Banpur 13, Dhenkanal & Koraput 12 each and Chandanpur, Nayagarh & Ranpur 10 each.
- 6 Oct 2004 : Jaipatna 13, Balimundali & Madanpur & Rampur 10 each, Baripada, Titlagarh & Bolgaon 9 each and Panagarh 8.

Its northeastward movement after reintensification caused much damage over Gangetic West Bengal, Orissa and northeastern states.

Gangetic West Bengal

- People died : 51
- Birds died : 3000 Migratory Birds
- Houses damaged : 10
- Agricultural crop damage : Rs. 110 crores
- People affected : 10 lakh

Orissa

- People died : 4

One bridge washed away and several villages affected due to flood.

Northeastern states

- People died : 218
- People affected : 783622
- Agricultural crop damage : 98721 Hectares

The system caused exceptionally heavy to very heavy rainfall over these regions during 7 – 9 October. The significant amounts are given below :

- 7 Oct 2004 : Malda 28, Tantloi 27, Tilpara 26, Mahro 23, Suri 20, Massanjore 18, Khesiary 16, Durgapur 15, Shillong, Guwahati & Diamond Harbour 14 each, Kolkata 3, Haldia 12, Honavar 10, Canning 8, Shantiniketan, Talchar & Telkoi 7 each and Mundali 6.
- 8 Oct 2004 : Alipurduar (NH) 31, Shillong 26, Malda and Guwahati 15 each, Tezpur 11, Kolkata, Berhampore, Hindol, Udala & Lanjigarh 6 each and Jalpaiguri, Canning town, Agartala, Sevoke, Gajoldoba & Mathabhanga 5 each.
- 9 Oct 2004 : Tezpur, Passighat & Dibrugarh 4 each and Imphal 2.

5.2. *Deep depression over the Arabian Sea (2 – 7 November 2004)*

5.2.1. *Life cycle*

A well marked low pressure area over southeast and adjoining east-central Arabian Sea concentrated into a depression on 2 evening and lay centred near Lat. 12.0° N / Long. 67.0° E at 1200 UTC of 2; Lat. 13.0° N / Long. 67.0° E at 0300 UTC of 3; Lat. 13.5° N / Long. 67.0° E at 1200 UTC of 3 & 0300 UTC of 4 and near Lat. 14.0° N / Long. 67.0° E at 1200 UTC of 4. It remained practically stationary over there and further intensified into a deep depression at 0300 UTC of 5. It lay centred near Lat. 15.0° N / Long. 66.0° E at 1200 UTC of 5 and near Lat. 15.0° N / Long. 63.0° E at 0300 UTC of 6. Subsequently it weakened into a depression and lay centred near Lat. 15.0° N / Long. 61.5° E at 0900 UTC of 6; near Lat. 15.0° N / Long. 61.0° E at 1200 UTC of 6; near Lat. 14.5° N / Long. 58.5° E at 0300 UTC of 7 and near Lat. 13.5° N / Long. 56.5° E at 1200 UTC of 7. It further weakened into a low pressure area and became unimportant on 8 morning.

5.2.2. *Satellite cloud features and RADAR observations*

The maximum intensity based on satellite imagery was T 2.0 from 0300 UTC of 5 to 0900 UTC of 6.

5.2.3. *Other features observed*

The estimated lowest central pressure was 1004 hPa at 1200 UTC of 7 and 0300 UTC of 8. The maximum estimated wind speed was 25 knots.

5.2.4. *Weather and damage*

No damage occurred due to this system, as the system moved away from the coast and dissipated over the sea.

5.3. *Severe cyclonic storm over the Arabian Sea (29 November – 2 December 2004)*

5.3.1. *Life cycle*

A low pressure area formed in the equatorial wave, concentrated into a depression on 29 morning and lay centred near Lat. 1.5° N / Long. 66.0° E at 0300 UTC of 29. Moving northwestwards, it rapidly intensified into a cyclonic storm and lay centred near Lat. 3.0° N / Long. 64.5° E at 1200 UTC of 29 and near Lat. 5.0° N / Long. 62.5° E at 0300 UTC of 30. It further intensified into a severe cyclonic storm and lay centred near Lat. 5.5° N / Long. 61.5° E at 0600 UTC of 30 and near Lat. 6.0° N / Long. 60.5° E at 1200 UTC of 30. Subsequently it weakened into a cyclonic storm at 1800 UTC of 30 November and lay centred near Lat. 6.0° N / Long. 60.0° E. It lay centred near Lat. 7.0° N / Long. 59.5° E at 0300 UTC of 1 December and weakened into a deep depression at 0900 UTC of 1, near Lat. 7.5° N / Long. 58.5° E and into a depression at 0300 UTC of 2 near Lat. 8.0° N / Long. 56.5° E and near Lat. 8.0° N / Long. 55.0° E at 1200 UTC of 2. It weakened into a low pressure area off Somalia coast on 3 morning.

5.3.2. *Satellite cloud features and RADAR observations*

The maximum intensity based on satellite imagery was T 3.5 from 0600 UTC to 1500 UTC of 30 November.

5.3.3. *Other features observed*

The estimated lowest central pressure was 994 hPa from 0600 UTC to 1500 UTC of 30 November. The maximum estimated wind speed was 55 knots.

5.3.4. *Weather and damage*

No damage occurred due to this system, as the system moved away from the west coast and dissipated over the sea.